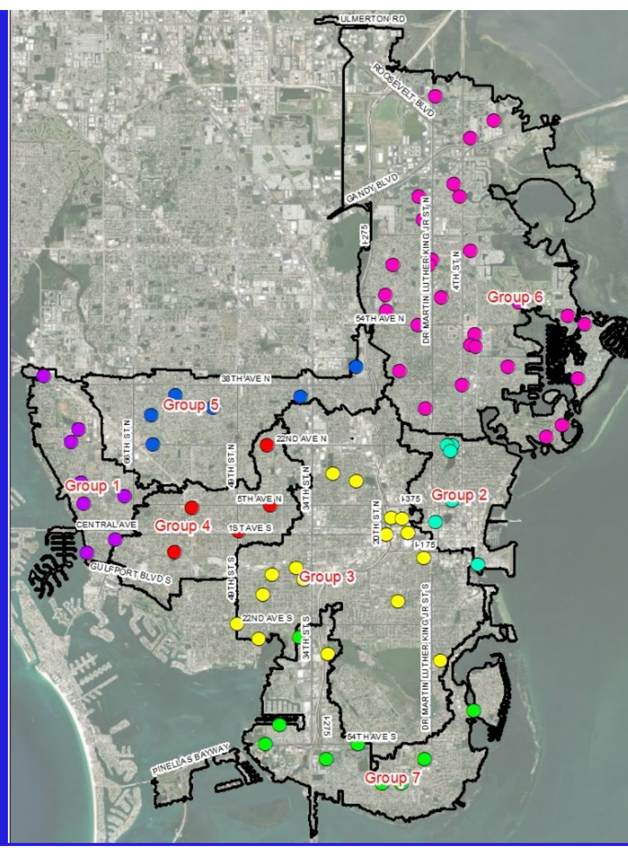
Jacobs

Best Management Practices Alternative Analysis Report

Document no: 230825154518_70d2527c
Version: Draft

City of St. Petersburg
Project No. 17037-110

Stormwater Management Master Plan Update



Best Management Practices Alternative Analysis Report

Client name:	City of St. Petersburg		
Project name:	Stormwater Management Master Plan Update		
Client reference:	Project No. 17037-110	Project no:	697448CH
Document no:	230825154518_70d2527c	Project manager:	Swamy Pati
Version:	Draft	Prepared by:	CH2M (Jacobs) Team
		File name:	Best Management Practices Alternative Analysis_v5

Document History and Status

Version	Date	Description	Author	Checked	Reviewed	Approved
00	12/21/23	Draft Report	HN/JM/HH	RL	MG	SP

CH2M HILL, Inc.

5401 West Kennedy Boulevard
Suite 300
Tampa, FL 33609
United States

T +1 813 676 2300
www.jacobs.com

Executive Summary

Jacobs (as CH2M HILL, Inc., [CH2M], a wholly owned subsidiary of Jacobs) is under contract with the City of St. Petersburg (City) to perform a Stormwater Management Master Plan Update for the City. The goal of developing the Stormwater Management Master Plan Update is to evaluate the capacity and performance of the watershed with regard to flood protection, water quality, and natural systems enhancement. The Stormwater Management Master Plan is updated through various plans and reports, including the following:

- Watershed Evaluation Report (Jacobs 2020) addressing how information was collected and developed for use in updating the Stormwater Management Master Plan
- Watershed Model Development and Floodplain Analysis Report (Jacobs 2023) addressing hydrologic and hydraulic (H&H) model development, model calibration/verification, and 100-year/24-hour floodplain analysis
- Level of Service Analysis Report (Jacobs 2023b) addressing the identification of level of service of various roadways and structures within the City

This document is the Best Management Practices (BMPs) Alternative Analysis Report that describes the proposed BMP projects to reduce the flooding and improve water quality.

Watershed Characteristics

The watershed is approximately 62 square miles, located within the City in southern Pinellas County, Florida. The City's watershed is a highly urbanized coastal community bounded by water on three sides and shares boundaries on the northern side with the Pinellas County portion of Roosevelt Creek Basin, Joes Creek Basin, and Long Bayou Basin. On the northwestern side, there is a shared boundary with the Pinellas County portion of Sawgrass Lake Basin. On the southwestern side, there is a shared boundary with the City of Gulfport's portion of the Clam Bayou Basin and Bear Creek Basin and the Pinellas County portion of Bear Creek Basin.

Watershed Evaluation

The Watershed Evaluation Report presented a summary of the data collected and work completed through the watershed evaluation element of the Watershed Management Plan. The watershed evaluation element had the following goals:

- Compile, review, and evaluate existing watershed data.
- Develop watershed features that define stormwater H&H infrastructure.
- Identify survey requirements.
- Perform data acquisition from existing sources, field verification, and survey.
- Develop a watershed geographic information system (GIS) database.

Based on the information collected through desktop data collection and acquired through the field reconnaissance and the survey data, the watershed scale model database, called Geographic Watershed Information Systems (GWIS) Geodatabase (GDB), was developed and further refined to incorporate the collected information. During the data refinement phase, all the individual basin GWIS GDBs were combined into one master GWIS GDB for the City watershed. Table ES-1 presents model features and the total number of sub-basins, links, and nodes (links represent flow conveyance connections between basins, and nodes represent junctions connecting links).

Table ES-1. Summary of Total Model Features

Model Features		Total
Basins		26
Sub-basins		11,867
Nodes	Stage/Area	15,906
	Time/Stage	174
	Maintenance Hole	5,567
	TOTAL	**21,647**
Links	Pipe	20,217
	Weir	383
	Bridge	16
	Rating Curve	6
	Drop Structure	716
	Channel	550
	TOTAL	**21,888**

The completed GWIS GDB included features that were used to develop the H&H parameters for the Interconnected Pond Routing (ICPR) Version 4 (ICPR4) model platform.

Watershed Model Development and Floodplain Analysis

Watershed model development included model parameterization, model calibration/verification, and floodplain analysis. CH2M prepared the H&H model parametrization for the model features, sub-basins, links, and nodes, which were developed during the watershed evaluation phase. The model parameters were stored and populated in appropriate data tables in the GWIS geodatabase that was developed for the watershed. The model-ready GWIS geodatabase was imported into the ICPR4 model interface after the parameterization was completed.

The hydrologic input parameters developed to estimate runoff from the sub-basins included Green-Ampt Infiltration parameters, which are based on the soils and land use characteristics of the watershed and the time of concentration (Tc). The hydraulic input parameters were developed for all the model links and nodes. The primary parameters required for model nodes are initial stages and the stage/area or time/stage relationships, depending on type of the node. The City's watershed primarily contains link types of pipes, weirs, channels, and drop structures. Appropriate input parameters were developed for each link type, such as pipe dimensions, inverts, Manning's roughness (n), and entrance/exit losses for pipe links.

Initially, major efforts were made to export the City-wide GWIS GDB into one ICPR4 model. However, because of the size of the GDB, with more than 6 million data points, it was difficult to import the data into one ICPR4 model. Both Streamline Technologies (the ICPR4 developer) and the Southwest Florida Water Management District (District) were contacted on this matter and their suggestions were incorporated into the GDB to be able to import data into ICPR4. After spending a few weeks on this process, the City, District, CH2M, and CH2M's team member Land and Water Engineering Science agreed that continuing with one City-wide model would be inefficient and would impact the schedule significantly. Jacobs proposed dividing the watershed into seven model groups, listed as follows and shown on Figure ES-1:

- Group 1 (G, R & S) – Western Bayfront
- Group 2 (A & J) – Downtown and Crescent Lake
- Group 3 (B, C, D, E and Z) – Booker Creek, Lake Maggiore, and Clam Bayou
- Group 4 (F) – Bear Creek
- Group 5 (H & I) – Joes Creek
- Group 6 (K, L, N, O, P, T, X, Y, M) – Northern Basins
- Group 7 (Q, U, V, W) – Southern Basins

These groups were divided based on the hydrology. Availability of water level loggers in each group was also taken into consideration to be able to calibrate and verify each group. The interactions between the groups along the shared boundaries were captured, along with boundary time/stage inputs from corresponding shared adjacent group ICPR model results. A few iterations were conducted by inputting results from one group to the other until a reasonable stage balance was obtained between the groups along the boundary. Boundary stage time series were input using the ICPR_TIME_STAGE table for Groups 4 to 7 and the BOUNDARY_STAGE_SET table for Groups 1 to 3.

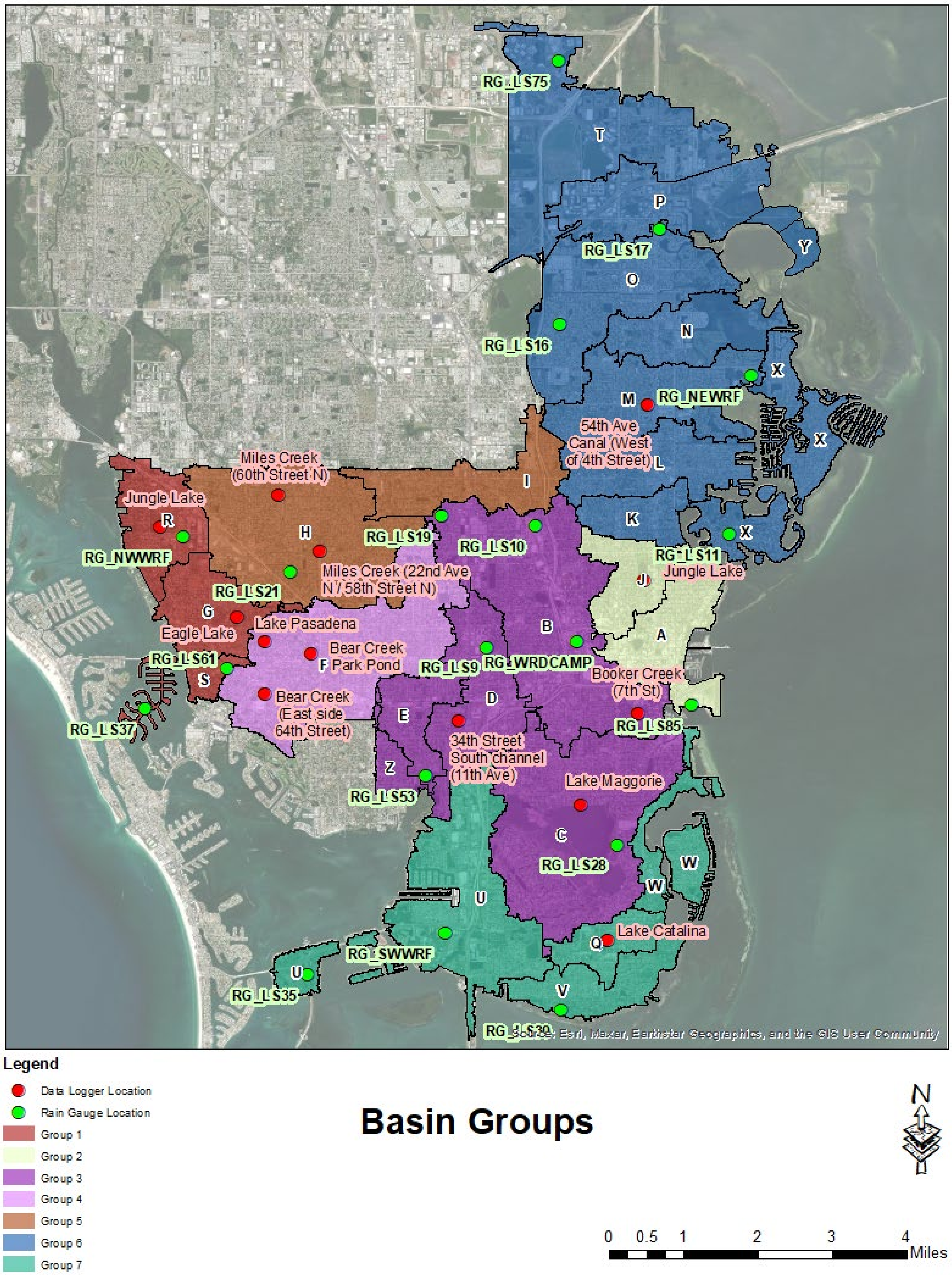


Figure ES-1. Model Groups, Water Level Data Logger Locations, and City's Rain Gauge Locations

Each group model was calibrated using the measured water level and rainfall amounts from the gauges that the City installed as part of this project. The locations of these gauges are shown on Figure ES-1. The chosen calibration and verification rainfall events were from August 2019 and November 2020 (Tropical Storm Eta). As a result of the high level of updated detail provided in the model setup, the models calibrated well for all the groups. The calibrated group models were used to conduct a floodplain analysis for the 100-year/24-hour design storm. Simulation results were used to delineate the floodplain. A representative example of floodplain delineation is presented on Figure ES-2 for Group 6.

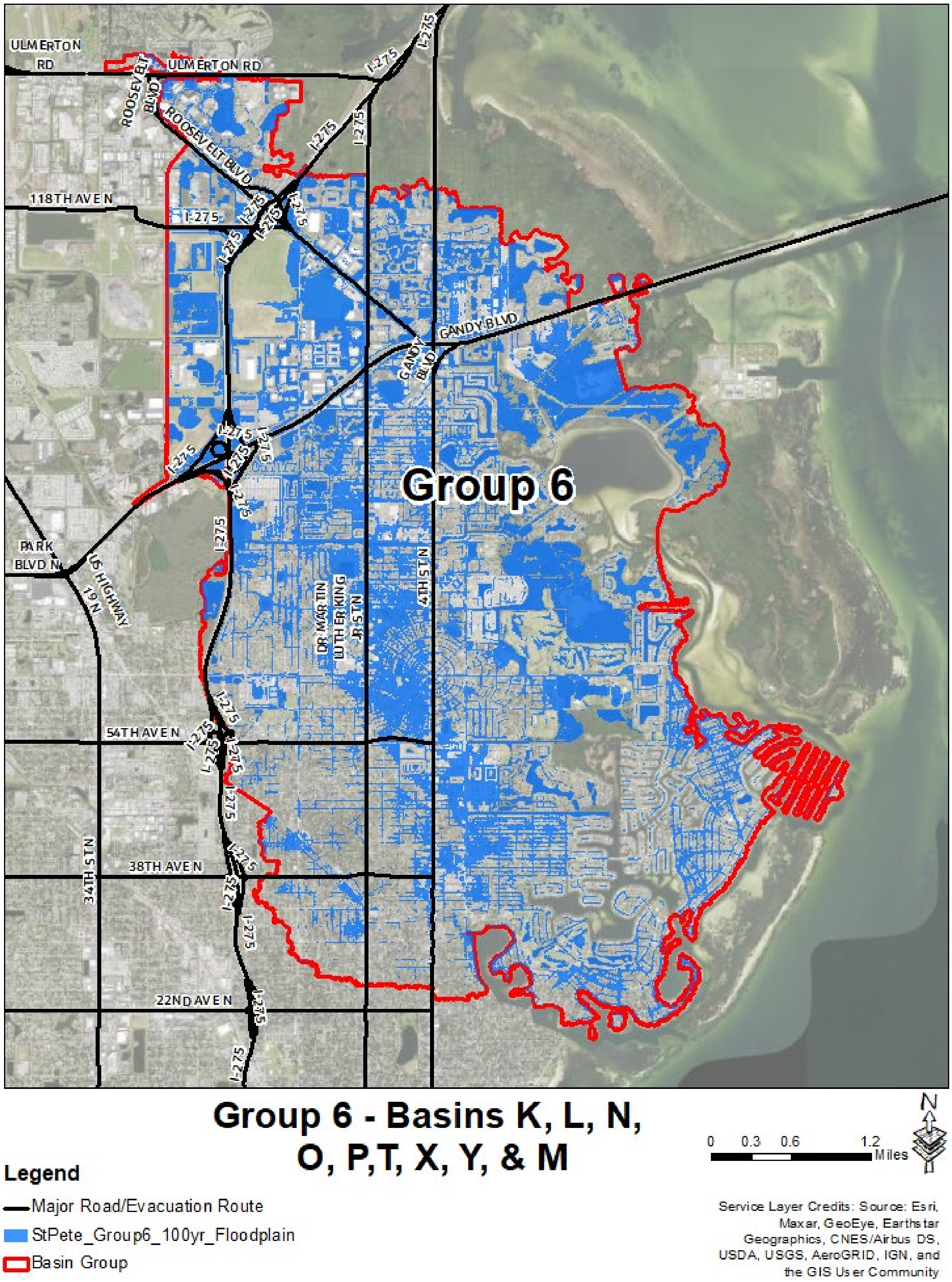


Figure ES-2. Floodplain Map for Group 6

Level of Service Analysis

The level of service (LOS) analysis identified locations that do not meet the City's LOS criteria for roads and structures based on the flood inundation depths derived from the calibrated H&H model results.

The City provided LOS criteria was used for the analysis, which includes the following:

- For roadway LOS: 10-year/24-hour event with maximum 6 inches of flooding in the roads. The same criteria was used for all roadway categories in the City, including neighborhood/local, collector, and arterial roads.
- For building structures: 100-year/24-hour event maximum stage elevations below the finished floor elevation. Buildings' finished floor elevations were assumed to be 1 foot above the adjacent ground elevation.

A graphical depiction of the LOS criteria is presented on Figure ES-3 highlighting the target LOS for the structures and roadways.

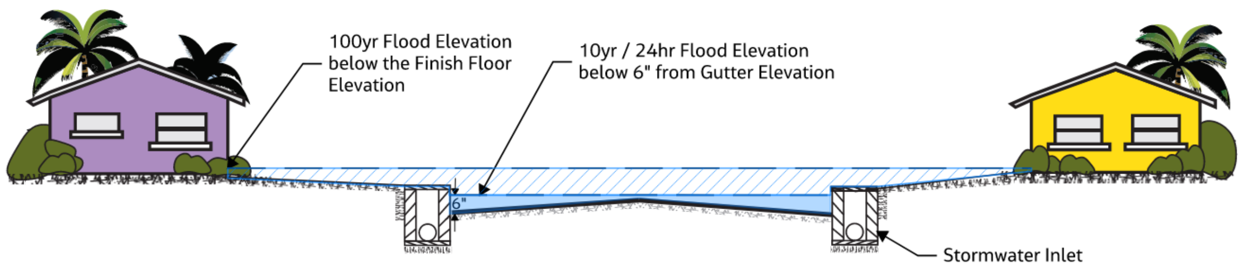


Figure ES-3. Graphical Depiction of Target Flooding LOS

The design storm event rainfall amounts were based on the District's Environmental Resource Permit Application Handbook as shown in Table ES-2.

Table ES-2. Design Storm Events Rainfall Amounts

Design Storm Event	Rainfall Total (inches)	Data Source
10-yr/24-hr	7.5	District
25-yr/1-day	9.0	
100-yr/1-day	12.0	

Along with H&H model results, building footprint layers, digital elevation map, roads GIS layer and adjacent watershed data were used to conduct the analysis.

The results of the LOS analysis identified flooding hotspots. Both roadways and structures that do not meet the criteria were identified. Figure ES-4 shows the structure hotspots in Group 5, which has the most structures that do not meet the criterion. Figure ES-5 shows the roads hotspots in Group 6, which has the most roads that do not meet the criterion.

The LOS analysis was also conducted for future conditions for the year 2050. Year 2050 was selected in discussions with the City to be consistent with the City's other future planning efforts and evaluations studies, including Vision 2050. The future conditions were simulated for 100-year/24-hour, 25-year/24-hour, and 10-year/24-hour storm events and used in the LOS analysis with similar criteria as described previously. The roadways and structures that do not meet the LOS in future conditions were identified and mapped.

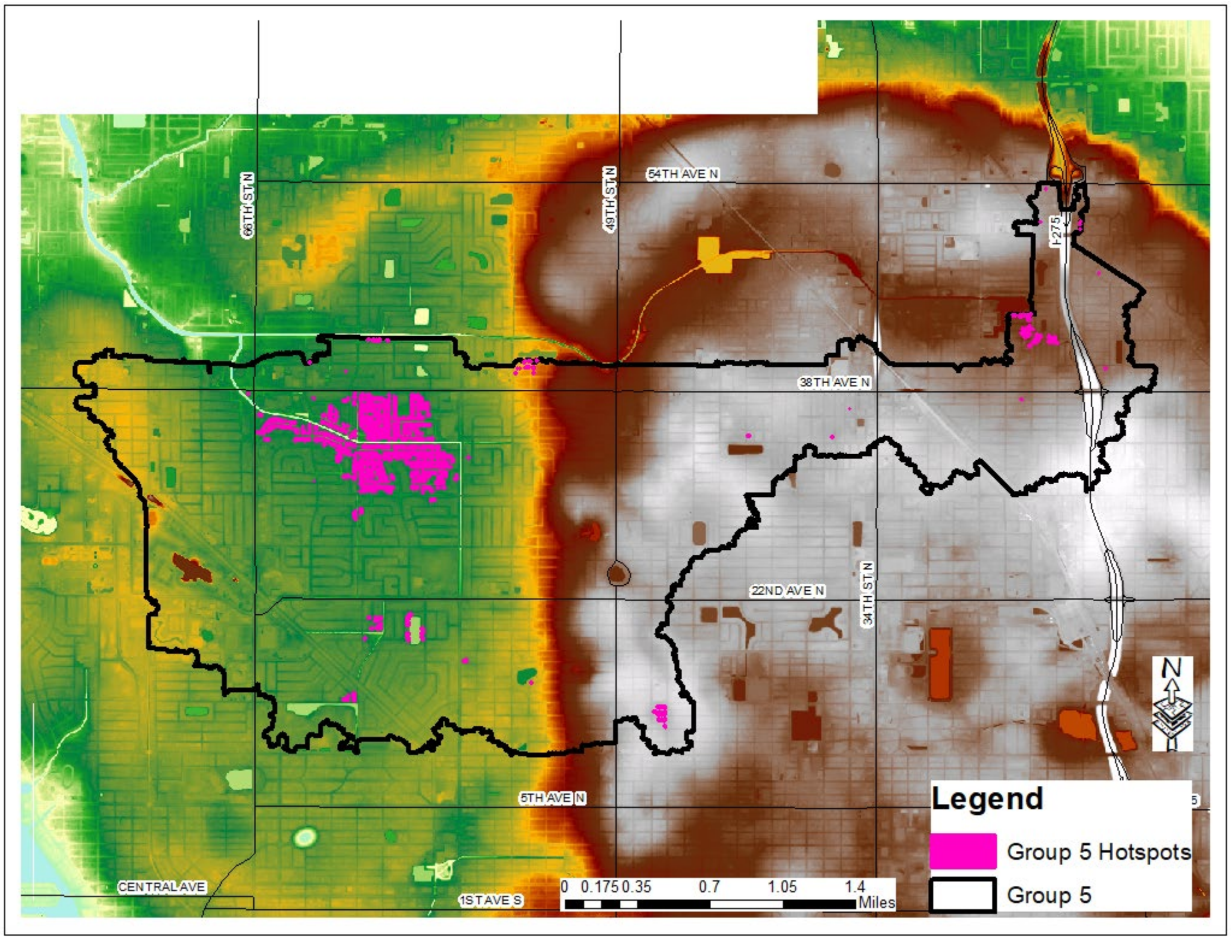


Figure ES-4. Group 5 Structure Flooding Hotspots that Do Not Meet LOS Criteria during 100-year Storm

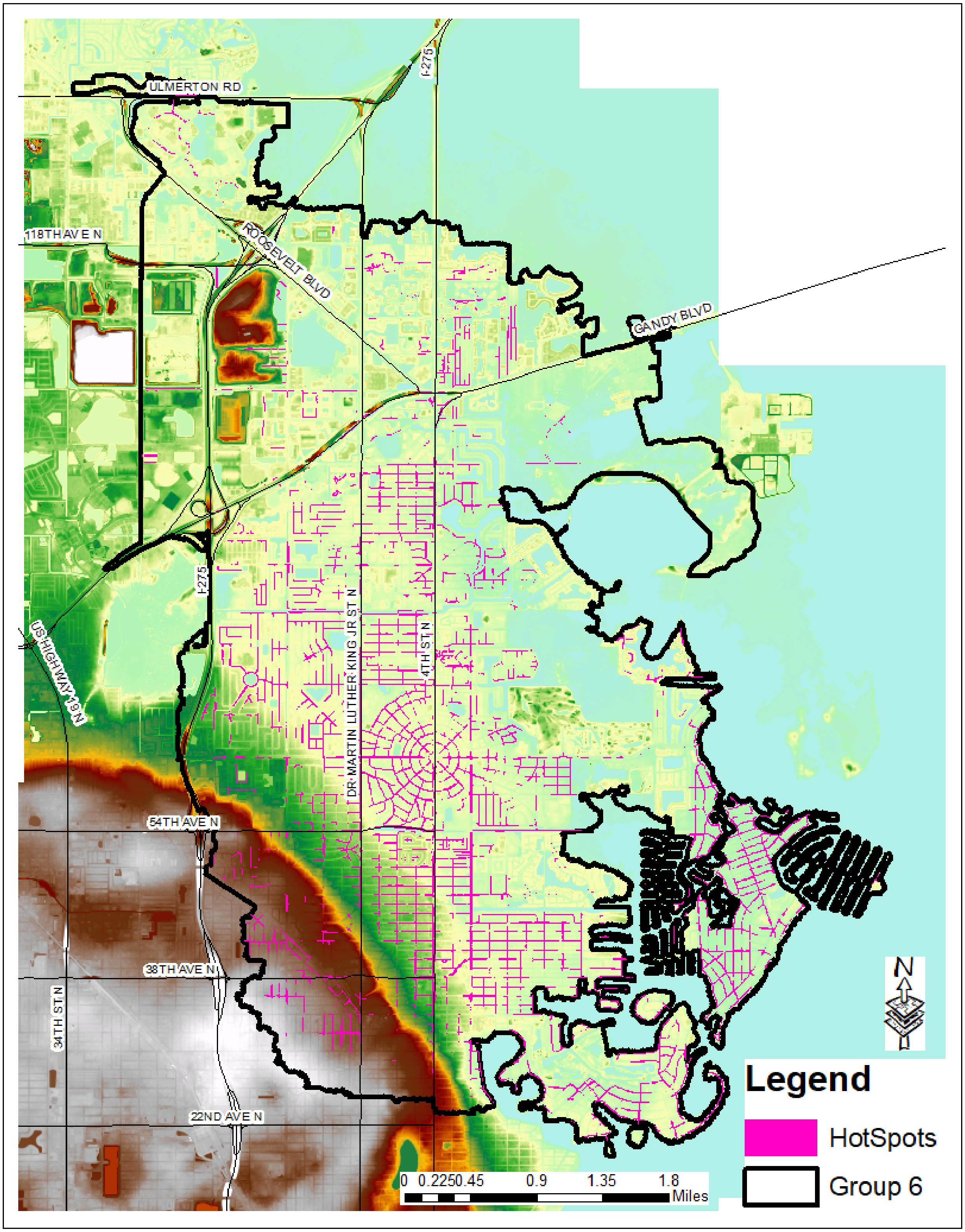


Figure ES-5. Group 6 Road Flooding Hotspots that Do Not Meet LOS Criteria during 10-year Storm

Best Management Practice Alternative Analysis

Based on the results of the LOS Analysis, flooding complaints from the City's SeeClickFix database, and ongoing projects at the City, 76 areas were identified for BMP alternative analysis. Conceptual solutions for flood reduction and improved LOS were developed for those areas. The areas identified are presented on Figure ES-6.

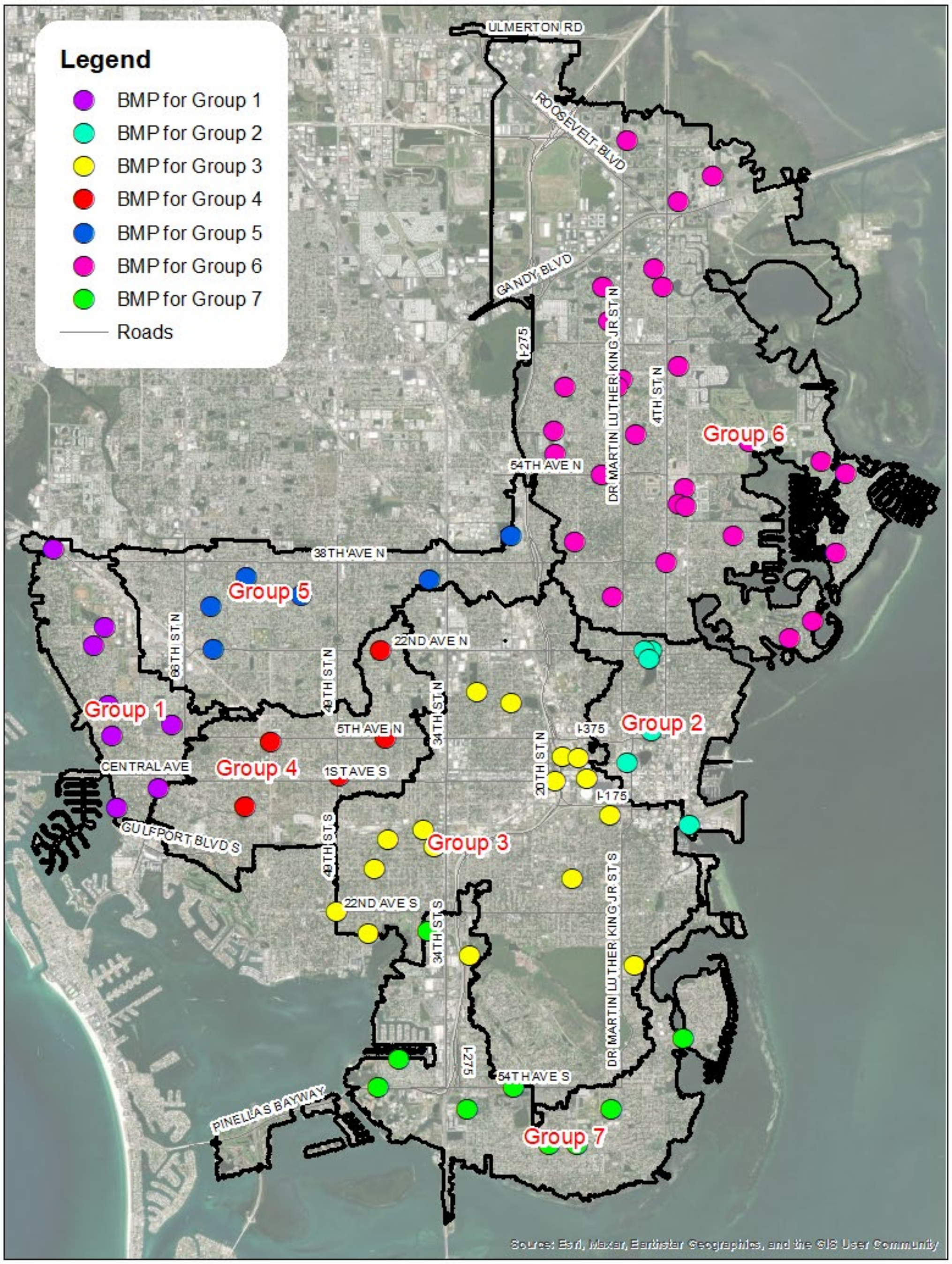


Figure ES-6. Locations Identified for BMP Development

After thorough evaluation of each of the identified flood problem locations, potential solutions were developed for each area. Typical solution types that were evaluated for various BMPs included:

- Conveyance capacity upgrades
- Bypass systems
- Pre-storm drawdown, either by control gates or pump stations
- Creating additional storage with a combination of the above

A multi-criteria analysis (MCA) was also developed to score the benefit of alternatives and to prioritize projects (that is, ranking them). The multi-criteria scoring basis included:

- Street flooding reduction
- Structure flooding reduction
- Water quality improvement
- Cost
- Benefit area – regional, intermediate or local
- The need for precedent projects
- Impaired water or total maximum daily load requirements

Detail explanation regarding MCA score criteria can be found in Section 8.1, Multi-criteria Analysis.

A Preliminary Engineer's Opinion of Probable Construction Cost has been developed for each BMP location. The unit costs applied have been developed with the appropriate contingencies using the Association for the Advancement of Cost Engineering guidance for a Class 4 estimate. Typically engineering for a Class 4 estimate is between 1% and 15% complete and additional details such as survey, environmental and other data is available. In this case, though no survey data is available, stormwater modelling has been conducted to assess size and scale of each BMP. A Class 4 estimate is used to assess feasibility and evaluate alternatives to assist with strategic business planning.

These opinions of probable cost are prepared using quantity take-offs from the available stormwater model information and estimated baseline work activities required to complete the project. GIS, LIDAR elevations and aerial information have been used to estimate quantities. Table ES-3 provides the assumed contingencies and markups utilized for each BMP location.

Table ES-3. Estimated Contingencies and Markups

Markups	Percentage
Contractors Overhead, General Conditions, Temp Facilities	15%
Contractor Profit	10%
Engineering/Design	15%
Class 4 Estimate Contingency	25%

The cost estimates have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. The costs are presented in

2023 US dollars and may require escalation to the estimated mid-point of construction due to assist in handling market volatility.

An example MCA is shown in Table ES-4.

Table ES-4. Example Multi-criteria Analysis

	Alternative and Score (1 - 5)				
Criteria	**Weight (1 - 10)**	**BMP 1**	**BMP 2**	**BMP 3**	**Maximum Possible**
Reduces Street Flooding	7	4	5	2	5
Reduces Structure Flooding	10	5	1	5	5
Repetitive Loss Area	8	3	4	5	5
Requires Precedent Project	4	5	1	5	5
Has Previous Capital Improvement Program	6	1	5	1	5
Regional (high score) versus Local Benefits (low score)	4	5	3	1	5
Improves Water Quality	3	3	4	5	5
Impaired Water or Total Maximum Daily Load	3	5	5	5	5
Cost	10	2	4	3	5
TOTAL		192	190	194	275

The MCA scores along with the costs and benefits of the BMPs are shown in Table ES-5.

Table ES-5. Best Management Practices Summary Table Showing Costs, Benefits, and MCA Score

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G6-11	Denver Street Northeast	6	X	6,853	54	165	$3,708,088
G3-11	Childs Park Pond Sump Removal	3	E	1,010	4	158	$210,000
G6-22	Arizona Avenue Northeast	6	X	6,075	45	155	$6,038,206
G6-28	88th Avenue North	6	O	3,064	46	155	$9,615,000

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G6-6	62nd Avenue North	6	M	13,350	182	155	$49,733,406
G3-6	Emerald Lake Outfall into Booker Pond	3	B	71	19	147	$600,000
G6-25	82nd Terrace North	6	O	4855	57	145	$158,003,165
G7-2	58th Avenue S and 11th Street South	7	Q	2,100	54	145	$53,039,059
G2-5	Crescent Lake Drawdown	2	J	765	4	143	$60,000
G3-16	34th Street Improvements	3	D	819	2	143	$643,000
G6-7	92nd Avenue	6	P	2,750	44	143	$6,600,000
G6-15	Brightwaters Boulevard Northeast Area	6	X	1,600	1	142	$698,081
G2-1	Crescent Lake 22nd Avenue Bypass	2	J	855	25	141	$4,020,000
G2-6	Crescent Lake 22nd Avenue Bypass with Smart Box	2	J	855	25	141	$4,100,000
G7-3	54th Avenue S and Osprey Drive South	7	U	2,700	0	139	$966,397
G3-14	17th Avenue South	3	C	1,500	56	138	$41,939,000

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G6-26	Walnut Street Northeast and 43rd Avenue Northeast Area	6	L	2,917	18	137	$6,974,054
G6-3	88th Avenue North	6	O	6,256	52	137	$24,364,776
G7-8	63rd Avenue South and 16th Street South	7	V	7,998	40	137	$10,550,277
G4-3	5th Avenue North Road	4	F	12,922	17	135	$49,500,000
G4-4	22nd Avenue and 43rd Street	4	F	9,815	30	135	$35,484,473
G5-3	36th Street North Flooding	5	I	2,491	18	135	$24,747,054
G6-10	Poplar Street	6	T	1,500	12	132	$3,605,000
G6-5	Oklahoma Avenue Northeast	6	X	1,324	6	132	$1,736,549
G6-8	116th Avenue North	6	T	1,319	6	132	$1,722,594
G1-1	Golf Creek 9th Avenue Bridge	1	G	1,960	0	128	$4,800,000
G4-1	Dartmouth Avenue North and 58th Street North	4	F	4267	14	127	$61,678,508
G6-14 Solution A	1st Street North	6	M	2,380	14	127	$55,376,188
G6-16	Appian Way Northeast Area	6	X	5,230	24	127	$17,719,439

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G1-3	Tyrone Boulevard Connection	1	R	400	0	126	$775,000
G2-2	Round Lake	2	A	397	2	126	$1,032,000
G3-10	Lake Maggiore West Outfall	3	C	3,281	7	125	$31,400,000
G3-5	Lake Maggiore East Outfall	3	C	3,281	7	125	$10,865,556
G7-9	63rd Avenue South and 20th Way South	7	V	4,070	6	125	$19,807,247
G3-13	26th Avenue South	3	Z	672	2	123	$3,054,000
G4-2	60th Street South	4	F	1,535	16	122	$24,308,455
G6-23	82nd Avenue	6	k	1,330	37	122	$11,773,523
G6-9 & G6-24	Dr Martin Luther King Jr Street North	6	N	1,250	45	122	$26,886,094
G1-4	Villagrande Avenue	1	S	1,101	0	120	$3,555,554
G3-9	49th Street Connection Pipes	3	Z	1,639	0	120	$2,172,000
G3-12	15th Avenue & 44th Street	3	E	130	2	119	$1,277,000
G6-1	1st Lane	6	T	3,600	1	119	$5,675,000
G7-4	54th Avenue S and Caesar Way South	7	U	4,594	4	119	$8,123,495
G7-7	49th and 50th Avenue South	7	U	4,181	8	119	$5,993,127

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G6-2	74th Avenue North	6	N	6,256	9	117	$10,916,464
G6-12 & G6-19	59th Avenue North & 62nd Avenue North	6	O	2,301	5	115	$8,008,330
G3-15	Emerald Lake Add Pump	3	B	321	21	114	$19,500,000
G6-20	Foch Street Northeast	6	M	787	19	113	$30,781,823
G6-18 & G6-21	3rd Street	6	L	1,930	17	112	$77,630,424
G6-9 & G6-24	Dr Martin Luther King Jr Street North	6	N	1,085	23	112	$158,366,591
G7-6	Lewis Boulevard Southeast and Elkcam Boulevard Southeast	7	W	1,545	0	112	$2,185,302
G3-17	34th Street Bypass	3	D	783	6	111	$12,390,000
G3-3	Booker Creek Water Quality Detention	3	B	0	0	111	$500,000
G6-4	70th Avenue North	6	O	3,251	0	109	$15,306,274
G1-7	Grevilla Avenue South	1	S	709	0	105	$2,387,000
G5-2	53rd Street North Flooding of Road	5	H	693	2	105	$8,237,411

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G1-5	22nd Avenue Alternative Outfall	1	R	930	0	103	$5,707,000
G2-3	1st Street Southeast	2	A	542	0	103	$6,245,000
G6-13	4th Street North & 38th Avenue North Area	6	L	1,330	2	102	$30,085,960
G2-4	2nd Avenue N Mirror Lake	2	A	243	0	101	$1,958,000
G1-2	5th Avenue Improvements	1	G	211	8	99	$8,300,000
G3-8	Campbell Park Creek Widening	3	B	250	0	99	$2,200,000
G6-27	42nd Avenue North	6	L	6,098	0	99	$24,439,929
G7-5	56th Avenue South and 31st Street South	7	U	2,320	0	99	$19,777,551
G1-6	26th Avenue North	1	R	855	0	95	$8,203,000
G1-8	Eagle Lake Outfall	1	G	643	0	93	$21,596,000
G3-7	2nd Avenue Bypass Pipe	3	B	0	3	91	$6,200,000
G6-17	54th Avenue	6	M	540	0	85	$16,168,093
G5-5	29th Avenue	5	I	0	2	81	$82,463,988
G3-1	Booker Creek Box Culvert Reroute	3	B	286	0	78	$21,960,000

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G3-2	Booker Creek Rail Easement Bypass	3	B	0	0	71	$20,515,000

Contents

Appendices

Tables

Figures

Acronyms and Abbreviations

BMP	best management practice
CH2M	CH2M HILL, Inc.
CIP	Capital Improvement Program
City	City of St. Petersburg
DEM	digital elevation model
District	Southwest Florida Water Management District
ERP	Environmental Resource Permit
FDOT	Florida Department of Transportation
GDB	geodatabase
GIS	geographic information systems
GWIS	Geographic Watershed Information System
H&H	hydrologic and hydraulic
ICPR	Interconnected Pond Routing
ICPR4	ICPR Version 4
LiDAR	light detection and ranging
LOS	level of service
LWES	Land and Water Engineering Science
MCA	multi-criteria analysis
NAVD 88	North American Vertical Datum of 1988
SLR	sea level rise
SWMP	Stormwater Management Master Plan
Tc	time of concentration
TMDL	total maximum daily load

1. Introduction

CH2M HILL Engineers, Inc. (CH2M), a wholly owned subsidiary of Jacobs, is under contract with the City of St. Petersburg (City) to complete a City-wide Stormwater Management Master Plan (SWMP) Update. The SWMP incorporates Watershed Evaluation and Watershed Management Plan elements from the Southwest Florida Water Management District (District) Guidelines (District 2017), including the Watershed Evaluation, Watershed Management Plan, and Watershed Alternative Analysis. CH2M completed the watershed evaluation element in October 2020, and the corresponding Watershed Evaluation Report is included in this deliverable package.

CH2M completed the best management practice (BMP) alternatives analysis element under Task 4.3 of the project. This report documents the BMP alternative analysis phase, including conceptual BMPs development, preliminary engineer's opinion of probable construction cost estimate, and ranking of the developed proposed BMPs.

2. Watershed Description

The City watershed is approximately 62 square miles in size, located in southern Pinellas County, Florida. The watershed is in a coastal community bounded by water on three sides and shares boundaries with Pinellas County and the City of Gulfport watersheds on other sides. St. Petersburg is highly urbanized, and approximately 50% of it is categorized as residential high-density land use. Approximately 16% of the land area is made up of bays and estuaries. On the northern side, there is a shared boundary with the Pinellas County portion of Roosevelt Creek Basin, Joes Creek Basin, and Long Bayou Basin. On the northwestern side, there is a shared boundary with the Pinellas County portion of Sawgrass Lake Basin. On the southwestern side, there is a shared boundary with the City of Gulfport's portion of Clam Bayou Basin and Bear Creek Basin and the Pinellas County portion of Bear Creek Basin. The City's watershed consists of 26 primary basins, named from A to Z, as shown on Figure 2-1. All the basins' information were updated as a part of this project.

The latest soils information was downloaded from the National Resources Conservation Service website. The watershed consists of a mix of A, B/D, C, D, urban land, and water, with B/D soil types covering approximately 40% of the City. The B/D soils were presumed to be performing under wet weather conditions and were modeled as Type D soils. The soils coverage in the watershed is presented on Figure 2-2.

Topographic data were provided in the High Accuracy Reference Network North American Datum of 1983 (feet) and were used for the horizontal coordinate system. The North American Vertical Datum of 1988 (NAVD 88) (feet) was used for the vertical coordinate system. Topographic data were projected in North American Datum of 1983 High Accuracy Reference Network State Plane Florida West FIPS 0902 (feet), in accordance with District requirements. The resolution of the digital elevation model (DEM) was a 2.5-by-2.5-foot grid cell (Figure 2-1).

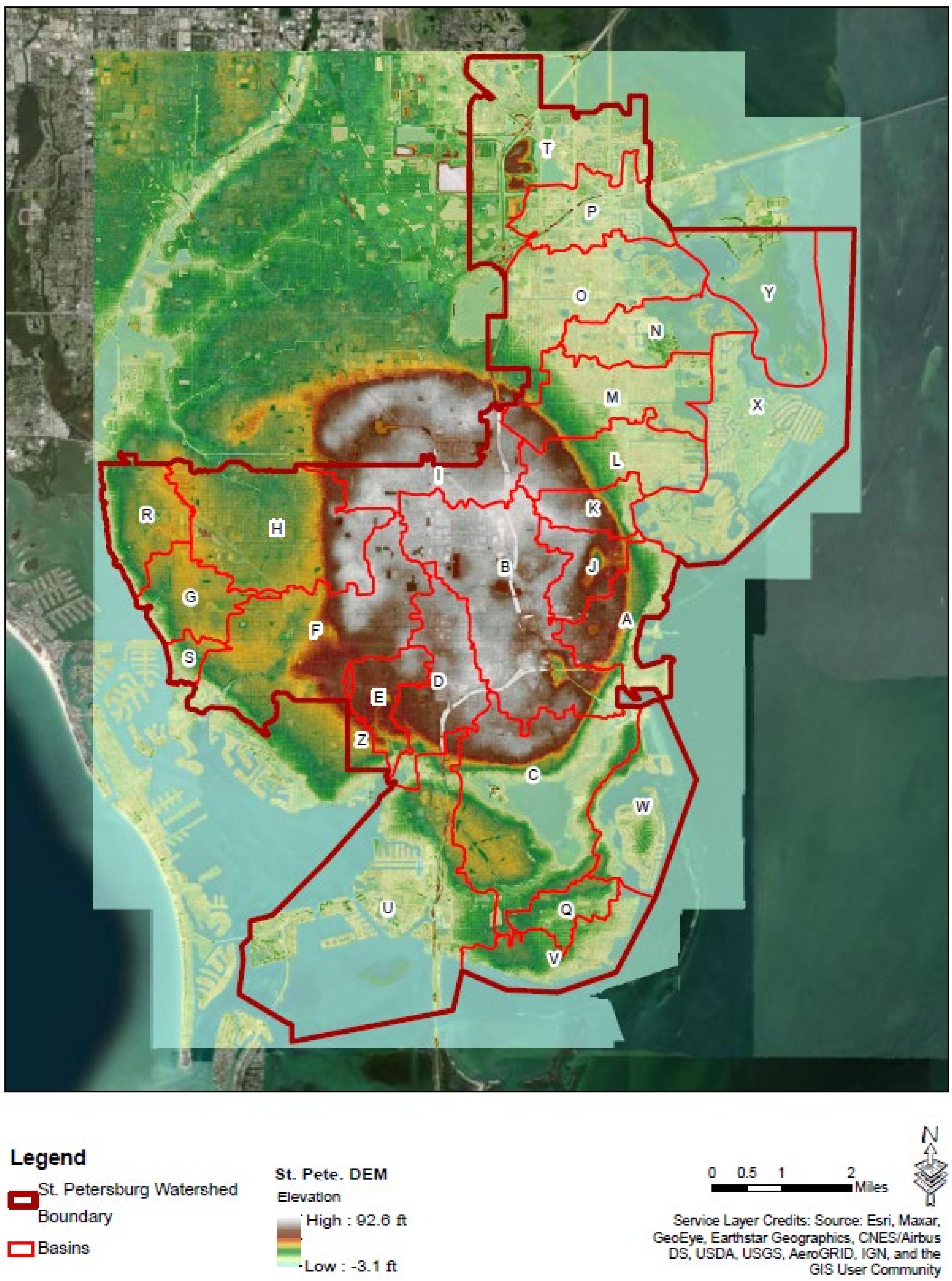


Figure 2-1. Stormwater Basins

Figure 2-2. Hydrologic Soil Groups within the St. Petersburg Watershed

3. Watershed Evaluation

The District process for watershed analysis consists of the following five elements that are performed as a Watershed Management Plan is developed:

- Topographic information
- Watershed evaluation
- Watershed Management Plan
- Implementation of BMPs
- Maintenance of watershed parameters and models

The SWMP Update covers three of the five elements listed previously: topographic information, watershed evaluation, and Watershed Management Plan (floodplain analysis and alternative analysis). This study does not cover implementation of BMPs or maintenance of watershed parameters and models.

The Watershed Evaluation Report (Jacobs 2020) represents a summary of the data collected and work completed through the watershed evaluation element of the Watershed Management Plan. The watershed evaluation element had the following goals:

- Compile, review, and evaluate existing watershed data.
- Develop watershed features that define stormwater hydrologic and hydraulic (H&H) infrastructure.
- Identify survey requirements.
- Perform data acquisition from existing sources, field verification, and survey.
- Develop a watershed geographic information system (GIS) database.

The watershed data collection and evaluation efforts were focused on obtaining the following information required to develop a watershed scale model for the SWMP Update:

- Previous City watershed studies
- Stormwater inventory
- Neighborhood watershed studies
- Topographic data –DEM
- Environmental Resource Permit (ERP) plan sets
- Groundwater data
- Soils map
- Land use
- Historical water levels

Based on the data collected, initial GIS processing was conducted to develop a model-specific Geographic Watershed Information System (GWIS) Geodatabase (GDB) compatible with Interconnected Pond Routing (ICPR) Version 4 (ICPR4), which was the model specified for this project. The GDB structure included HydroNetwork and model features. The HydroNetwork included sub-basins, links, nodes, and associated data tables. Initially, a GWIS GDB was developed for each of the City's 26 basins. there, these basin GDBs were later combined into one GDB after the data acquisition process was completed.

The topographic data through DEM were also analyzed to identify topographic voids. Topographic voids are areas within the populated DEM from captured light detection and ranging (LiDAR) information where there is no data, erroneous data, or elevations that do not correctly reflect the true ground elevation. These voids can result from post-processing of the raw data to create the DEM. The DEM was reviewed using the following information:

- 2017 Florida Department of Transportation aerial imagery
- 2018 aerial imagery provided by the City
- The District's GIS tool, Dual Maps, which uses Bird's Eye View aerial imagery and Google StreetView

The DEM was also reviewed against the District's ERP Polygon layer. A total of 330 topographic void points were located within City limits. The following three types of voids were identified:

- Differences in aerial imagery and the DEM elevations
- Artificially high or low elevations based on DEM processing
- DEM cells without elevation data

The voids that would have had a significant impact on the modeling were corrected using available ERP plan sets, aerial imagery, and other surrounding topographic information around the void.

As the GWIS GDBs were being developed for the basins, the data were analyzed to determine the need for additional field reconnaissance and data acquisition. Field reconnaissance was focused on the team obtaining a better understanding of the sub-basin delineations and confirmation or detection of the structures that were questionable or missing in the available data. City personnel found several dozen as-built plans while searching City records, and most of the remaining undocumented facilities were surveyed by a professional land surveyor approved by the City as a subconsultant. Based on the field reconnaissance and the desktop data gap analysis, data to be obtained from the field survey were identified. Field data were acquired by a professional land surveyor for approximately 2,000 structures across the City.

Based on the information collected during the field reconnaissance and the survey data, the GWIS GDBs were refined to incorporate the collected information. During the data refinement phase, all the individual basin GWIS GDBs were combined into one master GWIS GDB for the City watershed. Table 3-1 presents model features, the total number of sub-basins, links, and nodes (links represent H&H connections between basins, and nodes represent junctions connecting links).

Table 3-1. Summary of Total Model Features

Model Features		Total
Basin		26
Sub-basins		11,867
Nodes	Stage/Area	15,906
	Time/Stage	174
	Maintenance Hole	5,567
	TOTAL	**21,647**

Model Features		Total
Links	Pipe	20,217
	Weir	383
	Bridge	16
	Rating Curve	6
	Drop Structure	716
	Channel	550
	TOTAL	**21,888**

The completed GWIS GDB includes model features that can be used to develop the H&H parameters and the H&H model in the ICPR4 model platform. The next steps include model parameterization, model calibration/verification, floodplain analysis, level of service (LOS) analysis, surface water resource assessment, and a BMP alternatives analysis to develop projects for flood reduction and water quality improvements.

The final detailed Watershed Evaluation Report, submitted to the City in October 2020, is included as Appendix A.

4. Watershed Model Development and Floodplain Analysis

The watershed model development and floodplain analysis phase of the project included:

- Model parameterization
- Model testing
- Model calibration and verification
- 100-year floodplain analysis and delineation

H&H model parametrization was developed for the model features, sub-basins, links, and nodes that were developed during the watershed evaluation phase. The model parameters were stored and populated in appropriate data tables in GWIS geodatabase that was developed for the watershed. The model-ready GWIS geodatabase was imported into the ICPR4 model interface after the parameterization was completed.

The hydrologic parameters used to estimate runoff from the sub-basins include Green-Ampt Infiltration parameters, which were based on the soils and land use characteristics of the watershed. The District's Soil Data Retrieval and Processing Tool was used to populate the required soil parameters for the ICPR4 input. The time of concentration (Tc) values were developed using the commonly accepted TR-55 approach (USDA 1986) using land surface DEM based slope and land use type for Manning's roughness coefficients.

The hydraulic parameters were developed for all the model links and nodes. The primary parameters required for model nodes are initial stages and the stage/area or time/stage relationship, depending on type of the node. Stage/area data were mostly derived from the DEM at 0.25-foot increments, with some supplemental changes from ERP data for newer projects. These data were developed in the watershed evaluation step and extracted from the GWIS.

The associated hydraulic parameter for all link types were acquired from the GWIS or developed based on site-specific information. The City's watershed primarily contains link types of pipes, weirs, channels, and drop structures. Hydraulic parameters for pipes and channels were developed for each link type. Typical pipe input included dimensions, inverts, Manning's roughness (n), and entrance/exit losses for pipe links. For bridges, rating curves were developed. For weirs, dimensions, invert elevations, and weir coefficients are critical input parameters.

Initially, major efforts were made to export the City-wide GWIS GDB into ICPR4 model. However, due to the size of the GDB, with more than 6 million data points, it was difficult to import the data into ICPR4. Both Streamline Technologies (ICPR4 developer) and the District were contacted on this matter, and their suggestions were incorporated into the GDB to be able to import into ICPR4. After spending a few weeks on this process, the City, District, Jacobs, and Jacobs' team member Land and Water Engineering Science (LWES) agreed that continuing with one City-wide model would be inefficient and would impact the schedule significantly. Jacobs proposed dividing the watershed into seven groups, as follows and shown on Figure 4-1:

- LWES Groups
  - Group 1 (G, R, and S) – Western Bayfront
  - Group 2 (A and J) – Downtown and Crescent Lake
  - Group 3 (B, C, D, E and Z) – Booker Creek, Lake Maggiore, and Clam Bayou
- Jacobs Groups

- Group 4 (F) – Bear Creek
- Group 5 (H and I) – Joes Creek
- Group 6 (K, L, N, O, P, T, X, Y, and M) – Northern Basins
- Group 7 (Q, U, V, and W) – Southern Basins

These groupings were based on hydrology and perceived major basin divides between groups. Availability of water level loggers in each group was also taken into consideration to be able to calibrate and verify via model simulations for each group. The interactions between the groups along the shared boundaries were captured along with boundary time/stage inputs from corresponding shared adjacent group ICPR model results. A few iterations were conducted by inputting results from one group to the other until a reasonable stage balance was obtained between the groups along the boundary. Boundary stage time series were input using the ICPR_TIME_STAGE table for Groups 4 to 7 and the BOUNDARY_STAGE_SET table for Groups 1 to 3.

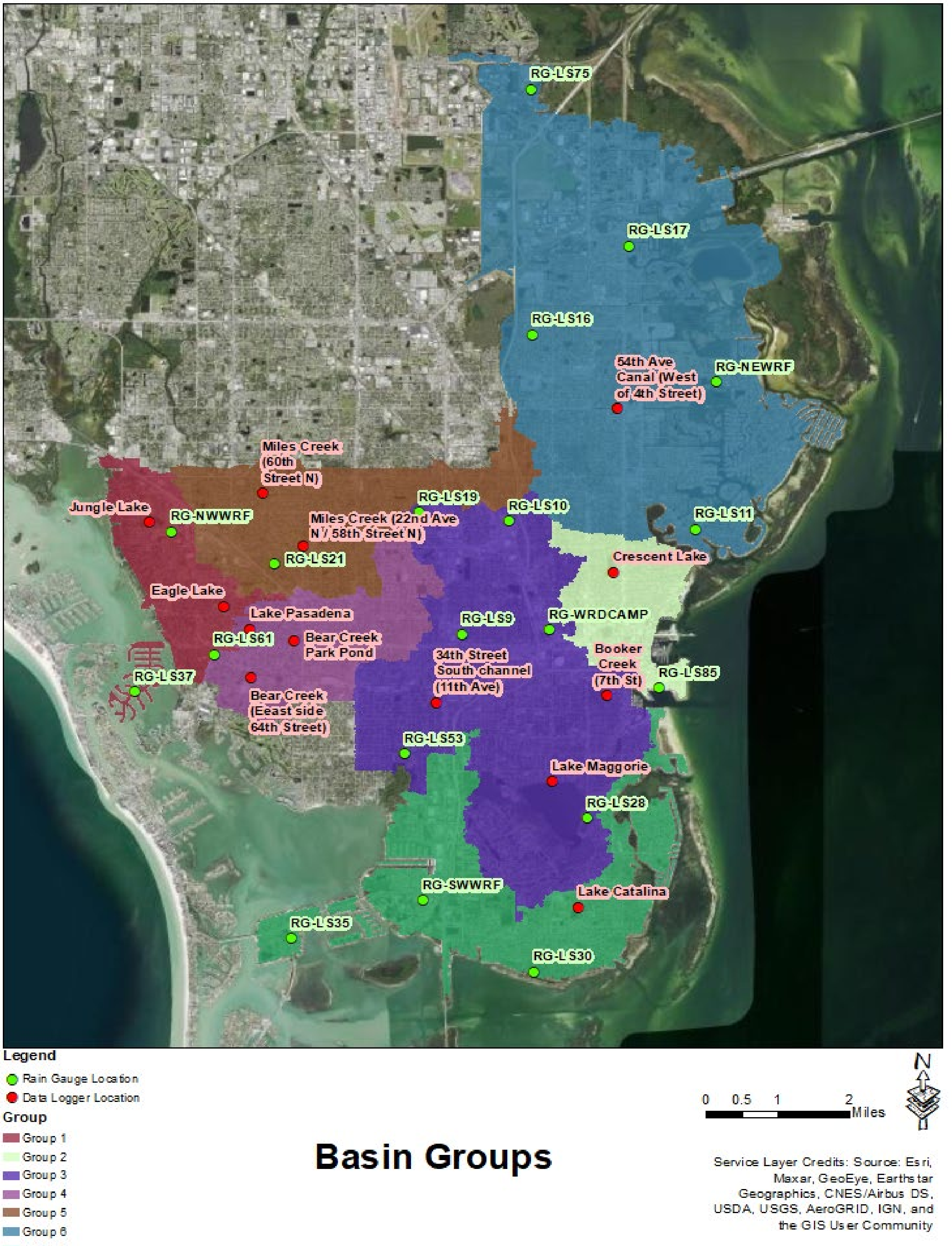


Figure 4-1. Seven Basin Groups, City Water Level Data Logger, and Rain Gauge Locations

Each group model was tested for instabilities and mass balance errors and resolved before continuing to calibration and verification. For calibration and verification purposes, the water level gauge and rain gauge data were analyzed. Two events were selected to conduct calibration and verification in consensus with the City and District. The chosen calibration and verification rainfall events were from August 2019 and November 2020 (Tropical Storm Eta). The events selected for calibration and verification for each group is shown in Table 4-1.

Table 4-1. Events used for Calibration and Verification Simulations

Group	Calibration Event	Verification Event
Group 1	August 11 to 18, 2019	November 11 to 15, 2020
Group 2	November 11 to 15, 2020	August 11 to 18, 2019
Group 3	November 11 to 15, 2020	August 11 to 18, 2019
Group 4	August 11 to 18, 2019	November 11 to 15, 2020
Group 5	August 11 to 18, 2019	November 11 to 15, 2020
Group 6	August 11 to 18, 2019	November 11 to 15, 2020
Group 7	August 11 to 18, 2019	November 11 to 15, 2020

All the group models calibrated well and verified compared to the observed data. Examples of comparison plots are shown on Figures 4-2 and 4-3. Comparison plots for all other gauges are presented in Appendix B along with the full final report of Watershed Model Development and Floodplain Analysis.

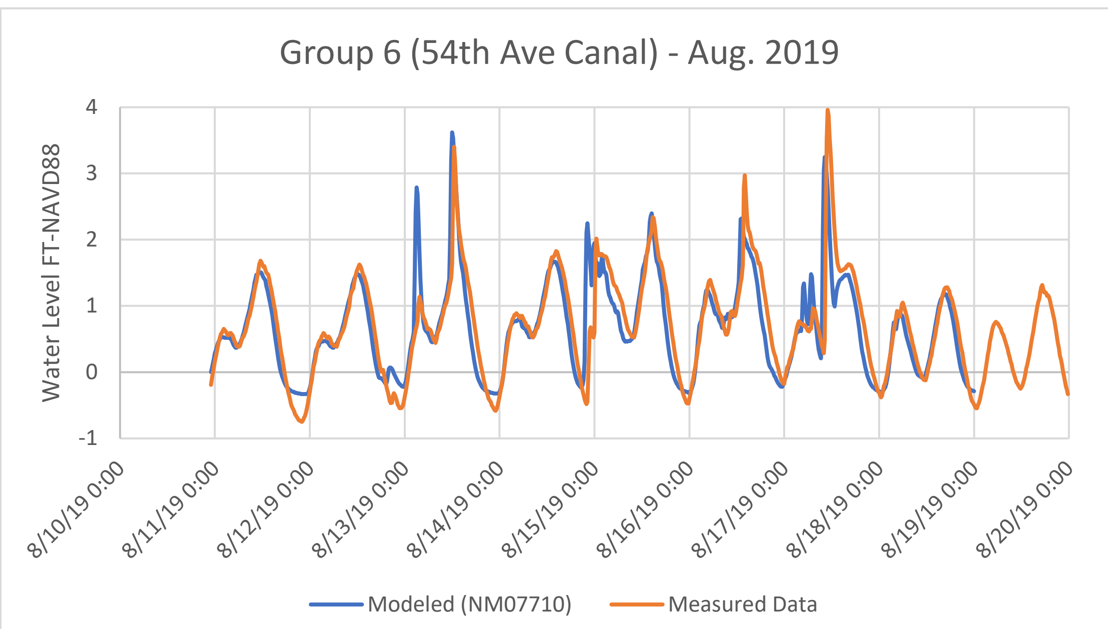


Figure 4-2. Group 6 (54th Avenue Canal) – Calibration Event August 2019

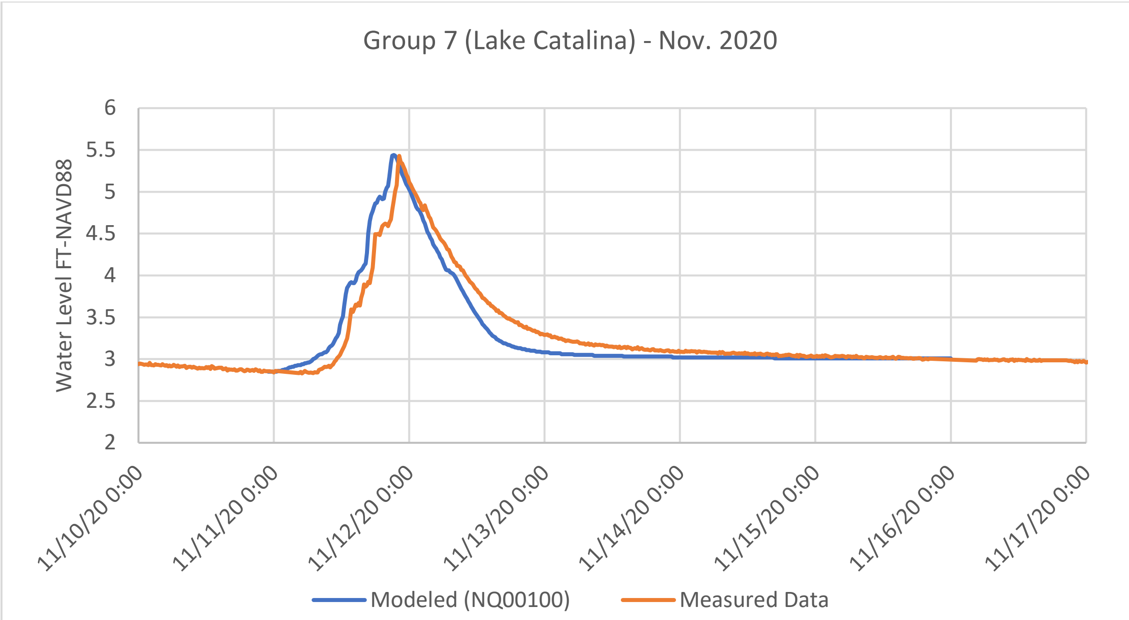


Figure 4-3. Group 7 (Lake Catalina) – Verification Event November 2020

Each calibrated model was used to conduct a floodplain analysis for the 100-year/24-hour design storm. Simulation results were used to conduct the analysis and to delineate the floodplain (that is, to map the flooded areas). An example floodplain delineation for Group 6 is presented on Figure 4-4.

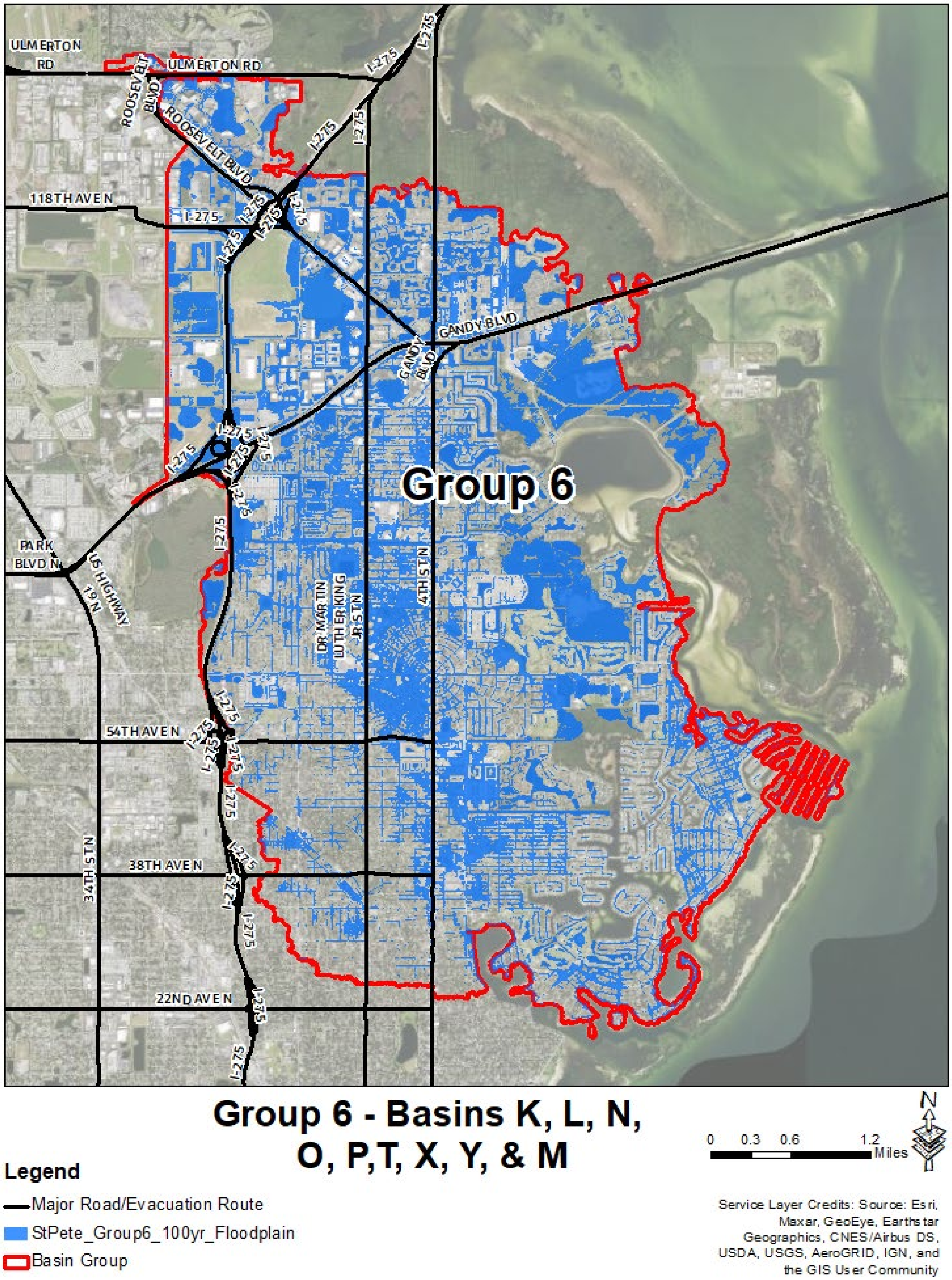


Figure 4-4. Floodplain Map for Group 6

The Watershed Model Development, Verification and Floodplain Analysis Report (Jacobs 2023a), submitted to the City in April 2023, is provided as Appendix B and provides detailed information of model testing, boundary condition development, calibration/verification process, comparison plots, and 100-year floodplain delineation for each group.

5. Floodplain Level of Service Analysis

The LOS analysis was developed to identify locations that do not meet the City's LOS criteria for roads and structures based on the flood inundation depths developed from H&H models.

5.1 Supporting Data

The LOS analysis for the area of City of St Petersburg Watershed was developed by using the following data:

- Building Footprint: Polygon feature class containing the building area for their given group
- DEM: Representation of the topographic surface of the given area
- ArcMap/ICPR4 Models: Developed as part of the floodplain analysis task
- Group GWIS_FLOOD: Floodplains developed for each individual group by using their respective 10-year and 100-year/24-hour design storm model results
- Road: Polyline feature class containing both the spatial location and related data of each road in the area
- Adjacent Watershed: Models adjacent to the City's watershed that has direct flow impact to the City's watershed

5.2 Boundary Stage Development

The City's watershed shares boundaries with other watersheds that have boundary flows (into or out of the model). Time series were extracted from the adjacent watershed models along the individual group model boundaries and implemented within the St. Petersburg models as time-stage tables. This implementation accounts for flow that were simulated from the adjacent watersheds that may impact the St. Petersburg watershed models. Along with the non-City watersheds, this adaptation was also performed between groups within the St. Peterburg watershed.

5.3 Design Storm Simulations and Inundation Mapping

The calibrated group models developed in the ICPR4 H&H software was used to simulate design storm rain events, including 100-year/24-hour, 25-year/24-hour, and 10-year/24-hour. After simulations were performed, the model results were used to create inundation maps (flood extents). The flood extents along with flood depth grids generated in GIS from model results and then were used for the LOS analysis.

5.4 Level of Service Analysis Methodology

The LOS analysis methodology for roadways and structures used the City's LOS criteria and the H&H modeling simulation results. The City identified the LOS criteria to be used for this analysis, which includes:

- For roadway LOS: 10-year/24-hour event with maximum 6-inches of flooding in the roadways for the LOS. The same criteria was used for all roadway categories in the City, including neighborhood/local, collector, or arterial roads.
- For building structures: 100-year/24-hour event maximum stage elevation below the finished floor elevation. Buildings finished floor elevations were assumed to be 1 foot above the adjacent ground.

5.4.1 Roadways

The City's road feature class containing all roadway centerline spatial locations with their appropriate data was used to conduct the LOS analysis for roadways. The analysis was started by buffering the road centerlines based on the representative number of road lanes per roadway type, to identify reasonable spatial width extent of each roadway for LOS analysis. For example, a road containing two lanes was buffered by an amount of 24 feet. By spatial correlation of the floodplain developed from the 10-year/24-hour model simulation results and buffered roadway width, locations where possible roadway flooding is simulated to occur were identified. The identified locations are intersected with the flood depth data along with the floodplain to identify road flooding greater than 6 inches in depth.

5.4.2 Structures

The building footprint product from Microsoft (https://github.com/Microsoft/USBuildingFootprints), link provided by the District, was used to conduct structures LOS analysis. Per the website, the footprints are from 2019 through 2020. To develop finished floor elevations to compare with flood elevation, the LiDAR DEM was used to estimate a mean ground elevation within the footprint polygon of each structure. Based on discussions with the City, 1 foot above the DEM mean ground elevation was considered the finish floor elevation of the structure footprint. After the finish floor elevations were established, a correlation between the new building footprint and the most recent 100-year/24-hour floodplain was conducted to locate possible structure flooding locations. The structure is considered flooded if the estimated finish floor elevation is below the modeled 100-year/24-hour floodplain base flood elevation.

5.4.3 Level of Service Analysis Results

The LOS results presented on the figures in Appendix C show the structures and roadways that do not meet the criteria.

5.5 Future Condition Modeling and LOS

In addition to the LOS analysis for the existing conditions, future conditions for the year 2050 were also analyzed by simulating the future conditions models and performing LOS analysis using the methodology described in Section 5.4.

5.5.1 Future Condition Projections

To conduct future condition modeling, sea level rise (SLR) projections and future rainfall projections are taken into consideration. CH2M has completed climate science review and recommended projections to use for future conditions modeling as part of Task 1.5, Climate Science Review. The associated task technical memorandum titled *Incorporating Climate Science into the City of St. Petersburg Stormwater Master Plan* is included as Appendix D. The climate science and the projections were further reviewed with the City during the meetings on January 29, 2021, and February 12, 2021. To be consistent with the other ongoing City future planning projects and evaluations and studies, including Vision 2050, year 2050 provides a good baseline between the years 2040 and 2070 and was originally recommended in the technical memorandum. It was agreed upon to simulate the year 2050 conditions as part of future conditions modeling. The projections for the year 2050 for SLR and future rainfall projections are shown Table 5-1 and Table 5-2.

Table 5-1. Sea Level Rise Projections

Year	NOAA Intermediate - Low (feet)	NOAA Intermediate (feet)	NOAA High (feet)
2000[a]	0	0	0
2030	0.56	0.79	1.25
2040	0.72	1.08	1.77
2050	0.95	1.44[b]	2.56
2060	1.15	1.87	3.48
2070	1.35	2.33	4.56
2080	1.54	2.82	5.71
2090	1.71	3.38	7.05
2100	1.90	3.90	8.50

Source: NOAA 2017.

[a] Sea level change relative to the year 2000 for St. Petersburg, Florida, in feet above mean sea level.

[b] During the February 12, 2021, meeting, it was discussed and agreed upon that the 2050 National Oceanic and Atmospheric Administration Intermediate SLR projections will be adopted for SWMP future conditions modeling.

Table 5-2. Rainfall Projections

	Rainfall Totals (inches)			
Design Storm	Current St. Pete Gauge	Updated Historical	2050 (RCP 6.0)[a]	2050 (RCP 8.5)[a]
100-year/24-hour	12.00	13.45	14.64	15.22
25-year/24-hour	9.00	9.56	10.14	10.42
10-year/24-hour	7.5	7.48	7.8	7.95

[a] Source: CH2M predicted rainfall as part of Wet Weather I/I Study (CH2M 2017).

Historical and future rainfall projections are based on KSPG (St. Petersburg rainfall gauge) historical data.
During the February 12, 2021, meeting, it was agreed upon that 2050 future condition will be adopted for the SWMP.

5.5.2 Future Conditions Modeling

Based on the projections defined in Section 5.5.1, the future conditions models were developed. They were developed using the existing conditions models and updating the following parameters:

- Tidal boundary conditions were increased to 2.44 feet NAVD 88, which is estimated by adding 1.44 feet of SLR to existing condition mean higher high water of 1 foot NAVD 88.
- Initial conditions of the nodes that are directly impacted by the tide were adjusted to reflect the projected future tidal condition.
- Rainfall totals were updated in the model.

The future condition models were simulated for the following design storms: 100-year/24-hour, 25-year/24-hour, and 10-year/24-hour.

5.5.3 Future Conditions Level of Service

Using the simulation results from future condition models and the LOS methodology defined in Section 5.4, LOS analysis was conducted for future conditions. The LOS analysis was focused on the structures and roadways similar to existing conditions LOS, as discussed in Section 5.4. The results of LOS analysis are presented on the figures included in Appendix C, identifying roadways and structures that do not meet the criteria.

6. Best Management Practice Locations Identification

6.1 Identification Sources and Criteria

The following location sources were used for BMP alternative analysis:

- Results of LOS analysis conducted (Section 5)
  - Structures that do not meet the LOS criteria were identified as structure hotspots
  - Roads that do not meet the LOS criteria were identified as roadways hotspots
- City's flooding complaint information provided by the City as part of the data collection from SeeClickFix database
- Planned Capital Improvement Program (CIP) projects by the City or Florida Department of Transportation (FDOT) within the City limits

The identification criteria used included:

- Significant concentration of structure hotspots; hotspots were correlated with the flood complaints to prioritize for selection
- Isolated hotpots for roads and structures, away from channels and other water bodies, with associated complaints.; these isolated locations may need new infrastructure
- Road flooding hotspots that are near storage areas, such as ponds, lakes, or channels.; these locations may need upgrading of infrastructure with possible new connections to storage areas
- Any ongoing or planned projects in the future by the City or FDOT in the vicinity

6.2 Identification of BMPs per Group

Per the scope of the projects, CH2M was scheduled to develop up to 3 BMPs per each of the 26 basins. When distributed to the model groups, the following are the count of BMPs that were assessed for each of the groups.

- Group 1 (G, R, and S) – up to 9
- Group 2 (A and J) – up to 6
- Group 3 (B, C, D, E, and Z) – up to 15
- Group 4 (F) – up to 3
- Group 5 (H and I) – up to 6
- Group 6 (K, L, M, N, O, P, T, X, and Y) – up to 27
- Group 7 (Q, U, V, and W) – up to 12

It should be noted that if the BMP areas are regional in nature and covering more than one area for flood alleviation, it is counted as more than one BMP. Locations of the BMP areas are shown on Figure 6-1.

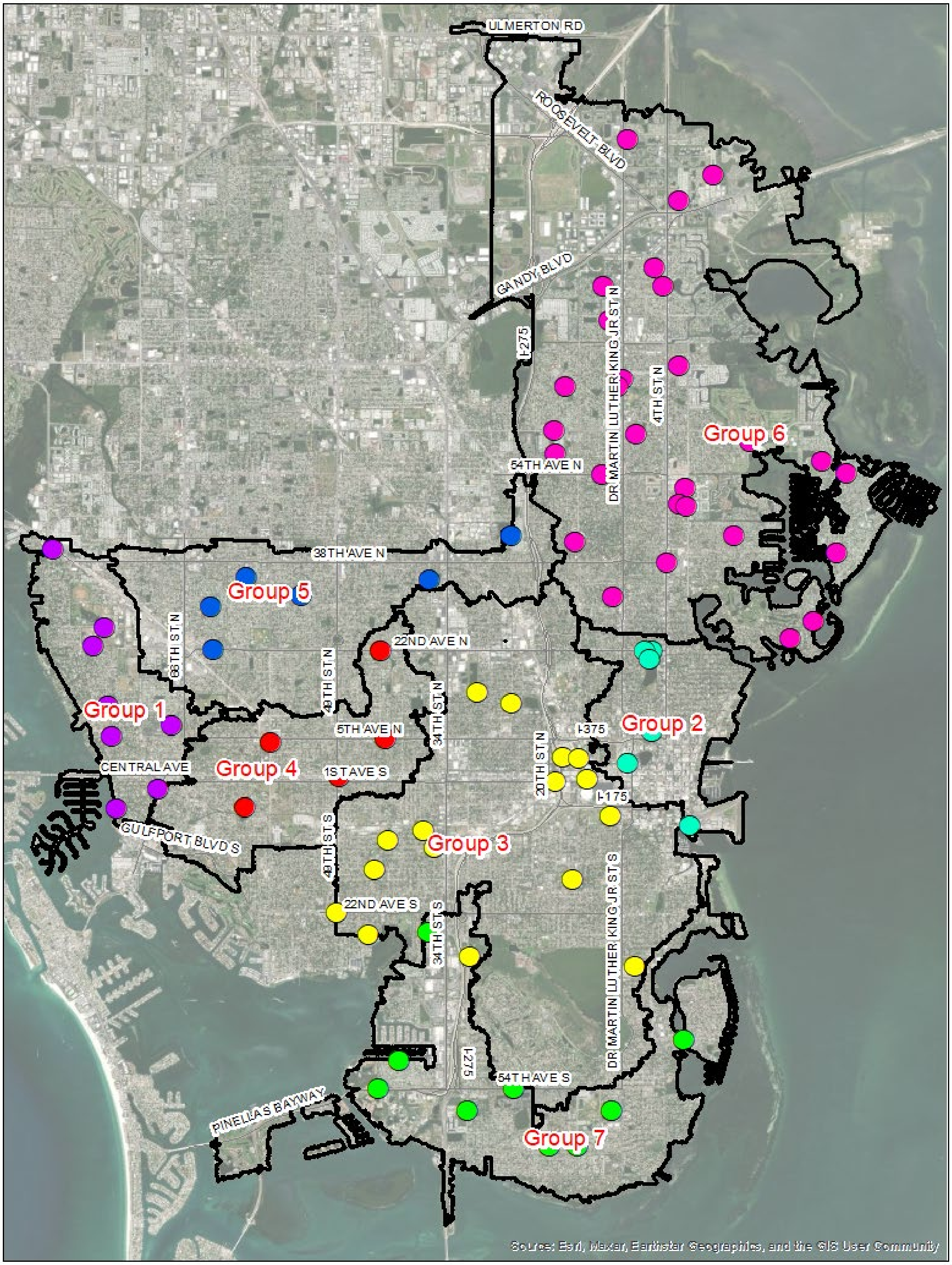


Figure 6-1. Potential BMP Locations Identified to be Evaluated

6.3 Approach to Potential Level of Service Improvements

Typical BMP types that were evaluated for the seven groups (Table 6-1) included the following:

- Conveyance capacity upgrades
- Bypass systems with box culverts
- Pre-storm drawdown, either by control gates or pump stations
- Combination of additional storage with either of the above

All BMPs were carefully analyzed and reviewed. The following alternatives (listed in Table 6-1) provided the best results for their specific areas.

Table 6-1. Typical BMP Types Recommended per Group

Group Number	Typical BMP Types
Group 1	Stormwater conveyance improvements and alternative outfalls
Group 2	Stormwater conveyance improvements, Crescent Lake pre-storm drawdown, bypass systems, and water quality benefits
Group 3	Stormwater conveyance improvements, Lake Maggiore alternate outfalls, bypass systems, and Emerald Lake pump station improvements
Group 4	Stormwater conveyance improvements, alternative outfalls, bypass systems, pre-storm drawdown, and pump stations
Group 5	Stormwater conveyance improvements and alternative outfalls
Group 6	Stormwater conveyance improvements, alternative outfalls, bypass systems, and pump stations
Group 7	Stormwater conveyance improvements, alternative outfalls, and bypass system

BMPs from each group are named based on the group names and BMP number, for example, G1-1. Each BMP is presented as a BMP sheet containing two to three pages with the following information:

- Page 1: Details of the problem areas, listing of the proposed improvements, length of the roadway with flood reduction, and estimate of probable construction cost
- Page 1: Map showing proposed improvements and 10-year/24-hour pre- and post-BMP flood inundation extents
- Page 2: Details of the reduction of flood stages at various nodes and locations within the BMP area and the number of structures removed from flooding
- Page 2 or 3: Map showing pre- and post-BMP implementation 100-year/24-hour flood inundation extents

The BMPs are summarized in Table 6-2 and are presented in more detail in the following sections of this report:

Table 6-2. Summary of Potential BMP Alternatives Identified by Group

BMP Number	BMP Name	Group Number	Basin
G1-1	Golf Creek 9th Ave Bridge	1	G

BMP Number	BMP Name	Group Number	Basin
G1-2	5th Avenue Improvements	1	G
G1-3	Tyrone Blvd Connection	1	R
G1-4	Villagrande Avenue	1	S
G1-5	22nd Avenue Alternative Outfall	1	R
G1-6	26th Avenue North	1	R
G1-7	Grevilla Avenue South	1	S
G1-8	Eagle Lake Outfall	1	G
G2-1	Crescent Lake 22nd Avenue Bypass	2	J
G2-2	Round Lake	2	A
G2-3	1st Street Southeast	2	A
G2-4	2nd Avenue North Mirror Lake	2	A
G2-5	Crescent Lake Drawdown	2	J
G2-6	Crescent Lake 22nd Avenue Bypass with Smart Box	2	J
G3-1	Booker Creek Box Culvert Reroute	3	B
G3-2	Booker Creek Rail Easement Bypass	3	B
G3-3	Booker Creek Water Quality Detention	3	B
G3-5	Lake Maggiore East Outfall	3	C
G3-6	Emerald Lake Outfall into Booker Pond	3	B
G3-7	2nd Avenue Bypass Pipe	3	B
G3-8	Campbell Park Creek Widening	3	B
G3-9	49th Street Connection Pipes	3	Z
G3-10	Lake Maggiore West Outfall	3	C
G3-11	Childs Park Pond Sump Removal	3	E
G3-12	15th Avenue & 44th Street	3	E
G3-13	26th Avenue South	3	Z
G3-14	17th Avenue South	3	C
G3-15	Emerald Lake Add Pump	3	B
G3-16	34th Street Improvements	3	D
G3-17	34th Street Bypass	3	D
G4-1	Dartmouth Avenue North and 58th Street North	4	F
G4-2	60th Street South	4	F
G4-3	5th Avenue North	4	F

BMP Number	BMP Name	Group Number	Basin
G4-4	22nd Avenue and 43rd Street	4	F
G4-5	Central Avenue	4	F
G5-1	Around Creek between 58th Street North and 6th Street North	5	H
G5-2	53rd Street North Flooding of Road	5	H
G5-3	36th Street North Flooding	5	I
G5-4	Canal Street	5	I
G5-5	30th Avenue and 64th Street	5	H
G5-6	22nd Avenue North	5	H
G6-1	1st Lane	6	T
G6-2	74th Avenue North	6	N
G6-3	88th Avenue North	6	O
G6-4	70th Avenue North	6	O
G6-5	Oklahoma Avenue Northeast	6	X
G6-6	62nd Avenue North	6	M
G6-7	92nd Avenue	6	P
G6-8	116th Avenue North	6	T
G6-9 & G6-24	Dr Martin Luther King Jr Street North	6	N
G6-9 & G6-24	Dr Martin Luther King Jr Street North	6	N
G6-10	Poplar Street	6	T
G6-11	Denver Street Northeast	6	X
G6-12 & G6-19	59th Avenue North & 62nd Avenue North	6	O
G6-13	4th Street North & 38th Avenue North Area	6	L
G6-14 Solution A	1st Street North	6	M
G6-15	Brightwaters Boulevard Northeast Area	6	X
G6-16	Appian Way Northeast Area	6	X
G6-17	54th Avenue	6	M
G6-18 & G6-21	3rd Street	6	L
G6-20	Foch Street Northeast	6	M
G6-22	Arizona Avenue Northeast	6	X
G6-23	82nd Avenue	6	k
G6-25	82nd Terrace North	6	O

BMP Number	BMP Name	Group Number	Basin
G6-26	Walnut Street Northeast and 43rd Avenue Northeast Area	6	L
G6-27	42nd Avenue North	6	L
G6-28	88th Avenue North	6	O
G7-1	36th Street South	7	U
G7-2	58th Avenue South and 11th Street South	7	Q
G7-3	54th Avenue South and Osprey Drive South	7	U
G7-4	54th Avenue South and Caesar Way South	7	U
G7-5	56th Avenue South and 31st Street South	7	U
G7-6	Lewis Boulevard Southeast and Elkcam Boulevard Southeast	7	W
G7-7	49th and 50th Avenue South	7	U
G7-8	63rd Avenue South and 16th Street South	7	V
G7-9	63rd Avenue South and 20th Way South	7	V

7. BMP Alternative Analysis

7.1 Group 1 BMPs

Group 1 is located along the western bayfront edge of the City and is typically characterized by flat terrain. Drainage is achieved mainly though ditch and pipe conveyances with one small stream (Golf Creek) located in the southern portion of the group. Typical flood relief alternatives in the area involve conveyance capacity improvements including some that tie into other drainage improvement projects along Golf Creek. Several known flood issue areas benefit from the addition of new stormwater pipes either to complement existing ones or provide drainage capacity to underserved areas. BMPs in this group tend to provide more local rather than regional benefits.

7.2 Group 2 BMPs

Group 2 features Crescent Lake and the City's downtown. Flood reduction benefits can be provided through conveyance improvements, bypass systems, and pre-storm drawdown of Crescent Lake. Water quality improvements can also be provided by using a smart box to route low flows to Crescent Lake and diverting high flow past Crescent Lake.

7.3 Group 3 BMPs

Booker Creek is the main drainage feature of Group 3, which extends from its headwaters near Emerald Lake to its mouth south of the City's downtown. Much of the former creek has been piped and long segments of large box culverts run parallel to I-275. Lake Maggiore is also contained in Group 3. Flood relief alternatives in this group include conveyance improvements, alternate outfalls for Lake Maggiore, bypass systems, and Emerald Lake pump station improvements. Stormwater capital improvements in this group will need to be coordinated with the City's historic Gas Plant District Redevelopment project and the FDOT for projects along I-175, I-275, and I-375.

7.4 Group 4 BMPs

Bear Creek is the main drainage feature of Group 4. Stormwater conveyance features connect to the creek through open channel and large stormwater pipes extending east of Bear Creek Park at 58th Street North and as far northeast as Louise Lake Park and Harshaw Lake located near the 22nd Avenue North at 43rd Street North intersection. Bear Creek is the primary outfall for a large portion of the drainage area in Group 4. There is limited storage capacity within Group 4, and as a result, Bear Creek does not have the capacity to handle the stormwater it receives, and the surrounding lower lying areas are inundated with flooding easily. The flooding creates higher tailwater conditions that extend flooded conditions to the upstream areas as well where the existing lakes and storage features are unable to provide the storage and conveyance capacity required to prevent flooding.

As the elevations in the lower lying areas of Group 4 are lower than the flood elevations noted in Bear Creek, solutions will need to rely on either improvements along the creek to improve capacity, the creation of new outfalls to relieve the strain on the creek during storm events, pumps stations, expanded storage, or a combination of those solutions. Improvements to the creek itself will need to focus on expanding floodplain capacity within the creek and reducing erosion within the creek.

The BMPs through Group 4 provide limited, localized benefit at high cost due to the conditions noted within the creek. Similar to the creek, the surrounding stormwater conveyance system is also undersized, limiting regional benefits to flood depth and duration without additional extended improvements to service the targeted areas. The solutions noted for the BMPs evaluate improvements to Bear Creek's conveyance capacity and potential stormwater bypass pipes that collect water from upstream low-lying areas and discharge to areas of the creek that may be more suitable to handle the additional flow. These improvements will require phasing to manage the expanded creek capacity with the improvements to the surrounding stormwater systems.

7.5 Group 5 BMPs

Group 5 is located at the north part of the St Petersburg watershed with Miles Creek being the prominent drainage system draining to Joes Creek and eventually the bay. The regions along the Miles Creek have seen significant historical flooding and the systems draining into the Miles Creek face similar issues. The solutions are focused on conveyance improvements by draining the water from the flood impacted regions to the Miles Creek outfall or through evaluating potential benefits from proposing new outfalls directly to the bay, bypassing Miles Creek/Joes Creek.

The potential flood reduction results for the targeted BMP locations are limited due to boundary conditions in the model where the area discharges to Joes Creek. The Joes Creek watershed includes Miles Creek and much of the area encompassing Group 5. Pinellas County is in the process of completing an update to the Joes Creek watershed. Upon completion of this project the BMP targeted for Group 5 can be further evaluated for further potential to relieve flood depth and duration.

7.6 Group 6 BMPs

Group 6 is located on the east side of Pinellas County from the Howard Franklin Bridge, south to Snell Isle. The available existing storage is limited, and the existing large box culvert and open channel stormwater conveyance features are unable to provide the capacity required to avoid flooding the surrounding area. The flooding identified in Group 6 interconnects major features such as the 54th Avenue North Canal and the 77th Avenue North Canal through both stormwater pipes and overland flow. Improvements along the 77th Avenue North Canal area easily overcome from flooding in the surrounding area, which limits the potential for regional benefits. The BMPs evaluated for this area include removal and replacement of existing pipe systems to increase conveyance to open water, expand upon the potential outfalls, or otherwise bypass flow from flooded upstream areas to the eventual outfall locations with large box culverts. Solutions include evaluating pump locations where possible to increase inflow into the proposed, upsized pipe systems. Due to the widespread flooding throughout Group 6, the potential for flood depth and duration reduction at a regional scale is limited without large-scale expansion of the existing canals and box culverts that provide stormwater conveyance for the area.

Apart from the limited conveyance capacity and available storage, much of the area will be subject to high tidal conditions that may negate potential improvements without the implementation of widespread resiliency measures and policies to improve conditions, expand outfall capacity and limit backflow from high tailwater conditions. This may include the installation of large-scale tide gates and stormwater pump stations at critical outfall locations.

7.7 Group 7 BMPs

Group 7 located on the south section of the City's watershed includes Frenchman's Creek on its western extents and Bayou Creek that outfalls to Little Bayou in the east. Existing stormwater features include smaller, interconnected lakes as well as stormwater conveyance systems included open channels. The lakes and surrounding stormwater system are under capacity to prevent flooding in the area. BMP solutions within this group focus on conveyance capacity improvement projects since many of this location contain inadequate pipe sizes for the area and the potential for additional storage is limited. The proposed improvements identified for each BMP either complement existing stormwater conveyance features by expanding their capacity or otherwise bypassing stormwater flows from flooded areas to downstream reaches that may provide or be expanded to provide the required capacity to improve flood depth and duration.

7.8 Summary of Best Management Practice Evaluations

For each BMP, a BMP sheet was developed that summarizes the following:

- Problem and solution for flood reduction
- Benefits with regard to road length of flood reductions and a number of structures removed from 100-year flood extents
- Class V preliminary engineer's opinion of construction cost estimate

Table 7-1 summarizes the benefits and costs for all BMPs. BMP sheets are added following Table 7-2.

Table 7-1. Best Management Practices Ranked

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet, 10-year event)	Structures Removed (Quantity, 100-year event)	Cost Estimate
G1-1	Golf Creek 9th Avenue Bridge	1	G	1,960	0	$4,782,257
G1-2	5th Avenue Improvements	1	G	211	8	$8,301,216
G1-3	Tyrone Boulevard Connection	1	R	400	0	$774,993
G1-4	Villagrande Avenue	1	S	1,101	0	$3,555,554
G1-5	22nd Avenue Alternative Outfall	1	R	930	0	$5,706,819
G1-6	26th Avenue North	1	R	855	0	$8,202,720
G1-7	Grevilla Avenue South	1	S	709	0	$2,386,480
G1-8	Eagle Lake Outfall	1	G	643	0	$21,595,667
G2-1	Crescent Lake 22nd Avenue Bypass	2	J	855	25	$4,019,934
G2-2	Round Lake	2	A	397	2	$1,031,583
G2-3	1st Street Southeast	2	A	542	0	$6,244,206

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet, 10-year event)	Structures Removed (Quantity, 100-year event)	Cost Estimate
G2-4	2nd Avenue N Mirror Lake	2	A	243	0	$1,957,213
G2-5	Crescent Lake Drawdown	2	J	765	4	$60,000
G2-6	Crescent Lake 22nd Avenue Bypass with Smart Box	2	J	855	25	$4,100,000
G3-1	Booker Creek Box Culvert Reroute	3	B	286	0	$21,960,785
G3-2	Booker Creek Rail Easement Bypass	3	B	0	0	$20,514,857
G3-3	Booker Creek Water Quality Detention	3	B	0	0	$500,000
G3-5	Lake Maggiore East Outfall	3	C	3,281	7	$10,719,725
G3-6	Emerald Lake Outfall into Booker Pond	3	B	71	19	$577,078
G3-7	2nd Avenue Bypass Pipe	3	B	0	3	$6,197,840
G3-8	Campbell Park Creek Widening	3	B	250	0	$2,217,127
G3-9	49th Street Connection Pipes	3	Z	1,639	0	$2,172,253
G3-10	Lake Maggiore West Outfall	3	C	3,281	7	$31,375,415
G3-11	Childs Park Pond Sump Removal	3	E	1,010	4	$209,342
G3-12	15th Avenue & 44th Street	3	E	130	2	$1,276,102
G3-13	26th Avenue South	3	Z	672	2	$3,053,560
G3-14	17th Avenue South	3	C	1,500	56	$41,938,395
G3-15	Emerald Lake Add Pump	3	B	321	21	$19,506,144
G3-16	34th Street Improvements	3	D	819	2	$642,777

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet, 10-year event)	Structures Removed (Quantity, 100-year event)	Cost Estimate
G3-17	34th Street Bypass	3	D	783	6	$12,930,599
G4-1	Dartmouth Avenue North and 58th Street North	4	F	4627	14	$61,678,508
G4-2	60th Street South	4	F	1,679	43	$68,877,271.00
G4-3	5th Avenue North Road	4	F	12,922	17	$49,459,079.00
G4-4	22nd Avenue and 43rd Street	4	F	4,867	4	$7,415,392.00
G5-2	53rd Street North Flooding of Road	5	H	693	2	$8,237,411.00
G5-3	36th Street North Flooding	5	I	2,491	18	$24,747,054.00
G6-1	1st Lane	6	T	3,600	1	$5,675,000.00
G6-2	74th Avenue North	6	N	6,256	9	$10,916,464.00
G6-3	88th Avenue North	6	O	6,256	52	$24,364,776.00
G6-4	70th Avenue North	6	O	3,251	0	$6,421,212.00
G6-5	Oklahoma Avenue Northeast	6	X	1,324	6	$1,736,549.00
G6-6	62nd Avenue North	6	M	1,330	37	$11,773,523.00
G6-7	92nd Avenue	6	P	2,750	44	$6,600,000.00
G6-8	116th Avenue North	6	T	1,319	6	$1,722,594.00
G6-9 & G6-24	Dr Martin Luther King Jr Street North	6	N	1,250	45	$26,886,094.00
G6-9 & G6-24	Dr Martin Luther King Jr Street North	6	N	1,085	23	$158,366,591.00
G6-10	Poplar Street	6	T	1,500	12	$3,605,000.00
G6-11	Denver Street Northeast	6	X	6,853	54	$3,708,088.00
G6-12 & G6-19	59th Avenue North & 62nd Avenue North	6	O	2,301	5	$8,008,330.00

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet, 10-year event)	Structures Removed (Quantity, 100-year event)	Cost Estimate
G6-13	4th Street North & 38th Avenue North Area	6	L	1,330	2	$30,085,960.00
G6-14 Solution A	1st Street North	6	M	2,380	14	$55,376,188.00
G6-15	Brightwaters Boulevard Northeast Area	6	X	1,600	1	$698,081.00
G6-16	Appian Way Northeast Area	6	X	5,230	24	$17,719,439.00
G6-17	54th Avenue	6	M	540	0	$16,168,093
G6-18 & G6-21	3rd Street	6	L	1,930	17	$77,630,424.00
G6-20	Foch Street Northeast	6	M	787	19	$30,781,823
G6-22	Arizona Avenue Northeast	6	X	6,075	63	$6,038,206.00
G6-23	82nd Avenue	6	k	1,330	37	$11,773,523.00
G6-25	82nd Terrace North	6	O			
G6-26	Walnut Street Northeast and 43rd Avenue Northeast Area	6	L	2,917	18	$6,974,054.00
G6-27	42nd Avenue North	6	L	6,098	0	$24,439,929.00
G6-28	88th Avenue North	6	O	3,064	46	$9,615,000.00
G7-2	58th Avenue S and 11th Street South	7	Q	2,100	54	$53,039,059.00
G7-3	54th Avenue S and Osprey Drive South	7	U	2,700	0	$966,397.00
G7-4	54th Avenue S and Caesar Way South	7	U	4,594	4	$8,123,495.00
G7-5	56th Avenue South and 31st Street South	7	U	2,320	0	$19,777,551.00

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet, 10-year event)	Structures Removed (Quantity, 100-year event)	Cost Estimate
G7-6	Lewis Boulevard Southeast and Elkcam Boulevard Southeast	7	W	1,545	0	$2,185,302.00
G7-7	49th and 50th Avenue South	7	U	4,181	8	$5,993,127.00
G7-8	63rd Avenue South and 16th Street South	7	V	7,998	40	$10,550,277.00
G7-9	63rd Avenue South and 20th Way South	7	V	4,070	6	$19,807,247.00

7.9 Table of Non-viable Best Management Practices

A number of potential BMPs alternatives were investigated but found to be not helpful or feasible for a variety of reasons, such as excessive costs or no flood benefits realized. It is important to track such efforts to help understand the BMP development process and to prevent future rework (Table 7-1).

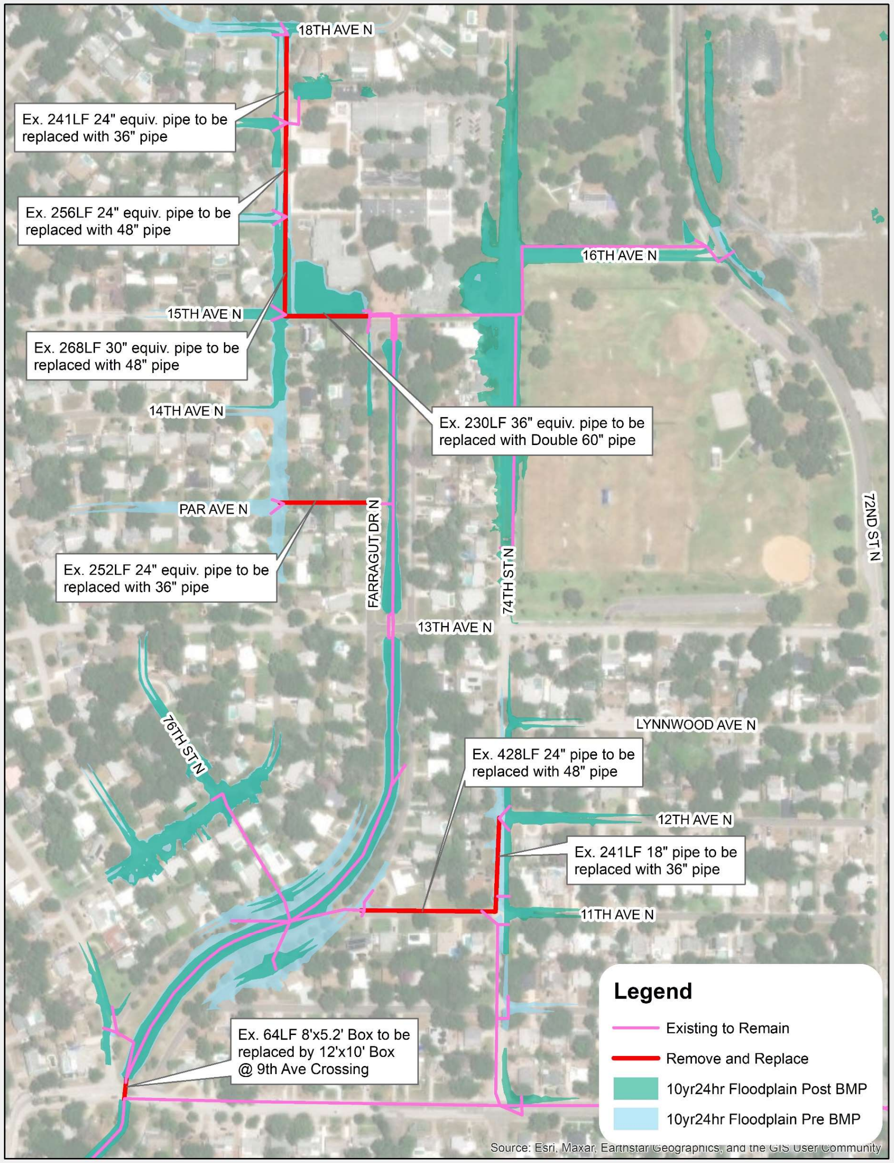
Table 7-2. Table of Non-viable BMPs

Group Number	BMP and Reason for Exclusion
Group 1	N/A
Group 2	Connection of Lake Maggiore into existing system to the west was not viable because of a local high point in the middle of the existing system, which is higher than the Lake Maggiore outfall.
Group 3	No flood reduction benefits realized by pre-storm drawdown of Emerald Lake, even for the case where the lake was drawn down 10 feet prior to the design storm. New gravity outfall structure in Emerald Lake was not viable because the downstream pipe system is at a higher elevation than the pond and water backflows into the pond. Adding a backflow preventer device was also tried, but it still did not provide much benefit since the water still could not move out of the pond. Expansion of storage volume in Booker Creek near Water Resources Building not viable due to small available space. Small storage would not provide flood reduction benefit. Expansion of culvert system in Booker Creek north of Water Resources Building Drawdown of Booker Pond

Group Number	BMP and Reason for Exclusion
	New connection across Pinellas Trail to west of Childs Park Pond
Group 4	BMP G4-5, Central Avenue Improvements is not viable due size of infrastructure necessary to mitigate flooding in this area is combined with the distance from Bear Creek. These factors make a solution cost prohibitive. The results are further skewed by other BMP projects taking up the additional capacity created in Bear Creek by BMPs G4-1 and G4-2, which further limits the potential flood improvements.
Group 5	Miles Creek BMP, the lo G5-1 BMP is located on Miles Creek which has historically flooded and has the highest number of flood insurance claims. The stormwater system here is controlled by the channel. Conveyance improvements along the Miles Creek with outfall at Joes Creek does not provide any major relief in flooding along the creek
Group 6	BMP 11, 30 – Conveyance improvements in the Dr. Martin Luther King Jr Street and 70th Avenue North area present a decrease in flooding for the 10-year storm, but the maximum reduction is no more than 1.5 feet. Additionally, the cost alone makes this solution less viable at $158M. BMP 18 – Expansion of conveyance and storage in the 54th Avenue and 1st Street area is not viable due to space restrictions. Because of this, the only option is to convert the residential areas to a community benefits solution. While this would provide regional benefits, a large amount of property acquisition would be required.
Group 7	NA

N/A = not applicable

Golf Creek 9th Ave Bridge - Project No. G1-1



PROJECT G1-1

Problem

The City made recently made improvements to Golf Creek, which included widening of the channel between 15th Avenue and 9th Avenue, replacement of the system near the intersection of 15th Avenue and 74th Street, and pipe enhancements for the outfall pipes into the creek where it was widened.

The results of the Group 1 WMP Model show that the streets along Golf Creek still do not meet the 10-Year level of service, and that the flooding is occurring because of backup of flow in the creek at the 9th Avenue Bridge, and also because of undersized pipes within the existing stormwater system along Russell Street and 74th Avenue. The majority of flooding is within the streets, with modeling showing no house flooding in the area during the 100-Year storm event.

Solution & Project Benefits:

In order to reduce upstream flooding, the 9th Avenue bridge, which currently has an approximate opening size of 8'x5.2', should be widened to an opening size of 12'x10'.

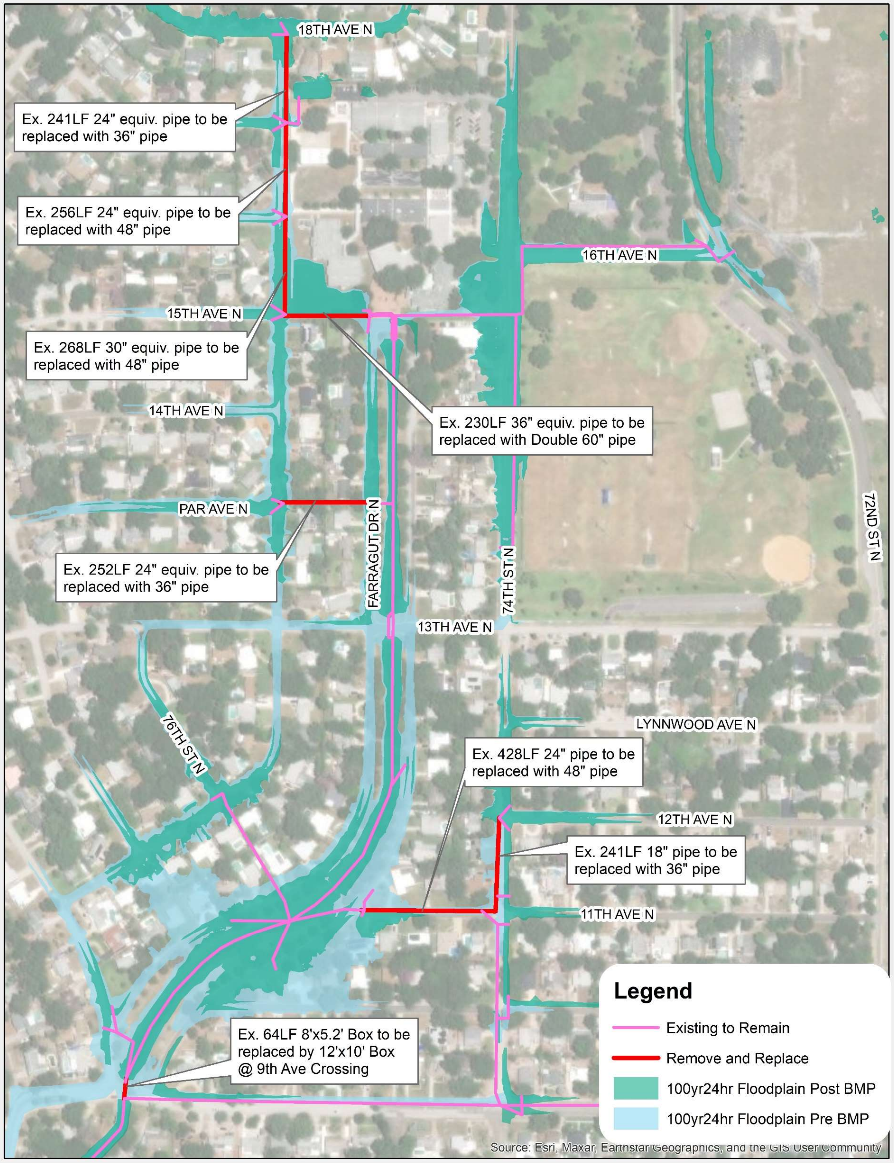
Additionally, pipe replacements should be made along Par Avenue, 15th Avenue, Russell Street, 11th Ave and 74th Street to reduce street flooding. All of these pipe replacements connect to pipes that were recently added with the Golf Creek Improvements project.

This solution will remove approximately 1,960 feet of roadway from the 10-year floodplain.

Estimated Cost:

Estimated cost for this project is approximately $4.8 million including planning, engineering, and permitting fees..

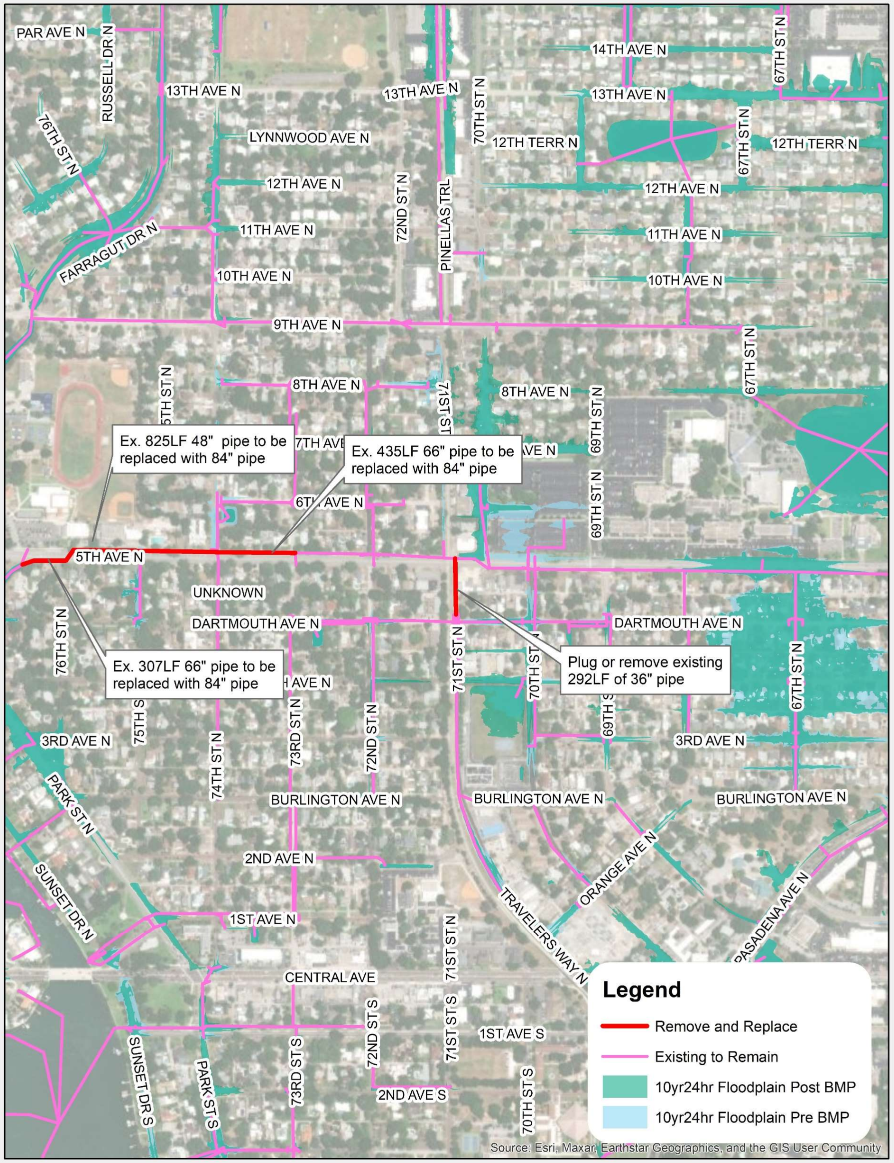
Golf Creek 9th Ave Bridge - Project No. G1-1 (continued)



PROJECT G1-1

Node	Location Description	Initial Stage	10-Year			100-Year			EOP
			EX	PR	Δ	EX	PR	Δ	
NG01770	18th Ave & Russell Dr	15.13	18.99	18.63	-0.36	19.39	19.26	-0.13	18.0
NG01720	17th Ave & Russell Dr	13.05	18.45	17.97	-0.48	18.61	18.39	-0.22	18.0
NG01700	16th Ave & Russell Dr	13.05	17.81	17.47	-0.34	18.08	17.92	-0.16	17.0
NG01650	15th Ave & Russell Dr	12.08	17.75	17.03	-0.72	18.01	17.84	-0.17	16.6
NG01480	Par Ave & Russell Dr	13.44	17.62	15.36	-2.26	17.98	17.77	-0.21	16.0
NG04971	13th Ave & Channel	7.12	15.07	13.77	-1.3	16.64	16.31	-0.33	16.0
NG01420	76th St & Russell Dr	11.16	15.56	15.55	-0.01	15.68	15.64	-0.04	14.0
NG01300	12th Ave & 74th St	13.18	19.39	17.86	-1.53	19.48	19.35	-0.13	18.2
NG01281	11th Ave & 74th St	11.97	18.79	16.06	-2.73	19.07	17.72	-1.35	18.0
NG01353	9th Ave & Channel US	3.67	14.08	11.67	-2.41	15.41	13.45	-1.96	14.0
NG04770	9th Ave & Channel DS	3.66	10.17	10.6	0.43	10.72	11.59	0.87	15.0
NG04771	Admiral Farragut	1.43	9.08	9.52	0.44	9.66	10.29	0.63	

5th Avenue Improvements - Project No. G1-2



PROJECT G1-2

Problem

The neighborhood near the intersection of Dartmouth Avenue N and 67th Street N currently experiences flooding of an estimated 20 homes during the 100-Year storm event. Additionally, there is extensive street flooding along 5th Avenue, Dartmouth Avenue and 67th Street during the 10-Year storm event.

This stormwater system discharges to the north along 67th Street to a main line along 5th Avenue flowing toward the west. The line along 5th Avenue also has three pipe connections to another main line system that flows to the west along Dartmouth Avenue before turning south and then west to discharge into the Gulf. For these three connections, two of them, at 68th Street and 70th Street, appear to mainly flow southward from 5th Avenue to Dartmouth Avenue. However, the third connection at 71st Street, which is a 36-inch pipe, appears to mainly have flow only from Dartmouth Avenue to 5th Avenue, which contributes to rising peak stages along 5th Avenue.

Analysis of the pipe system along 5th Avenue in the model shows a section of pipe roughly between 74th Street and 76th Street that, at 48-inches, is at a smaller size than the upstream and downstream pipe sizes of 66-inches. It also appears that the 66-inch pipe size itself is not a sufficient size to convey the amount of runoff coming from upstream during the 10-Year and 100-Year storm events. The existing 66-inch pipe along 5th Avenue discharges into a channel that connects directly into the Gulf to the west.

Solution & Project Benefits:

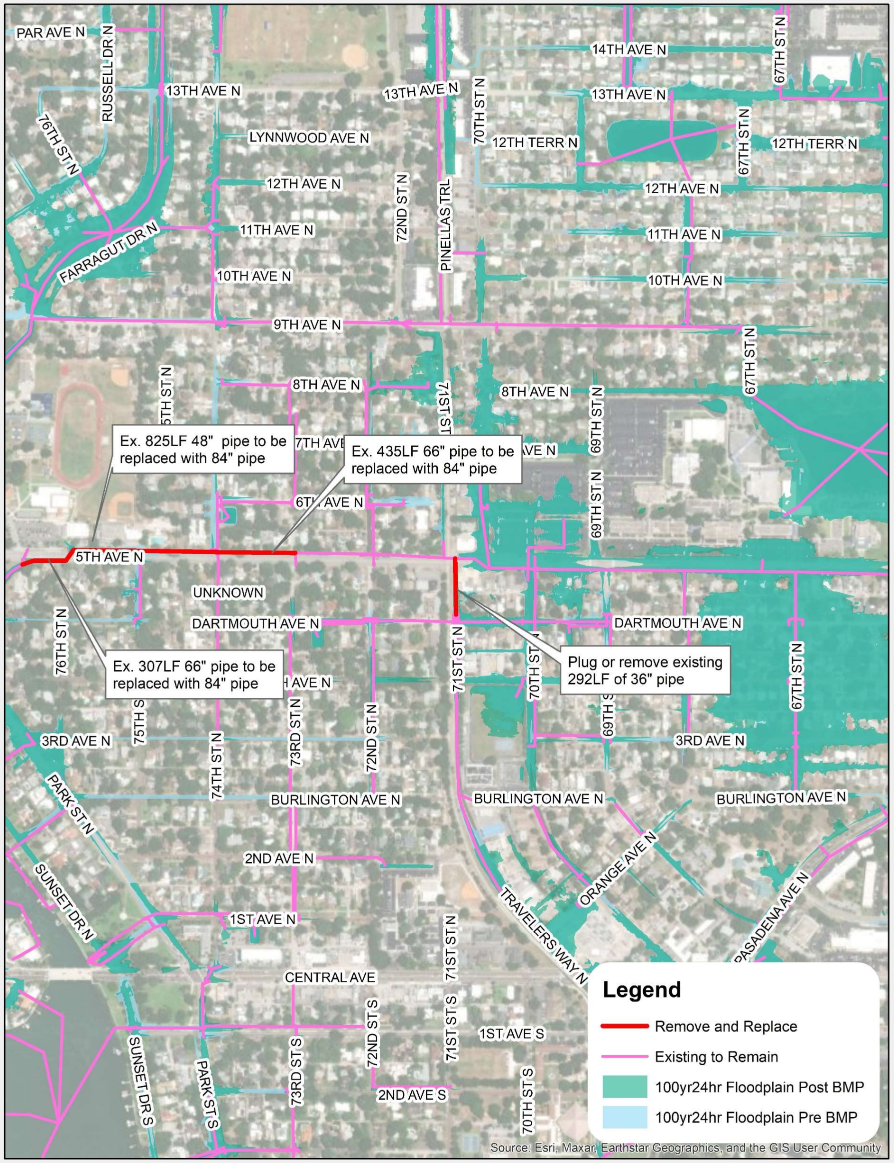
Replacing the portion of the main line pipe along 5th Avenue between 73rd Street and the pipe outlet to the west of 76th Street with a size 84-inch pipe will increase the capacity of this system to discharge runoff into inlets along 5th Avenue and from the 67th Street and Dartmouth Avenue systems. Additionally, blocking flow through the pipe connection between Dartmouth Avenue and 5th Avenue along 71st Street will prevent additional flows into the 5th Avenue drainage system from the Dartmouth Avenue system.

This solution will remove 211 feet of roadway from the 10-year floodplain and an estimated structures from the 100-Year floodplain.

Estimated Cost:

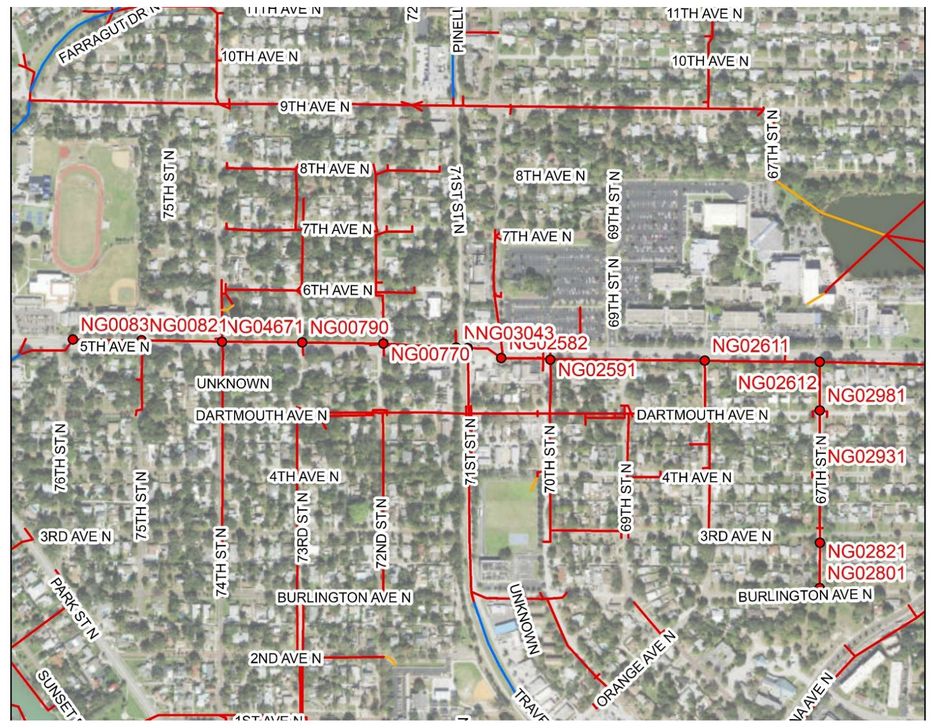
Estimated cost for this project is approximately $8.3 million including planning, engineering, and permitting fees..

5th Avenue Improvements - Project No. G1-2 (continued)

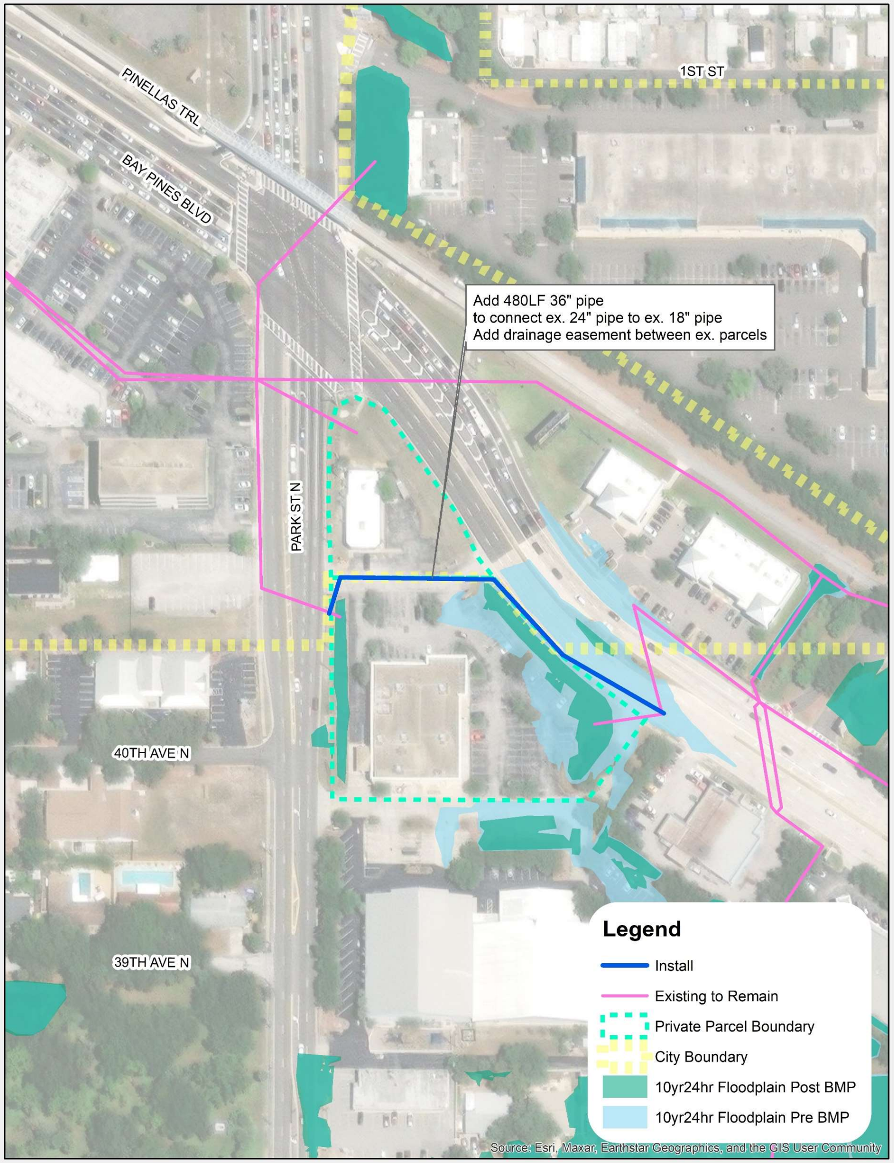


PROJECT G1-2

Node	Location Description	Initial Stage	10-Year			100-Year			EOP
			EX	PR	Δ	EX	PR	Δ	
NG02801	Burlington & 67th St	12.04	18.74	18.66	-0.08	19.42	19.29	-0.13	18.1
NG02821	3rd Ave & 67th St	10.51	18.69	18.5	-0.19	19.39	19.26	-0.13	17.0
NG02931	4th Ave & 67th St	9.63	18.65	18.44	-0.21	19.36	19.22	-0.14	16.0
NG02981	Dartmouth & 67th St	9.63	18.62	18.41	-0.21	19.34	19.2	-0.14	16.1
NG02612	5th Ave & 67th St	9.63	18.6	18.38	-0.22	19.33	19.19	-0.14	17.0
NG02611	5th Ave & 68th St	9.54	18.47	17.93	-0.54	19.24	19.09	-0.15	18.0
NG02591	5th Ave & 70th St	9.54	18.32	16.83	-1.49	19.11	18.59	-0.52	18.0
NG02582	5th Ave & 70th St	10.75	17.86	14.99	-2.87	18.57	16.94	-1.63	18.0
NG03043	5th Ave & 71st St	5.07	17.63	14.09	-3.54	18.31	16.10	-2.21	19.0
NG00771	5th Ave & 71st St	4.66	17.43	13.48	-3.95	18.07	15.55	-2.52	21.0
NG00770	5th Ave & 72nd St	4.66	17.07	12.43	-4.64	17.65	14.57	-3.08	18.0
NG00790	5th Ave & 73rd St	4.65	16.62	10.97	-5.65	17.04	13.03	-4.01	17.0
NG04671	5th Ave & 74th St	3.40	15.93	10.26	-5.67	16.19	12.21	-3.98	15.0
NG00821	5th Ave & 75th St	2.45	12.15	8.92	-3.23	12.59	10.44	-2.15	11.0
NG00830	5th Ave & 76th St	1.00	8.16	7.57	-0.59	8.81	8.62	-0.19	8.0



Tyrone Blvd Connection - Project No. G1-3



PROJECT G1-3

Problem

The drainage inlets along Tyrone Boulevard just east of the Park Street intersection currently discharge to the northeast into a channel and then a box culvert, which wind back around along the Pinellas Trail to the northwest and cross under the intersection of Tyrone Boulevard and Park Street. This circuitous drainage network experiences flooding within the Tyrone Boulevard roadway during the 10-Year storm event.

There is an existing structure located at the southwest corner of the intersection that connects to the main line outfall from Tyrone Boulevard as well as drainage inlets along Park Street. The main line outfall does not appear to experience any problems with flooding, just the inlets along Tyrone Boulevard.

Solution & Project Benefits:

Connecting the drainage inlets along Tyrone Boulevard directly to the drainage inlets on Park Street will create a shorter flow path for the road runoff to the outfall without requiring any construction work under the existing roadways. By routing a 36-inch pipe to connect the two inlets between the two adjacent parcels, the roadway flooding on Tyrone Boulevard will be mitigated while not creating any additional flooding on Park Street.

The route of this pipe follows an existing driveway between the two properties, and would require a new drainage easement along this boundary line as well as permission to excavate and replace the driveway.

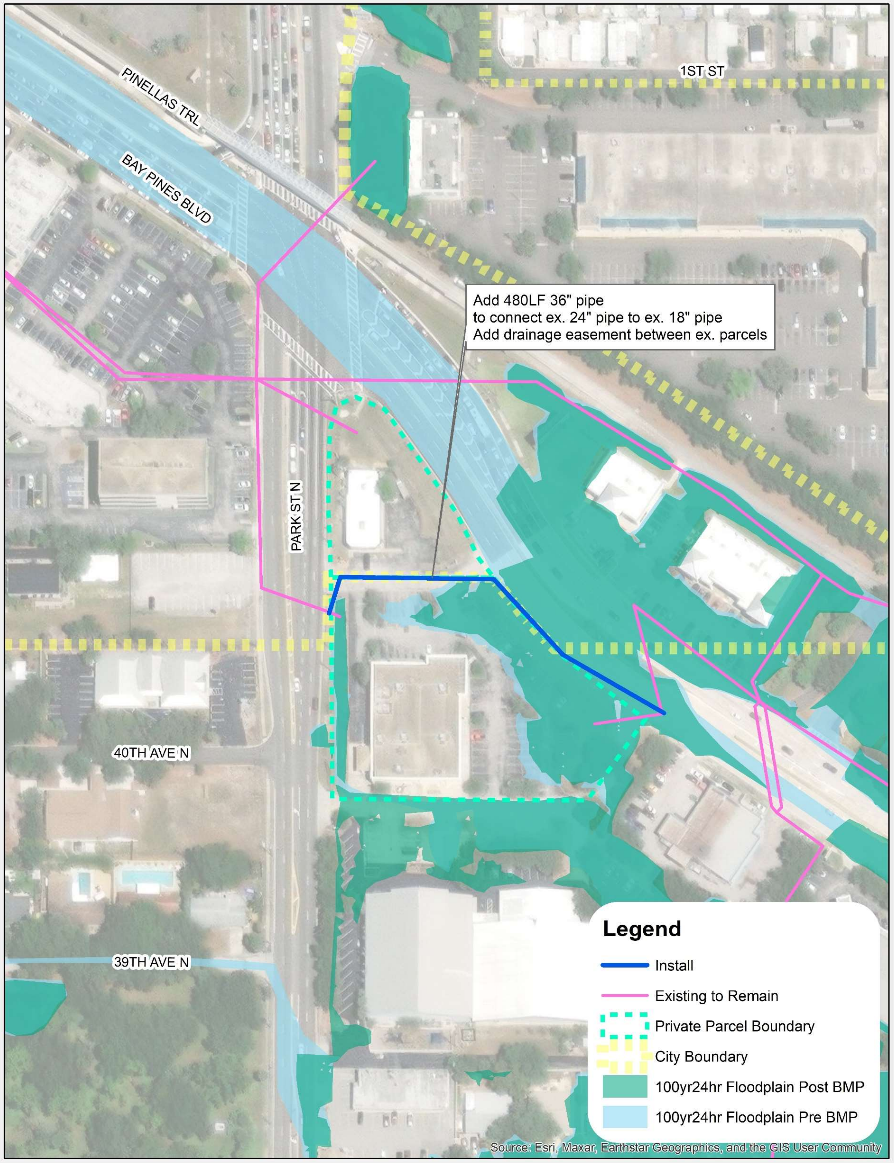
Additionally, the route of the pipe follows along the northern boundary for the limits of the City of St Petersburg, and therefore no work within the unincorporated county land to the north would be required.

This solution removes approximately 400 feet of roadway from the 10-year floodplain.

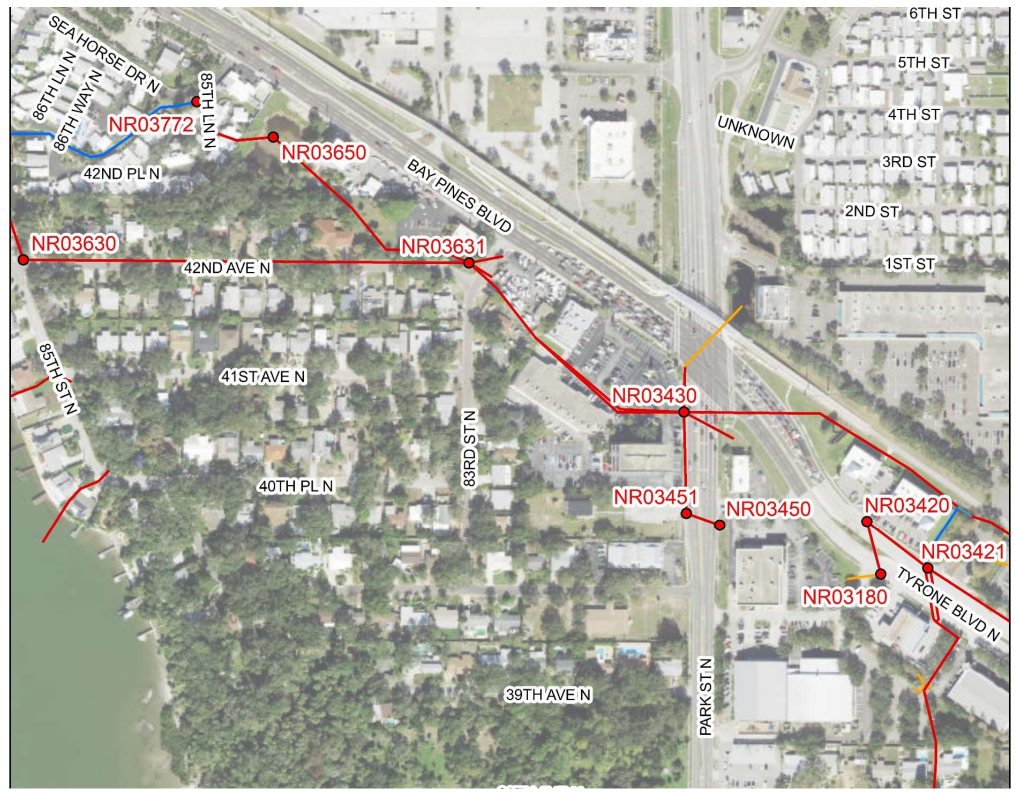
Estimated Cost:

Estimated cost for this project is approximately $670,000 including planning, engineering, and permitting fees. And there is an additional estimated cost of $105,000 for the land acquisition or easements that are required for this project..

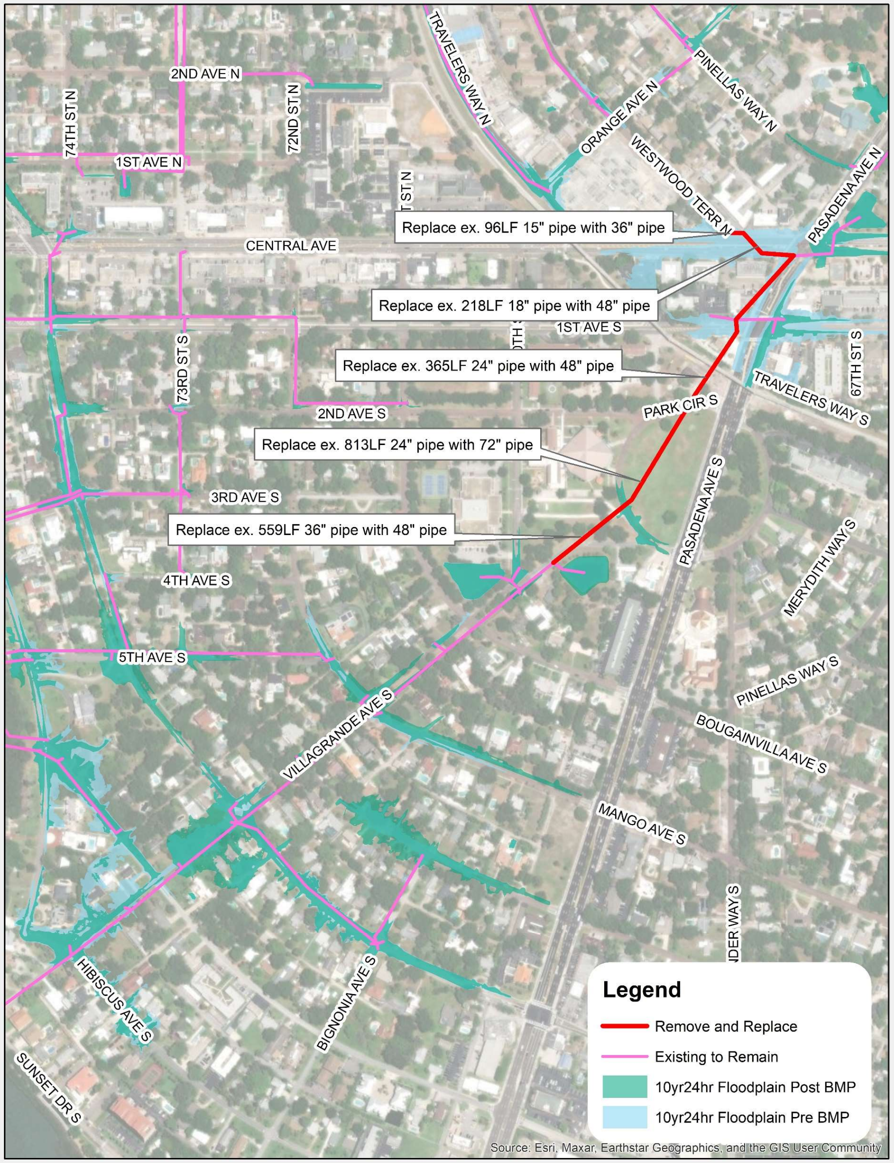
Tyrone Blvd Connection - Project No. G1-3 (continued)



Node	Location Description	Initial Stage	10-Year			100-Year			EOP
			EX	PR	Δ	EX	PR	Δ	
NR03180	Tyrone Blvd	8.52	13.29	12.32	-0.97	13.62	13.39	-0.23	12.2
NR03420	Tyrone Blvd	7.92	12.41	11.56	-0.85	13.61	13.4	-0.21	12.0
NR03421	Tyrone Blvd	7.83	10.53	10.36	-0.17	13.6	13.37	-0.23	13.0
NR03430	Tyrone Blvd & Park St	3.43	9.32	9.02	-0.3	11.51	11.02	-0.49	12.0
NR03631	83rd St & 42nd Ave	1.00	3.95	3.66	-0.29	5.34	5.03	-0.31	7.0
NR03630	42nd Ave	1.00	3	2.92	-0.08	3.48	3.40	-0.08	3.0
NR03650	Pond	1.00	3.05	2.96	-0.09	3.5	3.43	-0.07	5.0
NR03772	85th Way	1.00	2.85	2.77	-0.08	3.16	3.11	-0.05	4.0
NR03450	Park St	8.73	9.66	10.13	0.47	10.03	10.50	0.47	12.0
NR03451	Park St	8.53	9.48	9.87	0.39	10.66	10.59	-0.07	12.0



Villagrande Avenue - Project No. G1-4



PROJECT G1-4

Problem

Central Avenue, which is a vital arterial roadway that connects the Treasure Island Causeway with US 19 and I-275, experiences flooding during the 10-year and 100-year storm events. The runoff at the corner of Central Avenue and Pasadena Avenue enters a stormwater system that discharges into a pipeline running along Villagrande Avenue to the southwest to discharge into Boca Ciega Bay. There is also flooding along Villagrande Avenue, a local road, but this flooding is mainly contained within the roadway and occurs at low-lying sections that are less than 10-feet above sea level. There is a drop in ground elevation of 10-12 feet between Central Avenue and the north end of Villagrande Avenue.

Solution & Project Benefits:

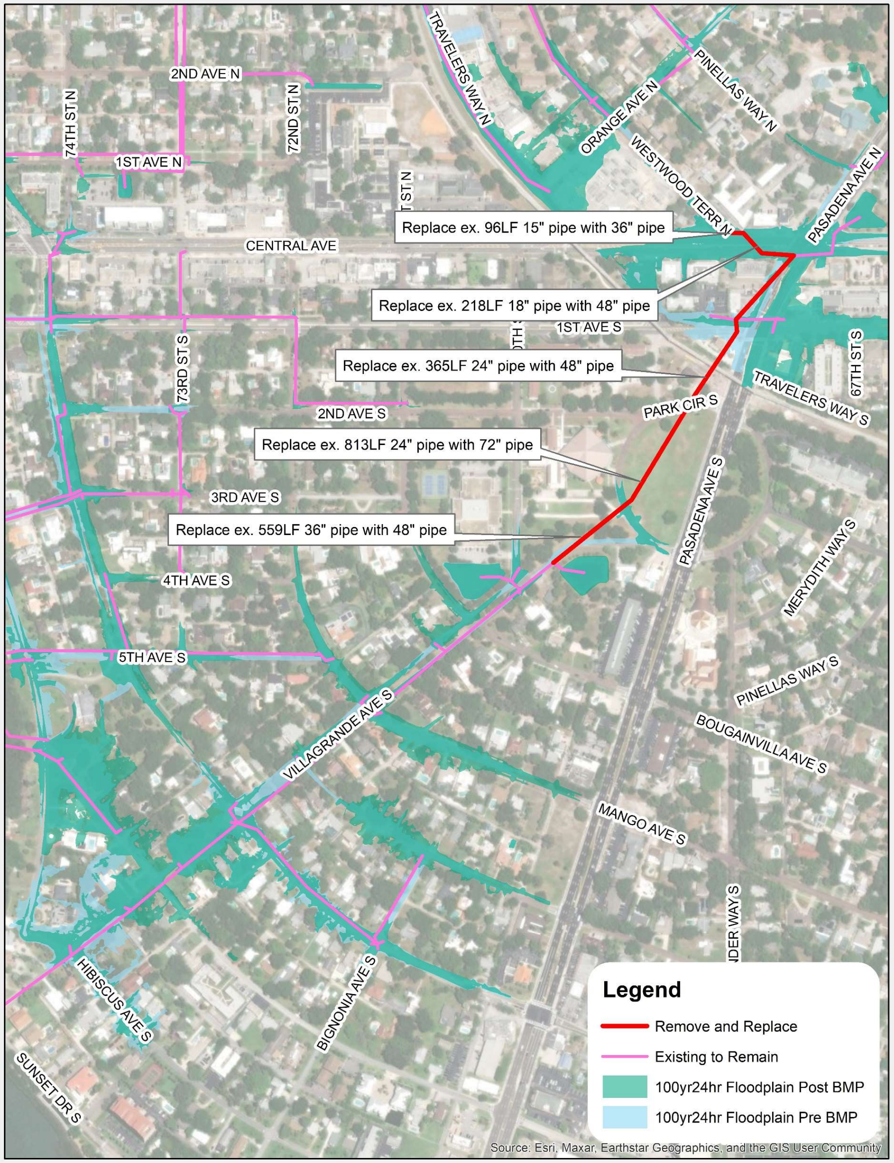
In order to lower peak stage elevations along Central Avenue, a larger pipe system is proposed to drain water away from this street and southward to Villagrande Avenue, which has an outfall pipe system that ranges from 42-inch to 60-inch in diameter. The proposed system will include larger 72-inch pipes during a long stretch of pipe along a steep gradient that will more efficiently remove runoff from the higher elevations and also provide some storage within the system. Some areas along Villagrande Avenue may experience a lower level-of-service due to these pipe increases, but the flooding will still be contained within the roadway. Increasing the level-of-service within Central Avenue, as an important arterial, will provide more overall community benefits than any rises along Villagrande Avenue, which is already flooded at some locations due to the low elevation. Additional accommodations for addressing flooding problems along Villagrande Avenue could be examined in conjunction with this project.

This project would remove approximately 1,101 feet of roadway from the 10-year floodplain.

Estimated Cost:

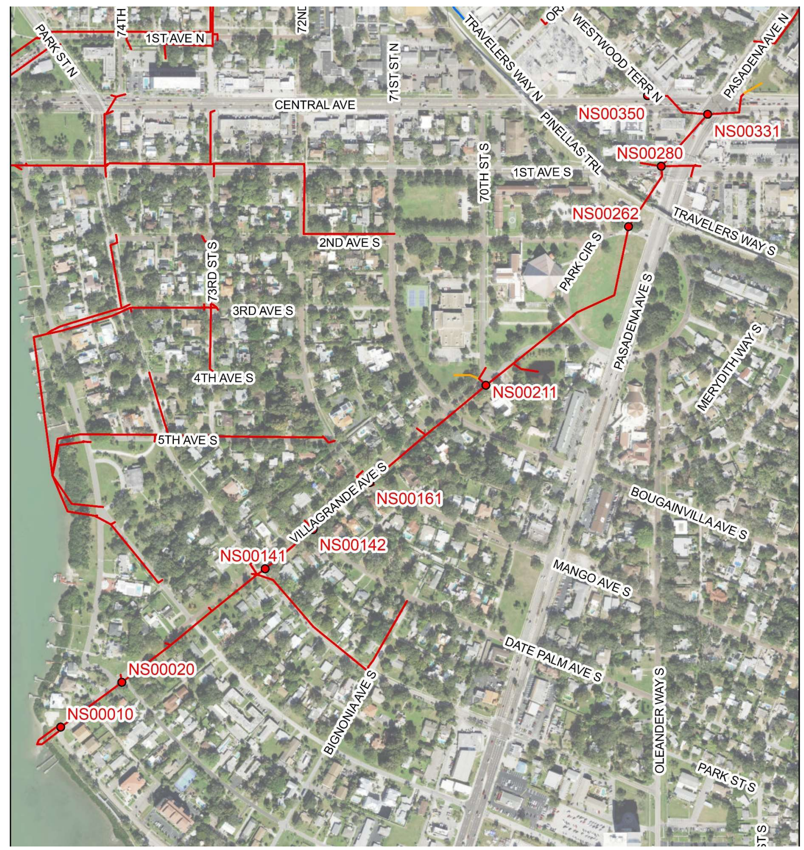
Estimated cost for this project is approximately $3,555,554 including planning, engineering, and permitting fees.

Villagrande Avenue - Project No. G1-4 (continued)

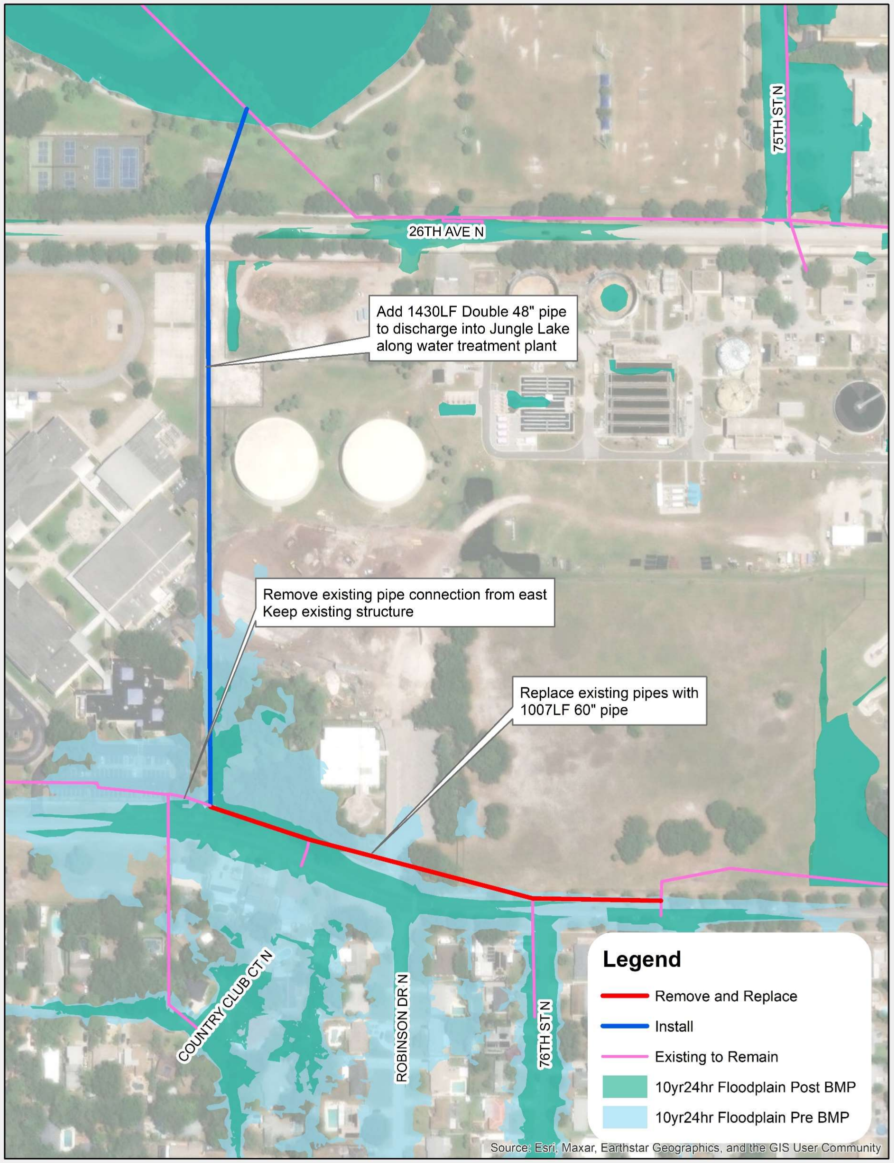


PROJECT G1-4

Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	EOP
NS00350	Central Ave & Westwood Ter	16.03	20.34	19	-1.34	20.5	20.36	-0.14	19.0
NS00331	Pasadena Ave & Central Ave	14.19	20.17	18.35	-1.82	20.35	19.91	-0.44	20.0
NS00280	Pasadena Ave & 1st Ave	12.92	19.86	17.45	-2.41	20.12	19.13	-0.99	19.0
NS00262	Park Circle & 2nd Ave	12.55	17.82	16.3	-1.52	18.1	17.45	-0.65	18.0
NS00211	Villagrande Ave & 70th St	6.35	11.67	13.28	1.61	12.01	13.83	1.82	12.0
NS00161	Villagrande Ave & 72nd St	2.07	8.51	8.86	0.35	8.77	9.09	0.32	8.0
NS00142	Villagrande Ave & Date Palm Ave	1.00	7.26	7.5	0.24	7.48	7.69	0.21	6.0
NS00141	Park St & Villagrande Ave	1.00	6.28	6.45	0.17	6.47	6.61	0.14	5.0
NS00020	Villagrande Ave & Hibiscus Ave	1.00	3.63	3.7	0.07	3.81	3.85	0.04	3.0
NS00010	Sunset Dr & Villagrande Ave	1.00	2.16	2.19	0.03	2.24	2.25	0.01	4.0



22nd Avenue Alternative Outfall - Project No. G1-5



Problem

There is significant flooding along 22nd Avenue during the 10-year storm event, which includes yard flooding up to house foundations. The existing outfall for this system heads north along 79th Street and discharges into Jungle Lake. There does not appear to be any houses flooded in this area during the 100-year storm event, as flooding is limited to the streets and yards in this area.

On the north side of 22nd Avenue where flooding is occurring is Azalea Middle School, the Science Center of Pinellas County, and the Northwest Water Reclamation Facility. Jungle Lake is located in Walter Fuller Park. The Science Center and the Northwest Water Reclamation Facility are owned by the City of St. Petersburg.

Solution & Project Benefits:

In order to shorten the distance of the outfall into Jungle Lake and to avoid road construction along 79th Street, a new outfall could be constructed along the land owned by the City directly from the worst flooding along 22nd Avenue to Jungle Lake. This outfall is designed to discharge only the pipe system to the east of Azalea Middle School, effectively bypassing the existing system at this point and diverting it directly to the north instead. The pipe system to the west of Azalea Middle School would continue to discharge to the 79th Street outfall system.

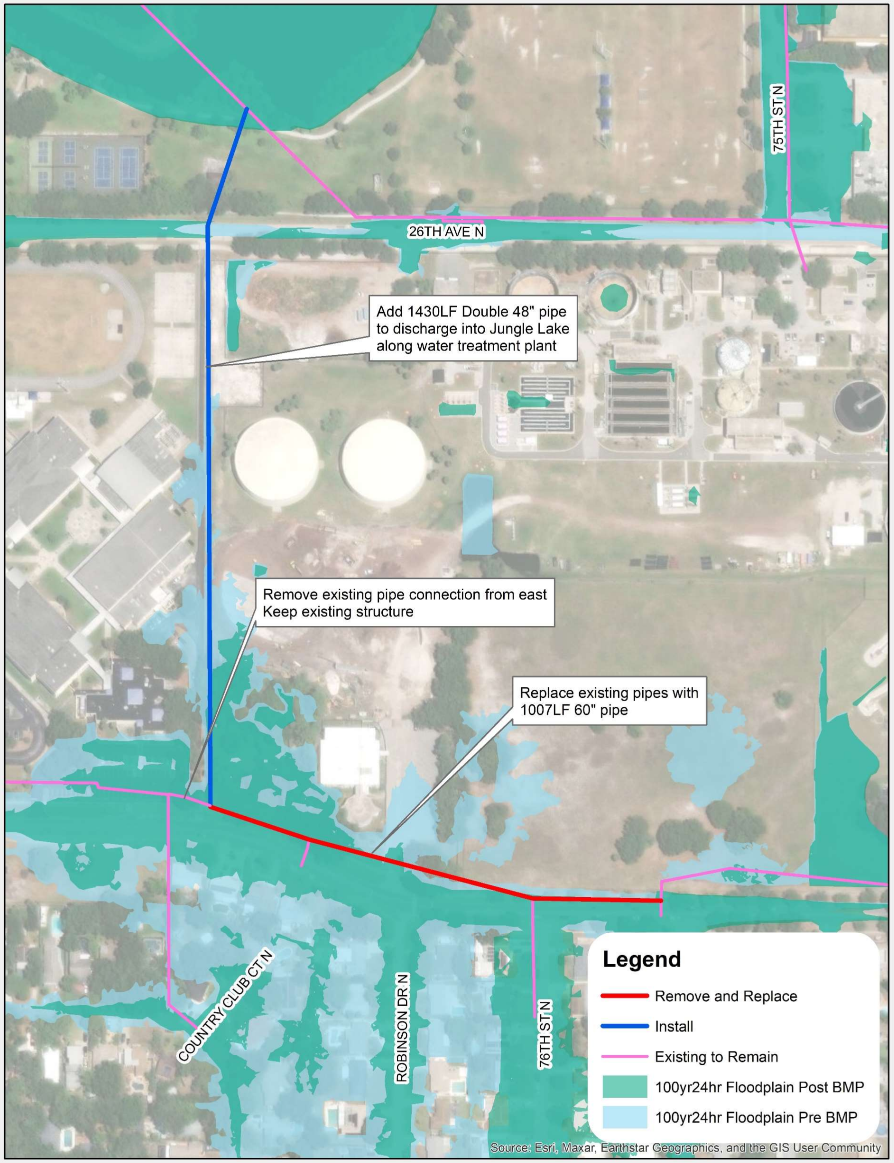
With this added outfall, road flooding along 22nd Avenue will be significantly reduced or removed. Additional benefits in reduced street flooding from increasing the sizes of pipes coming into the 22nd Avenue system might be realized in a future analysis, but this analysis was limited to just the 22nd Avenue flooding.

This project would remove approximately 930 feet of roadway from the 10-year floodplain.

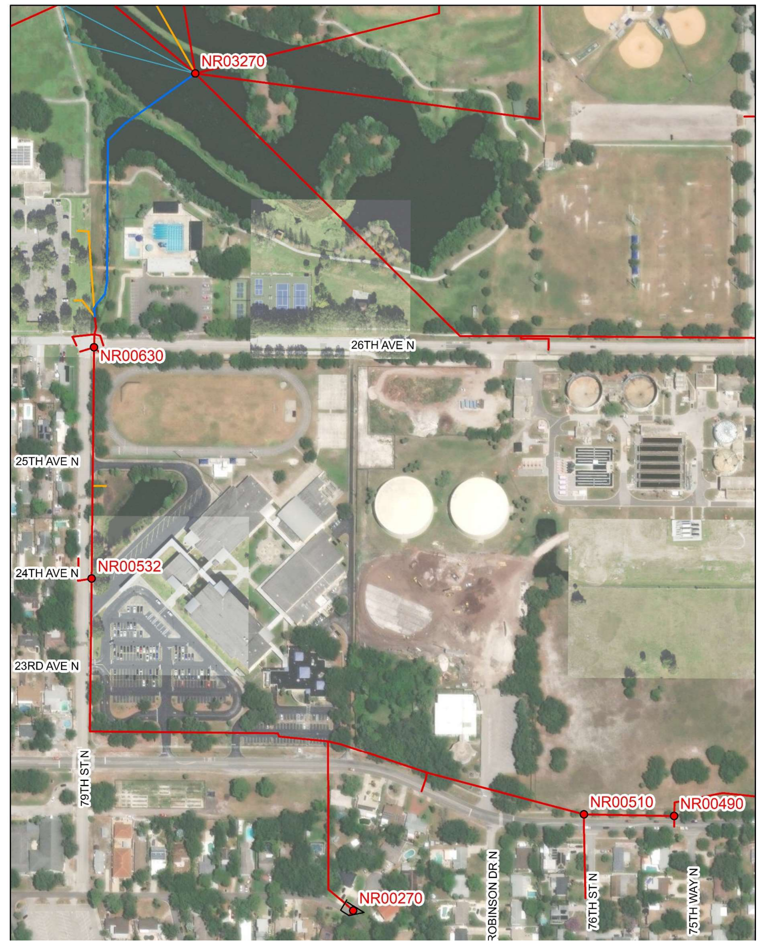
Estimated Cost:

Estimated cost for this project is approximately $5,707,000 including planning, engineering, and permitting fees.

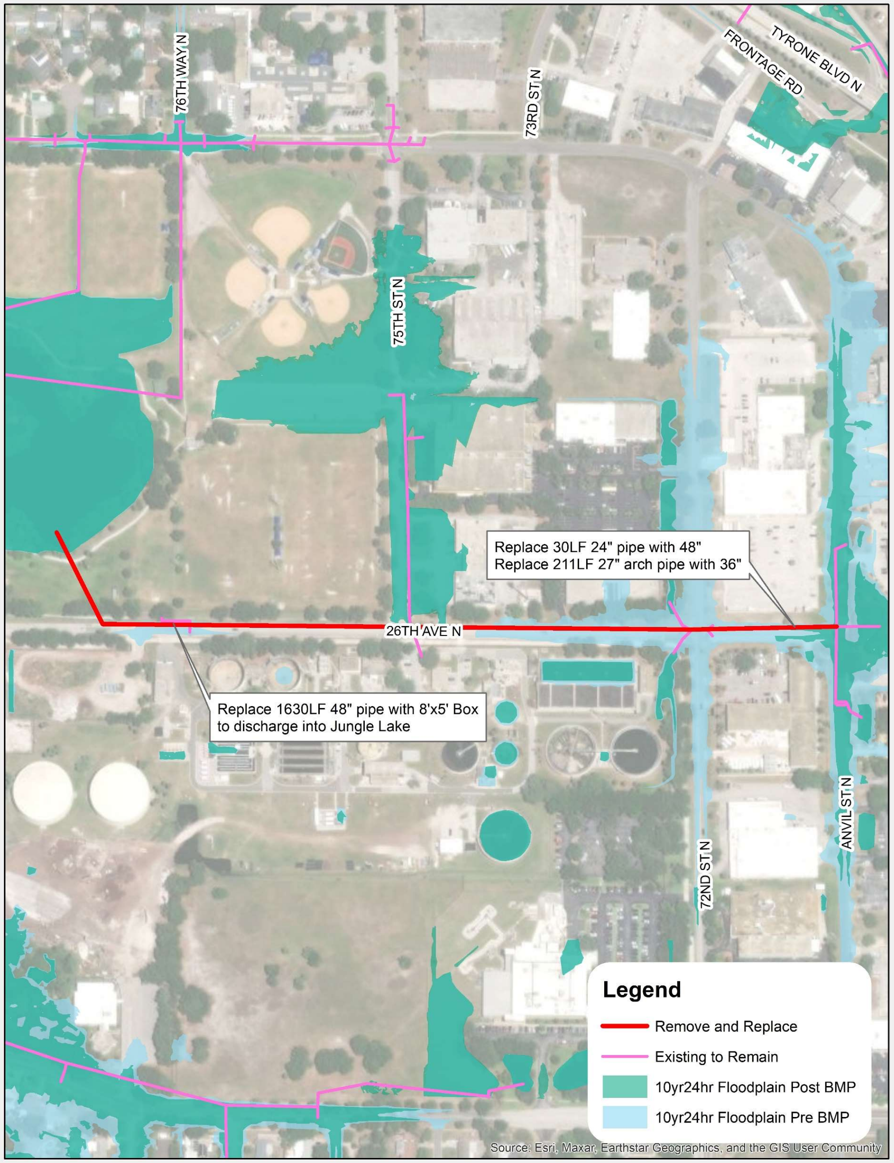
22nd Avenue Alternative Outfall - Project No. G1-5 (continued)



Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	EOP
NR00490	22nd Ave & 75th Way	14.46	19.93	18.98	-0.95	20.21	20.02	-0.19	19.0
NR00510	22nd Ave & 76th St	13.46	19.86	18.94	-0.92	20.14	19.97	-0.17	18.0
NR00532	24th Ave & 79th St	11.23	17.78	17.19	-0.59	18.5	18.48	-0.02	17.0
NR00630	26th Ave & 79th St	11.23	17.15	17.12	-0.03	18.32	18.43	0.11	17.0
NR03270	Jungle Lake	11.22	16.62	16.99	0.37	18.25	18.38	0.13	18.0
NR00270	Country Club Rd & Country Club Ct	15.62	19.87	19.82	-0.05	20.14	19.98	-0.16	19.0



26th Avenue North - Project No. G1-6



PROJECT G1-6

Problem

In the existing stormwater system, excessive flooding is occurring during the 10-year storm event along 26th Avenue North between Anvil Street and the discharge point at Jungle Lake. This flooding affects the businesses located along 72nd Street and Anvil Street, as well as the Northwest Water Reclamation Facility located along 26th Avenue.

Solution & Project Benefits:

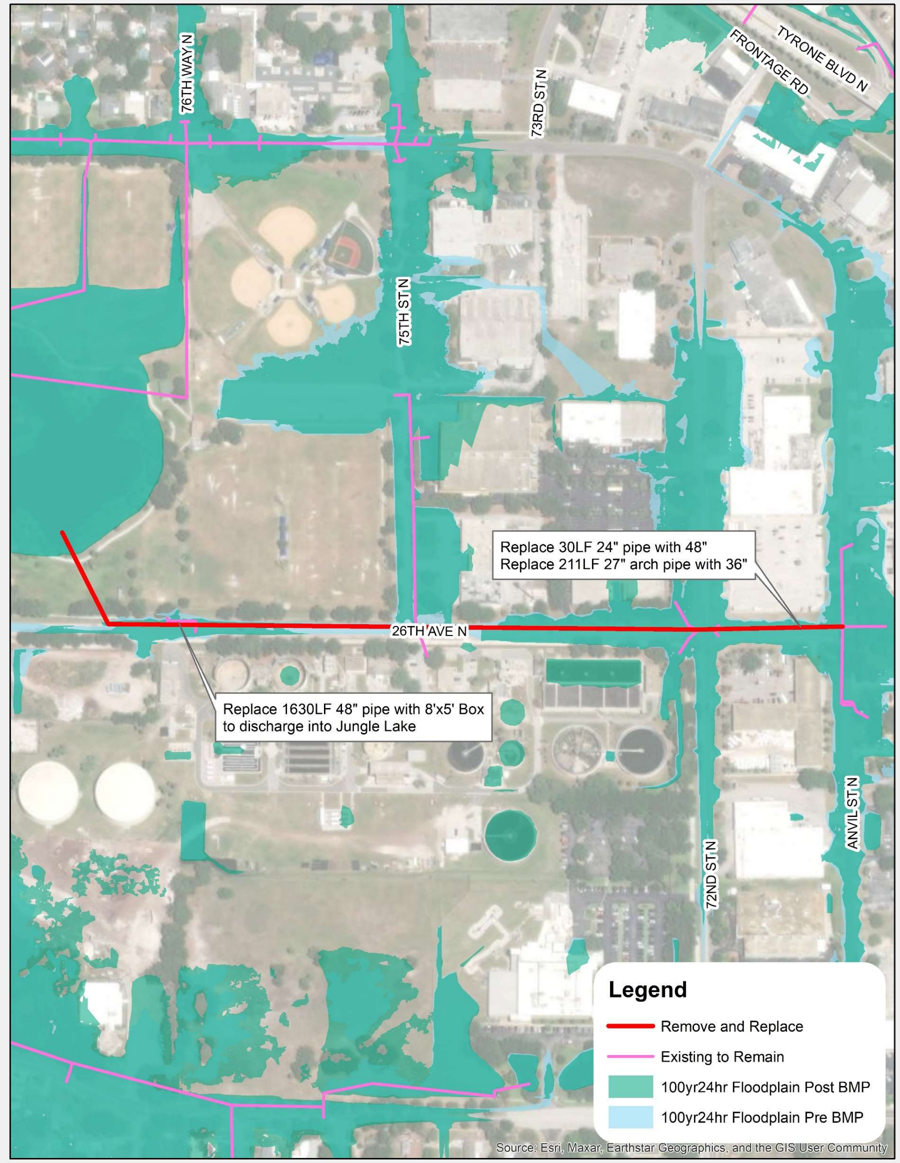
Increasing the hydraulic capacity of the stormwater system along 26th Avenue will alleviate road flooding at the intersection with 72nd Street and Anvil Street during the 10-year storm event.

This project would remove approximately 855 feet of roadway from the 10-year floodplain.

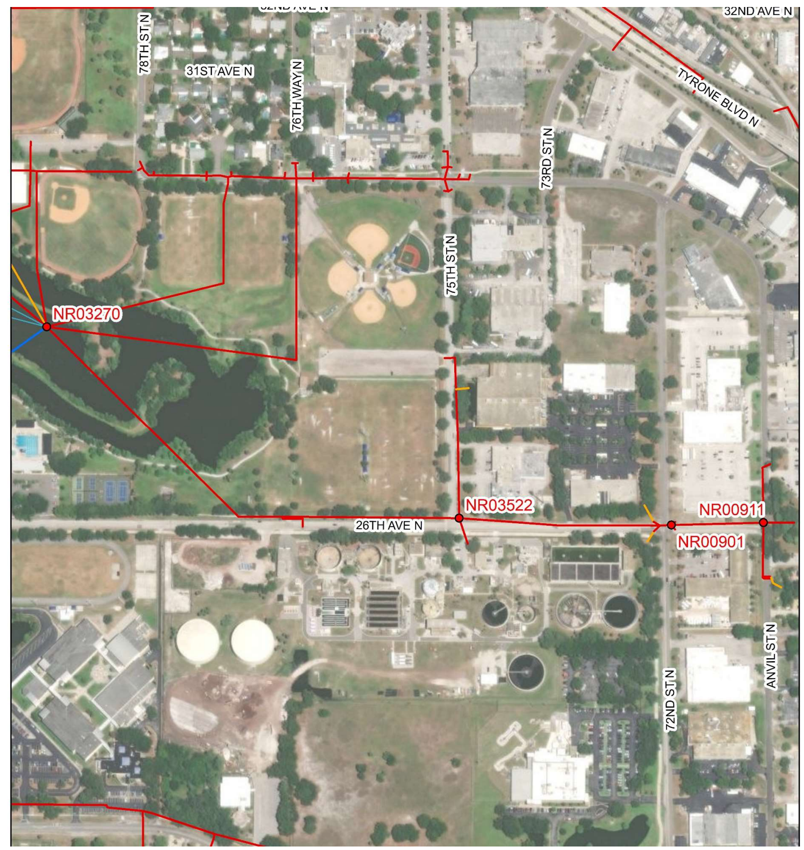
Estimated Cost:

Estimated cost for this project is approximately $8,203,000 including planning, engineering, and permitting fees.

26th Avenue North - Project No. G1-6 (continued)



Node	Location Description	Initial Stage	10-Year			100-Year			EOP/TOB
			EX	PR	Δ	EX	PR	Δ	
NR00911	26th Ave & Anvil St	13.98	21.3	19.97	-1.33	21.62	21.07	-0.55	20.0
NR00901	26th Ave & 72nd St	13.76	21.27	18.63	-2.64	21.58	20.68	-0.9	20.0
NR03522	26th Ave & 75th St	12.00	20.08	17.3	-2.78	20.57	19.54	-1.03	21.0
NR03270	Jungle Lake	11.22	16.62	16.84	0.22	18.25	18.33	0.08	20.0



Grevilla Avenue - Project No. G1-7

PROJECT G1-7

Problem

The existing stormwater system that discharges along Grevilla Avenue and then into the Intracoastal Waterway experiences excessive flooding during the 10-year and higher storm events. Flooding in this system also affects flooding at the intersection of Grevilla Avenue with Villagrande Avenue.

Solution & Project Benefits:

Increasing the size of the stormwater system along Grevilla Avenue will help to alleviate roadway flooding during the 10-year and 100-year storm events both along Grevilla Avenue and at the intersection with Villagrande Avenue.

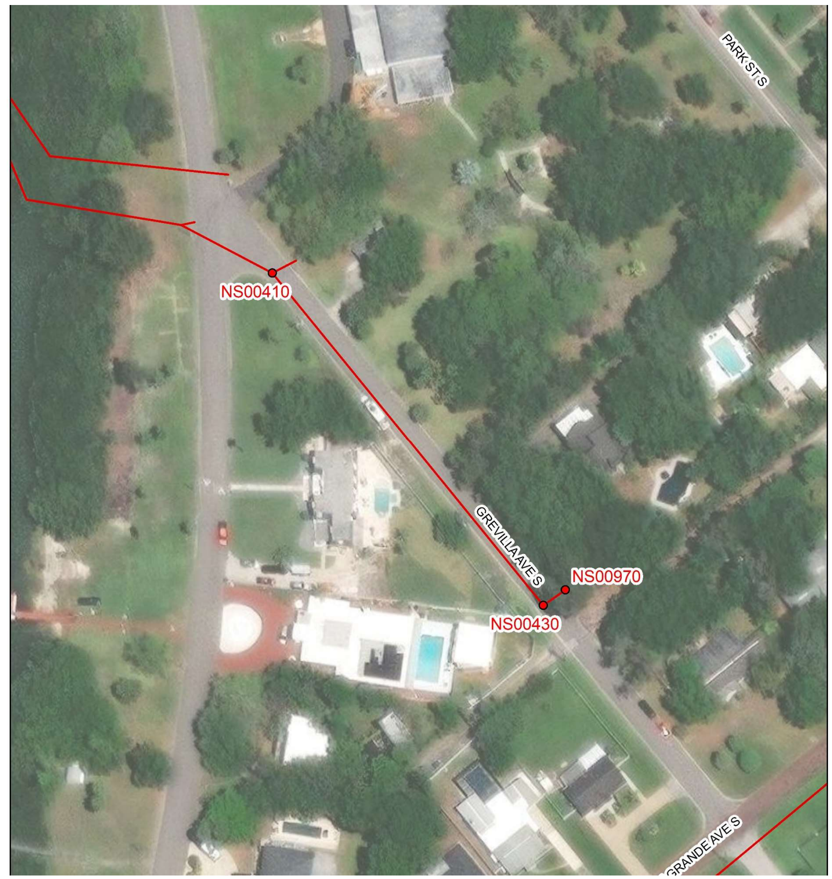
This project would remove approximately 709 feet of roadway from the 10-year floodplain.

Estimated Cost:

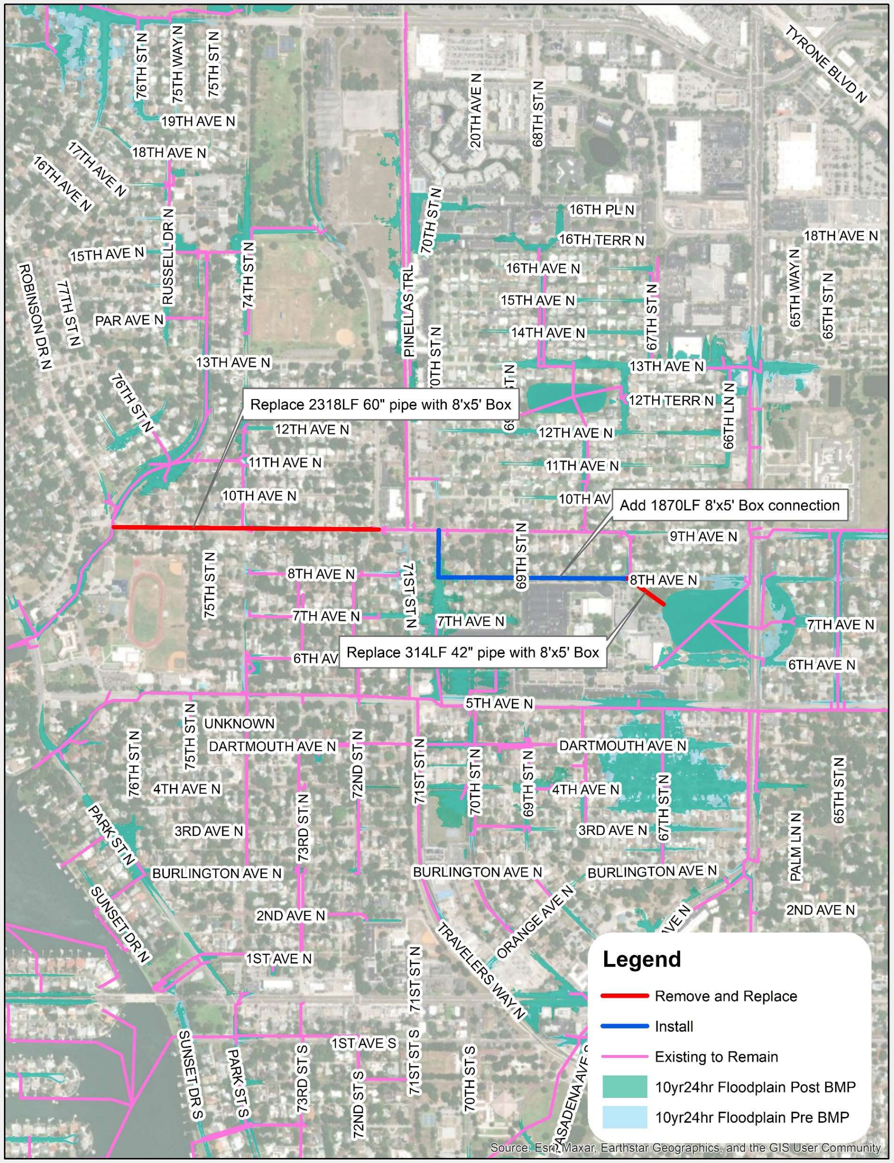
Estimated cost for this project is approximately $2,387,000 including planning, engineering, and permitting fees.

Grevilla Avenue - Project No. G1-7 (continued)

Node	Location Description	Initial Stage	10-Year			100-Year			EOP
			EX	PR	Δ	EX	PR	Δ	
NS00970	Grevilla Ave	1.00	3.92	3	-0.92	4.09	3.97	-0.12	3.0
NS00430	Grevilla Ave	1.00	3.9	2.84	-1.06	4.06	3.94	-0.12	3.0
NS00410	Grevilla Ave & Sunset Dr	1.00	3.85	2.4	-1.45	4.02	3.75	-0.27	3.0



Eagle Lake Outfall - Project No. G1-8



PROJECT G1-8

Problem

Eagle Lake, which is located near the intersection of 8th Avenue North and 66th Street, currently discharges into a pipe system that follows 9th Avenue to discharge into Golf Creek just north of the Admiral Farragut Academy. This lake experiences flooding above the estimated top-of-bank elevation of 19.0 feet during the 100-year storm event, which affects traffic along 66th Street, which is an arterial road, as well as flooding in the yards and parking lots of nearby businesses and residences. The existing discharge pipe from Eagle Lake is 42-inches in diameter, and the pipe size increases to 54-inch diameter at 68th Street and then 60-inch diameter west of the Pinellas Trail. Part of the cause of this flooding is a topographic ridge that exists between Eagle Lake and Golf Creek along 9th Avenue North, which restricts pipe slopes and the hydraulic capacity of the systems that connect into the 9th Avenue pipe system. The peak of this ridge appears to be at the intersection of 9th Avenue and the Pinellas Trail (71st Street).

Solution & Project Benefits:

Adding a supplemental discharge system along the smaller 8th Avenue to the current system will provide additional hydraulic capacity for the discharge of the lake while reducing the length of impacts to the pipe system along 9th Avenue, which is a more arterial roadway for this region. Improvements in the pipe size along 9th Avenue were added between the Pinellas Trail and the Admiral Farragut Academy in order to improve flow capacity into Golf Creek.

These improvements will reduce the peak stage of Eagle Lake to below the top-of-bank elevation during the 100-year storm event. It should be noted that further analysis of this outfall improvement may yield a different design that is more economical or that is easier to construct than this proposed design. Additionally, Project G1-1 Golf Creek 9th Avenue Bridge is located at the outfall for this project, and therefore it might be useful for the design and construction of these two projects to be coordinated, assuming that the City selects both projects for further development.

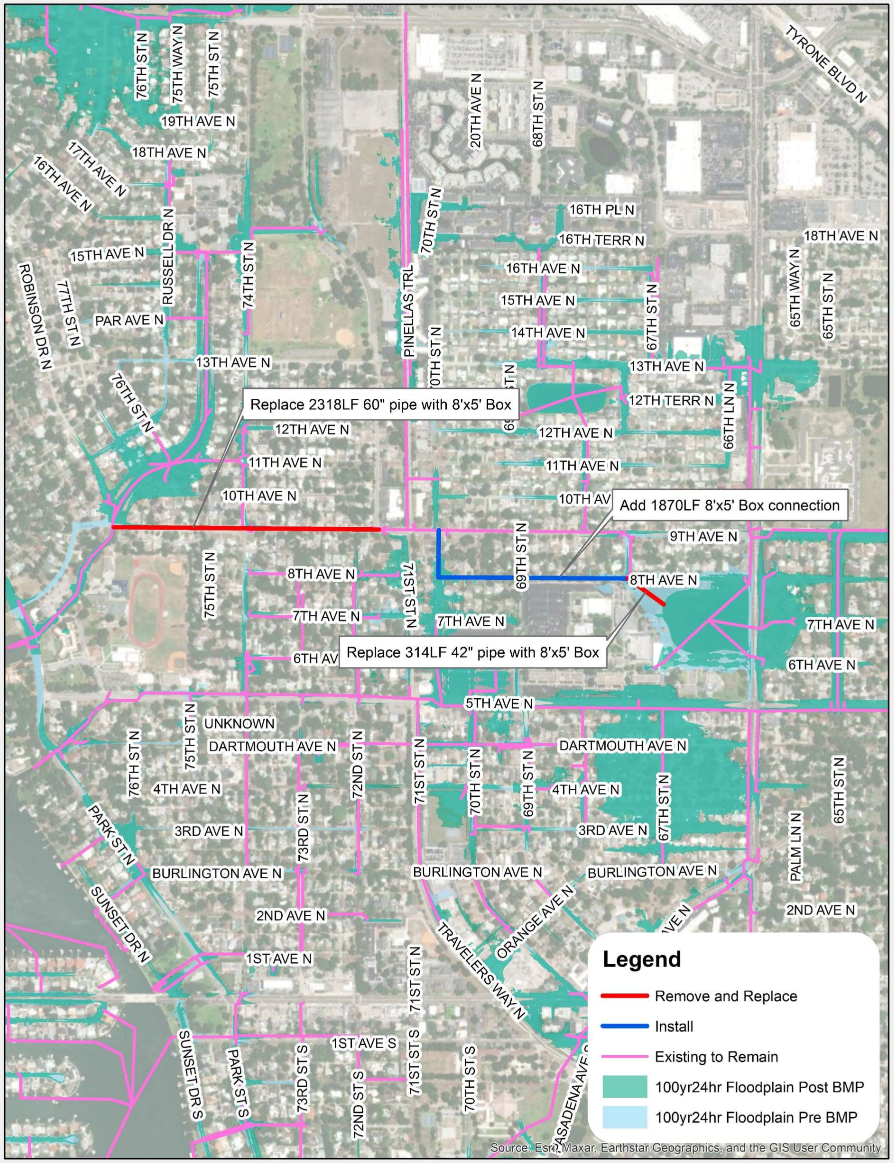
This project would remove approximately 643 feet of roadway from the 10-year floodplain.

Estimated Cost:

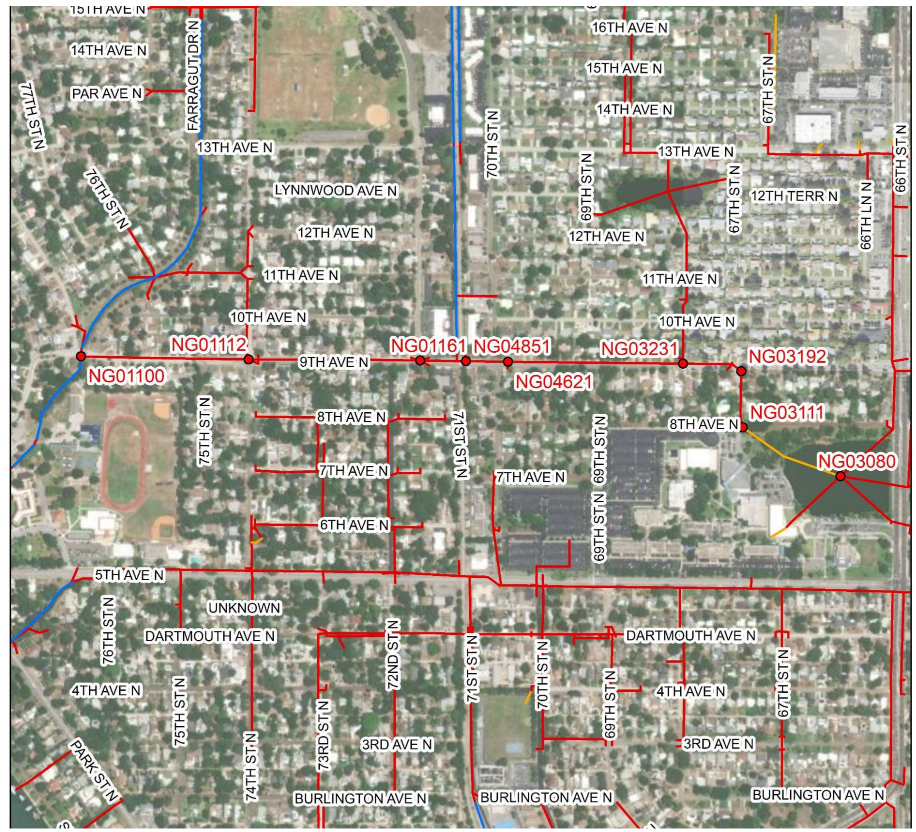
Estimated cost for this project is approximately $21,596,000 including planning, engineering, and permitting fees.

DEM topography between Eagle Lake and Golf Creek

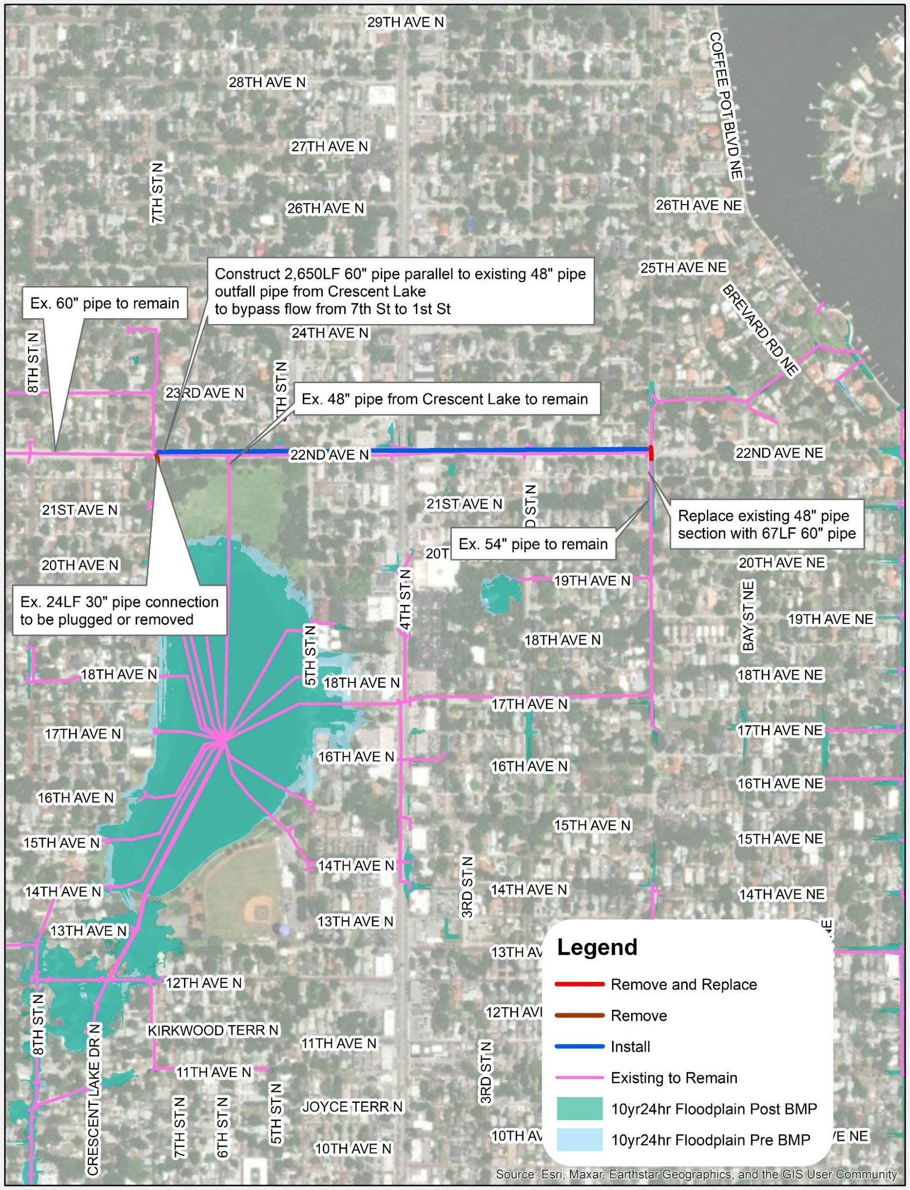
Eagle Lake Outfall - Project No. G1-8 (continued)



Node	Location Description	Initial Stage	10-Year			100-Year			EOP
			EX	PR	Δ	EX	PR	Δ	
NG03080	Eagle Lake	13.37	18.44	17.45	-0.99	19.38	18.96	-0.42	19.0
NG03111	8th Ave & 67th St	10.44	18.09	17.24	-0.85	19.31	18.82	-0.49	17.0
NG03192	9th Ave & 67th St	9.34	17.84	17.28	-0.56	19.19	18.86	-0.33	18.0
NG03231	9th Ave & 68th St	8.18	17.69	17.29	-0.4	18.99	18.82	-0.17	19.0
NG04621	9th Ave & 70th St	6.61	17.28	16.82	-0.46	18.6	18.41	-0.19	20.0
NG04851	9th Ave & Pinellas Trail	6.00	17.04	15.2	-1.84	18.45	17.20	-1.25	23.0
NG01161	9th Ave & 72nd St	5.61	16.38	14.02	-2.36	17.84	16.09	-1.75	20.0
NG01112	9th Ave & 74th St	4.41	15.04	13.42	-1.62	16.14	15.47	-0.67	18.0
NG01100	9th Ave & Farragut Dr	3.67	11.9	12.32	0.42	13.39	13.79	0.4	14.0



Crescent Lake 22nd Ave Bypass - Project No. G2-1



PROJECT G2-1

Problem

The 100-Year floodplain for Crescent Lake extends into the residential areas along the lake, and to the southwest of the lake along the box culvert system that collects runoff from 8th Street and Dr Martin Luther King Jr Street for inflow into the lake. The main outfall for Crescent Lake is through a concrete weir and 48-inch pipe at the north end of the lake. A secondary outfall is on the east side of the lake through a 54-inch pipe system along 17th Avenue.

The 48-inch pipe outfall at the north end of the lake joins a 48-inch pipe system along 22nd Avenue that flows east and then northeast to discharge directly into Tampa Bay. Upstream (west) of this system, starting near the corner of 22nd Avenue and 7th St and heading north and west of this intersection, is a major collection network that ends at a 60-inch pipe at this intersection. This pipe splits into a 30-inch pipe that flows southeast directly into Crescent Lake, and a 48-inch pipe along 22nd Avenue. The 48-inch pipe outfall from the lake connects to the 48-inch pipe along 22nd Avenue, which then continues to flow east along 22nd Avenue toward the Bay.

The hydraulic grade line (HGL) in the 60-inch pipe along 22nd Avenue is higher than the existing ground along the road. Furthermore, this HGL is several feet higher than the existing ground along the east and south sides of the lake. This elevated head causes the water in the pipes along 22nd Avenue to flow into the lake and increases the lake water levels, which causes flooding. As a result, flow out of Crescent Lake is impacted during large storm events, and causes elevated flow through the only other remaining outfall to the east along 17th Avenue.

In order to reduce flood levels in Crescent Lake, high flows through the 60-inch pipe need to be diverted to bypass the lake and continue through the system along 22nd Avenue in order to allow the primary lake outfall through the concrete weir to function as designed.

Solution & Project Benefits

In order to bypass the flows coming from the structure at the corner of 22nd Avenue and 7th Street around the outflows from Crescent Lake, a 60-inch bypass pipe is proposed along 22nd Avenue between 7th Street and 1st Street. At the 1st Street intersection, the existing 48-inch pipe along 22nd Avenue, which comes from the primary lake outfall, joins with the 54-inch pipe along 1st Street that comes from the secondary lake outfall along 17th Avenue. These pipes then outfall to a 60-inch pipe that heads north up 1st Street and then enlarges into a 6'x4' box culvert before discharging into the bay.

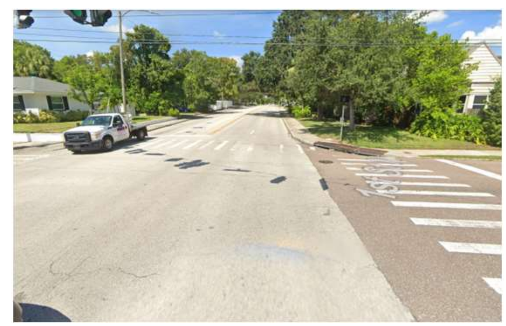
In order to avoid any flow from the structure at 22nd Avenue and 7th Street from entering the lake, the existing 30-inch pipe coming from the structure into the lake is proposed to be removed or plugged.

Also proposed is a replacement of the 48-inch pipe to the south of 22nd Avenue and 1st Street, which is downstream of the 54-inch pipe network connected to the east lake outfall, with a 54-inch pipe section in order to preserve the flow rate of this system.

Therefore, the 60-inch pipe heading north at 22nd Avenue and 1st Street will be receiving the flow from three pipes: 1) the existing 48-inch pipe along 22nd Avenue from the primary lake outfall, 2) the proposed 60-inch pipe along 22nd Avenue from the structure at 22nd Avenue and 7th Street, and 3) the existing 54-inch pipe system along 1st Street coming from the secondary lake outfall, which will have the last span of its pipe replaced in order to match the pipe size of the upstream system. Although the 60-inch pipe heading north is not sufficient to carry the flow from all of these pipes, the pipe inverts and existing ground elevations in this area are such that any increases in water head at this point do not contribute significantly to flooding. If there are concerns about routing flows into a smaller pipe size, then an analysis comparing the cost and benefit of such a system could be conducted in the future.

This alternative removes approximately 855 feet of roadway from the 10-year floodplain and 25 structures from the 100-year floodplain.

22nd Avenue looking East at 7th Street

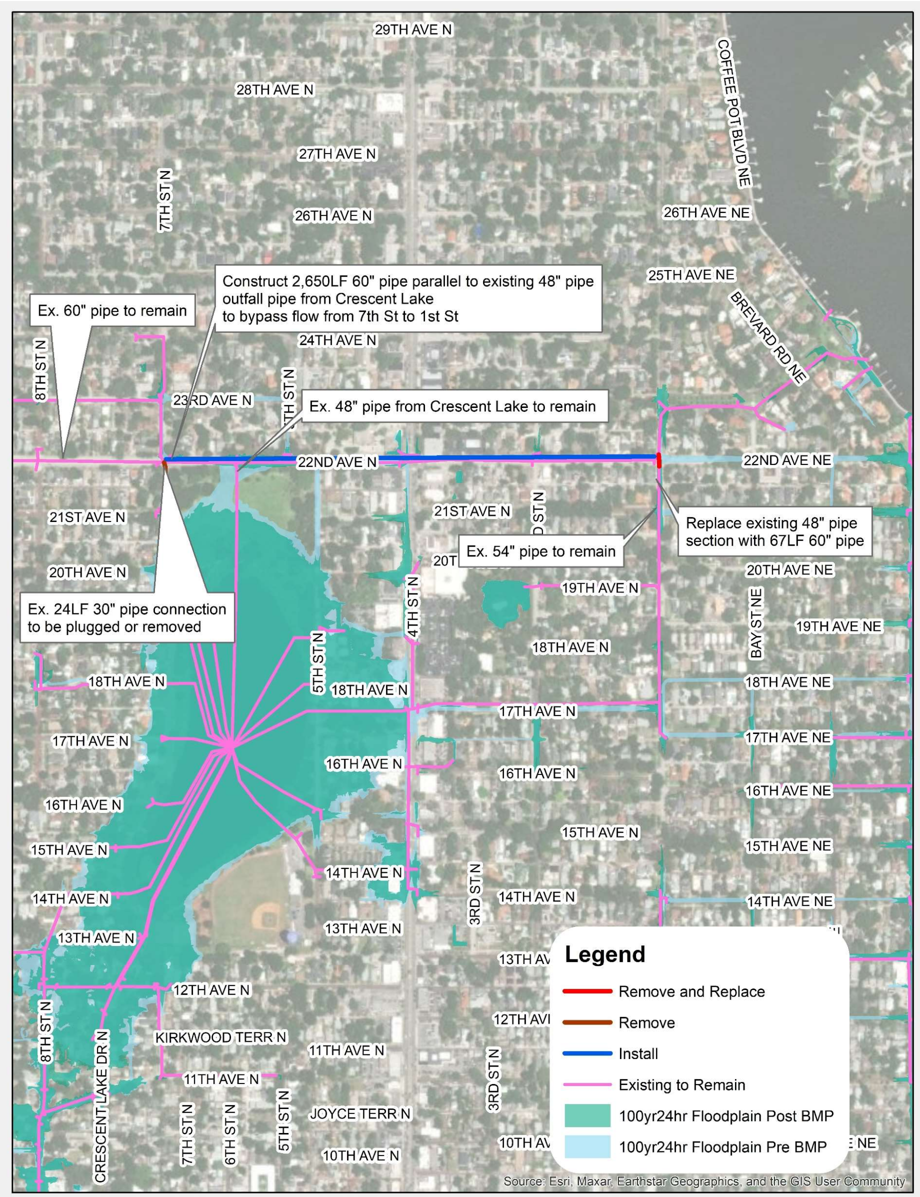


22nd Avenue looking West at 1st Street

Estimated Cost:

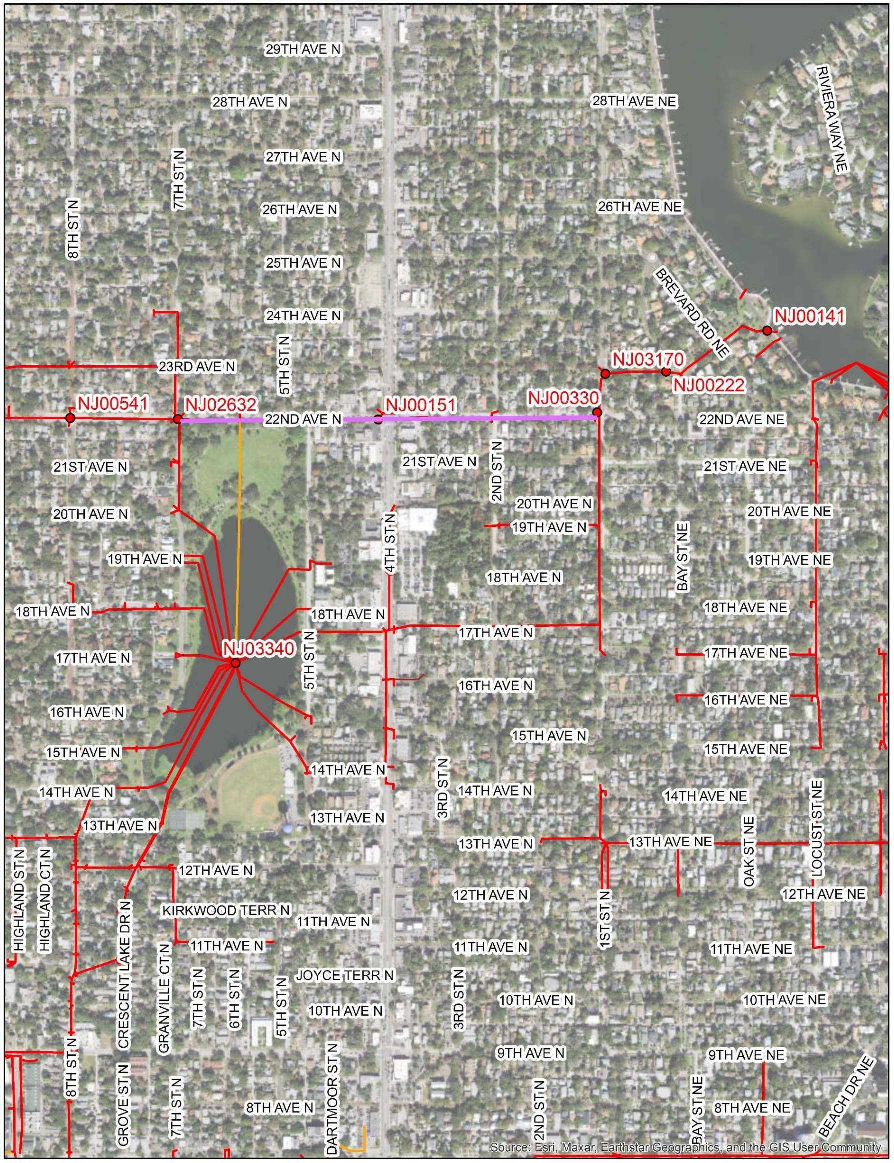
Estimated cost for this project is approximately $4,020,000 including planning, engineering, and permitting fees with 30% contingency. Project is proposed to address current LOS deficiencies.

Crescent Lake 22nd Ave Bypass - Project No. G2-1



PROJECT G2-1

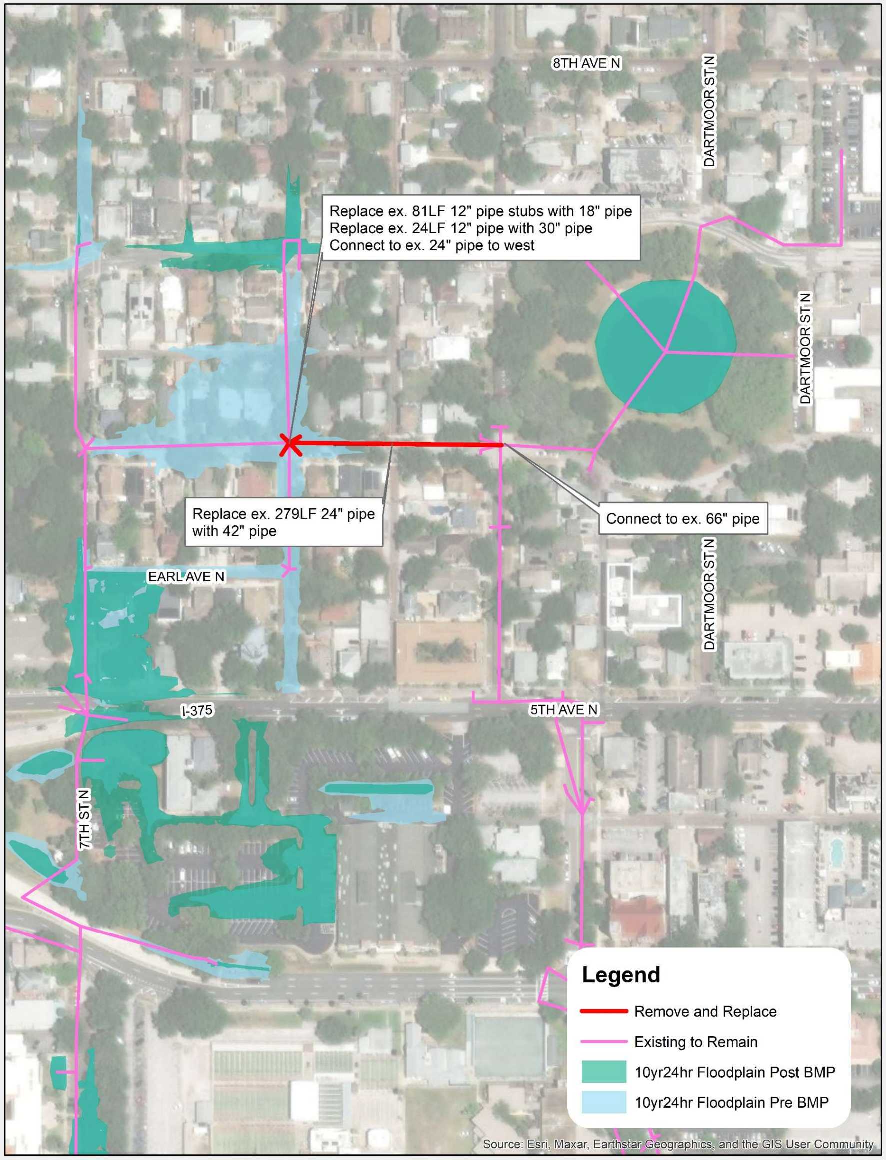
Crescent Lake 22nd Ave Bypass - Project No. G2-1 (continued)



PROJECT G2-1

Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ
NJ03340	Crescent Lake	15.7	25.05	24.03	-1.02	28.14	27.31	-0.83
NJ02632	22nd Ave & 7th St	25.4	36.39	36.57	0.18	37.23	37.19	-0.04
NJ00541	22nd Ave & 8th St	35.11	40.22	40.37	0.15	41.90	41.88	-0.02
NJ00301	23rd Ave & 7th St	34.55	41.81	41.83	0.02	42.16	42.16	0.00
NJ00151	22nd Ave & 4th St	12.86	27.47	21.93	-5.54	29.43	25.36	-4.07
NJ00330	22nd Ave & 1st St	9.96	15.30	15.35	0.05	15.39	15.41	0.02
NJ03170	23rd Ave & 1st St	5.33	13.77	14.86	1.09	14.57	15.15	0.58
NJ00222	23rd Ave & Bay St	3.97	10.74	11.42	0.68	11.32	11.69	0.37
NJ00141	23rd Ave & Coffee Pot Blvd	1.02	2.95	3.10	0.15	3.13	3.17	0.04

Round Lake - Project No. G2-2



PROJECT G2-2

Problem

Round Lake is located just north of Mirror Lake. There are pipes running along 6th Avenue to the west of Round Lake, and these pipes connect to Round Lake but also to Mirror Lake, and Round Lake also discharges to Mirror Lake through a 66-inch pipe along 5th Street.
There is considerable flooding in both the 10-Year and 100-Year storm events at the intersection of 6th Avenue and 6th Street, with two houses being affected by the 100-Year floodplain.

Solution & Project Benefits:

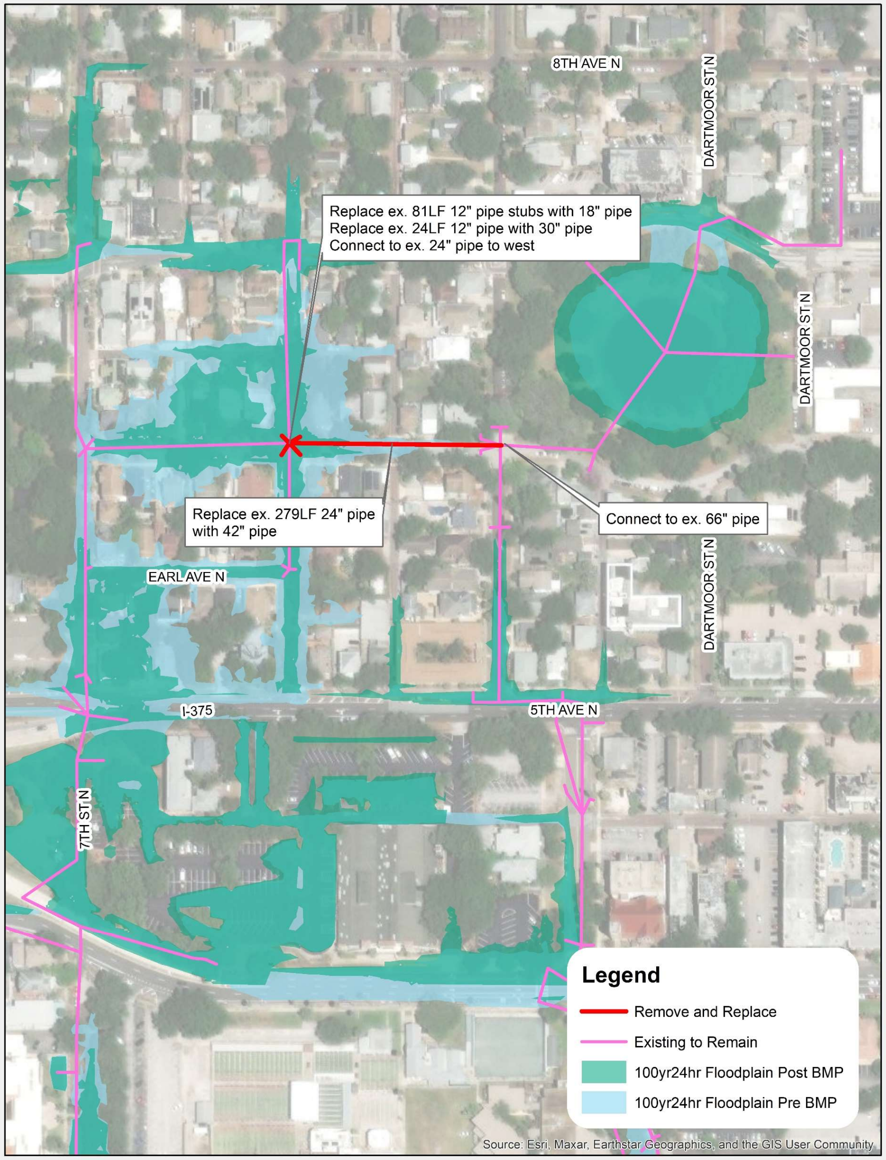
Replacing the existing pipe along 6th Avenue between 6th Street and 5th Street with a larger pipe to discharge into the existing 66-inch outlet pipe along 5th Street will decrease flooding in this intersection. Additionally, replacing the four pipes to the inlets at this intersection, some of which have a size of only 12-inch diameter, will reduce the flood depths at these inlets.

This solution removes approximately 397 feet of roadway from the 10-year floodplain and 2 structures from the 100-Year floodplain.

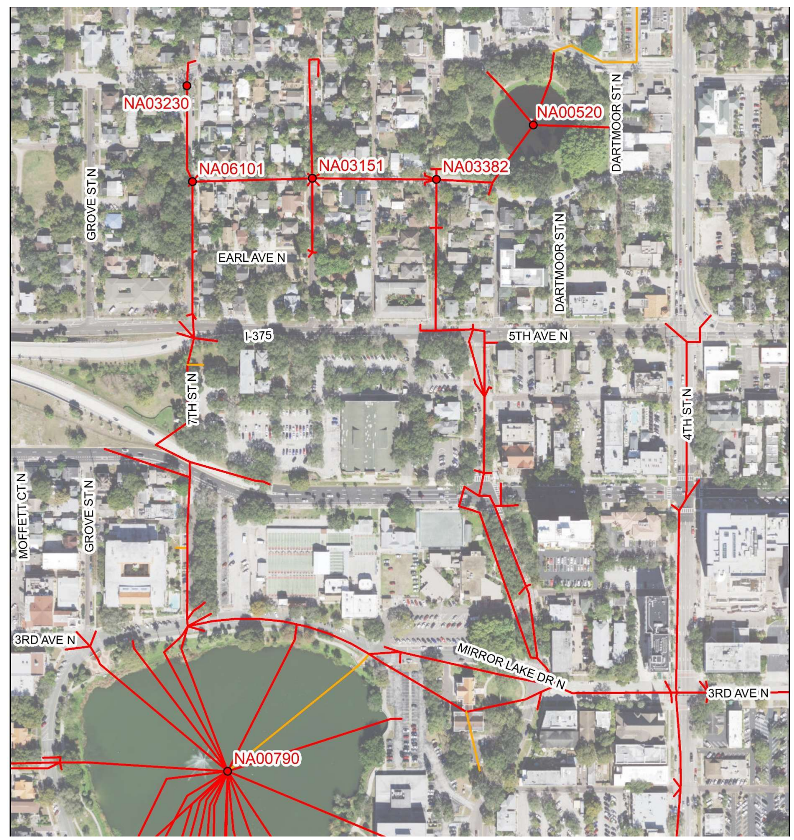
Estimated Cost:

Estimated cost for this project is approximately $1,032,000 including planning, engineering, and permitting fees.

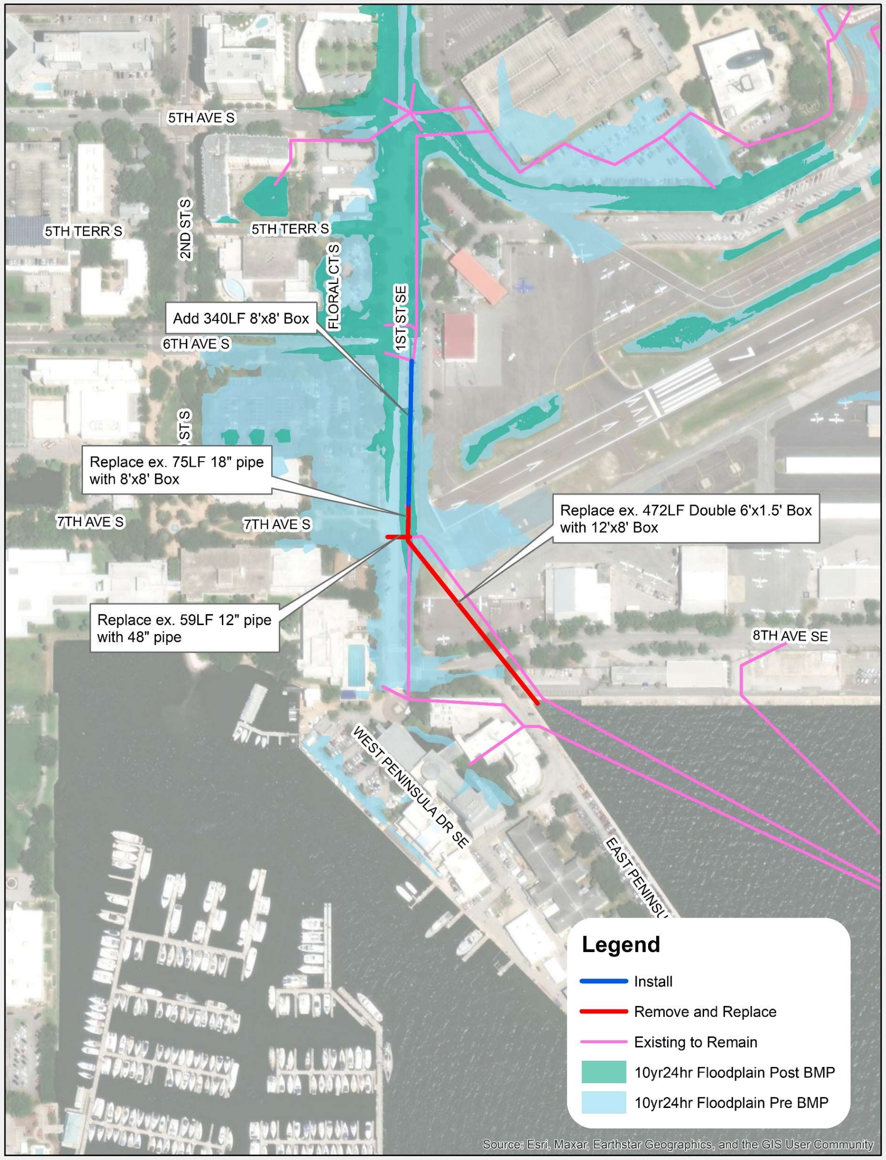
Round Lake - Project No. G2-2 (continued)



Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	EOP
NA03230	7th Ave N & 7th St	28.39	37.73	37.45	-0.28	37.95	37.94	-0.01	37.0
NA06101	6th Ave N & 7th St	27.52	36.45	35.12	-1.33	36.98	36.68	-0.30	36.0
NA03151	6th Ave N & 6th St	27.99	36.14	32.64	-3.50	36.86	36.38	-0.48	35.0
NA03382	6th Ave N & 5th St	26.62	30.37	31.36	0.99	34.18	34.93	0.75	37.0
NA00520	Round Lake	29.09	31.03	31.55	0.52	34.32	35.04	0.72	37.0
NA00790	Mirror Lake	25.84	29.61	29.59	-0.02	32.67	32.66	-0.01	35.0



1st Street SE - Project No. G2-3



PROJECT G2-3

Problem

The intersection of 1st Street and 5th Avenue South is adjacent to many downtown St Petersburg attractions and institutions such as the Albert Whitted airport, the Dali Museum, the Mahaffey Theatre, and the USF college campus. This intersection experiences significant flooding during both the 10-year and 100-year storm events, extending both into parking lots and into airport runways.

The inlets along 1st Street at the intersections with 5th and 6th Avenue South currently outfall to the northeast through the parking lots for Mahaffey Theatre and the Dali Museum. There is an existing system to the south that begins at the intersection of 1st Street and 7th Avenue South and discharges down 1st Street and directly into Tampa Bay near 8th Avenue South.

Solution & Project Benefits:

Discharging the pipe system along 1st Street to the south would be more efficient and easier to maintain. The size of this system could be increased to handle the additional flow from the 6th Avenue system.

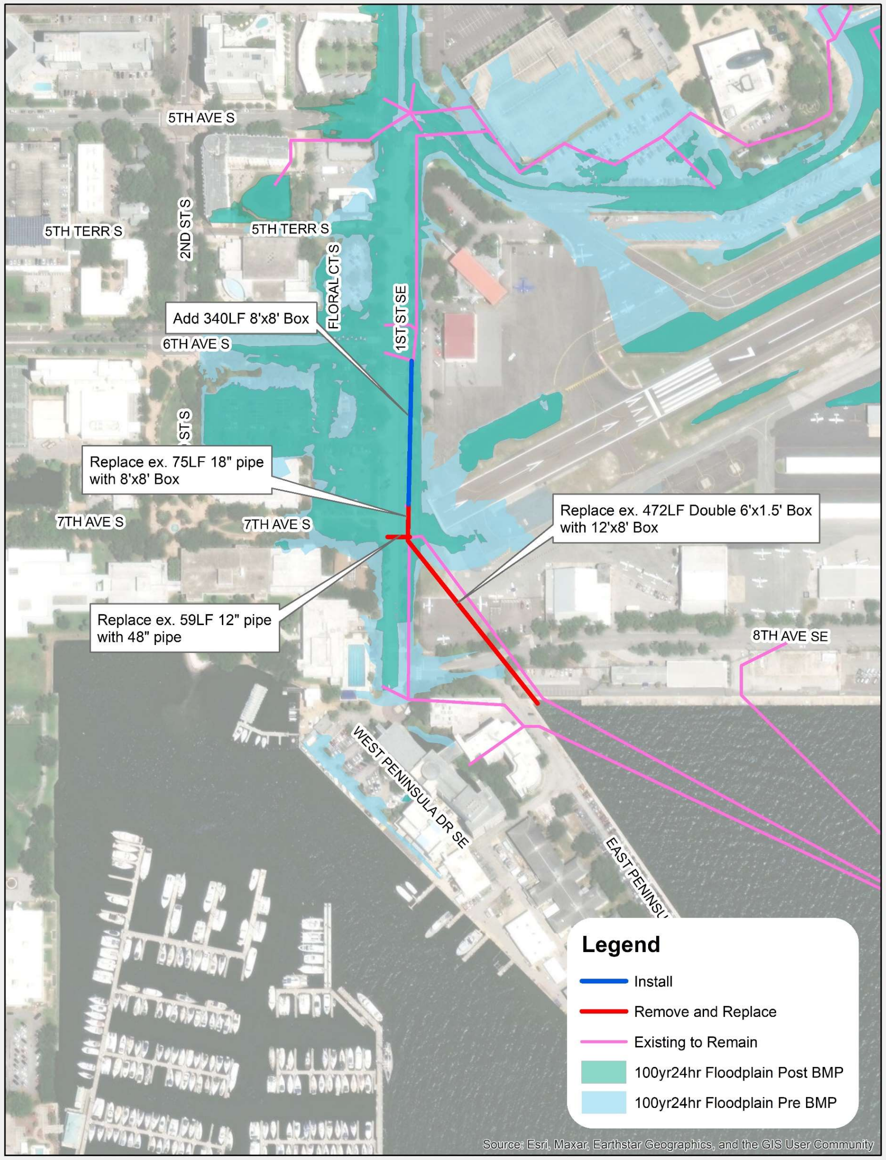
Such a system would significantly limit the flooding outside of the roadway during 10-year and 100-year storm events.

This project would remove approximately 542 feet of roadway from the 10-year floodplain.

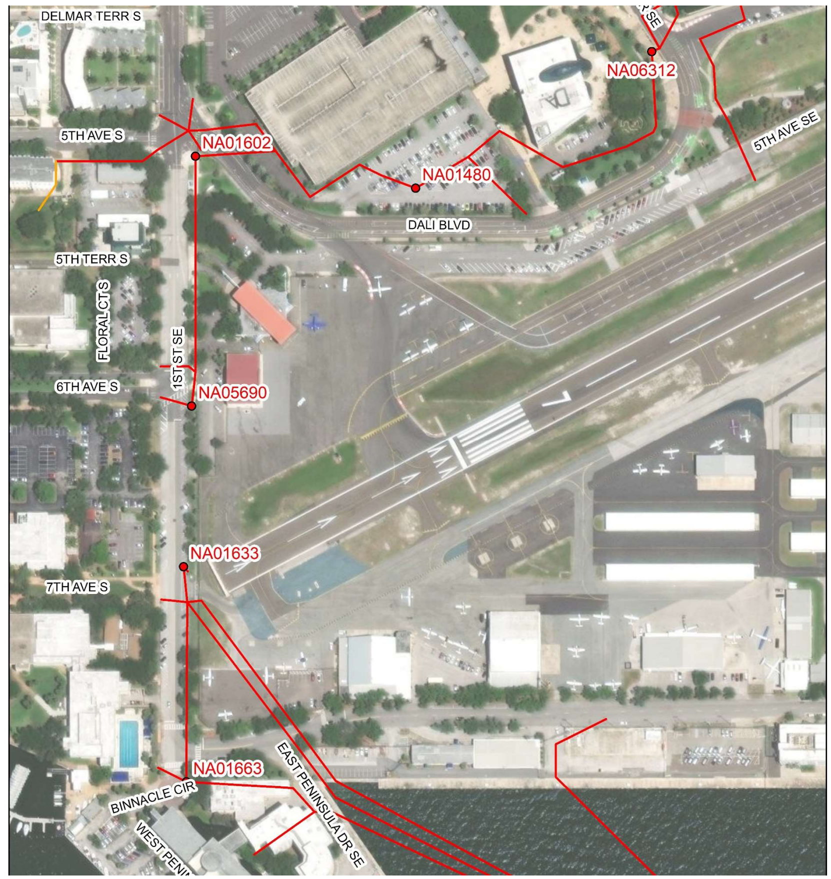
Estimated Cost:

Estimated cost for this project is approximately $6,245,000 including planning, engineering, and permitting fees.

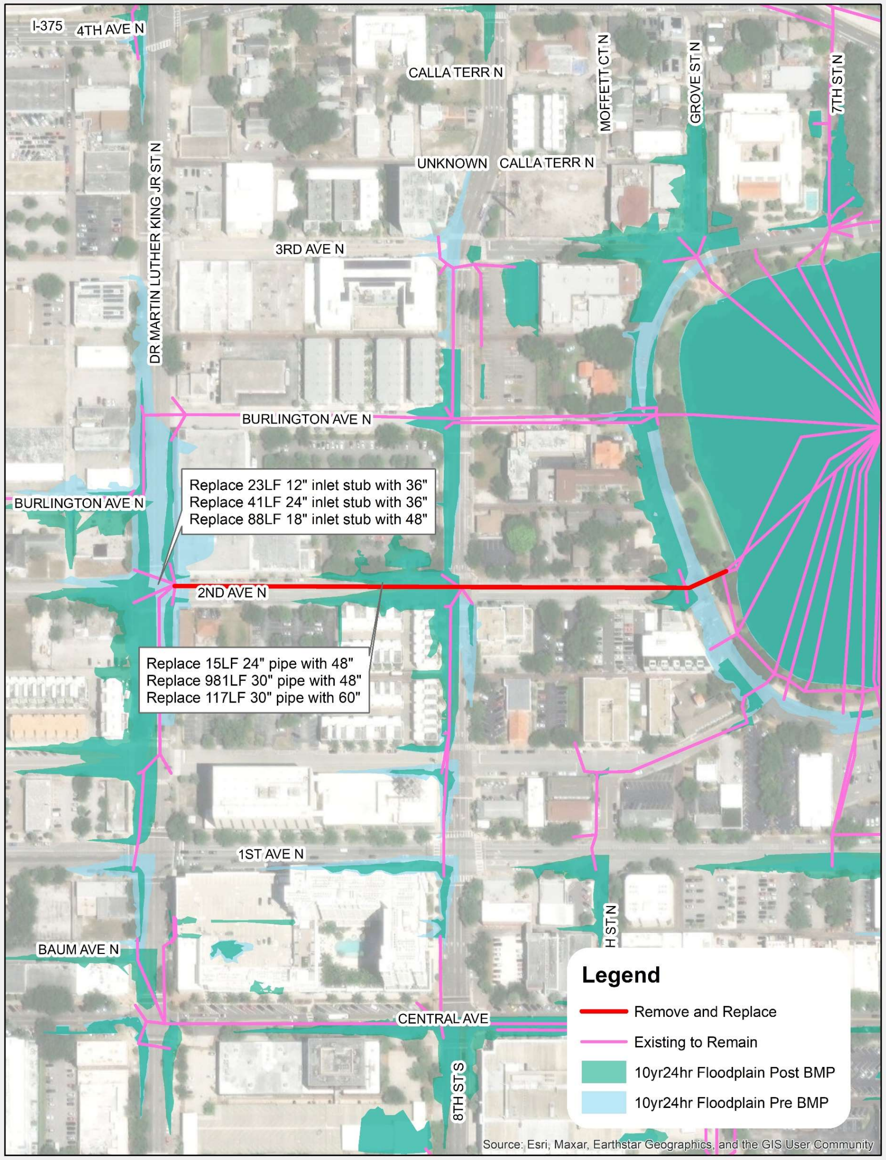
1st Street SE - Project No. G2-3 (continued)



Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	EOP
NA05690	6th Ave S & 1st St	1	4.95	2.93	-2.02	5.16	4.15	-1.01	3.0
NA01602	Dali Blvd & 1st St	1	4.87	3.98	-0.89	5.19	4.75	-0.44	4.0
NA01480	Mahaffey Parking	1	4.70	3.78	-0.92	5.16	4.73	-0.43	4.0
NA06312	Dali Blvd & Bayshore Dr	1	1.55	1.45	-0.10	2.88	1.75	-1.13	3.0
NA05690	6th Ave S & 1st St	1	4.95	2.93	-2.02	5.16	4.15	-1.01	3.0
NA01633	7th Ave & 1st St	1	2.18	2.30	0.12	2.24	3.42	1.18	3.0
NA01663	Binnacle Cir & 1st St	1	3.97	2.07	-1.90	4.11	3.23	-0.88	4.0



2nd Avenue North, Mirror Lake - Project No. G2-4



PROJECT G2-4

Problem

In the existing condition, there is excessive street flooding at the intersection of 2nd Avenue North and Dr Martin Luther King Jr (MLK) Street during the 10-year and higher storm events. The inlets at this intersection drain into a stormwater system that discharges along 2nd Avenue into Mirror Lake to the east. MLK Street is an important arterial road within the City, and therefore flooding along this road during storm events can be highly disruptive to traffic.

Solution & Project Benefits:

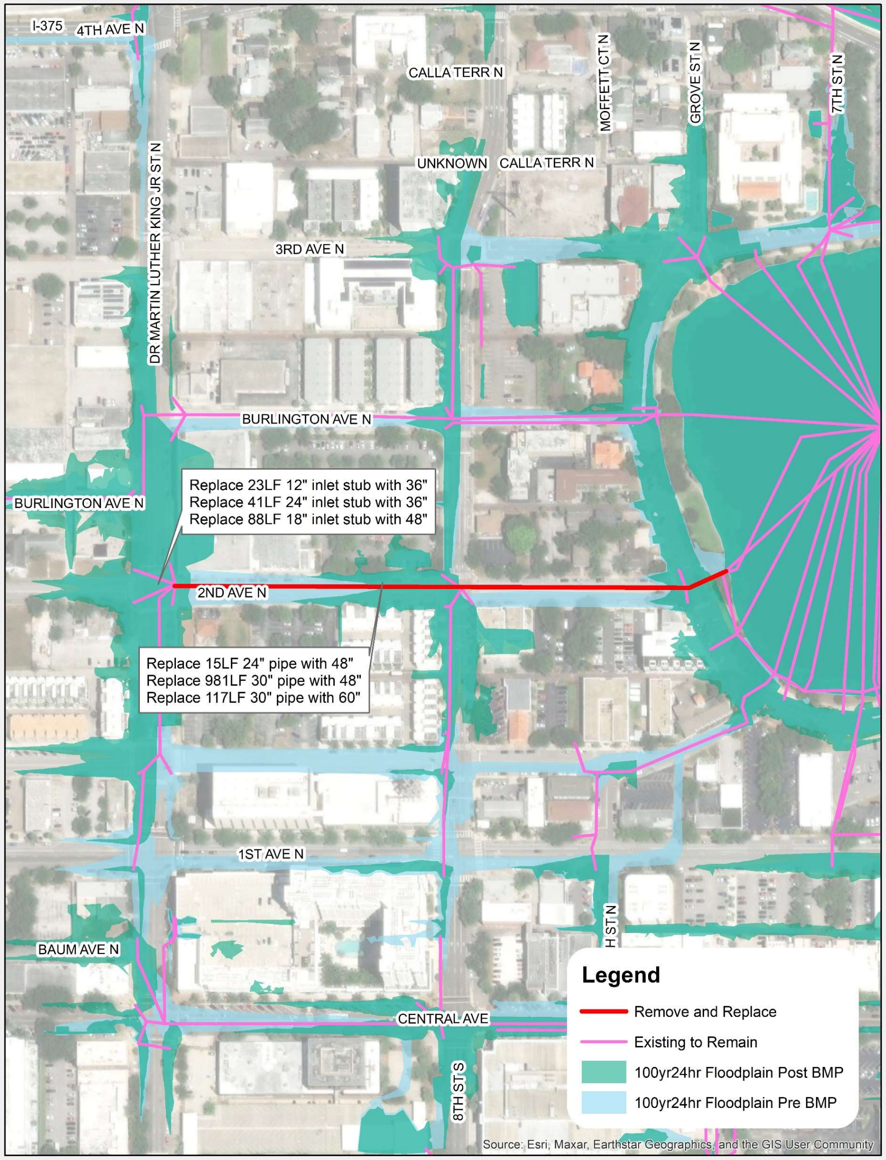
Increasing the size of the stormwater system along 2nd Avenue between MLK Street and Mirror Lake, as well as increasing the sizes of the stub pipes connecting the inlets on MLK Street, will remove flooding at the intersection of 2nd Avenue and MLK Street during the 10-year storm event.

This project would remove approximately 243 feet of roadway from the 10-year floodplain.

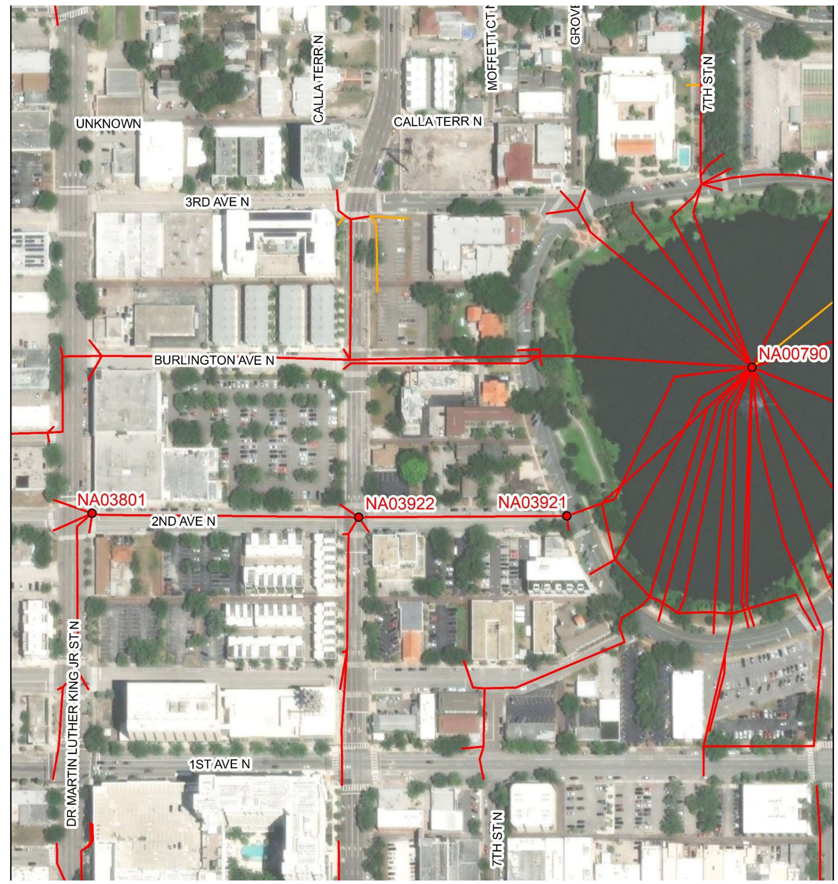
Estimated Cost:

Estimated cost for this project is approximately $1,958,000 including planning, engineering, and permitting fees.

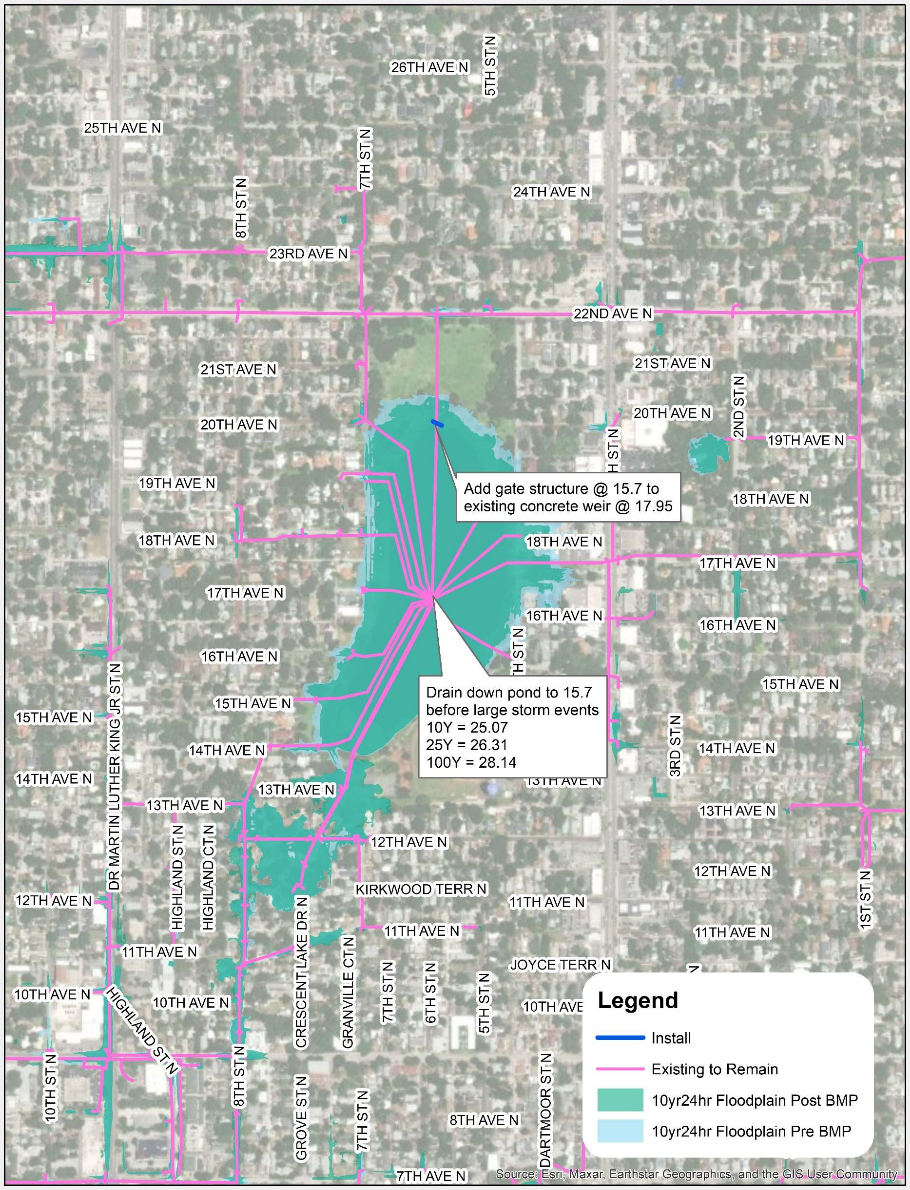
2nd Avenue North, Mirror Lake - Project No. G2-4 (continued)



Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	EOP/TOB
NA03801	2nd Ave & MLK St	34.01	40.89	39.58	-1.31	41.09	40.98	-0.11	40.0
NA03922	2nd Ave & 8th St	32	38.58	36.21	-2.37	38.90	37.96	-0.94	39.0
NA03921	2nd Ave & Mirror Lake Dr	30	34.65	32.63	-2.02	35.29	34.70	-0.59	34.0
NA00790	Mirror Lake	25.84	29.61	29.62	0.01	32.67	32.70	0.03	34.0



Crescent Lake Drawdown - Project No. G2-5



PROJECT G2-5

Problem

During large storm events, Crescent Lake and the surrounding system experience a high degree of flooding. The storage volume of the lake is insufficient to handle the large flows that result from these storms. The level of the lake is controlled by a concrete weir at the north end of the lake at invert elevation 17.95 feet, as well as an outlet pipe that exits along 17th Avenue to the east at invert elevation 18.93 feet. These structures maintain the water level in the lake within 6 feet of the top of bank of the pond, near elevation 24.0 feet. The existing 100-year flood elevation for Crescent Lake is 28.14 feet, and the existing 10-year flood elevation is 25.05 feet.

Solution & Project Benefits

Creating a mechanism to draw down the lake in anticipation of large storm events will increase the storage capacity of the lake before these events and mitigate some of the flooding experienced by surrounding properties during these storm events. This can be attained through either a pump system into the existing outfall pipe infrastructure, or by replacing all or part of the existing concrete weir with a gate that can be controlled manually or automatically to open before large storm events and draw down the lake. The invert elevation of the outlet pipe is 15.70 feet, so this would be the minimum level that could be attained through a gate system, which would provide over 2 feet of additional storage depth in the lake.

Due to the low cost and easy maintenance and operation of a flood gate within the existing concrete weir, this would be the preferred option for draw down of the lake before large storm events. To maximize the storage volume of the lake for these storm events, the gate invert would be set at elevation 15.70 feet, which is equal with the invert of the outfall pipe.

This alternative removes approximately 765 feet of roadway from the 10-year floodplain and 4 structures from the 100-year floodplain.

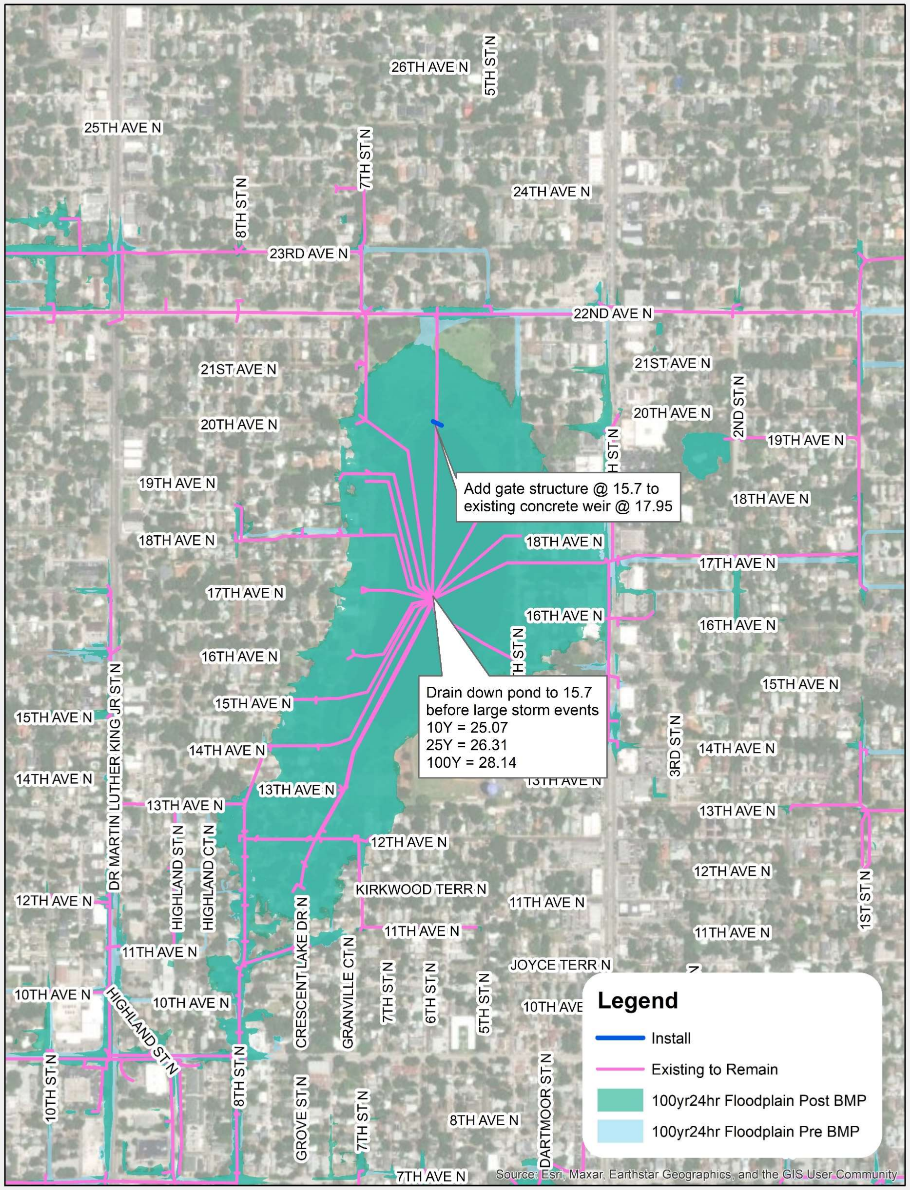
Crescent Lake north weir outfall structure

Outlet pipe on east side of lake @ 17th Avenue

Estimated Cost:

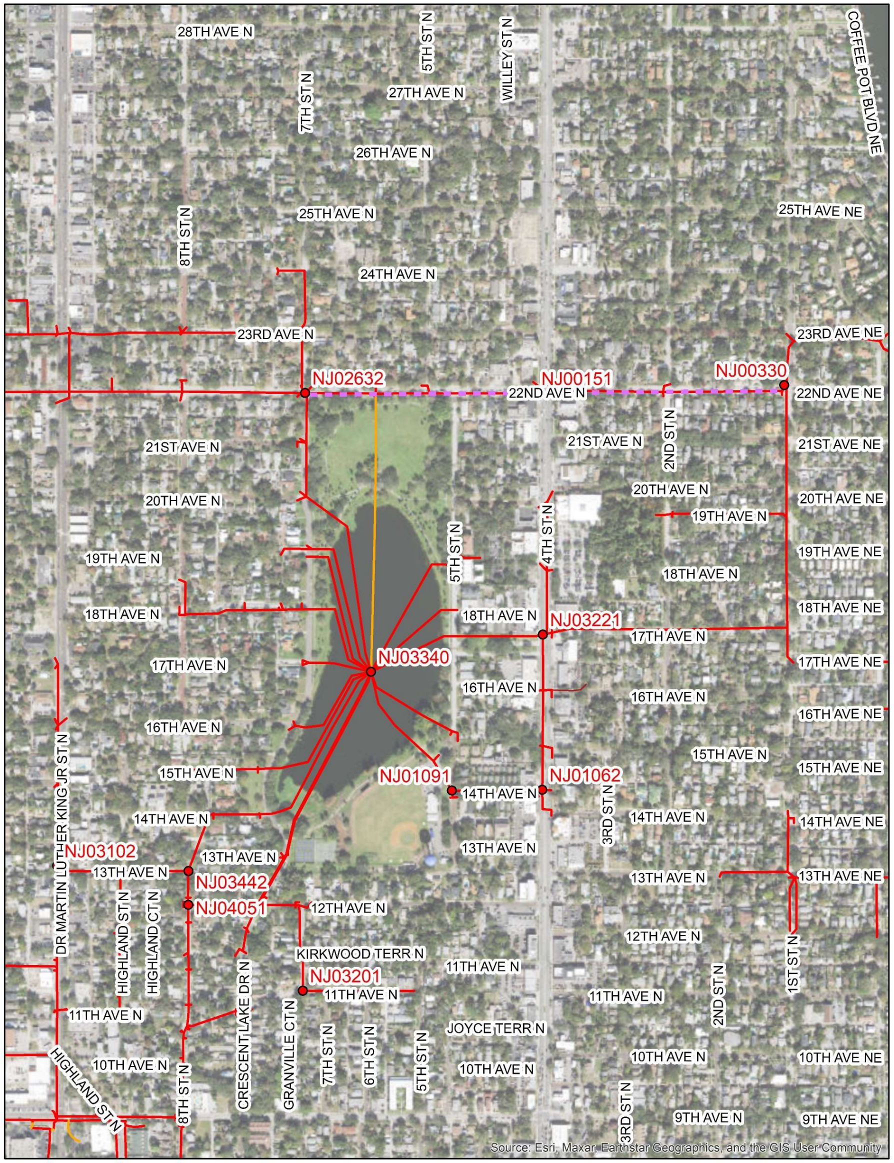
Estimated cost for this project is approximately $60,000 including planning, engineering, and permitting fees with 30% contingency, but the final cost would be dependent on a quote for construction and installation by a gate manufacturer.

Crescent Lake Drawdown - Project No. G2-5 (continued)



PROJECT G2-5

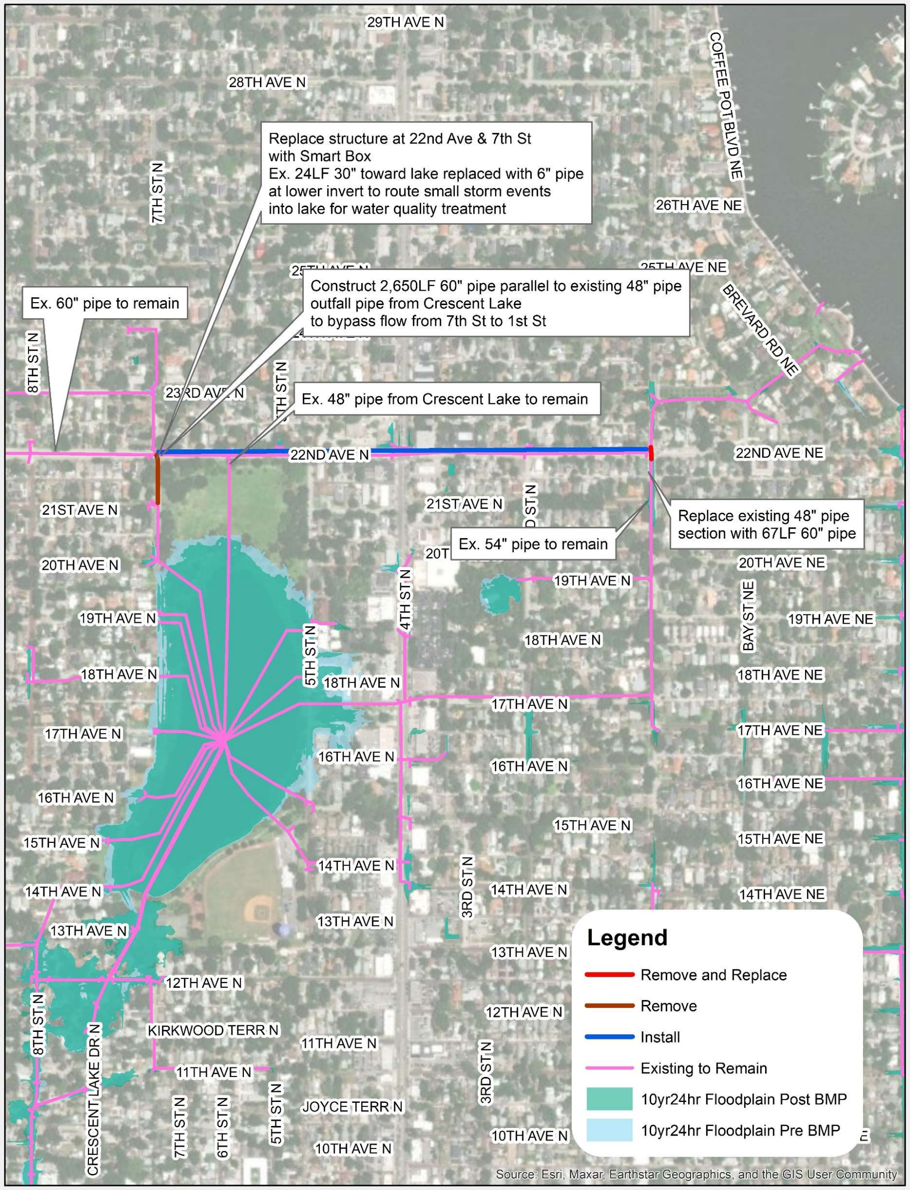
Crescent Lake Drawdown - Project No. G2-5 (continued)



PROJECT G2-5

Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ
NJ03340	Crescent Lake	15.7	25.05	24.66	-0.39	28.14	28.03	-0.11
NJ02632	22nd Ave & 7th St	25.4	36.39	36.43	0.04	37.23	37.20	-0.03
NJ03442	13th Ave & 8th St	16.12	27.23	27.21	-0.02	28.24	28.12	-0.12
NJ03102	13th Ave & MLK	35.35	38.89	38.89	0.00	39.26	39.27	0.01
NJ04051	12th Ave & 8th St	18.68	27.78	27.78	0.00	28.31	28.24	-0.07
NJ03201	11th Ave & 7th St	26.47	29.95	29.95	0.00	30.14	30.14	0.00
NJ01091	14th Ave & 5th St	17.46	25.10	24.71	-0.39	28.18	28.06	-0.12
NJ01062	14th Ave & 4th St	21.32	25.17	24.78	-0.39	28.79	28.68	-0.11
NJ03221	17th Ave & 4th St	14.5	22.81	22.49	-0.32	27.10	26.58	-0.52
NJ00151	22nd Ave & 4th St	12.86	27.47	27.58	0.11	29.43	29.37	-0.06
NJ00330	22nd Ave & 1st St	9.96	15.30	15.30	0.00	15.39	15.39	0.00

Crescent Lake 22nd Ave Bypass with Smart Box - Project No. G2-6



PROJECT G2-6

Problem

The solutions to the flooding issues addressed in Alternative 1 include removal of a 30-inch pipe connection to the lake from the system at the corner of 22nd Ave and 7th St in order to isolate these two systems from each other. The problem with the removal of this pipe is that during small storm events, the runoff water collected in inlets to the northwest of the lake now bypasses the lake instead of entering the lake and receiving some water quality treatment.

Removing this pipe connection and treatment, while enhancing the flood capacity of the system, does not address the environmental and water quality improvements goals set by the City.

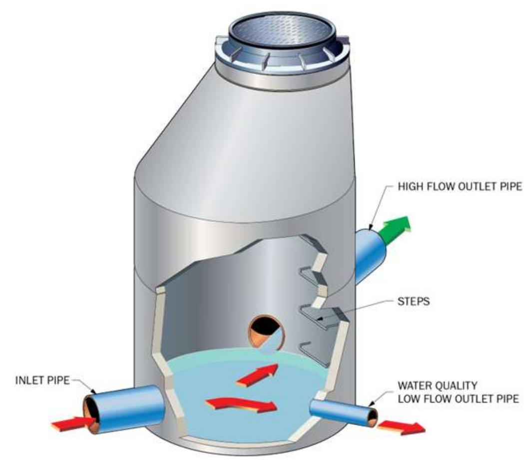
Solution & Project Benefits

Instead of closing the 30-inch pipe connection entirely, the structure at the corner of 22nd Avenue and 7th Street could instead be replaced by a diversion device, or "Smart Box", that routes runoff from small storm events into Crescent Lake for treatment via a 6-inch pipe at a lower invert elevation, and runoff from larger storm events into the 60-inch bypass pipe designed along 22nd Avenue from Alternative 1.

Such a system, although slightly more expensive, will maintain many of the water quality benefits currently served by the existing system and still provide flood protection benefits provided by the new system.

This alternative removes approximately 855 feet of roadway from the 10-year floodplain and 25 structures from the 100-year.

22nd Avenue looking East at 7th Street

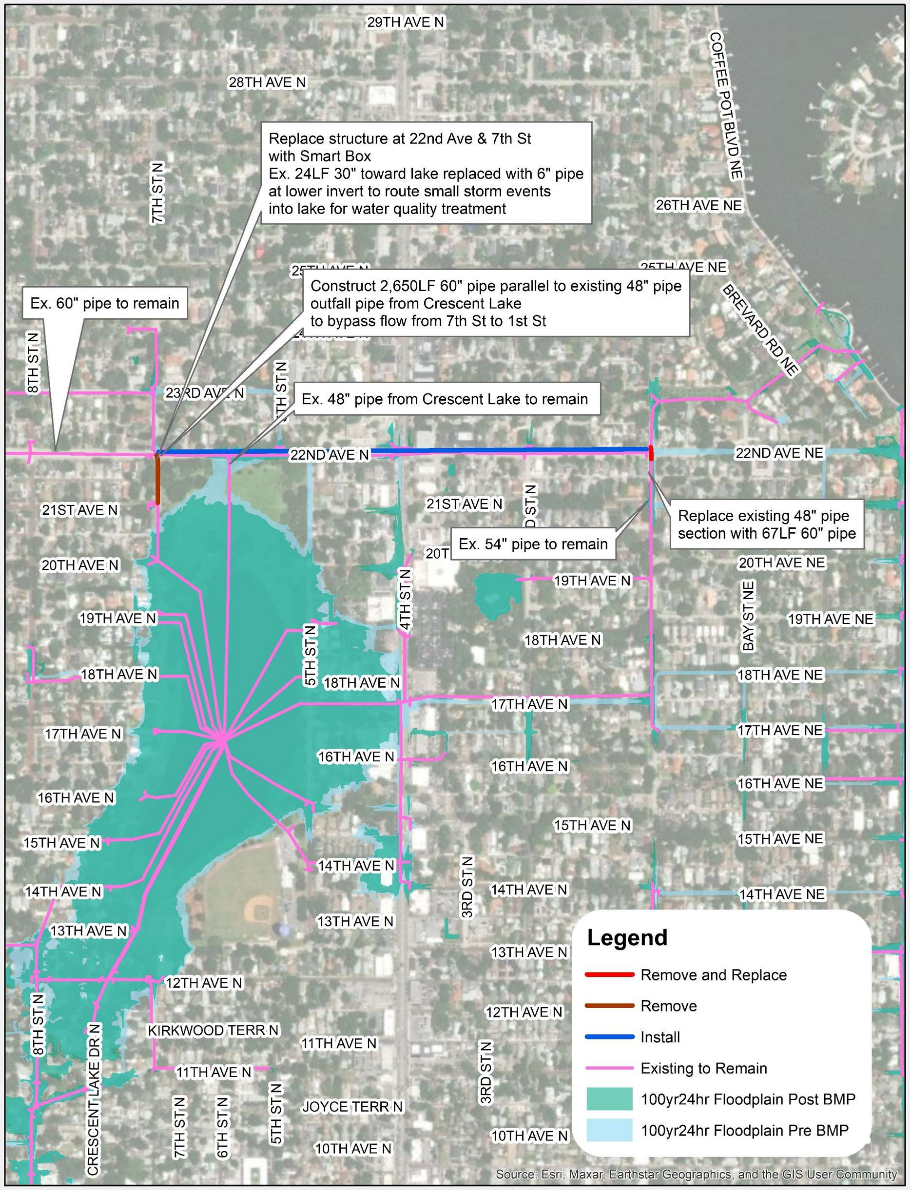


Example of a Smart Box design

Estimated Cost:

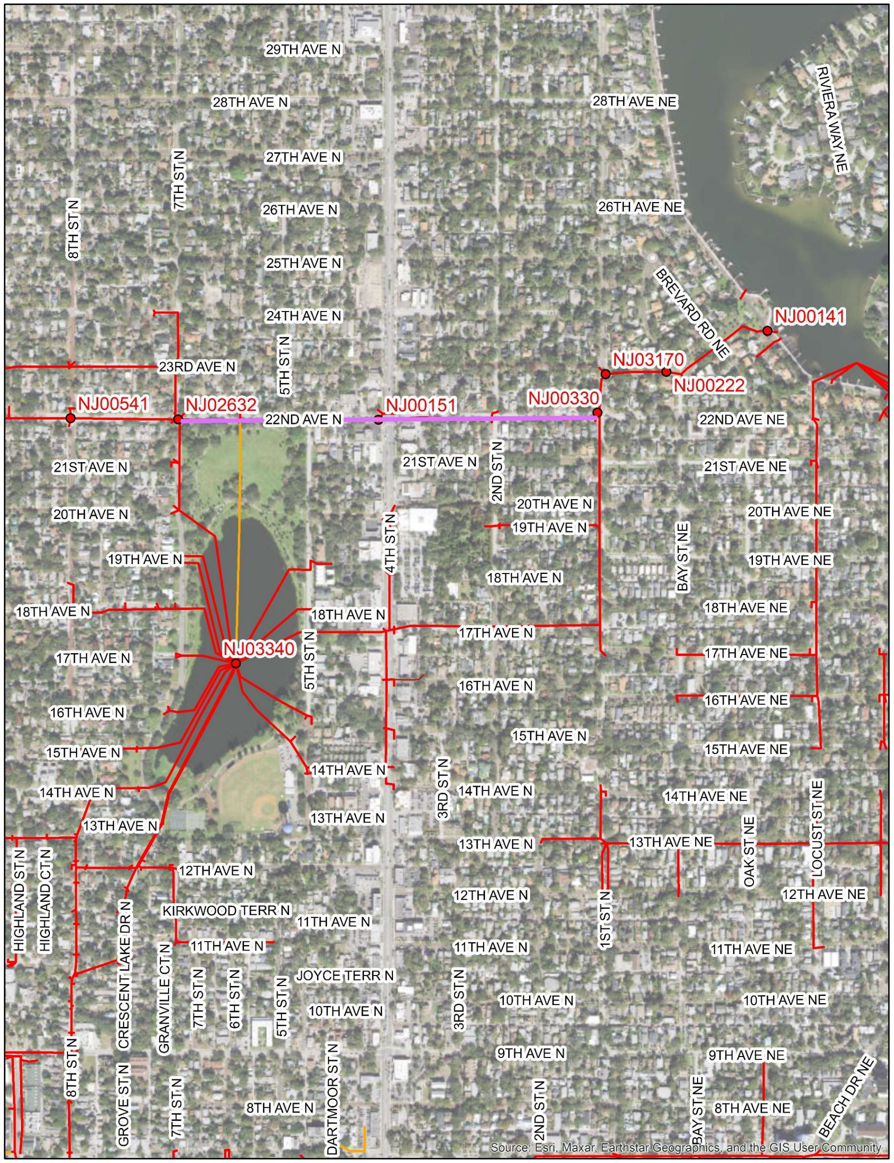
Estimated cost for this project is approximately $4,100,000 including planning, engineering, and permitting fees with 30% contingency. Project is proposed to address current LOS deficiencies.

Crescent Lake 22nd Ave Smart Box - Project No. G2-6 (continued)



PROJECT G2-6

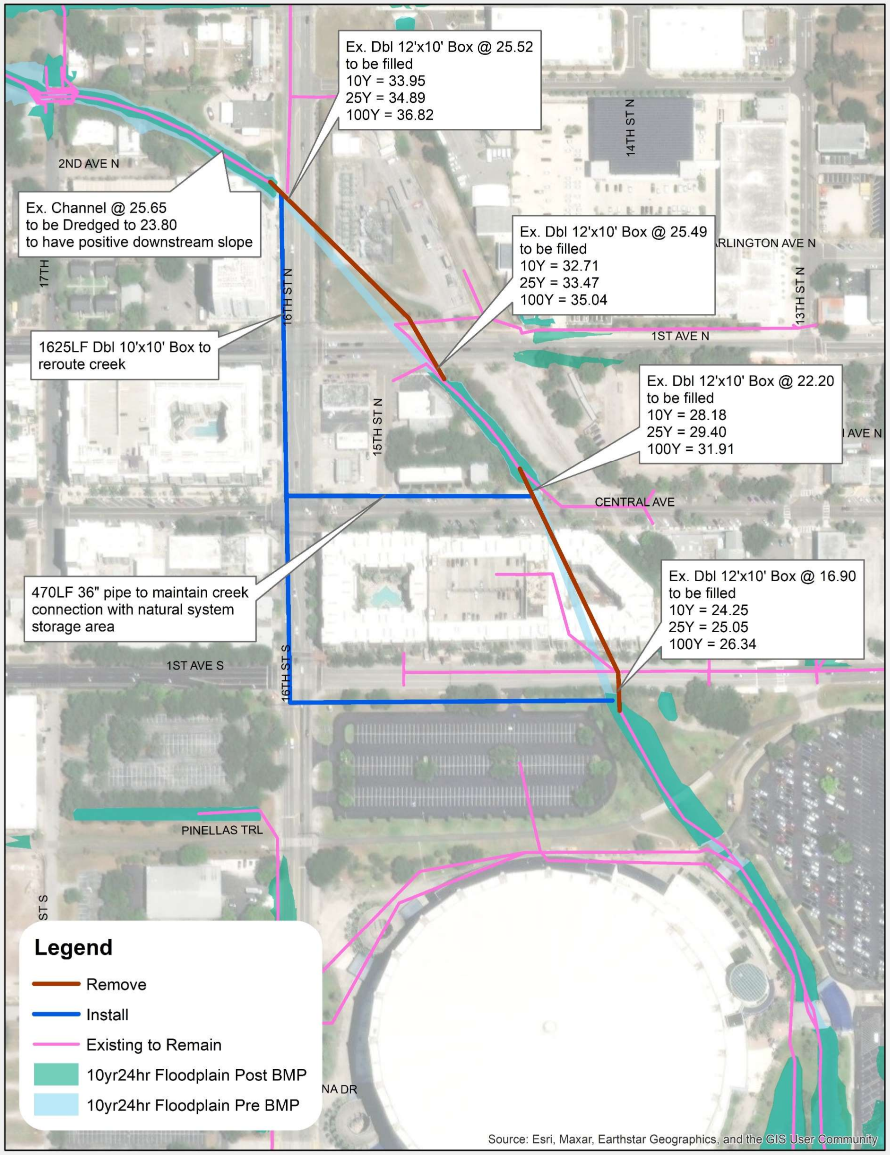
Crescent Lake 22nd Ave Smart Box - Project No. G2-6 (continued)



PROJECT G2-6

Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NJ03340	Crescent Lake	15.7	25.05	24.07	-0.98	28.14	27.32	-0.82
NJ02632	22nd Ave & 7th St	25.4	36.39	36.49	0.10	37.23	37.11	-0.12
NJ00541	22nd Ave & 8th St	35.11	40.22	40.32	0.10	41.90	41.83	-0.07
NJ00301	23rd Ave & 7th St	34.55	41.81	41.82	0.01	42.16	42.15	-0.01
NJ00151	22nd Ave & 4th St	12.86	27.47	21.94	-5.53	29.43	25.37	-4.06
NJ00330	22nd Ave & 1st St	9.96	15.30	15.35	0.05	15.39	15.41	0.02
NJ03170	23rd Ave & 1st St	5.33	13.77	14.86	1.09	14.57	15.15	0.58
NJ00222	23rd Ave & Bay St	3.97	10.74	11.41	0.67	11.32	11.69	0.37
NJ00141	23rd Ave & Coffee Pot Blvd	1.02	2.95	3.10	0.15	3.13	3.17	0.04

Booker Creek Box Culvert Reroute - Project No. G3-1



Problem

Booker Creek currently has two underground double 12'x10' box culvert connections, one that spans between 16th Street and 1st Avenue North, and one that spans between Central Avenue and 1st Avenue South. Both of these culverts are in downtown St. Petersburg just north of Tropicana Field, and one of the connections passes under an existing apartment building complex. The City would like to change the route of the creek so that it is entirely contained within City property and can provide adequate hydraulic capacity for Booker Creek.

The existing model demonstrates a head drop of 9-10 feet between the upstream and downstream portions of these culverts. The 100-year floodplain is contained within the existing creek banks adjacent to the box culverts, but is outside of the banks upstream of the box culverts.

The existing underground connection under the apartment building complex would need to be either blocked at the north and south ends or filled in order to block the flow of water through this area. This connection is not a box culvert, but is a structurally-reinforced corridor through the first floor of the building that has been built to surround the original canal, which has sheet pile-reinforced sides and a rocky bottom.

There are significant utility lines that will need to be traversed with the box culverts, including a large water main along the south side of 1st Avenue South.

Solution & Project Benefits:

The proposed improvements would entail a double 10'x10' box culvert from north to south along 16th Street, which would then connect to a double 10'x10' box culvert from west to east along the south side of 1st Avenue South to outlet into the existing Booker Creek just north of Tropicana Field. The extents of the proposed box culvert have been designed to be entirely within property owned by either the City or the County (e.g., road right of way). The total length of the proposed box culvert would be approximately 1,625 linear feet. The box culvert would be installed at an approximate 15 to 25 feet depth below the existing roadway surface, which would provide 4 to 14 feet of cover above the culvert. The slope would be maintained to match the upstream and downstream inverts.

The existing pipes convey a peak flow of 1,790 CFS and 2,340 CFS during the 25-year and 100-year storm events. The proposed pipes would convey 1,800 CFS and 2,380 CFS during these same storm events. The upstream peak stage would be lowered by approximately 5 feet in both the 25-year and 100-year storm events. This decrease would ease upstream bank overtopping during large storm events. The downstream peak stage would be maintained within 0.1 feet of the existing peak stage for both the 25-year and 100-year storm events.

Additional construction activities would be to dredge the channel immediately upstream of the proposed box culverts, which is approximately 2 feet higher than the existing box culvert invert elevation, and construction of a 36-inch pipe along Central Avenue to preserve the hydraulic connection to the natural creek portion between 1st Avenue North and Central Avenue. Not only is this portion a natural storage system, it also serves as an existing discharge point for the roadway drainage systems along 1st Avenue North and Central Avenue.

Construction of the project would cause significant traffic impacts along 16th Street, a four-lane roadway, and at the intersection with 1st Avenue North, Central Avenue and 1st Avenue South, which are all two-lane roadways. This project also abuts the proposed Historic Gas Plant District project, which will be built along the south side of 1st Avenue South, and it is also where the existing Pinellas Trail is located.

This solution will remove approximately 286 feet of roadway from the 10-year floodplain.

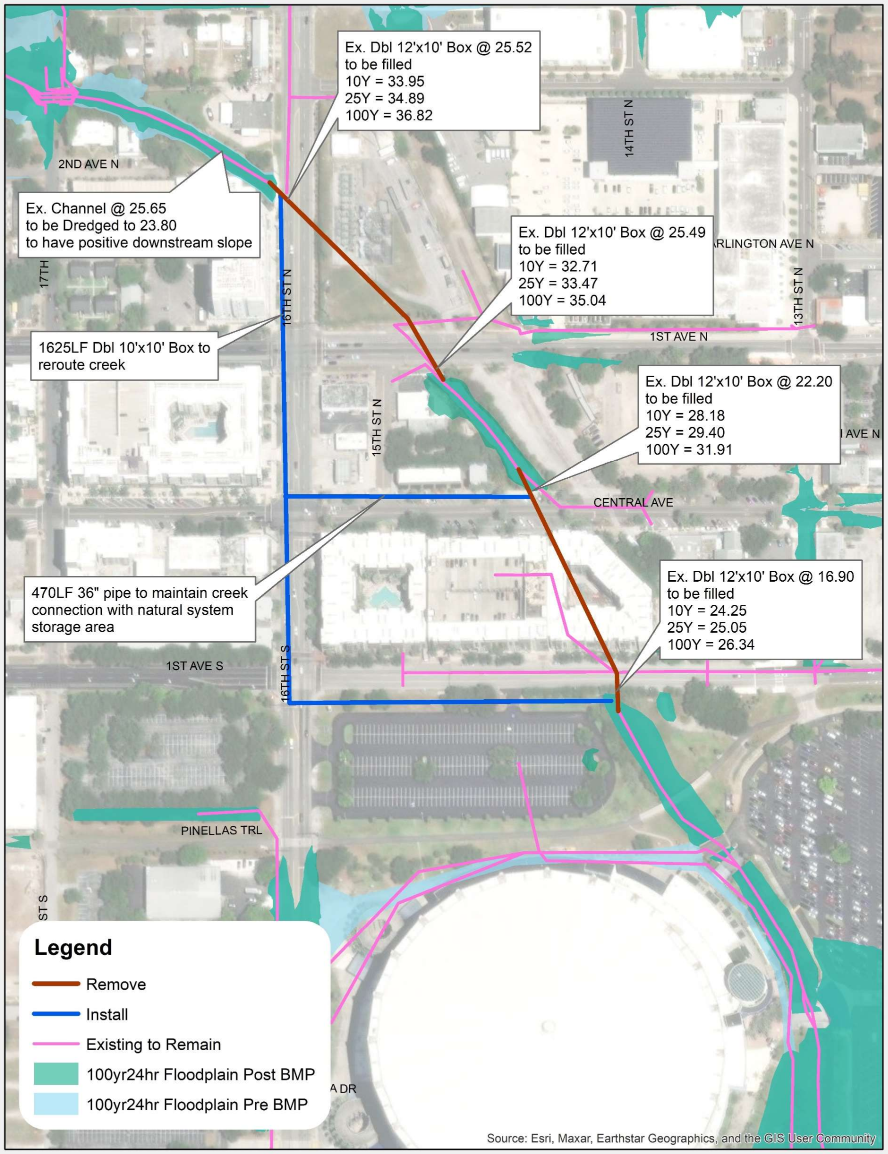
Existing double box culverts at Central Ave entrance

Existing double box culverts at 1st Avenue South

Estimated Cost:

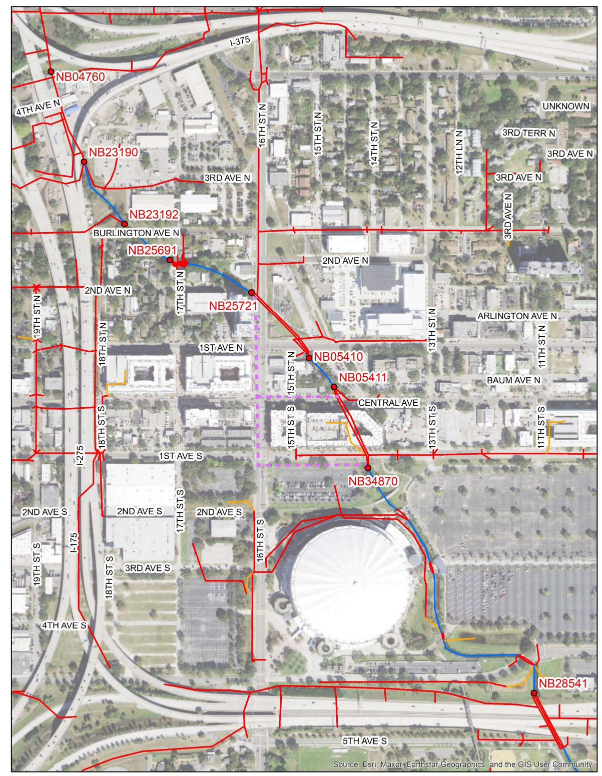
Estimated cost for this project is approximately $21,960,000 including planning, engineering, and permitting fees..

Booker Creek Box Culvert Reroute - Project No. G3-1 (continued)

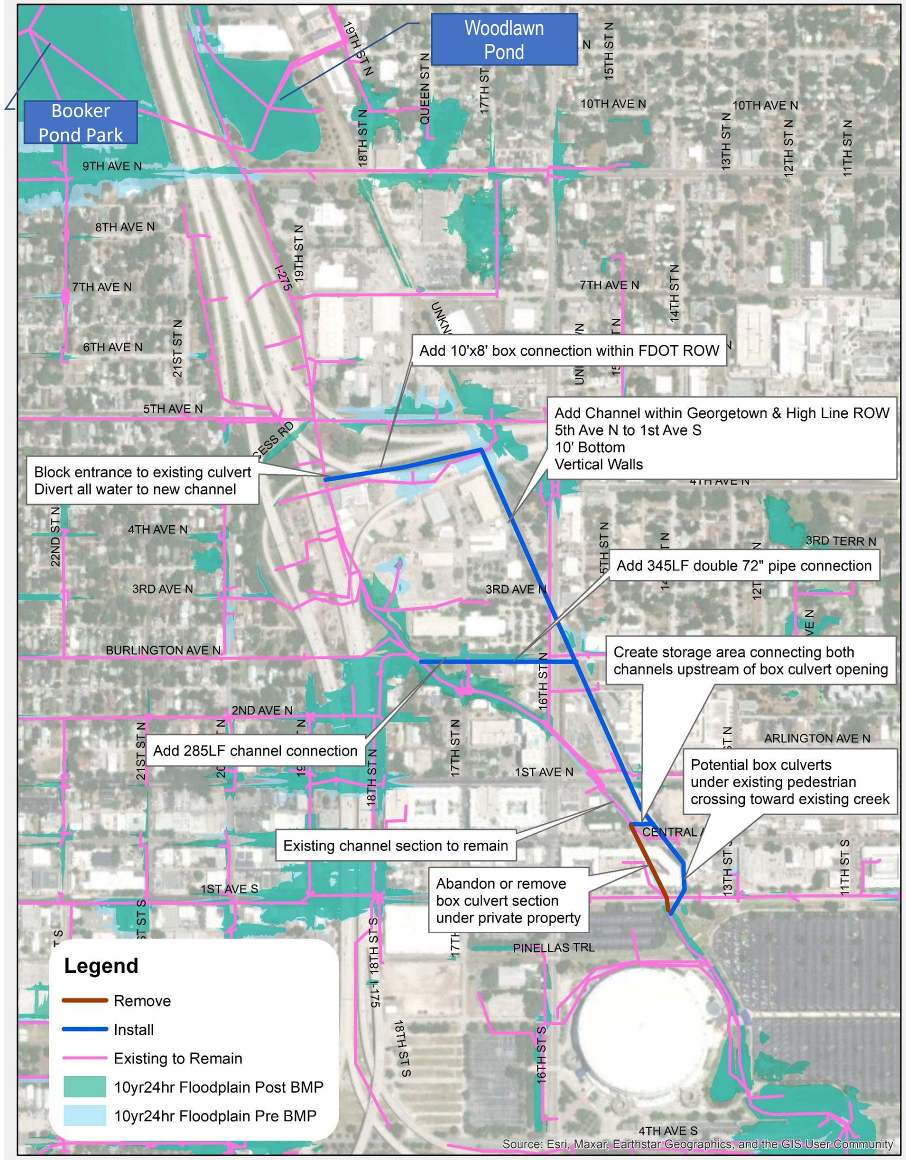


PROJECT G3-1

Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	Top of Bank
NB04760	I-375	28.48	37.82	37.10	-0.72	40.99	40.53	-0.46	39.0
NB23190	Water Resources Bldg	28.32	36.28	34.81	-1.47	39.42	38.68	-0.74	38.0
NB23192	Burlington Ave Bridge	26.23	36.12	34.43	-1.69	39.30	38.52	-0.78	38.0
NB25691	17th St Bridge	26.21	35.90	34.04	-1.86	39.16	38.26	-0.90	37.0
NB25721	16th St Bridge	25.79	33.54	30.68	-2.86	36.17	33.68	-2.49	38.0
NB05410	1st Ave N	25.5	29.58	31.45	1.87	32.44	36.77	4.33	42.0
NB05411	Central Ave	22.34	28.52	31.43	2.91	32.00	36.76	4.76	42.0
NB34870	1st Ave S	17.26	24.46	24.71	0.25	26.44	26.57	0.13	32.0
NB28541	I-175	7.39	18.77	18.97	0.20	21.87	21.95	0.08	20.0



Booker Creek Rail Easement Bypass - Project No. G3-2



PROJECT G3-2

Problem

Booker Creek between Booker Pond Park and Tropicana Field currently has three long box culvert sections with the first at a size of 10'x9', and the next two sections at a size of double 12'x10' box culverts. Much of these culverts lie within FDOT or private right-of-way and are difficult to access and maintain, and the 10'x9' box culvert appears to be undersized, which is creating flooding within Booker Pond Park and adjoining areas.

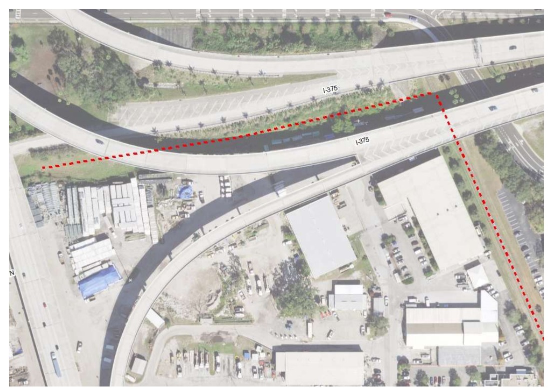
The estimated top-of-bank elevation of Booker Pond is at elevation ±44 feet. The existing 100-year flood elevation for this pond is 44.26 feet, and the 10-year flood elevation is 42.36 feet. The estimated top-of-bank elevation of Woodlawn Pond is at elevation ±43 feet. The existing 100-Year flood elevation for this pond is 44.16 feet, and the 10-Year flood elevation is 42.31 feet.

Solution & Project Benefits:

One solution to the undersized box culvert could be to route a large portion of the flow to the railway corridor to the east, which is not currently being utilized. CSX owns the railway north of 5th Ave N. The Georgetown and High Line Railway (apparently a CSX holding company) owns the railway between 5th Ave N and 1st Ave S, and this portion is currently inaccessible to rail traffic, with a portion of the right-of-way being used for parking and a portion used by Ferg's Sports Bar including the St Pete Axe & Ale bar. The right-of-way of this corridor ranges from 60 to 75 feet in width.

The corridor width is sufficient to accommodate both a channel, such as a 10 foot width sheet pile wall channel, and additional amenities such as biking paths and linear park features. The FDOT is currently reviewing ways to address stormwater management in this area for the I-275 expansion.
This new channel would provide a high flow bypass the existing box culverts and reduce flood levels around the lakes and along the current box culvert route.

Coordination with the FDOT and the railway companies (including land acquisition or drainage easements) would be required.



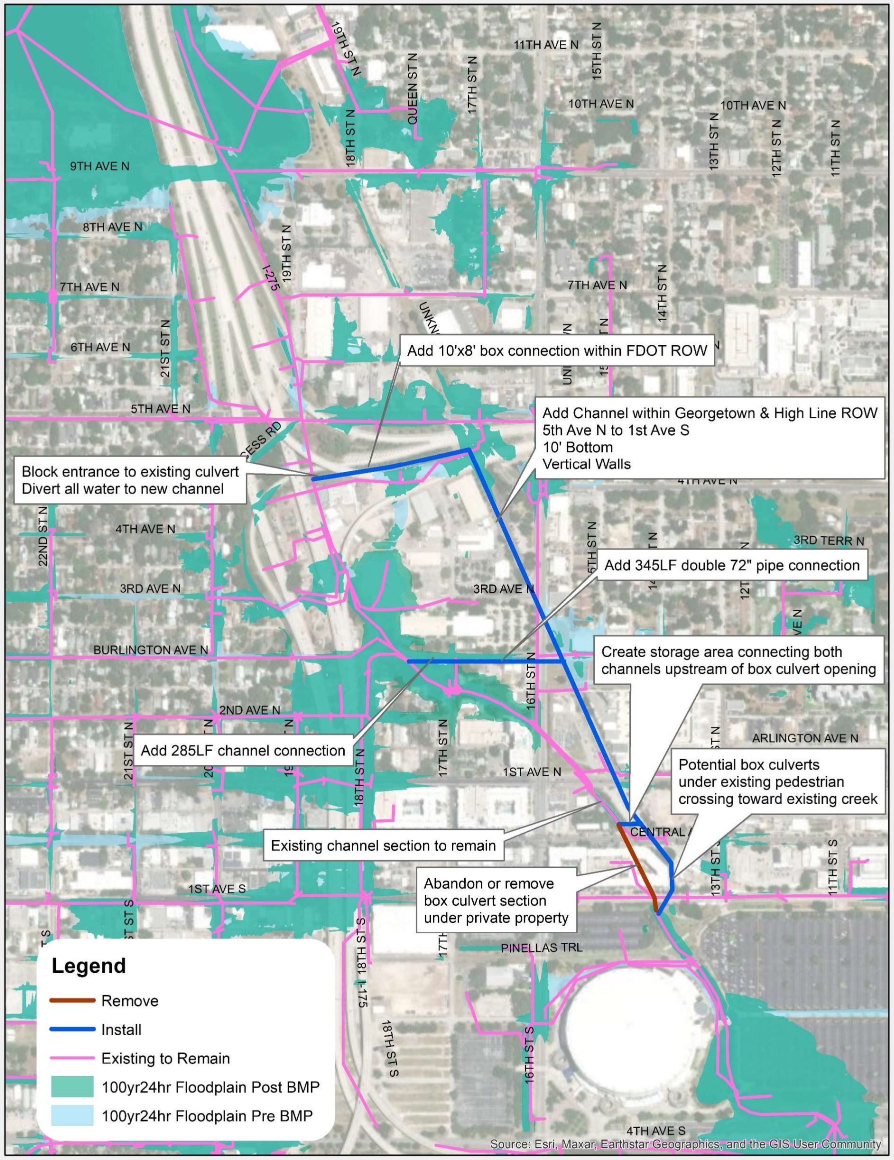
Proposed route of channel connection through FDOT ROW

Railway corridor between Central Ave and 1st Ave S

Estimated Cost:

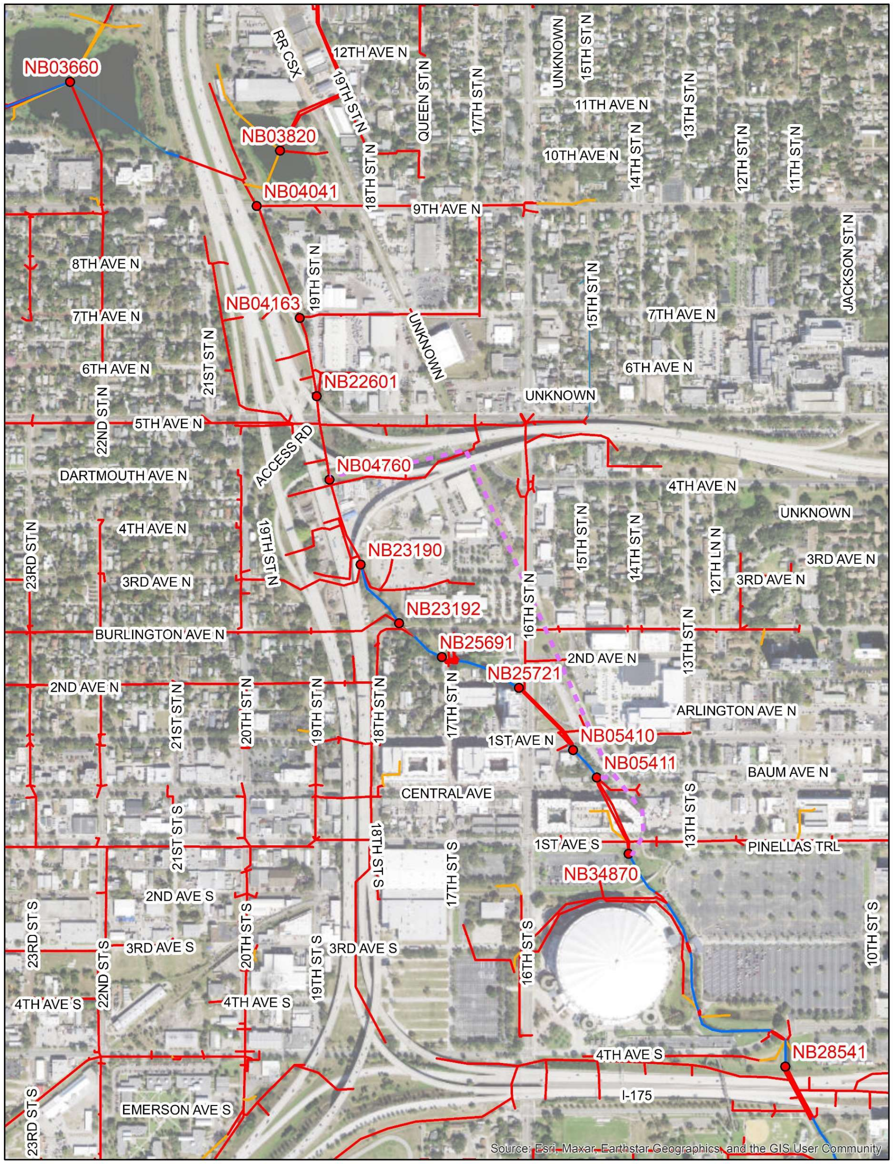
Estimated cost for this project is approximately $20,515,000 including planning, engineering, and permitting fees..

Booker Creek Rail Easement Bypass - Project No. G3-2 (continued)



PROJECT G3-2

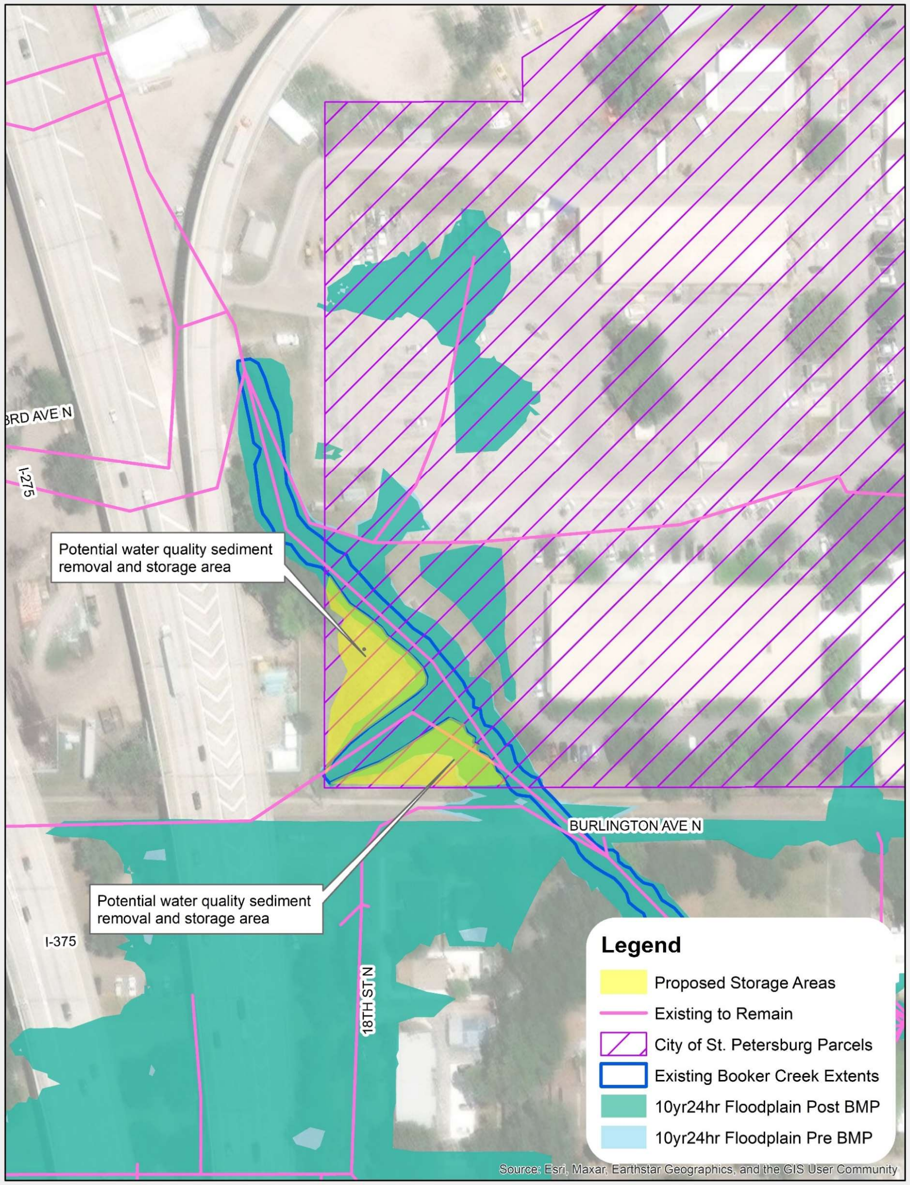
Booker Creek Rail Easement Bypass - Project No. G3-2 (continued)



PROJECT G3-2

Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ
NB03660	Booker Pond	29.42	42.36	41.93	-0.43	44.26	43.50	-0.76
NB03820	Pond	31.47	42.31	41.83	-0.48	44.16	43.40	-0.76
NB04041	9th Ave N	29.19	41.95	41.01	-0.94	44.11	43.30	-0.81
NB04163	7th Ave N	28.82	40.49	38.82	-1.67	44.01	43.07	-0.94
NB22601	5th Ave N	28.6	38.60	36.30	-2.30	41.87	39.32	-2.55
NB04760	I-375	28.48	37.82	37.47	-0.35	40.99	40.47	-0.52
NB23190	Water Resources Bldg	28.32	36.28	37.44	1.16	39.42	40.34	0.92
NB23192	Burlington Ave Bridge	26.23	36.12	37.42	1.30	39.30	40.31	1.01
NB25691	17th St Bridge	26.21	35.90	37.37	1.47	39.16	40.27	1.11
NB25721	16th St Bridge	25.79	33.54	36.73	3.19	36.17	39.66	3.49
NB05410	1st Ave N	25.5	29.58	26.84	-2.74	32.44	30.50	-1.94
NB05411	Central Ave	22.34	28.52	26.83	-1.69	32.00	30.40	-1.60
NB34870	1st Ave S	17.26	24.46	24.58	0.12	26.44	26.75	0.31
NB28541	I-175	7.39	18.77	18.81	0.04	21.87	22.00	0.13

Booker Creek Water Quality Detention - Project No. G3-3



Problem

There is City-owned land adjacent to Booker Creek at the point where it exits a 10'x9' box culvert along I-275 in the area between I-375 and Burlington Avenue, and before it flows southward under Burlington Avenue Bridge. This is adjacent to the City's Water Resources facility. Flows also enter Booker Creek at this point from the southwest via a 72-inch diameter pipe.

A large part of the flows coming out of the culvert are from untreated roadway runoff, and there is space along the creek here to provide water quality improvement through the use of a sediment sump or a contained removal device such as a hydrodynamic separator or baffle box. The design of a facility at this location will have to consider the locations of the existing water supply and reclaimed water lines that run through this area.

Solution & Project Benefits:

This is a water quality improvement BMP. Essentially no flood benefits are realized from this project due to the relatively small added storge volume.

The 100-year peak flows in the 10'x9' box culvert and the 72-inch pipe are 680 cfs and 275 cfs, respectively, and the 10-tear peak flows are 500 cfs and 250 cfs. Because of the large peak flows in this area, the sediment removal system would be best designed as an offline system that collects sediment primarily during small storm events, and allows flows from large storm events to bypass the devices in order to prevent any hydraulic impediments to the existing system.

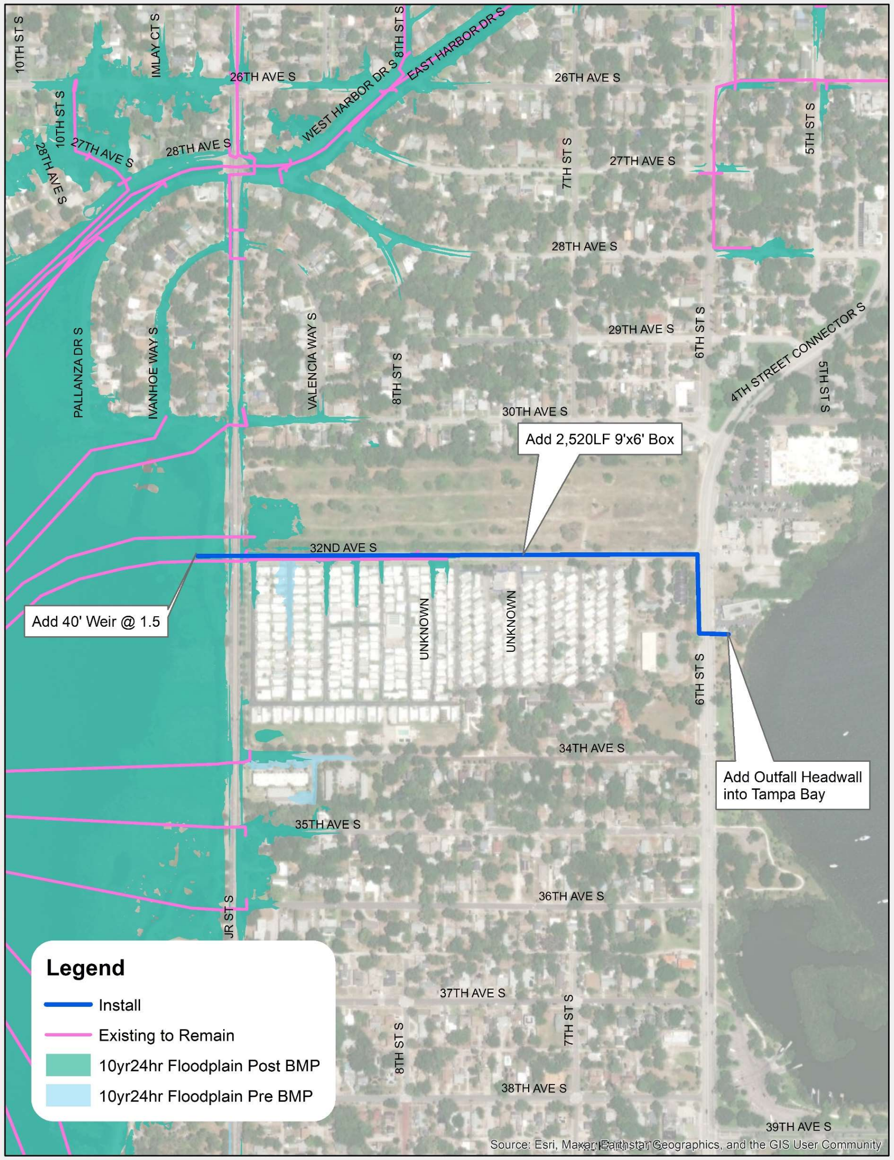
Further analysis will be required to determine the amount of nutrients and sediment in the runoff entering the system, and what technology will provide the greatest removal benefits at the lowest costs of installation and maintenance.

Aerial view of Booker Creek adjacent to Water Resources Facility

Estimated Cost:

Estimated cost for this project is approximately $50,000 to $500,000, depending on what technologies are selected.

Lake Maggiore East Outfall - Project No. G3-5



PROJECT G3-5

Problem

Salt Creek is the only outfall for the Lake Maggiore Watershed. It consists of a narrow channel, tidally influenced and meandering through residential, commercial, and light industrial neighborhoods, prior to discharging into Bayboro Harbor. About 80% of the basin of little over 3,400 Acres area discharges into Lake Maggiore. The lake covers an area close to 600 Acres and receives around 4,265 cfs of runoff during the peak of 100-year storm event. The Salt Creek Channel conveys 815 cfs during the 100-year design storm, while the rest of the runoff is attenuated in the Lake. These flow conditions are experienced with current mean high tide levels, and are expected to worsen with climatic changes. Model results indicate a reduced channel capacity decreases as the lake receiving 5,553 cfs by 2040 and 5,845 cfs by 2070, and 100-year flood stages increasing from 4.22 feet for today's conditions to 5.49 feet and 6.44 feet for the year 2040 and 2070, respectively. In addition to SLR, reduced infiltration is anticipated in the basin with rising groundwater conditions along the shoreline with higher intensity rainfalls. Salt Creek does not have the capacity to address current LOS conditions to further be considered for future improvements. Enhancing the Creek capacity will require acquisitions of neighborhoods and businesses surrounding the corridor. The socioeconomic impact of such proposal was deemed unacceptable; therefore, it was not studied further, and alternative outfall was considered to support the discharge need of the basin.

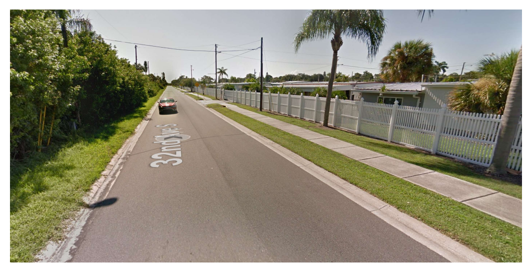
Solution & Project Benefits:

A proposed 6 feet by 9 feet CBC is to be installed along 32nd Avenue S, this is the shortest distance and the most feasible solution to convey an additional 294 cfs of flow to the bay, without conducting major widening of the Salt Creek. The proposed CBC flow will consist about 36% of the total discharge from the Lake to Salt Creek Channel (815 cfs). In turn, the cost to install the box culvert is much less than any additional creek widening projects that may require property acquisitions and environmental mitigations. The box culvert will be controlled by an outfall structure maintaining lake levels at 1.5 ft NAVD. The outfall control structure will be modified in the future to serve as the discharge point for a pump station to be placed at the lake, with an 8 feet of head differential , the box culvert has the capacity to convey 500 cfs from the Lake to the bay. Henceforth the discharge volume could be doubled with future improvements without the construction of a force main. Design consideration shall account for the receiving water body conditions, and environmental impacts associated with the project, more importantly the rate and velocity of discharge shall be further analyzed prior to expansion of the system with a future pumping station.

This solution will remove 3,281 feet of roadway from the 10-year floodplain and an estimated 7 structures from the 100-Year floodplain.

Estimated Cost:

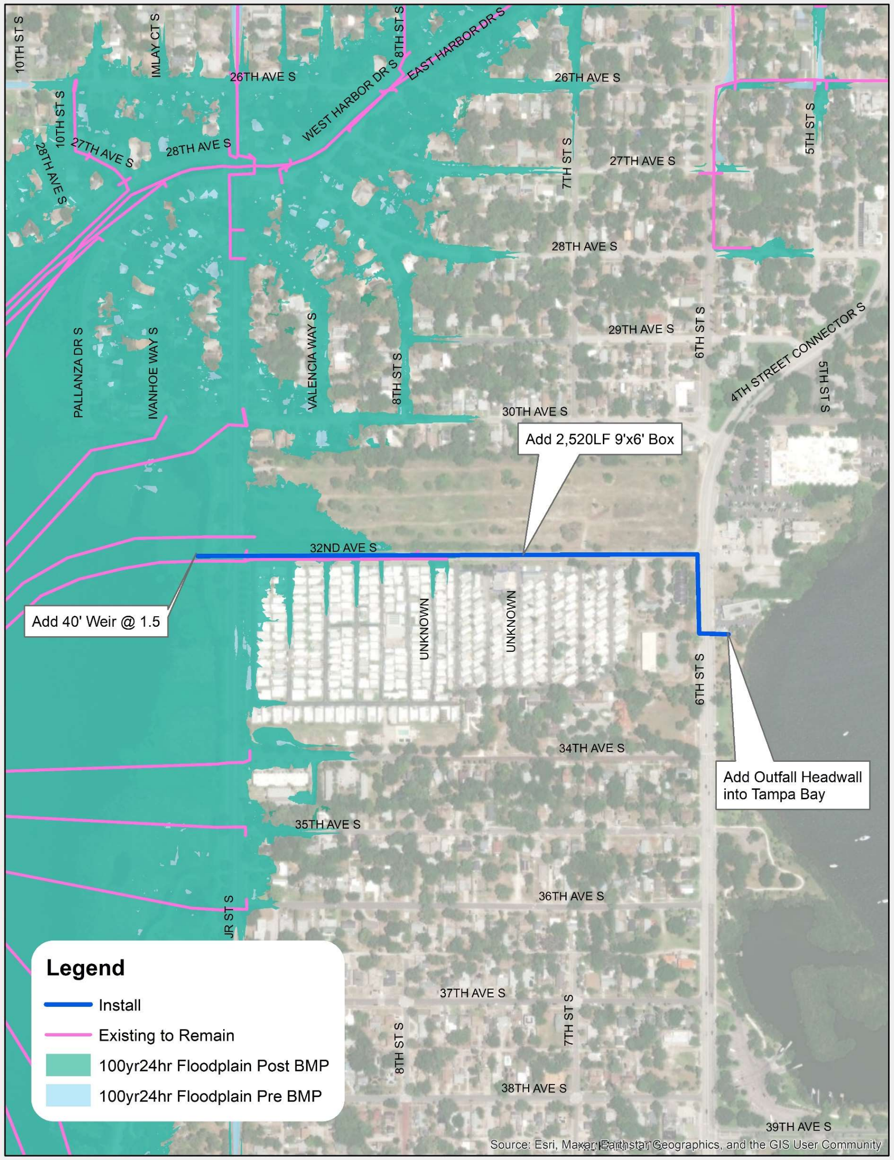
Estimated cost for this project is approximately $10,865,556 including planning, engineering, and permitting fees..



32nd Avenue S

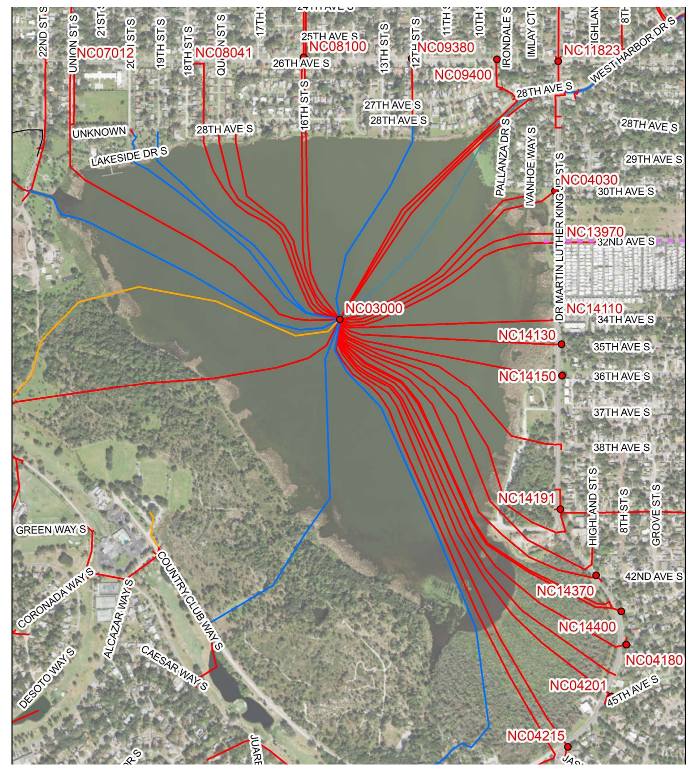
Potential Outfall at 6th Street S

Lake Maggiore East Outfall - Project No. G3-5 (continued)

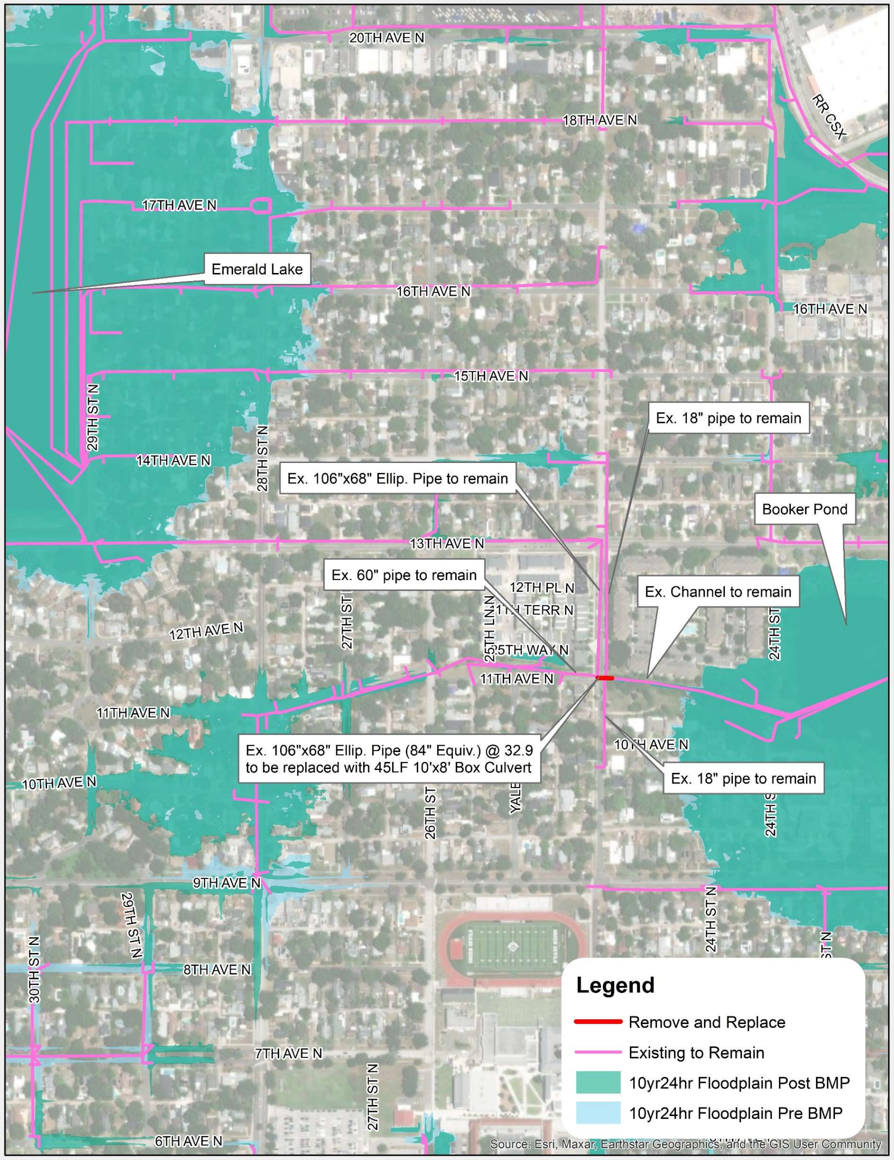


PROJECT G3-5

Node	Location Description	Initial Stage	10-Year			100-Year			EOP
			EX	PR	Δ	EX	PR	Δ	
NC03000	Lake Maggiore	1.00	3.86	3.65	-0.21	4.86	4.68	-0.18	
NC08041	26th Ave & 18th St	7.00	8.69	8.69	0.00	8.78	8.77	-0.01	11.0
NC09400	26th Ave & 10th St	1.00	4.18	4.18	0.00	4.81	4.63	-0.18	2.5
NC11823	26th Ave & MLK St	1.00	4.16	4.16	0.00	4.77	4.57	-0.20	3.5
NC04030	30th Ave & MLK St	1.00	3.86	3.66	-0.20	4.84	4.66	-0.18	3.0
NC13970	32nd Ave & MLK St	1.00	3.88	3.68	-0.20	4.85	4.68	-0.17	3.0
NC14110	34th Ave & MLK St	1.00	3.98	3.98	0.00	4.87	4.69	-0.18	2.5
NC14130	35th Ave & MLK St	1.36	4.19	4.19	0.00	4.87	4.70	-0.17	3.0
NC14150	36th Ave & MLK St	1.00	4.31	4.31	0.00	4.88	4.70	-0.18	3.0
NC14191	40th Ave & MLK St	1.00	3.89	3.69	-0.20	4.87	4.70	-0.17	3.0
NC14370	42nd Ave & MLK St	1.00	3.87	3.67	-0.20	4.87	4.69	-0.18	2.0
NC14400	Alamanda Way & MLK St	1.00	3.87	3.66	-0.21	4.87	4.69	-0.18	2.6
NC04180	Bayou Blvd & MLK St	1.00	3.87	3.67	-0.20	4.87	4.70	-0.17	3.0
NC04201	45th Ave & MLK St	1.00	4.22	4.22	0.00	4.91	4.75	-0.16	4.0
NC04215	Country Club Way & MLK St	1.00	3.92	3.71	-0.21	4.96	4.84	-0.12	4.0



Emerald Lake Outfall into Booker Pond - Project No. G3-6



PROJECT G3-6

Problem

Emerald Lake sits at the northern end of the Booker Creek system and sits in an area of isolated low topography. In order to discharge water toward Booker Pond to the southeast, the pond has to discharge into a pipe system that is higher than the pond initial stage. To assist with discharge of runoff into the pond, two existing pumps convey water at approximately 10 cfs each when the water elevation in the pond rises above the initial stage of 30 ft. However, the stormwater system downstream of the pump, which starts as a 72-inch equivalent pipe size and discharges into Booker Pond as an 84-inch equivalent pipe size, has a 100-Year peak stage approaching that of the pond, so that water pumped out of Emerald Lake returns back into the lake through the outlet pipe and over the banks of the pond. The capacity of this stormwater system to discharge into Booker Pond is limited, since Booker Pond also has extensive flooding during the 100-Year storm event, but the peak stage of the Booker Pond flooding is approximately 4 feet lower than the peak stage of Emerald Lake. Upon inspection of the stormwater system between Emerald Lake and Booker Pond, there is a confluence of two systems right before discharge into Booker Pond, one from Emerald Lake with an 84-inch equivalent pipe size, and one from the west with a 60-inch pipe size. The pipes to route the confluence of these flows into Booker Pond are only an 84-inch equivalent pipe size, and are therefore undersized to accommodate the flow from both of these systems.

Solution & Project Benefits:

The final 45 linear feet of 106"x68" (84" equivalent) pipe to discharge from the two stormwater systems into Booker Pond can be replaced with a 10'x8' box culvert in order to accommodate the larger combined flow from both of these systems. This will allow the system from Emerald Lake to have greater outflow, which will reduce the amount of flooding in this system and in Emerald Lake.

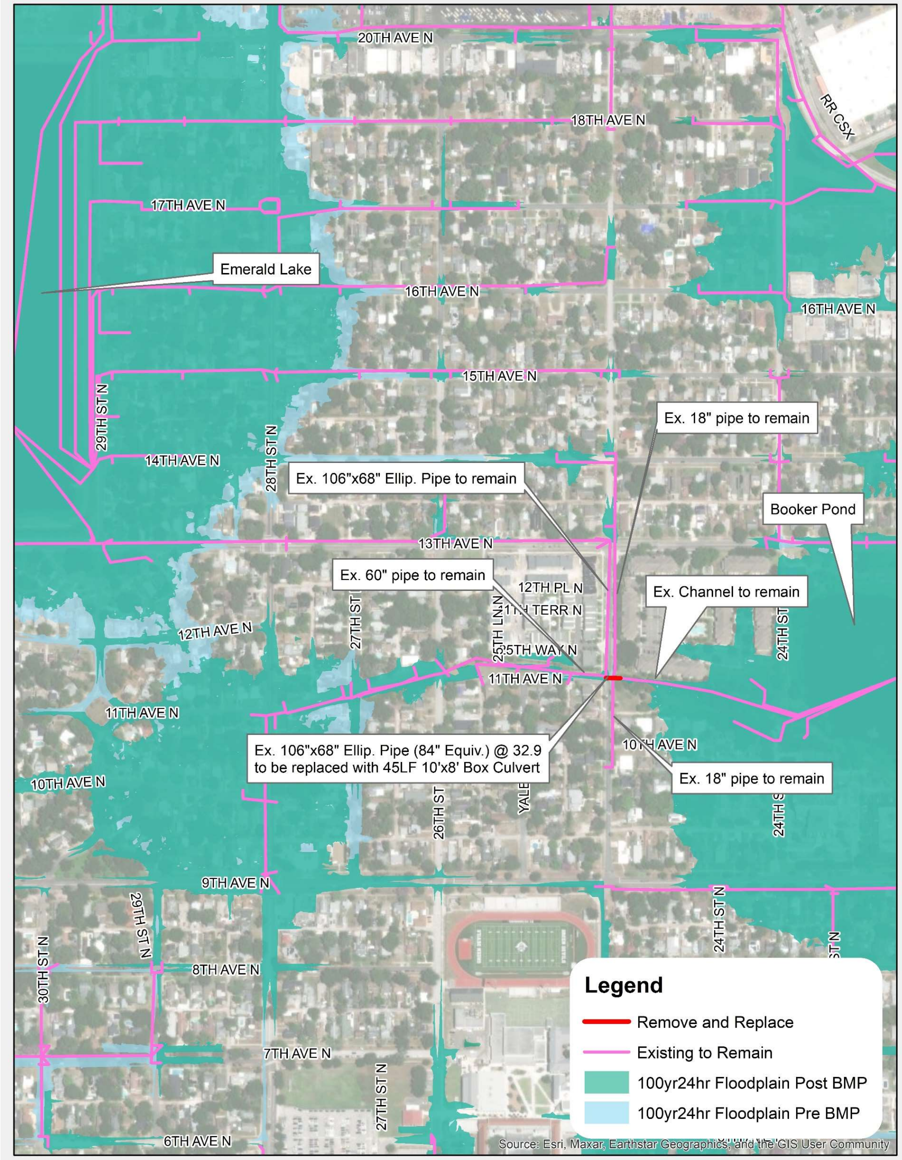
This solution will remove 71 feet of roadway from the 10-year floodplain and an estimated 19 homes from the 100-year floodplain of the 160 homes that are currently impacted by flooding.

Since the enlargement of the outfall pipes will increase flow into Booker Pond, the increase of peak stages within Booker Pond, which has a peak stage exceeding the pond banks during the 100-Year storm event, will need to be mitigated by a separate project either concurrent with or prior to this project in order to maintain or lower the Booker Pond floodplain and avoid adverse impacts.

Estimated Cost:

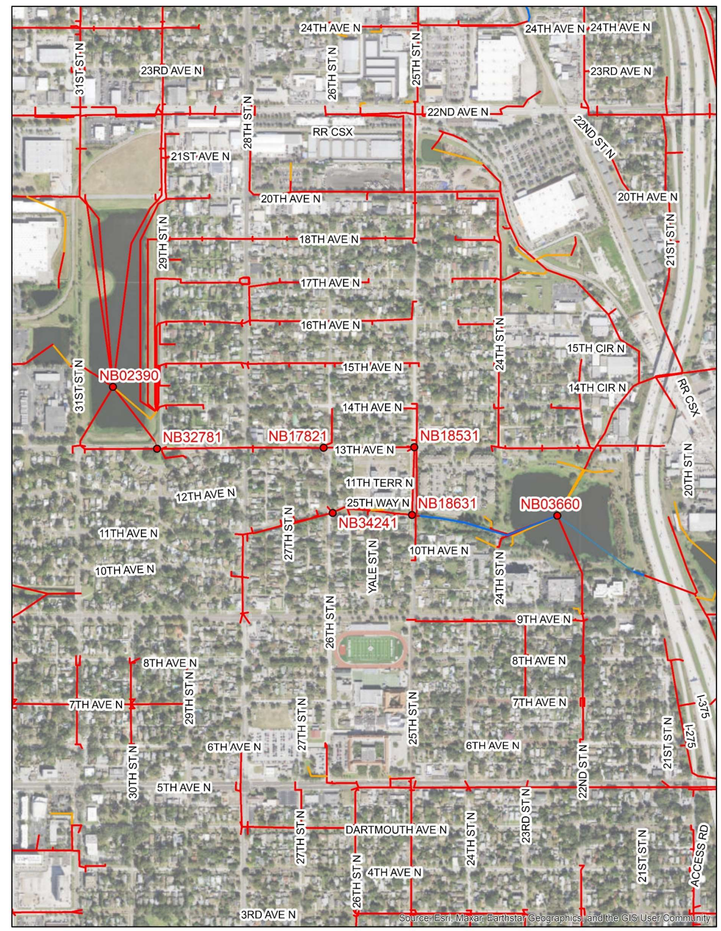
Estimated cost for this project is approximately $600,000 including planning, engineering, and permitting fees..

Emerald Lake Outfall into Booker Pond - Project No. G3-6 (continued)

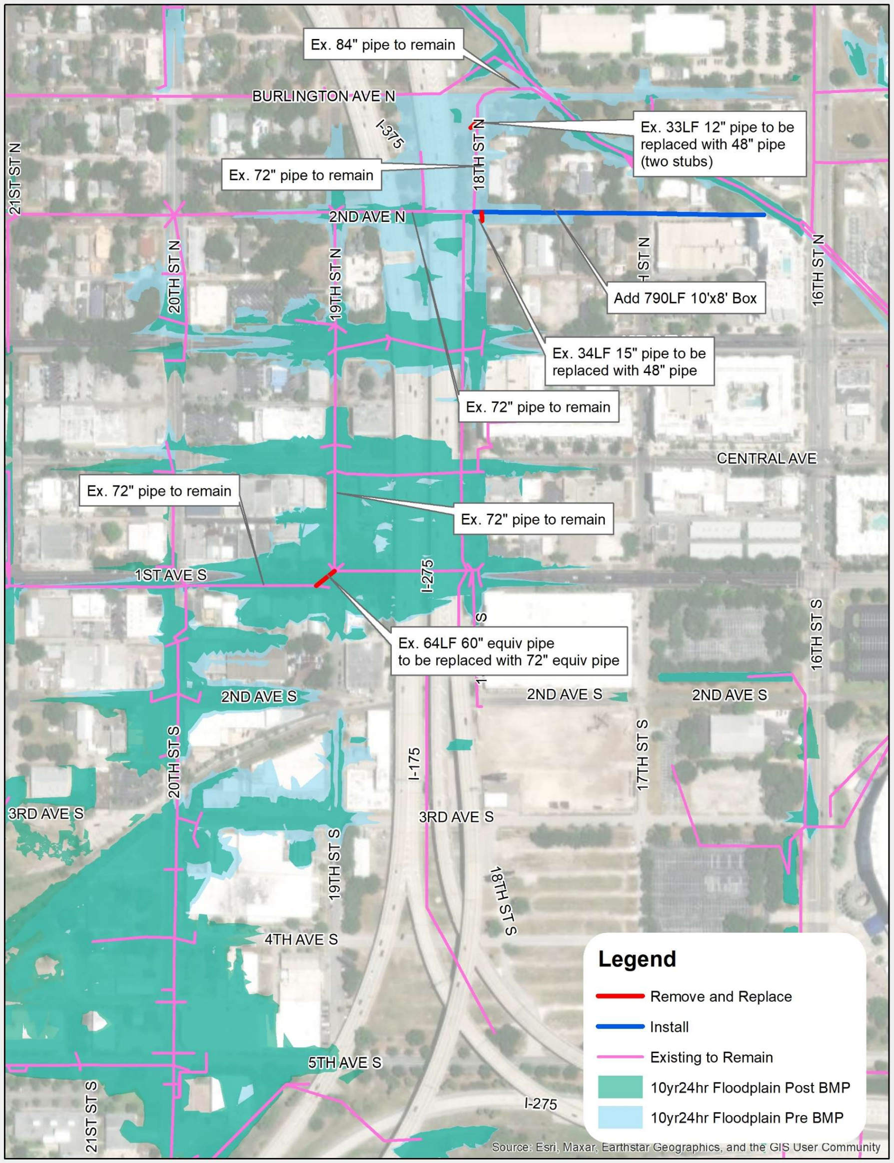


PROJECT G3-6

Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	TOB	EOP	FFE
NB02390	Emerald Lake	30.00	46.6	46.06	-0.54	48.27	47.88	-0.39	43	44	45
NB32781	13th Ave & 29th St	35.58	45.79	45.33	-0.46	47.74	47.22	-0.52	N/A	43	N/A
NB17821	13th Ave & 26th St	34.14	44.33	43.86	-0.47	46.6	45.86	-0.74	N/A	48.5	N/A
NB18531	13th Ave & 25th St	33.47	43.72	43.19	-0.53	46.08	45.24	-0.84	N/A	48	N/A
NB34241	11th Ave & 26th St	37.57	46.35	45.8	-0.55	47.59	47.40	-0.19	N/A	44.5	N/A
NB18631	11th Ave & 25th St	32.90	43.26	42.64	-0.62	45.66	44.72	-0.94	N/A	46	N/A
NB03660	Booker Pond	29.42	42.36	42.37	0.01	44.26	44.28	0.02	44	39	42



2nd Avenue Bypass Pipe - Project No. G3-7



PROJECT G3-7

Problem

The existing stormwater system, which has a main line that starts near 5th Avenue South and 20th Street and that discharges near the Burlington Avenue bridge over Booker Creek via an 84-inch pipe, has an undersized outfall and is limited by the Booker Creek peak stages at the outfall. Both of these factors cause water to back up in the system and widespread flooding in the area, both for houses and for roadways.

Solution & Project Benefits:

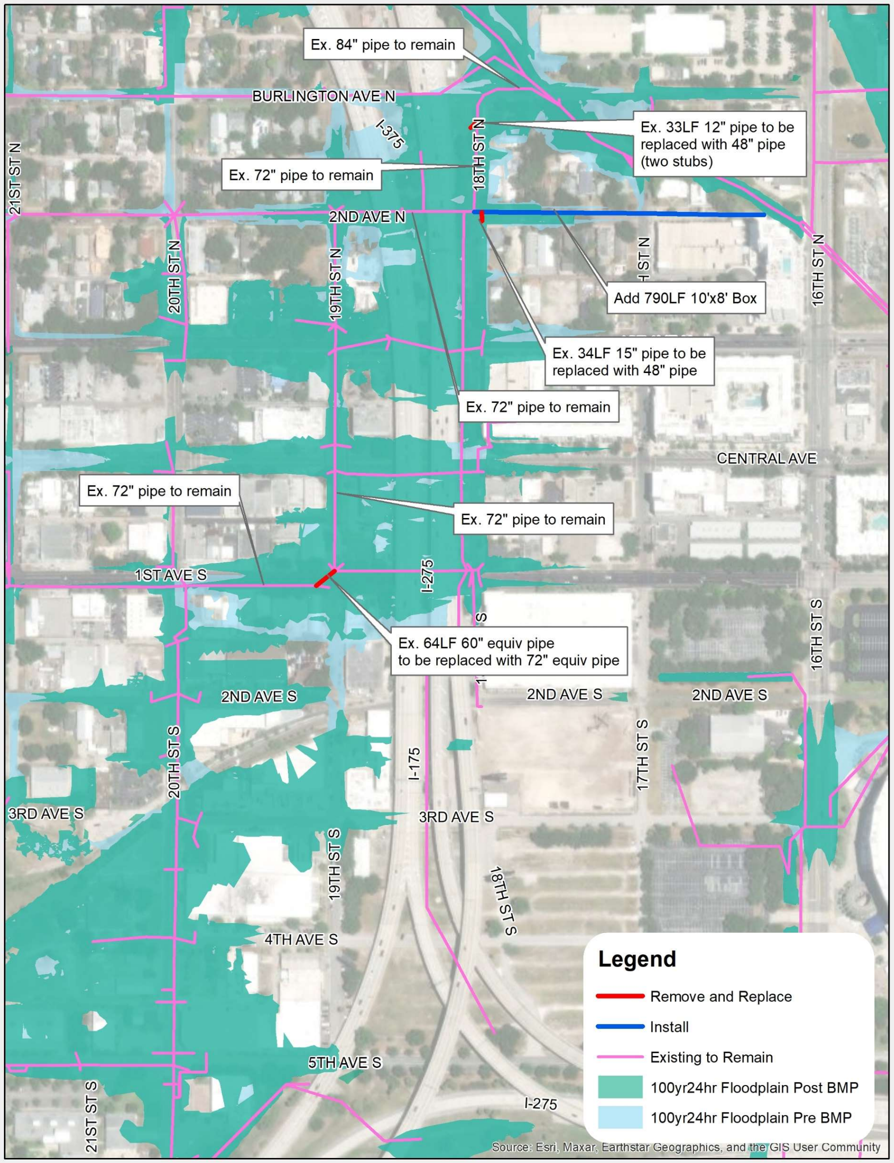
Adding an additional 10'x8' box culvert outfall along 2nd Avenue into Booker Creek will provide for a larger outfall capacity in the system, and will also discharge the system into a portion of Booker Creek with peak stages that are well below the hydraulic grade line within the stormwater system.

This solution will remove an estimated 3 structures from the 100-year floodplain.

Estimated Cost:

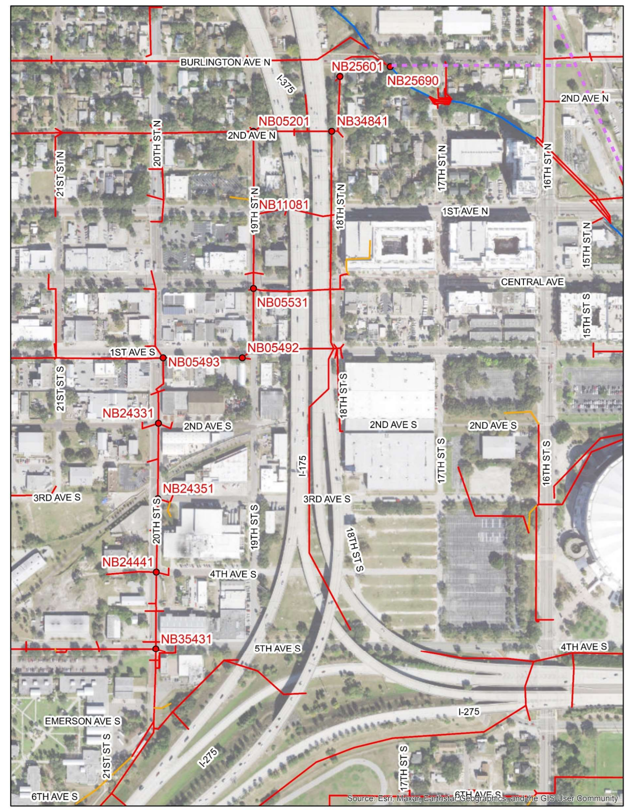
Estimated cost for this project is approximately $6.2 million including planning, engineering, and permitting fees..

2nd Avenue Bypass Pipe - Project No. G3-7 (continued)

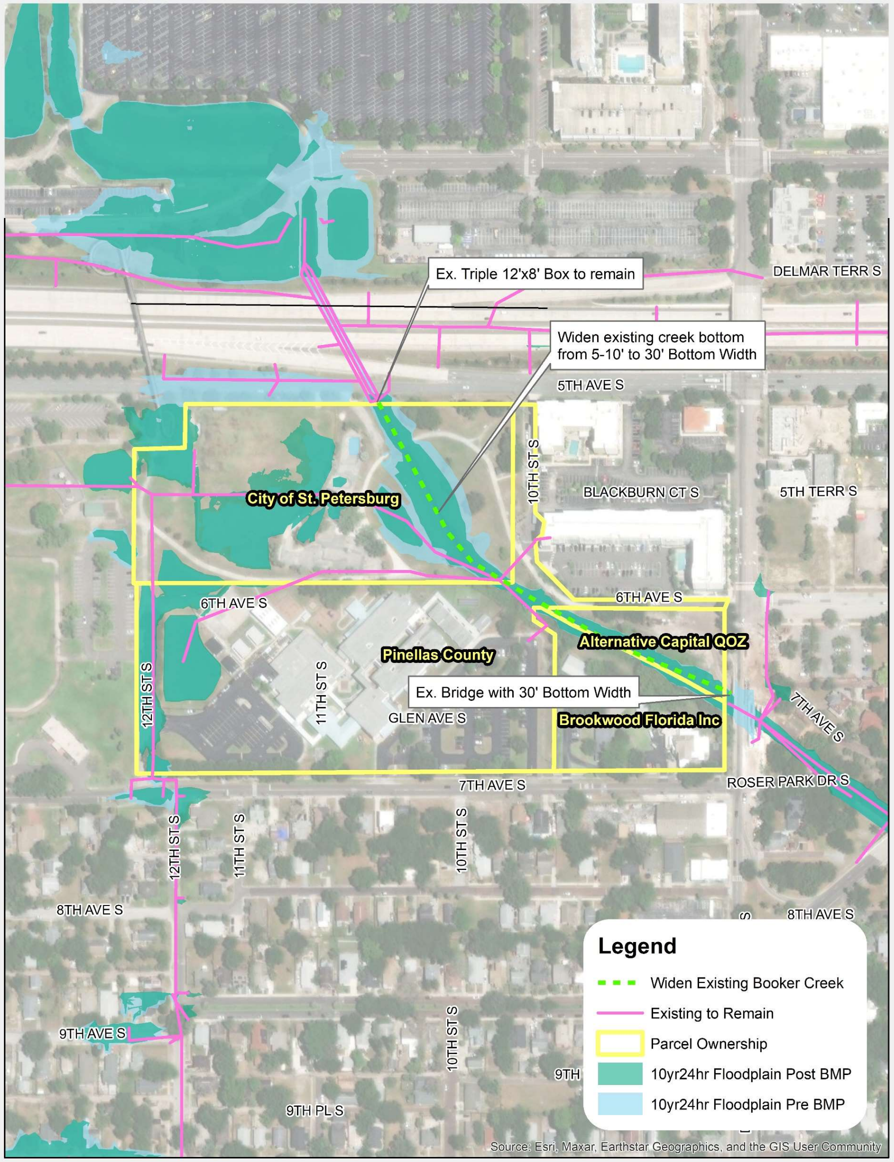


PROJECT G3-7

Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	EOP	TOB
NB35431	5th Ave S & 20th St	37.44	47.42	47.42	0.00	47.68	47.68	0.00	44.0	
NB24441	4th Ave S & 20th St	36.74	46.98	46.98	0.00	47.14	47.14	0.00	45.5	
NB24351	3rd Ave S & 20th St	36.36	46.34	46.33	-0.01	46.52	46.51	-0.01	45.0	
NB24331	2nd Ave S & 20th St	34.67	44.09	44.07	-0.02	44.43	44.41	-0.02	43.0	
NB05493	1st Ave S & 20th St	34.16	43.27	43.13	-0.14	43.55	43.45	-0.10	42.0	
NB05492	1st Ave S & 19th St	30.97	42.92	42.66	-0.26	43.26	43.08	-0.18	40.0	
NB05531	Central Ave & 19th St	30.12	42.34	42	-0.34	42.79	42.57	-0.22	40.5	
NB11081	1st Ave N & 19th St	29.03	41.61	40.63	-0.98	42.26	41.59	-0.67	39.0	
NB05201	2nd Ave N & 19th St	27.33	40.87	38.57	-2.30	41.75	40.4	-1.35	39.0	
NB34841	2nd Ave N & 18th St	27.33	39.27	35.9	-3.37	40.87	38.79	-2.08	39.0	
NB25601	Burlington Ave & 18th St	27.33	37.39	35	-2.39	39.92	38.86	-1.06	38.0	
NB23192	Booker Creek Burlington Ave Bridge	26.23	36.12	34.96	-1.16	39.3	38.43	-0.87		38.0
NB25721	Booker Creek 16th St Bridge	25.79	33.54	33.8	0.26	36.17	36.34	0.17		38.0



Campbell Park Creek Widening - Project No. G3-8



PROJECT G3-8

Problem

Booker Creek crosses under I-175 flowing southward just to the south of Tropicana Field and just to the north of the City-owned Campbell Park. Modeling shows that flooding is occurring within the I-175 roadway during the 100-Year storm event up to an estimated depth of 1.75 feet, which is caused by floodwaters backing up to the north of I-175.

The model data shows that there are currently three 12-foot by 8-foot box culverts conveying flow under I-175. Analysis of the system shows that these culverts are sufficient to carry the upstream flows during the 100-Year storm event, but that the portion of creek downstream of these culverts, which spans from I-175 to Dr. Martin Luther King Jr Street N, constricts to a width of approximately 5 feet and is of an insufficient size to convey the flow from the triple box culverts. It also appears that the invert of the channel through this portion is either flat or at a slightly upward slope, as the invert of the bridge under MLK Street is slightly higher than the invert of the culverts under I-175. The result of this is not only a limit to how much flow capacity can be conveyed along the creek, but also the build up of sediment and vegetation in the southeast of this portion of creek.

Downstream of this portion of the creek, to the east of MLK Street, is characterized by a creek with a water level that is much lower than the creek bank, and therefore there is capacity for the downstream to accept more inflow without causing any adverse flooding impacts.

Solution & Project Benefits:

Widening the bottom of this portion of the creek to 30-feet in order to more closely match the width of the I-175 box culverts opening of approximately 40 feet will increase flow conveyance between the I-175 and MLK Street crossings. Modeling of the 100-Year storm event with the 30-foot creek width shows that the peak stage of Booker Creek to the north of I-175 will be reduced from 21.75 ft in the existing condition to 19.95 ft in the proposed condition, which is below the estimated minimum shoulder elevation of 20.0 ft. As I-175 is a highway and an evacuation zone route, it is a matter of public safety to remove this roadway from the 100-Year floodplain.

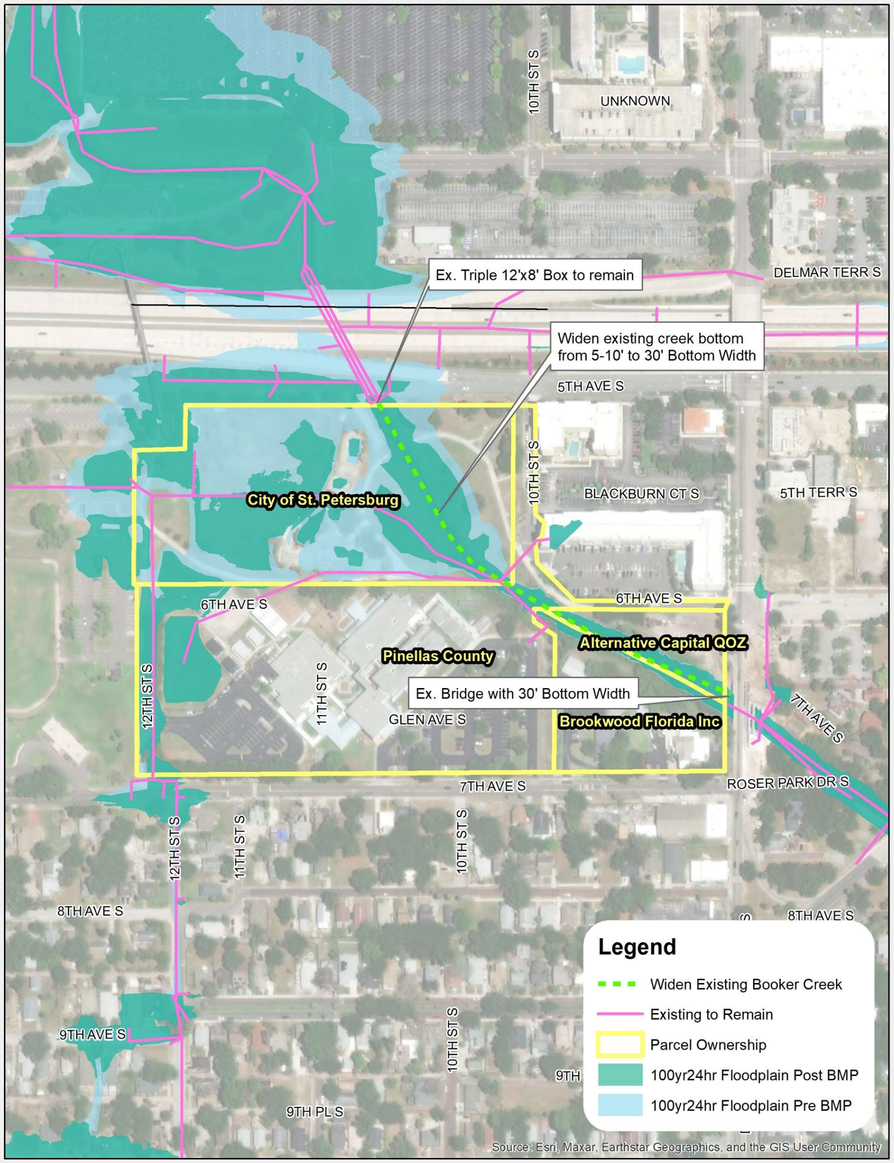
The creek portion within the proposed project crosses through four parcels. Campbell Park is owned by the City, Campbell Park Elementary School is owned by Pinellas County, and a portion of the creek has ownership by a Qualified Opportunity Zone Fund and by the Brookwood Florida social services organization. There do not appear to be any structures or roads that would impede the excavation and widening of the creek in this area.

This solution will remove approximately 250 feet of roadway from the 10-year floodplain.

Estimated Cost:

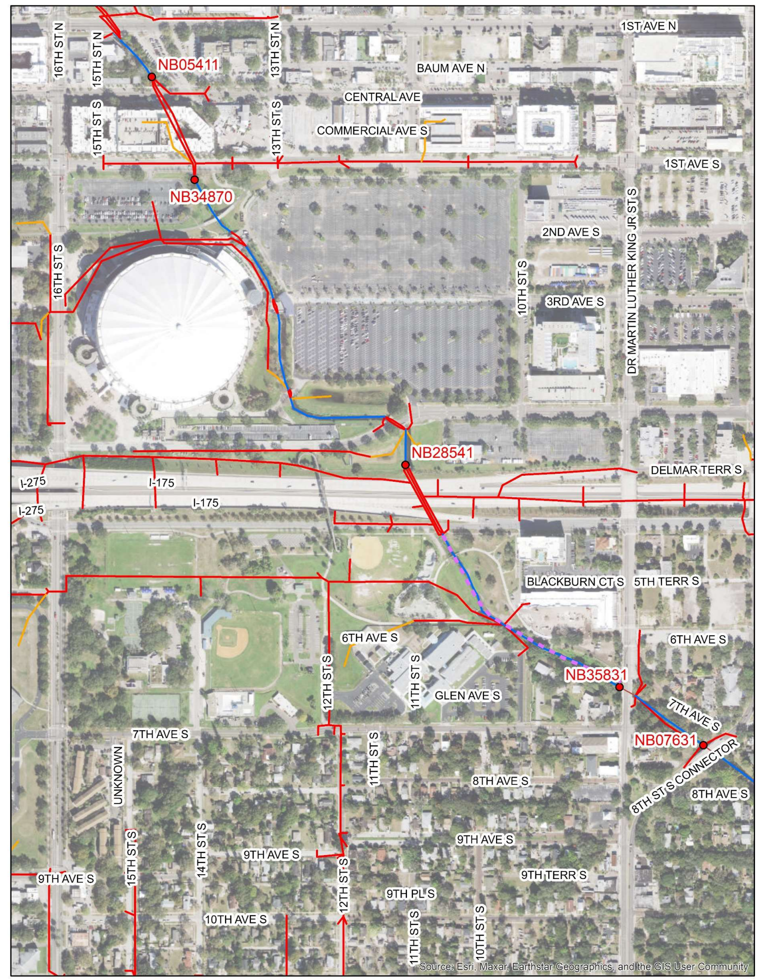
Estimated cost for this project is approximately $2.2 million including planning, engineering, and permitting fees.

Campbell Park Creek Widening - Project No. G3-8 (continued)

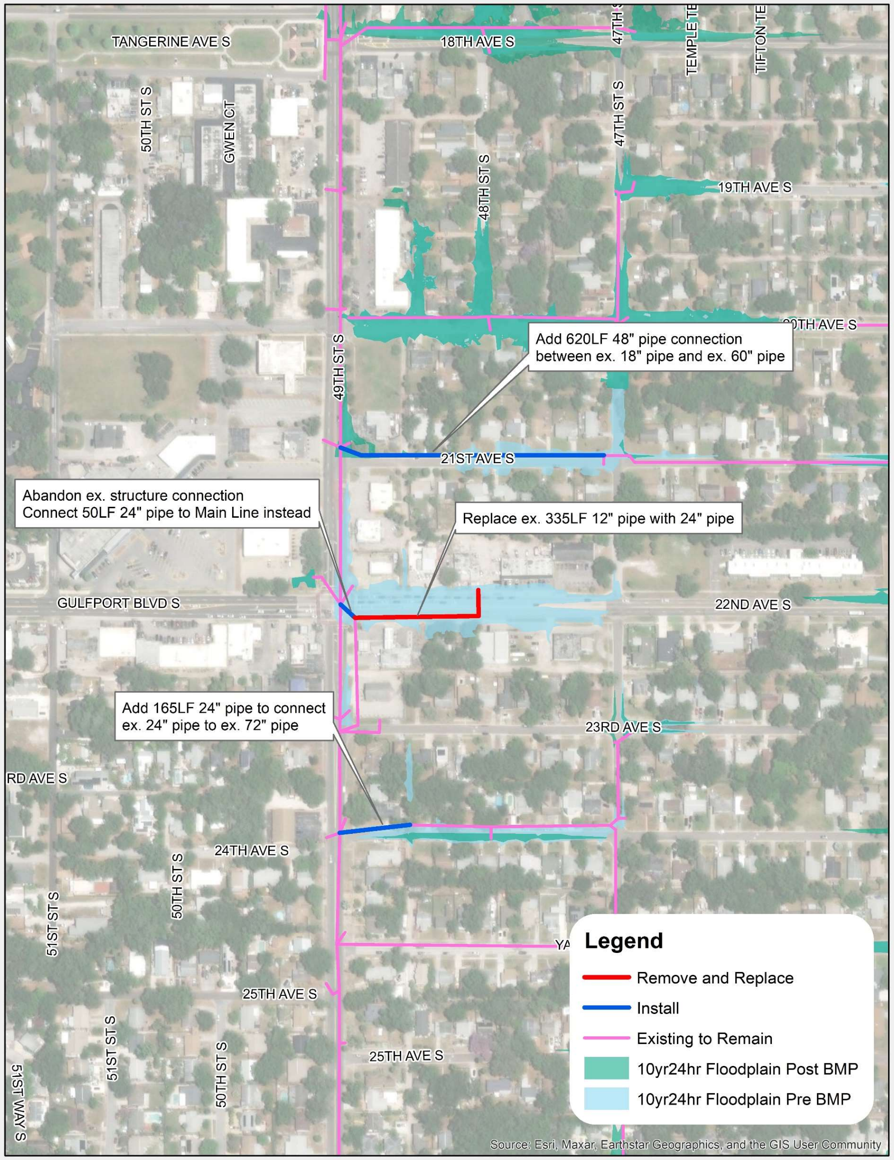


PROJECT G3-8

Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	Top of Bank	EOP
NB05411	Central Ave	22.34	28.53	28.53	0.00	32.01	32.00	-0.01	42.0	43.0
NB34870	1st Ave S	17.26	24.46	24.46	0.00	26.44	26.35	-0.09	32.0	40.0
NB28541	I-175	7.39	18.45	15.78	-2.67	21.75	19.95	-1.80	18.0	20.0
NB35831	MLK St	5.11	12.21	12.50	0.29	14.22	14.85	0.63	31.0	32.0
NB07631	8th St Connector	4.68	10.54	10.69	0.15	11.55	11.90	0.35	25.0	35.0



49th St Connection Pipes - Project No. G3-9



PROJECT G3-9

Problem

The existing pipes running north to south along 49th Street are the main line outfall for the stormwater system in this area, and eventually outfall to the Gulf of Mexico to the south. The pipe sizes in this main line increase from a 60-inch pipe to a 72-inch pipe, and then to a 10'x4' box. The peak stages in this main line are 3-5 feet lower than the peak stages in the contributing system along 21st Avenue, 22nd Avenue and 24th Avenue South.

The pipes in the contributing systems are, in some cases, undersized at a 12-inch pipe size, and can be more efficiently connected to the main line to reduce localized road flooding. The pipes along 21st Avenue currently connect to a system that runs down 46th Street into the Gulf. The pipes along 22nd Avenue and 24th Avenue currently connect to systems that discharge into the 49th Street main line farther to the south.

Solution & Project Benefits:

Three locations have been identified along 49th Street where additional pipe connections will cause improved stormwater hydraulic capacity.

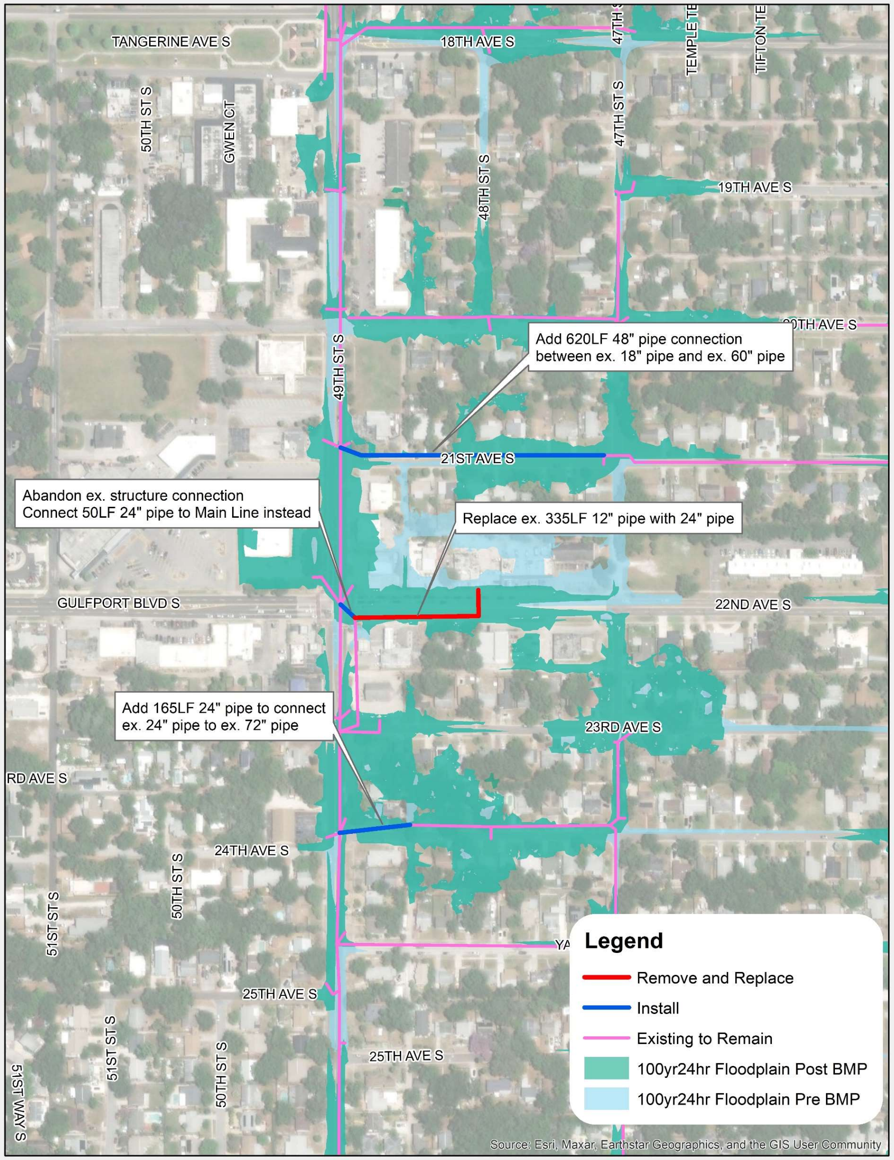
1. Along 21st Avenue South, the system to the east of 49th Street can be connected to the main line through a 620LF pipe connection
2. Along 22nd Avenue, the system to the east of 49th Street can be connected to the main line through a 50LF pipe connection.
3. Along 24th Avenue, the system to the east of 49th Street can be connected to the main line through a 165LF pipe connection.

This solution will remove approximately 1,639 feet of roadway from the 10-year floodplain.

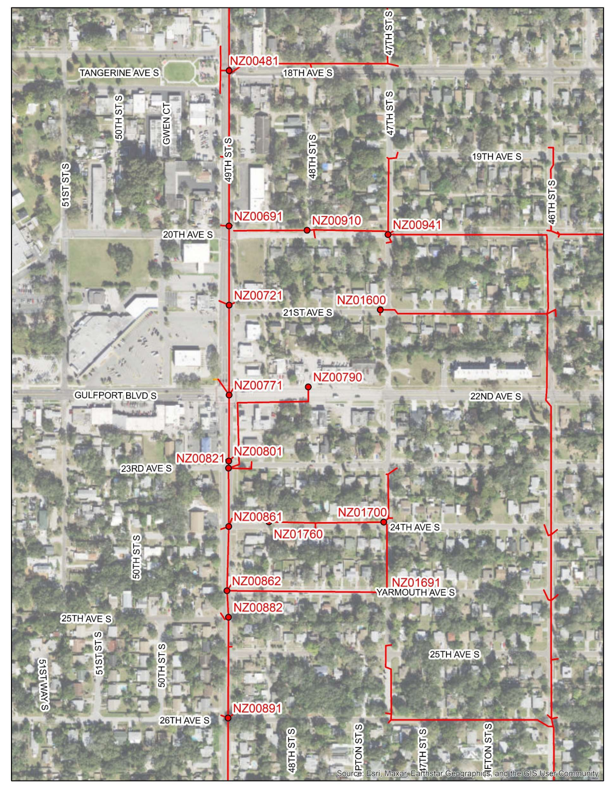
Estimated Cost:

Estimated cost for this project is approximately $2,172,000 including planning, engineering, and permitting fees..

49th St Connection Pipes - Project No. G3-9 (continued)



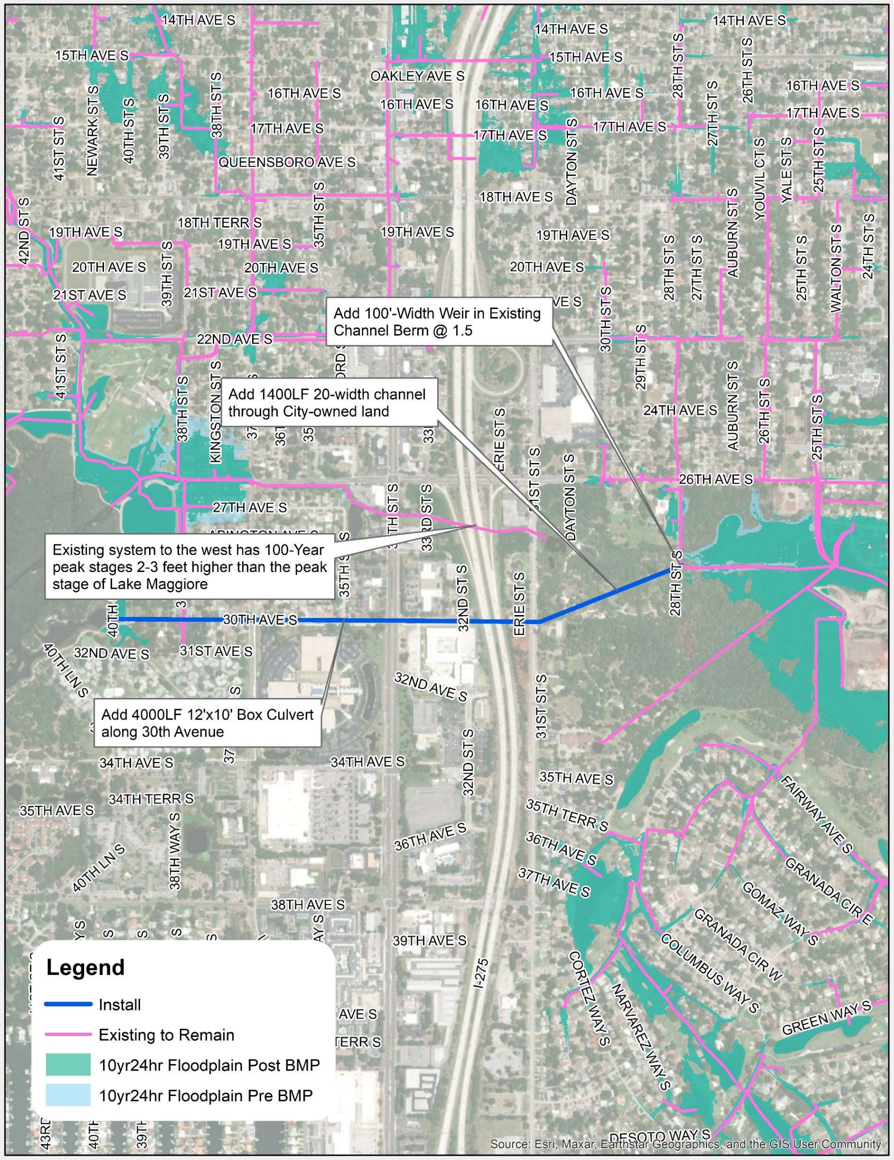
Node	Location Description	Initial Stage	10-Year			100-Year			EOP
			EX	PR	Δ	EX	PR	Δ	
NZ00481	49th St & 18th Ave	10.27	21.78	22.07	0.29	22.56	22.65	0.09	22.0
NZ00691	49th St & 20th Ave	5.43	17.97	19.01	1.04	19.88	20.58	0.70	20.0
NZ00721	49th St & 21st Ave	5.43	16.21	17.57	1.36	18.33	19.59	1.26	19.0
NZ01600	47th St & 21st Ave	16.32	19.96	18.70	-1.26	20.25	20.20	-0.05	19.0
NZ00771	49th St & 22nd Ave	5.81	13.62	13.92	0.30	15.99	17.33	1.34	16.0
NZ00790	48th St & 22nd Ave	15.71	18.62	16.35	-2.27	19.03	18.99	-0.04	17.0
NZ00801	49th St & 23rd Ave	4.23	12.95	12.74	-0.21	15.69	16.69	1.00	17.0
NZ00821	49th St & 23rd Ave	4.11	12.45	12.10	-0.35	15.43	16.24	0.81	17.0
NZ00861	49th St & 24th Ave	2.66	11.07	10.79	-0.28	14.54	15.32	0.78	16.0
NZ01760	48th St & 24th Ave	13.12	16.78	14.33	-2.45	17.40	17.34	-0.06	16.0
NZ01700	47th St & 24th Ave	11.81	16.71	15.60	-1.11	17.38	17.33	-0.05	16.0
NZ00862	49th St & Yarmouth Ave	1.74	9.90	9.64	-0.26	13.64	14.19	0.55	16.0
NZ01691	47th St & Yarmouth Ave	9.67	14.25	13.74	-0.51	15.05	15.04	-0.01	14.0
NZ00882	49th St & 25th Ave	1.42	8.83	8.60	-0.23	12.79	13.21	0.42	16.0
NZ00891	49th St & 26th Ave	1.00	6.00	5.89	-0.11	9.32	9.41	0.09	14.0



st.petersburg
www.stpete.org

Lake Maggiore West Outfall - Project No. G3-10

ch2m



PROJECT G3-10

Problem

Lake Maggiore has one existing outfall to the east, which is via an outlet gate that discharges into a tidally-controlled riverine system that stretches for 1.5 miles to outlet into Tampa Bay. The purpose of the gate is to prevent salt water intrusion from the bay into Lake Maggiore, as the lake is maintained as a freshwater water body. However, during large storm events, the single outfall gate to the east is insufficient at mitigating flows and flooding occurs around the lake. Also, high tide elevations can get higher than the gate flow invert and cause backflow into the lake.

Several options have been explored at enhancing the lake outflow to the east, but the area to the east of lake is generally medium-density residential and any increased conveyance is limited based on the existing roads and structures that exist within the east outfall.

Solution & Project Benefits:

The distance from Lake Maggiore to the Gulf of Mexico to the west is only 1.3 miles, and there is already a well-defined path for much of this distance, including double 6'x4' box culverts under I-275. Adding an additional outfall to the west could not only lower flood elevations in the lake during large storm events, but also serve as a redundant outfall in case the primary outfall becomes blocked or is under construction. Much of the land to the west is owned by the City or other municipalities, and there are less residential structures and roads within the west outfall.

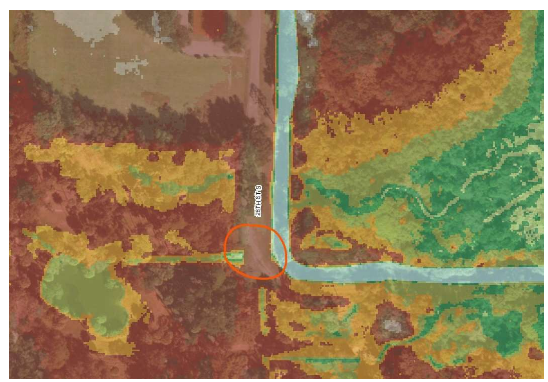
A west outfall could be connected to the existing system by creating a weir or gate, similar in design to the east outfall, a channel connecting this weir to the existing system, and then updates in the channels and pipe crossings of the existing system. The existing pipe and channel inverts in this existing system are all close to the tidal stage elevations, starting at 1.6 and dropping to -1.0 near the outfall into the Gulf.

However, preliminary modeling shows that the peak water elevations for the existing system to the west are 2-3 feet higher than the peak water elevation of Lake Maggiore. In the proposed condition, more water is actually entering the lake system than in the existing condition.
Instead of connecting to the existing system, therefore, a new 12'x10' box culvert system is proposed along 30th Avenue that will be isolated from localized flooding conditions between Lake Maggiore and Clam Bayou. The weir or gate would connect the existing channel to a new channel that would convey water to the proposed box culvert, which would outfall directly into the Gulf at Clam Bayou.

This solution will remove 3,281 feet of roadway from the 10-year floodplain and an estimated 7 structures from the 100-Year.

Estimated Cost:

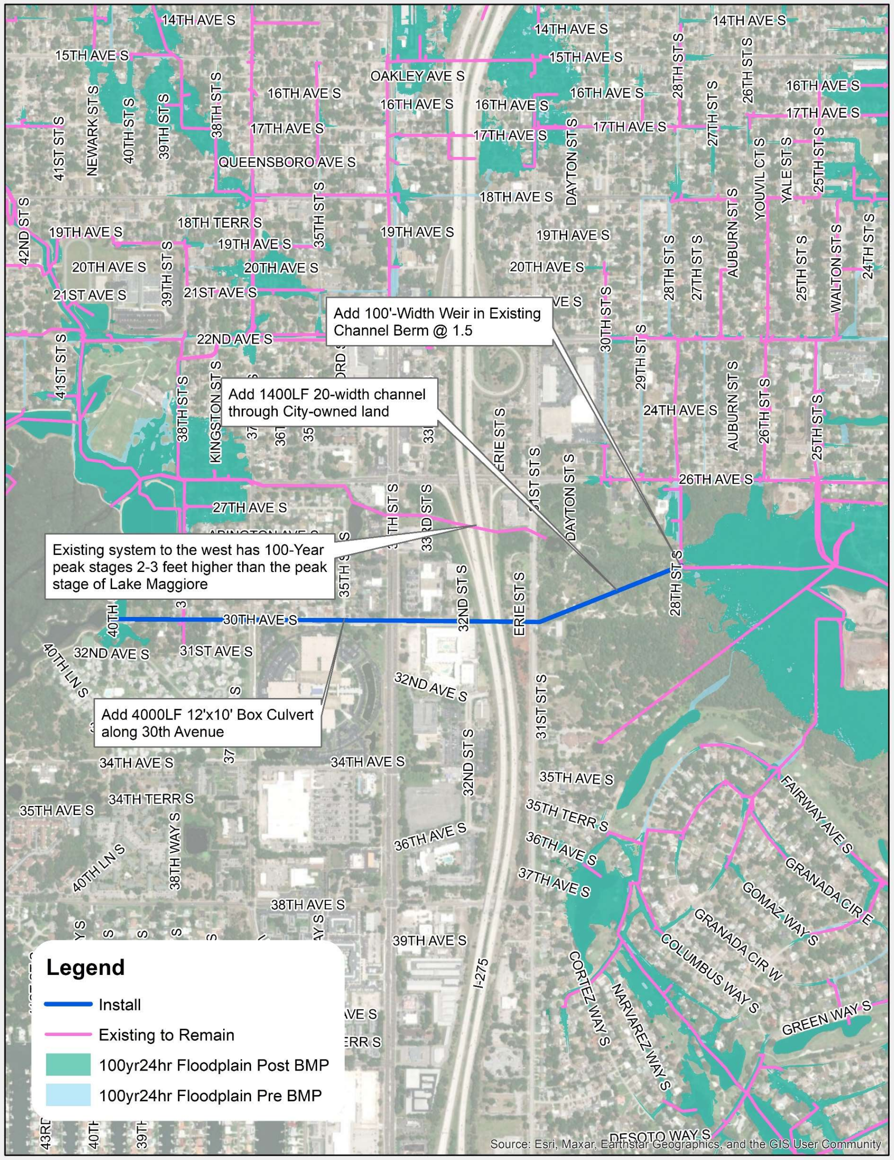
Estimated cost for this project is approximately $31.4 million including planning, engineering, and permitting fees..



Location of connection weir along existing channel berm with DEM

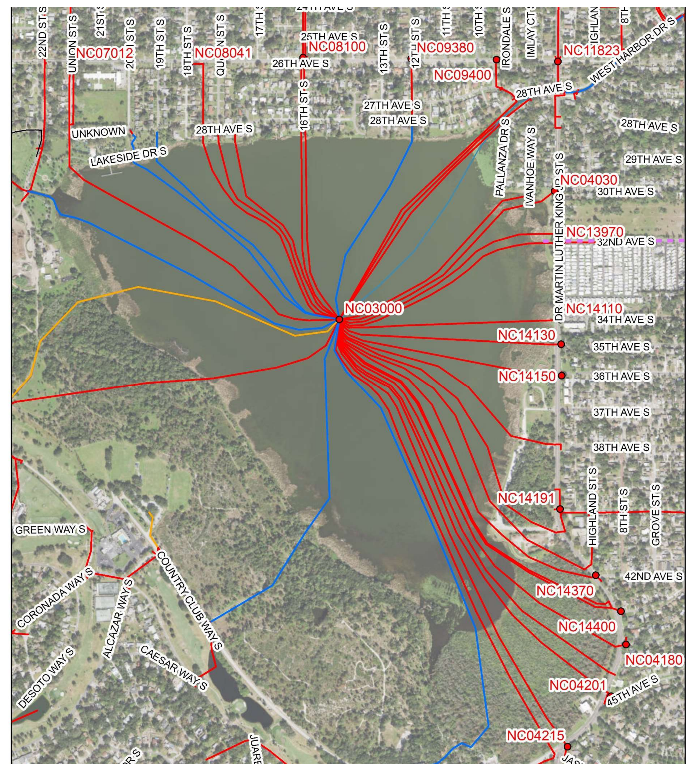
Existing culverts under 31st St and I-275

Lake Maggiore West Outfall - Project No. G3-10 (continued)

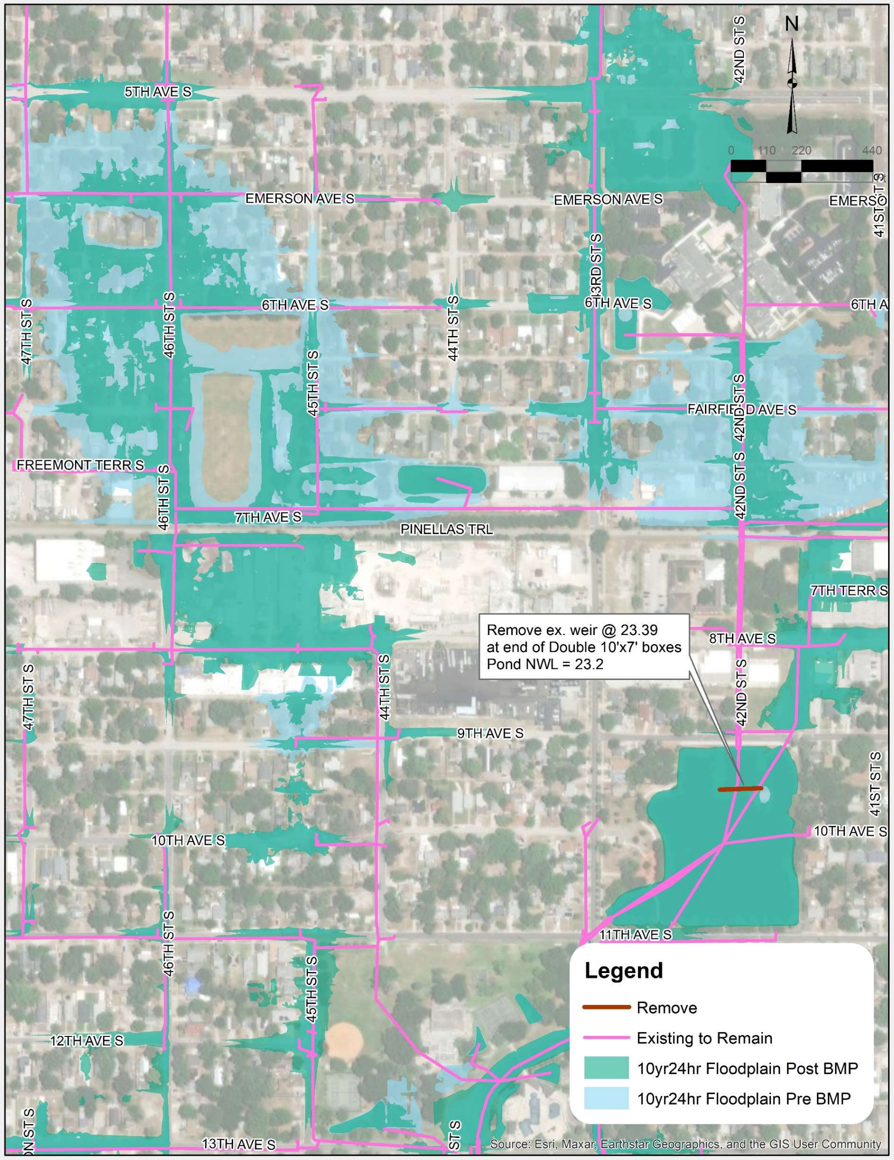


PROJECT G3-10

Node	Location Description	Initial Stage	10-Year			100-Year			EOP
			EX	PR	Δ	EX	PR	Δ	
NC03000	Lake Maggiore	1.00	3.87	3.6	-0.27	4.86	4.59	-0.27	
NC08041	26th Ave & 18th St	7.00	8.69	8.7	0.01	8.78	8.76	-0.02	11.0
NC09400	26th Ave & 10th St	1.00	4.18	4.18	0.00	4.81	4.54	-0.27	2.5
NC11823	26th Ave & MLK St	1.00	4.16	4.16	0.00	4.77	4.47	-0.30	3.5
NC04030	30th Ave & MLK St	1.00	3.86	3.64	-0.22	4.84	4.57	-0.27	3.0
NC13970	32nd Ave & MLK St	1.00	3.89	3.63	-0.26	4.86	4.59	-0.27	3.0
NC14110	34th Ave & MLK St	1.00	3.98	3.98	0.00	4.87	4.60	-0.27	2.5
NC14130	35th Ave & MLK St	1.36	4.19	4.19	0.00	4.87	4.61	-0.26	3.0
NC14150	36th Ave & MLK St	1.00	4.31	4.31	0.00	4.88	4.61	-0.27	3.0
NC14191	40th Ave & MLK St	1.00	3.9	3.63	-0.27	4.88	4.61	-0.27	3.0
NC14370	42nd Ave & MLK St	1.00	3.88	3.61	-0.27	4.87	4.61	-0.26	2.0
NC14400	Alamanda Way & MLK St	1.00	3.88	3.61	-0.27	4.87	4.60	-0.27	2.6
NC04180	Bayou Blvd & MLK St	1.00	3.88	3.61	-0.27	4.88	4.61	-0.27	3.0
NC04201	45th Ave & MLK St	1.00	4.22	4.22	0.00	4.91	4.68	-0.23	4.0
NC04215	Country Club Way & MLK St	1.00	3.92	3.65	-0.27	4.96	4.78	-0.18	4.0



Childs Park Pond Sump Removal - Project No. G3-11



Problem

There is a sediment sump area constructed within Childs Park Pond at the outfall of the existing double 10'x7' box culverts. This sump has earthen walls on three sides, and a concrete weir on the fourth side with an invert approximately 2 inches above the water elevation of the pond.

The detention of water in this smaller volume before discharge into the larger pond is causing the hydraulic gradient within the box culverts to stage higher than it would if it discharged directly into the pond. This is a problem since the system has peak stages affecting homes in the 100-year storm in several places upstream of the box culverts.

Solution & Project Benefits:

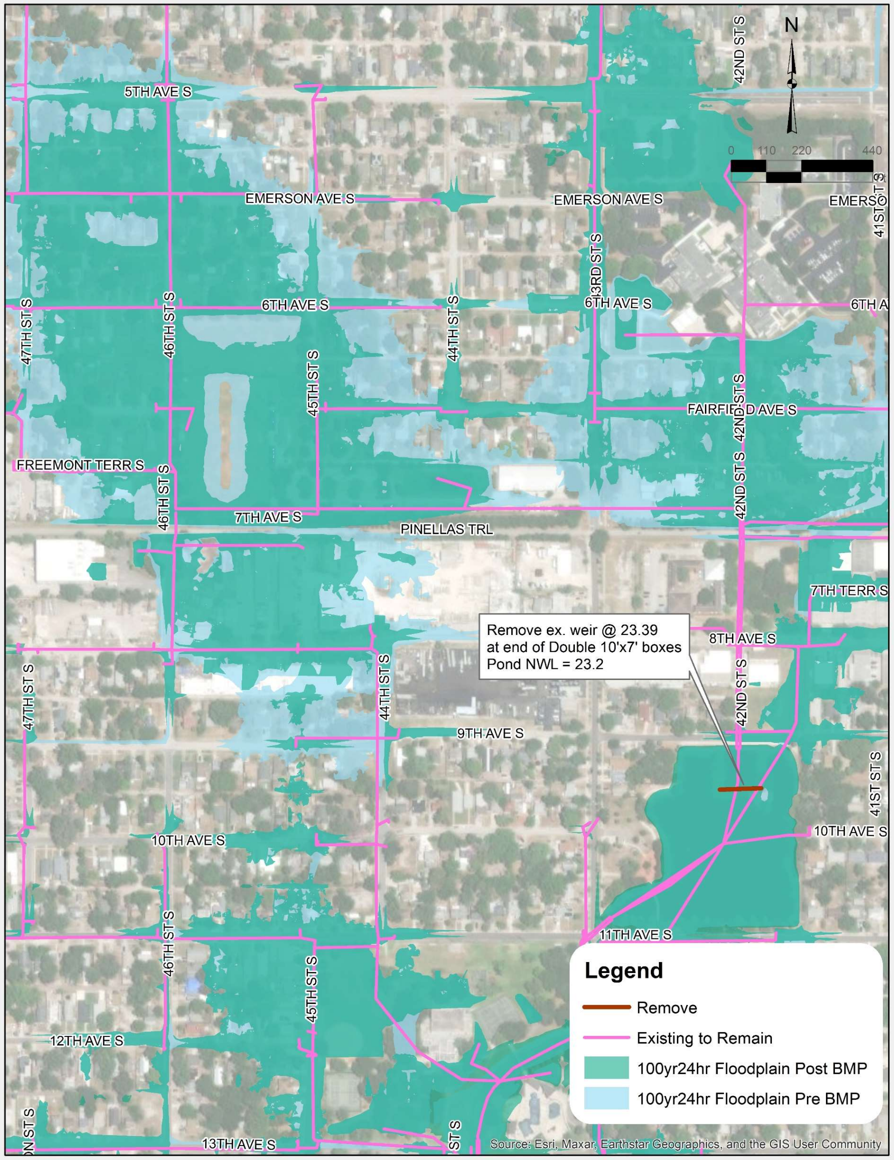
Removing the concrete weir in order to provide direct discharge of the box culverts into the pond will provide some reduction in upstream 100-year peak stages. The water quality benefits and sediment control provided by the sump can be regained through methods such as a skimmer or in-stream trash collector at the outlet of the box culverts. The pond itself also provides treatment, as it functions as a deep pool detention pond, and has an outlet weir at the southwest corner of the pond. This outlet weir could also be fitted with a skimmer in order to retain sediment and floatables within the pond for treatment or removal.

This project would remove approximately 1,010 feet of roadway from the 10-year floodplain and 4 structures from the 100-year floodplain.

Estimated Cost:

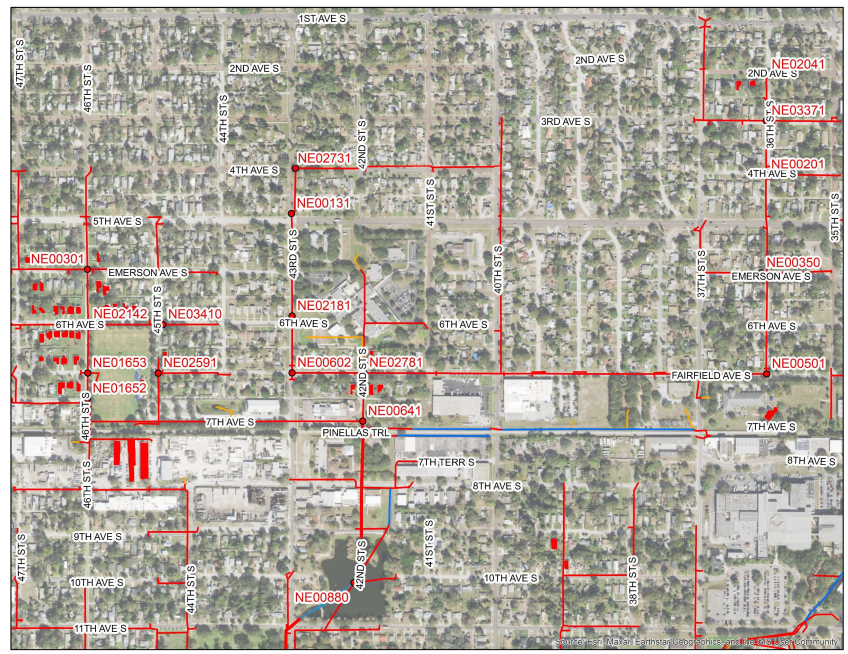
Estimated cost for this project is approximately $210,000 including planning, engineering, and permitting fees.

Childs Park Pond Sump Removal - Project No. G3-11 (continued)

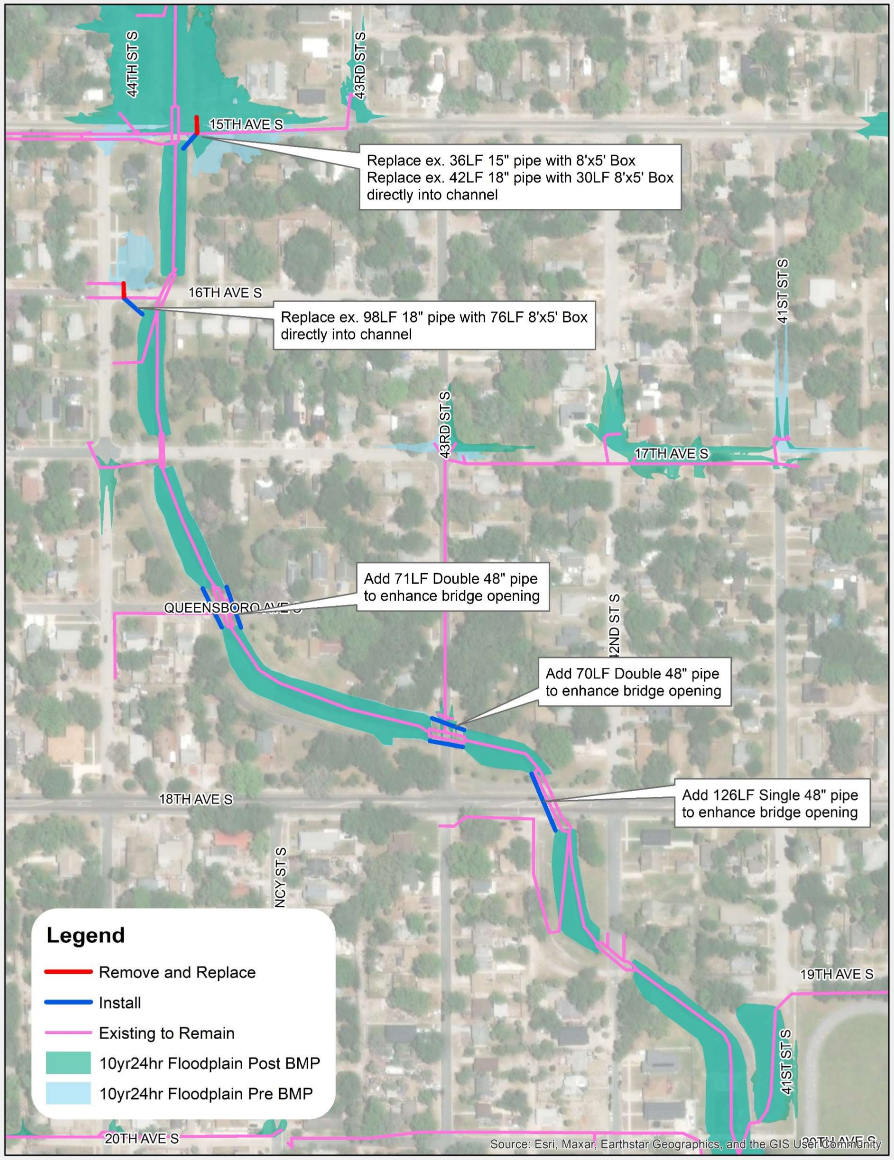


PROJECT G3-11

Node	Location Description	Initial Stage	10-Year			100-Year			EOP
			EX	PR	Δ	EX	PR	Δ	
NE00301	46th St & Emerson Ave	25.28	33.72	33.7	-0.02	34.61	34.59	-0.02	32.0
NE02142	46th St & 6th Ave S	24.60	33.67	33.64	-0.03	34.59	34.56	-0.03	32.0
NE01653	46th St & Fairfield Ave	25.25	33.53	33.47	-0.06	34.55	34.52	-0.03	31.0
NE01652	46th St & Freemont Ter	23.26	33.41	33.34	-0.07	34.53	34.50	-0.03	32.0
NE03410	45th St & 6th AveS	28.22	33.97	33.97	0.00	34.57	34.55	-0.02	33.0
NE02591	45th St & Fairfield Ave	27.72	33.69	33.67	-0.02	34.55	34.52	-0.03	33.0
NE02731	43rd St & 4th Ave S	34.02	38.54	38.54	0.00	38.62	38.62	0.00	37.0
NE00131	43rd St & 5th Ave S	26.29	37.18	37.18	0.00	37.31	37.31	0.00	36.0
NE02181	43rd St & 6th Ave S	25.32	36.03	36.01	-0.02	36.36	36.35	-0.01	35.0
NE00602	43rd St & Fairfield Ave	24.65	34.78	34.73	-0.05	35.49	35.45	-0.04	35.0
NE02781	42nd St & Fairfield Ave	23.30	33.44	33.36	-0.08	34.62	34.55	-0.07	33.0
NE02041	36th St & 2nd Ave S	38.94	43.96	43.96	0.00	44.24	44.24	0.00	43.0
NE03371	36th St & 3rd Ave S	34.30	43.69	43.68	-0.01	44.11	44.11	0.00	43.0
NE00201	36th St & 4th Ave S	33.31	43.25	43.25	0.00	43.96	43.96	0.00	43.0
NE00350	36th St & Emerson Ave	34.68	41.53	41.52	-0.01	42.27	42.27	0.00	40.0
NE00501	36th St & Fairfield Ave	29.57	39.62	39.59	-0.03	40.93	40.92	-0.01	40.0
NE00641	42nd St & 7th Ave S	23.22	32.86	32.76	-0.10	33.88	33.79	-0.09	32.0
NE00880	Childs Park Pond	23.20	31.53	31.56	0.03	32.16	32.18	0.02	31.0



15th Avenue & 44th Street - Project No. G3-12



PROJECT G3-12

Problem

The channel that discharges from Childs Park experiences overbank flooding during the 100-year storm event upstream of the crossings with 15th Avenue, 16th Avenue, 17th Avenue, Queensboro Avenue, 43rd Street, and 18th Avenue. Based on this flooding, it is estimated that one home is flooded upstream of the 15th Avenue crossing, and one home is flooded upstream of the 16th Avenue crossing.

The bridge culverts at 16th and 17th Avenue are an estimated double 10'x6' box, whereas the downstream bridge culverts at Queensboro Ave and 43rd Street are an estimated double 8'x6' box and the bridge culvert at 18th Avenue is an estimated double 9'x6' box. The bridge culvert at 42nd Street, downstream of the other crossings, is a double 10'x6' box. In order to provide continuity of flow in the channel, additional hydraulic capacity should be provided at the Queensboro Avenue, 43rd Street and 18th Avenue crossings, which will also reduce flooding at these crossings.

Solution & Project Benefits:

To increase hydraulic capacity at the bridge culverts under Queensboro Avenue, 43rd Street and 18th Avenue, additional 48-inch pipes were added alongside these bridges, with double 48-inch pipes added under Queensboro Avenue and 43rd Street, and a single 48-inch pipe added under 18th Avenue. These pipes were added to avoid complete reconstruction of these bridge openings, but the intent was to provide additional hydraulic capacity that could also be provided by widening existing openings. The method of constructing additional hydraulic capacity would need to be examined further based on field conditions, means and methods, and cost considerations.

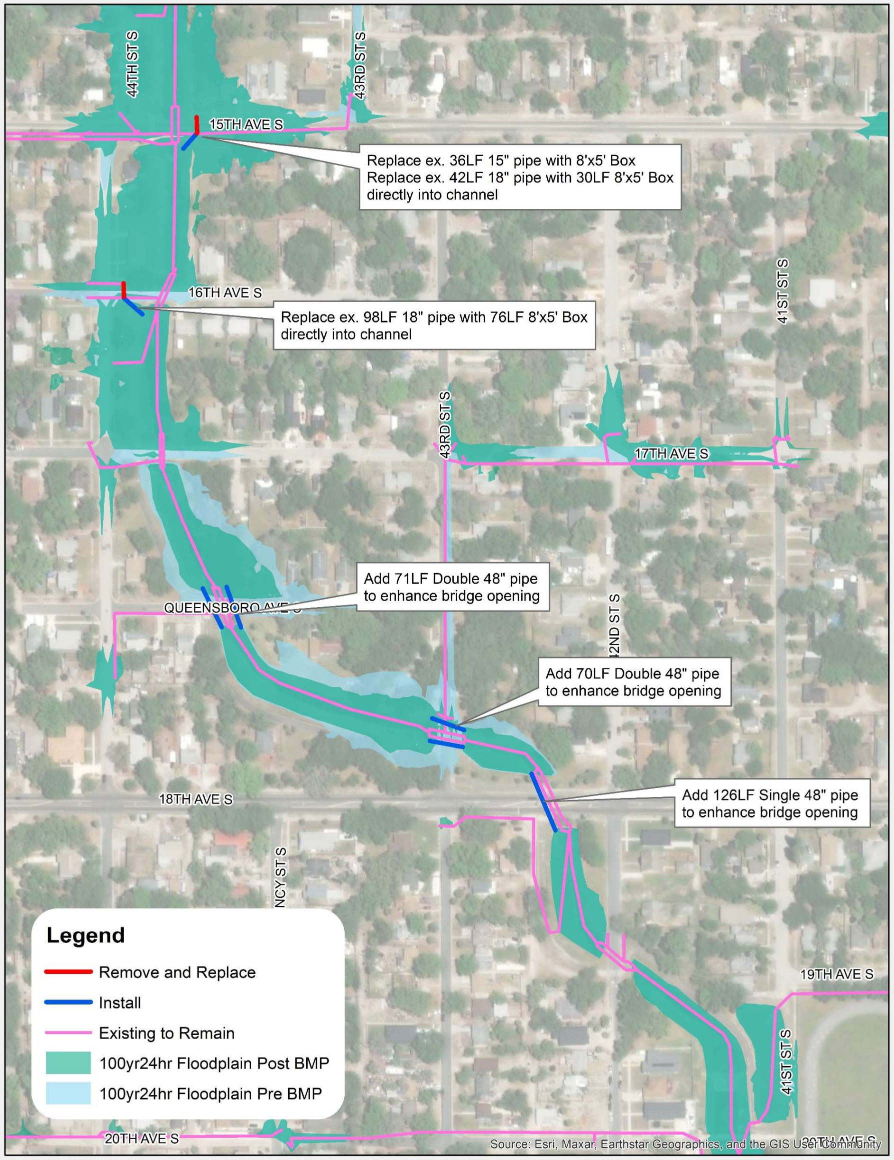
To remove the two houses from the 100-year floodplain, the pipe systems for the inlets adjacent to these houses need to be increased to a 8'x5' box culvert and need to discharge directly into the channel downstream of the bridge culverts rather than directly into the bridge culverts as they do currently. This is necessary as the hydraulic head inside the bridge culverts is higher than in the downstream channel.

This project would remove approximately 130 feet of roadway from the 10-year floodplain and 2 of the 2 homes that are currently impacted by the 100-year floodplain.

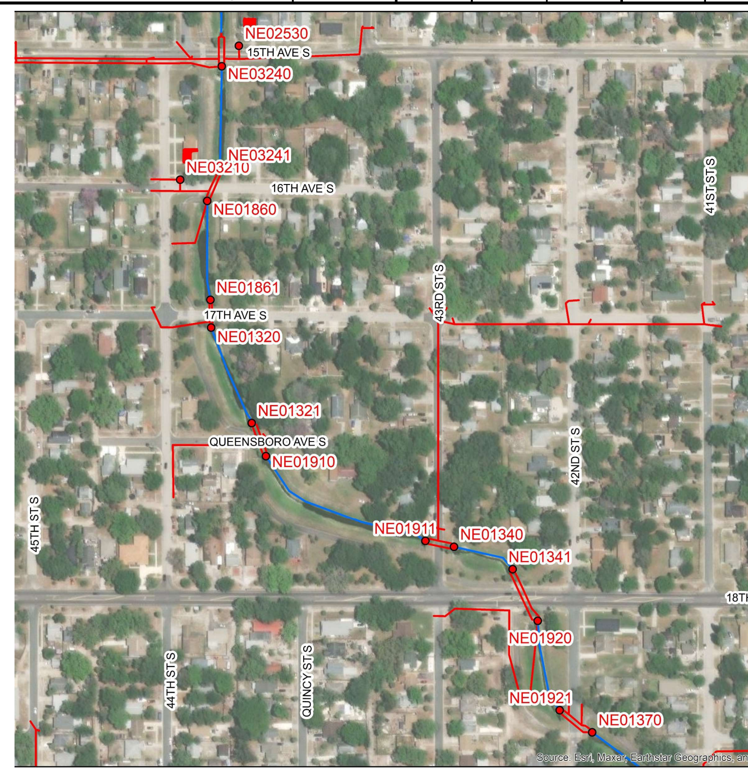
Estimated Cost:

Estimated cost for this project is approximately $1,277,000 including planning, engineering, and permitting fees.

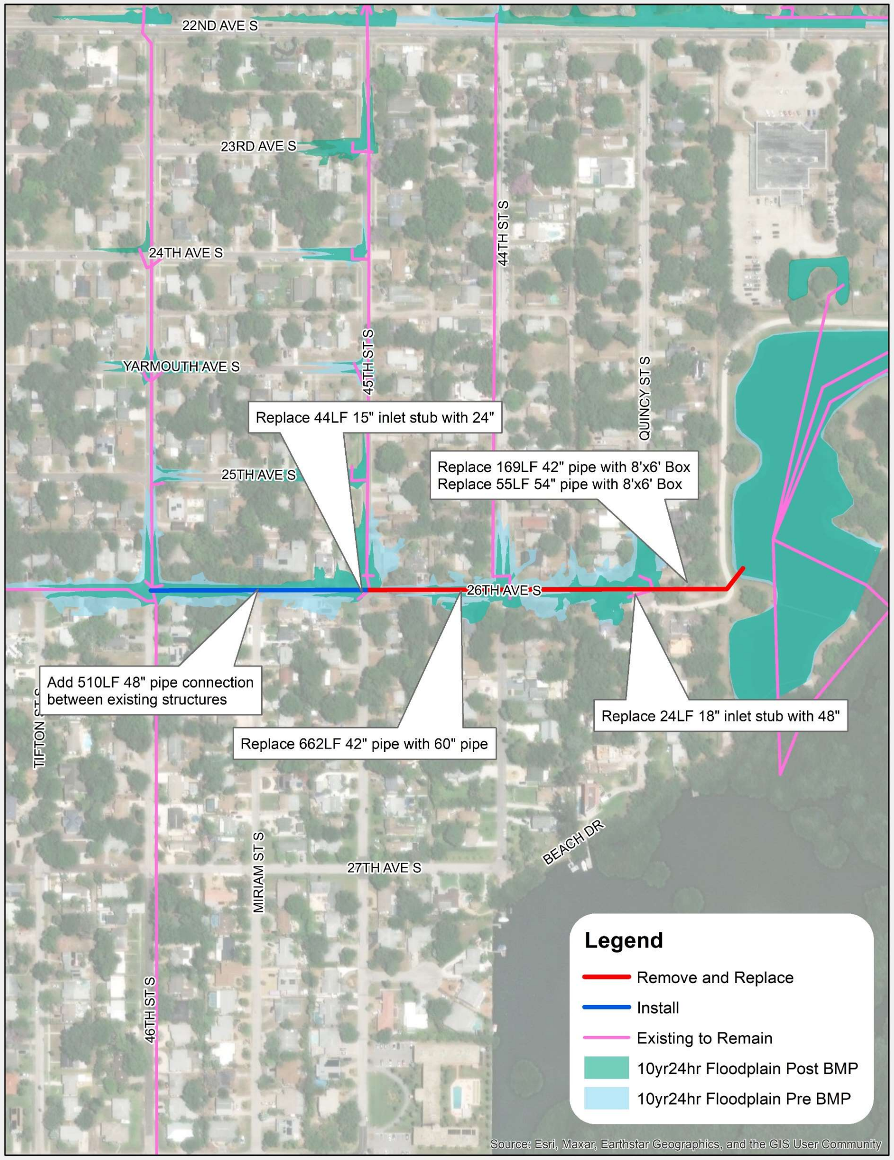
15th Avenue & 44th Street - Project No. G3-12 (continued)



Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	FFE/TOB
NE02530	House on 15th Ave	24.05	28.63	28.1	-0.53	29.04	28.58	-0.46	28.6
NE03240	Downstream of 15th Ave Bridge	16.84	26.44	24.25	-2.19	28.02	27.23	-0.79	27.0
NE03241	Upstream of 16th Ave Bridge	16.56	26.32	23.89	-2.43	27.98	27.16	-0.82	27.0
NE03210	House on 16th Ave	21.41	26.85	23.15	-3.70	27.99	27.18	-0.81	27.2
NE01860	Downstream of 16th Ave Bridge	16.47	25.25	23.1	-2.15	27.16	26.33	-0.83	26.0
NE01861	Upstream of 17th Ave Bridge	15.86	25.08	22.64	-2.44	27.12	26.22	-0.90	26.0
NE01320	Downstream of 17th Ave Bridge	15.64	23.63	21.59	-2.04	25.75	24.26	-1.49	24.0
NE01321	Upstream of Queensboro Ave Bridge	14.24	23.41	20.88	-2.53	25.71	24.07	-1.64	24.0
NE01910	Downstream of Queensboro Ave Bridge	13.18	20.82	19.59	-1.23	23.67	21.91	-1.76	22.0
NE01911	Upstream of 43rd St Bridge	11.92	20.3	18.43	-1.87	23.62	21.52	-2.10	22.0
NE01340	Downstream of 43rd St Bridge	11.02	18.39	17.33	-1.06	22.73	19.85	-2.88	22.0
NE01341	Upstream of 18th Ave Bridge	11.02	18.1	16.92	-1.18	22.63	19.64	-2.99	22.0
NE01920	Downstream of 18th Ave Bridge	11.02	16.05	15.66	-0.39	18.03	17.09	-0.94	18.0
NE01921	Upstream of 42nd St Bridge	11.02	15.32	14.88	-0.44	17.55	16.52	-1.03	18.0
NE01370	Downstream of 42nd St Bridge	11.02	13.64	13.52	-0.12	14.18	13.94	-0.24	17.0



26th Avenue South - Project No. G3-13



PROJECT G3-13

Problem

The existing stormwater system along 26th Avenue South, which discharges into Clam Bayou, produces excessive street flooding during the 10-year storm event, and flooding of 2 homes during the 100-year storm event. Additionally, street flooding along 26th Avenue between 45th Street and 46th Street is caused by flooding from two separate stormwater systems, one of which discharges at the south end of 46th Street into Boca Ciega Bay, and the other that discharges at the east end of 26th Avenue at Clam Bayou.

Solution & Project Benefits:

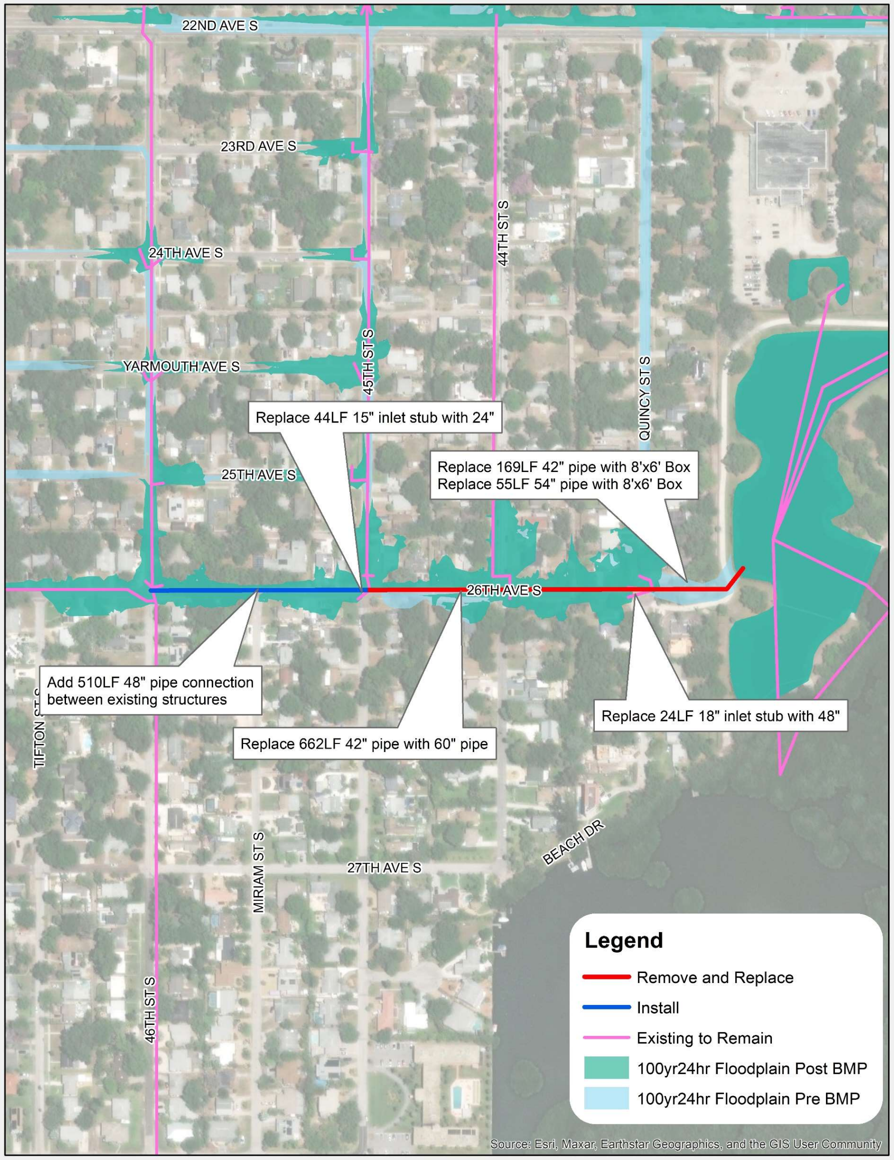
Constructing a pipe connection between the 46th Street and 26th Avenue systems along 26th Avenue, and then increasing the hydraulic capacity along 26th Avenue to the discharge point at Clam Bayou, will alleviate street flooding along this corridor and remove home flooding during the 100-year storm event.

This project would remove approximately 672 feet of roadway from the 10-year floodplain and 2 of the 2 homes that are currently impacted in this area by the 100-year floodplain.

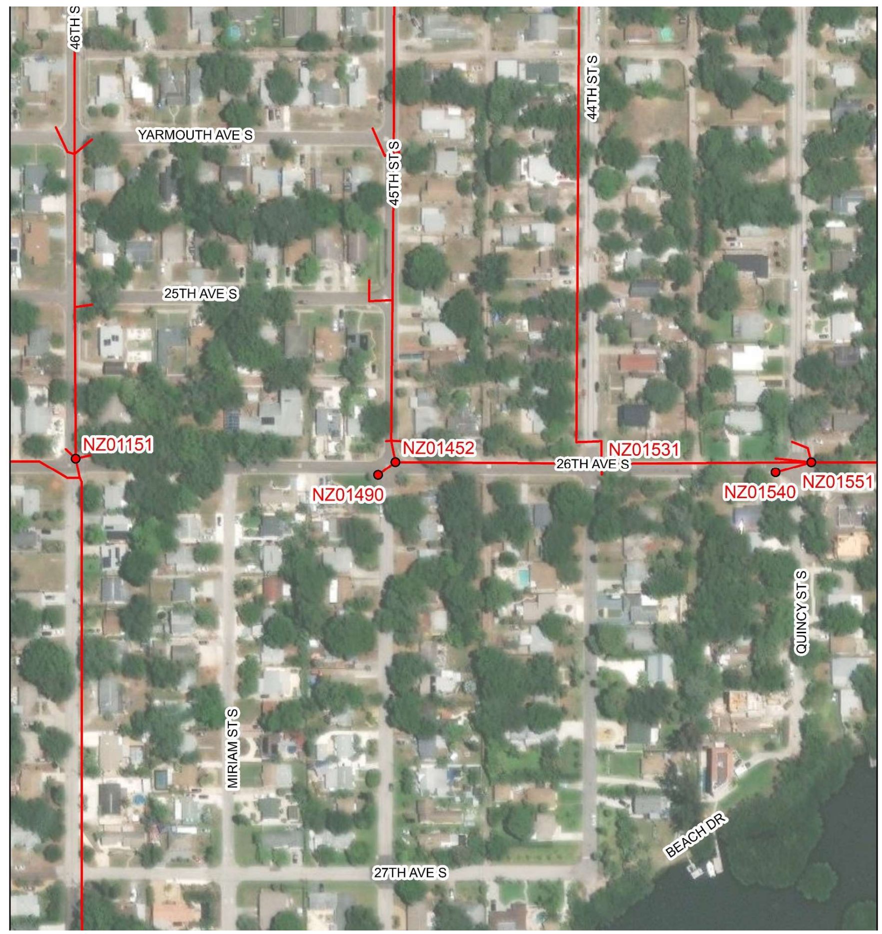
Estimated Cost:

Estimated cost for this project is approximately $3,054,000 including planning, engineering, and permitting fees.

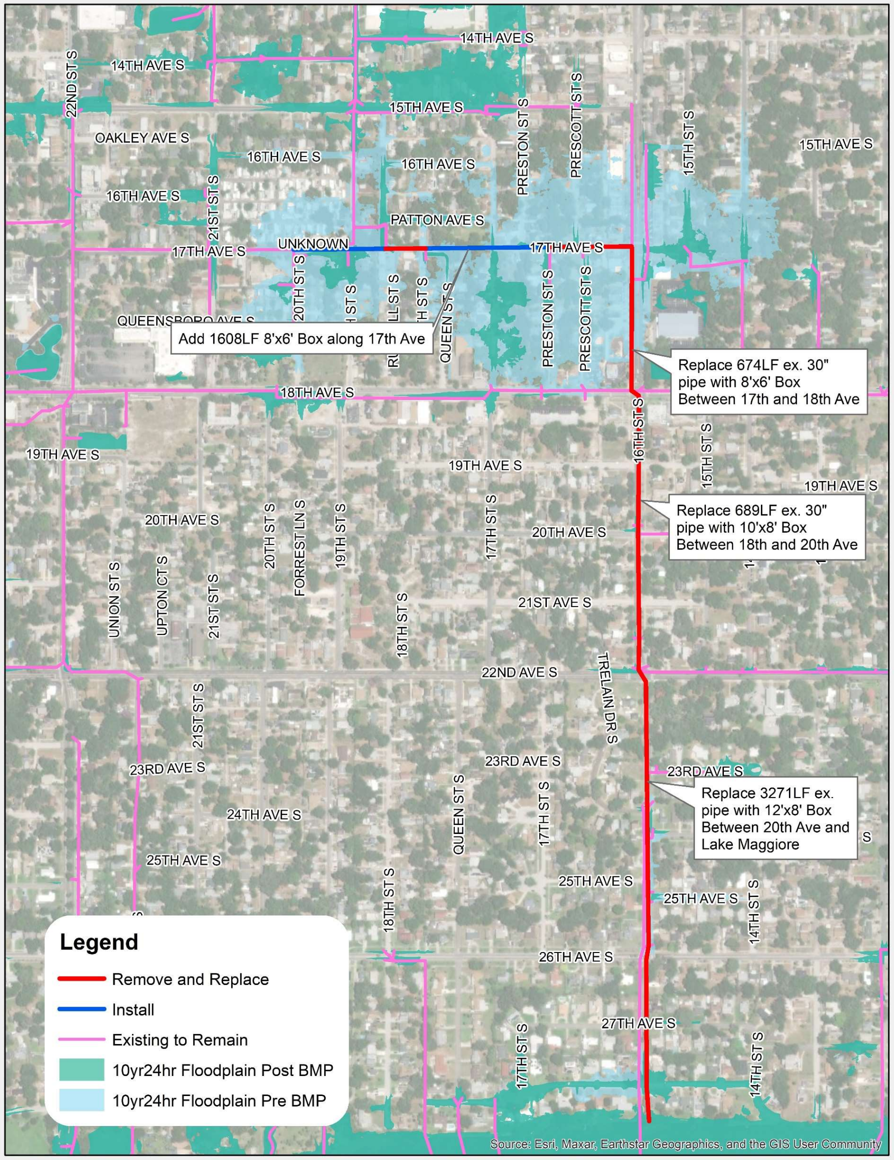
26th Avenue South - Project No. G3-13 (continued)



Node	Location Description	Initial Stage	10-Year			100-Year			EOP/FFE
			EX	PR	Δ	EX	PR	Δ	
NZ01151	26th Ave & 46th St	4.24	9.41	8.55	-0.86	9.90	9.12	-0.78	8.00
NZ01452	26th Ave & 45th St	1.00	7.75	7.2	-0.55	8.16	7.75	-0.41	7.00
NZ01531	26th Ave & 44th St	1.00	6.65	5.8	-0.85	7.08	6.31	-0.77	6.00
NZ01551	26th Ave & Quincy St	1.00	5.14	3.87	-1.27	5.62	4.37	-1.25	5.00
NZ01490	House near 45th St	1.06	8.41	8	-0.41	8.86	8.69	-0.17	8.83
NZ01540	House near Quncy St	1.00	6.35	5.07	-1.28	6.89	6.41	-0.48	6.49



17th Avenue South - Project No. G3-14



PROJECT G3-14

Problem

The neighborhood along 17th Avenue South between 16th Street and 21st Street, located approximately 0.8 miles north of Lake Maggiore, experiences excessive flooding during the 10-year and greater storm events, with an estimated 83 homes with finished floor elevations (FFEs) below the peak stage during the 100-year storm event. The inlets in this neighborhood discharge into three distinct stormwater systems, with one system running south along 22nd Street to Lake Maggiore, one system running north along 19th Street to eventually reach Booker Creek, and the third system running south along 16th Street to Lake Maggiore. The system along 22nd Street consists of a 48-inch diameter pipe, and the system along 16th Street consists of a 30-inch diameter pipe that eventually splits into a parallel 18-inch and 30-inch diameter pipes at 26th Avenue before discharging into the lake.

Part of the reason for flooding in this area is that the neighborhood lies within a natural depression, and therefore the hydraulic grade line within the stormwater system causes flooding within this area even though there is no flooding along 16th Street or 22nd Street.

Solution & Project Benefits:

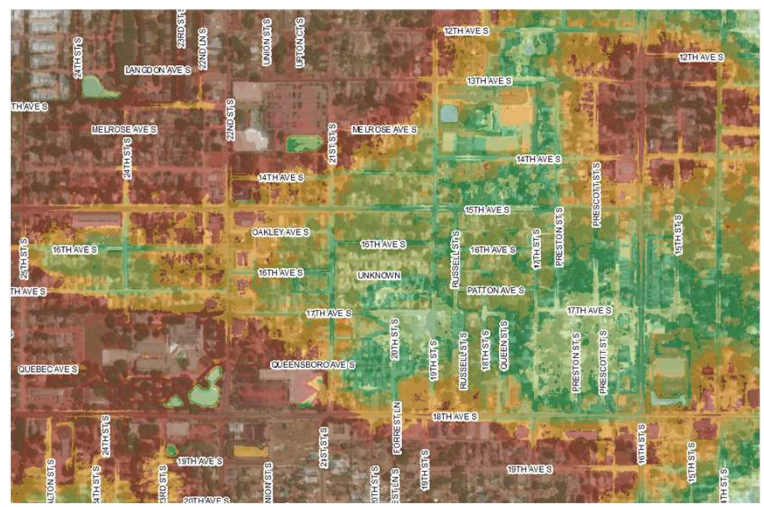
Due to the low ground elevation, increasing the hydraulic capacity of the stormwater pipes out of this neighborhood and to Lake Maggiore is the only practical way to alleviate flooding in this area. The proposed design would link and expand the three existing stormwater systems along 17th Avenue and then expand the stormwater system along 16th Street in order to provide a clear route to remove runoff from this area and discharge it into Lake Maggiore. Due to the large size of the network, the magnitude of the depression, and the length of pipe needed to reach the lake, the proposed system would need to range in size from an 8'x6' box culvert to a 12'x8' box culvert at the outfall. Even with this size of culverts, the 100-year peak stages will still not be lowered below the FFEs for all of the affected homes, but the proposed design was selected because it maintains a practical size while providing benefits to most of the neighborhood.

It should be noted that the selected design was based merely on utility, and may not represent the most efficient or economical design for this complex project. Further analysis should be pursued to determine the best design to alleviate flooding in this neighborhood. For example, an analysis should be conducted on expanding the system along 22nd Street in conjunction with improvements along 16th Street.

This project would remove approximately 1,500 feet of roadway from the 10-year floodplain and 56 structures from the 100-year floodplain.

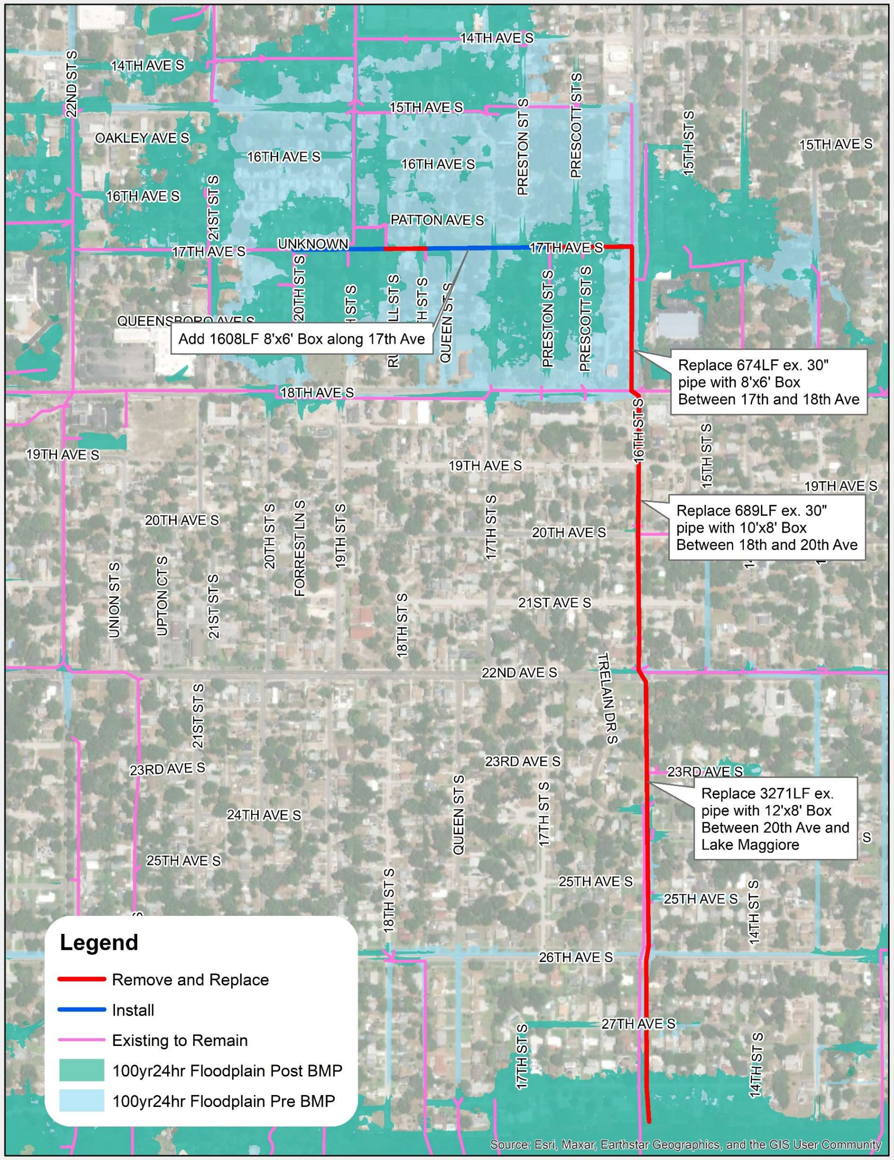
Estimated Cost:

Estimated cost for this project is approximately $41,939,000 including planning, engineering, and permitting fees.

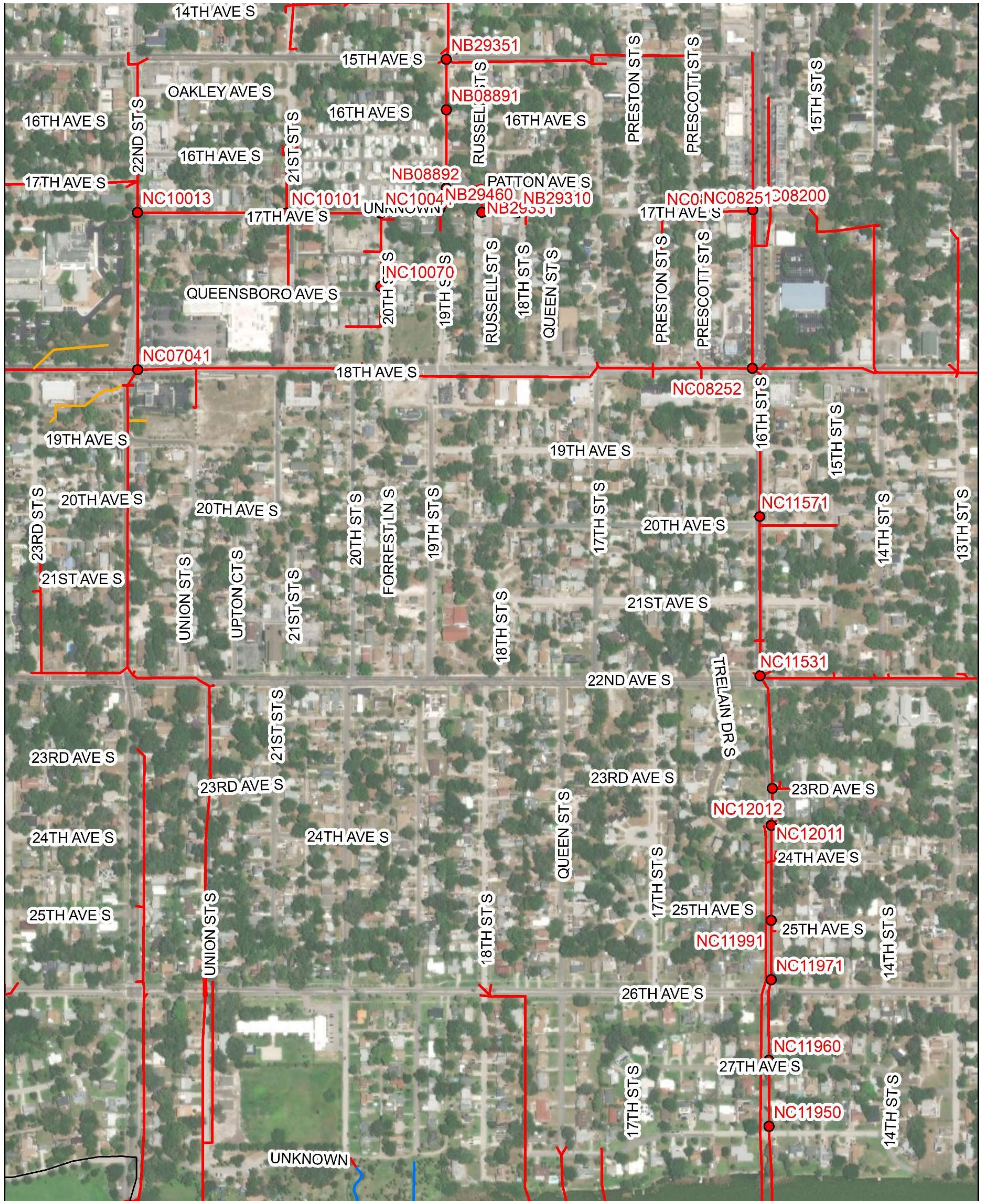


DEM topography along 17th Avenue South near the intersection with 16th Street

17th Avenue South - Project No. G3-14 (continued)

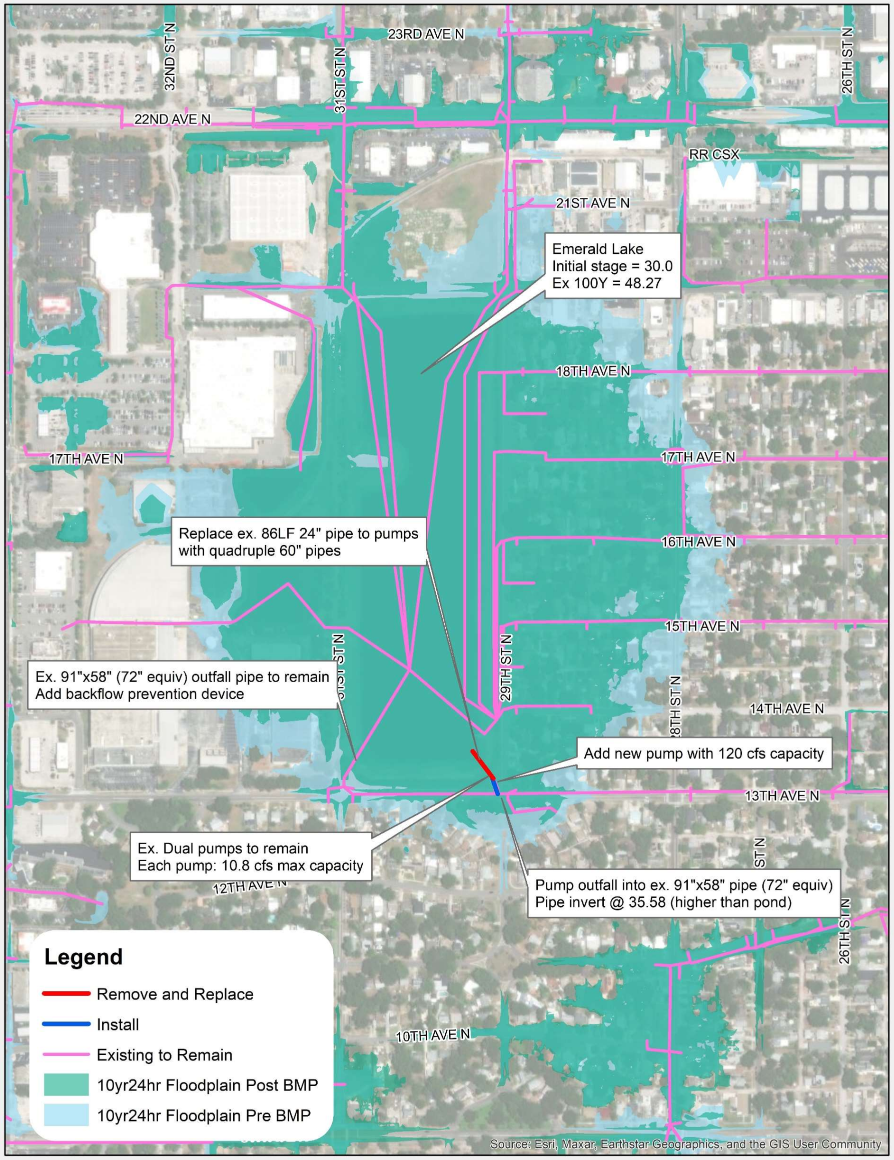


17^{th} Avenue South - Project No. G3-14 (continued)



Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	EOP/TOB
NC10070	Queensboro Ave & 20th St	39.21	43.76	42.98	-0.78	44.17	43.89	-0.28	42.0
NC10101	17th Ave & 21st St	35.77	43.67	43.18	-0.49	44.17	44.07	-0.10	43.0
NC10013	17th Ave & 22nd St	34.33	43.34	43.09	-0.25	44.17	44.10	-0.07	45.0
NC07041	18th Ave & 22nd St	33.70	42.76	42.57	-0.19	43.67	43.61	-0.06	46.0
NB08892	Patton Ave & 19th St	37.92	43.76	42.49	-1.27	44.14	43.87	-0.27	42.0
NB08891	16th Ave & 19th St	37.56	43.77	43.16	-0.61	44.15	43.90	-0.25	43.0
NB29351	15th Ave & 19th St	37.34	43.79	43.65	-0.14	44.16	43.92	-0.24	42.0
NC10041	17th Ave & 20th St	36.50	43.7	39.95	-3.75	44.17	43.85	-0.32	41.0
NB29460	17th Ave & 19th St	37.98	43.75	39.9	-3.85	44.16	43.84	-0.32	41.0
NB29331	17th Ave & Russell St	39.28	43.58	39.54	-4.04	44.11	43.43	-0.68	42.0
NB29310	17th Ave & 18th St	39.88	43.4	39.88	-3.52	44.11	43.04	-1.07	42.0
NC08261	17th Ave & Preston St	38.07	43.25	38.41	-4.84	44.05	41.41	-2.64	41.0
NC08251	17th Ave & Prescott St	38.75	43.23	38.75	-4.48	44.03	40.63	-3.40	41.0
NC08200	17th Ave & 16th St	37.20	43.23	37.24	-5.99	44.02	39.70	-4.32	42.0
NC08252	18th Ave & 16th St	34.69	42.64	34.75	-7.89	43.77	34.75	-9.02	44.0
NC11571	20th Ave & 16th St	32.48	40.93	32.97	-7.96	41.42	32.97	-8.45	42.0
NC11531	22nd Ave & 16th St	24.26	29.69	24.72	-4.97	30.19	24.72	-5.47	32.0
NC12012	23rd Ave & 16th St	15.75	21.23	17.69	-3.54	21.49	17.69	-3.80	21.0
NC12011	Trelain Dr & 16th St	10.98	18.95	16	-2.95	19.25	16.00	-3.25	18.0
NC11991	25th Ave & 16th St	10.94	16.71	13.67	-3.04	16.97	13.67	-3.30	16.0
NC11971	26th Ave & 16th St	10.94	15.28	10.94	-4.34	15.58	10.94	-4.64	15.0
NC11960	27th Ave & 16th St	2.21	6.02	6.39	0.37	6.15	6.39	0.24	6.0
NC11950	28th Ave & 16th St	1.00	3.9	4.29	0.39	4.89	4.99	0.10	3.0
NC03000	Lake Maggiore	1.00	3.86	3.95	0.09	4.86	4.97	0.11	5.0

Emerald Lake Add Pump - Project No. G3-15



PROJECT G3-15

Problem

Emerald Lake sits at the northern end of the Booker Creek system and sits in an area of isolated low topography. In order to discharge water toward Booker Pond to the southeast, the pond has to discharge into a pipe system that is higher than the pond initial stage. To assist with discharge of runoff into the pond, two existing pumps convey water at approximately 10 cfs each when the water elevation in the pond rises above the initial stage of 30 ft. However, the stormwater system downstream of the pump, which starts as a 72-inch equivalent pipe size and discharges into Booker Pond as an 84-inch equivalent pipe size, has a 100-Year peak stage approaching that of the pond, so that water pumped out of Emerald Lake returns back into the lake through the outlet pipe and over the banks of the pond. The capacity of this stormwater system to discharge into Booker Pond is limited, since Booker Pond also has extensive flooding during the 100-Year storm event, but the peak stage of the Booker Pond flooding is approximately 4 feet lower than the peak stage of Emerald Lake. Upon inspection of the stormwater system between Emerald Lake and Booker Pond, there is a confluence of two systems right before discharge into Booker Pond, one from Emerald Lake with an 84-inch equivalent pipe size, and one from the west with a 60-inch pipe size. The pipes to route the confluence of these flows into Booker Pond are only an 84-inch equivalent pipe size, and are therefore undersized to accommodate the flow from both of these systems.

Solution & Project Benefits:

The two pumps currently pump at the equivalent maximum flow of a 24-inch pipe, whereas the pipe size of the receiving system is 72 inches. Therefore, a pump could be added to pump at 120 cfs, which would bring the total outflow from Emerald Lake through the pumps approximately equal to the maximum flow capacity of a 72-inch pipe.

The existing outflow pipe from the pond, which is a 72-inch equivalent pipe, is carrying flow back into the lake from the downstream system during the peak stage events. To maintain only flow out of Emerald Lake and into the downstream system, a backflow prevention device could be added to this pipe to allow only positive flow to the south out of Emerald Lake.

This solution will remove 321 feet of roadway from the 10-year floodplain and an estimated 21 strcutures from the 100-year floodplain.

Since the addition of the pump will increase flow into Booker Pond, the increase of peak stages within Booker Pond, which has a peak stage exceeding the pond banks during the 100-Year storm event, will need to be mitigated by a separate project either concurrent with or prior to this project in order to maintain or lower the Booker Pond floodplain and avoid adverse impacts.

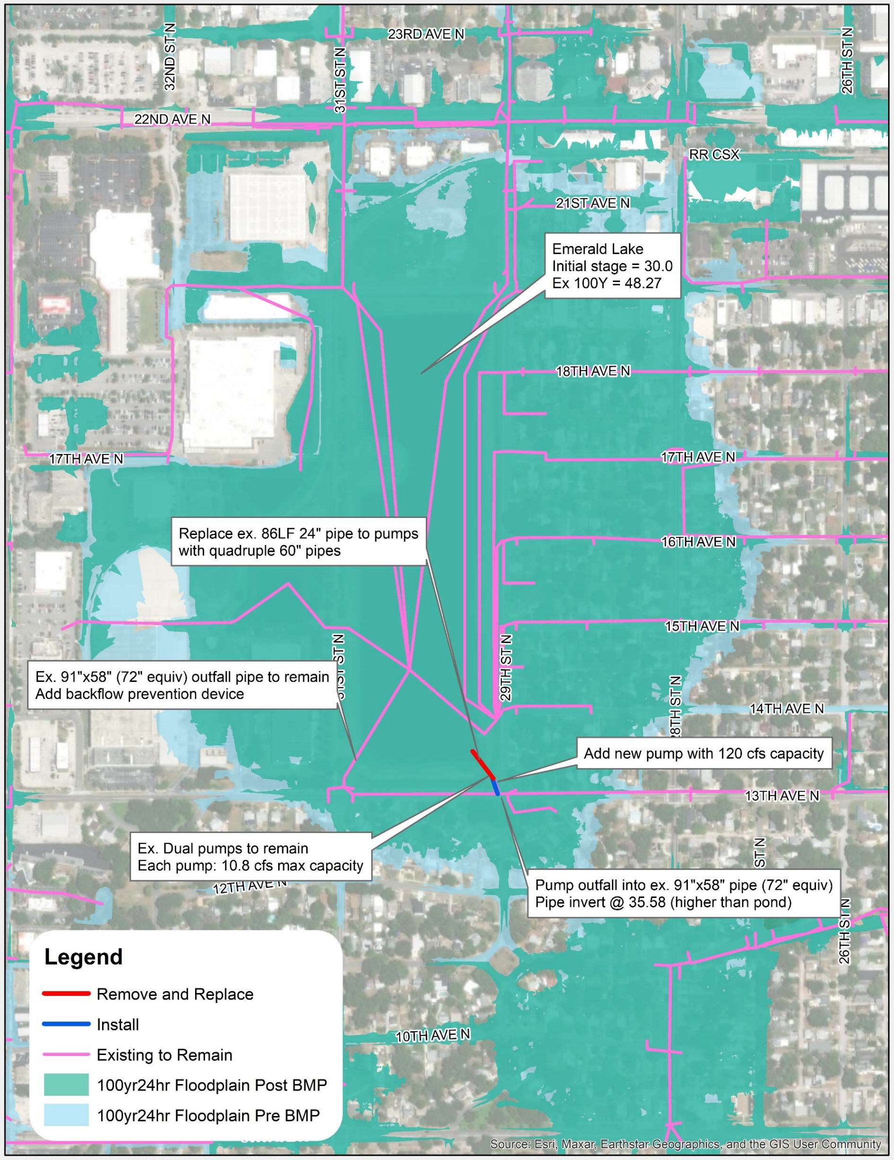
Estimated Cost:

Estimated cost for this project is approximately $19.5 million including planning, engineering, and permitting fees.

st.petersburg
www.stpete.org

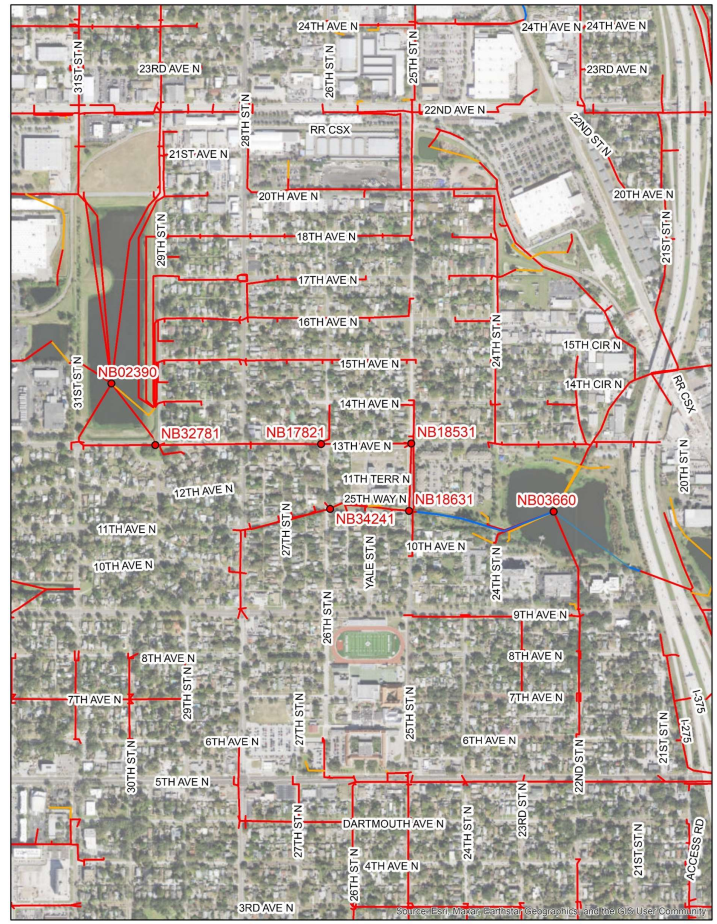
Emerald Lake Add Pump - Project No. G3-15 (continued)

ch2m

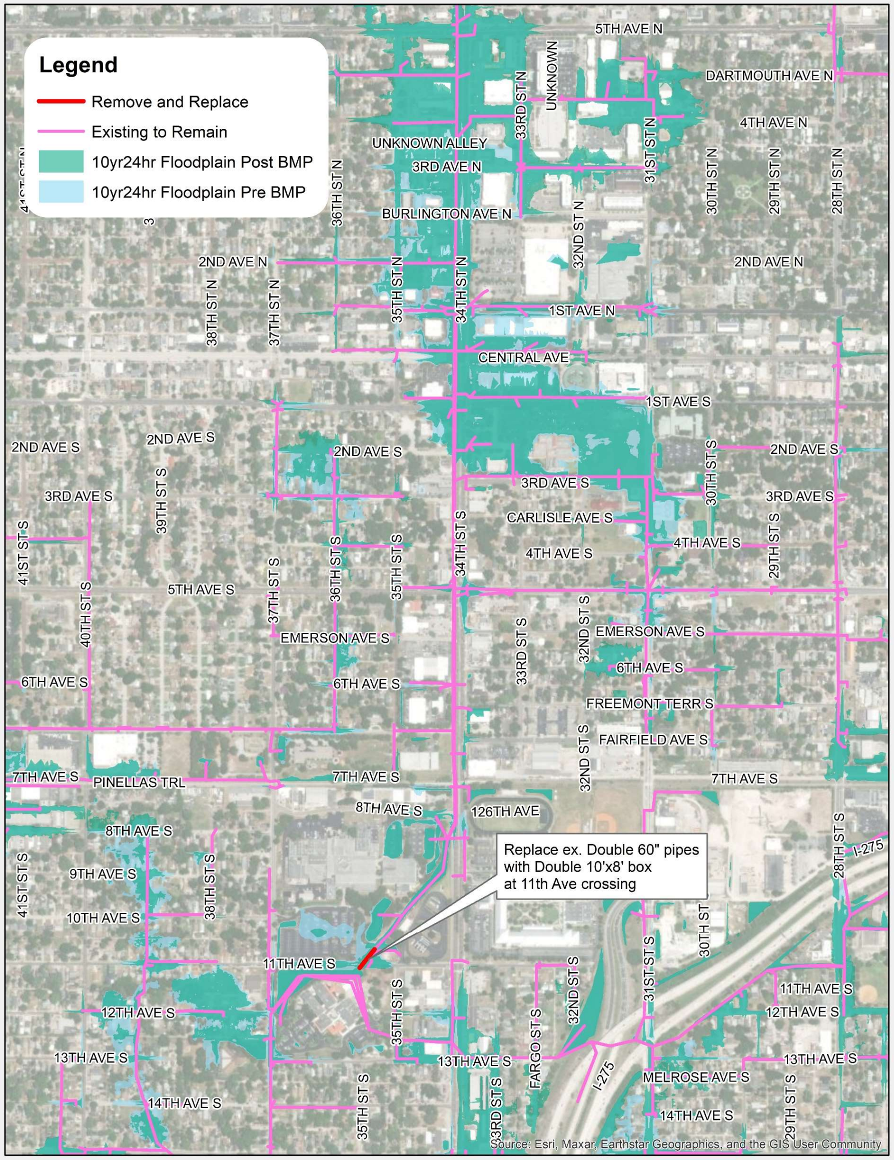


PROJECT G3-15

Node	Location Description	Initial Stage	10-Year			100-Year			TOB	EOP	FFE
			EX	PR	Δ	EX	PR	Δ			
NB02390	Emerald Lake	30.00	46.6	45.52	-1.08	48.27	47.86	-0.41	43	44	45
NB32781	13th Ave & 29th St	35.58	45.79	45.47	-0.32	47.74	47.79	0.05	N/A	43	N/A
NB17821	13th Ave & 26th St	34.14	44.33	44.12	-0.21	46.6	46.39	-0.21	N/A	48.5	N/A
NB18531	13th Ave & 25th St	33.47	43.72	43.72	0.00	46.08	45.94	-0.14	N/A	48	N/A
NB18631	11th Ave & 25th St	32.90	43.26	43.48	0.22	45.66	45.59	-0.07	N/A	44.5	N/A
NB34241	11th Ave & 26th St	37.57	46.35	46.77	0.42	47.59	47.63	0.04	N/A	46	N/A
NB03660	Booker Pond	29.42	42.36	42.63	0.27	44.26	44.4	0.14	44	39	42



34th Street Improvements - Project No. G3-16



PROJECT G3-16

Problem

The system along 34th Street, which experiences structure flooding in the 100-Year storm event, discharges into a creek next to the Pinellas Technical College (PTEC), which then passes under some pedestrian bridges and then 11 Avenue South before flowing into a pond just to the north of Douglas L. Jamerson Elementary School, which then discharges to a system along 37th Street that outlets into Clam Bayou.

According to the model, the bridge under 11th Avenue consists of double 60-inch pipes, which in considerably smaller than the double 9'x6' boxes upstream of this bridge.

Solution & Project Benefits:

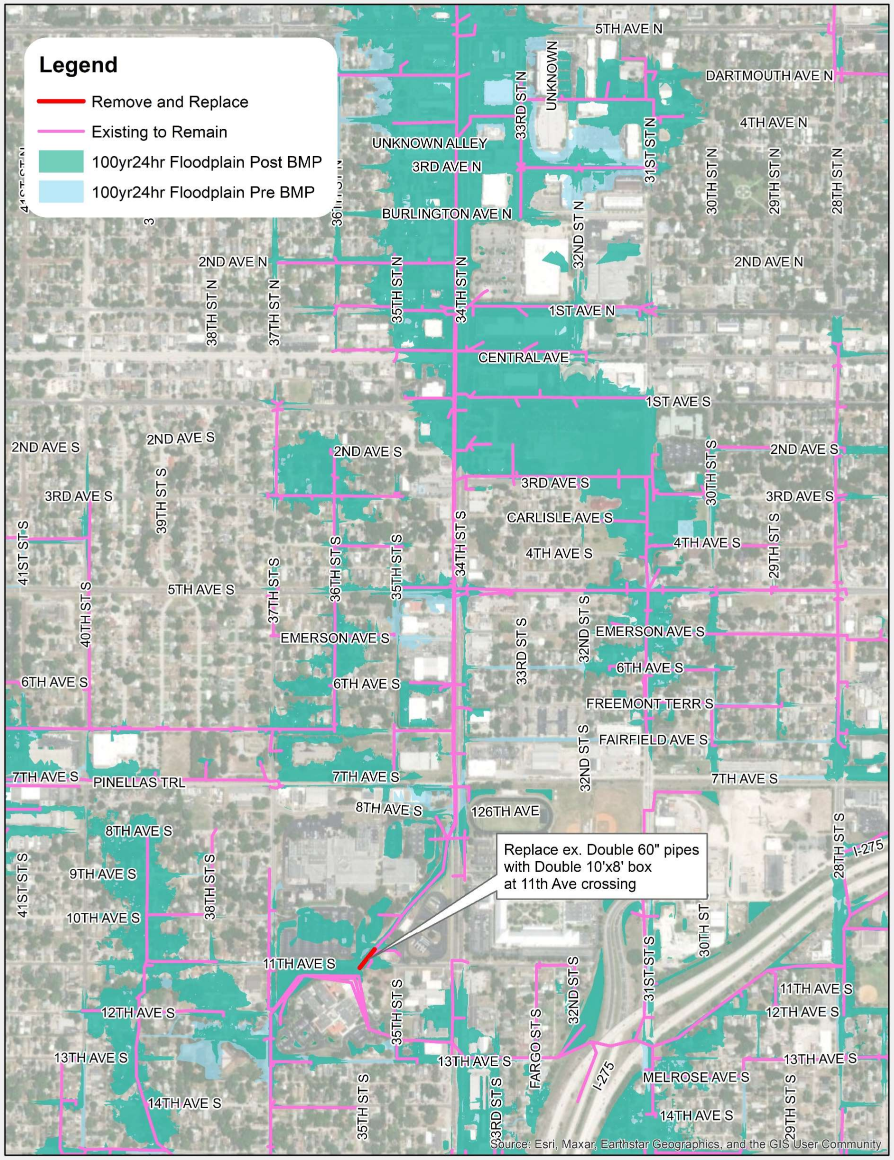
Enlarging the capacity of this bridge in order to accommodate upstream flows will decrease the amount of flooding that is experienced along 34th Street. It is estimated that a double 10'x8' box under 11th Avenue will be sufficient to produce benefits to the 34th Street drainage capacity.

This improvement removes approximately 819 feet of roadway from the 10-year floodplain and 2 structures from the 100-Year floodplain.

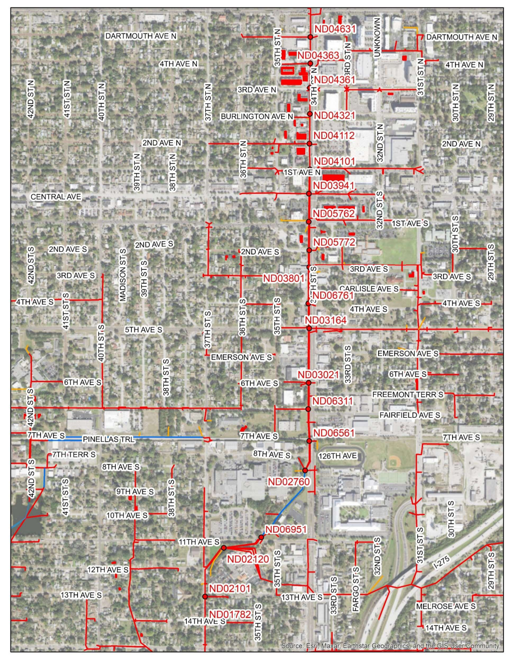
Estimated Cost:

Estimated cost for this project is approximately $643,000 including planning, engineering, and permitting fees.

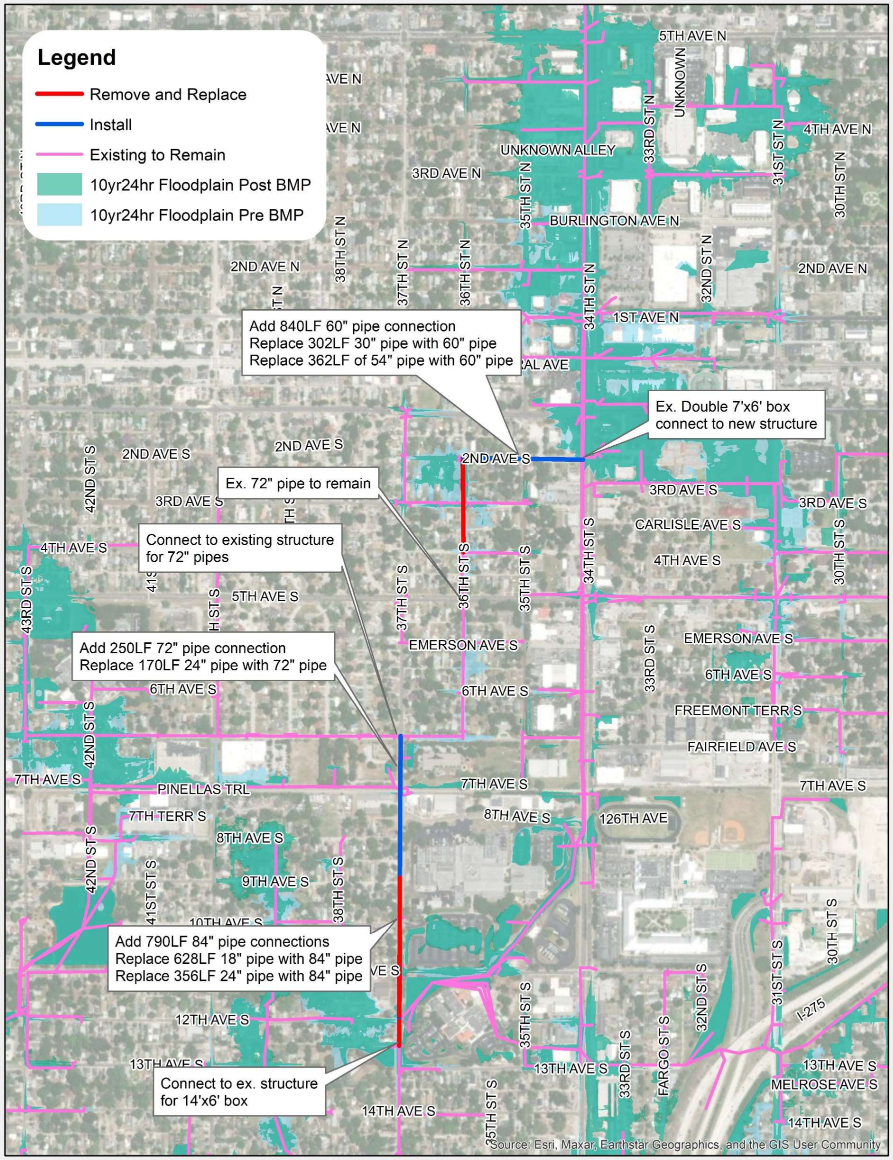
34th Street Improvements - Project No. G3-16 (continued)



Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	EOP
ND04631	34th St & Dartmouth Ave	33.54	44.08	44.05	-0.03	45.03	44.99	-0.04	42.0
ND04363	34th St & 4th Ave	33.50	44.04	44.01	-0.03	45.00	44.97	-0.03	42.0
ND04361	34th St & 3rd Ave	33.05	44.00	43.97	-0.03	44.98	44.94	-0.04	41.0
ND04321	34th St & Burlington Ave	33.00	43.93	43.89	-0.04	44.93	44.89	-0.04	42.0
ND04112	34th St & 2nd Ave	32.91	43.88	43.83	-0.05	44.90	44.86	-0.04	42.0
ND04101	34th St & 1st Ave N	32.27	43.82	43.76	-0.06	44.86	44.82	-0.04	43.0
ND03941	34th St & Central Ave	31.72	43.78	43.7	-0.08	44.85	44.81	-0.04	42.0
ND05762	34th St & 1st Ave S	31.16	43.73	43.64	-0.09	44.82	44.78	-0.04	40.0
ND05772	34th St & 2nd Ave S	31.31	43.23	43.11	-0.12	44.22	44.15	-0.07	41.0
ND03801	34th St & 3rd Ave S	31.11	42.96	42.81	-0.15	43.96	43.89	-0.07	45.0
ND06761	34th St & 4th Ave S	30.65	42.46	42.26	-0.20	43.62	43.56	-0.06	45.0
ND03164	34th St & 5th Ave S	30.47	42.09	41.86	-0.23	43.11	43.02	-0.09	42.0
ND03021	34th St & 6th Ave S	29.74	40.88	40.53	-0.35	42.01	41.89	-0.12	42.0
ND06311	34th St & Fairfield Ave	29.46	40.09	39.69	-0.40	41.04	40.86	-0.18	43.0
ND06561	34th St & Pinellas Trail	29.12	38.77	38.29	-0.48	39.35	39.09	-0.26	42.0
ND02760	PTEC	27.77	37.94	37.41	-0.53	38.25	37.93	-0.32	38.0
ND06951	11th Ave Bridge	25.18	37.68	37.06	-0.62	37.89	37.49	-0.40	36.0
ND02120	Pond @ Jamerson Elem.	25.17	36.61	36.68	0.07	37.10	37.12	0.02	36.0
ND02101	37th St & 13th Ave S	22.93	33.5	33.6	0.10	34.44	34.45	0.01	34.0
ND01782	37th St & 14th Ave S	22.87	31.62	31.73	0.11	32.87	32.88	0.01	35.0



34th Street Bypass - Project No. G3-17



PROJECT G3-17

Problem

The existing stormwater system running north to south along 34th Street consists of double 7'x6' box culverts, which become double 9'x6' box culverts before discharging into the creek that flows by the Pinellas Technical College south of 8th Avenue South. Even with these large box culverts, there is still considerable flooding north of 2nd Avenue along 34th Street in both the 10-Year and 100-Year storm events.

The 34th Street system connects into the existing 37th Street system between 8th Avenue and 13th Avenue South. The 37th Street system consists of double 14'x6' box culverts starting around 13th Avenue, but a 24-inch pipe system extends north of 13th Avenue along 37th Street to 8th Avenue, just south of the Pinellas Trail. North of the Pinellas Trail, running down 36th Street from the north and then turning to the west at Fairfield Avenue, is a stormwater system that discharges into Childs Park Pond.

Connecting the system along 34th Street with the system along 36th Street down to the double 14'x6' box culverts along 37th Street could provide stormwater flood improvements for both the 34th Street and the Childs Park Pond systems.

Solution & Project Benefits:

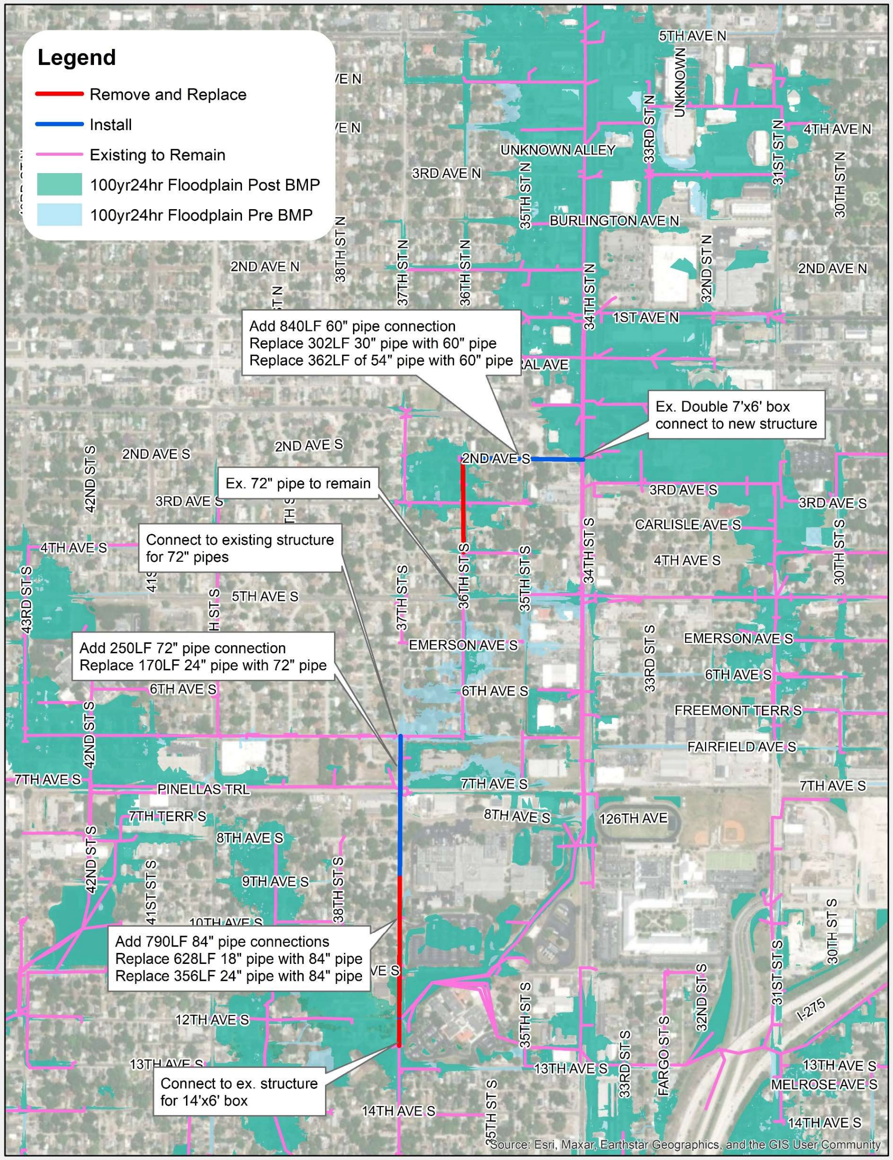
Connecting the two systems would require adding pipe along 2nd Avenue between 34th Street and 36th Street, and also between Fairfield Avenue and 13th Avenue South along 37th Street, which would run under the Pinellas Trail. This system would relieve some of the flow running down the pipes under 34th Street as well as relieving some of the flow running in the pipes to Childs Park Pond.

This project would remove approximately 783 feet of roadway from the 10-year floodplain and 6 structures from the 100Y floodplain. Four (4) of these houses are in Basin E, which flows to Childs Park Pond, and 2 of these houses are in Basin D, which flows down 37th Street to the Gulf.

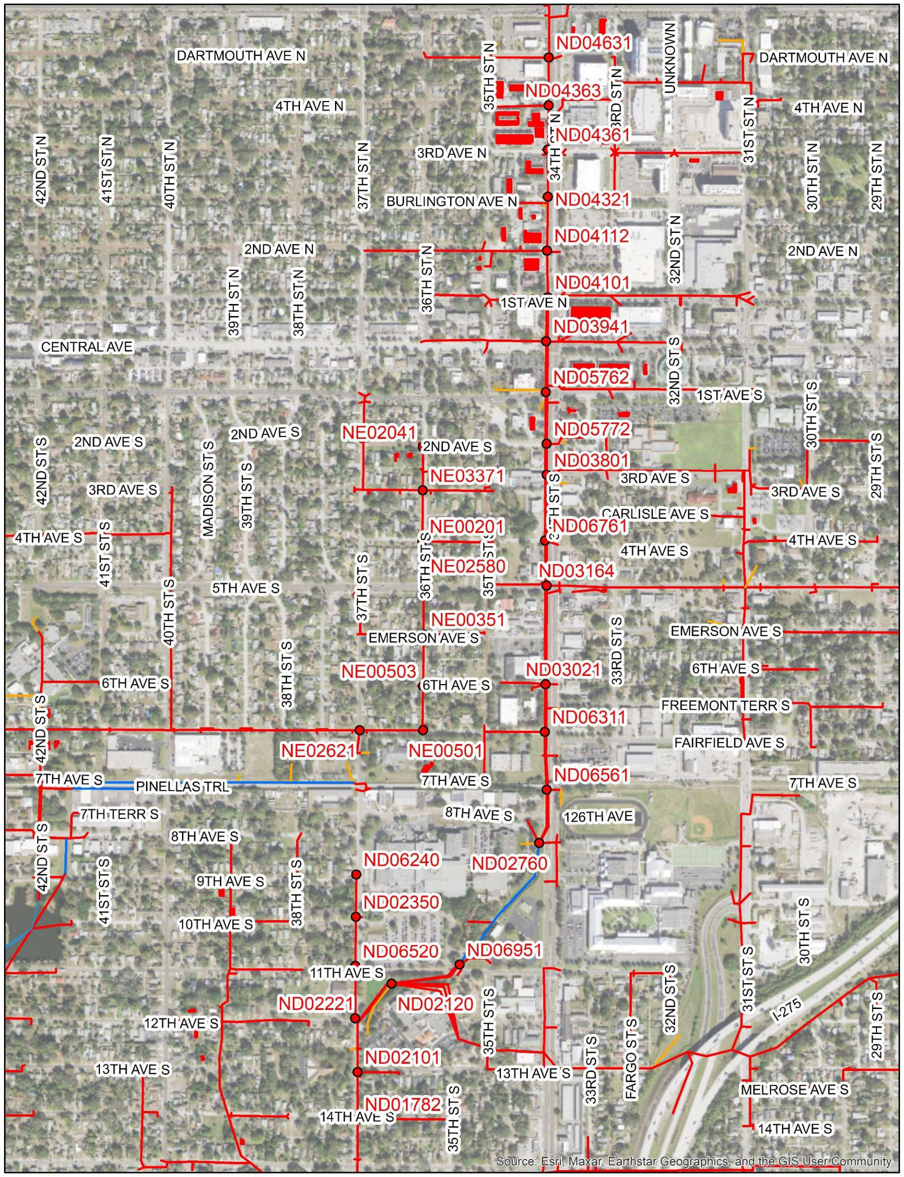
Estimated Cost:

Estimated cost for this project is approximately $12,390,000 including planning, engineering, and permitting fees.

34th Street Bypass - Project No. G3-17 (continued)

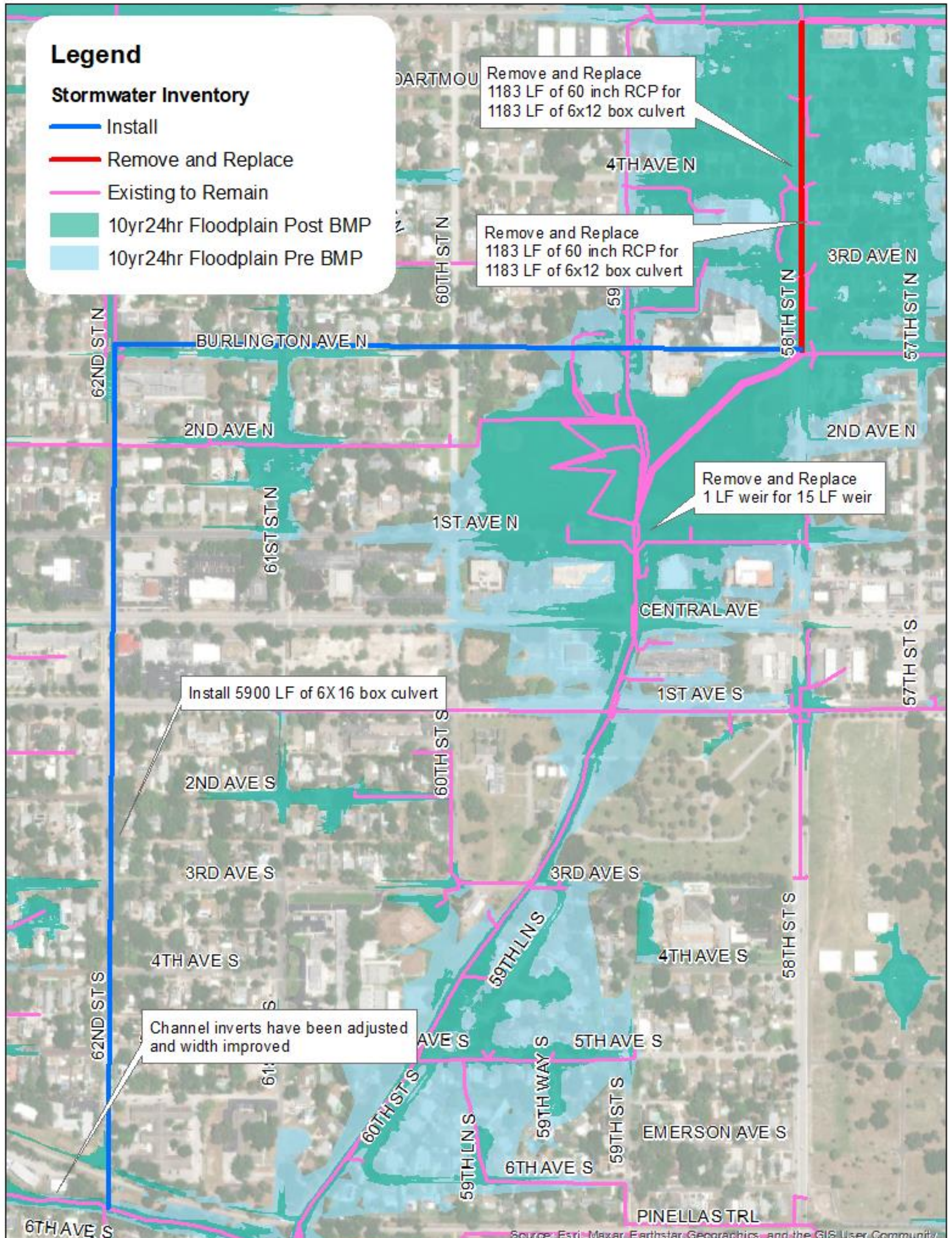


34th Street Bypass - Project No. G3-17 (continued)



Node	Location Description	Initial Stage	10-Year EX	10-Year PR	10-Year Δ	100-Year EX	100-Year PR	100-Year Δ	EOP
ND04631	34th St & Dartmouth Ave	33.54	44.08	44.08	0.00	45.03	45.00	-0.03	42.0
ND04363	34th St & 4th Ave	33.50	44.04	44.04	0.00	45.00	44.98	-0.02	42.0
ND04361	34th St & 3rd Ave	33.05	44.00	44.00	0.00	44.98	44.95	-0.03	41.0
ND04321	34th St & Burlington Ave	33.00	43.93	43.92	-0.01	44.93	44.91	-0.02	42.0
ND04112	34th St & 2nd Ave	32.91	43.88	43.87	-0.01	44.90	44.87	-0.03	42.0
ND04101	34th St & 1st Ave N	32.27	43.82	43.80	-0.02	44.86	44.83	-0.03	43.0
ND03941	34th St & Central Ave	31.72	43.78	43.74	-0.04	44.85	44.82	-0.03	42.0
ND05762	34th St & 1st Ave S	31.16	43.73	43.66	-0.07	44.82	44.79	-0.03	40.0
ND05772	34th St & 2nd Ave S	31.31	43.23	43.22	-0.01	44.22	44.22	0.00	41.0
ND03801	34th St & 3rd Ave S	31.11	42.96	42.96	0.00	43.96	43.96	0.00	45.0
ND06761	34th St & 4th Ave S	30.65	42.46	42.44	-0.02	43.62	43.60	-0.02	45.0
ND03164	34th St & 5th Ave S	30.47	42.09	42.09	0.00	43.11	43.09	-0.02	42.0
ND03021	34th St & 6th Ave S	29.74	40.88	40.89	0.01	42.01	41.96	-0.05	42.0
ND06311	34th St & Fairfield Ave	29.46	40.09	40.10	0.01	41.04	41.00	-0.04	43.0
ND06561	34th St & Pinellas Trail	29.12	38.77	38.80	0.03	39.35	39.32	-0.03	42.0
ND02760	PTEC	27.77	37.94	37.96	0.02	38.25	38.24	-0.01	38.0
ND06951	11th Ave Bridge	25.18	37.68	37.70	0.02	37.89	37.88	-0.01	36.0
ND02120	Pond @ Jamerson Elem.	25.17	36.61	36.82	0.21	37.10	37.15	0.05	36.0
ND02101	37th St & 13th Ave S	22.93	33.50	34.03	0.53	34.44	34.72	0.28	34.0
ND01782	37th St & 14th Ave S	22.87	31.62	32.18	0.56	32.87	33.13	0.26	35.0
NE02041	36th St & 2nd Ave S	38.94	43.98	43.24	-0.74	44.25	44.21	-0.04	43.0
NE03371	36th St & 3rd Ave S	34.30	43.74	43.08	-0.66	44.11	44.08	-0.03	43.0
NE00201	36th St & 4th Ave S	33.31	43.40	42.40	-1.00	43.96	43.89	-0.07	43.0
NE02580	36th St & 5th Ave S	33.13	42.77	41.55	-1.22	43.63	43.51	-0.12	43.0
NE00351	36th St & Emerson Ave	30.61	41.64	40.43	-1.21	42.25	41.84	-0.41	40.0
NE00503	36th St & 6th Ave S	30.31	41.11	39.62	-1.49	41.72	41.09	-0.63	41.0
NE00501	36th St & Fairfield Ave	29.57	40.29	38.41	-1.88	41.03	39.92	-1.11	40.0
NE02621	37th St & Fairfield Ave	29.14	39.14	36.84	-2.30	40.24	38.16	-2.08	41.0
ND06240	37th St & 9th Ave S	33.22	36.34	36.23	-0.11	36.87	37.06	0.19	38.0
ND02350	37th St & 10th Ave S	32.42	36.32	36.01	-0.31	36.85	36.73	-0.12	36.0
ND06520	37th St & 11th Ave S	31.17	35.45	35.77	0.32	36.41	36.37	-0.04	36.0
ND02221	37th St & 12th Ave S	29.82	35.51	35.54	0.03	35.98	36.00	0.02	34.0

Flooding Improvements at 58th Street N and Burlington Avenue- Project No. G4-1



Problem

BMP 4_1 focuses on the conveyance system draining 58th Street N and Burlington Avenue.

The existing condition of the 10yr24hr floodplain demonstrate severe road flooding and road flooding. Several structures along 58th Street N and Bear creek Road are flooding as seen on the Figure. The existing conveyance collect water and discharges to Bear creek. Existing structure are not sized adequately to the amount of discharge of the road. This solution requires the channel improvements included with project No. G4-2 to be completed.

BMP 4-1 Focuses on upgrading existing conveyance along 58th Street N and creating a new route to discharge where Bear Creek may provide additional capacity.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

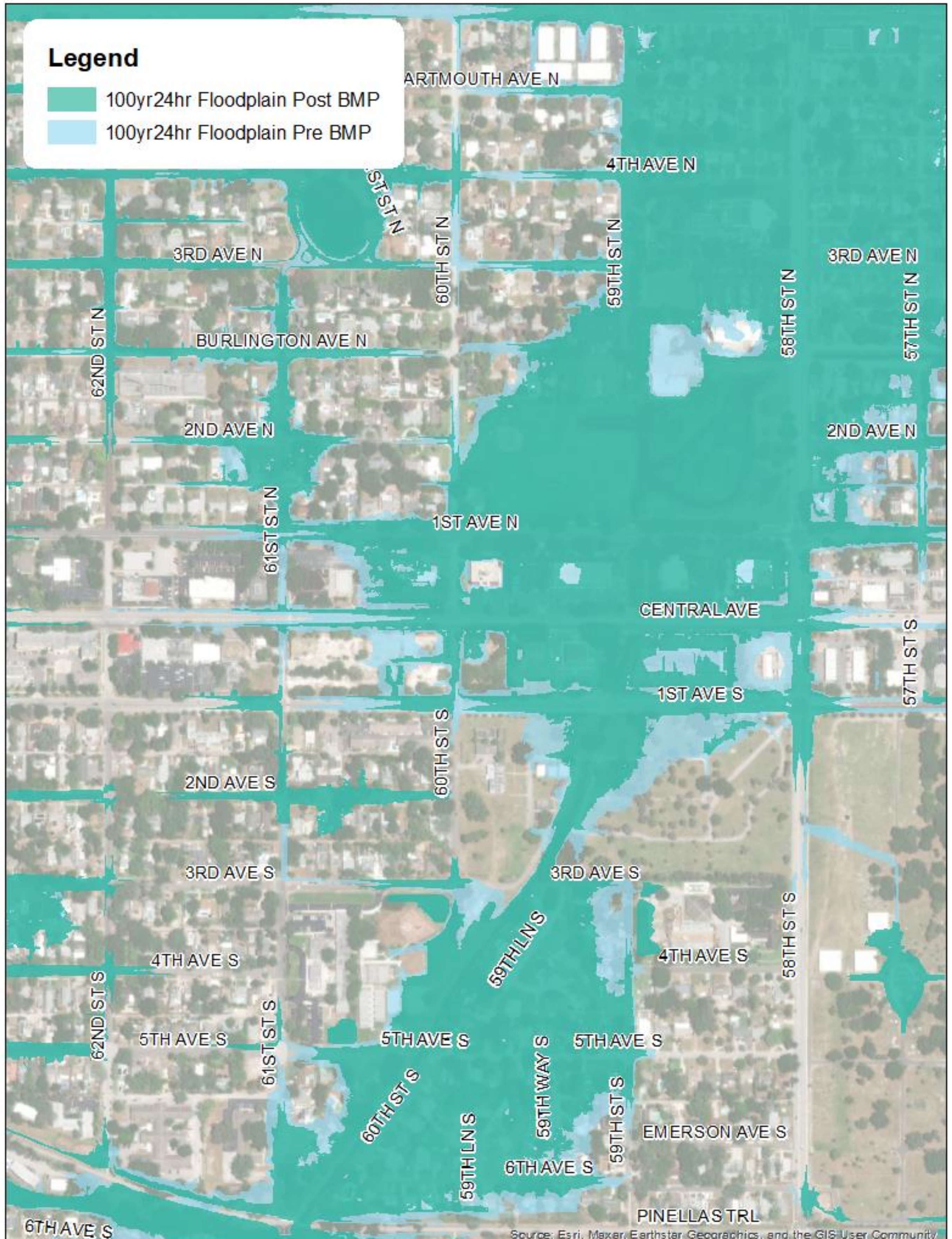
- Remove and Replace 1183 LF of 60-inch RCP for 1183 LF of 6x12 box culvert
- Remove and Replace 1183 LF of 60-inch RCP for 1183 LF of 6x12 box culvert
- Remove and Replace 1 LF weir for 15 LF weir.
- Install 5900 LF of 6X16 box culvert
- Channel inverts have been adjusted and width improved.

This alternative removes approximately 4267 feet of roadway from the 10-year floodplain and 14 structures from the 100-year floodplain.

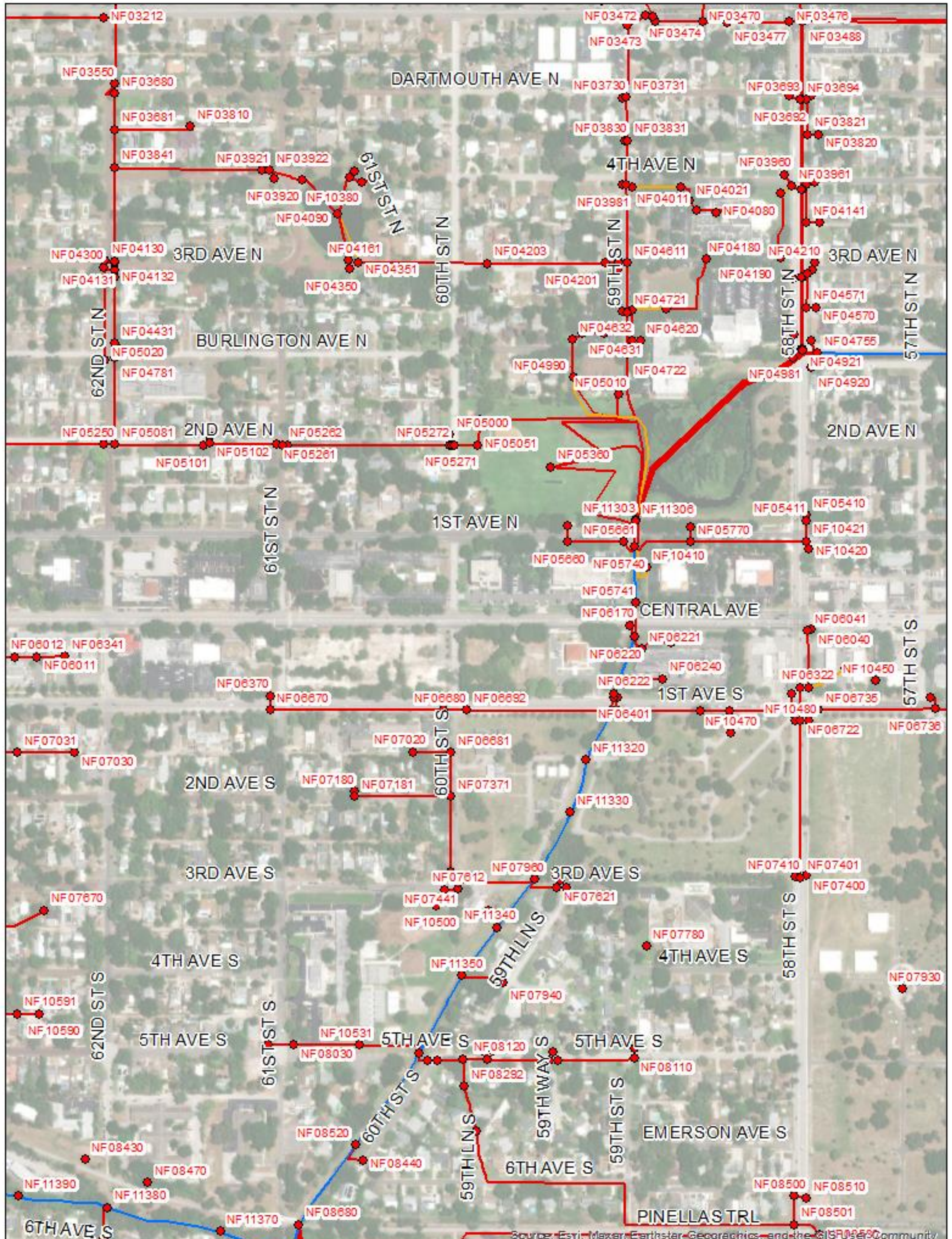
Estimated Cost:

Estimated cost for this project is approximately $61,678,508 including planning, engineering, and permitting fees..

Flooding Improvements at 58th Street N and Burlington Avenue- Project No. G4-1

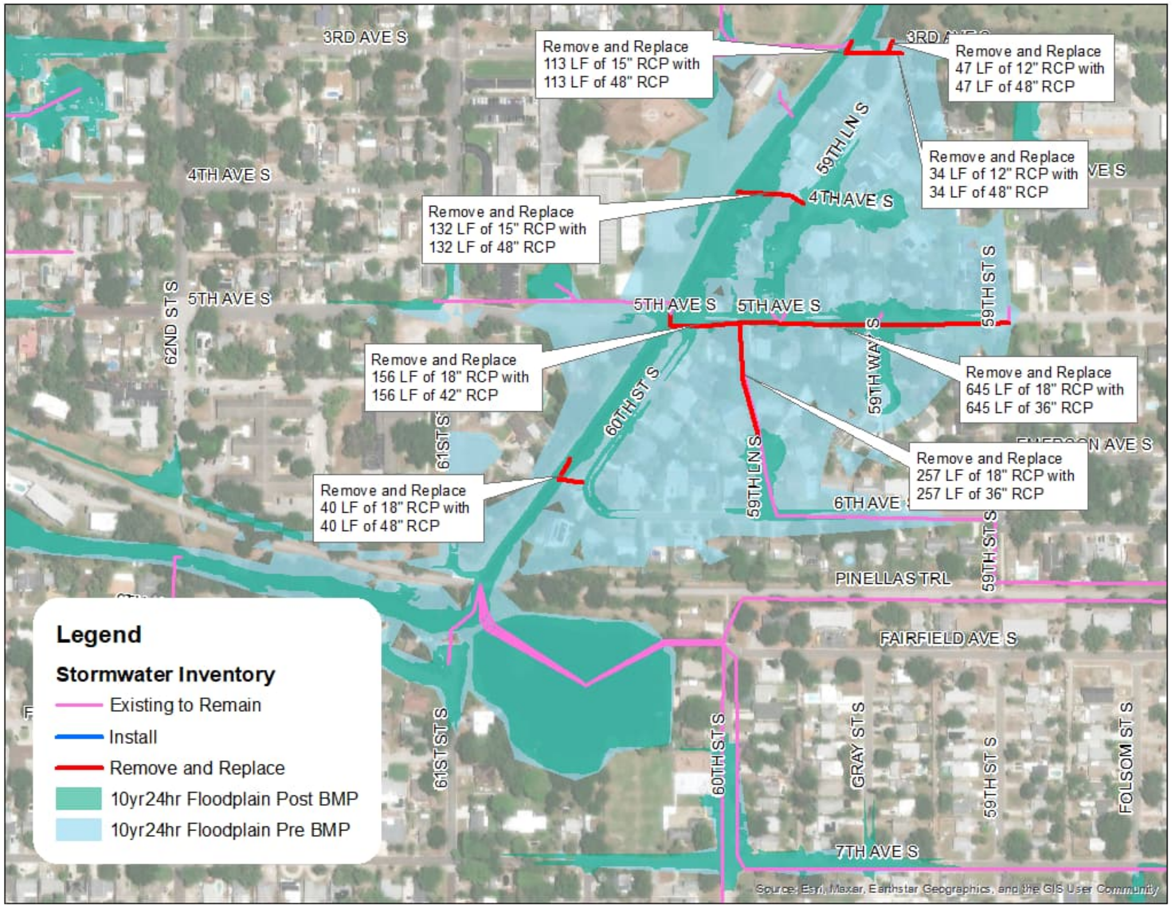


Node Reference Map - Project No. G4-1



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NF04922	58TH Street N	8.12	19.37	15.91	3.46	20.53	18.72	1.81
NF04442	58TH Street N	8.86	19.38	16.66	2.72	20.52	18.72	1.8
NF06990	58TH Street N	7.6	18.73	16.23	2.5	20.14	18.51	1.63

Flooding Improvements at 60th Street South – Project No. G4-2



Problem

BMP G4-2 focuses improvements to Bear Creek that will provide flood relief for the surrounding area. Bear Creek does not have the capacity to handle stormwater flows and requires widening and grading improvements from Mango Ave. S. To 1st Ave N. The proposed improvements for this BMP area centered on flood conveyance only and maintain a 25' wide minimum channel bottom through this stretch of the Creek. Further study may be utilized to identify potential to integrate the creek improvements with trails such as the Pinellas Trail as well as other features to prevent erosion and scour that may limit future capacity if not tended to.

The existing condition of the 10-year floodplain demonstrates severe road flooding along the banks of Bear's Creek and surrounding neighborhoods especially east of the creek. Once the proposed conveyance improvements are completed, this project includes expansion of the conveyance system servicing the area for optimal results.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Improve 5,060 LF of Bear Creek from Mango Ave S. to 1st Ave N. with 25' wide minimum channel bottom.
- Remove and replace 40 LF of 15" RCP with 48" RCP at 6th Ave. S. Connecting to the creek with a backflow prevention device.
- Remove and replace existing pipe at the north side of 5th Ave. S. with 156 LF of 42" ERCP connecting to the creek with a backflow prevention device.
- Remove and replace the remainder of the stormwater conveyance system at this location with 902 LF – 36" RCP
- Remove and replace existing pipe near 4th Ave. S. with 132 LF of 48" RCP connecting to the creek with a backflow prevention device.
- Remove and replace existing pipe at 3rd Ave. S. with 194 LF of 48" RCP connecting to the creek with a backflow prevention device.

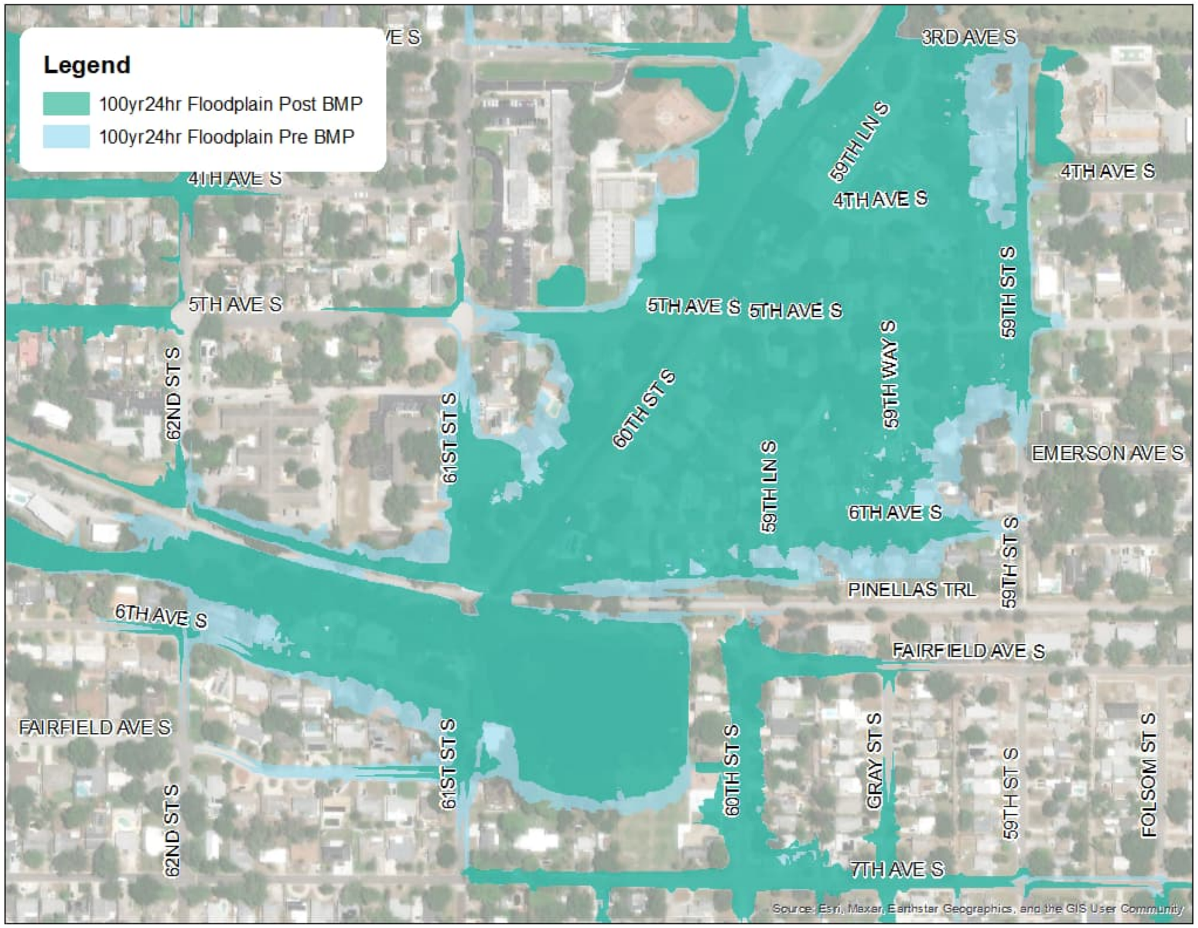
This area a highly residential area, two school, and some commercial developments in the vicinity. As the improvements center along the creek, transportation impacts would be minimized. Detailed study is required to maximize the benefits of improvements at Bear Creek and verify the maximum improvements possible. Likewise, a property study is necessary to confirm property and easements extents along the creek

This alternative removes approximately 1535 feet of roadway from the 10-year floodplain and 16 structures from the 100-year floodplain.

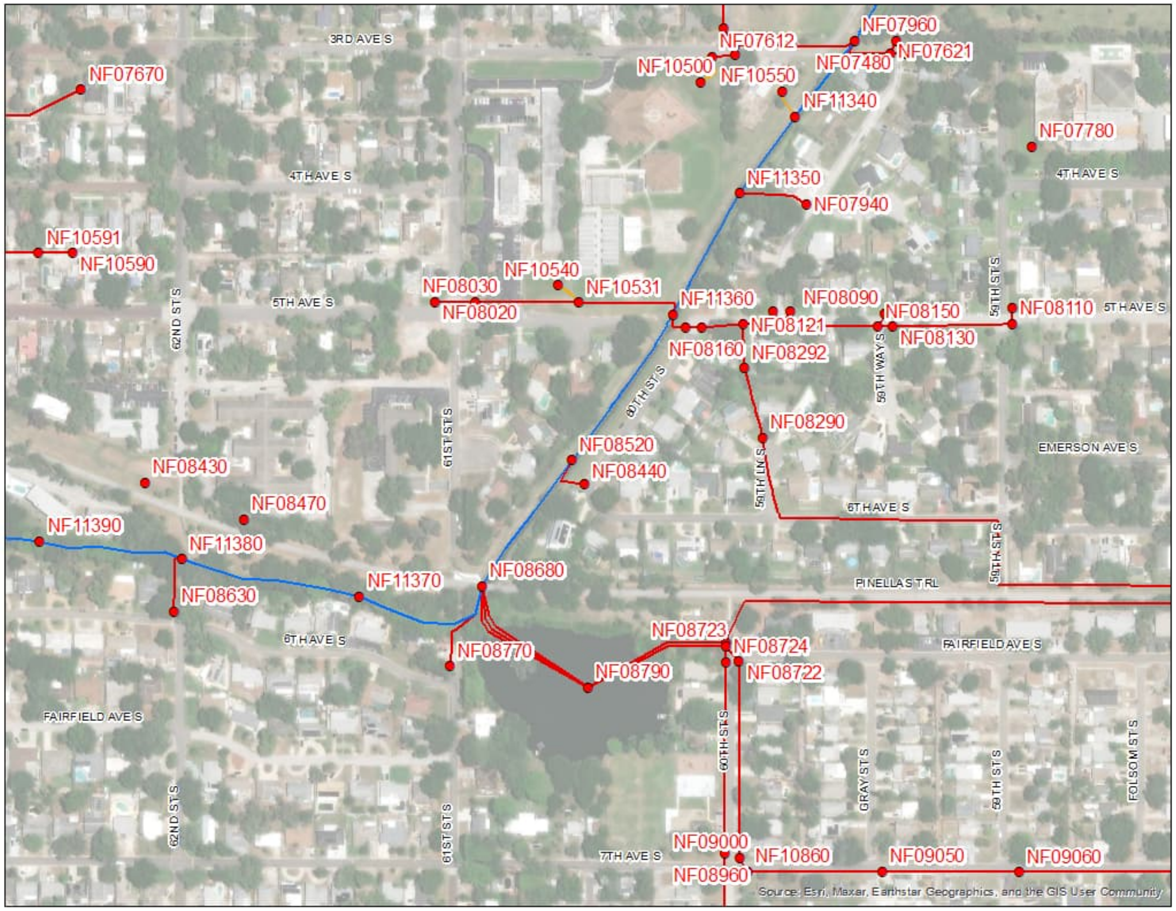
Estimated Cost:

Estimated cost for this project is approximately $24,308,455 including planning, engineering, construction, and permitting fees.

Flooding Improvements at 60th Street South – Project No. G4-2

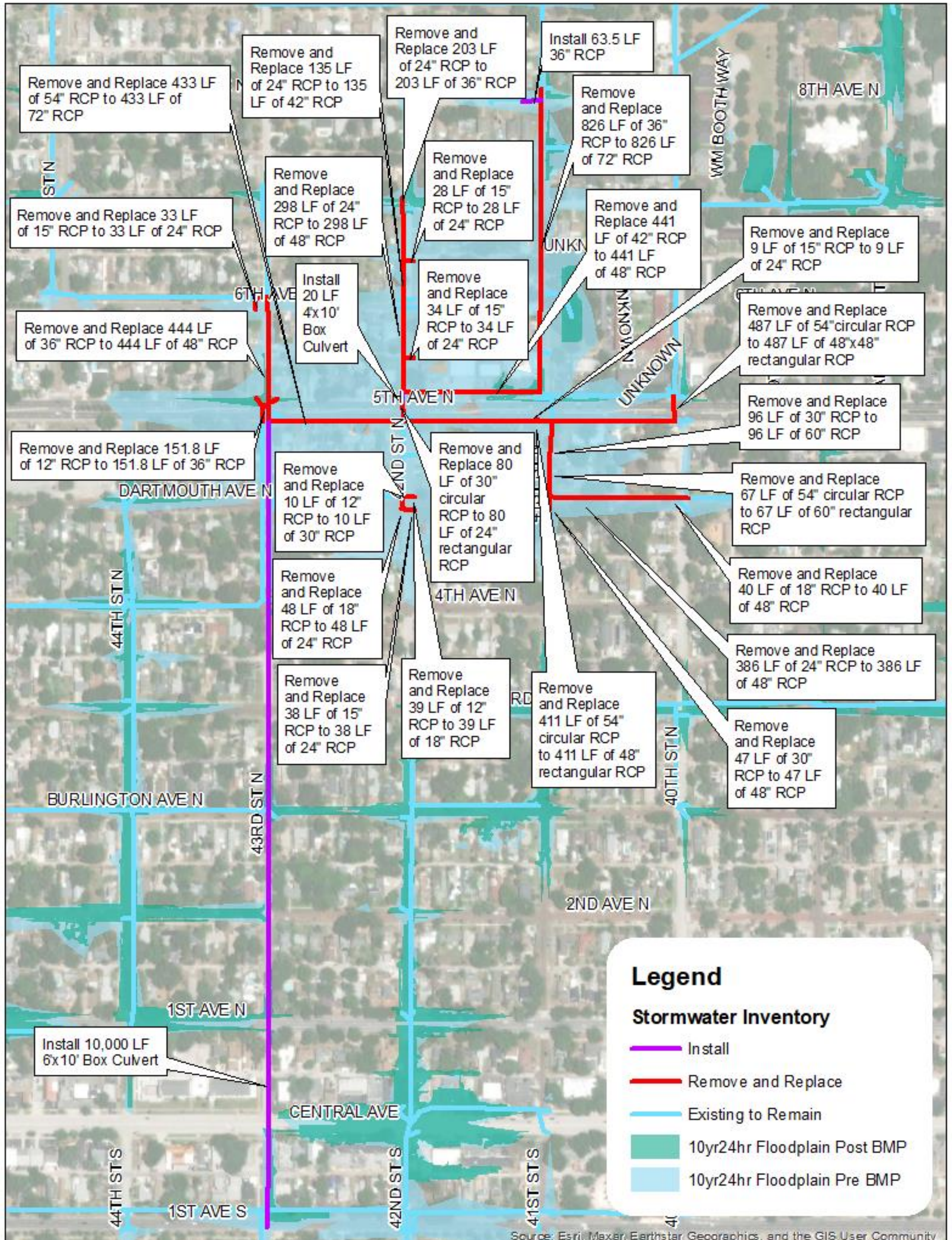


Node Reference Map – Project No. G4-2



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NF07940	59th Ln S at 4th Ave S	12.36	17.81	15.47	-2.34	19.27	18.17	-1.1
NF08290	Cul-de-sac at 59th Ln S	11.92	17.72	15.87	-1.85	19.2	18.1	-1.1
NF08440	6th Ave S at 60th ST S	12.14	17.7	15.08	-2.62	19.17	18.08	-1.09
NF08520	Bear Creek @ Pinellas Trail	10.13	16.93	15.06	-1.87	18.6	17.96	-0.64

Flooding Improvements at 5TH Avenue North - Project No. G4-3



Problem

BMP G4-3 focuses lack of conveyance system along 5th Avenue North (Figure G4-3-1).This area consists of an outdated pipe system which results in the flooding of the area. The existing conditions of the 10yr floodplain demonstrating severe road flooding as well as structure flooding along 5th Avenue North and adjacent roads. BMP G4-3 improvements includes updating current pipe systems along 5th Avenue North and the addition of a new outfall system along 5th Avenue North.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

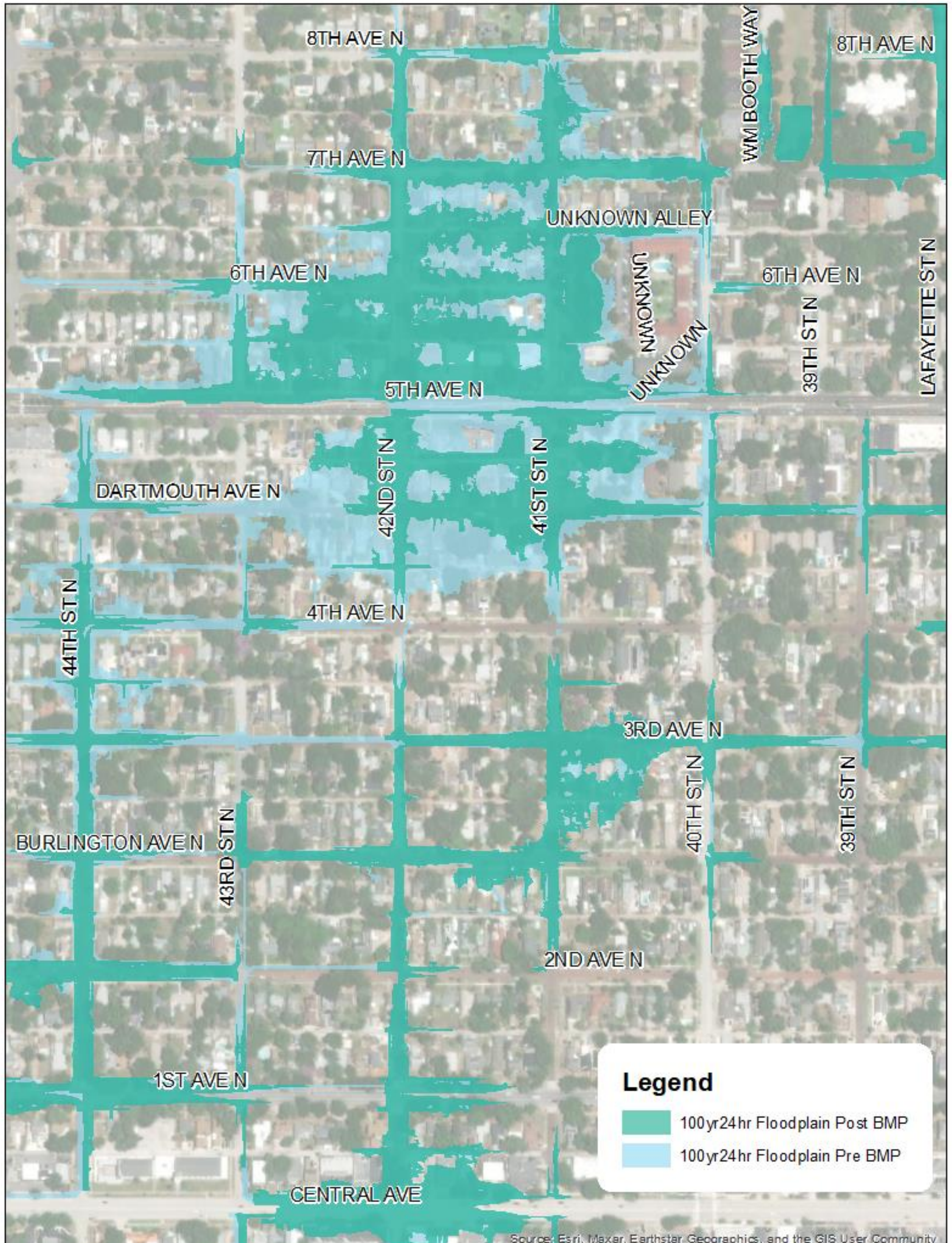
- Install 20 LF 4'x10' Box Culvert.
- Install 10,000 LF 6'x10' Box Culvert.
- Install 63.5 LF 36" RCP.
- Remove and Replace 433 LF of 54" RCP to 433 LF of 72" RCP.
- Remove and Replace 33 LF of 15" RCP to 33 LF of 24" RCP.
- Remove and Replace 444 LF of 36" RCP to 444 LF of 48" RCP.
- Remove and Replace 151.8 LF of 12" RCP to 151.8 LF of 36" RCP.
- Remove and Replace 135 LF of 24" RCP to 135 LF of 42" RCP.
- Remove and Replace 298 LF of 24" RCP to 298 LF of 48" RCP.
- Remove and Replace 203 LF of 24" RCP to 203 LF of 36" RCP.
- Remove and Replace 28 LF of 15" RCP to 28 LF of 24" RCP.
- Remove and Replace 34 LF of 15" RCP to 34 LF of 24" RCP.
- Remove and Replace 826 LF of 36" RCP to 826 LF of 72" RCP.
- Remove and Replace 441 LF of 42" RCP to 441 LF of 48" RCP.
- Remove and Replace 10 LF of 12" RCP to 10 LF of 12" RCP.
- Remove and Replace 48 LF of 18" RCP to 48 LF of 24" RCP.
- Remove and Replace 38 LF of 15" RCP to 38 LF of 24" RCP.
- Remove and Replace 80 LF of 30" circular RCP to 80 LF of 24" rectangular RCP.
- Remove and Replace 39 LF of 12" RCP to 39 LF of 18" RCP.
- Remove and Replace 411 LF of 54" circular RCP to 411 LF of 48" RCP.
- Remove and Replace 9 LF of 15" RCP to 9 LF of 24" RCP.
- Remove and Replace 487 LF of 54" circular RCP to 487 LF of 60" rectangular RCP.
- Remove and Replace 96 LF of 30" RCP to 96 LF of 60" RCP.
- Remove and Replace 67 LF of 54" circular RCP to 67 LF of 60" rectangular RCP.
- Remove and Replace 40 LF of 18" RCP to 40 LF of 48" RCP.
- Remove and Replace 386 LF of 24" RCP to 386 LF of 48" RCP.
- Remove and Replace 47 LF of 30" RCP to 47 LF of 48" RCP.

The benefits of implementing this proposed BMP include removing 12,922 LF of roadway from the 10yr-24hr floodplain. As an ancillary benefit, the proposed improvements would also reduce the volume and peak flow rate of stormwater sent through the existing downstream outfall which leads to other areas with historical flooding outside of the BMP area including the Burlington Ave N canal between 52nd Street N and 58th Street N. This BMP removes 17 structures from the 100-year floodplain

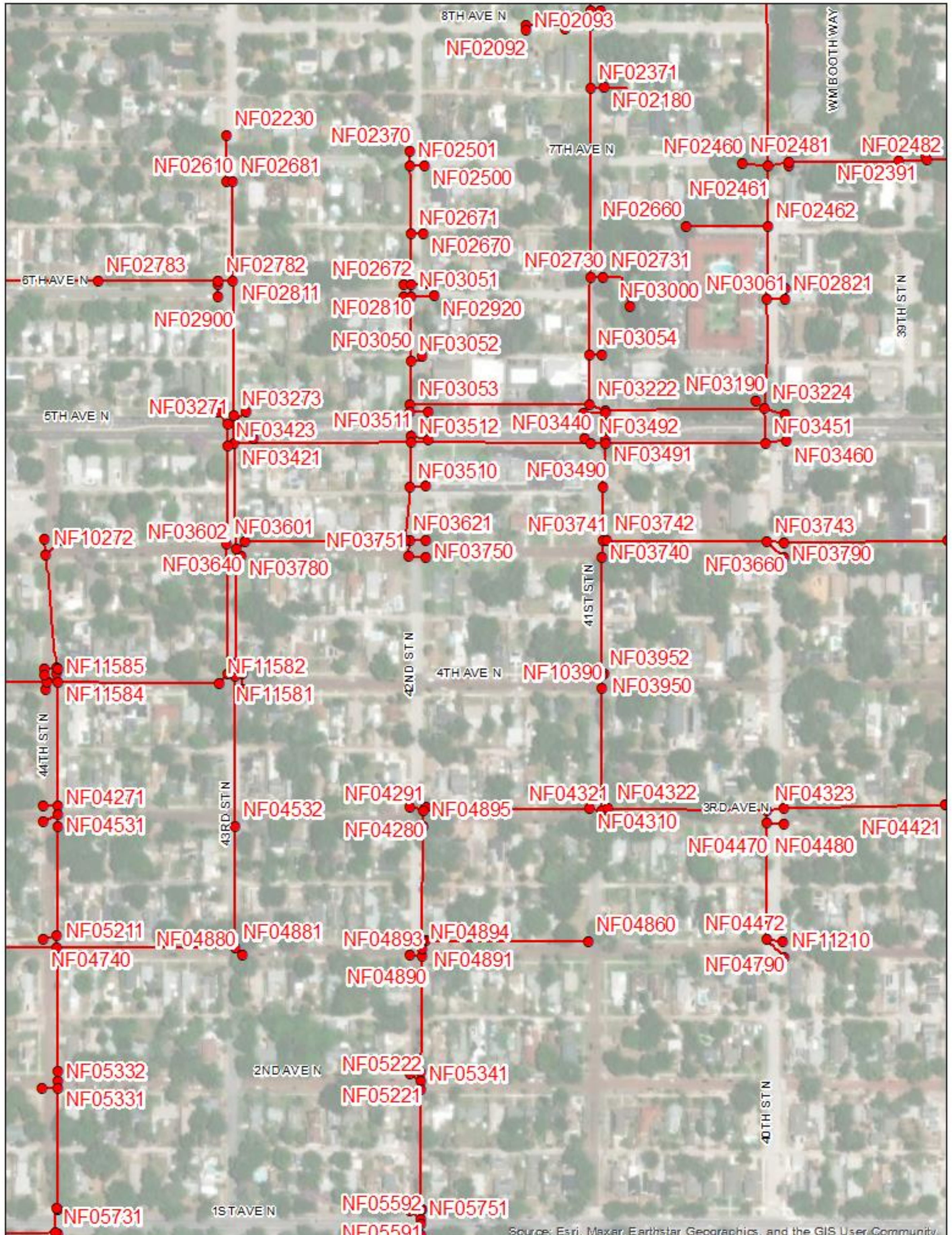
Estimated Cost:

Estimated cost for this project is approximately $49.5 M including planning, engineering, and permitting fees..

Flooding Improvements at 5TH Avenue North - Project No. G4-3

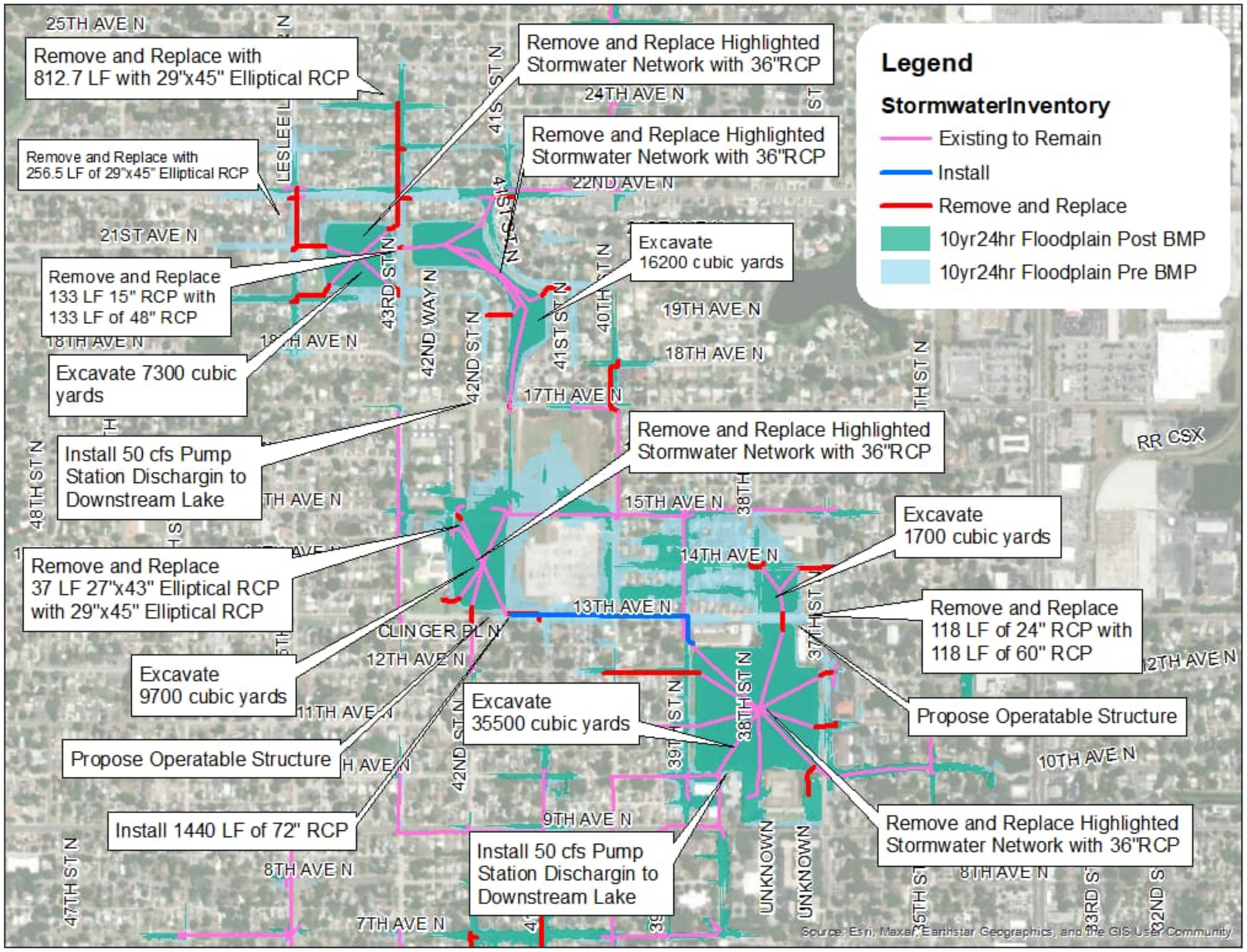


Node Reference Map - Project No. G4-3



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NF03440	5th Ave N	37.53	42.55’	38.12’	4.43’	42.79’	41.99’	0.80’
NF03273	5th Ave N	34.47	42.75’	38.06’	4.69’	42.96’	41.14’	1.82’
NF03620	Dartmouth Ave N	37.7	42.52’	39.38’	3.14’	42.74’	41.98’	0.76’
NF02920	6th Ave N	39.21	42.59’	40.05’	2.54’	42.84’	42.36’	0.46’

Flooding Improvements at 22nd Ave and 43rd St – Project No. G4-4



Problem

BMP 4-4 focuses on creating more storage within the retention ponds located in this area then increasing pipe sizes around the ponds to 36" pipe sizes. Most of the pipe's systems in this area are undersized and are unable to convey the volume of inflow needed during heavy rain events. This area consist of high-density residential land use east of 34th St N and south of 22nd Avenue N. The solution relies on the ability to create drawdown storage in advance of predicted adverse weather or respond to changing weather conditions by interconnecting the retention ponds in the area through control structure and concrete pipes or pump stations as needed. Pump stations would operate in advance of flood stages, assisting at preventing adverse impacts.

Solution & Project Benefits:

BMP 4-4 proposes the following changes to alleviate roadway, residential, and commercial flooding within the 60th Street South area of Bear's Creek:

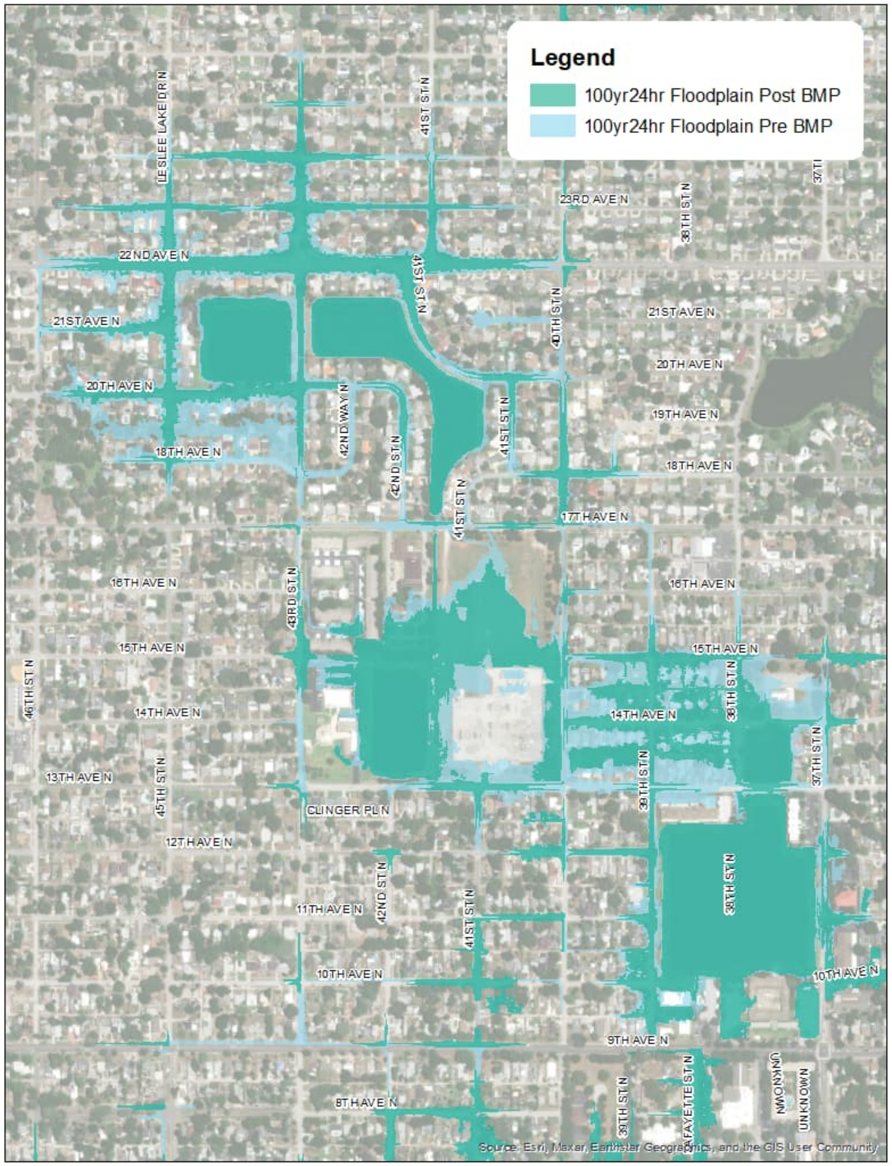
- Create more storage by excavating an additional 3' of depth across the 3 acre retention pond located west of 43rd St and south of 22nd Ave N.
- Remove and replace the existing ERCP with 256.5 LF of 29"x45" ERCP on 45th St N from 22nd Ave N into the retention ponds located west of 43rd St N.
- Remove and replace the existing ERCP with 812.7 LF of 29"45" ERCP on 43rd St N from 24th Ave N into the retention pond located west of 43rd St N.
- Excavate an additional 4' of depth across the 5 acre retention pond located east of 43rd St and south of 22nd Ave N.
- Remove and replace the existing pipe connecting these two ponds with 133 LF – 48" RCP.
- Install a 50 CFS pump station located at the pond east of 43rd St that discharges to the downstream pond.
- Increase the capacity of the existing pipes and drainage structures within the retention pond located east of 43rd St N from 18" pipes to 36" pipes.
- The retention pond located east of St. Therese Byzantine Catholic Church on 13th Ave N is excavated an additional 4' across 3 acres.
- Install an operable structure leaving the pond to assist in managing lake levels in advance of adverse weather.
- Remove and replace the existing pipes connecting to Jorgenson Lake Park with 1,440 LF – 72" RCP
- The capacity of the existing 18" pipes around the retention pond located next to the church is increased to 36" to help alleviate roadway flooding on 13th Ave N.
- Excavate Jorgenson lake an additional 4' across 11 acres.
- Excavate the pond north of Jorgenson lake an additional 2' across 1 acre.
- Remove and replace the pipes connecting the two ponds with 118 LF – 60" RCP
- The existing pipes around the two retention ponds range from 15" to 18" are all increased to 36" pipes.
- Install a 50 CFS pump station to control lake levels in Jorgenson Lake

This alternative removes approximately 9815 feet of roadway from the 10-year floodplain and 30 structures from the 100-year floodplain.

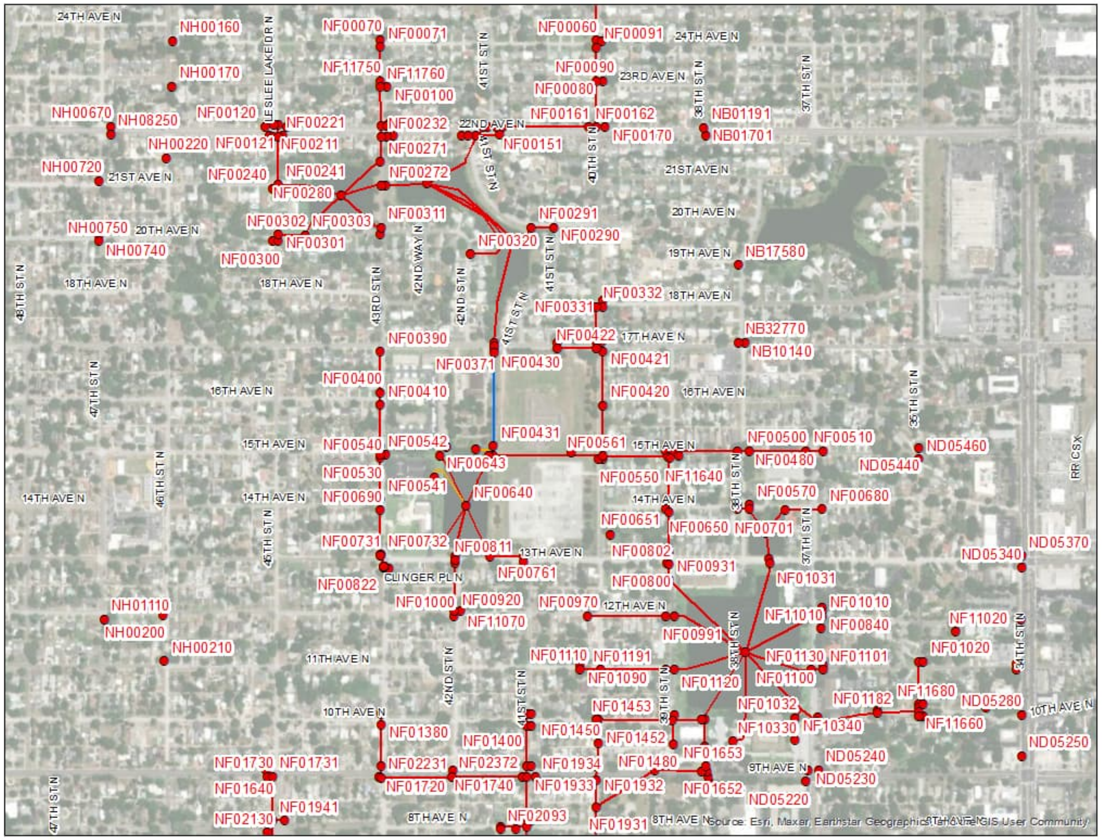
Estimated Cost:

Estimated cost for this project is approximately $35,484,473 including planning, engineering, construction, and permitting fees.

Flooding Improvements at 22nd Ave and 43rd St – Project No. G4-4

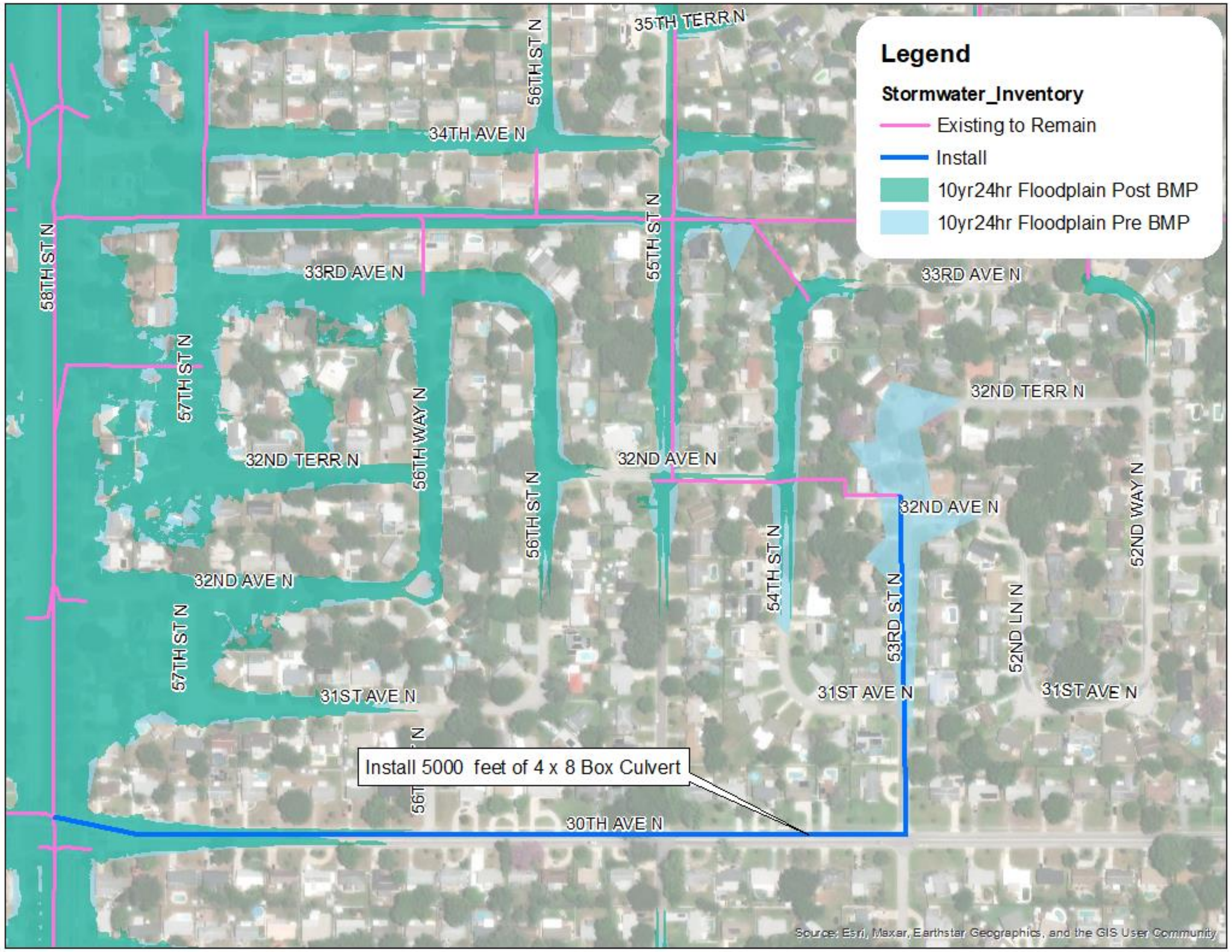


Node Reference Map – Project No. G4-4



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NF00270	43rd Street N	43.19	49.21	46.08	3.13	49.79	48.89	0.9
NF00272	43rd Street N	45.11	49.23	46.1	3.13	49.79	48.93	0.5
NF00271	43rd Street N	40.31	49.26	46.44	2.82	49.8	49	0.8
NF00311	19th Avenue N at 43th Street N	39.77	49.25	46.45	2.8	49.79	48.99	0.8

Flooding Improvements at 53rd Street N - Project No. G5-2



Problem

BMP 5-2 focuses on the conveyance system draining from 53rd Street North out falling to the channel along 58th Street N.

BMP 5-2's location experiences both structural and road flooding in a residential neighborhood. This location is drained to an existing channel running north to outfall channel along 34th Avenue N. Currently this BMP area does not have an adequate pipe system to allow the current runoff to drain appropriately to the channel. Additional benefits can be achieved by increasing the conveyance around the neighborhood, but there are downstream impacts along the ditch if more area is drained faster to the channel.

BMP 5-3 will increase the current water drainage from the target location to its outfall along 58th Street N.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

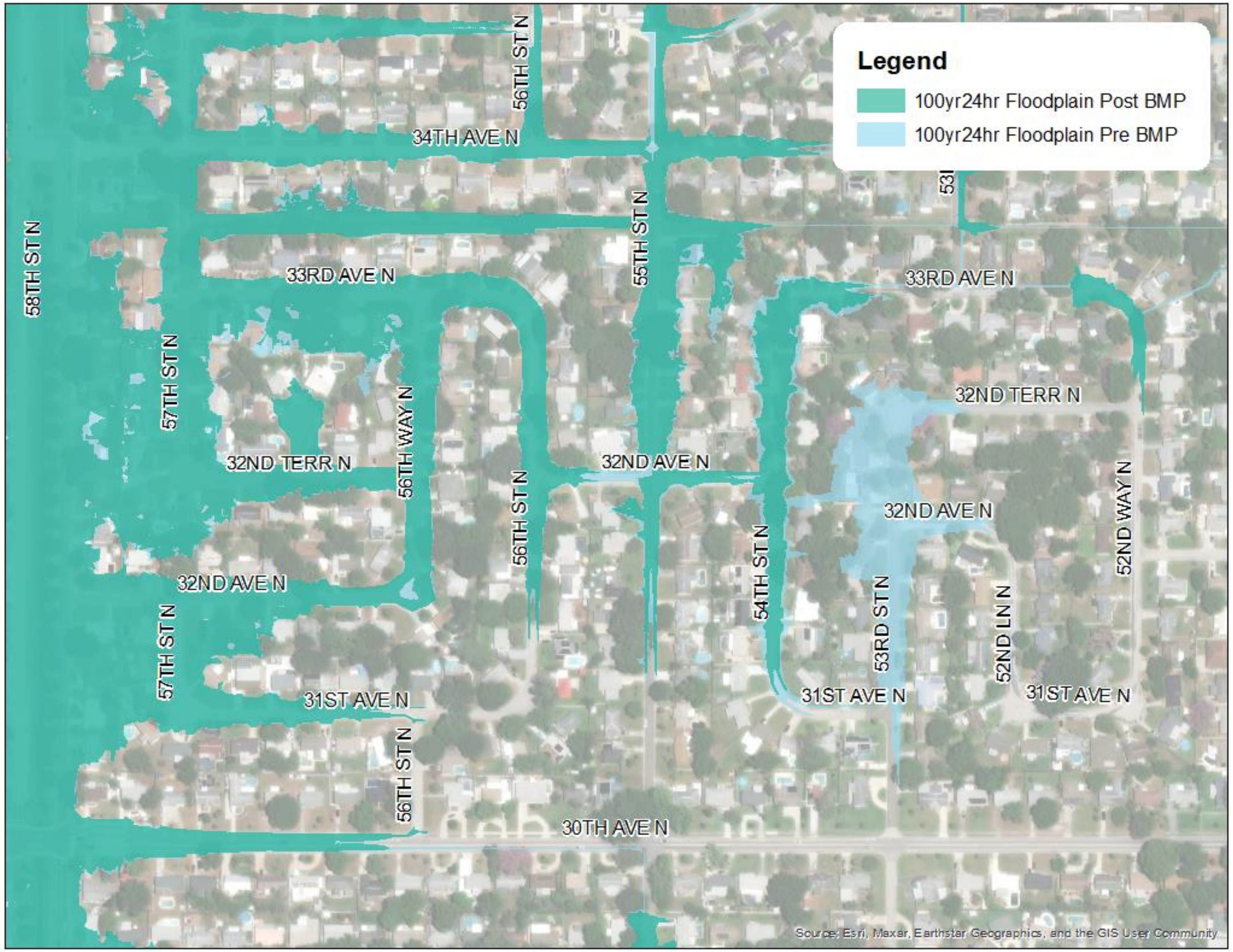
- Install 2700 feet of 4x8 box culvert

This alternative removes approximately 693 feet of roadway from the 10-year floodplain and 2 structures from the 100-year floodplain.

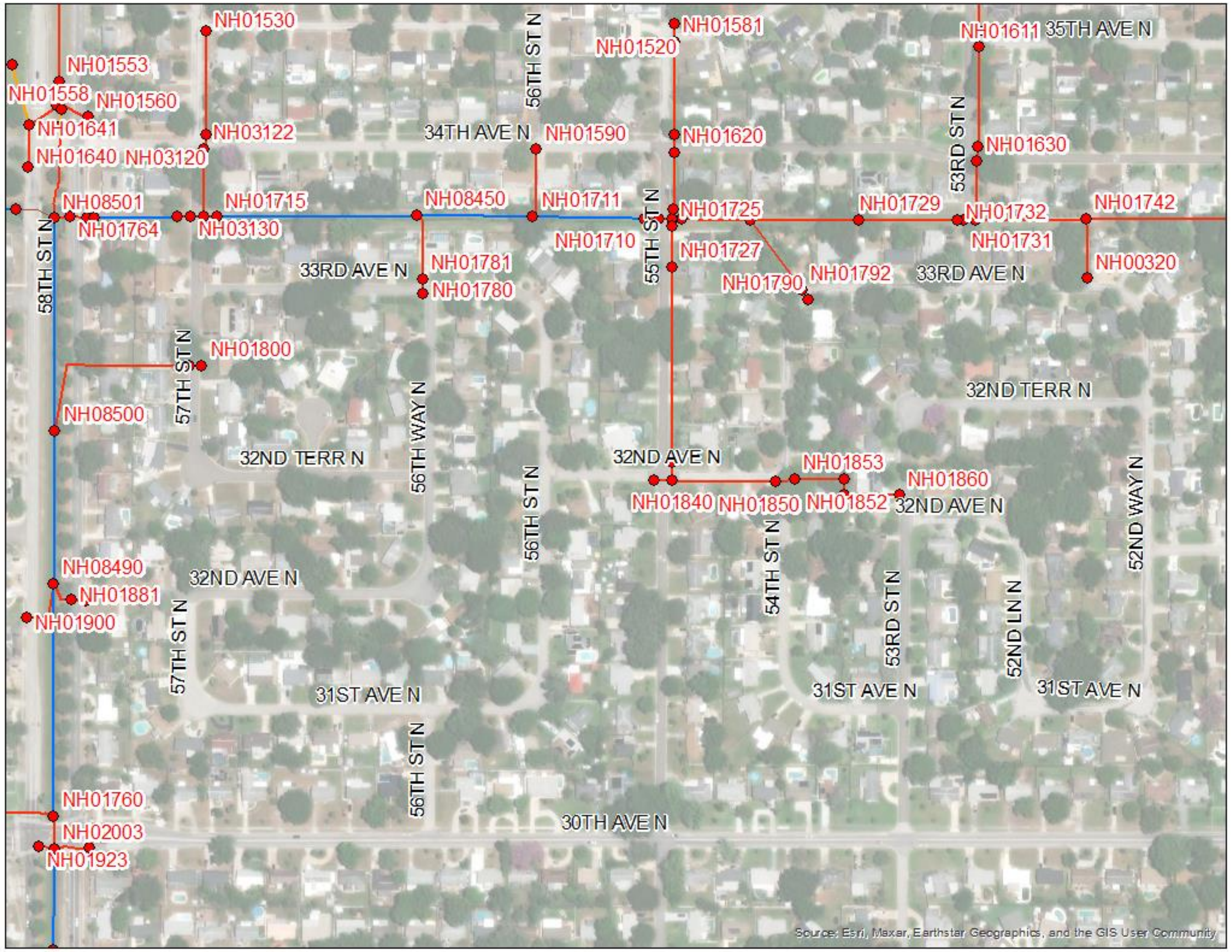
Estimated Cost:

Estimated cost for this project is approximately $8,237,411 including planning, engineering, and permitting fees..

Flooding Improvements at 53rd Street N - Project No. G5-2

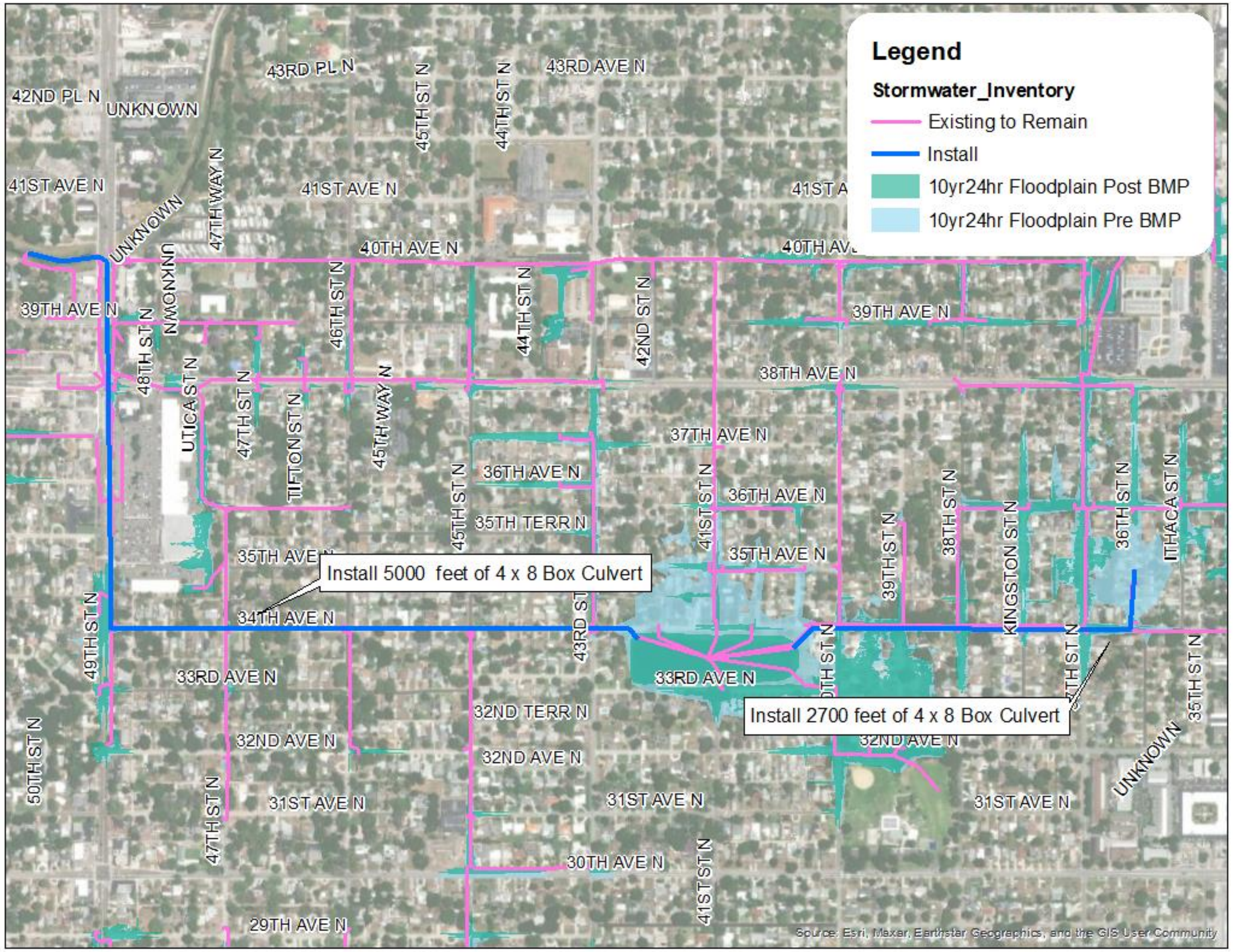


Node Reference Map - Project No. G5-2



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NH01860	53RD Street N	16.47	22.63	17.97	4.66	22.87	20.15	2.72
NH01851	53RD Street N	16.31	22.13	19.32	2.81	22.49	20.52	1.97
NH01852	53RD Street N	16.27	21.84	19.69	2.15	22.27	20.73	1.54

Flooding Improvements at 36th Street N - Project No. G5-3



Problem

BMP 5-3 focuses on adding conveyance system draining from mid-block 36th Street North and upgrading the system outfalling to an existing pond along 33rd Avenue North. This pond's discharge conveyance to the north also needs upgrading.

While the BMP 5-3 hotspot experiences both structural and road flooding, this location drains toward an existing pond located parallel to 33rd Ave North, which ultimately discharges toward the north. Currently the BMP location does not have an adequate pipe system that would allow the current runoff to drain appropriately to the pond.

BMP 5-3 will increase the current water drainage from the target location to the existing pond; and then increase the capacity of the pond's outfall along 33rd Avenue North and all the way to 40th Avenue North. Other neighborhood roads surrounding the BMP area remain flooded due to inadequate pipe sizes.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

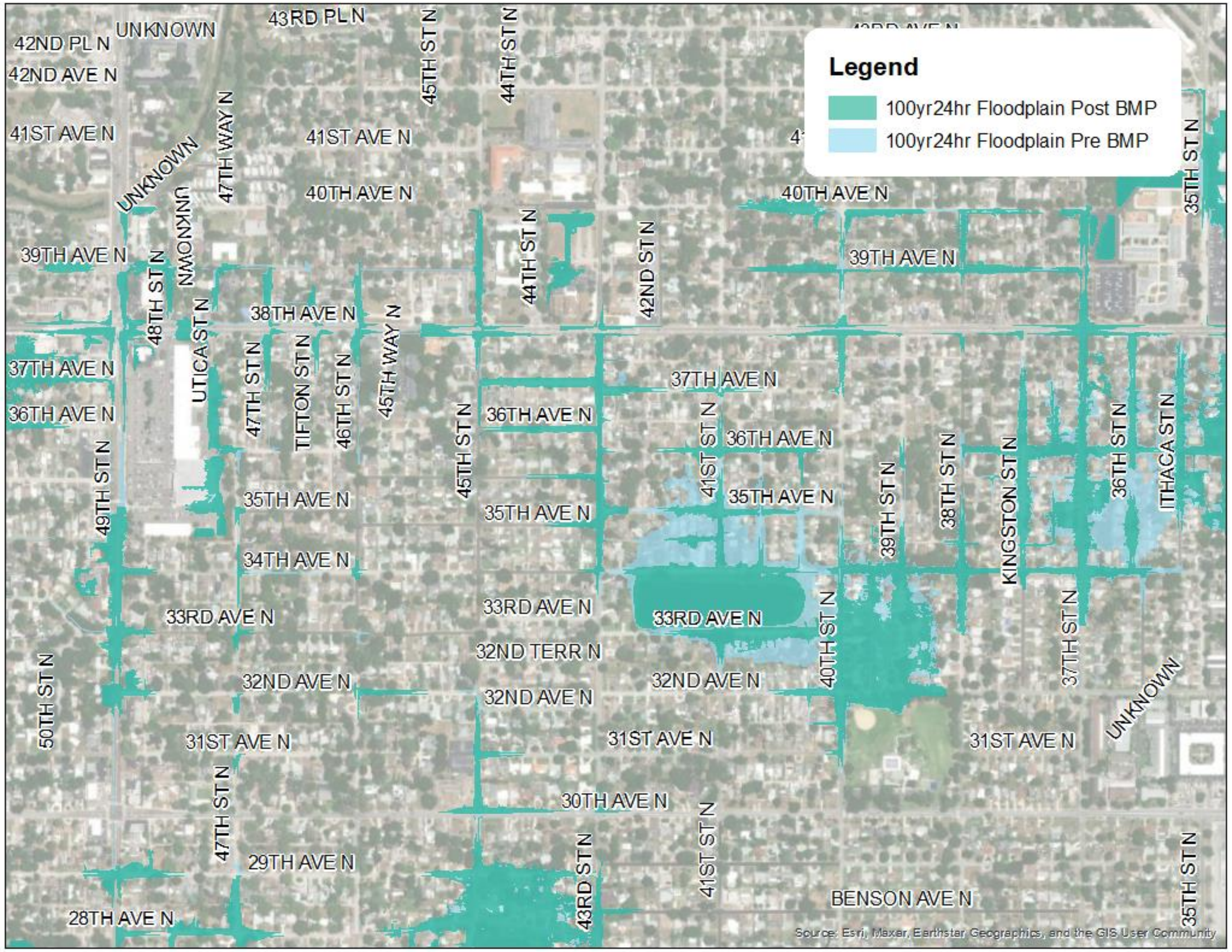
- Install 5000 feet of 4x8 Box culvert
- Install 2700 feet of 4x8 Box culvert

This alternative removes approximately 2491 feet of roadway from the 10-year floodplain and 18 structures from the 100-year floodplain.

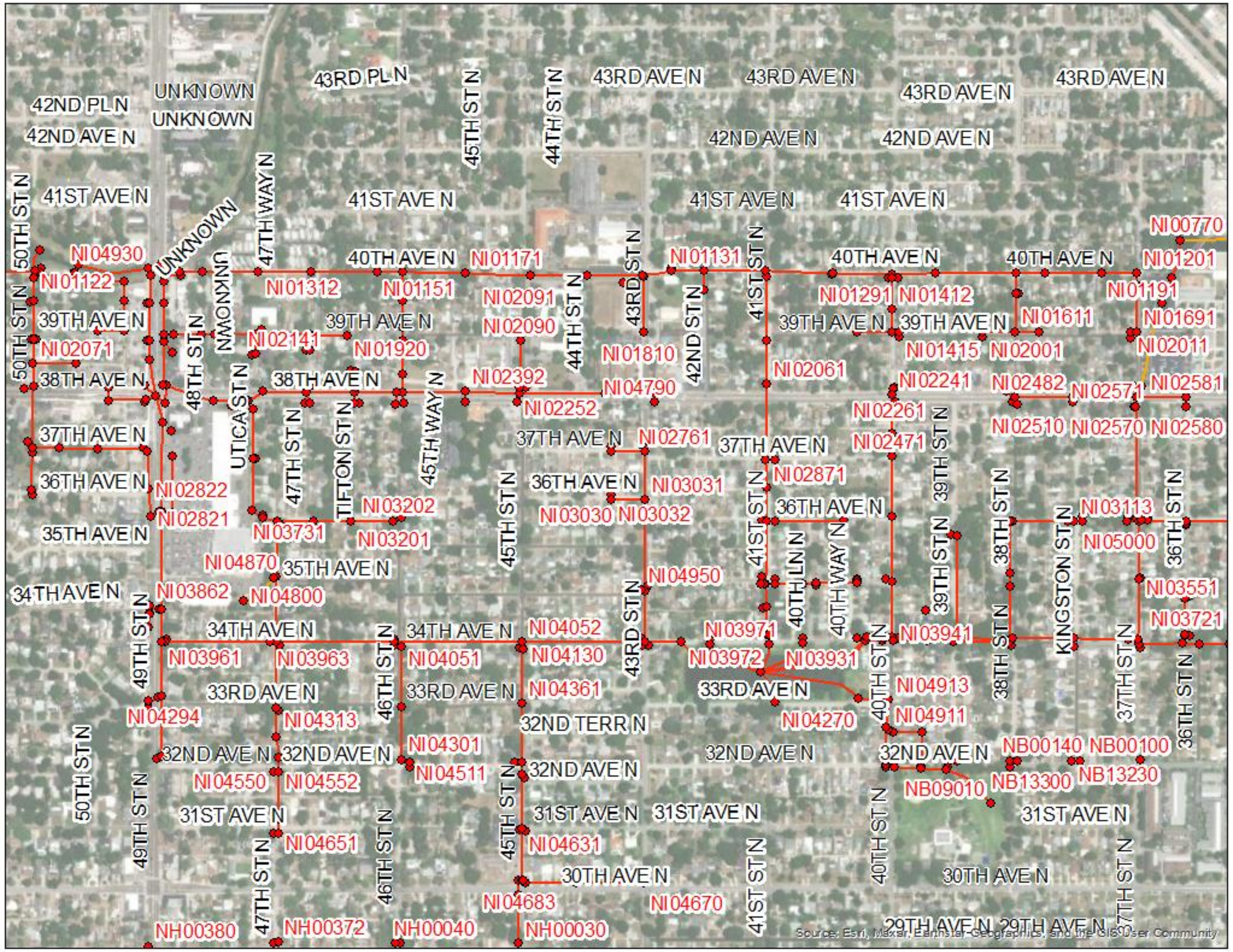
Estimated Cost:

Estimated cost for this project is approximately $24,747,054 including planning, engineering, and permitting fees..

Flooding Improvements at 36th Street N - Project No. G5-3

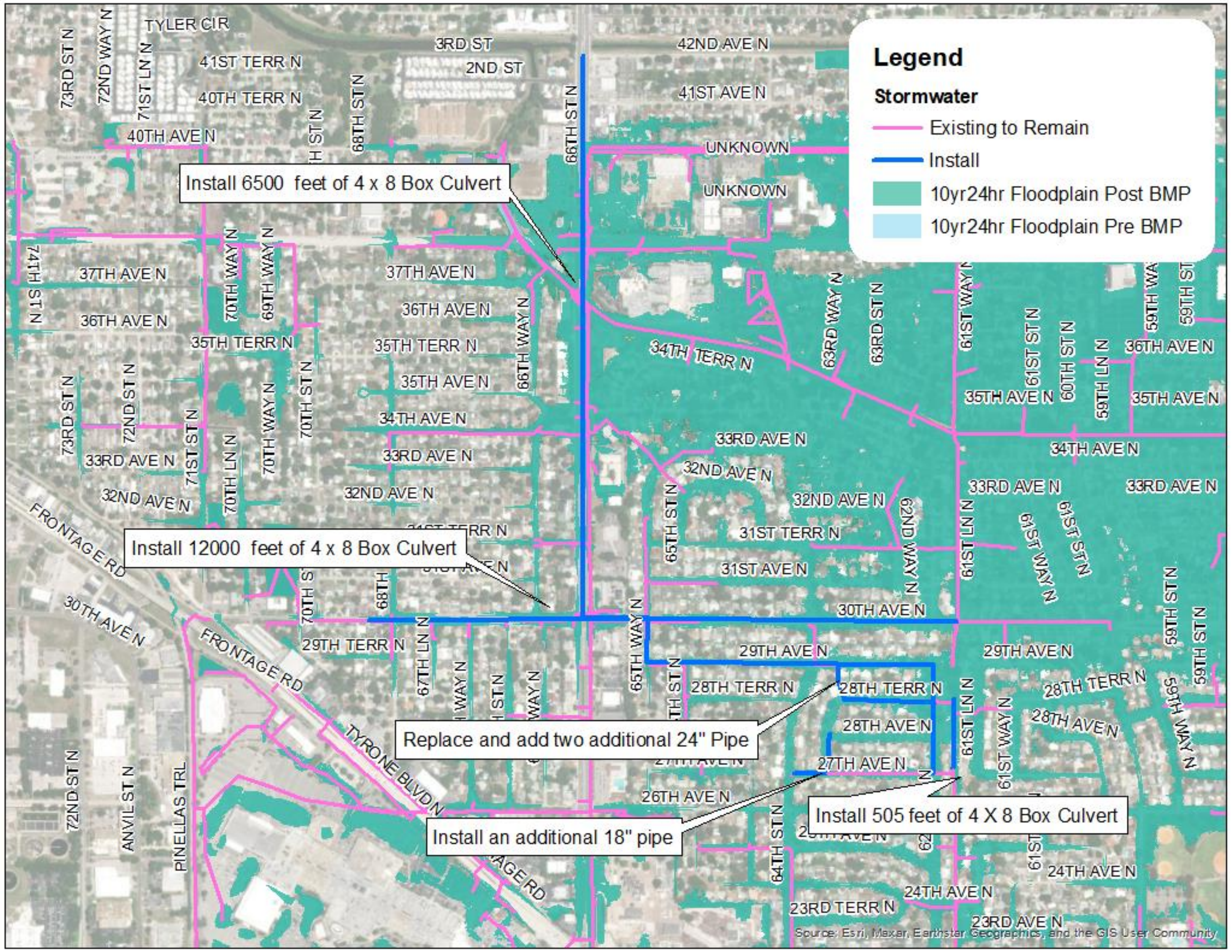


Node Reference Map - Project No. G5-3



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NI03720	36th Street North	46.94	51.32	48.13	3.19	51.29	49.85	1.44
NI03882	42st Street North	42.66	51.18	48.06	3.12	51.27	49.94	1.33
NI04071	43st Street North	40.62	50.92	47.83	3.09	51.46	50.28	1.18
NI03881	42st Street North	40.99	51.18	48.09	3.09	51.28	49.94	1.34

Flooding Improvements at 29th Avenue - Project No. G5-5



Problem

BMP 5-5 focuses on reducing the flooding along the system connecting to the Miles Creek watershed. The 30th avenues is draining into the north channel with outfall to Miles creek north of 34th Avenue. Flooding is mostly road level flooding.

While the BMP 5-5 hotspot experiences both structural and road flooding, this location drains toward an the channel which connecting to the Miles Creek through pipe networks parallel to 62nd North Street. BMP is focused on improving conveyance at the target location by connecting the flooded area with the tidal boundary to the west and channel outfall to the boundary at Joes Creek.

BMP 5-5 doesn't produce any significant relief in the region. The 4*12' Box culvert conveys 260 cfs of peak flow from the target area. This results in a low head within basin and nearly same amount of flow is added into the system through overland links through adjacent basins. Drainage relief provided by BMP is negated by the overland link flows.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

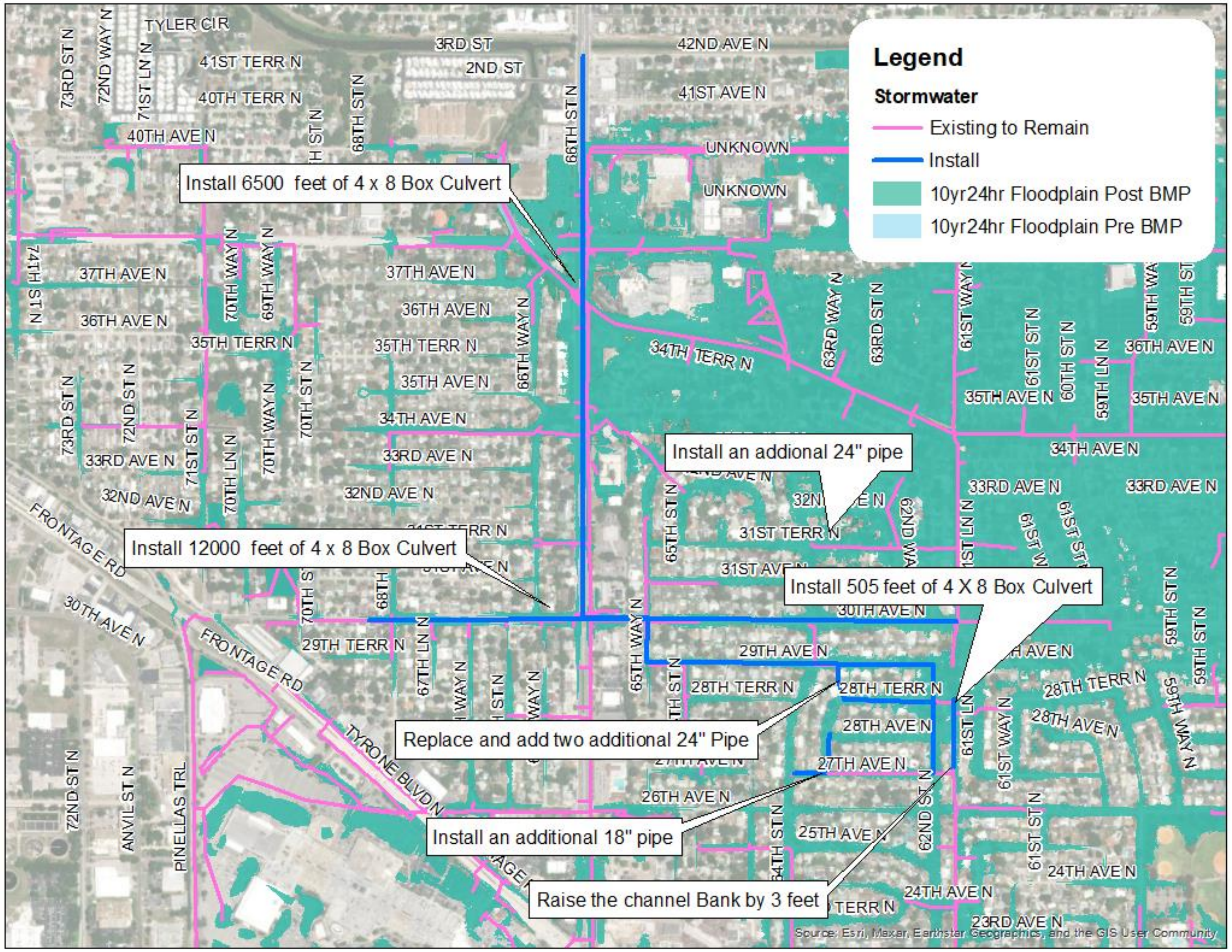
- Install 12000 feet of 4x12 Box culvert
- Install 7005 feet of 4x8 Box culvert
- Install 1800 feet of 24" pipe
- Install 1000 feet of 18" pipe

This alternative removes approximately 0 feet of roadway from the 10-year floodplain and 2 structures from the 100-year floodplain

Estimated Cost:

Estimated cost for this project is approximately $82,463,988 including planning, engineering, and permitting fees..

Flooding Improvements at 29th Avenue - Project No. G5-5

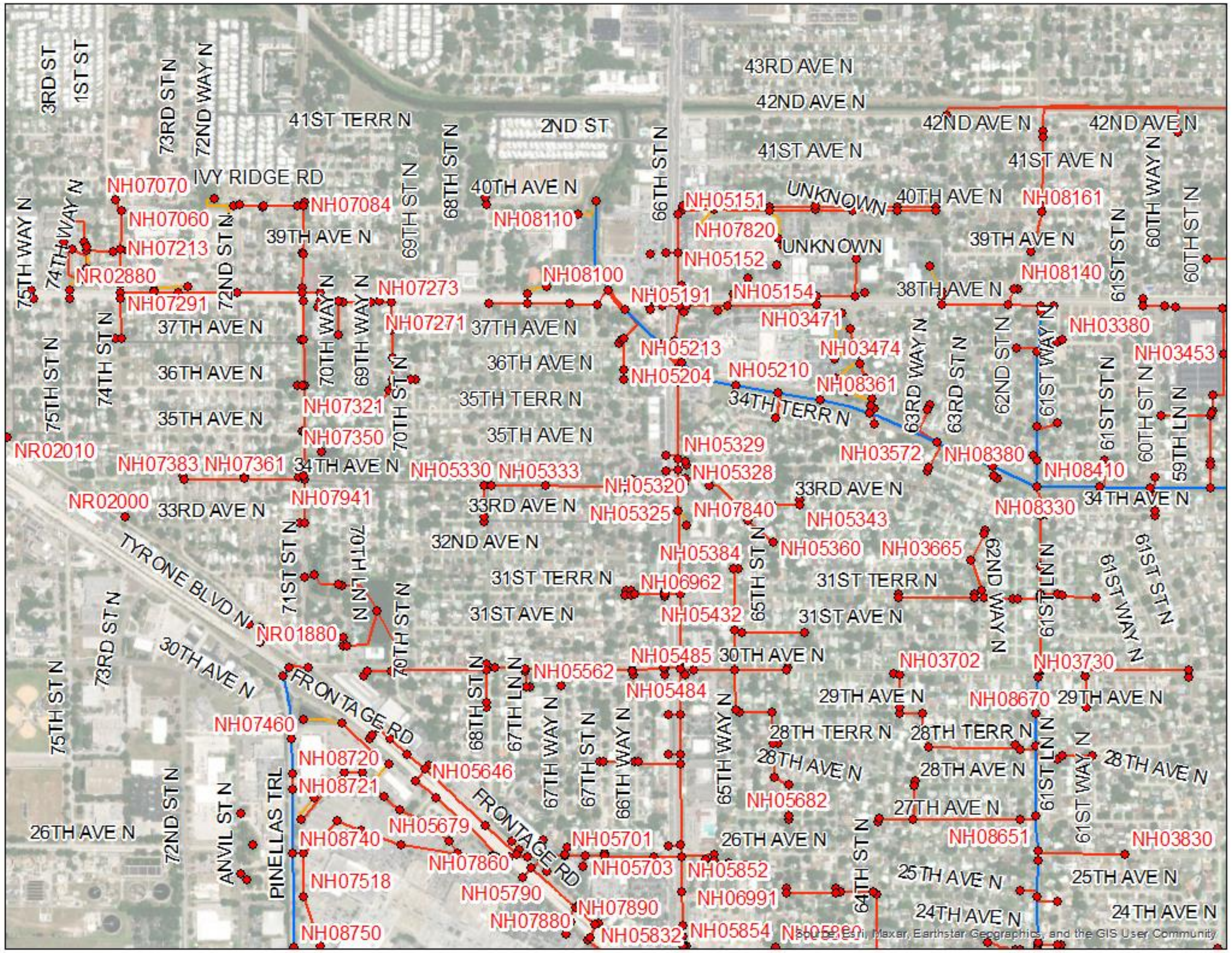


G5-5 Alternate concept

BMP G5-5 had limited impact on the targeted area. Flooding Reduction obtained in the basin was compensated by the increased overland weir flow. An scenario was developed with raising the overland weir connecting to the location by raising the channel banks. This provided flood reduction along the targeted area. Flood reduction for any system connected to the Miles Creek requires solutions that prevents flows through overland weir negating the reduction in targeted area.

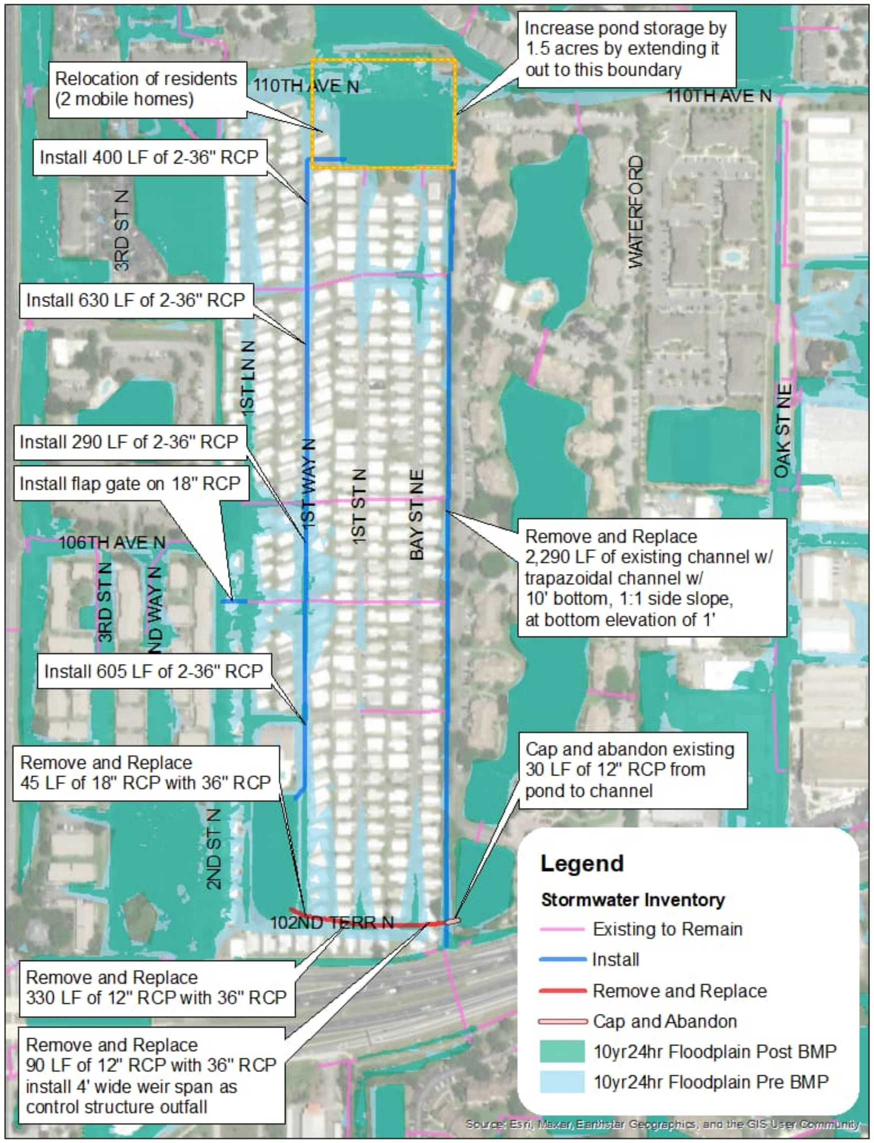
Flooding Improvements at 29th Avenue - Project No. G5-5

Node Reference Map - Project No. G5-5



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NH03760	62nd Street N	11.92	17.84	17.69	0.15	18.04	17.95	0.09
NH03750	29th Avenue N	12.12	17.81	17.69	0.12	18.05	17.96	0.09
NH03800	28th Avenue N	12.72	17.84	17.7	0.14	18.11	18.03	0.08

Flooding Improvements at 1st Way North Mobile Home Subdivision - Project No. G6-1



Problem

BMP 1 focuses on the conveyance system within the mobile home park located along 102nd Terrace North, 1st Lane N, 1st Way N, 1st St N, and Bay St NE. (Figure 1-1). This area consists of high-density residential land use. BMP 1 improvements includes expanding the existing conveyance system along 102nd Terrace North, adding additional conveyance along 1st Way North, expanding the existing channel east of Bay Steet NE, and expanding the existing pond by 1.5 acres at the north end of the mobile home park.

The runoff collected from this area currently discharges to both existing ponds located at the north and south end of the property and the existing channels to the east and west of the property. The existing channel system to the west of the property flows westward, the north pond flows to an existing channel eastward and into proposed BMP 12 location (see BMP 12 for further details), the southern pond currently flows to the pond within the apartment complex east of the mobile home park, and the channel east of the mobile home park flows both north to the existing northern pond and southward under Gandy Blvd. The existing conveyance system is not sized adequately to allow for rapid runoff which is resulting in flooding observed during the 10yr/24hr storm event.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Expand existing northern pond by 1.5 acres by acquiring 2 lots currently occupied by mobile home residents and expending it to undeveloped land north of the pond within the mobile home park property limits,
- Install a combined 1,925 LF of 2-36" RCP along 1st Way North from the southern pond to the northern pond,
- Remove and replace 45 LF of 18" RCP with 36" RCP 102nd Terrance North,
- Remove and replace 330 LF of 12" RCP with 36 RCP along 102nd Terrance North,
- Remove and replace 90 LF of 12" RCP with 36" RCP and install a 4' wide weir span to provide an outfall control structure from the southern pond to the east side channel,
- Cap and abandon the existing 30 LF of 12" RCP from the pond in the eastern subdivision to the east side channel, and
- Expand the existing 2,290 LF of channel with a trapezoidal channel with a 10' bottom, 1:1 side slopes, at elevation 1'

This alternative removes approximately 3600 feet of roadway from the 10-year floodplain and 1 structures from the 100-year floodplain

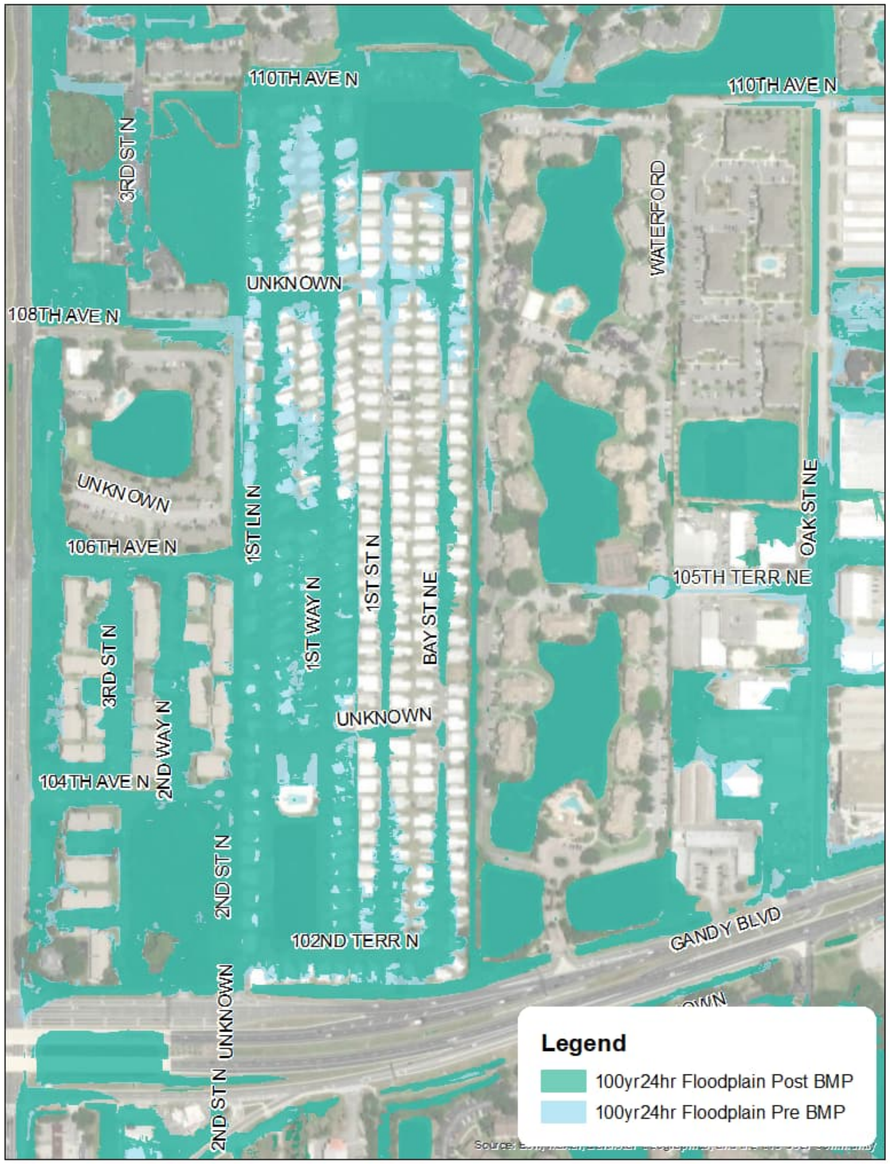
North stormwater pond east of 1st Way N

Existing channel east of Bay St NE

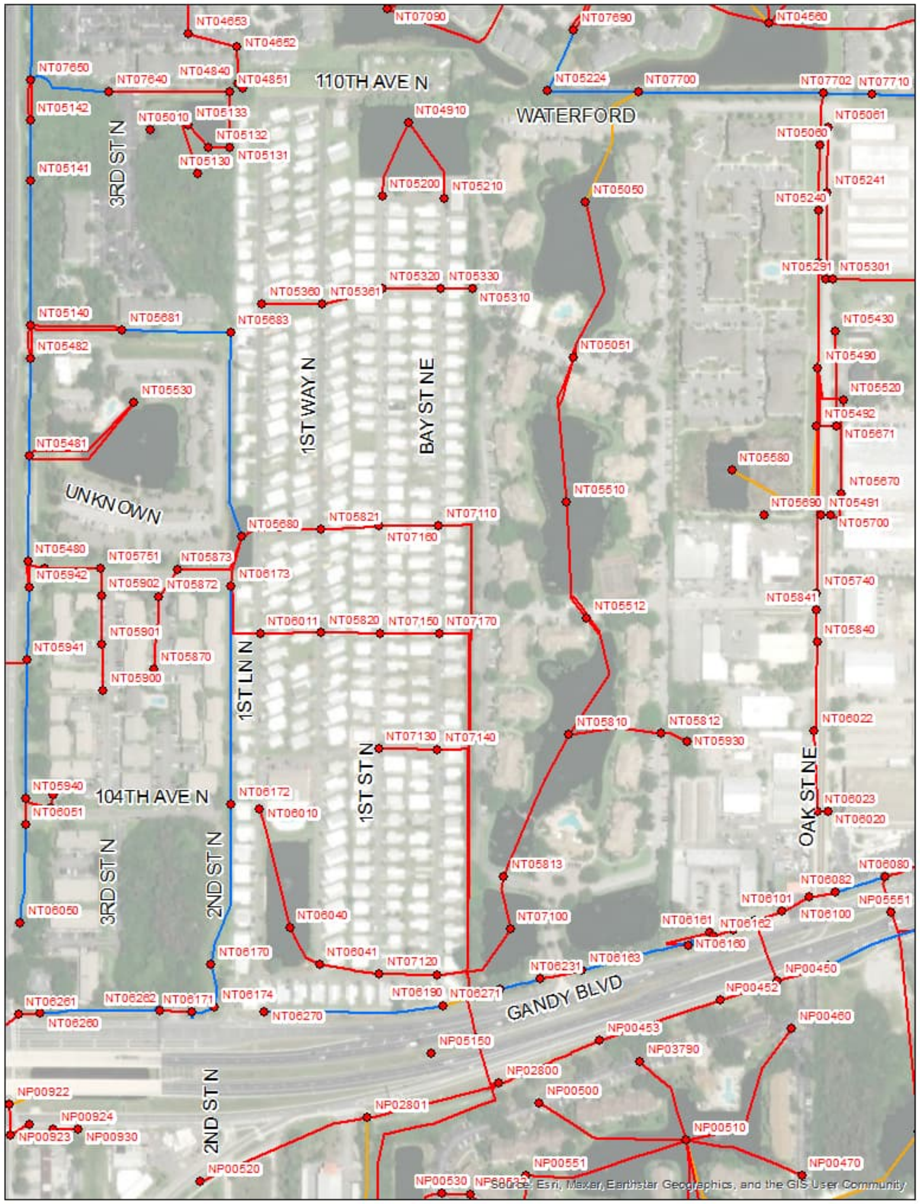
Estimated Cost:

Estimated cost for this project is approximately $5,675,000 including planning, engineering, and permitting fees..

Flooding Improvements at 1st Way North Mobile Home Subdivision - Project No. G6-1

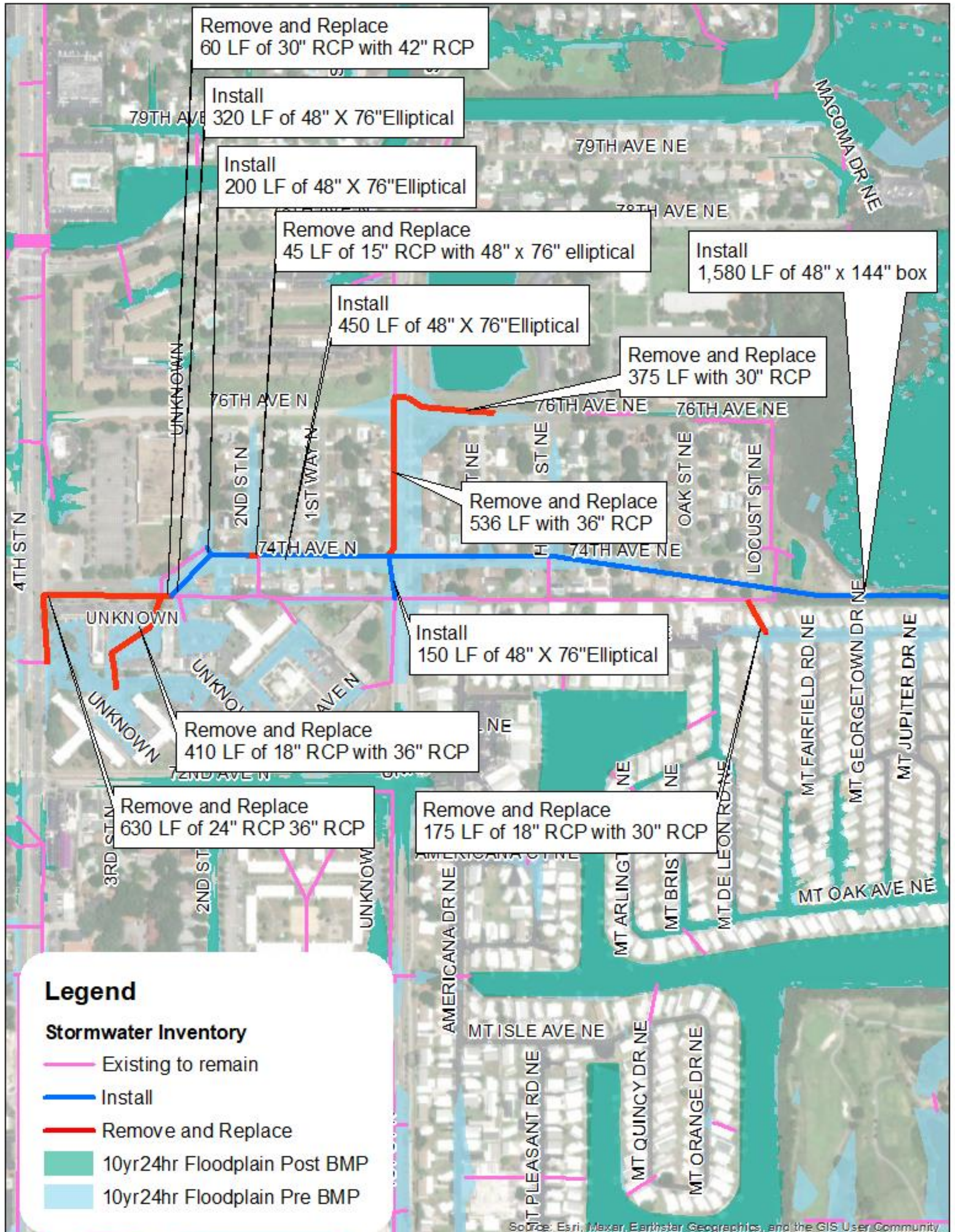


Node Reference Map - Project No. G6-1



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NT04910	North stormwater pond east of 1st Way N	1.46	4.68	4.03	0.65	5.22	4.99	0.23
NT05820	1st Way N, north of south stormwater pond	1.81	4.85	4.29	0.56	5.25	5.12	0.13
NT06040	South stormwater pond east of 1st LN N	3.27	4.85	4.31	0.54	5.24	5.12	0.12
NT06190	Bay St NE & 102nd Terr N	3.27	4.86	4.14	0.72	5.22	5.1	0.12

Flooding Improvements at 74th Avenue North – Project No. G6-2



Problem

BMP 6-2 focuses on the conveyance system draining from west to east from Emerald Pointe Apartments on 4th Street N to 74th Avenue N towards wetlands east of 74th Avenue NE. This area is impacted by roadway flooding and flooding onto residential and commercial properties.

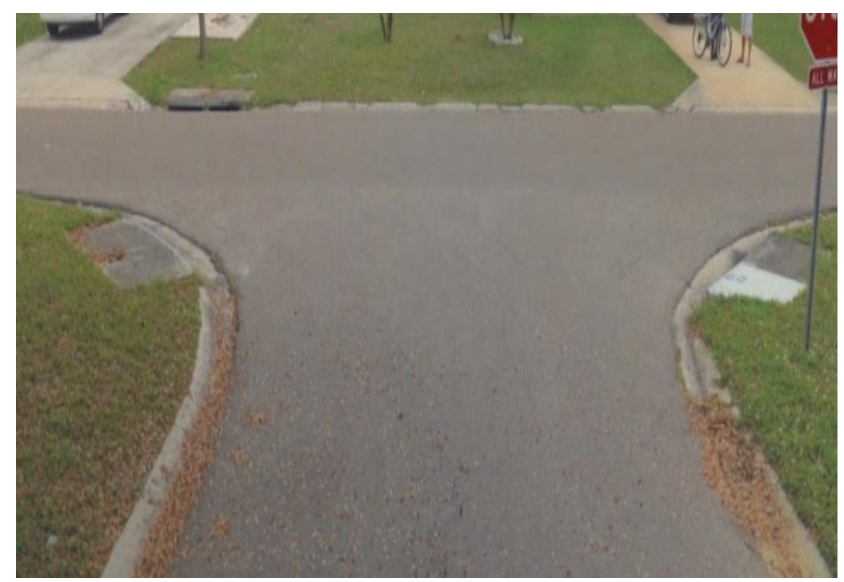
Solution & Project Benefits:

BMP 6-2 proposes the following changes to alleviate roadway, residential, and commercial flooding within the 74th Avenue North area.

- Increasing the capacity of the existing 24" pipe on 4th Street N from curb inlet at Emerald Pointe Apartments to manhole at intersection of 4th street N and 7th Avenue N to 36" pipe.
- Increasing capacity of pipe and structures from 24" to 36" along 74th Avenue N from manhole at intersection of 4th street N and 7th Avenue N to curb inlet at access road to Emerald Pointe Apartments.
- Increasing the capacity of the existing pipes and drainage structures within Emerald Pointe Apartments from 18" pipes to 36" pipes.
- Shifting flow from 74th Avenue N at Emerald Pointe Apartments to the north side of the intersection of 74th Avenue N and 2nd Street by creating a new pipe and drainage network. This new network will be constructed along 74th Avenue N in new 48" x 76" elliptical pipes and 2 new 4' x 12' box culverts along 74th Avenue NE. This will eventually outfall into the wetland area east of 74th Avenue NE.
- Changing the direction of flow and increasing capacity of pipes and structures from 76th Avenue NE to new drainage network along 74th Avenue NE.
- Connecting existing pipe network south of 74th Avenue N along 1st Street N to 74th Avenue NE by increasing the capacity of an existing pipe and structure and constructing a new 48" x 76" elliptical pipe that ties into new network along 74th Avenue NE
- Increasing the capacity of the existing pipe and drainage structure on Mt Piney Avenue NE from 18' to 30".

This area is a high-density residential area and some commercial developments in the vicinity, therefore, impacts to vehicular and pedestrian traffic should be expected for the improvements listed above.

This alternative removes approximately 6256 feet of roadway from the 10-year floodplain and 9 structures from the 100-year floodplain.



Existing drainage structures at 74th Avenue N and 2nd Street N

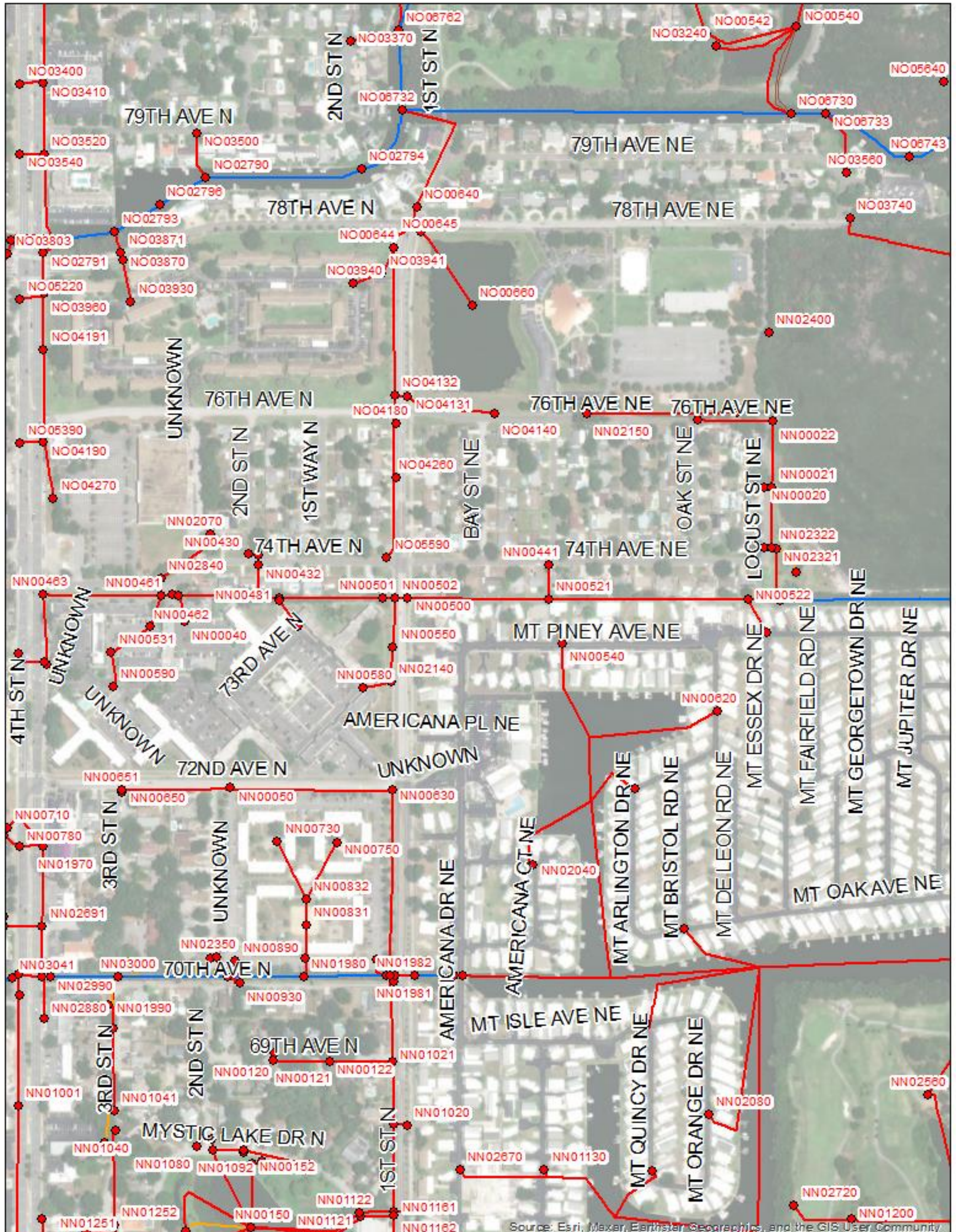
Existing curb inlet on 4th Street N at Emerald Pointe Apartments.

Estimated Cost:

Estimated cost for this project is approximately $10,916,464 including planning, engineering, construction, and permitting fees.

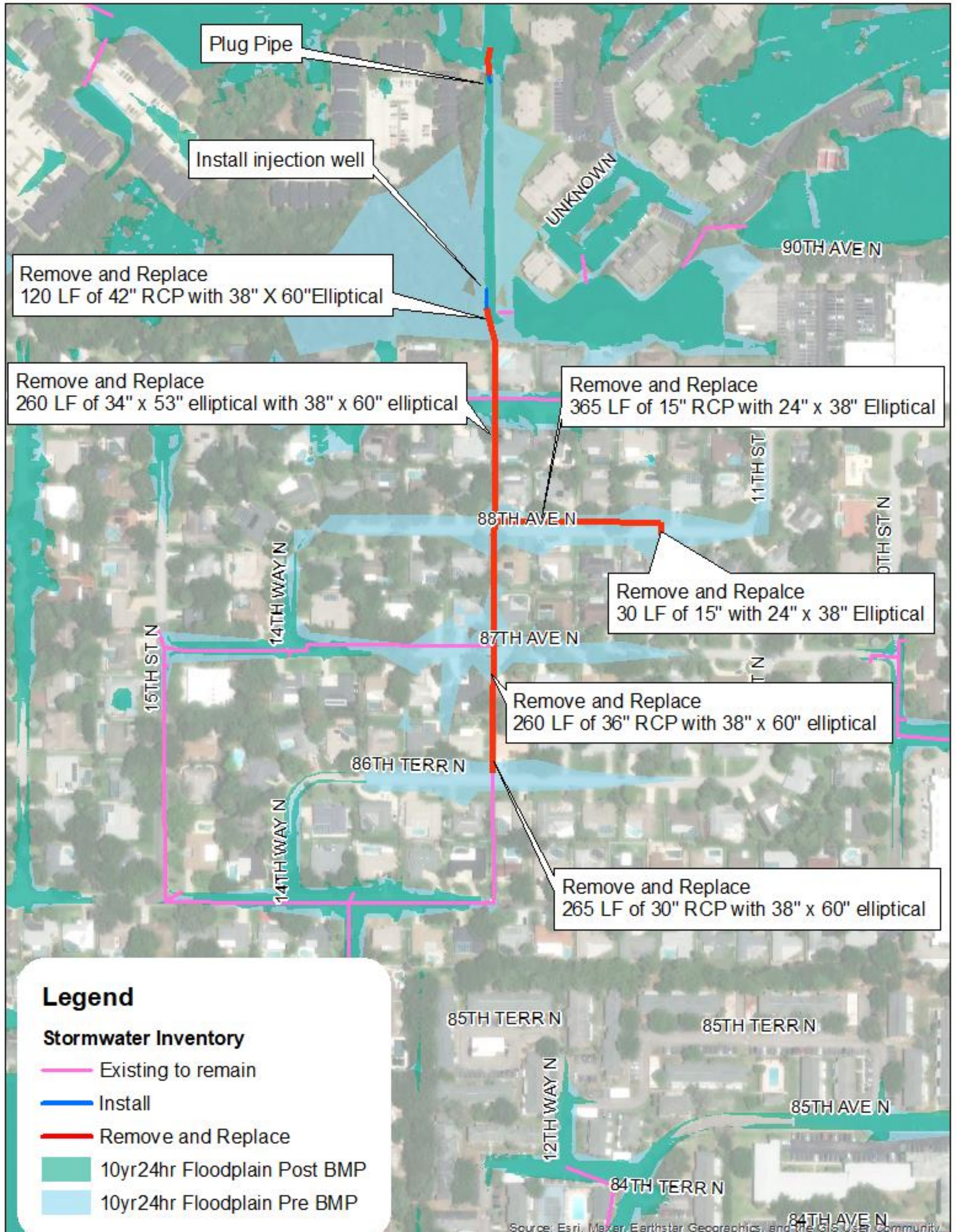
Flooding Improvements at 74th Avenue North – Project No. G6-2

Node Reference Map – Project No. G6-2



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NN00560	4th Street N at Emerald Pointe	1	5.58	4.1	-1.48	5.76	5.46	-0.3
NN00460	74th Avenue N at Emerald Pointe	1	4.98	3.26	-1.72	5.14	4.74	-0.4
NO05590	74th Avenue N at 1st Street N	1	4.81	2.32	-2.49	5.09	3.85	-1.24
NN00431	74th Avenue N at 2nd Street N	1	4.96	2.92	-2.04	5.13	4.47	-0.66

Flooding Improvements at 88th Avenue North – Project No. G6-3



Problem

BMP 6-3 focuses on the conveyance system draining from south to north intersecting 86th Terrace North, 87th Avenue North, 88th Avenue North, and 89th Avenue North. This area is impacted by roadway flooding and flooding onto residential properties.

Solution & Project Benefits:

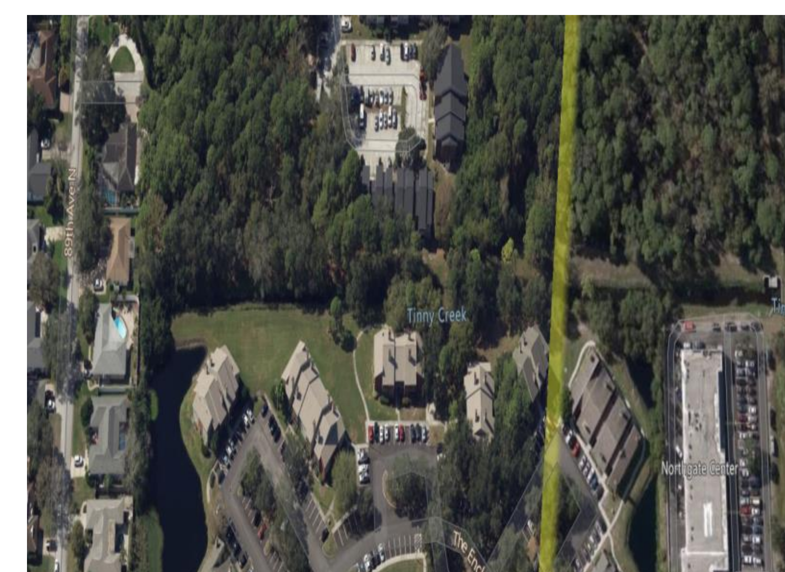
BMP 6-3 proposes the following changes to alleviate roadway and residential flooding within the 88th Avenue North area.

- Install an injection well into the existing channel north of 89th Avenue North that will collect and expel water from the impacted area. The existing pipe that connects the channel will be plugged to prevent backflow of water to the pump. The channel will be modified in order to accommodate the injection well.
- Increasing the capacity of the existing pipe and drainage structure at 86th Terrace North from a 30" pipe to a 38"x60" elliptical pipe. The same will be done to the structure on south side of 87th Avenue North and the pipe that connects the two structures at 87th Avenue North.
- Increasing the capacity of the existing pipe and drainage structure on north side of 87th Avenue North from a 36" pipe to a 38"x60" elliptical pipe. The same will be done to the structure on south side of 88th Avenue North and the pipe that connects the two structures at 88th Avenue North.
- Increasing the capacity of the existing pipe and drainage structure on north side of 88th Avenue North from a 34"x53" pipe to a 38"x60" elliptical pipe.
- Increasing capacity of pipes from 15" to 24"x38" elliptical and structures along 88th Avenue Northeast of the main trunk line.
- Increasing the capacity of the existing pipe and drainage structure on the north side of 89th Avenue from a 42" pipe to a 38"x60" elliptical pipe. This will flow into the channel.

This area is a high-density residential area and impacts to vehicular and pedestrian traffic should be expected for the improvements listed above. Temporary work easements may be necessary to perform the necessary upgrades.

This alternative removes approximately 6,256 feet of roadway from the 10-year floodplain and 52 structures from the 100-year floodplain.

Existing drainage structures at 87th Avenue North

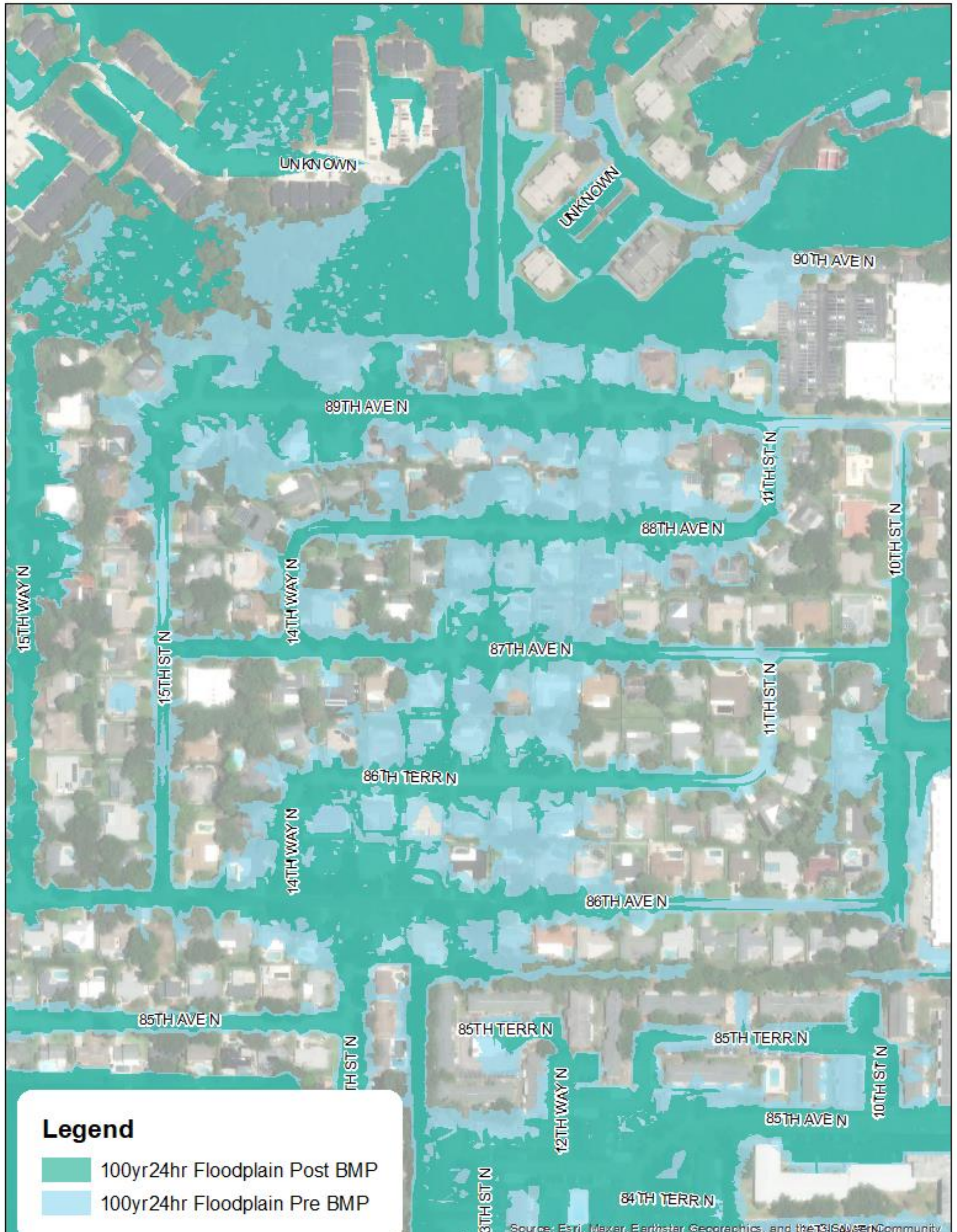


Existing channel north of 89th Avenue North.

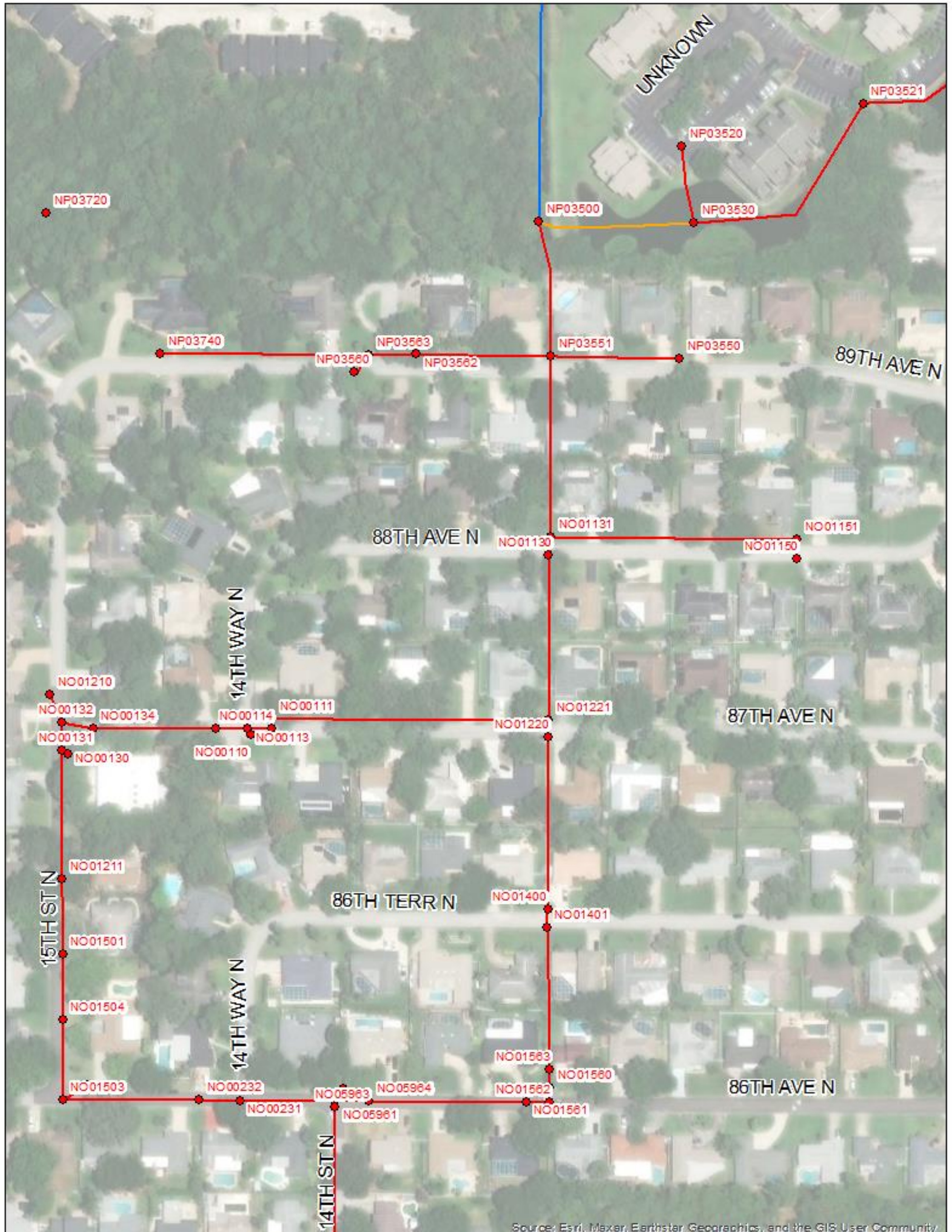
Estimated Cost:

Estimated cost for this project is approximately $24,364,776 including planning, engineering, construction, and permitting fees.

Flooding Improvements at 88th Avenue North – Project No. G6-3

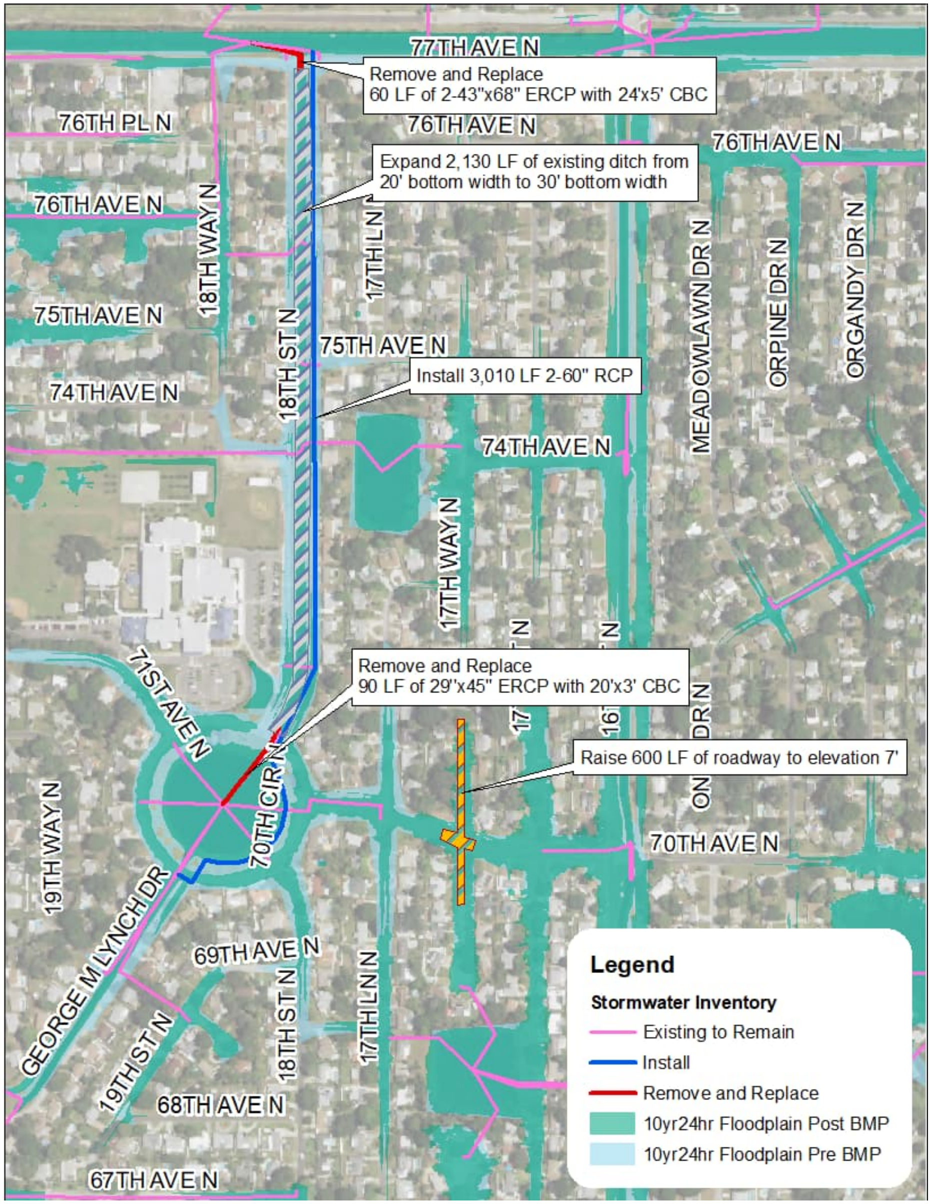


Node Reference Map – Project No. G6-3



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NP03551	89th Avenue North	1	5.58’	2.80’	2.78’	6.18'	5.08'	0.9'
NO01131	88th Avenue North	1	5.62’	3.67’	1.95’	6.12'	5.5'	0.62'
NO01221	87th Avenue North	1	5.66’	4.22’	1.44’	6.09'	5.68'	0.41'
NO01400	86th Terrace North	1	5.58’	4.38’	1.20’	5.93'	5.79'	0.14'

Flooding Improvements at 70th Avenue North- Project No. G6-4



Problem

BMP 6-4 focuses on the conveyance system draining north of Lynch Lake Park near 70th Avenue North to the channel at 77th Avenue North. This area sees flooding along streets and on private property. The existing pond at Lynch Lake does not provide enough storage capacity and floods the surrounding residential area. A low elevation at the intersection of 17th Way North and 70th Avenue North also causes flooding in the impacted area.

Solution & Project Benefits:

BMP 6-4 proposes the following changes to alleviate roadway flooding within the 70th Avenue North area.

- Expanding the existing ditch along 18th Street North in the median from 20-foot bottom width to 30-foot bottom width.
- Remove and replace 60 LF of 2-43"x68" ERCP with 24'x5' CBC under 77th Ave N at the intersection of 18th St N
- Remove and replace 90 LF of 29"x45" ERCP with 20'x3' CBC under 70th Circ N at 18th St N
- Install 3,010 LF of 2-60" RCP as a bypass system from George M Lynch Drive along 18th St N to channel system north of 77th Ave N
- Increase the elevation of 17th Way North to an elevation of 7-feet, 400' to the north of 70TH Avenue North and 200' to the sound of 17th Avenue North.

This area consists of high-density residential use and the construction of box culverts, and the reconstruction of 17th Way North will cause traffic detours. The proposed solutions listed above will provide more conveyance capacity and reduce flooding in the impacted area.

The benefits of implanting this proposed BMP could remove approximately 6,050 LF of roadway from being flooded.

This alternative removes approximately 3251 feet of roadway from the 10-year floodplain and 0 structures from the 100-year floodplain.

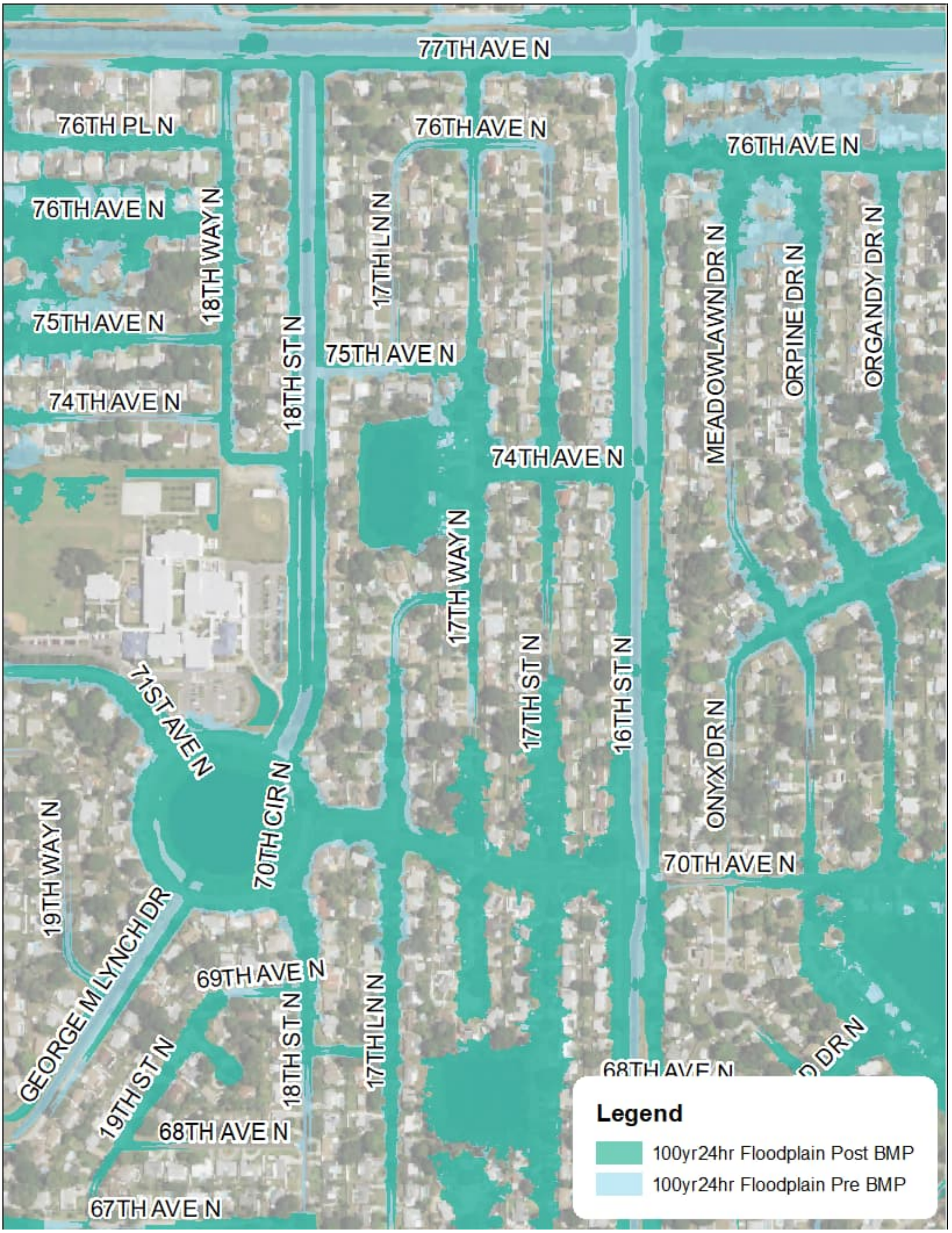
Existing double pipe culvert and endwalls at 77th Ave N


Lynch Lake and existing channel and drainage culvert

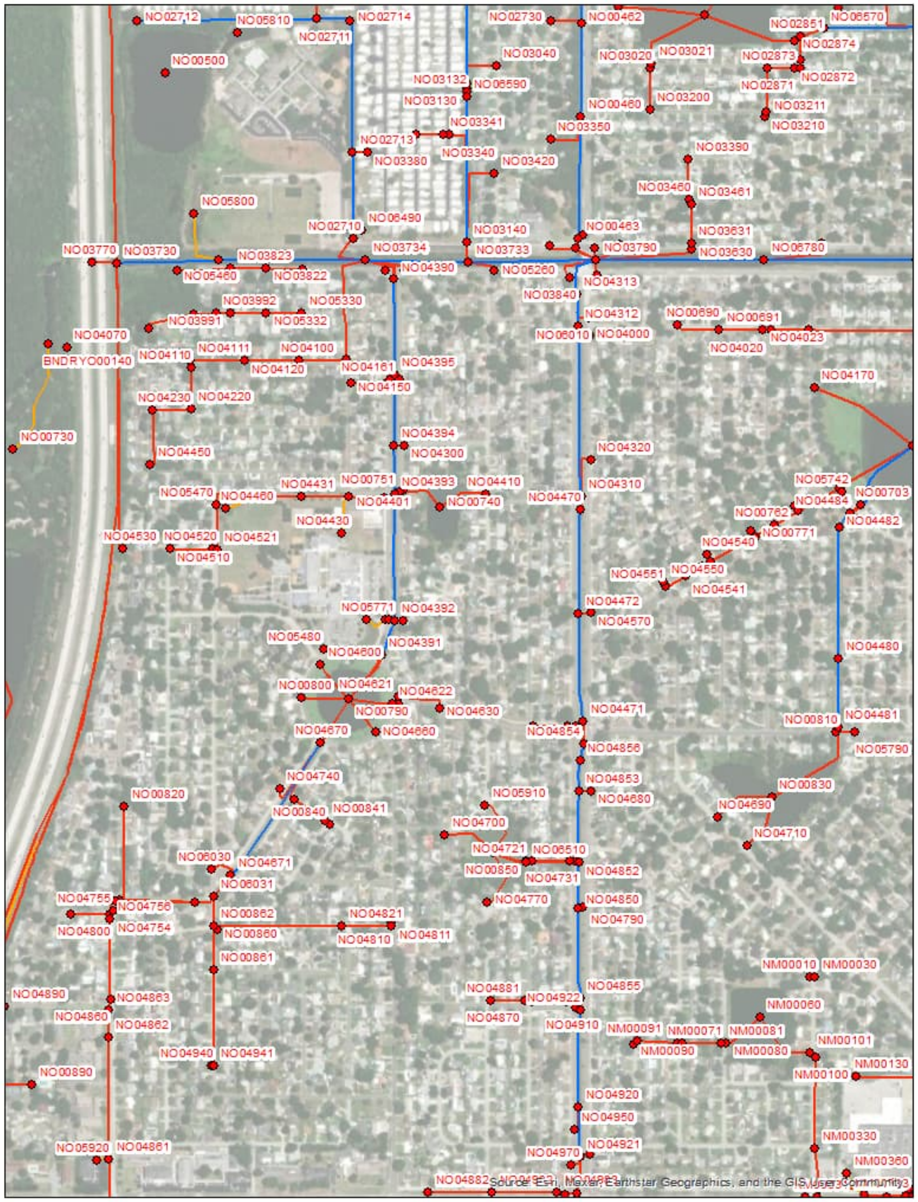
Estimated Cost:

Estimated cost for this project is approximately $15,306,274 including planning, engineering, and permitting fees..

Flooding Improvements at 70th Avenue North- Project No. G6-4

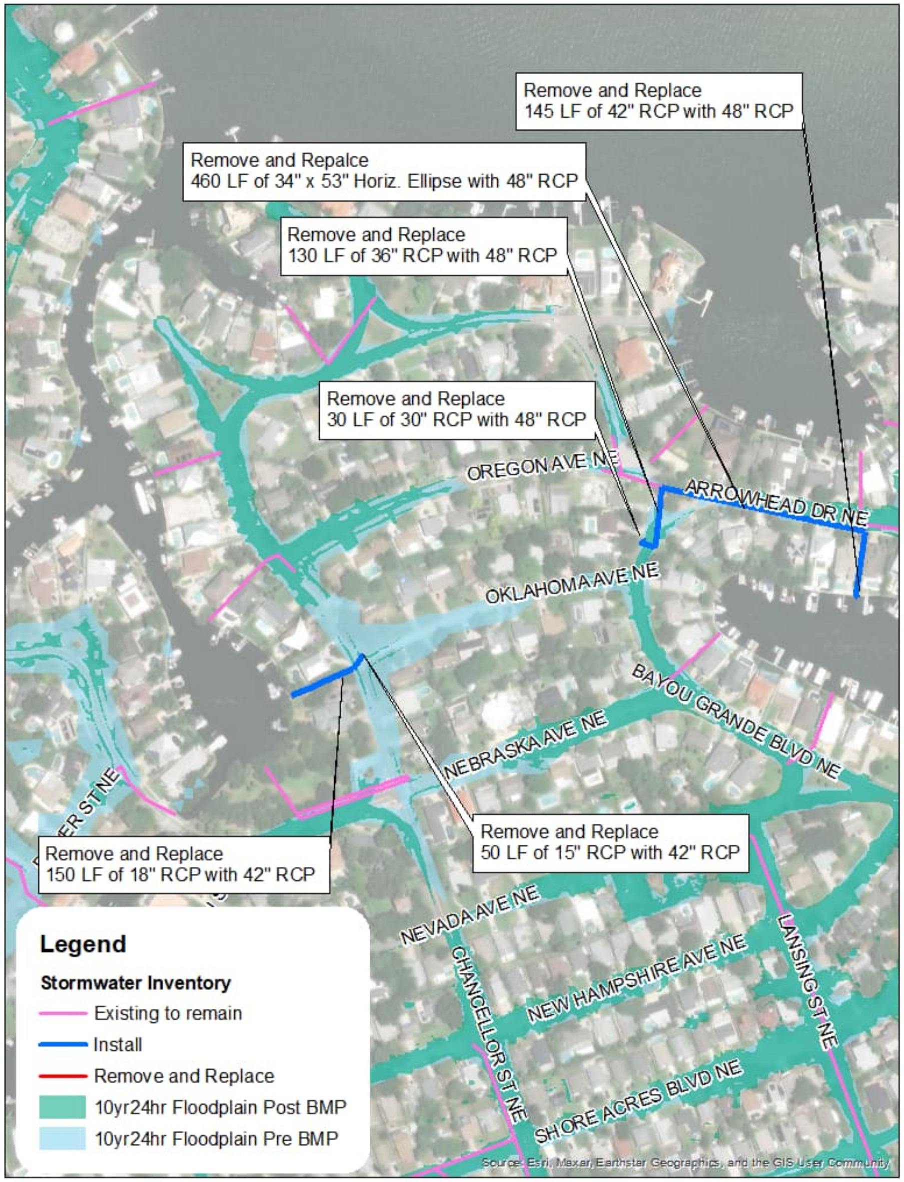


Flooding Improvements at 70th Avenue North- Project No. G6-4



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NO00790	Lynch Lake	1.37	6.94	5.47	-1.47	7.32	6.88	-0.44
NO04391	Lynch Lake Outfall	1	6.48	5.34	-1.14	6.77	6.57	-0.2
NO04390	Channel Outfall	1	6.37	4.81	-1.56	6.66	6.25	-0.41

Flooding Improvements at Oklahoma Avenue NE – Project No. G6-5



Problem

BMP 6-7 focuses on the conveyance system in two locations. One drains west along Oklahoma Avenue NE to Bayou Grande Blvd NE into nearest waterbody and the other from Bayou Grande Blvd NE to Arrowhead Drive NE into the nearest waterbody. Street and residential flooding occur along Oklahoma Avenue NE and Bayou Grande Blvd NE.

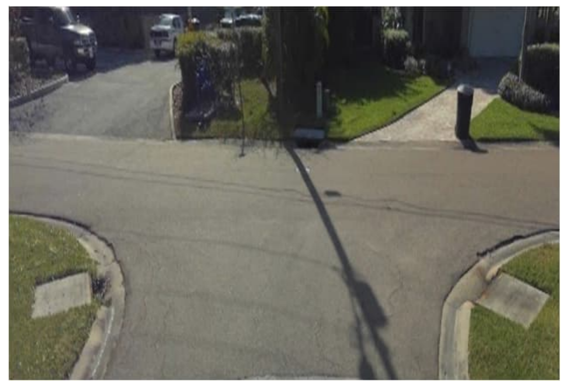
Solution & Project Benefits:

BMP 6-7 proposes the following changes to alleviate roadway and residential flooding within the Oklahoma Avenue NE area.

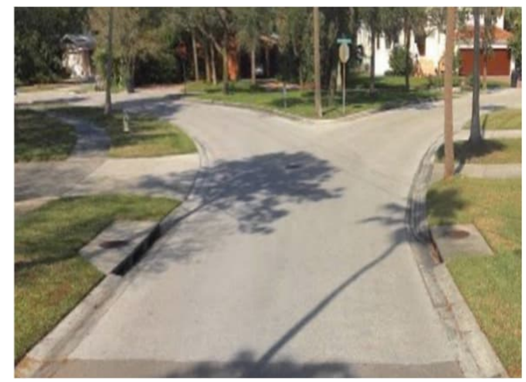
- Increasing the capacities of existing pipes from Oklahoma Avenue NE across Bayou Grande Blvd NE from sizes 1.25' and 1.5' to 3'.
- Increasing the capacity of existing pipes from Bayou Grande Blvd NE to Arrowhead Drive NE from size range 2.5'-3.5' to 4'.

This is a high-density residential area and impacts to vehicular and pedestrian traffic should be expected for the improvements listed above. The proposed solutions will provide more conveyance capacity and reduce street and residential flooding in the impacted area.

This alternative removes approximately 1324feet of roadway from the 10-year floodplain and 6 structures from the 100-year floodplain



Existing conditions at Oklahoma Ave NE/Bayou Grande Blvd NE



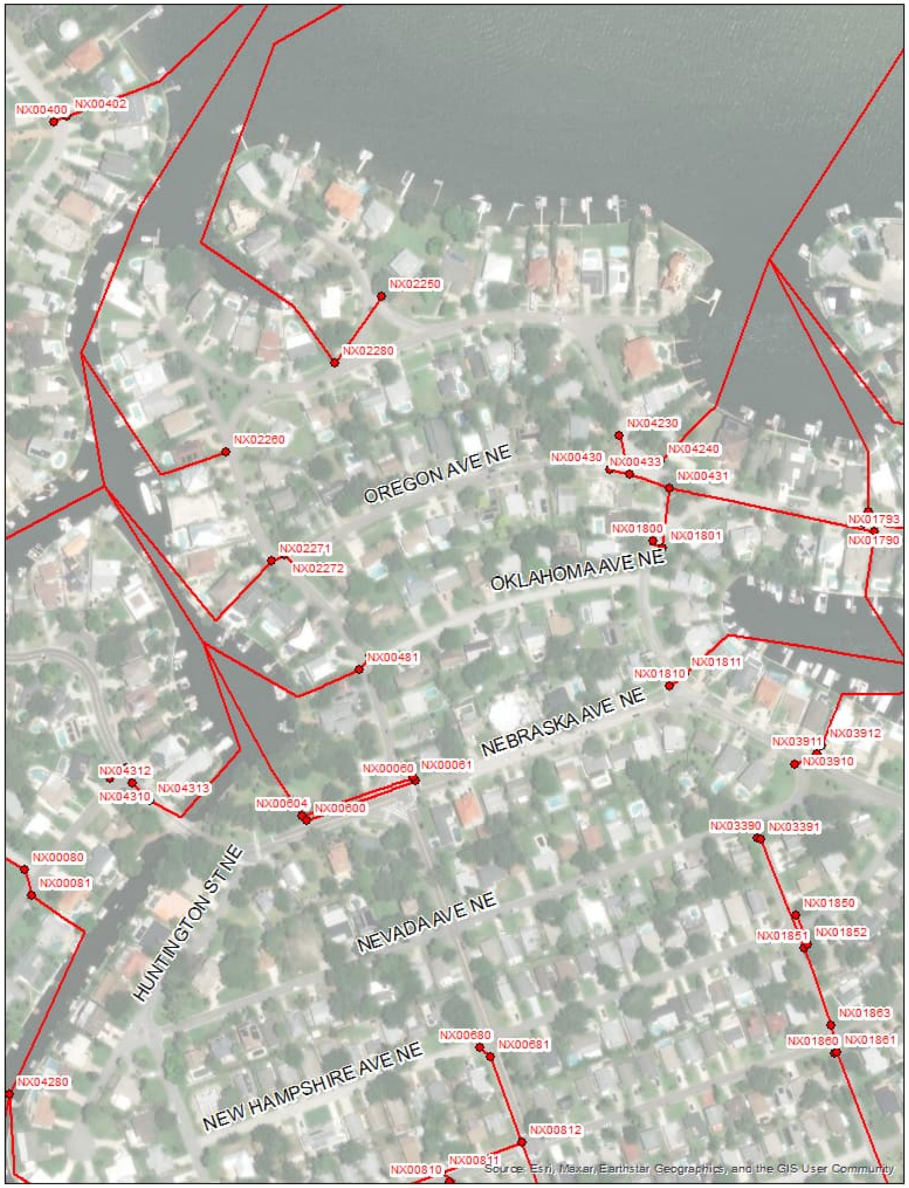
Existing drainage inlets at Bayou Grande Blvd NE near Arrowhead Dr NE

Estimated Cost:

Estimated cost for this project is approximately $1,736,549 including planning, engineering, and permitting fees..

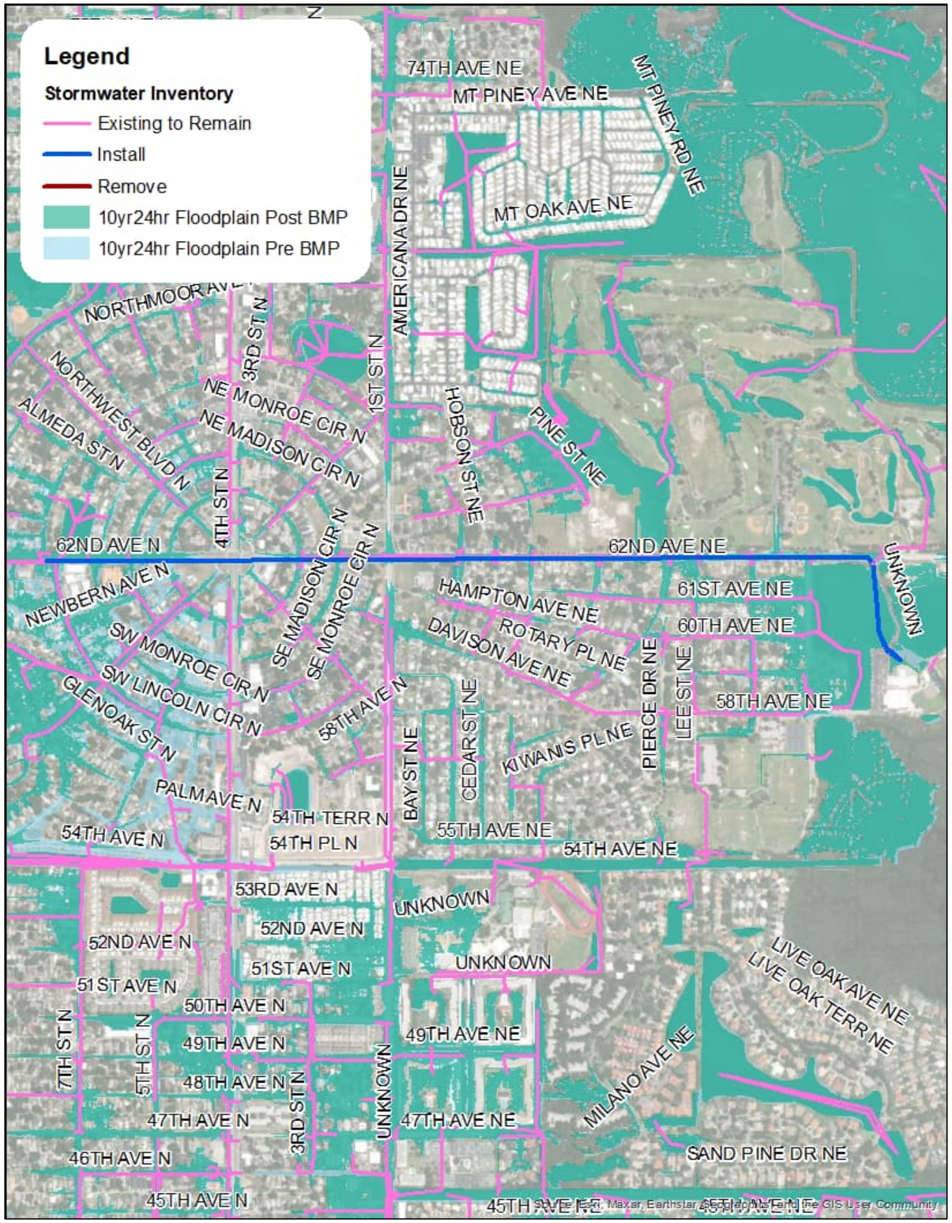
Flooding Improvements at Oklahoma Avenue NE – Project No. G6-5

Node Reference Map – Project No. G6-5



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NX00480	Oklahoma Ave NE/Bayou Grande Blvd NE	1	2.5	1.56	-0.94	3.1	2.84	-0.26
NX01800	Bayou Grande Blvd NE near Arrowhead Dr NE	1	2.52	2.13	-0.39	3.08	2.86	-0.22
NX00430	Oregon Ave NE/Arrowhead Dr NE	1	2.17	1.94	-0.23	3.08	2.84	-0.24

Flooding Improvements at 62nd Ave North Area – Project No. G6-6



Problem

BMP 8 focuses on alleviating regional flooding around 62nd Avenue North and SW Lincoln Circle North (Figure 8-1). This area consists of residential and commercial properties with infrastructure mainly consisting of 15'' to 30'' pipe systems and a larger trunk line (48"x122") running along SW Lincoln Circle North.

Improvements include bypassing flow from the collection system on the intersection of 62nd Avenue North and NW Lincoln Circle North to take flow east to outfall to Placido Bayou. Channel improvements will also be needed to extend the outfall to open water conditions downstream of Shorecrest Preparatory School. In addition, it is recommended to increase surrounding stormwater pipes that inflow to the bypass box culvert.

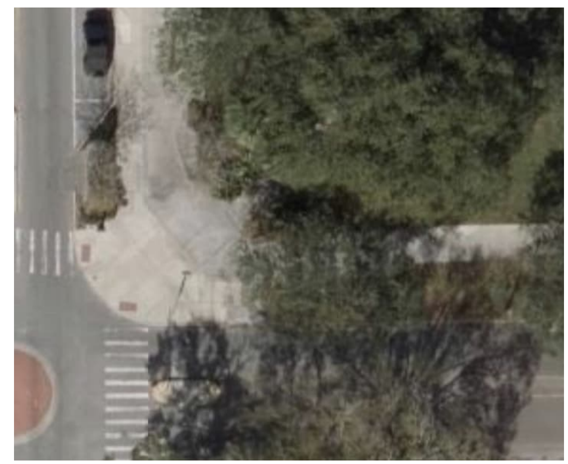
Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Install 7,700 LF of 5'x12' CBC
- Extend outfall to open water conditions downstream of Shorecrest Preparatory School

This alternative removes approximately 13,350 feet of roadway from the 10-year floodplain and 182 structures from the 100-year floodplain

Tie in location on 11th St N and 32nd Ave N

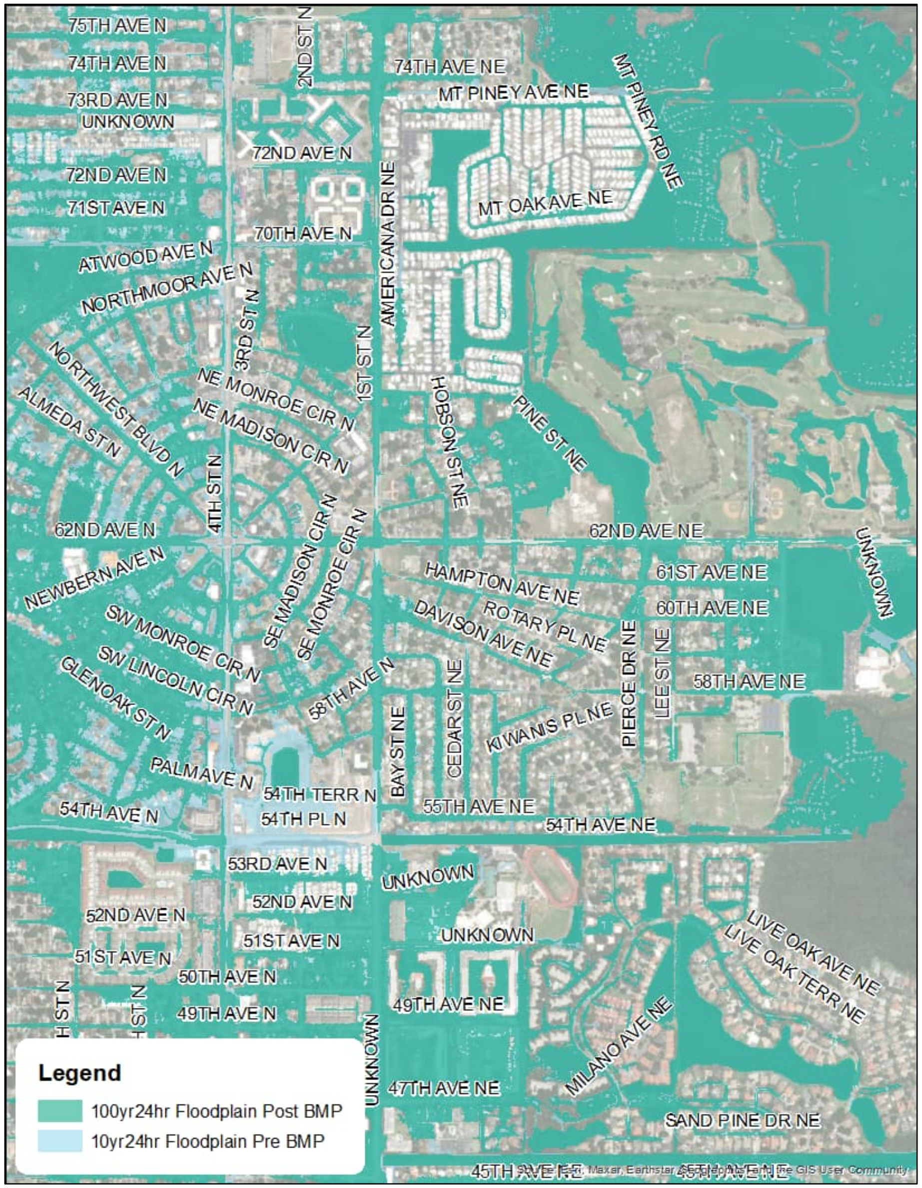


Coffee Bayou Outfall on 31st Ave N

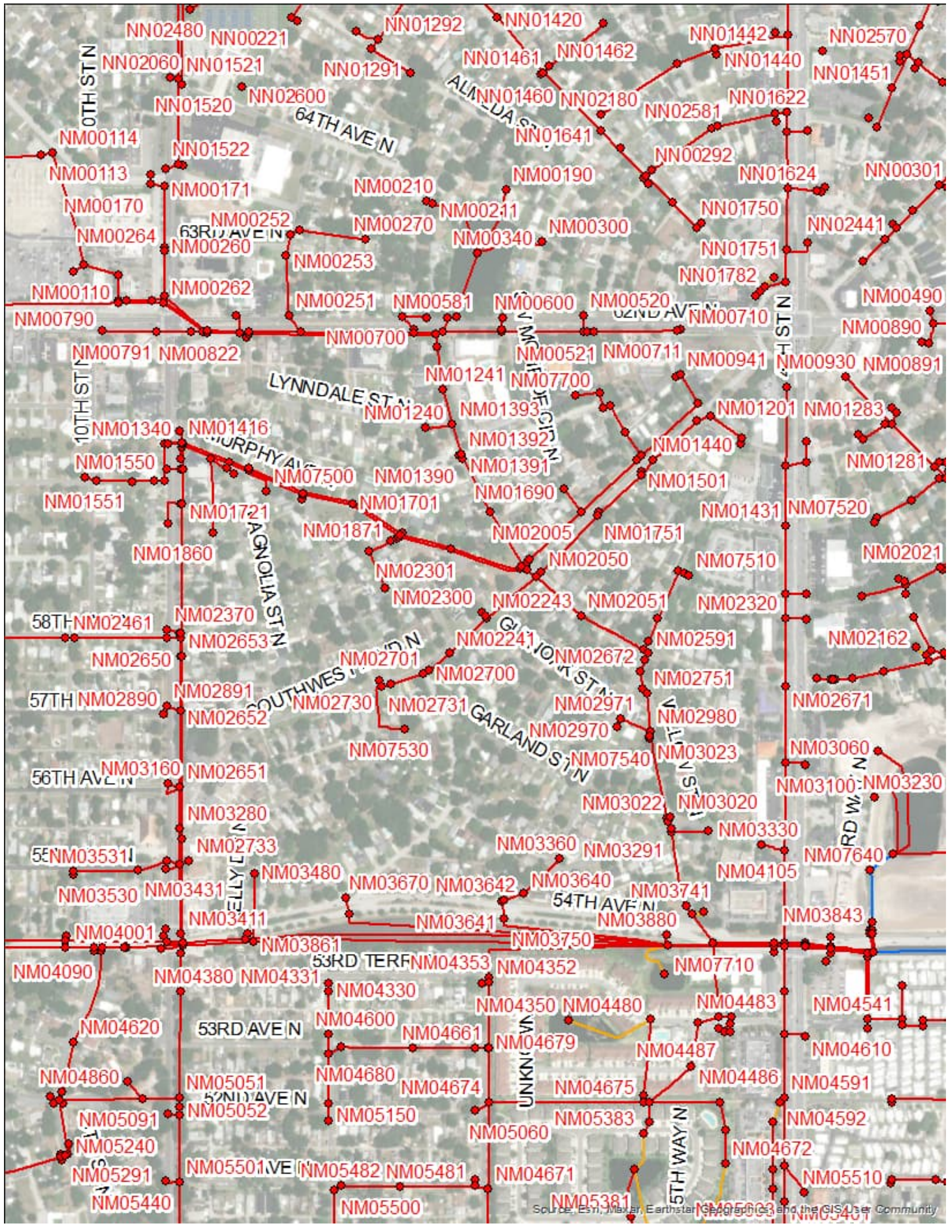
Estimated Cost:

Estimated cost for this project is approximately $49,733,406 including planning, engineering, and permitting fees..

Flooding Improvements at 62nd Ave North Area – Project No. G6-6

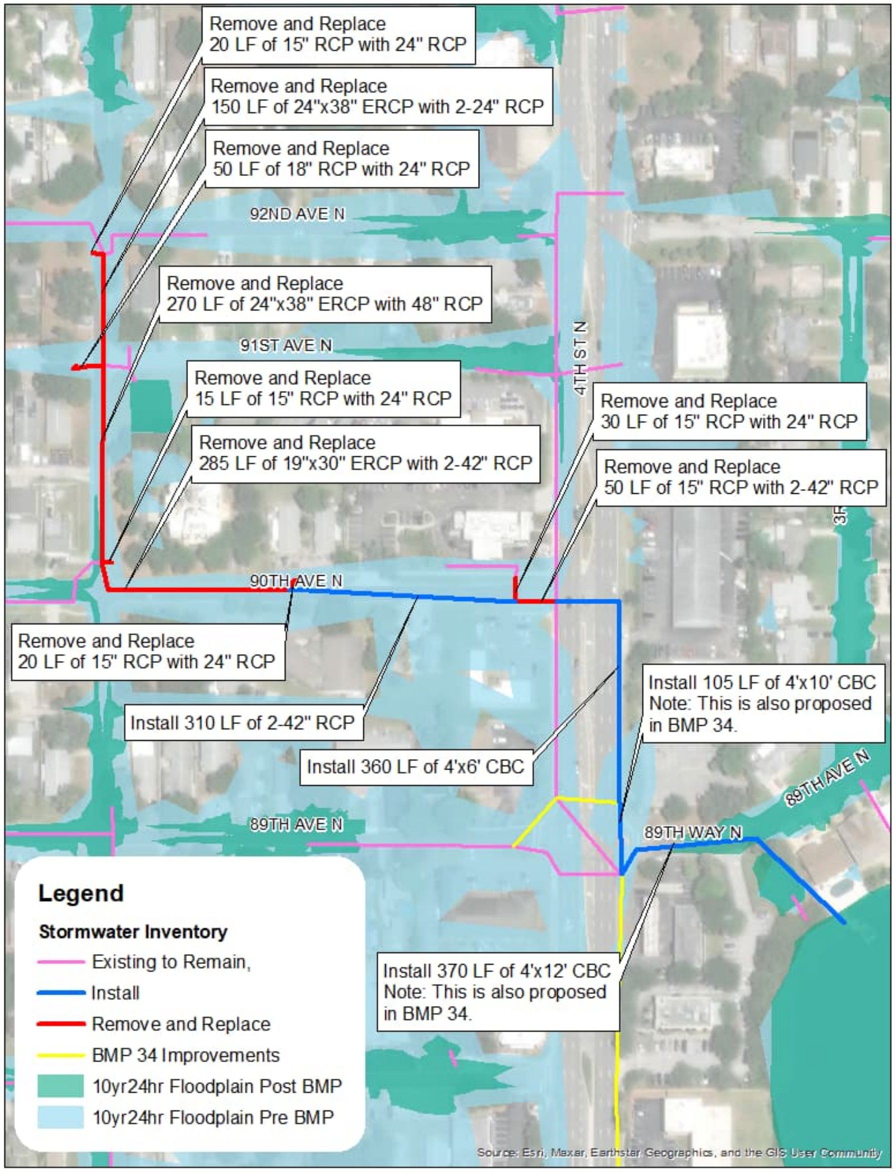


Node Reference Map – Project No. G6-6



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NM00700	NW Lincoln Cir N and 62nd Ave N	1	6.2	5.89	0.31	6.61	6.39	0.22
NM00600	NW Monroe Cir N and 62nd Ave	1	6.19	5.89	0.3	6.6	6.38	0.22
NM00520	NW Madison Cir N and 62nd Ave N	1	6.19	5.9	0.29	6.6	6.37	0.23
NM02000	Southwest Blvd N and SW Lincoln Cir N	1	6.2	5.82	0.38	6.62	6.36	0.26

Flooding Improvements at 5th Street North & 90th Avenue North - Project No. G6-7



Problem

BMP 9 proposed stormwater conveyance system improvements to the existing structures along 5th Street North and 90th Avenue North for the residential area incurring flooding issues along 92nd Avenue North, 91st Avenue North, and 90th Avenue North (Figure 9-1).

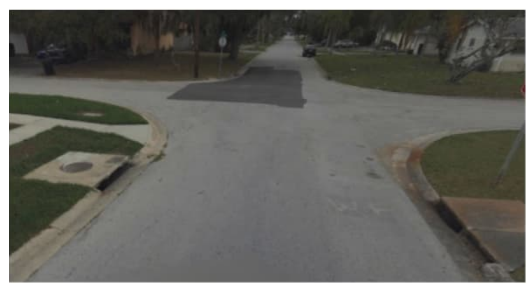
The improvements being proposed are an extension of improvements also proposed in BMP 34. BMP 34 proposes improvements along 4th Street North and 89th Way North which outfall to a tidally influenced water body. The BMP 9 improvements include reversing the flow of the system along 5th Street North from going north and westward along 92nd Avenue North, and redirecting the flow to go south along 5th Street North, east along 90th Avenue North, and south along 4th Street North where it will tie into BMP 34 improvements.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Remove and replace 20 LF of 15" RCP with 24" RCP at the intersection of 92nd Avenue North and 5th Street North
- Remove and replace 150 LF of 24"x38" ERCP with 2-24" RCP along 5th Street North south of 92nd Avenue North
- Remove and replace 50 LF of 18" RCP with 24" RCP at the intersection of 91st Avenue North and 5th Street North
- Remove and replace 270 LF of 24"x38" ERCP with 48" RCP along 5th Street North south of 91st Avenue North
- Remove and replace 15 LF of 15" RCP with 24" RCP at the intersection of 90th Avenue North and 5th Street North
- Remove and Replace 285 LF of 19"x30" ERCP with 2-42" RCP along 90th Avenue North east of 5th Street North
- Remove and Replace 20 LF of 15" RCP with 24" RCP along 90th Avenue North
- Install 310 LF of 2-42" RCP along 90th Avenue North and tie into existing system at 4th Street North
- Remove and Replace 30 LF of 15" RCP with 24" RCP at the intersection of 90th Avenue North and 4th Street North
- Remove and Replace 50 LF of 15" RCP with 2-42" RCP at the intersection of 90th Avenue North and 4th Street North
- Install 360 LF of 4'x6' CBC under 4th Street North and southward along 4th Street North and tie into proposed BMP 12 improvements at the intersection of 4th Street North and 89th Way North
- Install 105 LF of 4'x10' CBC under 4th Street North at the intersection with 89th Way North, and
- Install 370 LF of 4'x12' CBC along 89th Way North from 4th Street North to the outfall

This alternative removes approximately 2750 feet of roadway from the 10-year floodplain and 44 structures from the 100-year floodplain



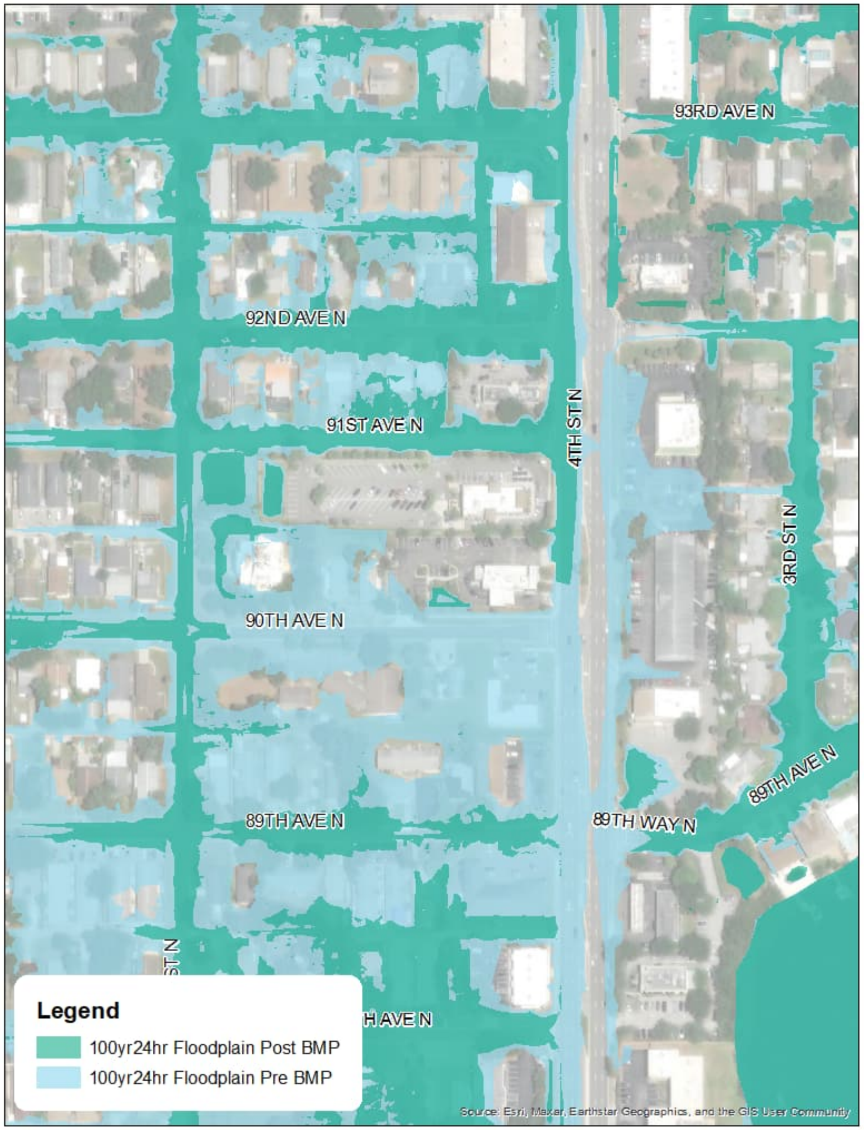
Intersection of 92nd Ave N & 5th St N

Intersection of 90th Ave N & 5th St N

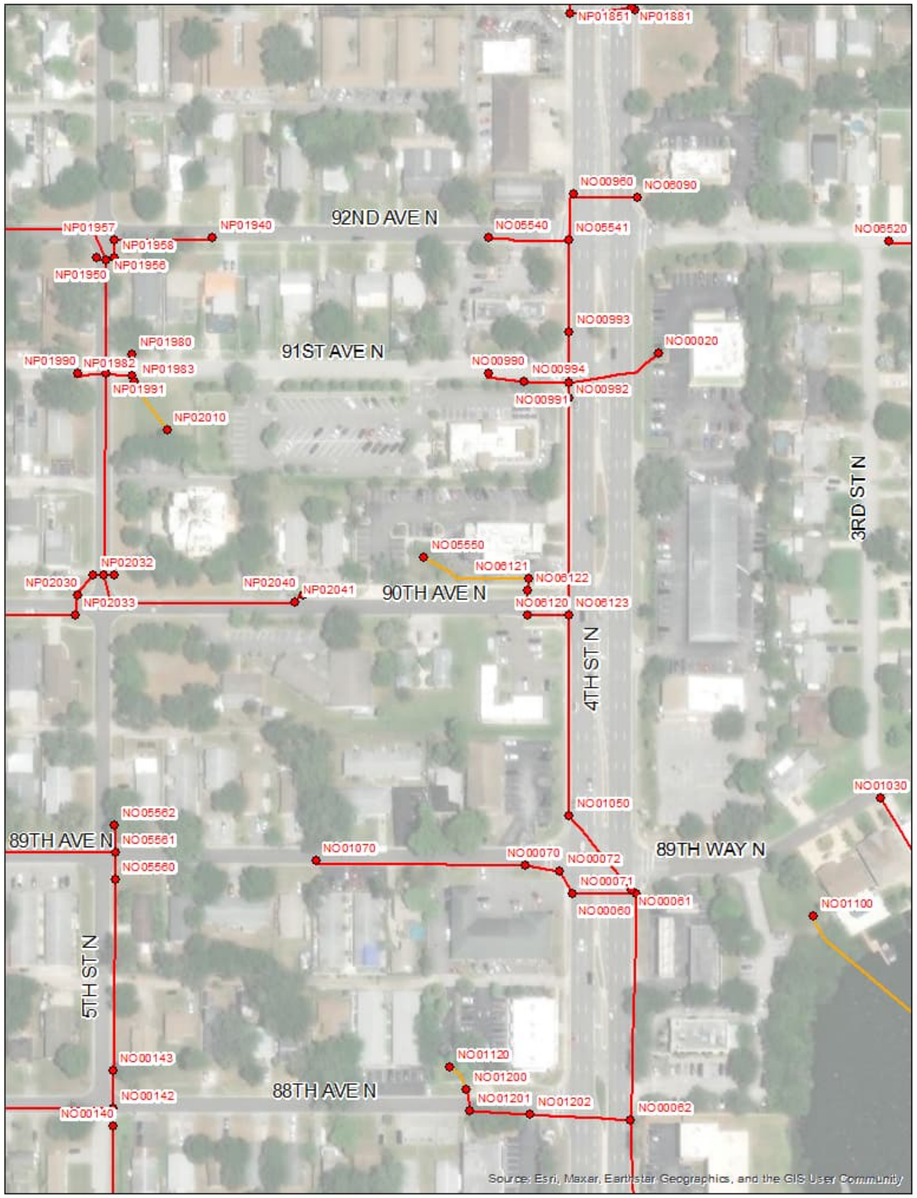
Estimated Cost:

Estimated cost for this project is approximately $6,600,000 including planning, engineering, and permitting fees..

Flooding Improvements at 5th Street North & 90th Avenue North - Project No. G6-7

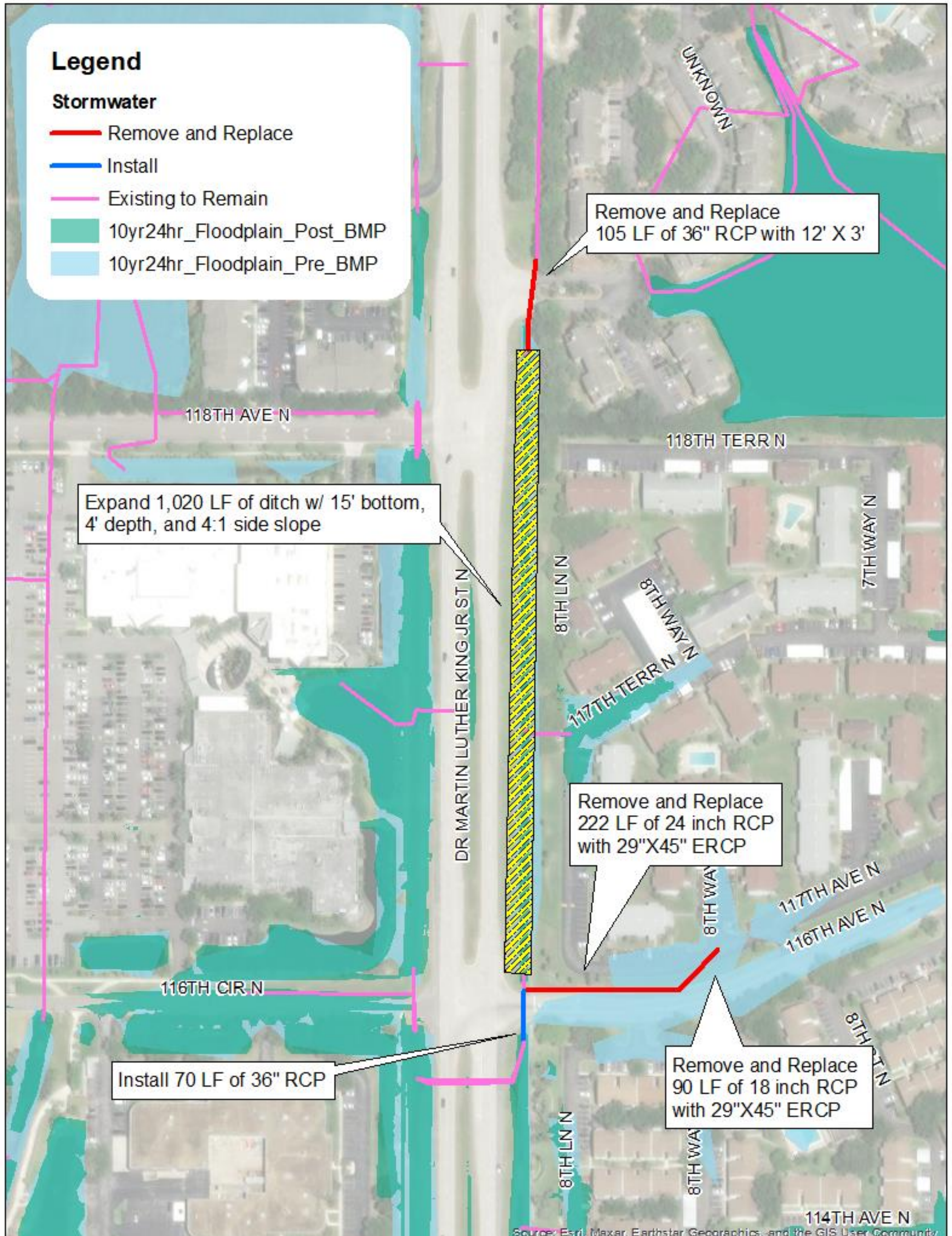


Node Reference Map - Project No. G6-7



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NP01950	92nd Ave N & 5th St N	1	5.27	4.27	1	5.53	5.22	0.31
NP01980	91st Ave N & 5th St N	1.92	5.25	3.9	1.35	5.53	5.18	0.35
NP02030	90th Ave N & 5th St N	1.12	5.11	4.75	0.36	5.54	5.01	0.53
NO06120	90th Ave N & 4th St N	1	5.06	2.4	2.66	5.52	3.5	2.02

Flooding Improvements at 116th Avenue North – Project No. G6-8



Problem

BMP 6-10 focuses on the conveyance system draining west from The Meadows Apartments on 116th Avenue North to the channel east of Dr. Martin Luther King Jr. Street North and north along Dr. Martin Luther King Jr. Street North. This area is impacted by roadway flooding along 116th Avenue North and flooding into the adjacent apartment complexes.

Solution & Project Benefits:

BMP 6-10 proposes the following changes to alleviate roadway and residential flooding within the 116th Avenue North area.

- Remove and replace 105 LF of 30" RCP with 6'x6' CBC
- Expand ~1,020 LF of existing ditch to 15' bottom, 4' depth, and 4:1 side slopes from Inlet Bay Apts to 116th Cir N east of Dr Martin Luther King Jr St N
- Install 70 LF of 36" RCP under 116th Cir N east of Dr Martin Luther King Jr St N
- Remove and replace 220 LF of 24" RCP with 29"x45" ERCP along 116th Cir N east of Dr Martin Luther King Jr ST N
- Remove and replace 90 LF of 18" RCP with 29"x45" ERCP along 116th Cir N east of Dr Martin Luther King Jr St N

This area consists of multiple multi-family dwellings and impacts to vehicular and pedestrian traffic should be expected for the improvements listed above. The proposed solutions will provide more conveyance capacity and reduce flooding in the impacted area.

This alternative removes approximately 1319 feet of roadway from the 10-year floodplain and 6 structures from the 100-year floodplain.

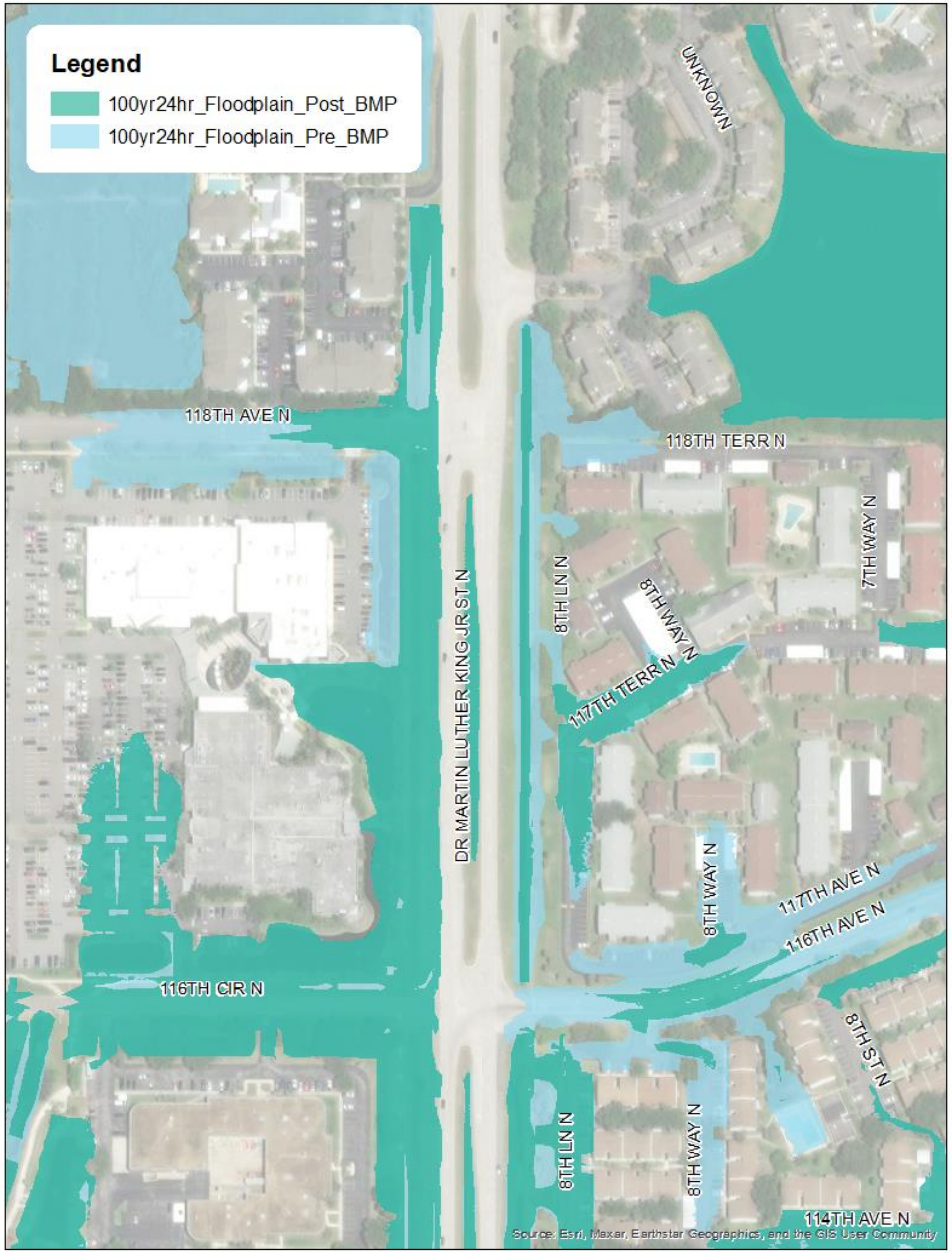
Existing drainage network at CR 803 and 116th Avenue North

Existing drainage culvert at Inlet Bay Apartments

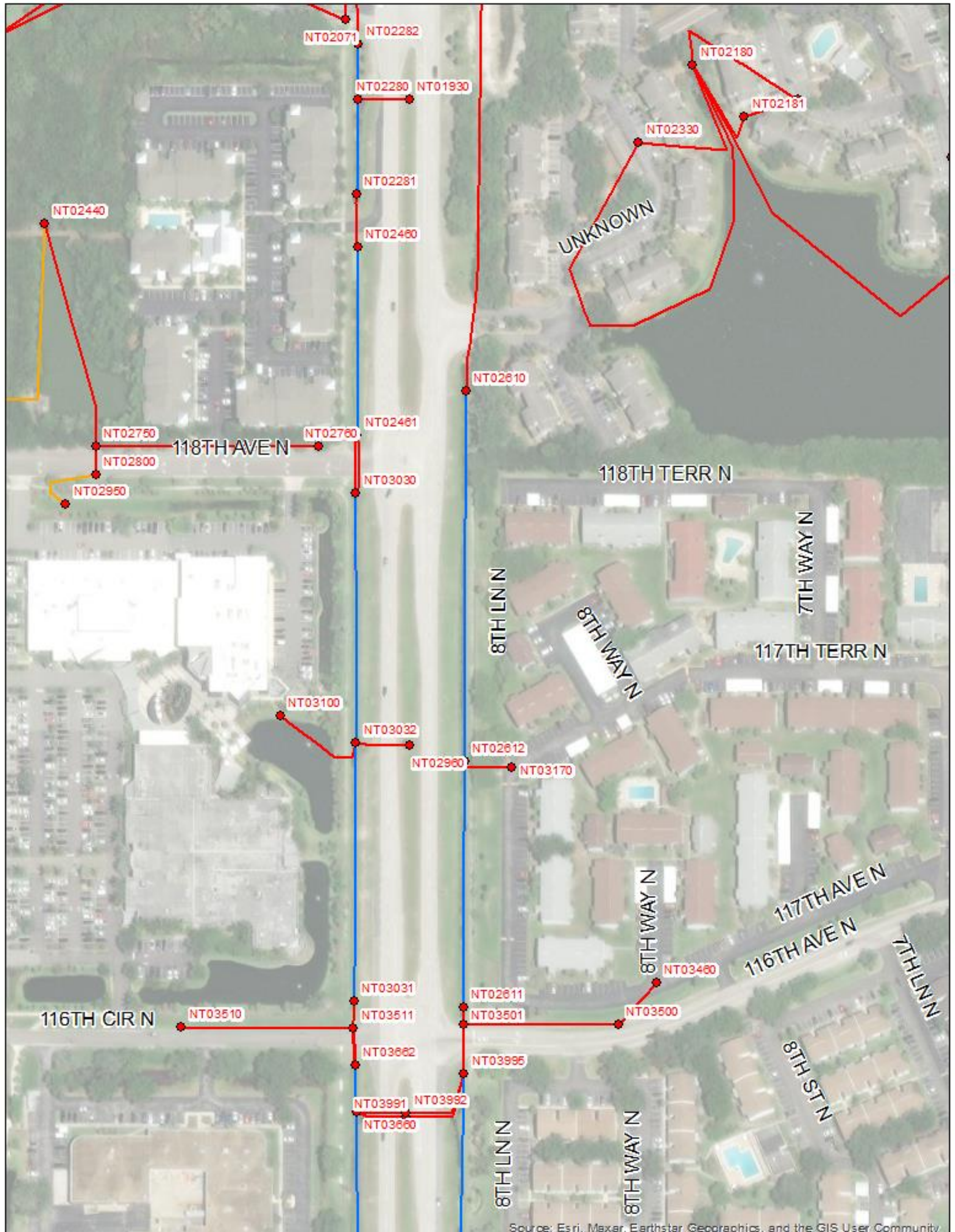
Estimated Cost:

Estimated cost for this project is approximately $1,722,594 including planning, engineering, and permitting fees..

Flooding Improvements at 116th Avenue North – Project No. G6-8



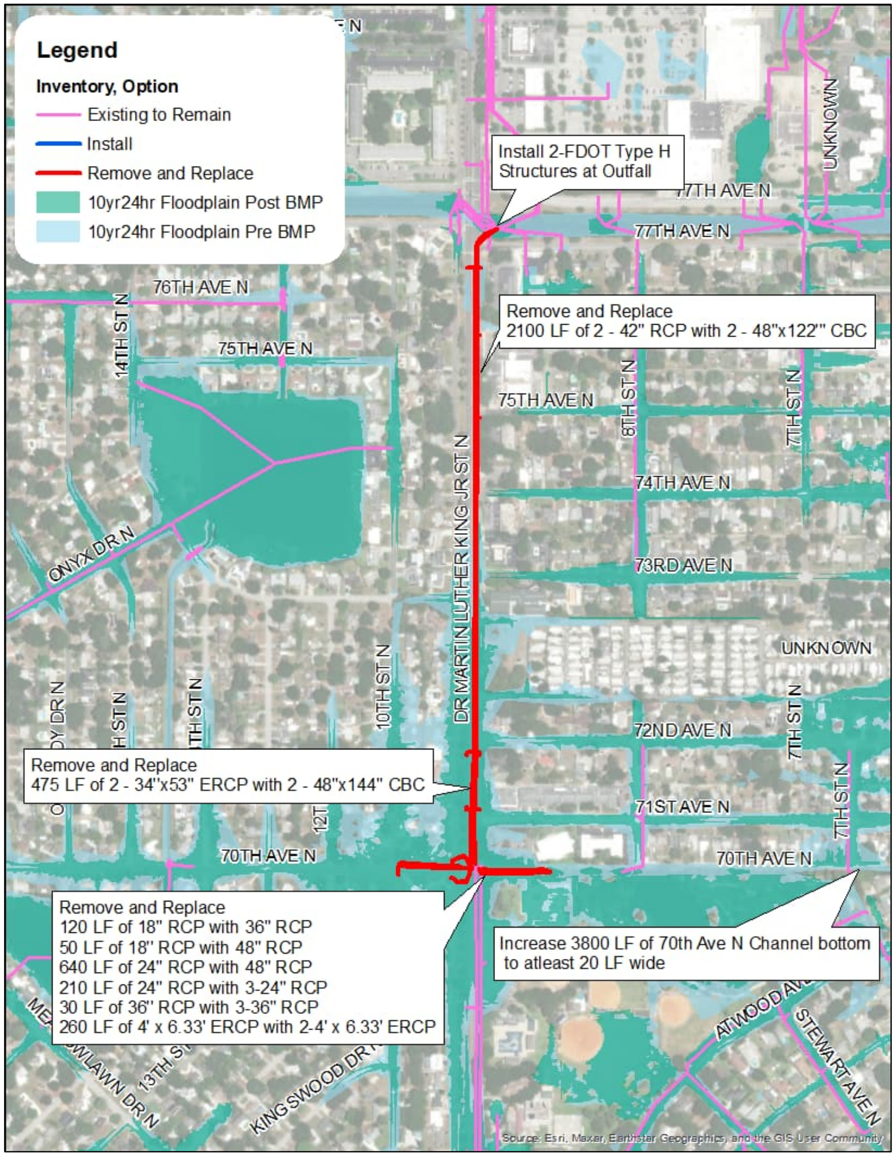
Node Reference Map – Project No. G6-8



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NT03460	The Meadows Apartment	2.11	5.35	3.9	-1.45	5.56	4.66	-0.9
NT02611	Channel at 116th Ave N	2.11	4.57	3.52	-1.05	5	3.93	-1.07
NT02610	Channel at Inlet Bay Apartments	1.02	3.82	2.49	-1.33	4.76	2.96	-1.8

PS3!

Flooding Improvements at Dr. MLK Jr. Street N and 70th Ave N - Project No. G6-9 & 24A



SOLUTION A

Problem

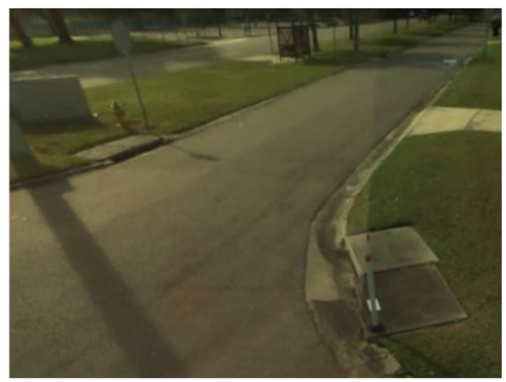
BMPs 11 and 30 focus on alleviating structural and roadway flooding along the intersection of Dr. Martin Luther King Jr. Street N and 70th Avenue North. The roadway and surrounding structures experience around 2 to 3 ft of flooding during 10yr storm events. The area of interest consists of mainly residential housing as well as a few commercial properties and a local park. Improvements for the two BMPs include upsizing the conveyance systems along Dr. Martin Luther King Street North and 70th Avenue North that outfall into the channels. Additionally, because there is excessive flow even with upsizing, two bypass systems will also be installed near the two BMP locations to divert flow to open water during periods of high flow.

Solution & Project Benefits:

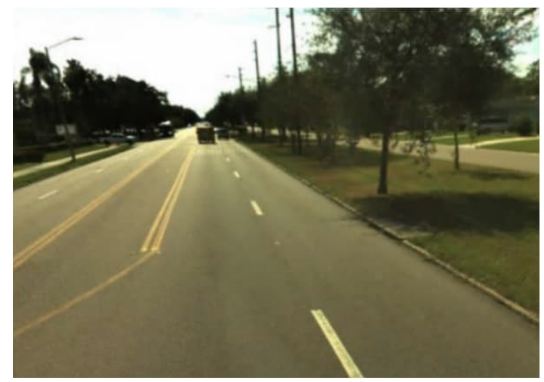
The proposed improvements would include the following upgrades to the existing system:

- Install 2- FDOT Type H structures at channel outfall
- Remove and Replace 120 LF of 18" RCP with 36" RCP along 70th Avenue N
- Remove and Replace 50 LF of 18" RCP with 48" RCP along 70th Avenue N
- Remove and Replace 640 LF of 24" RCP with 48" RCP along 70th Avenue N
- Remove and Replace 210 LF of 24" RCP with 3-24" RCP along 70th Avenue N
- Remove and Replace 30 LF of 36" RCP with 3-36" RCP along 70th Avenue N
- Remove and Replace 260 LF of 4' x 6.33' ERCP with 2-4' x 6.33' ERCP along 70th Avenue N
- Remove and Replace 475 LF of 2 – 34"x53" ERCP with 2 – 48"x122" CBC along Dr. Martin Luther King Jr. St N
- Remove and Replace 475 LF of 2 – 42" RCP with 2 – 48"x122" CBC along Dr. Martin Luther King Jr. St N
- Widen 70th Ave N channel bottom to at least 20 LF wide
- Deepen 70th Ave N channel by ~3.2 FT

This alternative removes approximately 1,250 feet of roadway from the 10-year floodplain and 45 structures from the 100-year floodplain



Existing drainage inlets at Dr. MLK Jr St N and 70th Ave N



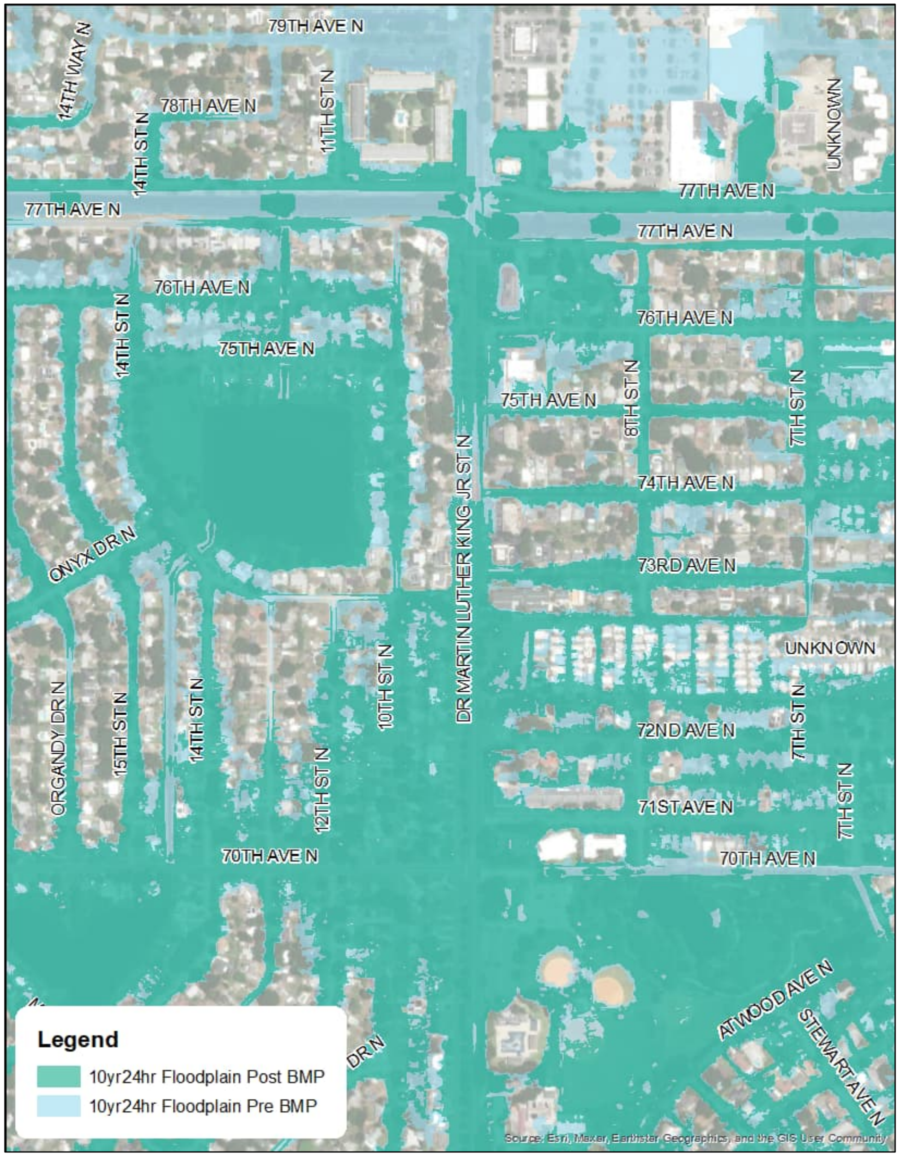
Existing drainage inlets at Dr. MLK Jr St N and 72nd Ave N

Estimated Cost:

Estimated cost for this project is approximately $26,886,094 including planning, engineering, and permitting fees..

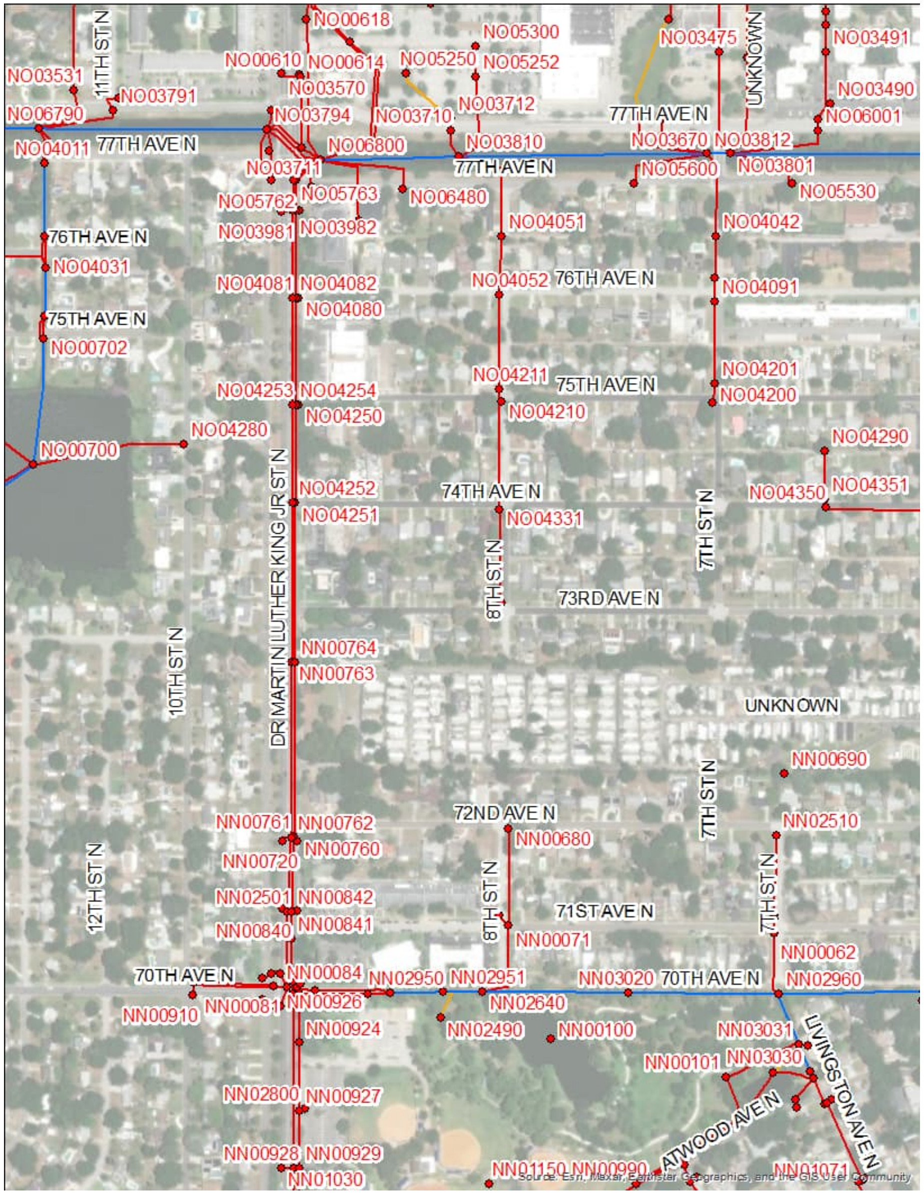
HB2

Flooding Improvements at Dr. MLK Jr. Street N and 70th Ave N - Project No. G6-9 & 24A



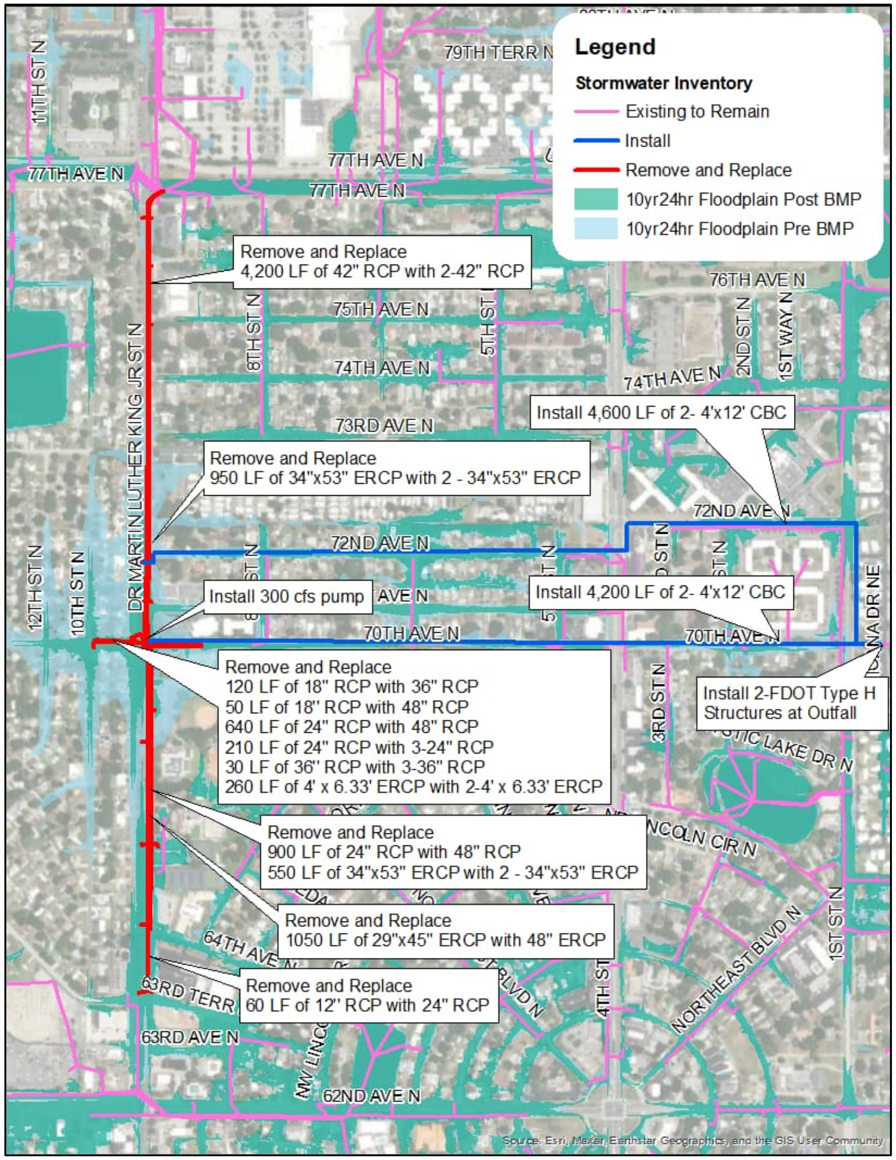
SOLUTION A

Node Reference Map - Project No. G6-9 and 24A



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NN00720	Dr. MLK Jr. St. N and 72nd Ave N	1.00'	5.94'	5.45'	0.49'	6.49'	6.39'	0.10'
NN00080	Dr. MLK Jr. St. N and 70th Ave N	1.00'	5.94'	5.46'	0.48'	6.51'	6.40'	0.11'
NN00910	70th Ave N and 10th St. N	1.00'	5.94'	5.48'	0.46'	6.51'	6.41'	0.10'

Flooding Improvements at Dr. MLK Jr. Street N and 70th Ave N - Project No. G6-9 & 24B



SOLUTION B

Problem

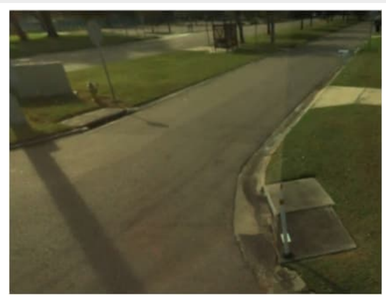
BMPs 11 and 30 focus on alleviating structural and roadway flooding along the intersection of Dr. Martin Luther King Jr. Street N and 70th Avenue North. The roadway and surrounding structures experience around 2 to 3 ft of flooding during 10yr storm events. The area of interest consists of mainly residential housing as well as a few commercial properties and a local park. Improvements for the two BMPs include upsizing the conveyance systems along Dr. Martin Luther King Street North and 70th Avenue North that outfall into the channels. Additionally, because there is excessive flow even with upsizing, two bypass systems will also be installed near the two BMP locations to divert flow to open water during periods of high flow.

Solution & Project Benefits:

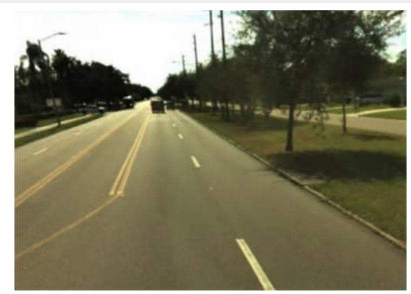
The proposed improvements would include the following upgrades to the existing system:

- Install 2- FDOT Type H structures at channel outfall
- Install 300 cfs pump at southern bypass
- Install 8800 LF of 2-4'x12' CBC going east to open water
- Install 50 LF of 36" RCP along Dr. Martin Luther King Jr. St. N
- Remove and Replace 120 LF of 18" RCP with 36" RCP along 70th Avenue N
- Remove and Replace 50 LF of 18" RCP with 48" RCP along 70th Avenue N
- Remove and Replace 640 LF of 24" RCP with 48" RCP along 70th Avenue N
- Remove and Replace 210 LF of 24" RCP with 3-24" RCP along 70th Avenue N
- Remove and Replace 30 LF of 36" RCP with 3-36" RCP along 70th Avenue N
- Remove and Replace 260 LF of 4' x 6.33' ERCP with 2-4' x 6.33' ERCP along 70th Avenue N
- Remove and Replace 60 LF of 12" RCP with 24" RCP along Dr. Martin Luther King Jr. St. N
- Remove and Replace 130 LF of 15" RCP with 30" RCP along Dr. Martin Luther King Jr. St. N
- Remove and Replace 1350 LF of 18" RCP with 36" RCP along Dr. Martin Luther King Jr. St. N
- Remove and Replace 900 LF of 24" RCP with 48" RCP along Dr. Martin Luther King Jr. St. N
- Remove and Replace 1500 LF of 34"x53" ERCP with 2-34"x53" ERCP along Dr. Martin Luther King Jr. St. N
- Remove and Replace 1050 LF of 29"x45" ERCP with 48" ERCP along Dr. Martin Luther King Jr. St. N
- Remove and Replace 4200 LF of 42" RCP with 2-42" RCP along Dr. Martin Luther King Jr. St. N

This alternative removes approximately 1,085 feet of roadway from the 10-year floodplain and 23 structures from the 100-year floodplain



Existing drainage inlets at Dr. MLK Jr St N and 70th Ave N

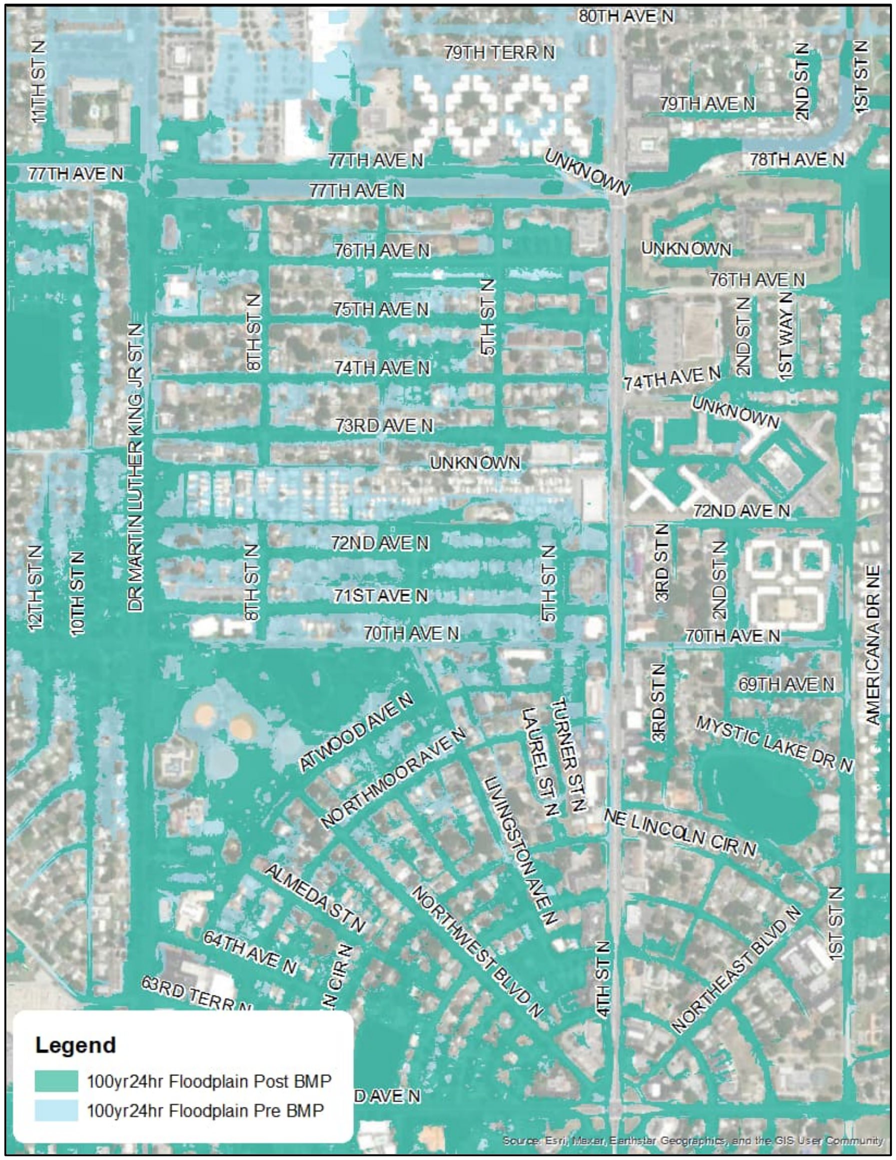


Existing drainage inlets at Dr. MLK Jr St N and 72nd Ave N

Estimated Cost:

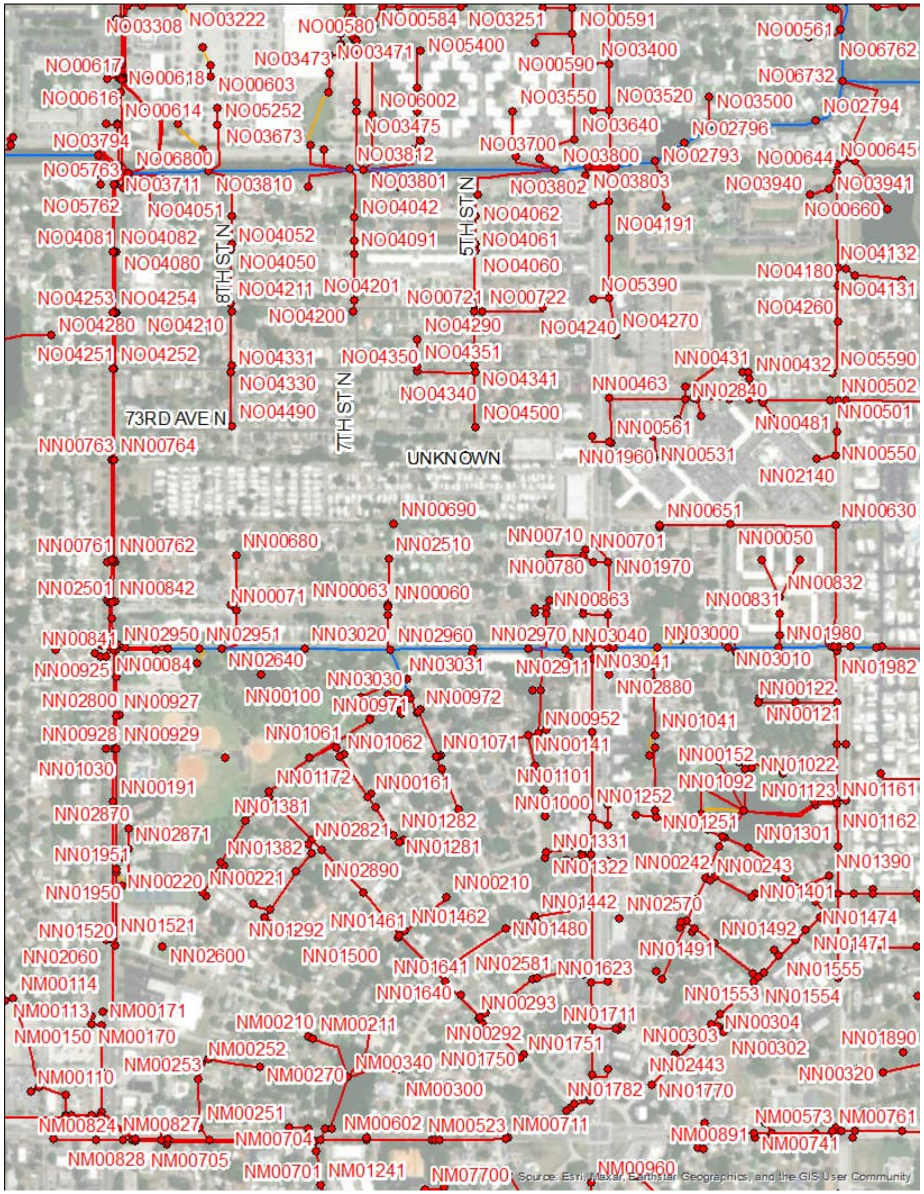
Estimated cost for this project is approximately $158,366,591 including planning, engineering, and permitting fees..

Flooding Improvements at Dr. MLK Jr. Street N and 70th Ave N - Project No. G6-9 & 24B



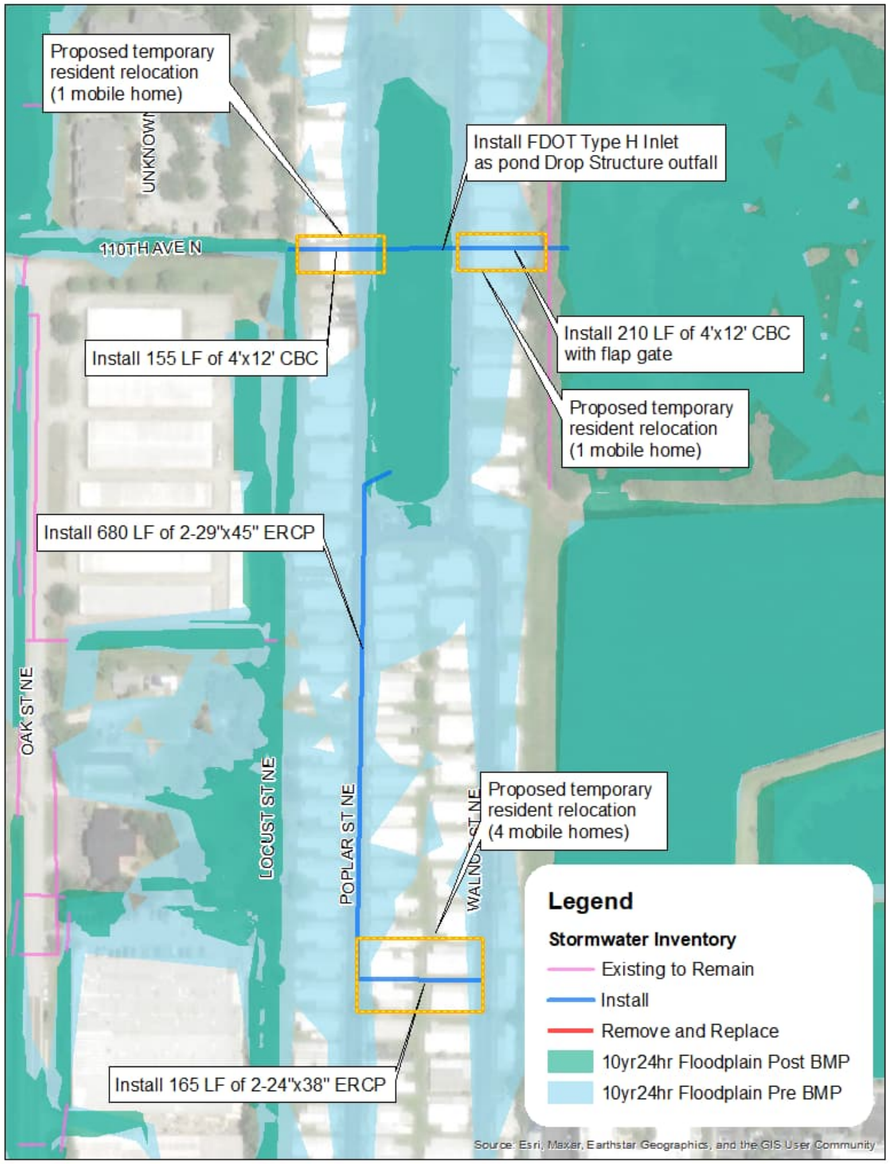
SOLUTION B

Node Reference Map - Project No. G6-9 & 24B



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NN00720	Dr. MLK Jr. St. N and 72nd Ave N	1.00'	5.94'	4.73'	1.21'	6.49'	6.04'	0.45'
NN00080	Dr. MLK Jr. St. N and 70th Ave N	1.00'	5.94'	4.80'	1.14'	6.51'	6.06'	0.45'
NN00910	70th Ave N and 10th St. N	1.00'	5.94'	4.86'	1.08'	6.51'	6.09'	0.42'

Flooding Improvements at Poplar Street NE Mobile Home Subdivision - Project No. G6-10



Problem

BMP 12 focuses on the lack of conveyance system within the Mobile Home Subdivision located along Poplar Street NE and Walnut Street NE (Figure 12-1). This area consists of residential landuse and adjacent properties are commercial land use. BMP 9 improvements includes installing a 4'x12' CBC from the channel system north of 110th Avenue North eastward, connecting into the Mobile Home Subdivision stormwater pond with a proposed FDOT Type H inlet as an outfall from the pond, and to the wetland area east of the subdivision which includes flap gates to prevent tidal inundation. This element of the BMP would provide the stormwater pond and outfall, which it currently does not have, and allow for flood reduction from the added channel conveyance eastward which also benefits BMP 1 (see BMP 1 for further details).

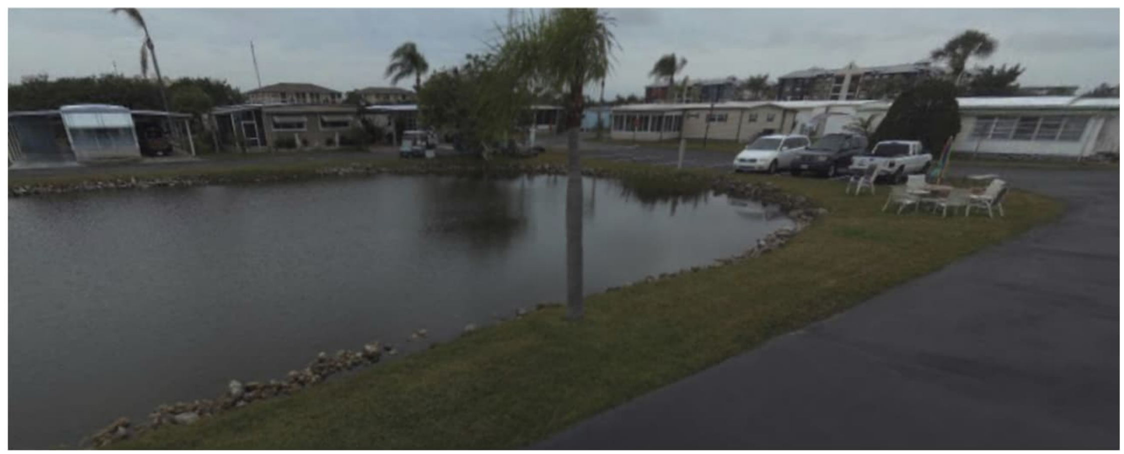
Additionally, this BMP proposed the installation of stormwater conveyance system to collect runoff from Poplar Street NE and Walnut Street NE and divert it to the stormwater pond.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Install 155 LF of 4'x12' CBC from the channel north of 110th Avenue North to the Mobile Home Subdivision stormwater pond
- Install a FDOT Type H Inlet as a pond drop structure outfall
- Install 210 LF of 4'x12' CBC with flap gate from Mobile Home Subdivision stormwater pond to wetland area east of subdivision
- Install 680 LF of 2-29x45" ERCP from along Poplar Street NE to the stormwater pond north
- Install 165 LF of 2-24"x38" ERCP from Walnut Street NE to the south end of the proposed pipe on Poplar Street NE

This alternative removes approximately 1500 feet of roadway from the 10-year floodplain and 12 structures from the 100-year floodplain

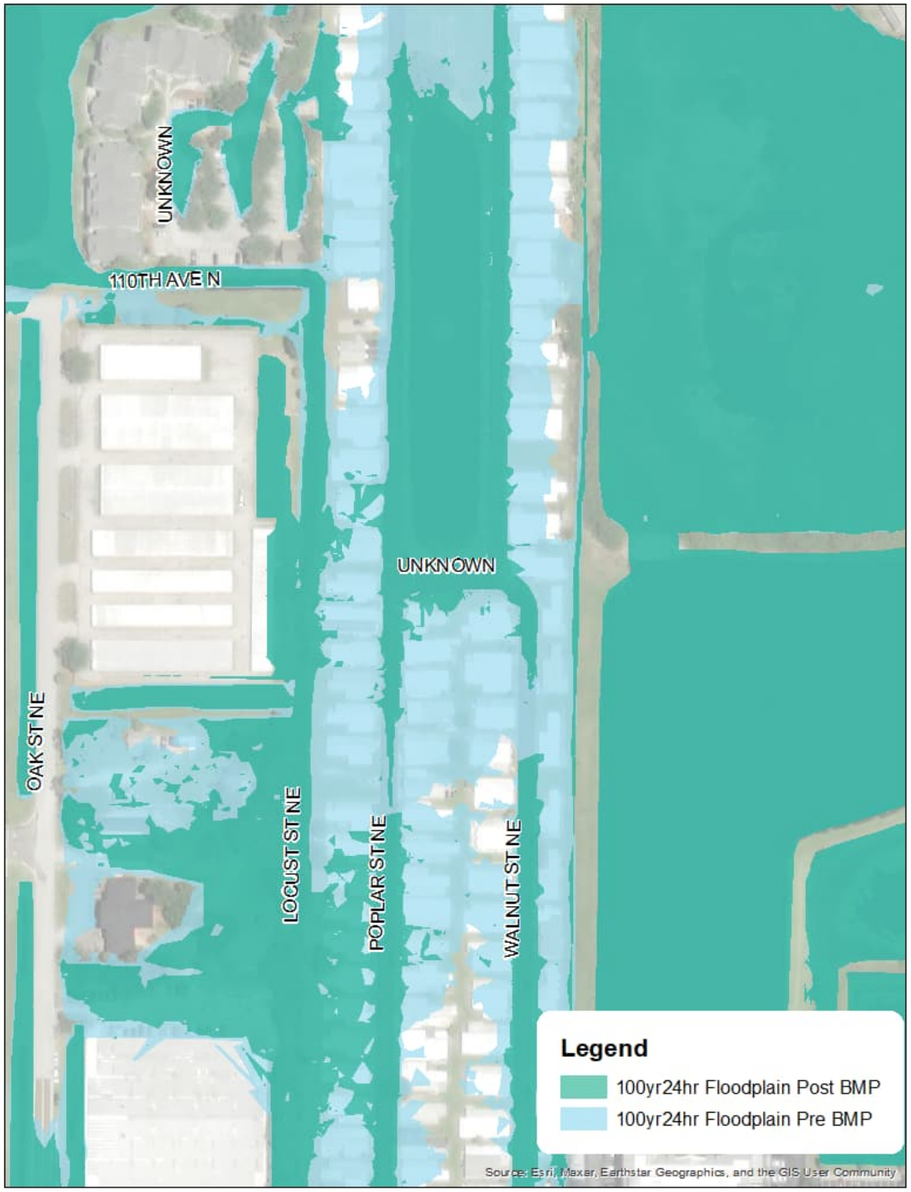


Existing stormwater pond, view from Poplar St NE facing southeast

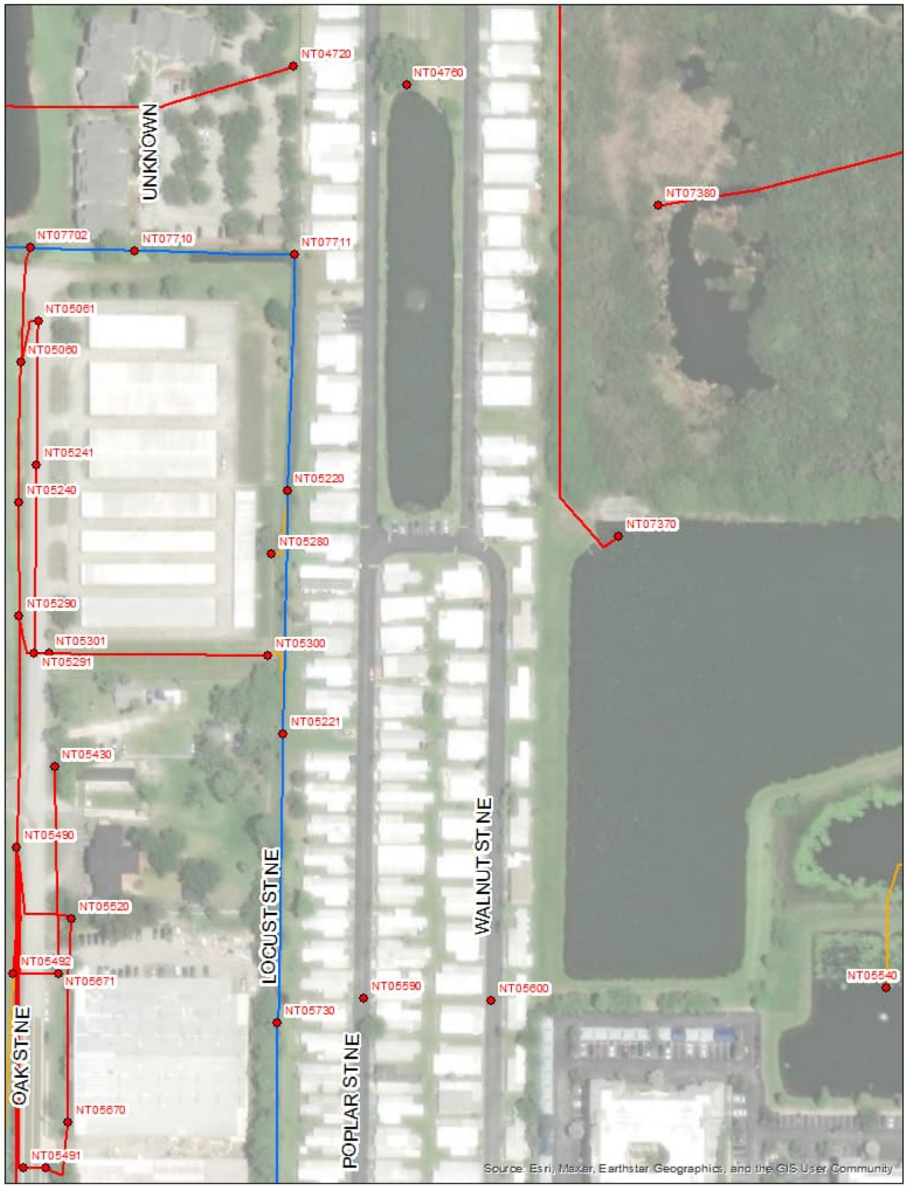
Estimated Cost:

Estimated cost for this project is approximately $3,605,000 including planning, engineering, and permitting fees..

Flooding Improvements at Poplar Street NE Mobile Home Subdivision - Project No. G6-10

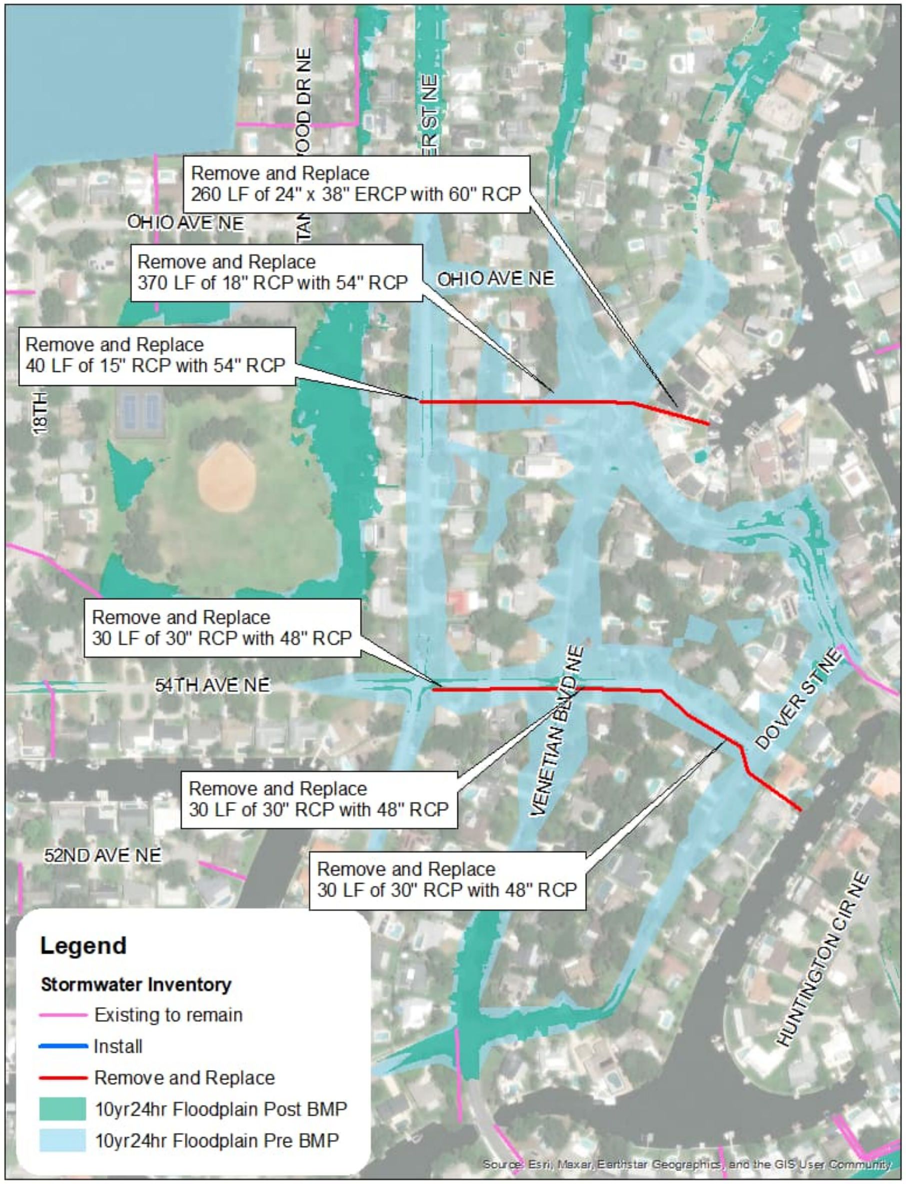


Node Reference Map - Project No. G6-10



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NT04760	Stormwater Pond east of Poplar St NE	1	4.5	3.39	1.11	4.72	3.92	0.8
NT05600	Walnut St NE	3.38	4.46	3.66	0.8	4.57	4.29	0.28
NT05590	Poplar St NE	3.27	4.5	3.63	0.87	4.75	4.23	0.52

Flooding Improvements at Denver Street NE – Project No. G6-11



Problem

BMP 6-14 focuses on the conveyance system in two locations draining east from Denver Street NE to the nearest waterbody. Street and residential flooding occurs along Denver Street NE and nearby areas.

Solution & Project Benefits:

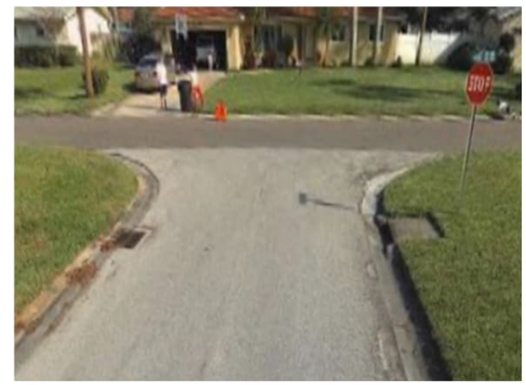
BMP 6-14 proposes the following changes to alleviate roadway and residential flooding within the Denver Street NE area.

- Remove and replace 40 LF of 15" RCP with 54" RCP under Denver St NE
- Remove and replace 370 LF of 18" RCP with 54" RCP from Denver St NE toward Venetian Blvd NE
- Remove and replace 260 LF of 24"x38" ERCP with 60" RCP to canal system and outfall into eastward intercoastal area
- Remove and replace 255 LF of 15" RCP with 60" RCP with 54th Ave NE from Denver St NE to Venetian Blvd NE
- Remove and replace 75 LF of 18" RCP with 72' RCP along 54th Ave NE at Venetia Blvd NE, and
- Remove and replace 615 LF of 24" RCP with 72" RCP along 54th Ave NE from Venetian Blvd NE to outfall east of Cover St NE to intercoastal area

This is a high-density residential area and impacts to vehicular and pedestrian traffic should be expected for the improvements listed above. The proposed solutions will provide more conveyance capacity and reduce street and residential flooding in the impacted area.

This alternative removes approximately 6853 feet of roadway from the 10-year floodplain and 54 structures from the 100-year floodplain.

Existing drainage inlets on Denver Street NE

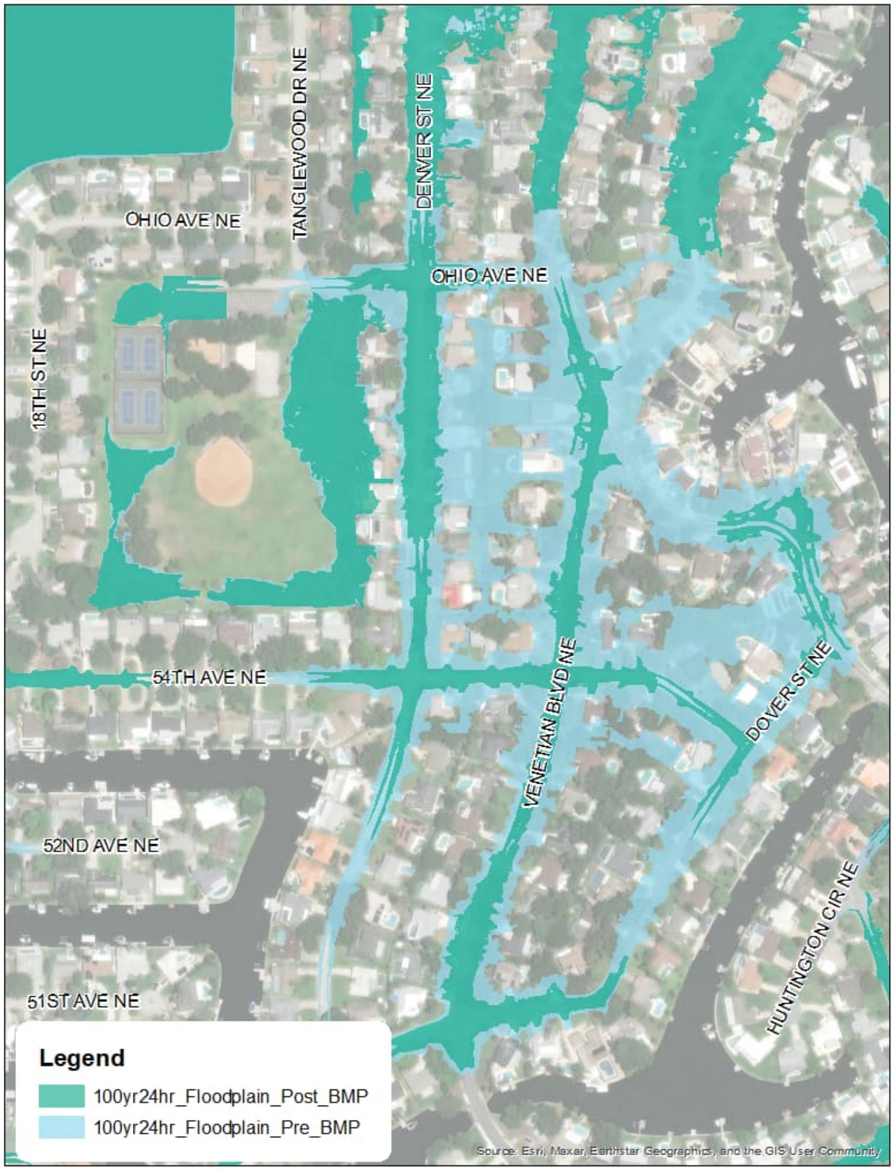


Existing drainage inlets at North Dakota Avenue NE and Dover Street NE

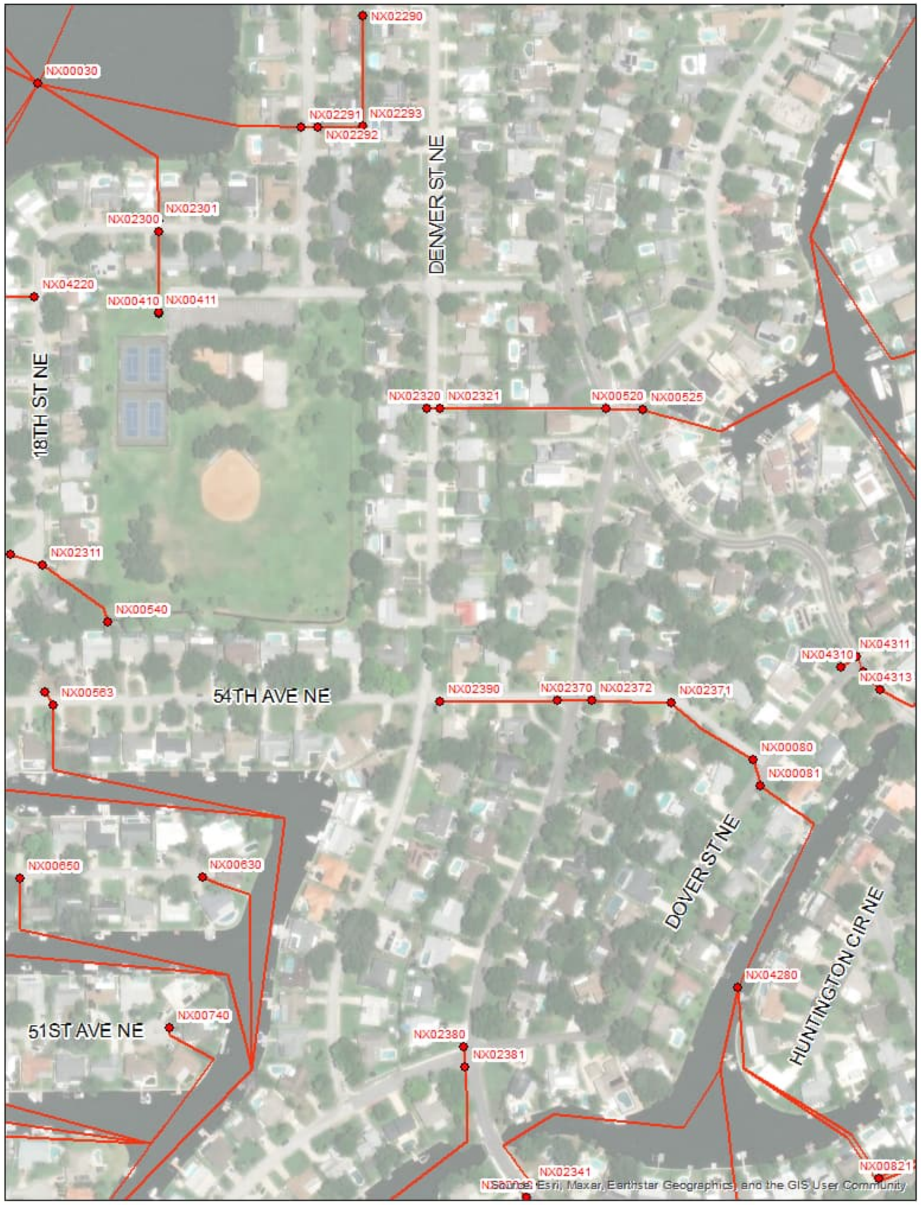
Estimated Cost:

Estimated cost for this project is approximately $3,708,088 including planning, engineering, and permitting fees..

Flooding Improvements at Denver Street NE – Project No. G6-11

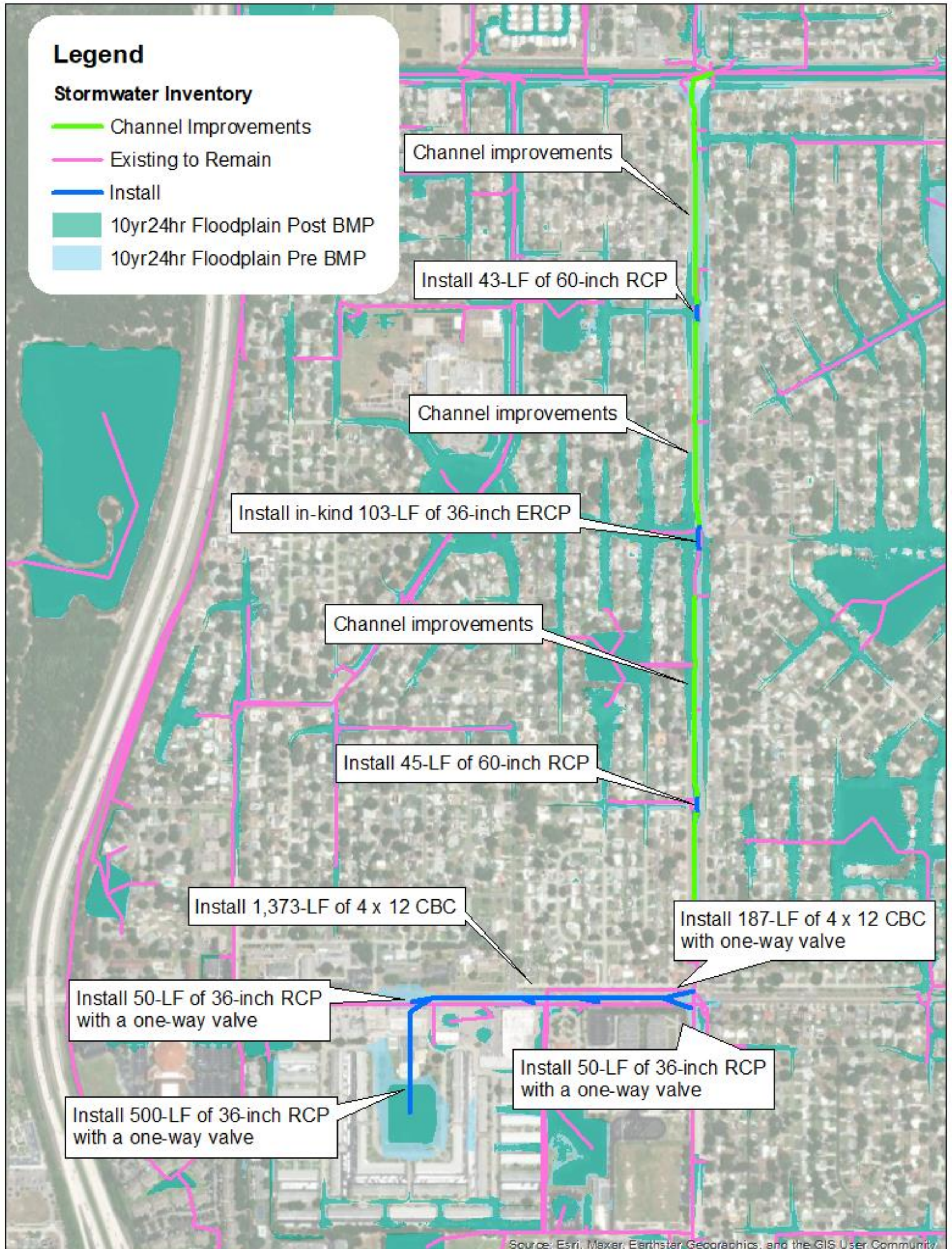


Node Reference Map – Project No. G6-11



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NX00520	Venetian Blvd NE at Bayou Grande Blvd NE	1	3.07	1.5	-1.57	3.35	2.34	-1.01
NX02372	Venetian Blvd NE at North Dakota Ave NE	1	3.07	1.65	-1.42	3.36	2.37	-0.99
NX00081	North Dakota Ave NE at Dover St NE	1	2.52	1.36	-1.16	2.73	1.84	-0.89
NX02390	North Dakota Ave NE at Denver St NE	1	3.1	1.75	-1.35	3.37	2.53	-0.84

Flooding Improvements at 62nd Avenue S and 16th Street N - Project No. G6-12 & 19



Problem

BMP 6-21 focuses on the conveyance system draining from west to east along 62nd Avenue North, intersecting 18th Street North, 17th Way North with an ultimate outfall to the open channel at 16th Street North where roadways are heavily impacted by flooding.

While BMP 6-19 is at a location with no known outfall from the pond serving the area and also experiences roadway flooding at 59th Avenue North, 19th and 20th Street North, as well as 61st Avenue North. These two BMP locations are interconnected and as such written up in a manner that combines each as BMP 6-19 will not function without some of if not all, the conveyance improvements associated with BMP 6-21, as the area already experiences significant flooding conditions.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- 1,560-LF of 4 x 12 concrete box culvert along 62nd Avenue North.
- 50-LF tie-ins of 36-inch reinforced concrete pipe (RCP) along the run of box culvert for additional conveyance capacity for this system.
- Channel invert and geometry revisions for approximately 4,583-LF along 16th Street channel, north to the confluence with the large open channel north of this area that generally flows along 77th Avenue North.
- Additional 45-LF 60-inch RCP Culvert Crossing at 66th Avenue North at existing crossing within open channel.
- Additional in-kind 103-LF 36-inch elliptical concrete pipe Culvert Crossing at 70th Avenue North at existing crossing within open channel.
- Additional 43-LF 60-inch RCP Culvert Crossing at 74th Avenue North at existing crossing within open channel.

The BMP 6-19, builds upon BMP 6-21 and proposes the following changes to alleviate roadway flooding along 59th Avenue North and nearby roadways:

- Proposed outfall from pond: 500-LF of 36-inch RCP, invert set 1.5-ft above pond starting elevation, assumed to be a seasonal high-water elevation.

This alternative removes approximately 2301 feet of roadway from the 10-year floodplain and 5 structures from the 100-year floodplain.

Existing drainage structures at 62nd Ave S and 16th St N

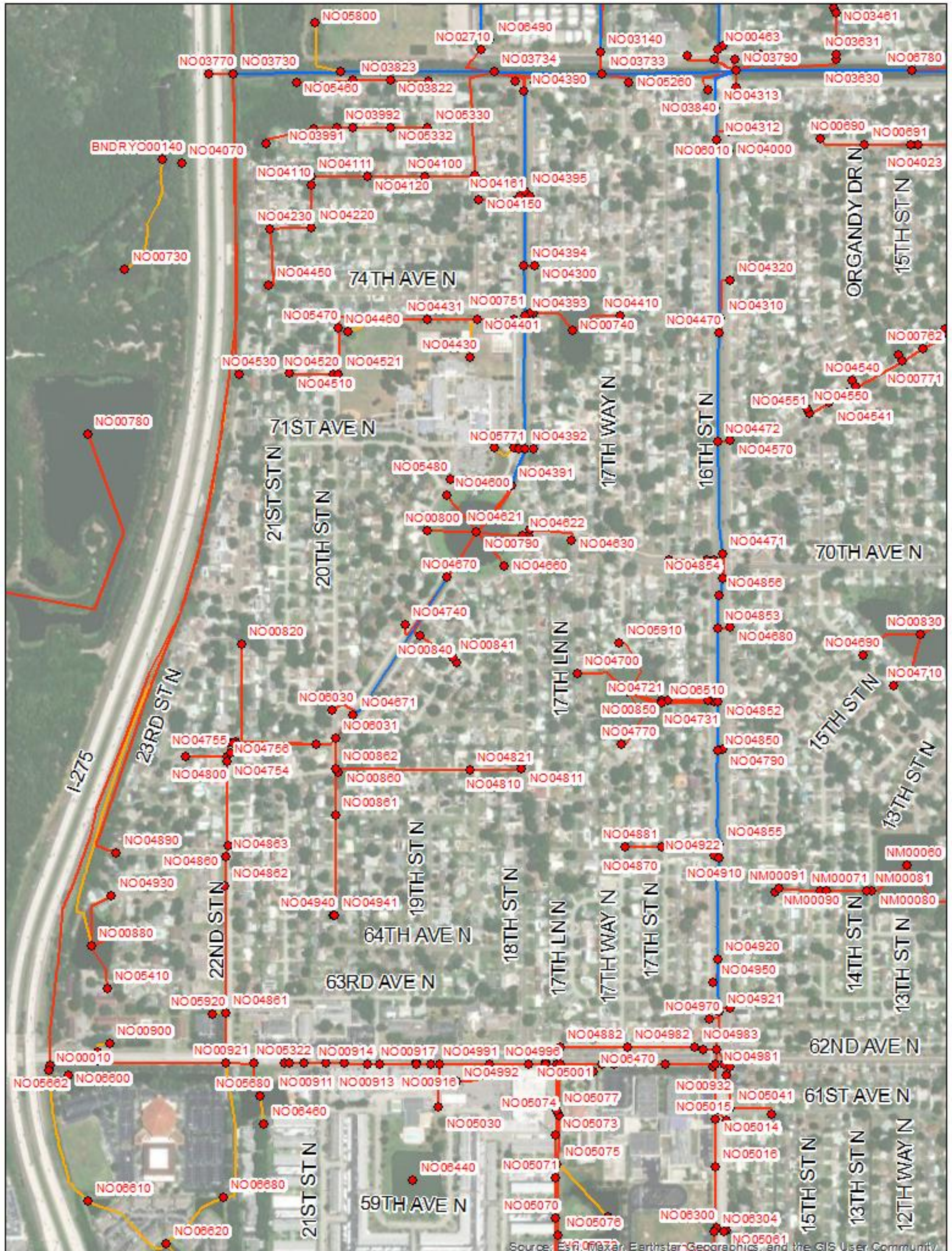
Existing Channel on 16th Street North

Estimated Cost:

Estimated cost for this project is approximately $8.008,330 including planning, engineering, and permitting fees..


Legend
100yr24hr Floodplain Post BMP
100yr24hr Floodplain Pre BMP
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

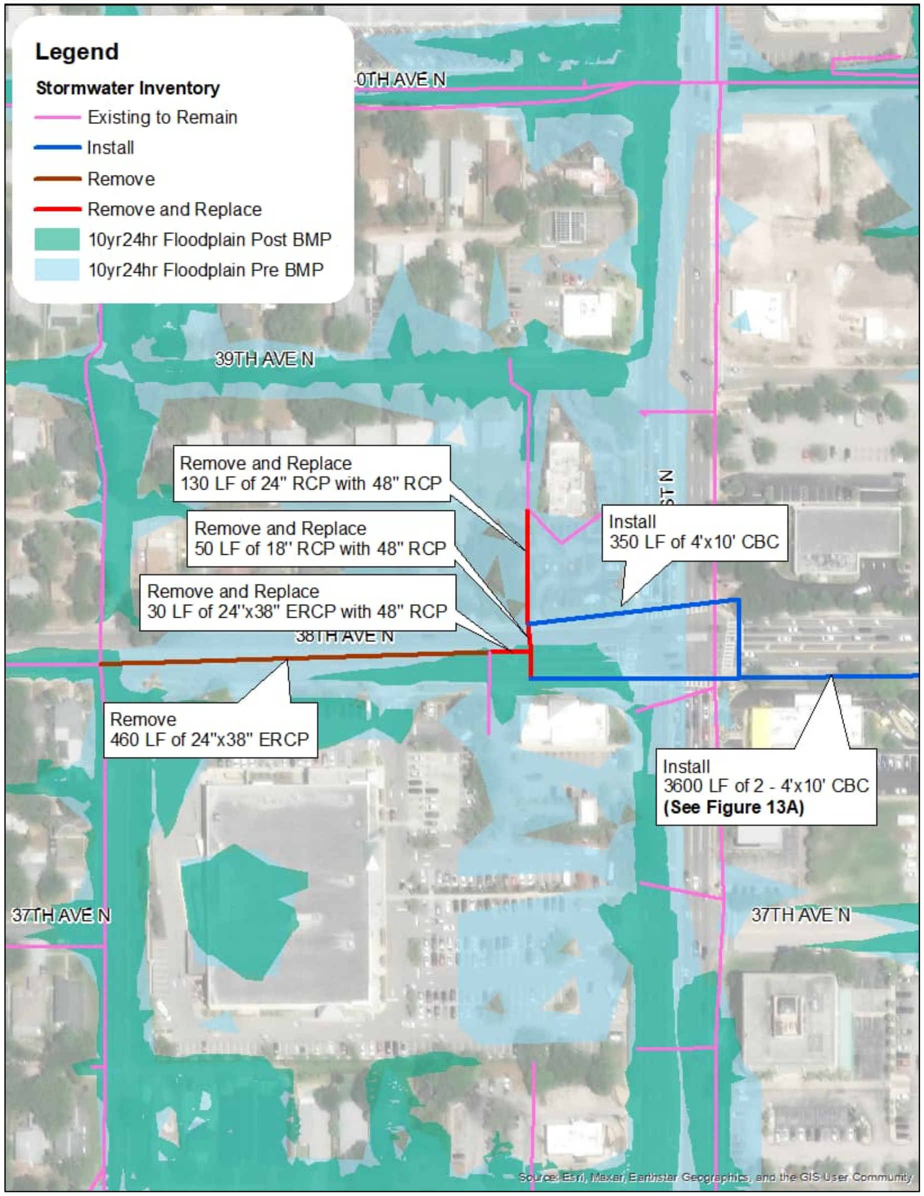
Node Reference Map - Project No. G6-12 & 19



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NO05000	62nd Avenue N	7.17	11.64	8.75	-2.89	12	11.79	-0.21
NO00910	62nd Avenue N	8.92	13.82	11.01	-2.81	14.05	13.95	-0.1
NO00915	62nd Avenue N	7.92	13.31	11.17	-2.14	13.73	13.65	-0.08
NO00916	62nd Avenue N	7.92	13.21	11.15	-2.06	13.65	13.58	-0.07
NO03840	Channel along 16th St	1	5.99	4.66	-1.33	6.44	6.19	-0.25

MJ3

Flooding Improvements at 4th Street N & 38th Avenue N – Project No. G6-13



Problem

BMP 16 focuses on alleviating severe flooding at the intersection of 4th Street North and 38th Avenue North (Figure 16-1). This area consists of residential and commercial land along highly-trafficked roadways. Much of the pipe system in this area is undersized; ranging from 18-inch to 36-inch pipes that are unable to convey the volume of inflow needed during heavy rain events.

Improvements include increasing pipe sizes, by at least double, along 38th Avenue and installing a double-box culvert to bypass localized flooding from the affected area to the channel north of 45th Avenue N. One existing pipe along 38th Avenue North is recommended to be removed to isolate flow during wet weather events to the bypass.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Remove 460 LF of 24"x38" ERCP along 38th Avenue North
- Remove and Replace 80 LF of 24"x38" ERCP with 48" RCP along 38th Avenue North
- Remove and Replace 50 LF of 18" RCP with 48" RCP north of 38th Avenue North
- Remove and Replace 130 LF of 24" RCP with 48" RCP north of 38th Avenue North
- Install 350 LF of 4'x10' CBC under 4th Street North eastward and northward under 38th Street North
- Install 3,600 LF of double 4'x10' CBC under 4th Street North and eastward to outfall into the east to outfall at Coffee Pot or Smacks Bayou (Figure 16A)

The outfall route for the system has the potential to be sized to allow for additional flow from the surrounding flooded areas and optimized depending on preferred outfall location.

This alternative removes approximately 1330 feet of roadway from the 10-year floodplain and 2 structures from the 100-year floodplain

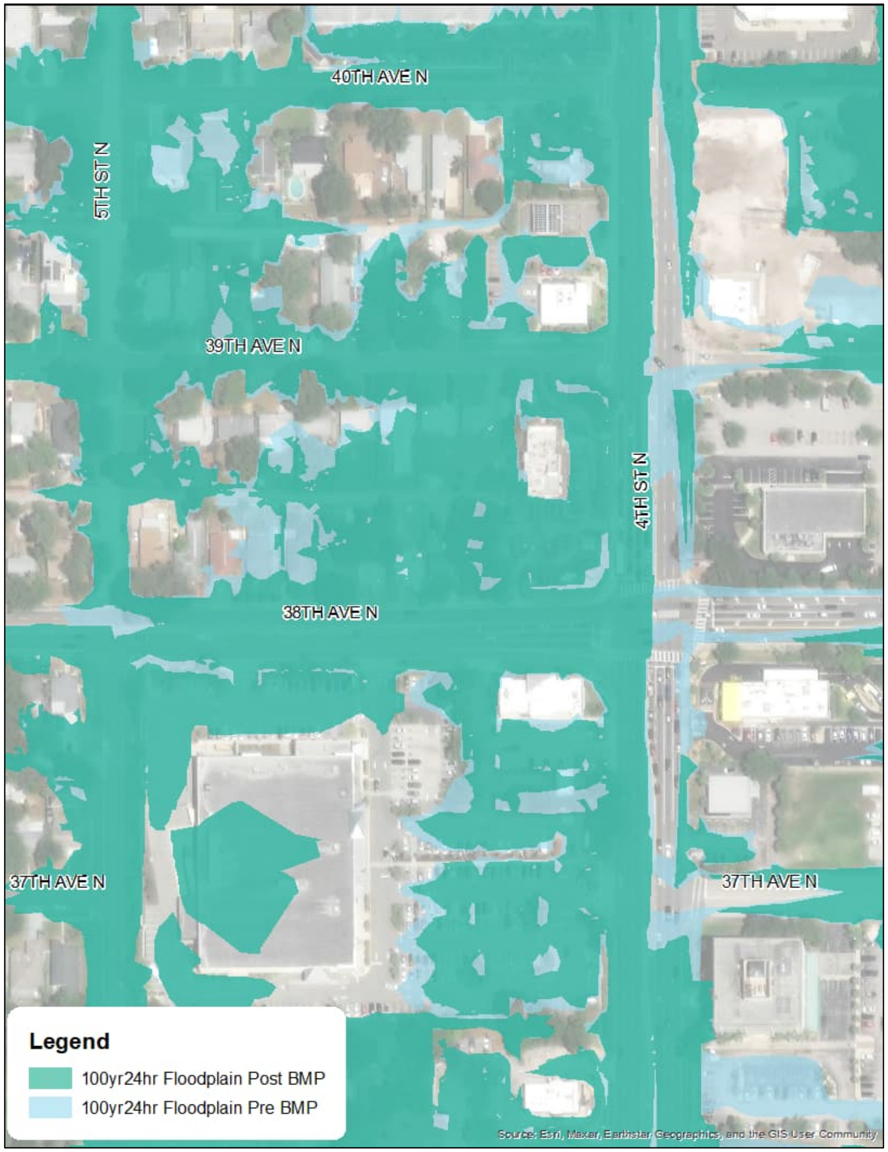
Existing conditions at 38th Ave N and 4th Street N

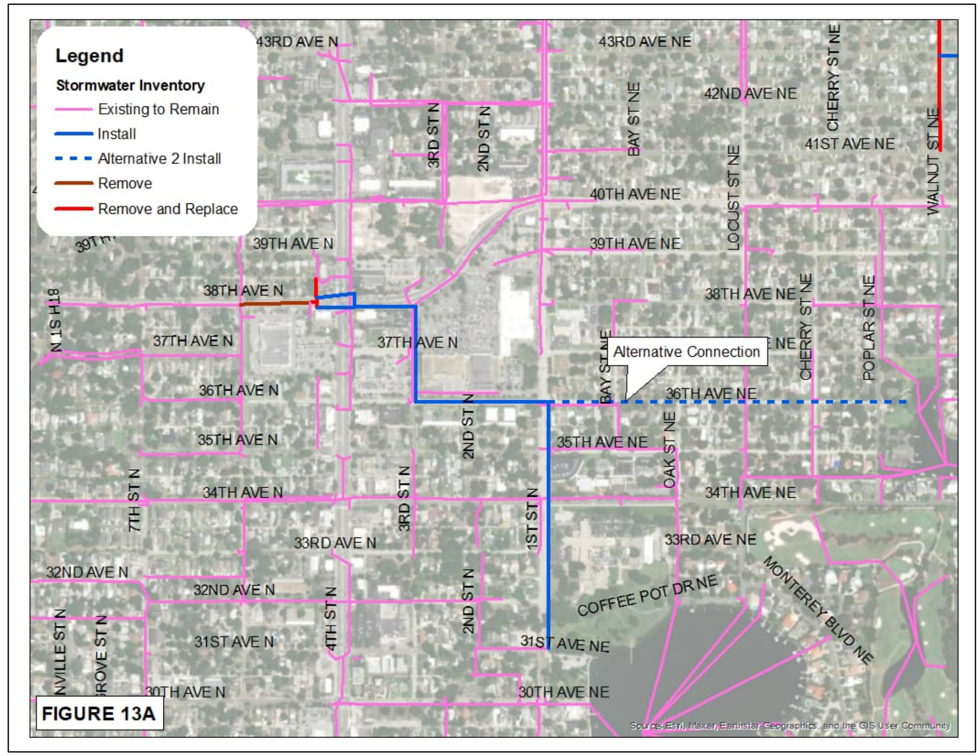

Existing 24" Outfall North of 45th Ave N

Estimated Cost:

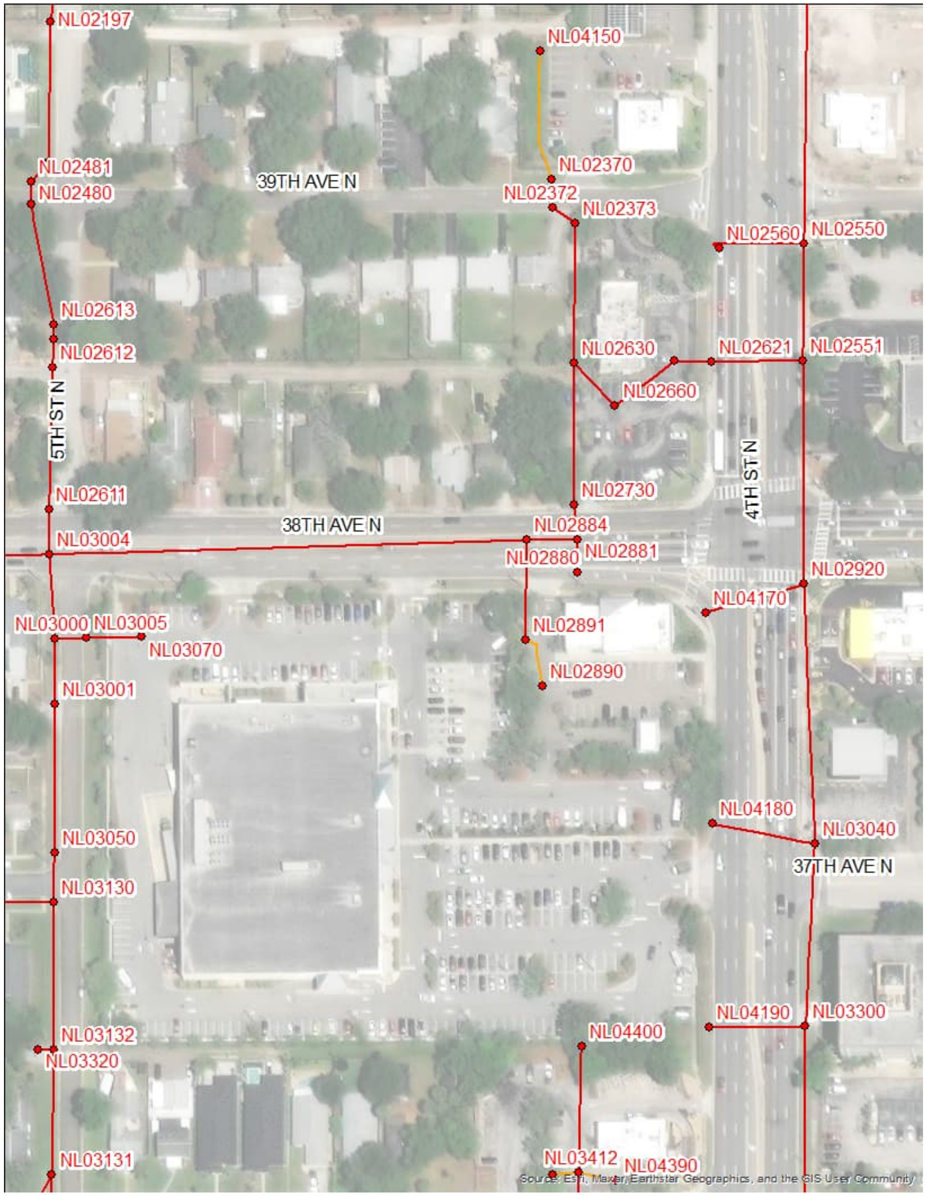
Estimated cost for this project is approximately $30,085,960 including planning, engineering, and permitting fees..

Flooding Improvements at 4th Street N & 38th Avenue N – Project No. G6-13



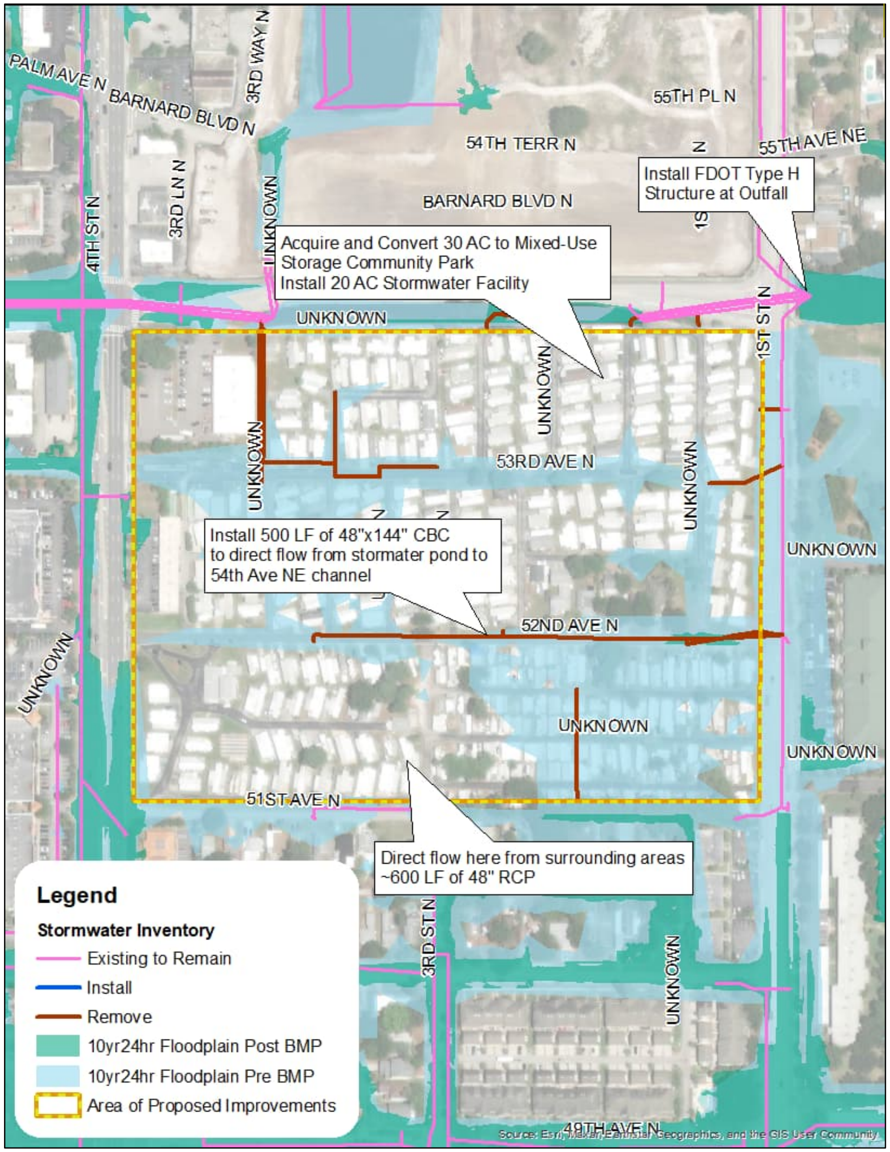


Node Reference Map – Project No. G6-13



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NL02660	Parking Lot and Structures NW of 4th Street N and 38th Avenue N	5.48'	11.50'	8.57'	2.93'	11.84'	11.56'	0.28'
NL02730	38th Avenue N (West of 4th Street N)	6.22'	11.69'	7.77'	3.92'	12.00'	11.74'	0.26'
NL02920	4th Street and 38th Avenue	4.82'	10.98'	9.48'	1.5'	11.15'	11.03'	0.12'

Flooding Improvements at 52nd Ave Mobile Home Subdivision - Project No. G6-14A



SOLUTION A

Problem

BMP 18 focuses on the lack of conveyance system within the Mobile Home Subdivision located along 1st Street and 52nd Avenue (Figure 18-1). This area consists of residential land use and an adjacent school to the east. BMP 18 improvements include conversion of the mobile home subdivision north of the BMP area, from the 54th Avenue channel to 52nd Street, to a mixed-use property. This property would include a stormwater pond of approximately 20 acres with the potential for a plethora of community benefits as a community park. This element of the BMP would provide the stormwater pond and outfall, which it currently does not have, and reduce excessive inflow strains from the 54th Avenue channel. Provides flooding improvement for approximately 30 acres of residential property.

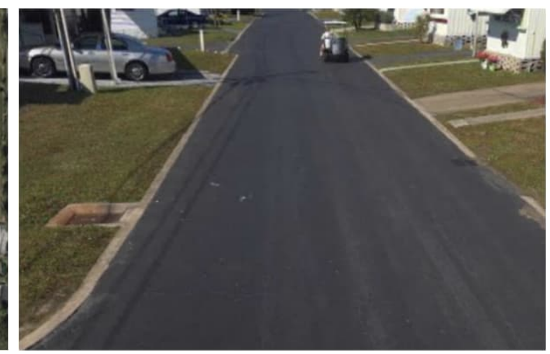
Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Acquire approximately 295 properties north of 52nd Ave N to convert to a community benefits facility
- Excavate 30 acres of land
- Install 20-acre stormwater facility
- Remove 1,700 LF of 12" to 21" RCP
- Install 600 LF of 48" RCP from surrounding low-lying areas to the Mobile Home Subdivision stormwater pond
- Install 500 LF of 48"x144" CBC with drop structure from stormwater pond to 50th Ave NE channel
- Install FDOT Type H structure at 50th Ave NE channel outfall

This alternative removes approximately 2380 feet of roadway from the 10-year floodplain and 14 structures from the 100-year floodplain.

Treasure Village Mobile Home Park

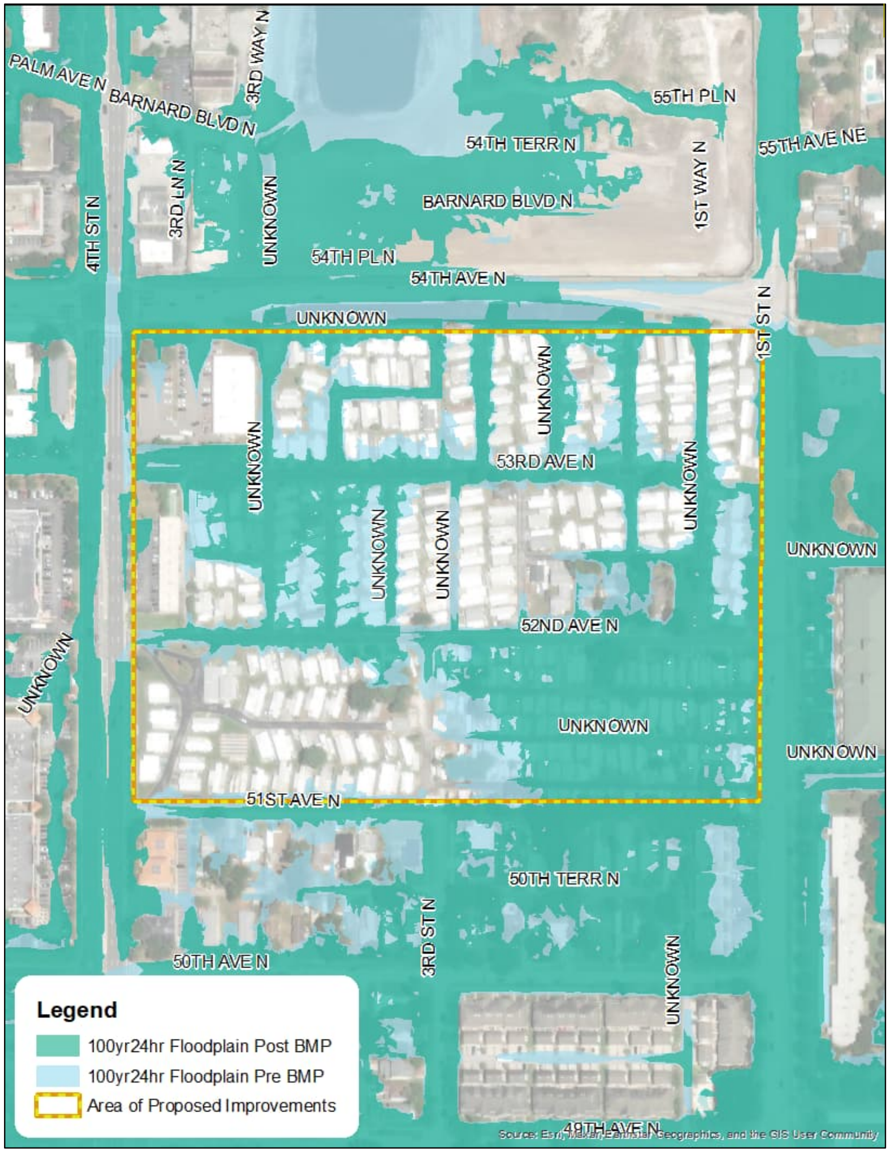


Existing drainage inlets at 53rd Ave N in Mobile Home Park

Estimated Cost:

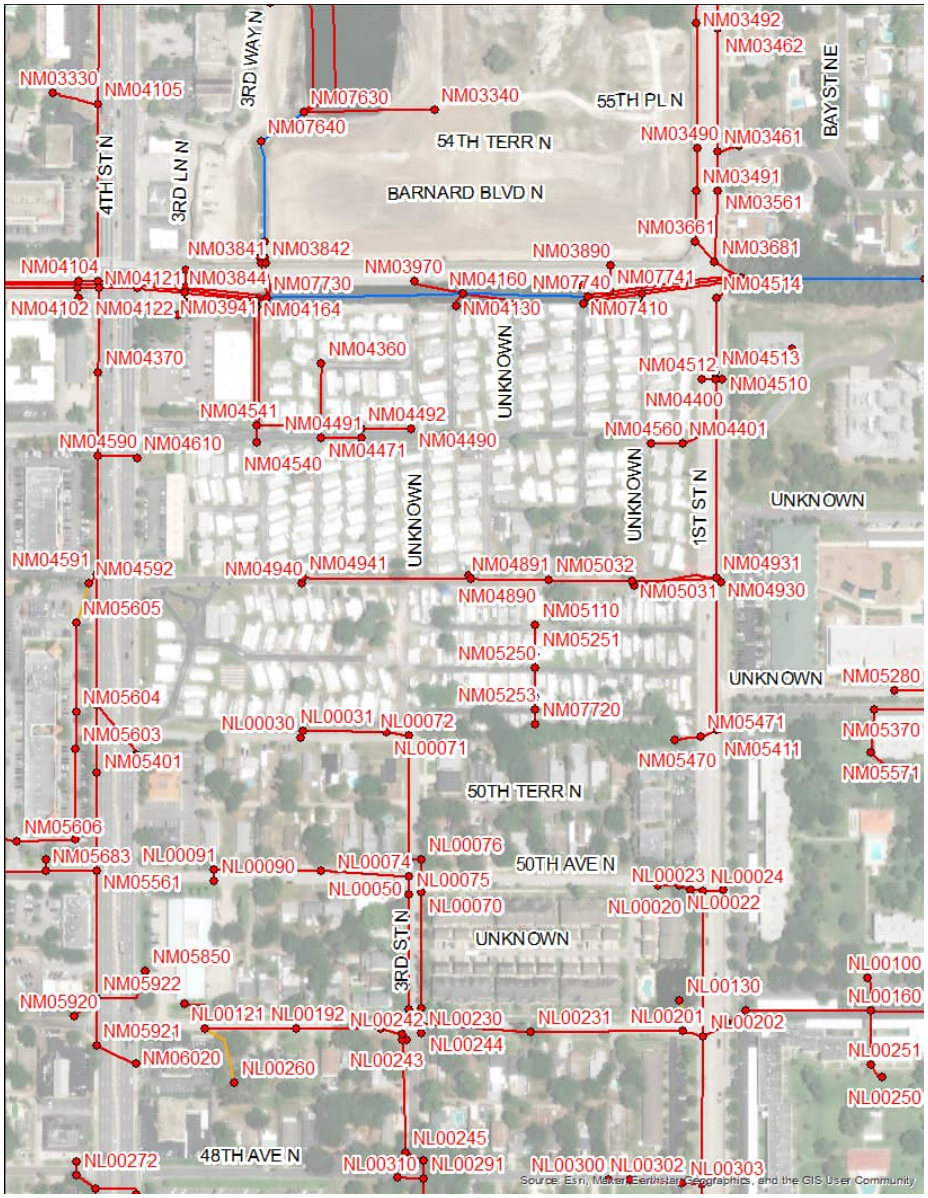
Estimated cost for this project is approximately $55,376,188 including planning, engineering, and permitting fees. This project does have the potential to be eligible for funding through the FEMA Mitigation Assistance (FMA) Grant Program.

Flooding Improvements at 52nd Ave Mobile Home Subdivision - Project No. G6-14A



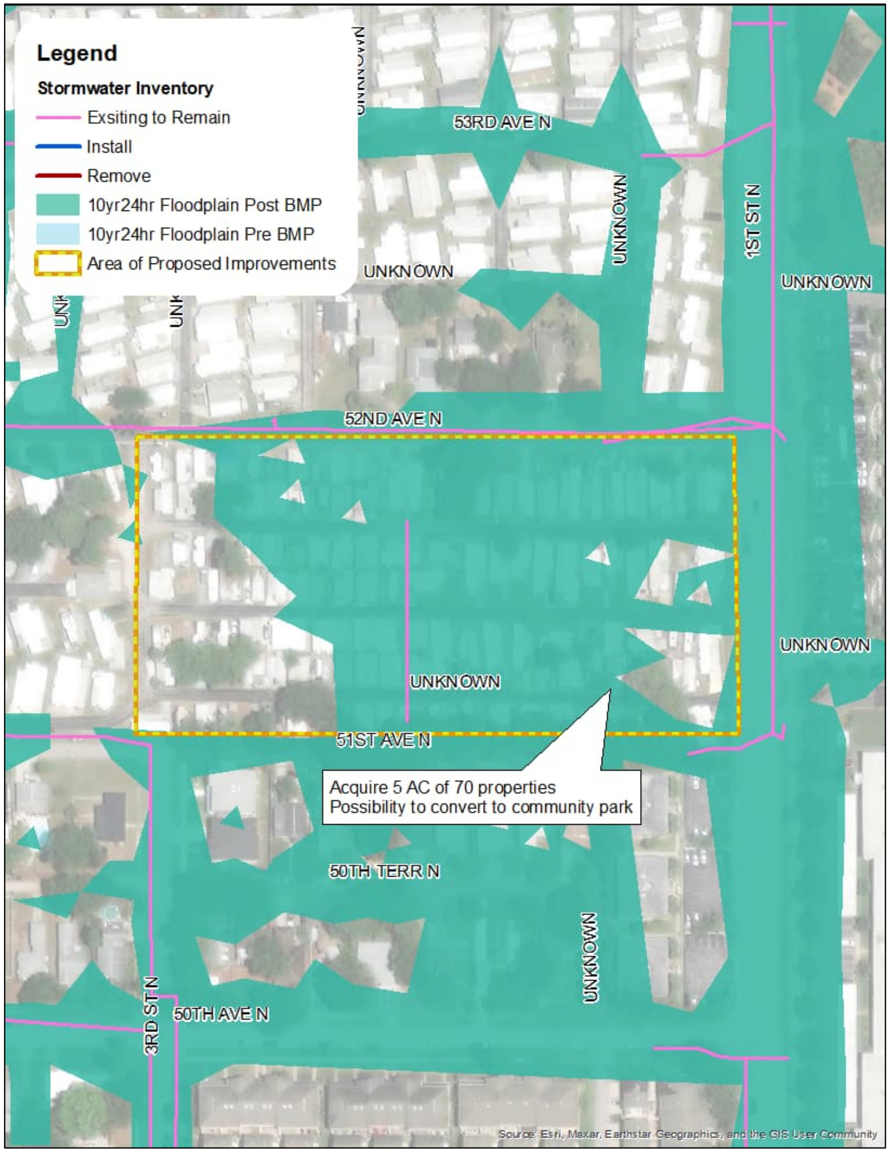
SOLUTION A

Node Reference Map - Project No. G6-14A



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NM05250	Treasure Village Mobile Home Park (Central Street)	1.00'	5.41'	3.71'	1.70'	5.89'	5.55'	0.34'
NM05030	52nd Avenue N and 1st Street N	1.00'	5.39'	3.71'	1.68'	5.86'	5.53'	0.33'
NM05110	Treasure Village Mobile Home Park (North Street)	1.00'	5.4'	3.71'	1.69'	5.88'	5.54'	0.34'

Flooding Improvements at 52nd Ave Mobile Home Subdivision - Project No. G6-14B



SOLUTION B

Problem

BMP 18 focuses on the lack of conveyance system within the Mobile Home Subdivision located along 1st Street and 52nd Avenue (Figure 18-1). This area consists of residential land use and an adjacent school to the east. BMP 18 improvements include conversion of the mobile home subdivision north of the BMP area, from the 54th Avenue channel to 52nd Street, to a mixed-use property. This property would include a stormwater pond of approximately 20 acres with the potential for a plethora of community benefits as a community park. This element of the BMP would provide the stormwater pond and outfall, which it currently does not have, and reduce excessive inflow strains from the 54th Avenue channel. Provides flooding improvement for approximately 30 acres of residential property.

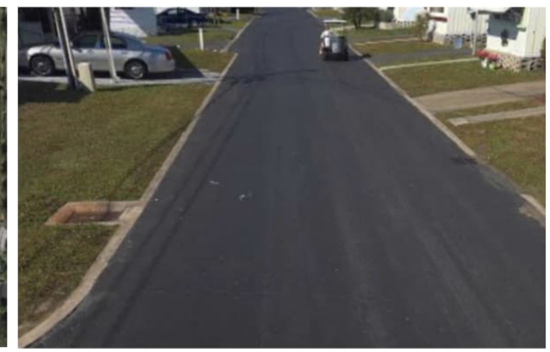
Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Acquire approximately 70 properties with possibility to convert to a community benefits facility

This alternative removes approximately 0 feet of roadway from the 10-year floodplain and 70 structures from the 100-year floodplain.

Treasure Village Mobile Home Park

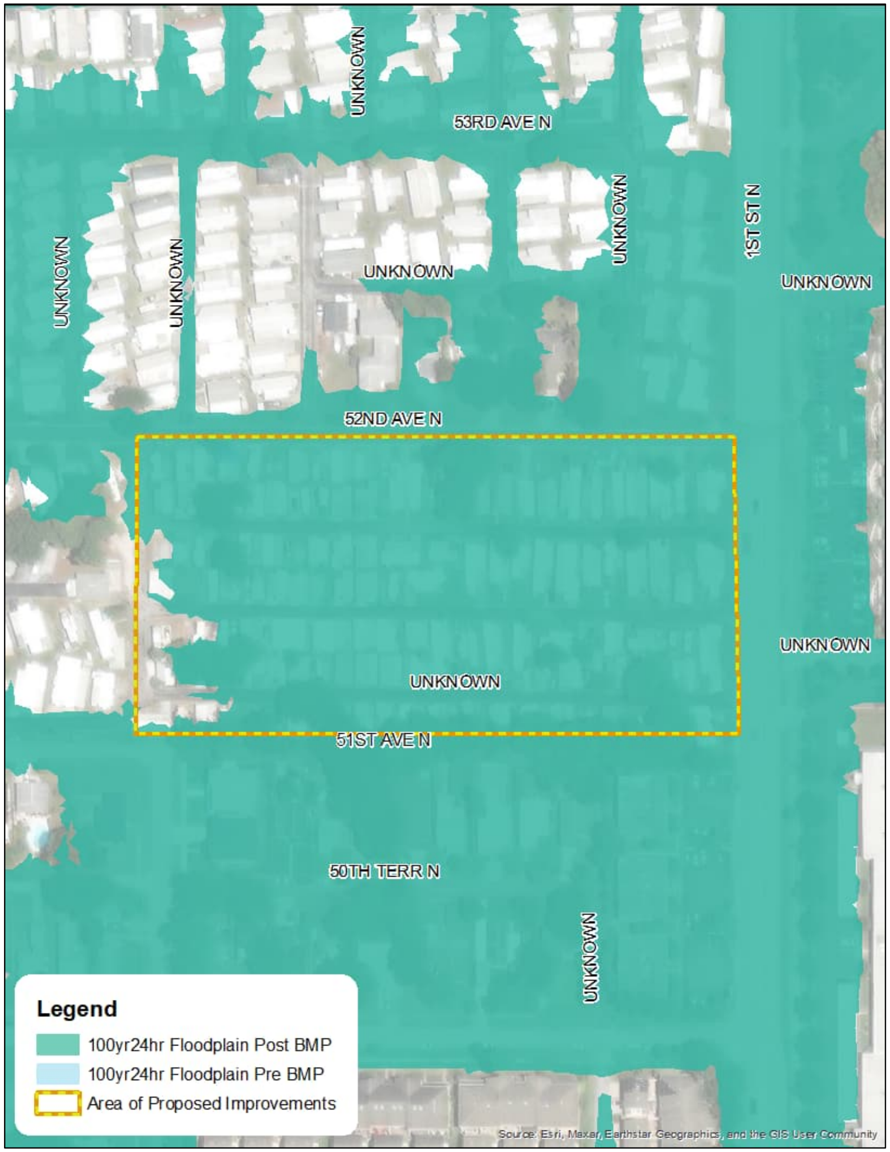


Existing drainage inlets at 53rd Ave N in Mobile Home Park

Estimated Cost:

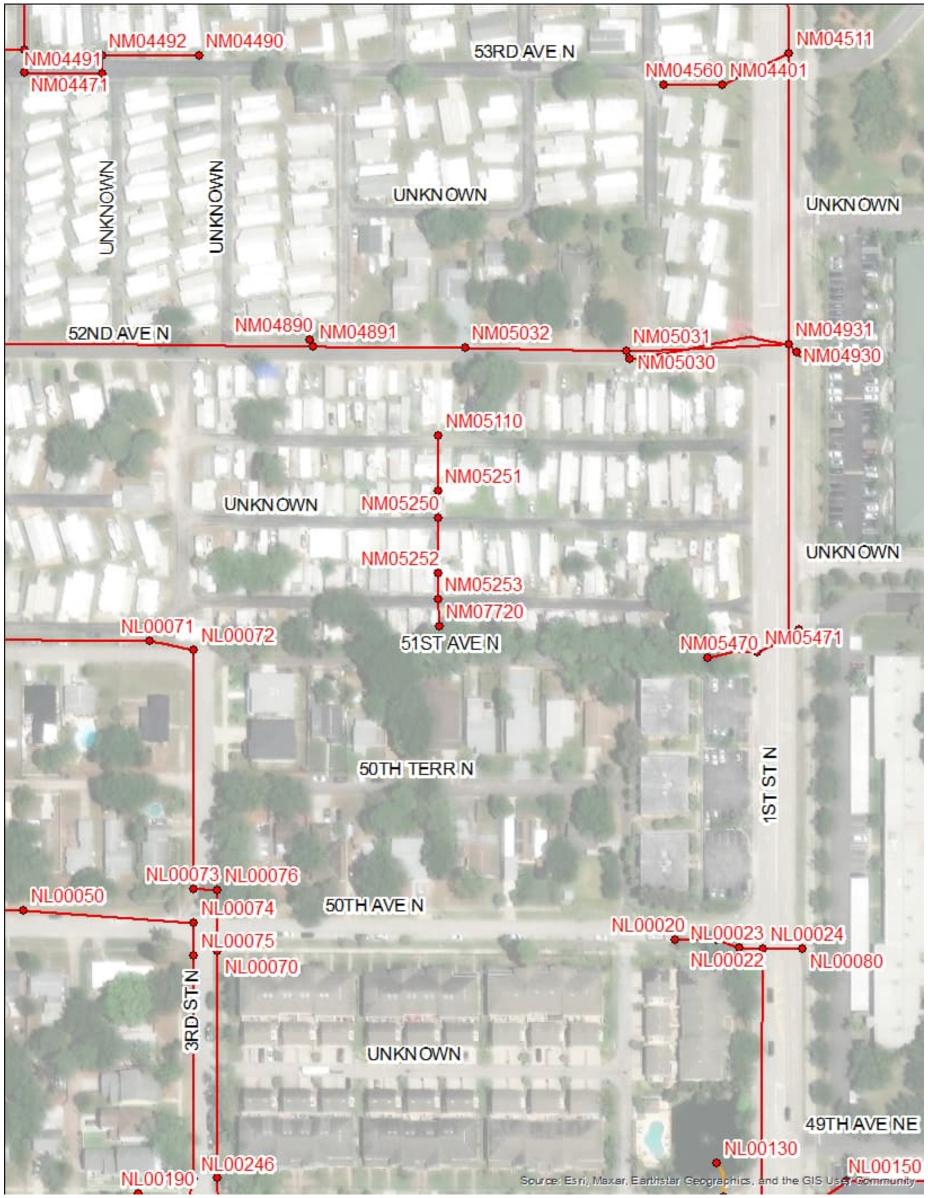
Estimated cost for this project is approximately $14,623,492 including planning, engineering, and permitting fees. This project does have the potential to be eligible for funding through the FEMA Mitigation Assistance (FMA) Grant Program.

Flooding Improvements at 52nd Ave Mobile Home Subdivision - Project No. G6-14B



SOLUTION B

Node Reference Map - Project No. G6-14B



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NM05250	Treasure Village Mobile Home Park (Central Street)	1.00'	5.41'	5.41'	0.00'	5.89'	5.89'	0.00'
NM05030	52nd Avenue N and 1st Street N	1.00'	5.39'	5.39'	0.00'	5.86'	5.86'	0.00'
NM05110	Treasure Village Mobile Home Park (North Street)	1.00'	5.4'	5.4'	0.00'	5.88'	5.88'	0.00'

HB2

Brightwaters Blvd NE Area – Project No. G6-15

Problem

BMP 19 focuses on alleviating flooding along Brightwaters Blvd NE (Figure 19-1). This area consists of residential properties with infrastructure mainly consisting of inlets draining to 18" pipes that outfall to open water.

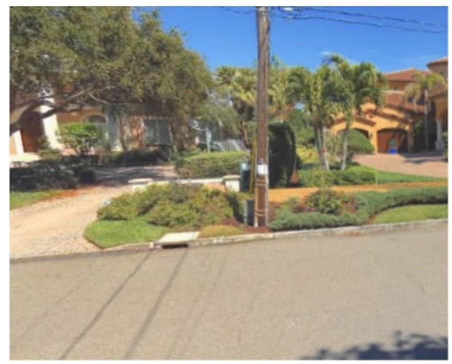
Improvements include increasing the pipe sizes of these outfalls and including check vales to eliminate tidal backflow into the system. Removal and replacement of these pipes will include lowering the pipe inverts by approximately 3.36 FT (NAVD88).

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Install 36" check valves at each outfall to eliminate tidal inflows
- Lower outfall inverts from 0.36 FT to –3.0 FT (NAVD88)
- Remove and replace 400 LF of 18" RCP with 36" RCP

This alternative removes approximately 1600 feet of roadway from the 10-year floodplain and 1 structures from the 100-year floodplain.



Existing 18'' Outfall (North)

HB1

Existing 18'' Outfall (South)

Estimated Cost:

Estimated cost for this project is approximately $698,081 including planning, engineering, and permitting fees..

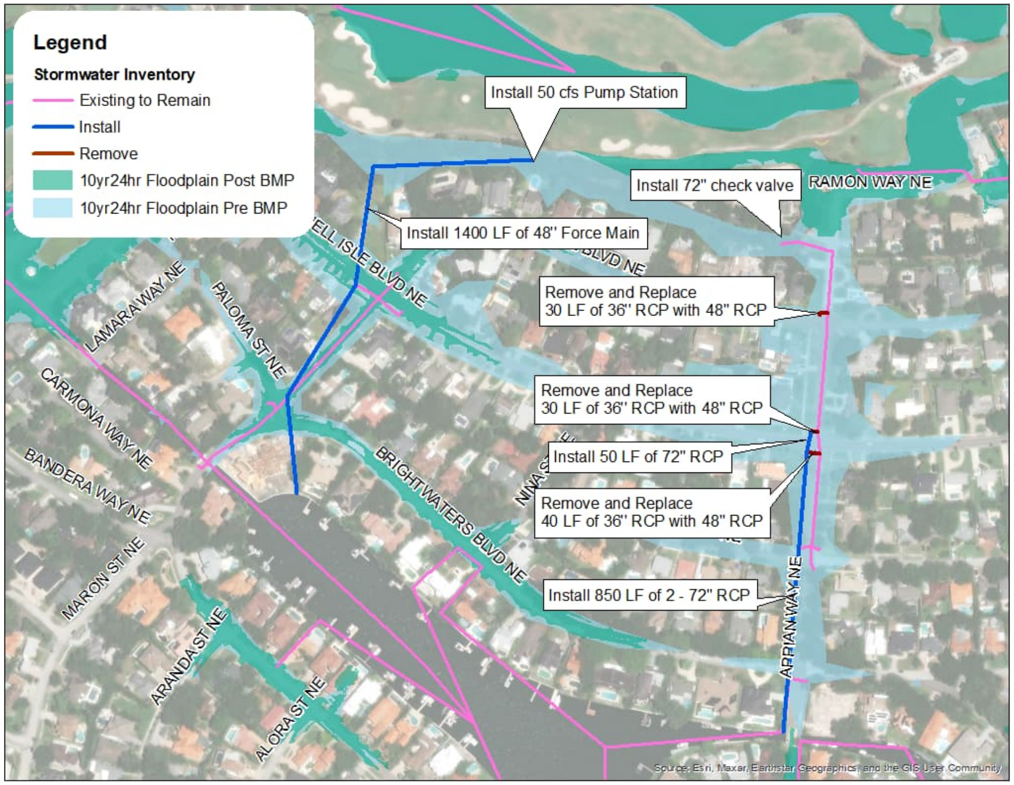
HB1

Brightwaters Blvd NE Area – Project No. G6-15

Node Reference Map – Project No. G6-15

Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NX01640	Brightwaters Blvd NE Outfall (North)	1.00'	5.36'	2.14'	3.22'	5.70'	3.90'	1.80'
NX04070	Brightwaters Blvd NE Outfall (North)	1.00'	5.37'	1.34'	4.03'	5.69'	3.32'	3.27'

Appian Way NE Area – Project No. G6-16



Problem

BMP 20 focuses on alleviating flooding along Appian Way NE (Figure 20-1). This area consists of residential properties with infrastructure mainly consisting of pipe systems along Appian Way NE and Rafael Blvd NE and several outfalls in the surrounding area that drain to open water.

Improvements include bypassing flow with a pump and force main from the area north of Rafael Blvd NE to open water south of Brightwaters Blvd NE; the installation of twin 72" pipes running along Appian Way NE; a new check valve at the channel outfall north of Rafael Blvd. NE; and the replacement of undersized, lateral pipe along Appian Way NE.

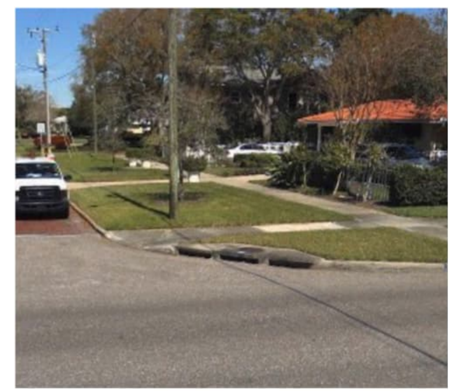
Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Install 72" check valve at outfall
- Install 50 cfs pump station
- Install 1400 LF of 48" force main
- Install 850 LF of 2 – 72" RCP
- Install 50 LF of 72" RCP
- Remove and Replace 100 LF of 36" RCP with 48" RCP along Appian Way NE

This alternative removes approximately 5230 feet of roadway from the 10-year floodplain and 24 structures from the 100-year floodplain.

Proposed Pump Station Location



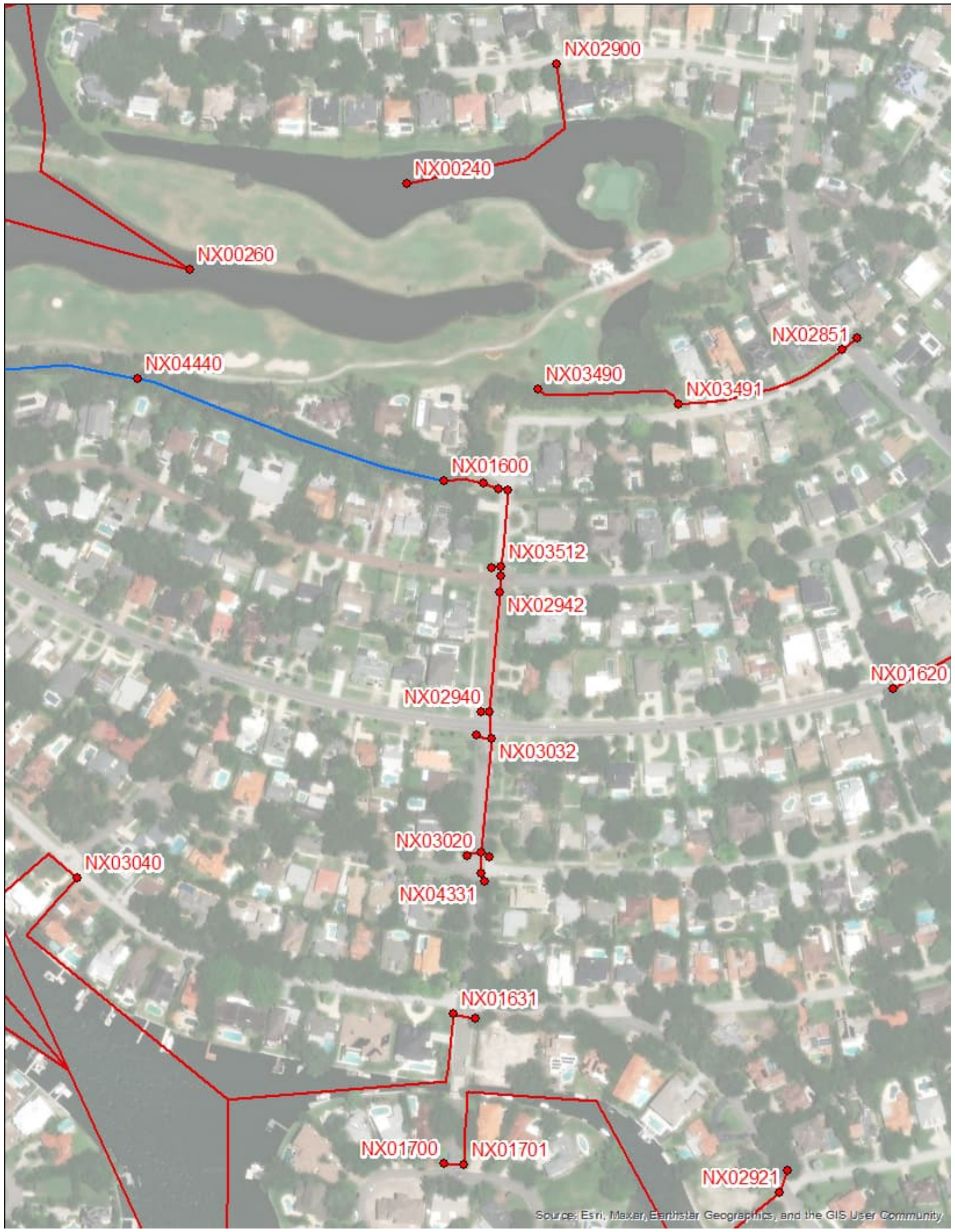
Appian Way NE and Snell Island Blv NE Existing Conditions

Estimated Cost:

Estimated cost for this project is approximately $17,719,439 including planning, engineering, and permitting fees..

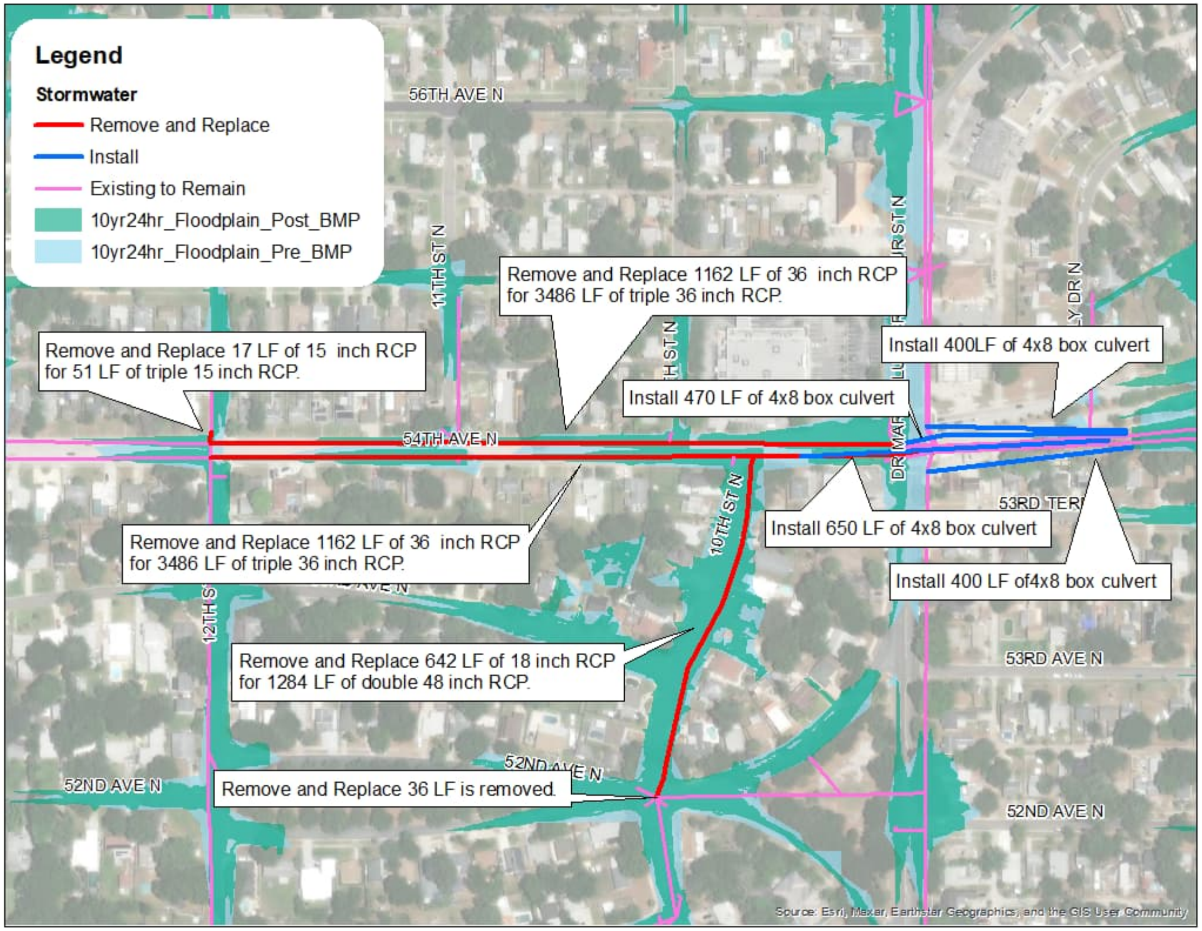
Appian Way NE North Area – Project No. G6-16

Node Reference Map – Project No. G6-16



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NX03020	Catalan Blvd NE and Appian Way NE	1.00'	4.07	2.88'	1.19'	4.33'	3.34'	0.99'
NX02940	Snell Island Blvd NE and Appian Way NE	1.00'	4.06'	1.97'	2.09'	4.33'	3.28'	1.05'
NX04440	South of golf course and north of Rafael Blvd NE	1.09'	3.77'	1.09'	2.68'	4.28	3.79'	0.53'

Flooding Improvements at 54th Ave N - Project No. G6-17



Problem

BMP 6_21 focuses on the conveyance system draining along 54th Avenue N towards the pond on the east side of the area.

BMP 6_21 area experiences a large amount of flooding along 54th Avenue N and along Dr Martin Luther King street. Existing system present on both roads are not adequate for the amount of water that needs to be drained. This BMP focuses on upgrading section of pipes along 54th Avenue N and 10th Street N. Also, new outfalls for 54th and Dr Martin Luther King Road have been implemented to facilitate drainage for both roads towards the pond.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

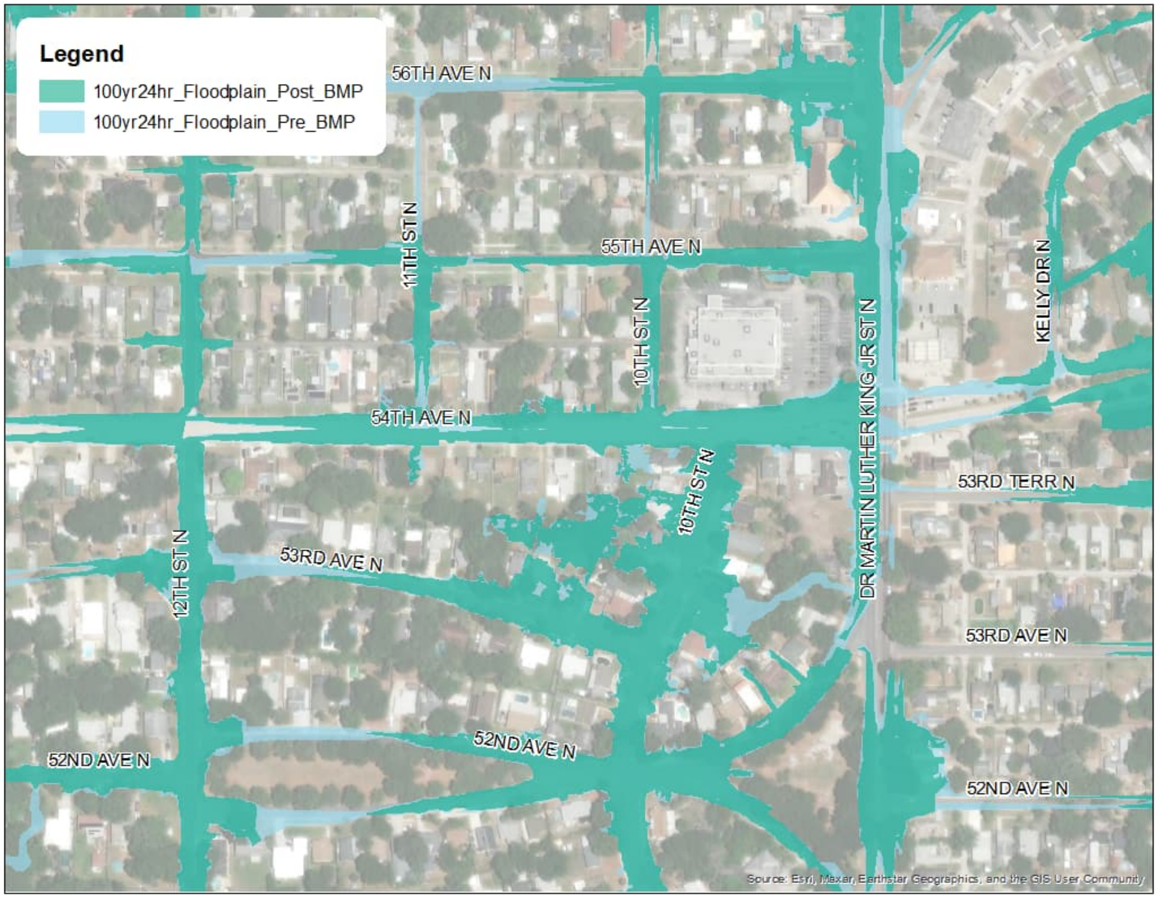
- Remove and Replace 1162 LF of 36-inch RCP for 3486 LF of triple 36-inch RCP.
- Remove and Replace 17 LF of 15-inch RCP for 51 LF of triple 15-inch RCP.
- Install 1920 LF of 4x8 box culvert
- Remove and Replace 1162 LF of 36-inch RCP for 3486 LF of triple 36-inch RCP.
- Remove and Replace 642 LF of 18-inch RCP for 1284 LF of double 48-inch RCP.
- Remove and Replace 36 LF is removed.

This alternative removes approximately 540 feet of roadway from the 10-year floodplain and 0 structures from the 100-year floodplain

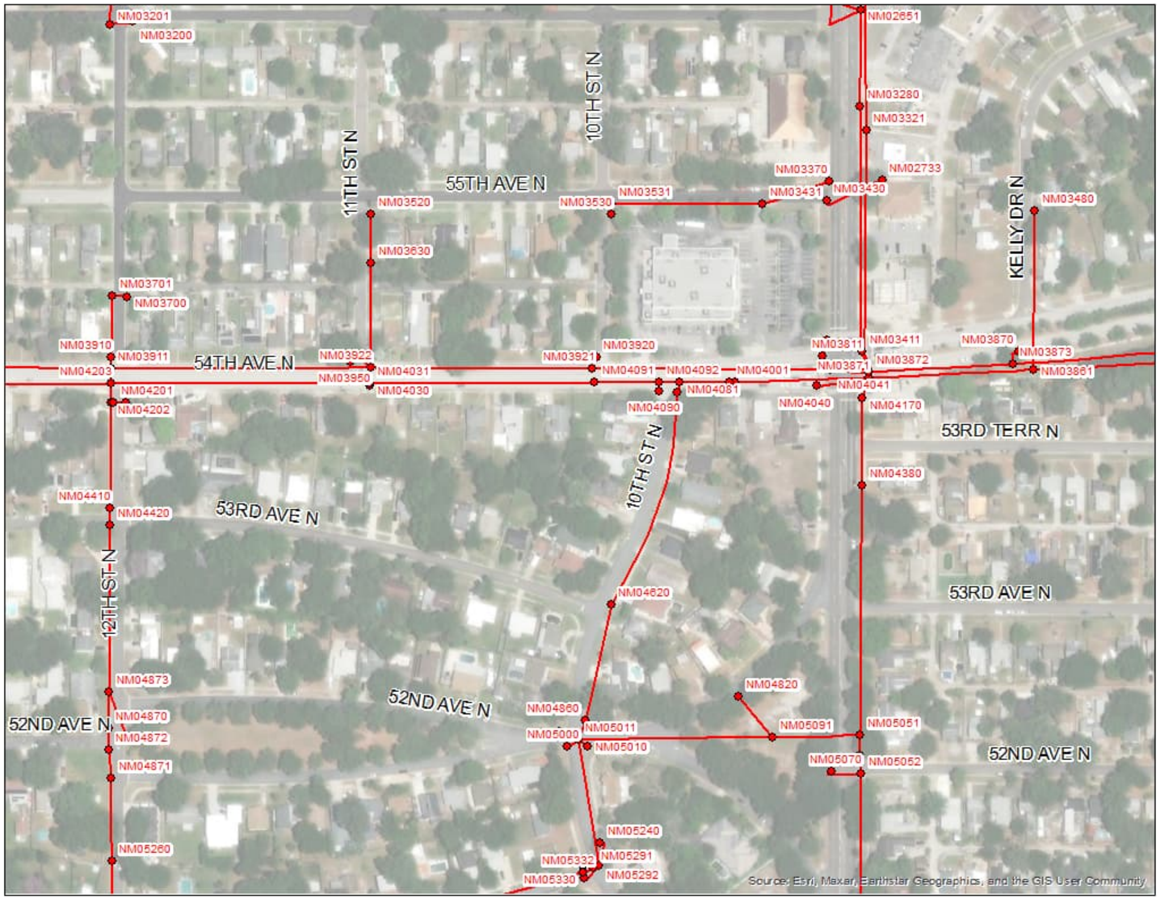
Estimated Cost:

Estimated cost for this project is approximately $16,168,093 including planning, engineering, and permitting fees..

Flooding Improvements at 54th Ave N - Project No. G6-17



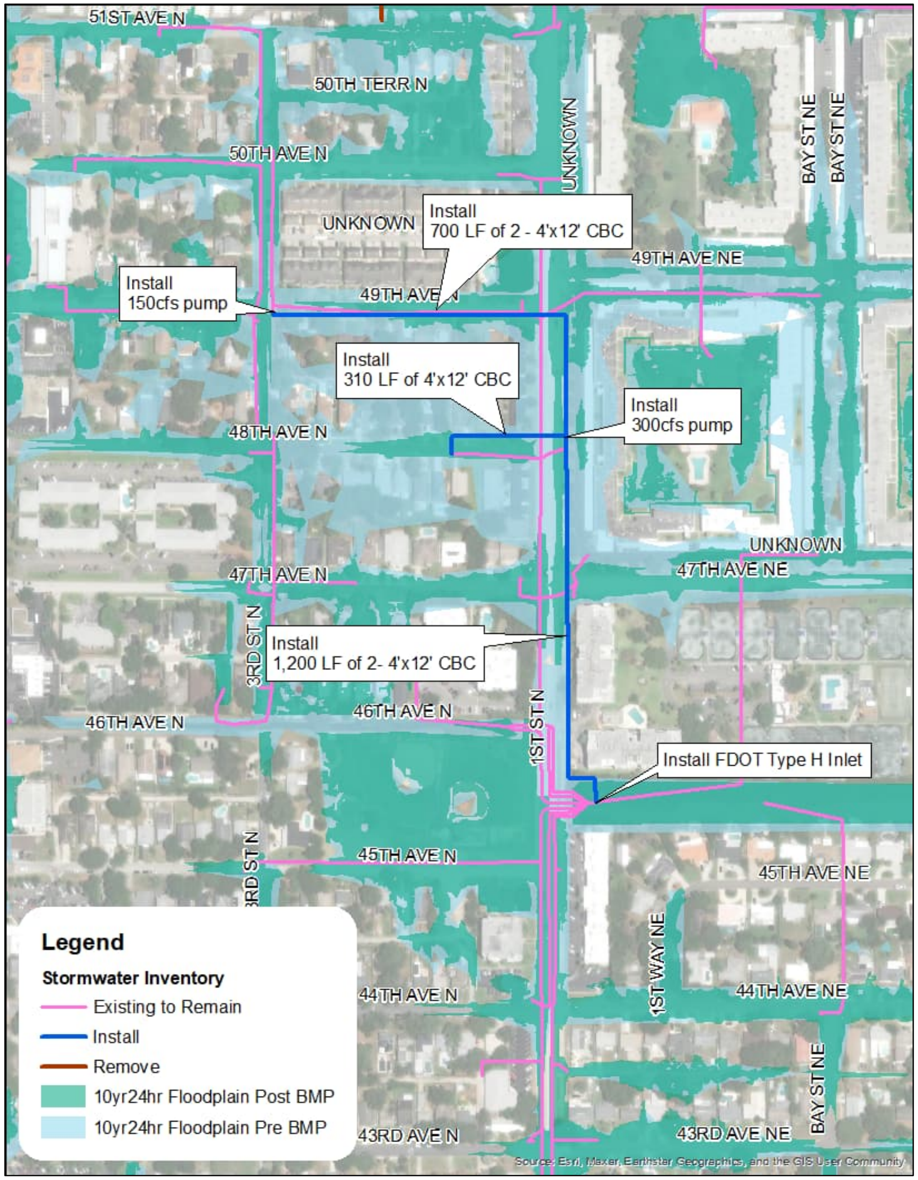
Flooding Improvements at 54th Ave N - Project No. G6-17



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NM04000	54th Avenue N	3.38	9.99	7.59	2.4	10.29	10.01	0.28
NM03911	54th Avenue N	5.59	12.3	10.9	1.4	12.58	11.36	1.22
NM02733	54th Avenue N	5.52	7.88	6.54	1.34	9.03	8.46	0.57

PS0

Flooding Improvements at 1st Street N and 49th Avenue N - Project No. G6-18 & 21



Problem

BMPs 22 and 26 focus on the conveyance system of the 5 acres of residential land from 3rd Street North and 1st Street North between 48th Avenue North to 49th Avenue North. This area consists of high-density residential land use with structural and roadway flooding. Improvements include bypassing flow from both 48th Avenue North as well as the intersection of 3rd Street North and 49th Avenue North directly to the channel. Both bypasses will include a 150 cfs or 300 cfs pump that will increase flow to the channel during wet weather events.

The runoff collected from this area currently discharges to the same channel north of 45th Avenue which is tidally influenced by Tampa Bay. The existing conveyance system includes larger box culverts that outfall directly to this channel; however, the channel is observed to be overwhelmed during periods of high flow which causes overflow in these pipes during the 10yr/24hr storm event.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Install 700 LF of 2- 4'x12' CBC along 49th Avenue North
- Install 310LF of 4'x12' CBC along 48th Avenue North
- Install 1,200 LF of 2- 4'x12' CBC along 1st Street North and a backflow preventer at the channel outfall
- Install one 150 cfs pump at the intersection of 49th Avenue North and 3rd Street North
- Install one 300 cfs pump along 1st Street North at its intersection with 48th Avenue North
- Install FDOT Type H structure at channel outfall

This alternative removes approximately 1,930 feet of roadway from the 10-year floodplain and 17 structures from the 100-year floodplain.

Existing drainage inlets at 3rd St N and 49th Ave N

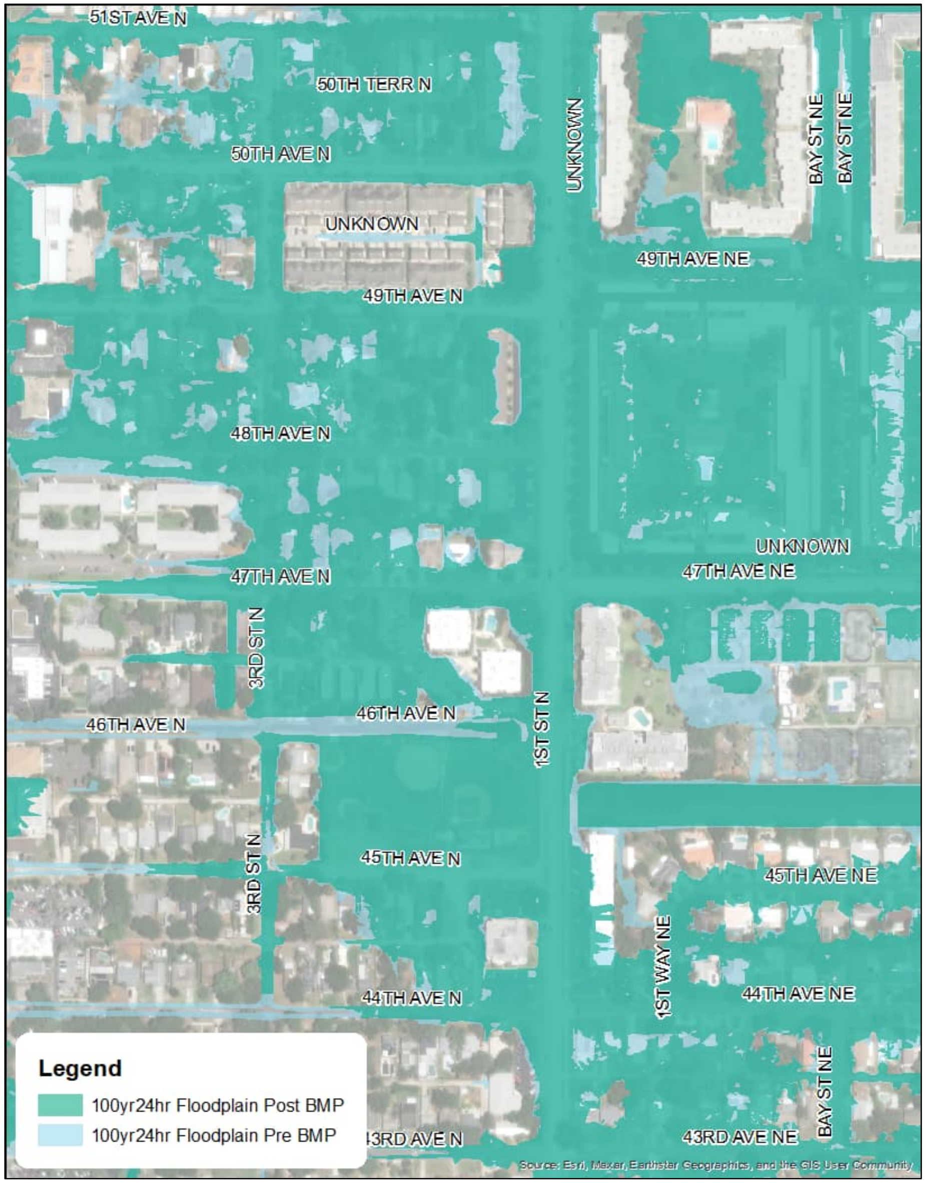
Existing drainage inlets at 48th Ave N and 1st St N

Estimated Cost:

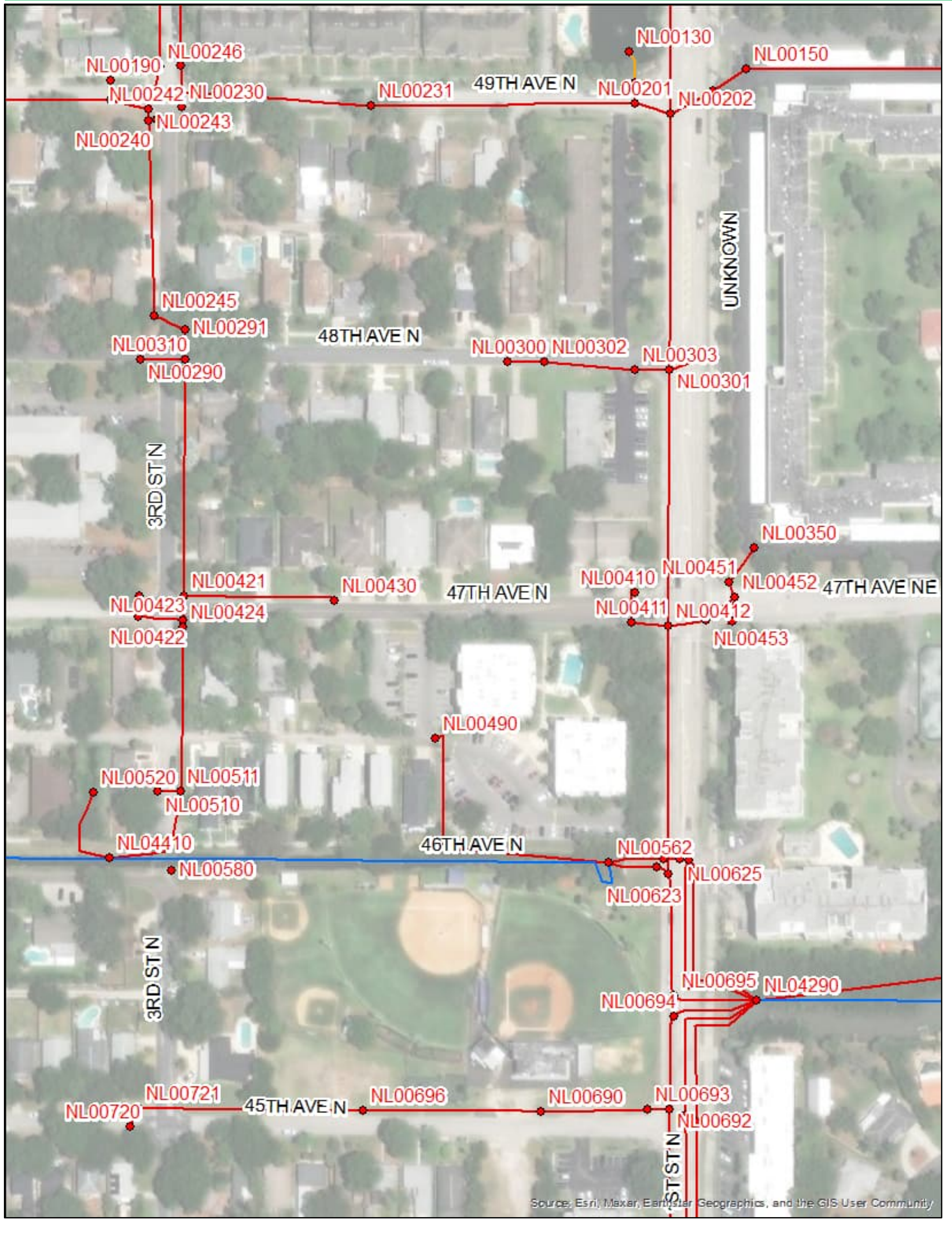
Estimated cost for this project is approximately $77,630,424 including planning, engineering, and permitting fees.

HB0

Flooding Improvements at 1st Street N and 49th Avenue N - Project No. G6-18 & 21



Node Reference Map - Project No. G6-18 & 21



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NL00200	1st St N and 49th Ave N	1.00'	5.44'	4.31'	1.13'	5.96'	5.71'	0.25'
NL00230	3rd Street N and 49th Ave N	1.00'	5.54'	3.92'	1.62'	6.07'	5.76'	0.31'
NL00300	48th Ave N	1.00'	5.42'	3.48'	1.94'	5.96'	5.70'	0.26'

Flooding Improvements at 62nd Ave NE and Foch St NE – Project No. G6-20

Problem

BMP 25 focuses on alleviating structural flooding west of Foch St NE (Figure 25-1). This area consists of residential properties with infrastructure mainly consisting of a wider range of pipes from 15" to 12" RCP and CBC.

Improvements include replacing the two 15" box culverts south of 62nd Ave NE with one 60" box culvert to reduce flooding over the roadway. Also included is adding approximately 4 acres of storage to the existing pond to reduce flooding to the homes to the west of Foch St NE. The final improvement is to add an outfall and 150cfs pump to outfall to the east of the storage pond.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Remove existing two 15” culverts south of 62nd Ave NE and replace with one 60” culvert
- Add storage to pond, approximately 4 acres
- Add an outfall and pump (~150 cfs) to outfall to the southeast

This alternative removes approximately 787 feet of roadway from the 10-year floodplain and 19 structures from the 100-year floodplain

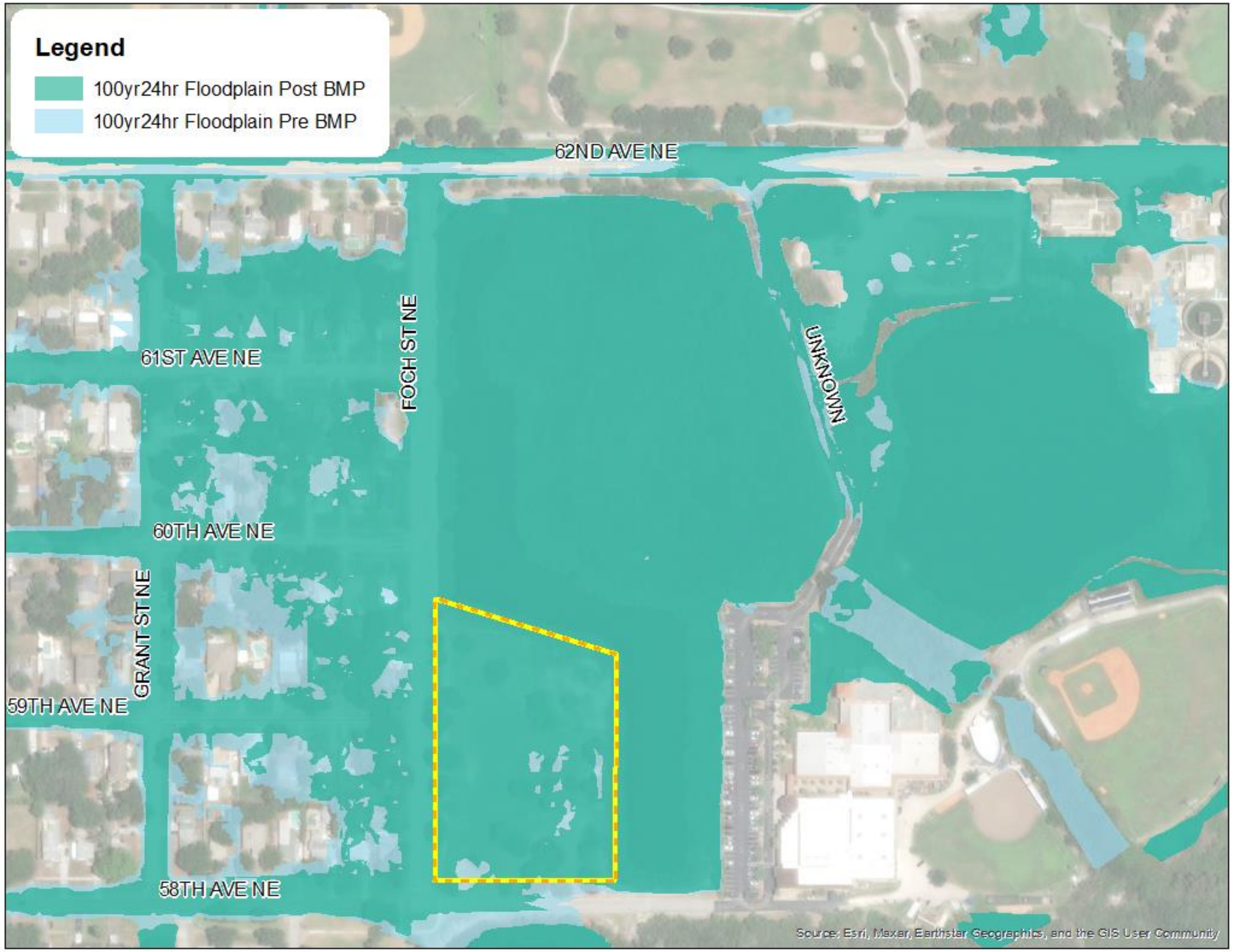
Tie in location on 62nd Ave NE for new 60'' culvert

Storage pond on the intersection of Foch St NE and 58th Ave NE

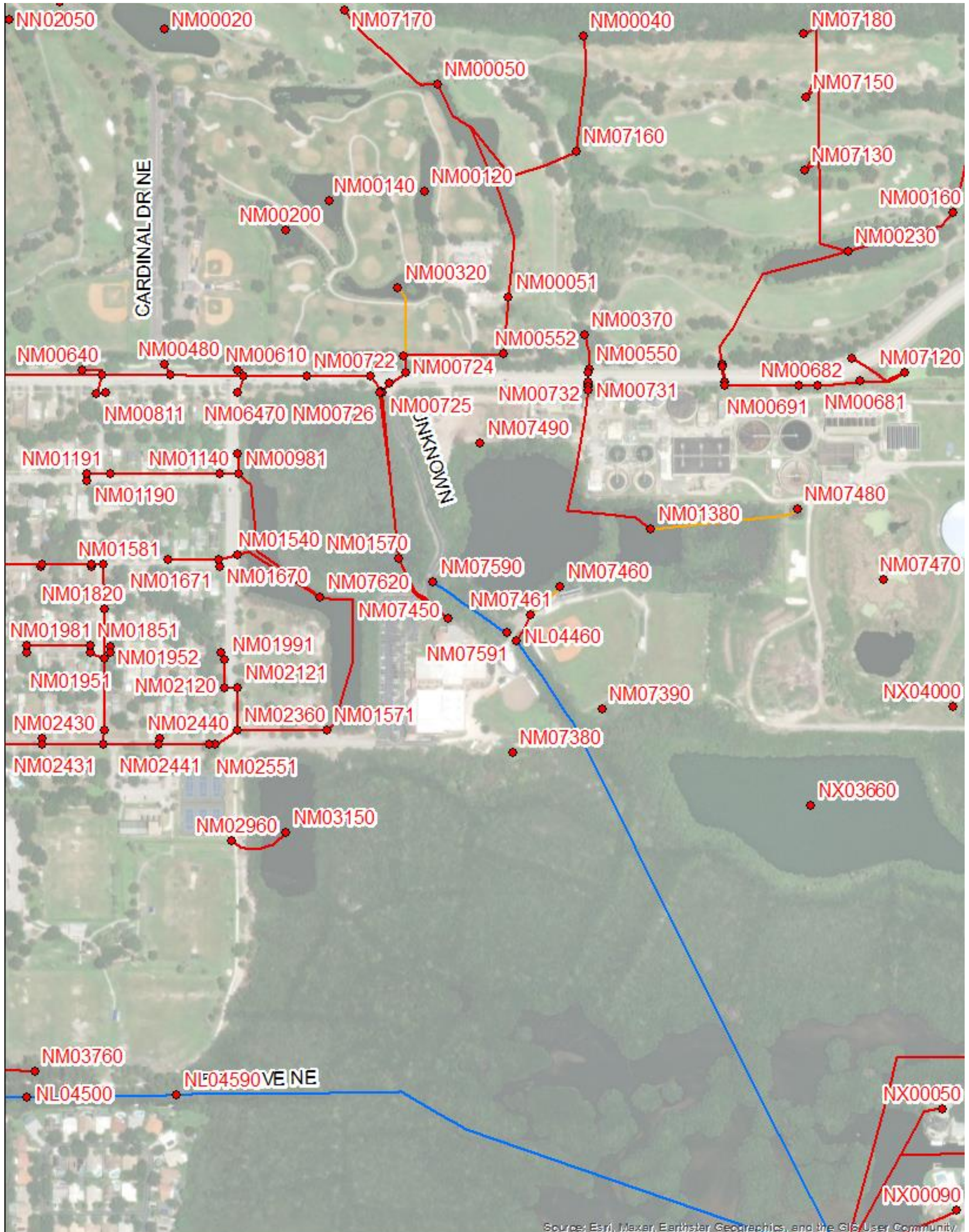
Estimated Cost:

Estimated cost for this project is approximately $30,781,823 including planning, engineering, and permitting fees..

Flooding Improvements at 62nd Ave NE and Foch St NE – Project No. G6-20

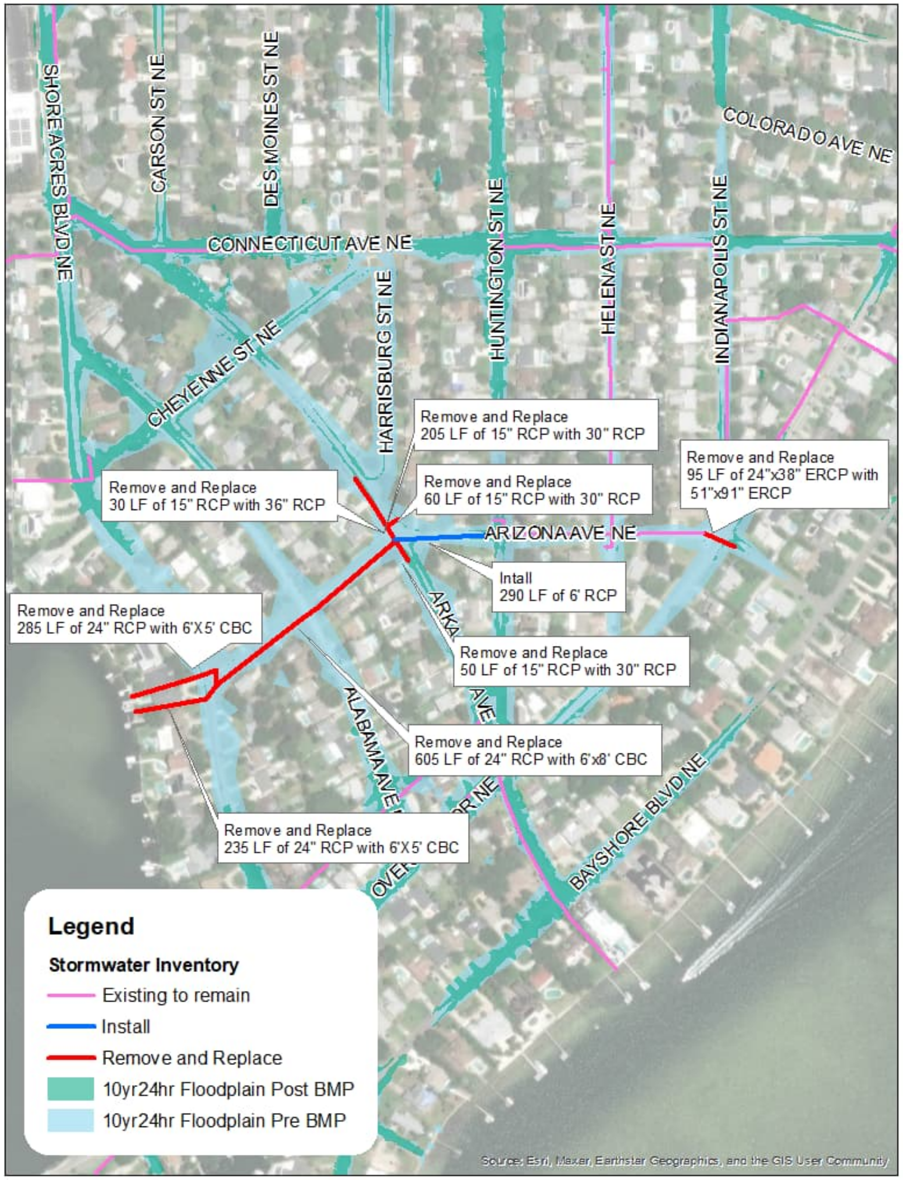


Node Reference Map – Project No. G6-20



		10-Year				100-Year			
Node	Location Description	Initial Stage	EX	PR	Diff	Initial Stage	EX	PR	Diff
NM02360	Intersection of 58th Ave NE and Foch St NE	1.0	3.60	3.11	0.49	1.0	4.08	3.72	0.36
NM07620	East of Foch Street in wetland area	1.0	3.62	3.03	0.59	1.0	4.13	3.74	0.39
NM00721	Connection on 62nd Ave NE going south to wetland area	1.0	4.33	3.53	0.80	1.0	4.49	4.09	0.40

Flooding Improvements at Arizona Avenue NE – Project No. G6-22



Problem

BMP 6-28 focuses on the conveyance system draining east from Overlook Dr NE to the waterbody west of Shore Acres Blvd. NE. Flooding occurs along Arizona Avenue NE and intersecting streets and on residential properties.

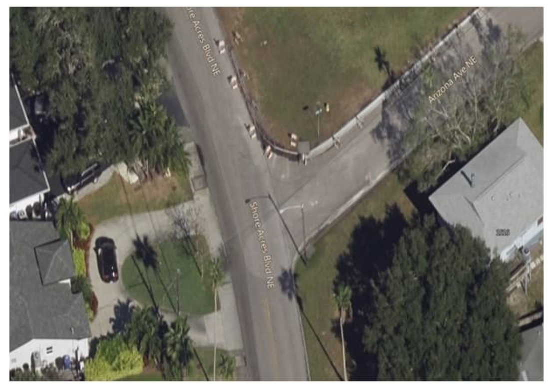
Solution & Project Benefits:

BMP 6-28 proposes the following changes to alleviate roadway and residential flooding within the Arizona Avenue NE area.

- Remove and replace a total of 520 LF of 24" RCP with dual 6'x5' CBC from Shore Acres Blvd NE to the outfall westward
- Remove and replace 605 LF of 24" RCP with 6'x8' CBC along Arizona Ave NE from Arkansas Ave NE to Shore Acres Blvd NE
- Remove and replace 50 LF of 15" RCP with 30" RCP along Arkansas Ave NE at the intersection of Arizona Ave NE
- Remove and replace 205 F of 15" RCP with 30" RCP along Arkansas Ave NE north of Arizona Ave NE
- Remove and replace 60 LF of 12" RCP with 30" RCP along Arkansas Ave NE north of Arizona Ave NE
- Remove and replace 30 LF of 15" RCP with 36" RCP along Arkansas Ave NE north of Arizona Ave NE
- Install 290 LF of 6' RCP along Arizona Ave NE from Arkansas Ave NE to Huntington St NE, and
- Remove and replace 95 LF of 24"x38" ERCP with 58"x91 ERCP at the intersection of Overlook Dr NE and Arizona Ave NE

This is a high-density residential area and impacts to vehicular and pedestrian traffic should be expected for the improvements listed above. The proposed solutions will provide more conveyance capacity and reduce street and residential flooding in the impacted area.

This alternative removes approximately 6075 feet of roadway from the 10-year floodplain and 45 structures from the 100-year floodplain



Existing conditions at Arizona Ave NE and Shore Acres Blvd NE

Existing conditions at Arizona Ave NE and Overlook Dr NE

Estimated Cost:

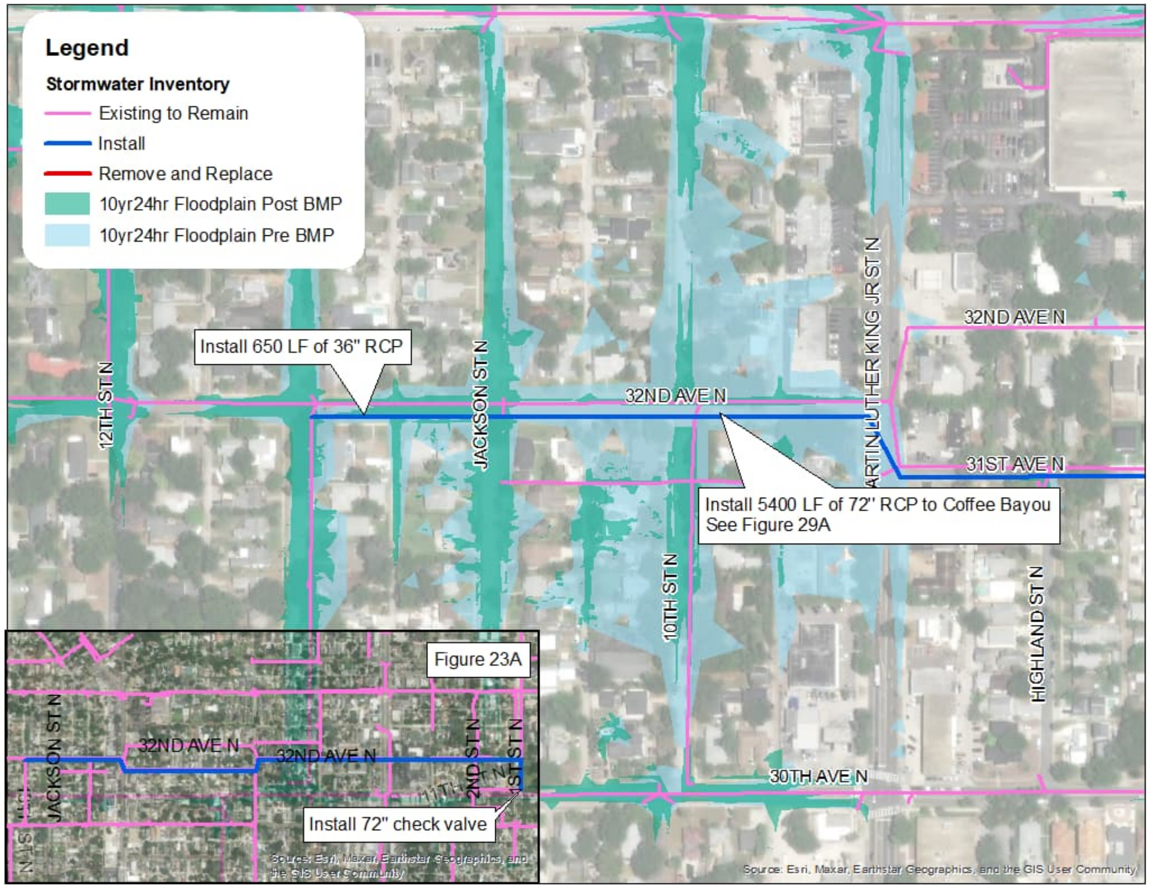
Estimated cost for this project is approximately $6,038,206 including planning, engineering, and permitting fees..

Flooding Improvements at Arizona Avenue NE – Project No. G6-22

Node Reference Map – Project No. G6-22

Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NX02070	Arizona Ave NE at Bayshore Blvd NE	1	2.82	2	-0.82	3.23	2.93	-0.3
NX02103	Arizona Ave NE at Huntington St NE	1	2.72	1.88	-0.84	3.15	2.77	-0.38
NX03591	Arizona Ave NE at Arkansas Ave NE	1	2.87	2.11	-1.1	3.24	2.69	-0.55
NX02523	Arizona Ave NE at Shore Acres Blvd NE	1	2.86	1.5	-1.36	3.23	2.48	-0.75

Flooding Improvements at 32nd Ave North – Project No. G6-23



Problem

BMP 29 focuses on alleviating widespread flooding around 32nd Avenue North, 11th Street North, Jackson Street North and 10th Street North (Figure 29-1). This area consists of residential and commercial properties with infrastructure mainly consisting of 15'' to 30'' pipe systems along 32nd Ave N, 11th St N, and 10th St N.

Improvements include bypassing flow from the collection system at the intersection of 32nd Avenue North and 10th Street North to the Coffeepot Bayou outfall east of 31st Avenue North and 1st Street North. The bypass system will start with a 36'' pipe from 11th Street North and continue east to 10th Street North where the pipe will increase to a 72'' pipe all the way to Coffeepot Bayou.

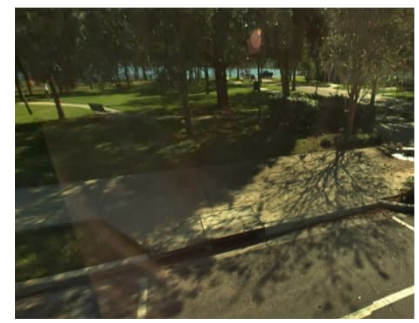
Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Install 72" check valve at outfall
- Install 650 LF of 36'' RCP
- Install 5400 LF of 72'' RCP

This alternative removes approximately 1330 feet of roadway from the 10-year floodplain and 37 structures from the 100-year floodplain

Tie in location on 11th St N and 32nd Ave N



Coffeepot Bayou Outfall on 31st Ave N

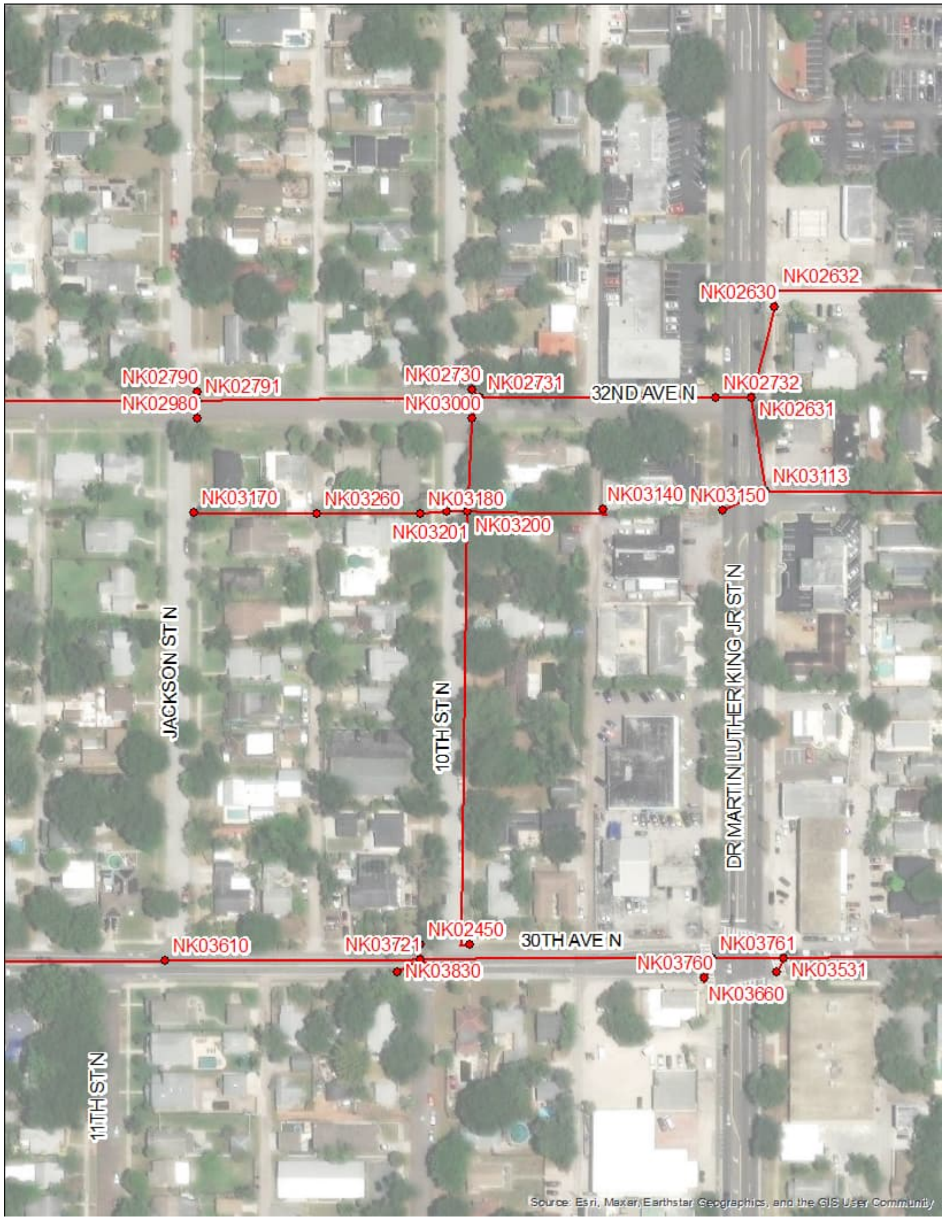
Estimated Cost:

Estimated cost for this project is approximately $11,773,523 including planning, engineering, and permitting fees..

Flooding Improvements at 32nd Ave North – Project No. G6-23

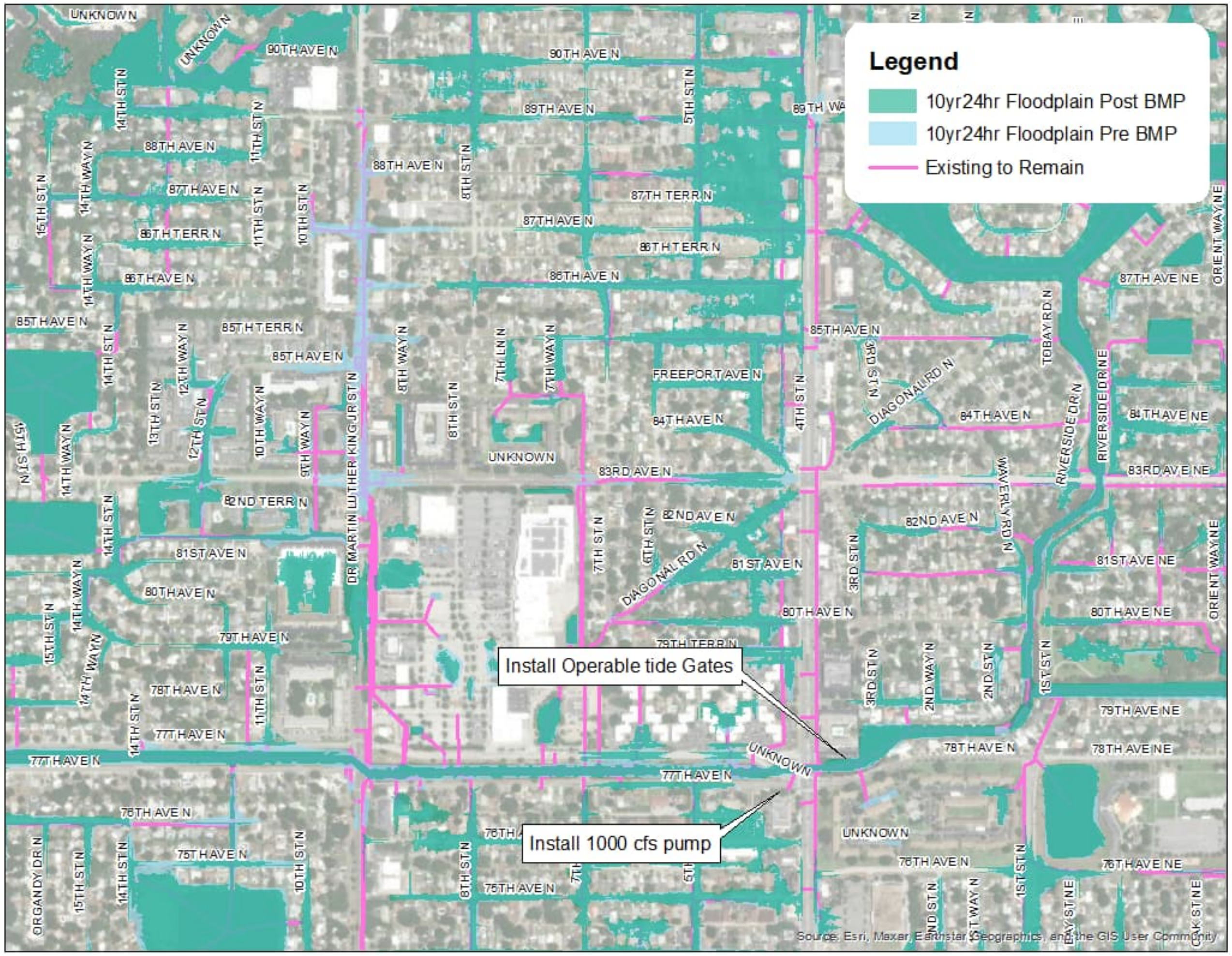
Structures:
Total number of structures removed from the 100-year 24-hour floodplain = 37 structures.

Node Reference Map – Project No. G6-23



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NK03000	10th Street N and 32nd Avenue N	39.48'	44.33'	42.99'	1.34'	44.53'	44.01'	0.52'
NK03150	31st Avenue N and Dr. MLK Jr Street N	36.43'	44.32'	41.72'	2.60'	44.52'	43.67'	0.85'
NK03200	North Central 10th Street N	39.52'	44.35'	43.75'	0.59'	44.58'	44.12'	0.46'

Flooding Improvements at 78^{TH} Avenue N – Project No. G6-25



Problem

BMP 6-25 focuses on the conveyance system along 78^{TH} Avenue N and its surrounding area. Street, residential, and commercial flooding occur along 78^{TH} Avenue N and its intersections. This area focuses on solutions along the channel that would benefit road and building flooding on surrounding areas

Solution & Project Benefits:

BMP 6-25 proposes the following changes to alleviate roadway and residential flooding within the 78^{th} Avenue N area.

- Install 1000 cfs pump station with the reduction of 3 feet of sediment along the width of the 78^{th} Avenue channel
- Install Operable Tide Gates

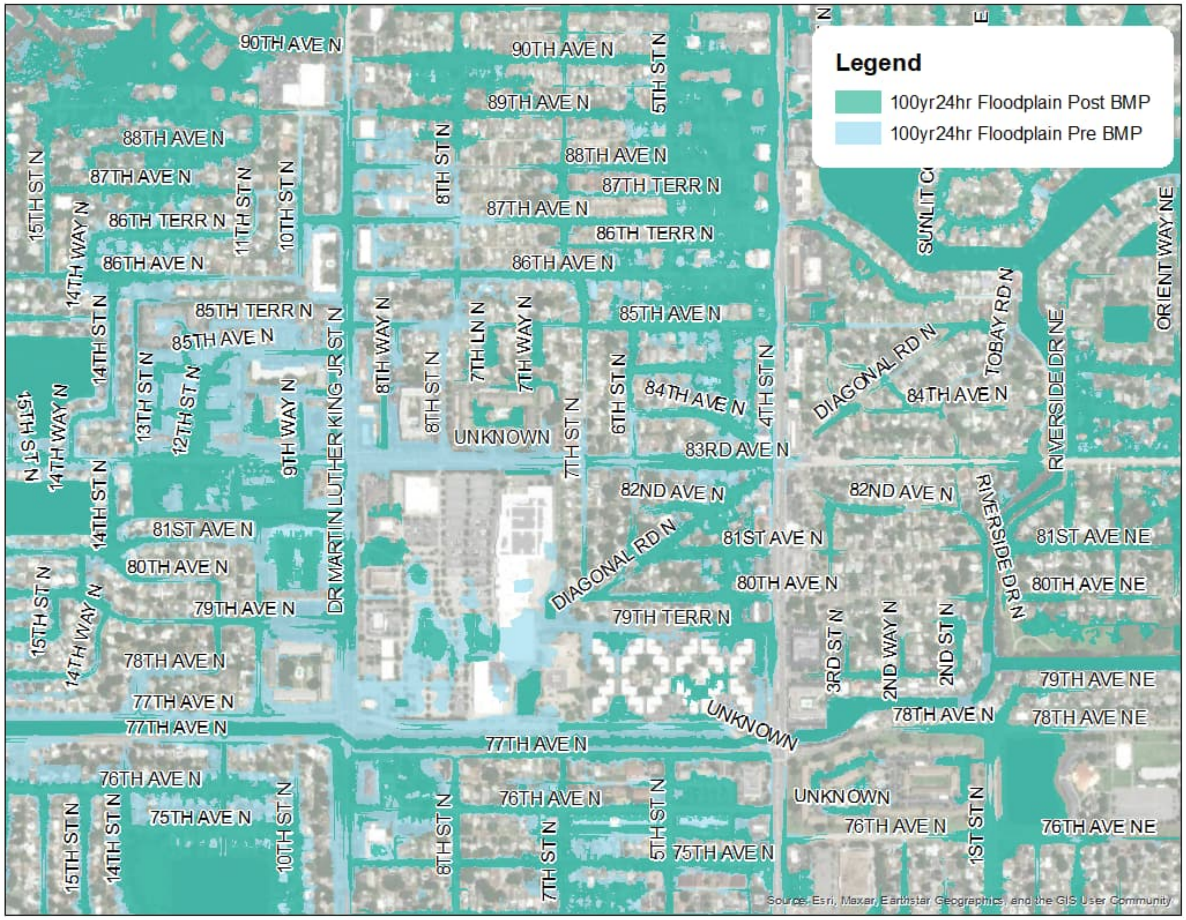
This area is impacted on both roadway and structural due to inadequate drainage of the channel towards the boundary.

This alternative removes approximately 4855 feet of roadway from the 10-year floodplain and 57 structures from the 100-year floodplain.

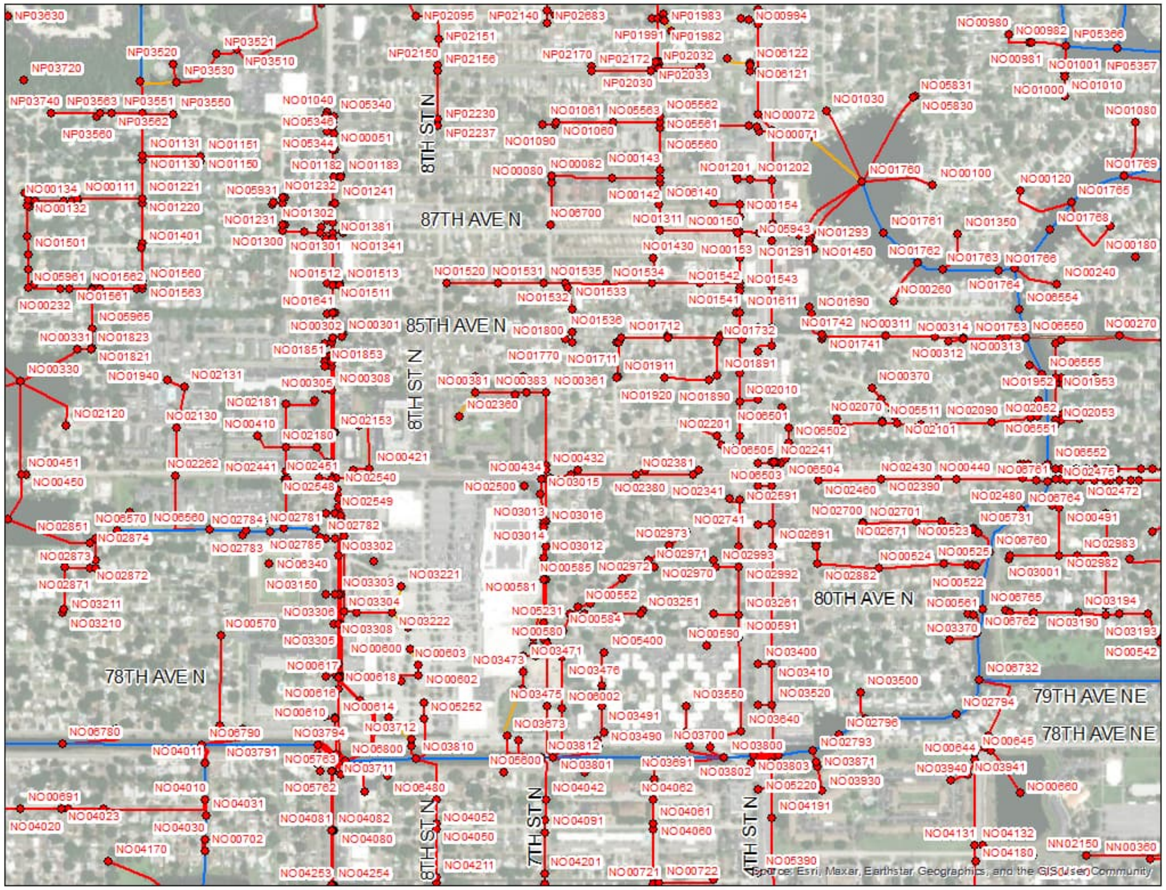
Estimated Cost:

Estimated cost for this project is approximately $158,003,165 including planning, engineering, and permitting fees..

Flooding Improvements at 78TH Avenue N – Project No. G6-25

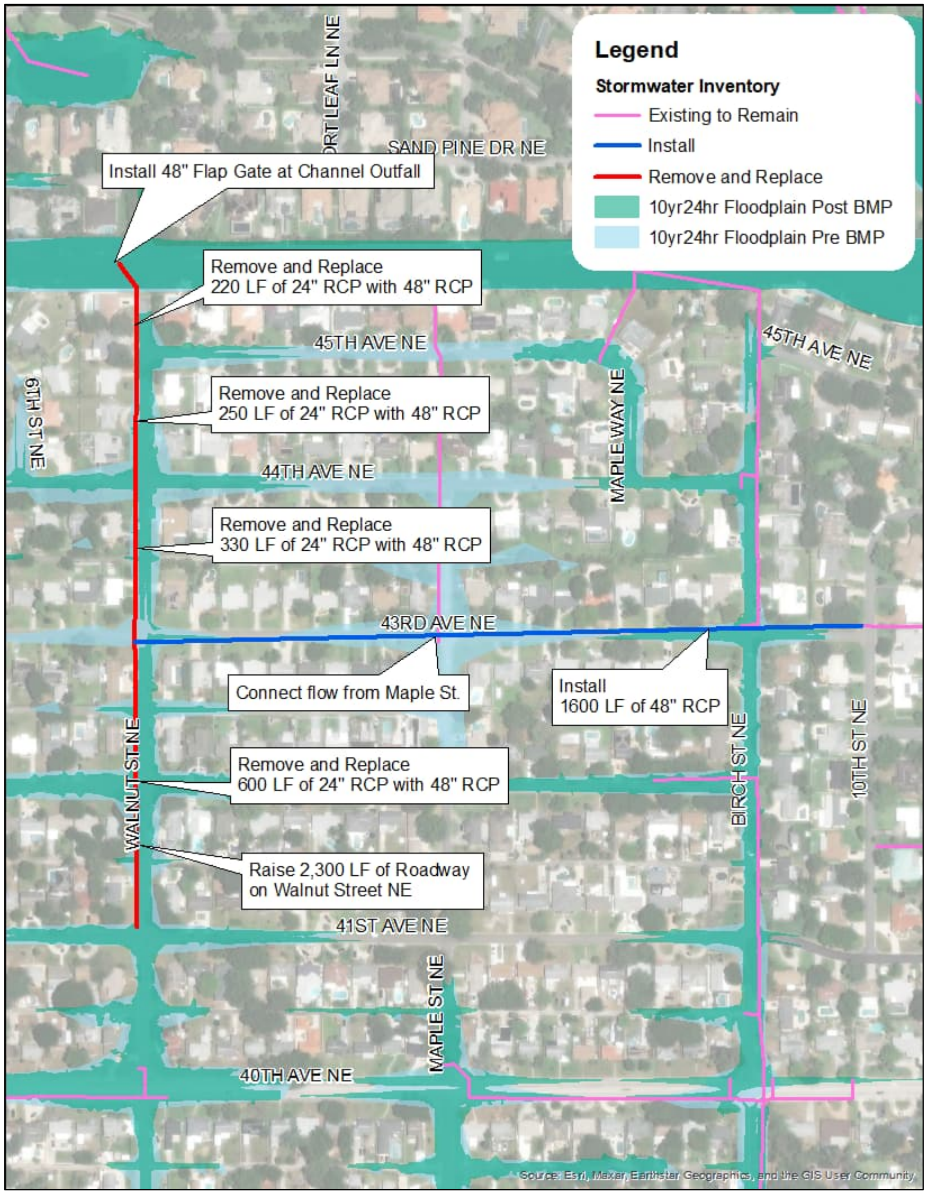


Flooding Improvements at 78^{TH} Avenue N – Project No. G6-25



Node Name	Location Description	Initial stage	10-Year			100-Year			
			EX	PR	Δ	Initial stage	EX	PR	Δ
NO00320	Dr Martin Luther King Jr St	1	4.56	2.51	2.05	1	5.81	4.5	1.31
NO01960	Dr Martin Luther King Jr St	1	4.53	2.25	2.28	1	5.8	3.97	1.83
NO02260	83rd Avenue N	1	4.64	4.11	0.53	1	5.82	5.27	0.55

Flooding Improvements at Walnut Street NE and 43rd Avenue NE - Project No. G6-26



Problem

BMP 32 focuses on roadway flooding along Walnut Street NE, specifically the intersection with 43rd Avenue NE. This area consists of high-density residential land use. The area includes the channel to the north and open water to the east. Improvements include increasing size for the pipe system along Walnut Street NE, bypassing flow at the intersection with 43rd Avenue NE, and raising the road by 6 inches each direction of the bypass to increase inflow to the pipe. This new bypass system would also incorporate flow from the Maple Street NE system as it flows east to open water. The runoff collected from this area currently discharges to the channel north of 45th Avenue which is tidally influenced by Tampa Bay. The existing conveyance system includes 24-inch pipes that outfall directly to this channel; however, the channel is observed to be overwhelmed during periods of high flow which causes overflow in these pipes during the 10yr/24hr storm event.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Remove and replace 1400 LF of 24" RCP with 48" RCP along Walnut Street NE
- Install 1600 LF of 48" RCP along 43rd Avenue NE to tie into 10th Street NE pipe
- Raise 1,400 LF of roadway along Walnut Street NE
- Install 24" flap gate at channel outfall

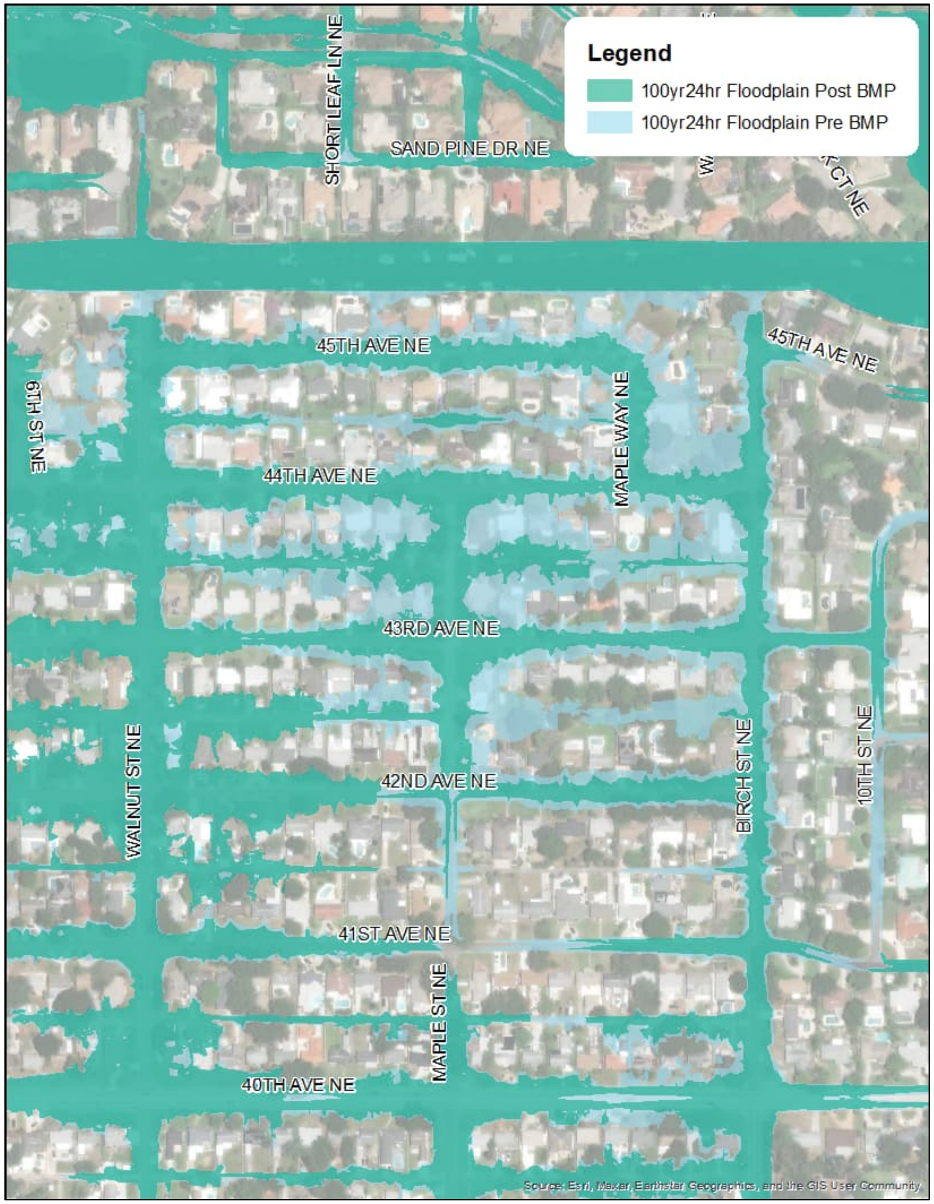
This alternative removes approximately 2917 feet of roadway from the 10-year floodplain and 18 structures from the 100-year floodplain.

Walnut St NE and 43rd Ave NE

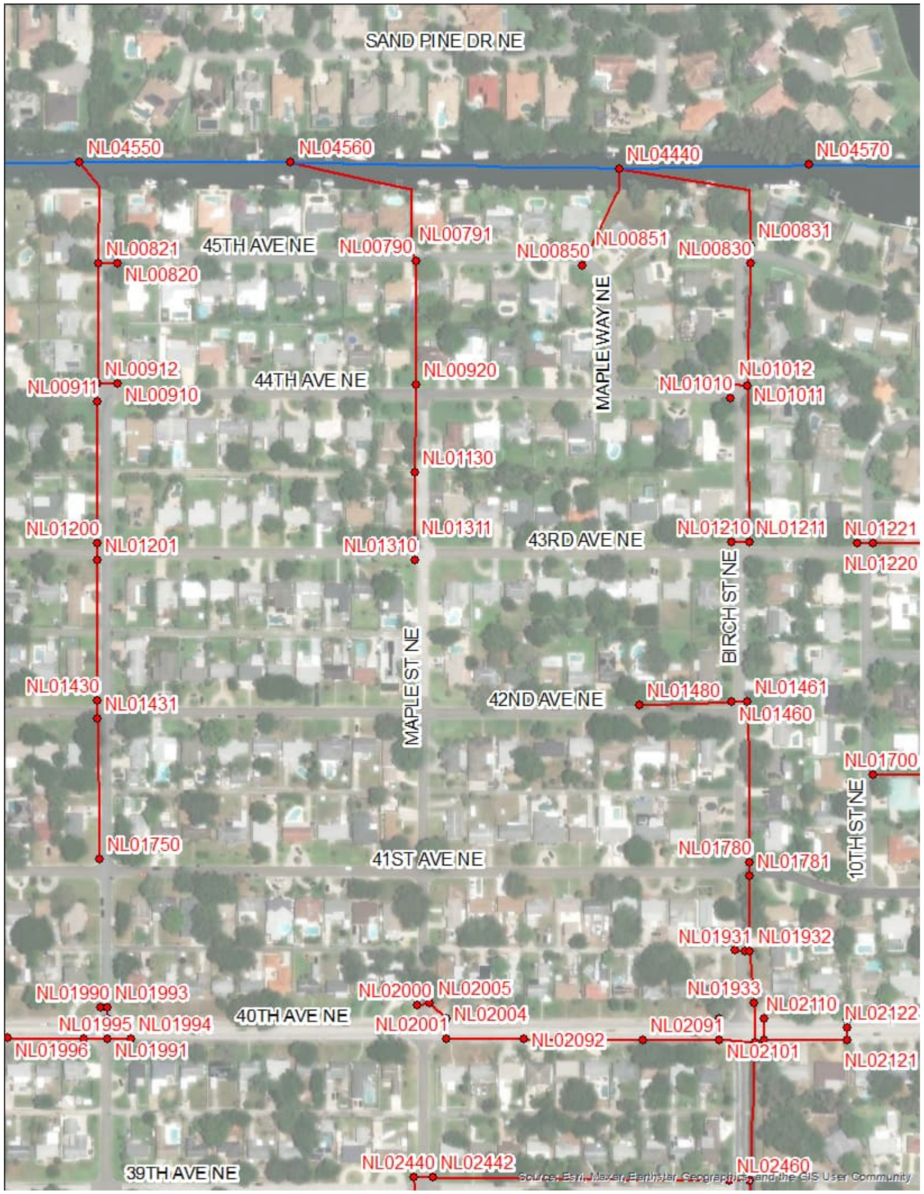
Existing drainage inlets at 42nd Ave and Walnut St NE

Estimated Cost:
Estimated cost for this project is approximately $6,974,054, including planning, engineering, and permitting fees..

Flooding Improvements at Walnut Street NE and 43rd Avenue NE - Project No. G6-26

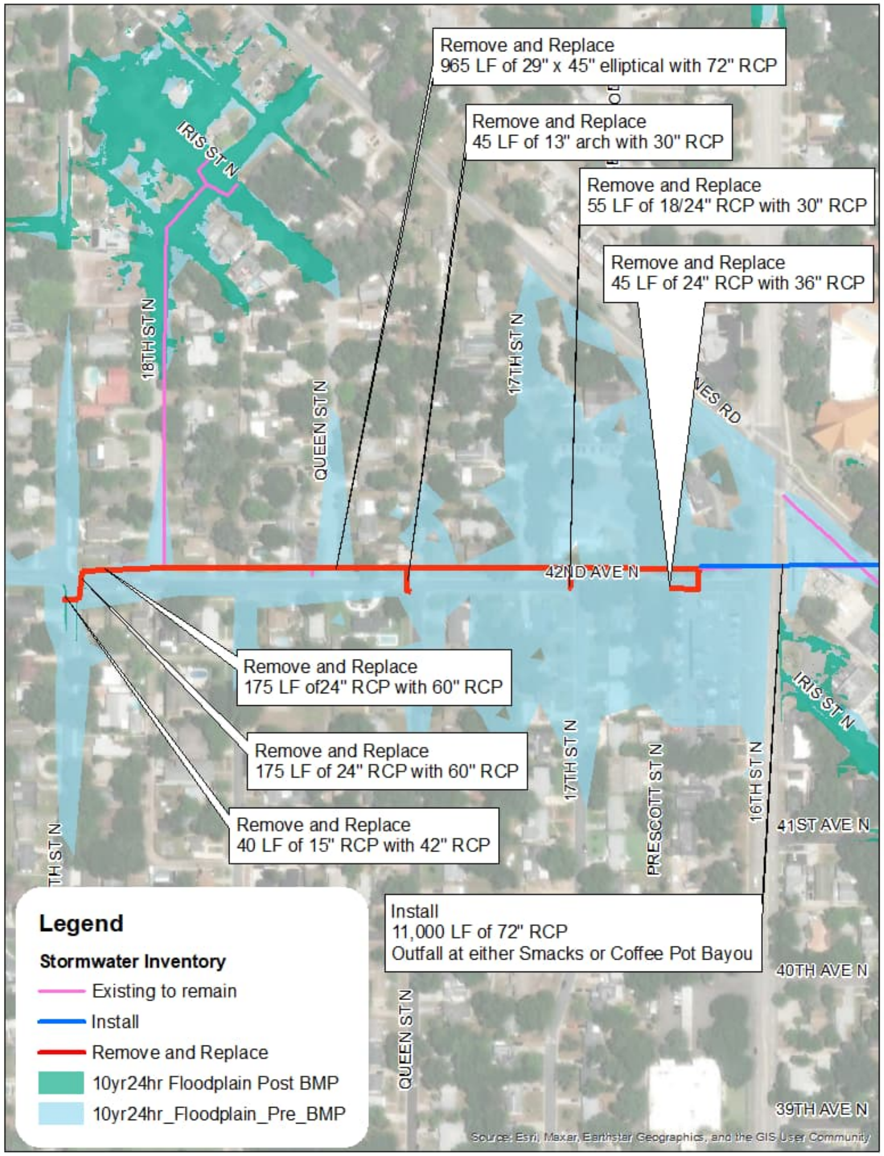


Node Reference Map - Project No. G6-26



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NL00910	Walnut St NE and 44th Ave NE	1.00'	5.19'	4.68'	0.51'	5.88'	5.68'	0.20'
NL01200	Walnut St NE and 43rd Ave NE	1.00'	5.23'	3.45'	1.78'	5.92'	5.93'	0.01'
NL01310	Maple St NE and 43rd Ave NE	1.00'	5.07'	2.89'	2.18'	5.69'	5.21'	0.48'

Flooding Improvements at 42nd Avenue N – Project No. G6-27



Problem

BMP 6-33 focuses on the conveyance system along 42nd Avenue N and its surrounding area. Street, residential, and commercial flooding occur along 42nd Avenue N and its intersections.

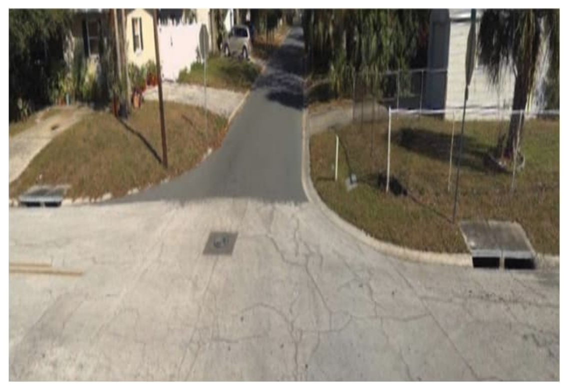
Solution & Project Benefits:

BMP 6-33 proposes the following changes to alleviate roadway and residential flooding within the 42nd Avenue N area.

- Increasing the capacities of existing pipes along 42nd Avenue N from 19th Street N towards 16th Street N.
- Creating a new 72" pipe system that extends from 42nd Avenue N/16th Street N intersection to either Smacks Bayou or Coffee Pot Bayou. This new pipe is proposed only because improvements from the current trunkline to the channel it outfalls into created additional flooding issues. The specific route of this pipe can be adjusted as desired. This pipe could be upsized as it nears the bayou so that additional areas could be tied into it and potentially reduce flooding in those areas.

This is a high-density residential area along with commercial properties. impacts to vehicular and pedestrian traffic should be expected for the improvements listed above. The proposed solutions will provide more conveyance capacity and reduce street, commercial, and residential flooding in the impacted area.

This alternative removes approximately 6098 feet of roadway from the 10-year floodplain and 0 structures from the 100-year floodplain



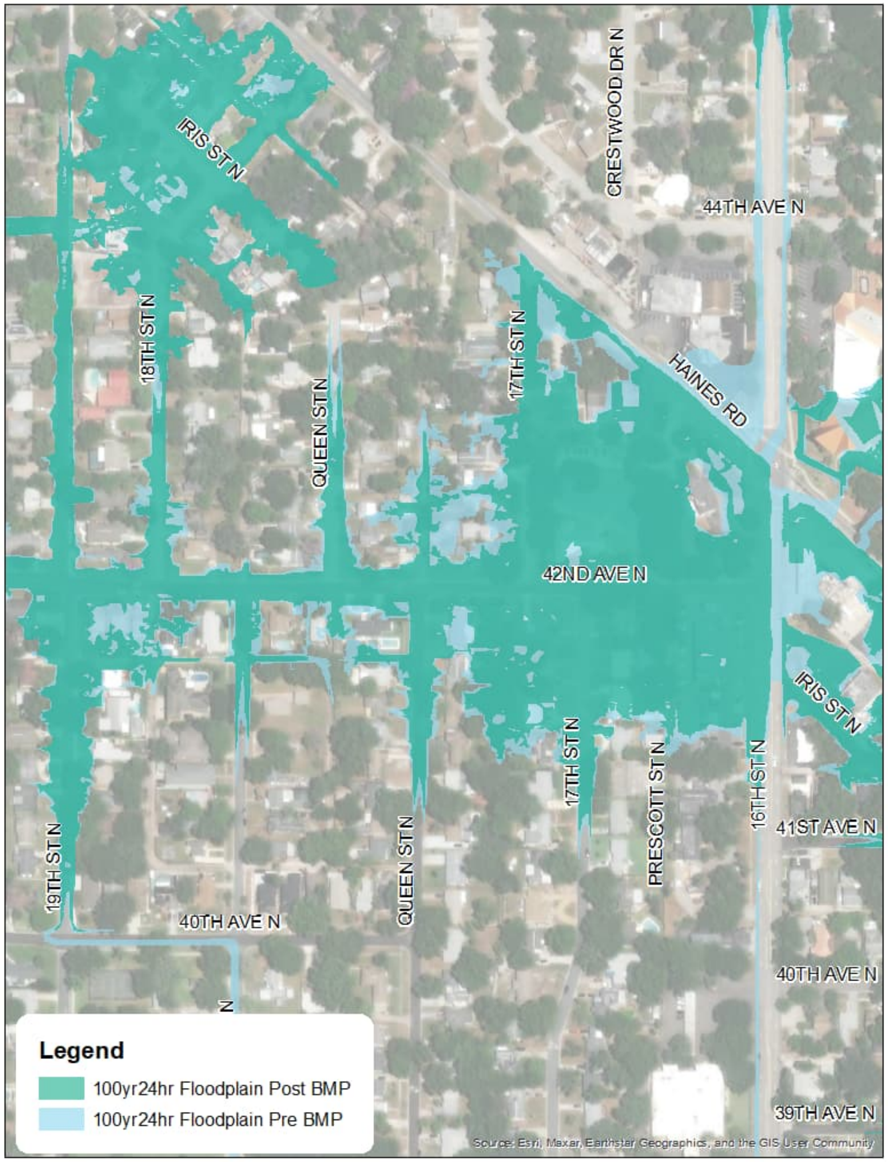
Existing conditions at 42nd Avenue N and 19th Street N

Existing drainage inlet at 42nd Avenue N and Queen Street N

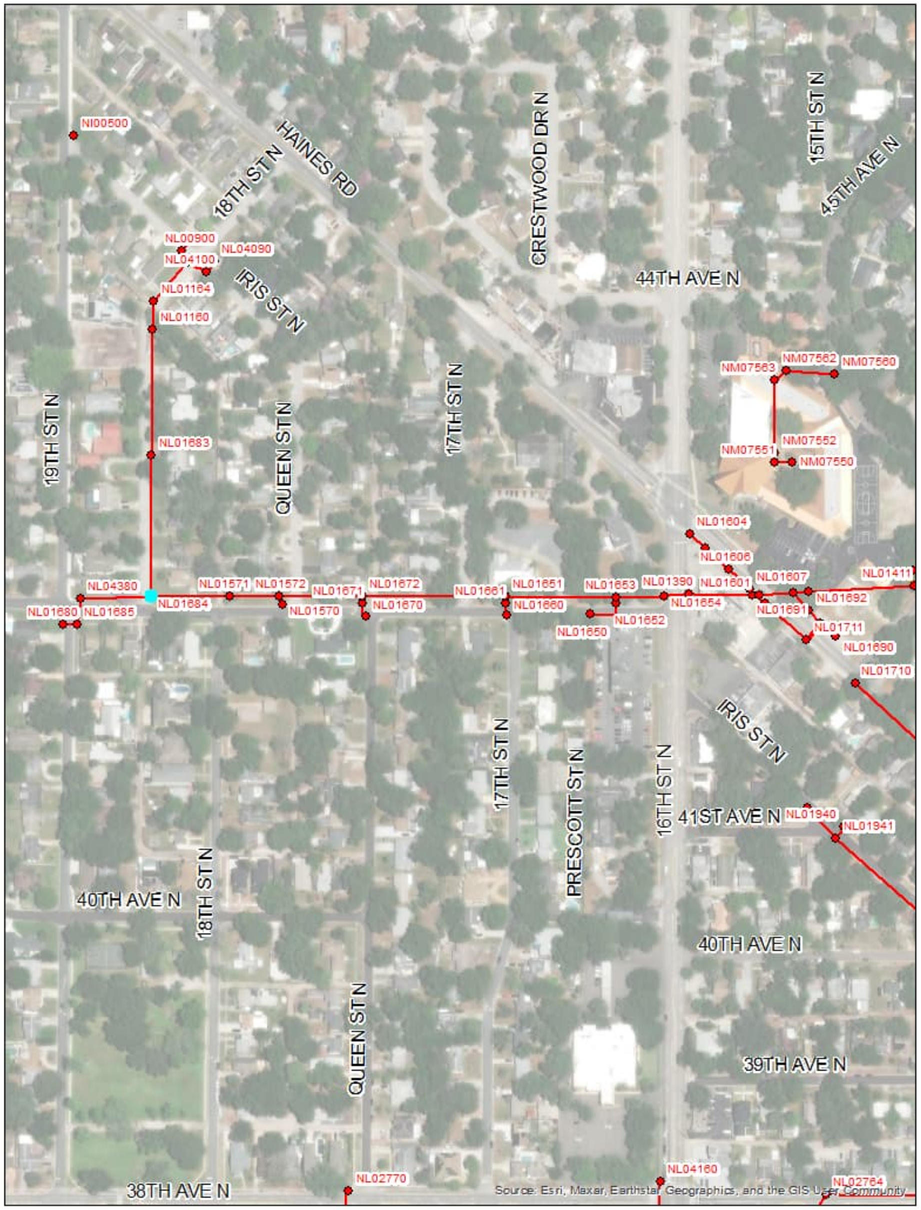
Estimated Cost:

Estimated cost for this project is approximately $24,439,929 including planning, engineering, and permitting fees..

Flooding Improvements at 42^{nd} Avenue N – Project No. G6-27

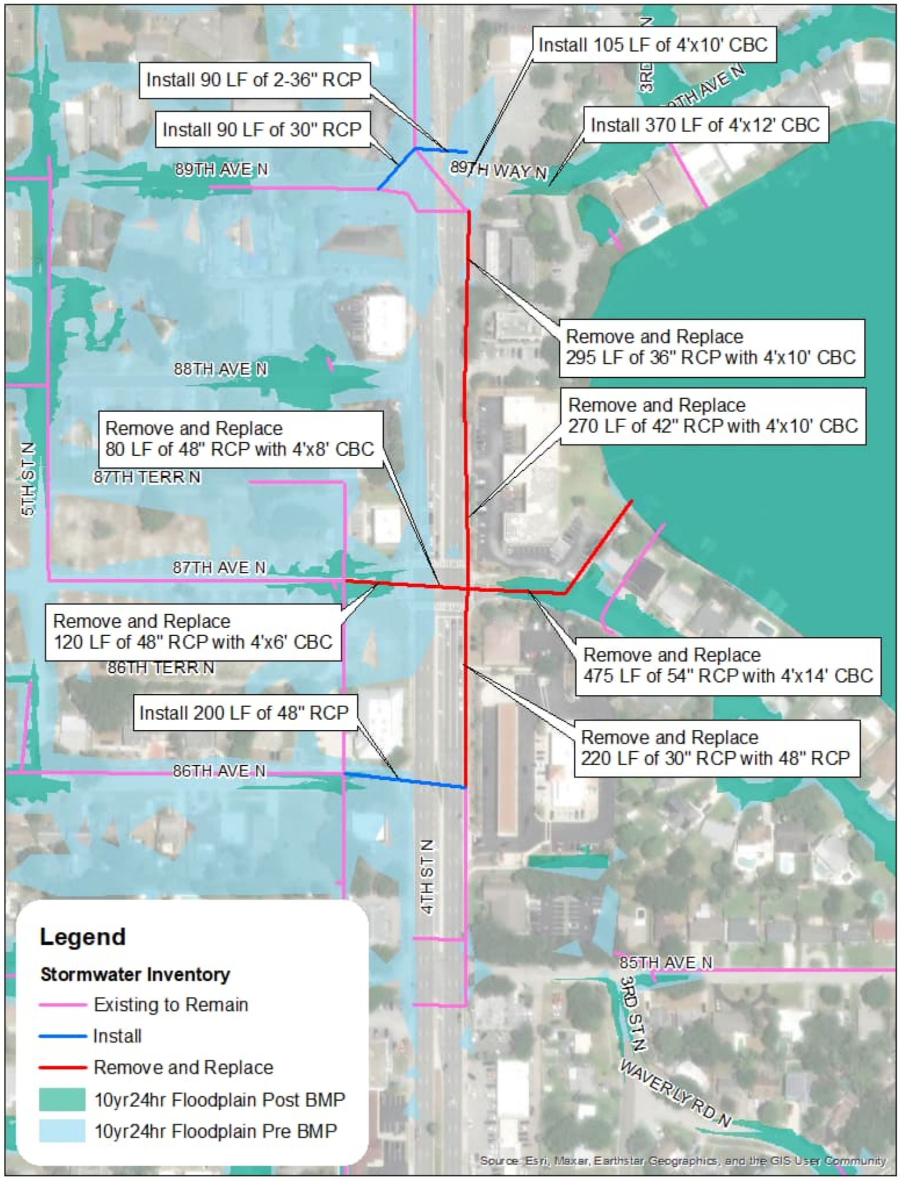


Node Reference Map – Project No. G6-27



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NL01684	42nd Ave N/19th St N	39.67	45.56'	42.85'	2.71'	45.84'	45.42'	0.42'
NL01653	42nd Ave N/16th St N	32	45.09'	37.68'	7.41'	45.36'	43.16'	2.2'
NL01672	42nd Ave N/Queen St N	38.31	45.40'	41.42'	3.98'	45.67'	44.64'	1.03'

Flooding Improvements at 4th Street North and 87th Avenue North - Project No. G6-28



Problem

BMP 34 focuses on the conveyance system along 4th Steet North and between 86th Avenue North to 90th Avenue North (Figure 34-1). This area consists of high-density residential and commercial land use. BMP 34 improvements includes expanding the existing conveyance system along 4th Street North, 86th Avenue North, 87th Avenue North to an outfall south of 89th Way North, 88th Avenue North, and 89th Avenue North to an outfall north of 87th Avenue North.

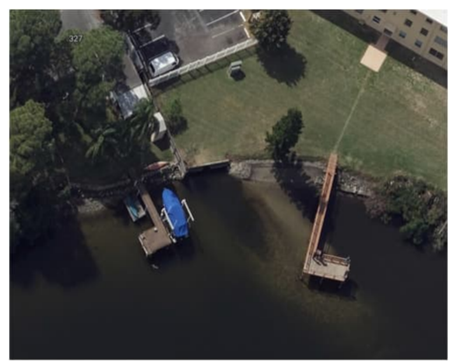
The runoff collected from this area currently discharges to the water body east of 4th Street North, south of 89th Avenue North and north of 87th Avenue North which is tidally influenced by Tampa Bay. The existing conveyance system is not sized adequately to allow for rapid runoff which is resulting in flooding observed during the 10yr/24hr storm event.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Install 90 LF of 30" RCP, 90 LF of 2-36" RCP from west side of 89th Avenue North to the east side of 4th Street North,
- Install 105 LF of 4'x10' CBC along 4th Street North across 89th Way North,
- Install 370 LF of 4'x12' CBC along 89th Way North to an outfall,
- Remove and replace 295 LF of 36" RCP with 4'x10' CBC on the east side of 4th Street North from 89th Way North to 88th Avenue North,
- Remove and replace 270 LF of 42" RCP with 4'x10' CBC on the east side of 4th Street North from 88th Avenue North to 87th Avenue North,
- Remove and replace 120 LF of 48" RCP with 4'x6' CBC across 4th Street North along 87th Avenue North,
- Remove and replace 80 LF of 48" RCP with 4'x8' CBC across 4th Street North along 87th Avenue North,
- Remove and replace 475 LF of 54" RCP with 4'x14' CBC along 87th Avenue North east of 4th Street North,
- Remove and replace 220 LF of 30" RCP with 48" RCP along 4th Street North from 86th Avenue North to 87th Avenue North, and
- Install 200 LF of 48" RCP

This alternative removes approximately 3064 feet of roadway from the 10-year floodplain and 46 structures from the 100-year floodplain



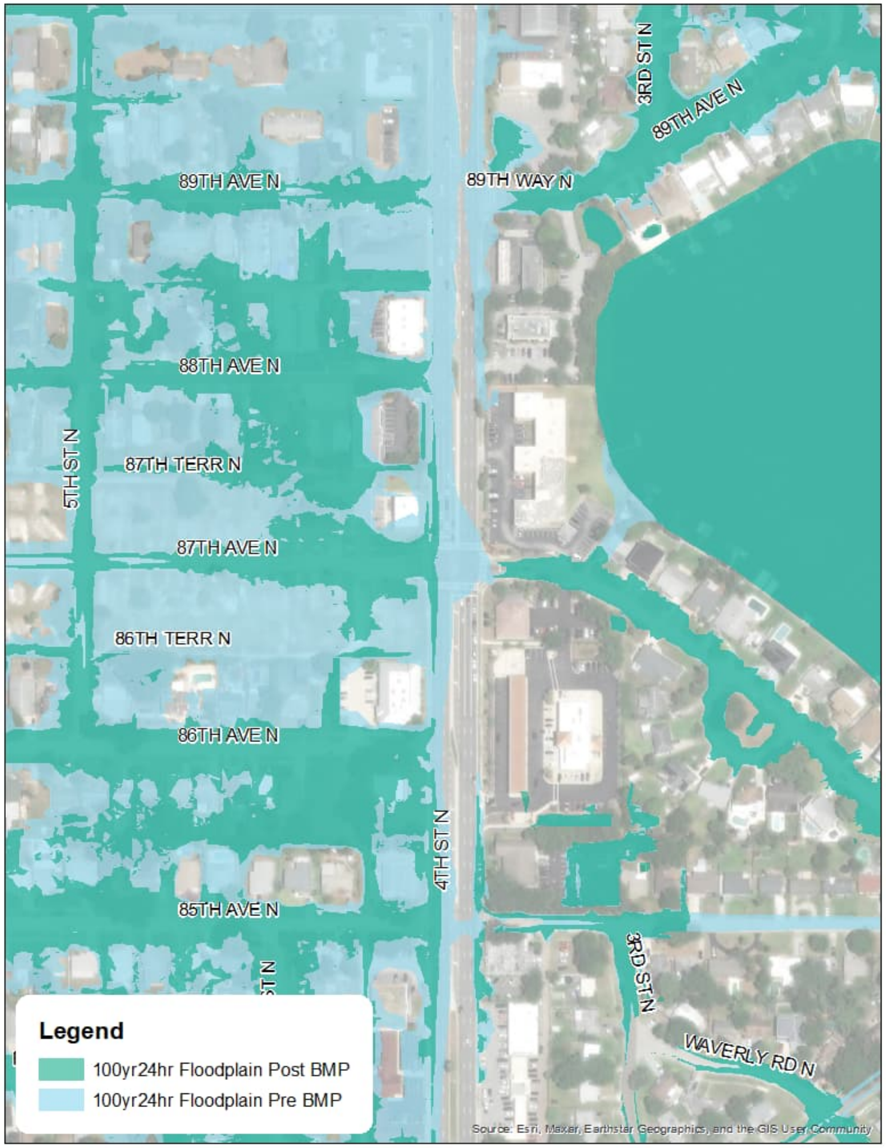
Existing 54" RCP outfall east of 87th Ave N

Existing intersection of 89th Ave N & 4th St N

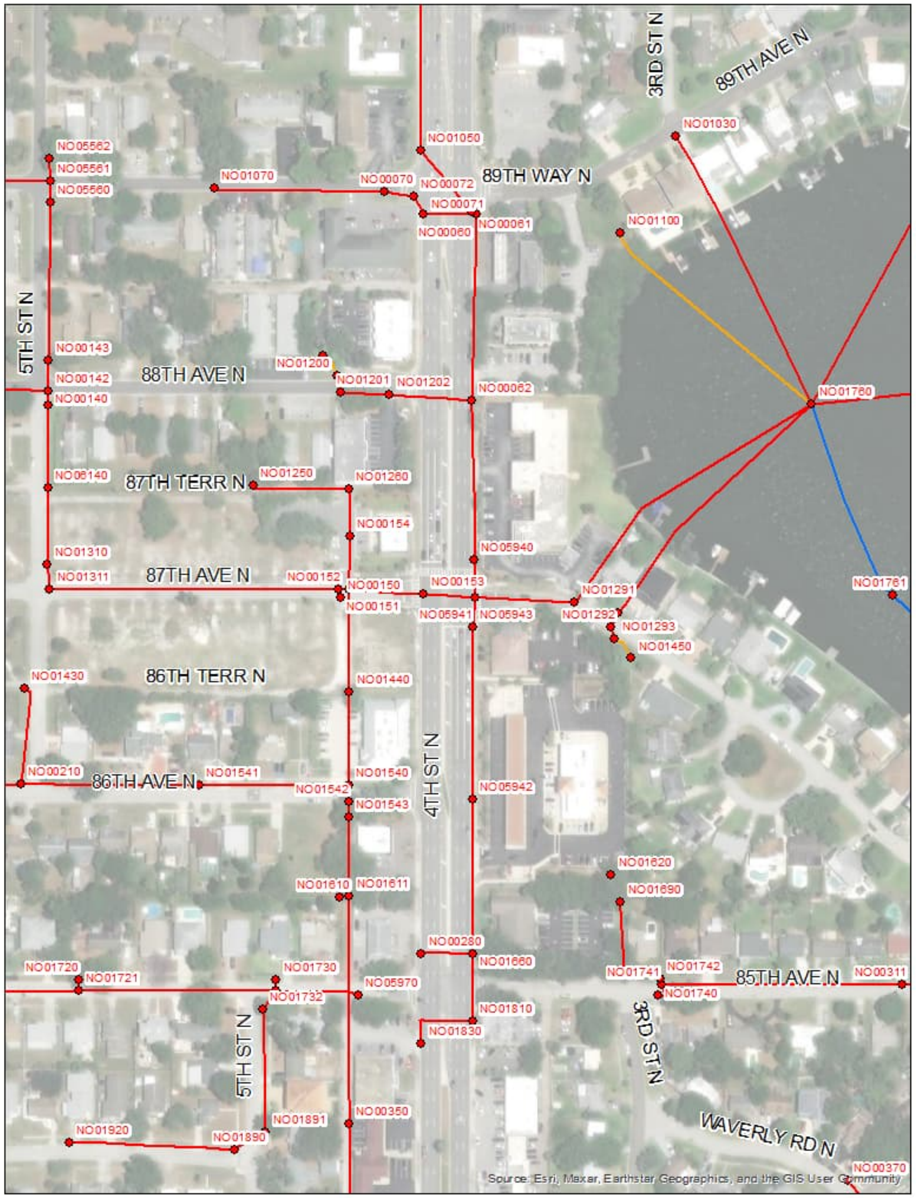
Estimated Cost:

Estimated cost for this project is approximately $9,615,000 including planning, engineering, and permitting fees..

Flooding Improvements at 4th Street North and 87th Avenue North - Project No. G6-28

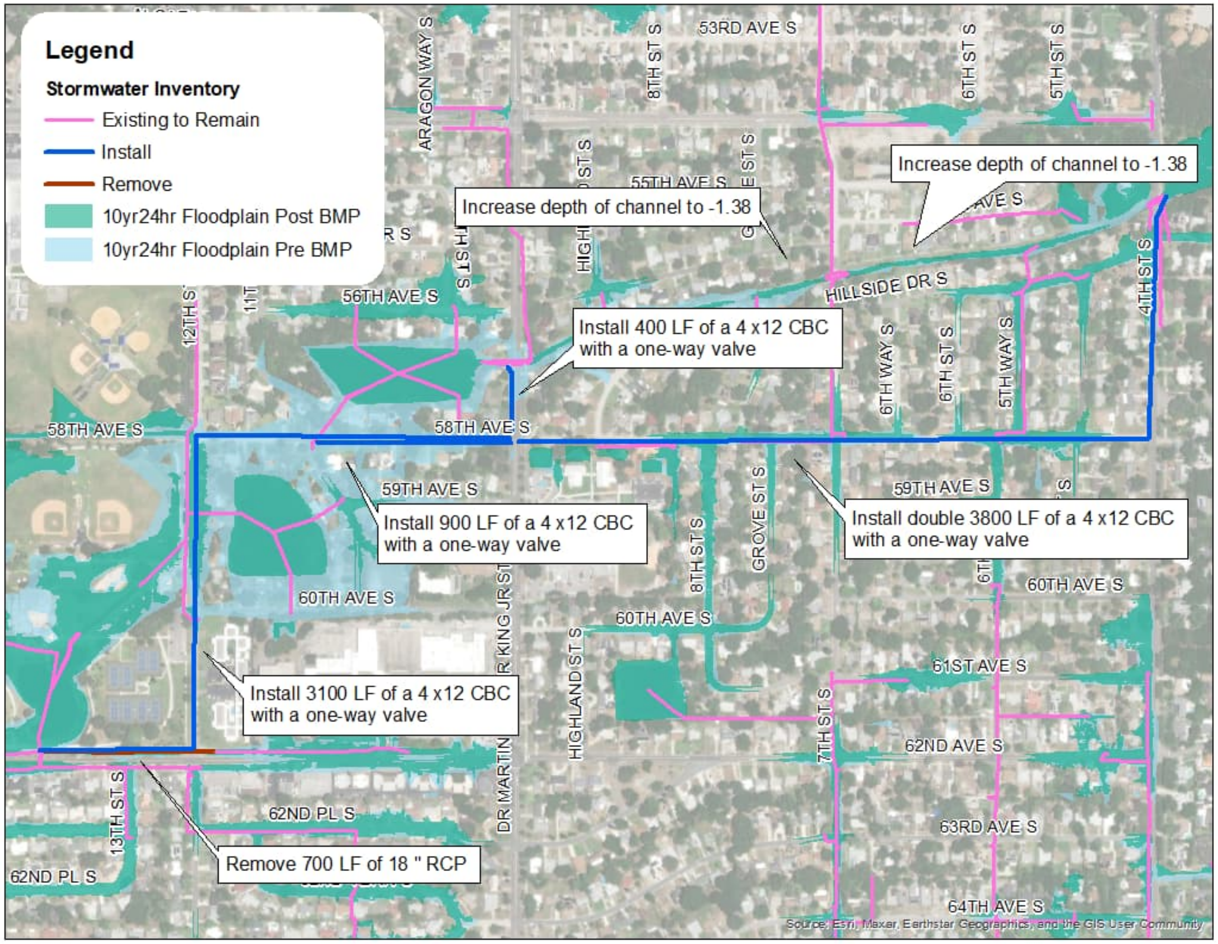


Node Reference Map - Project No. G6-28



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NO01540	86th Ave N & 4th St N	1	5.2	3.59	1.61	5.57	5.17	0.4
NO00150	87th Ave N & 4th St N	1	5.05	4	1.05	5.53	4.73	0.8
NO01200	88th Ave N & 4th St N	1	5.05	3.62	1.43	5.53	4.47	1.06
NO00060	89th Ave N & 4th St N	1	4.48	1.72	2.76	4.81	2.4	2.41

Flooding Improvements at 58th Ave S and 11th St S- Project No. G7-2



Problem

BMP G7-2 Focuses on conveyance system along 58th Ave South between Lake Catalina and Coronado Lake. The existing condition of the 10-year floodplain demonstrates severe road flooding as well as structure flooding along 58th Ave South and adjacent roads as seen on Figure#.

Runoff from Lake Catalina and Coronado Lake are collected and flowing towards the 58th Ave S and structures located between them. The existing conveyance system is not adequate for the amount discharge both of this ponds are out falling

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

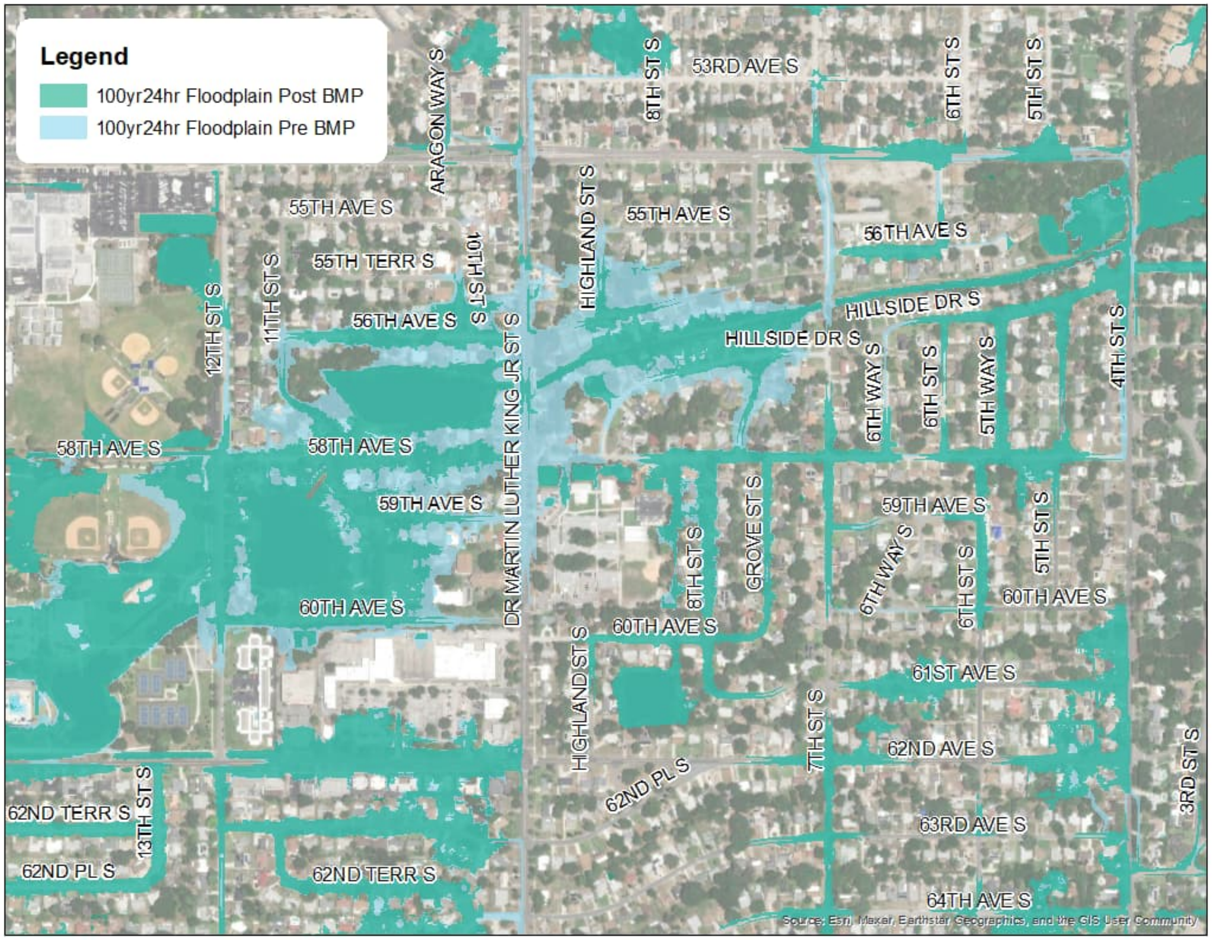
- Install 3100 LF of 4 x 12 Concrete Box Culvert with a one-way valve at the south connection of Lake vista along 62nd Ave S
- Install 900 LF of 4 x 12 Concrete Box Culvert with a one-way valve at 58th Ave S south of Lake Catalina
- Install 400 LF of 4 x 12 Concrete Box Culvert with a one-way valve along Dr MLK Jr connecting to 58th Ave S
- Install Double 3800 LF of 4 x 12 Concrete Box Culvert along 58th Ave S and north along 4th St S
- Remove 700 LF of 18-inch RCP Along 62nd Ave S
- Increase the depth of the channel along Hillside Dr S to -1.38

This alternative removes approximately 2100 feet of roadway from the 10-year floodplain and 54 structures from the 100-year floodplain.

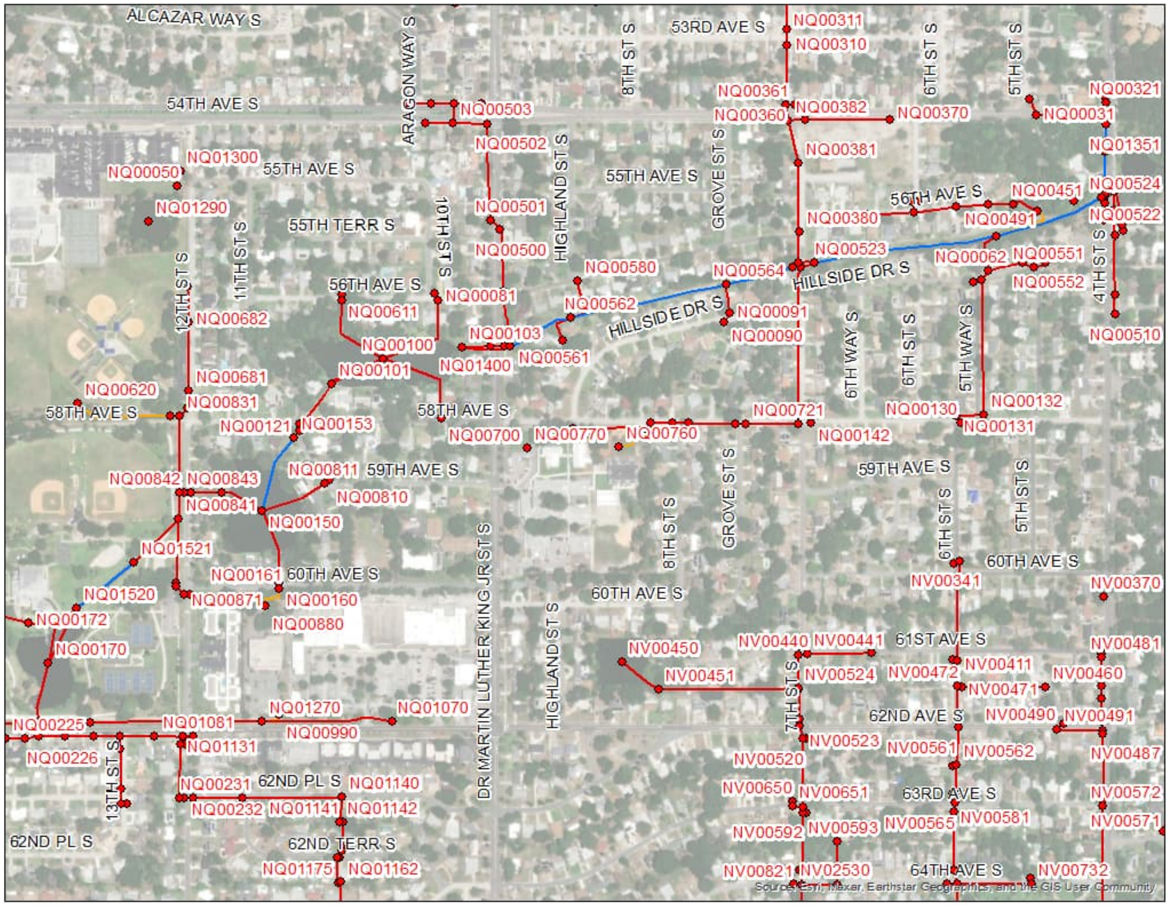
Estimated Cost:

Estimated cost for this project is approximately $53,039,059 including planning, engineering, and permitting fees..

Flooding Improvements at 58th Ave S and 11th St S- Project No. G7-2

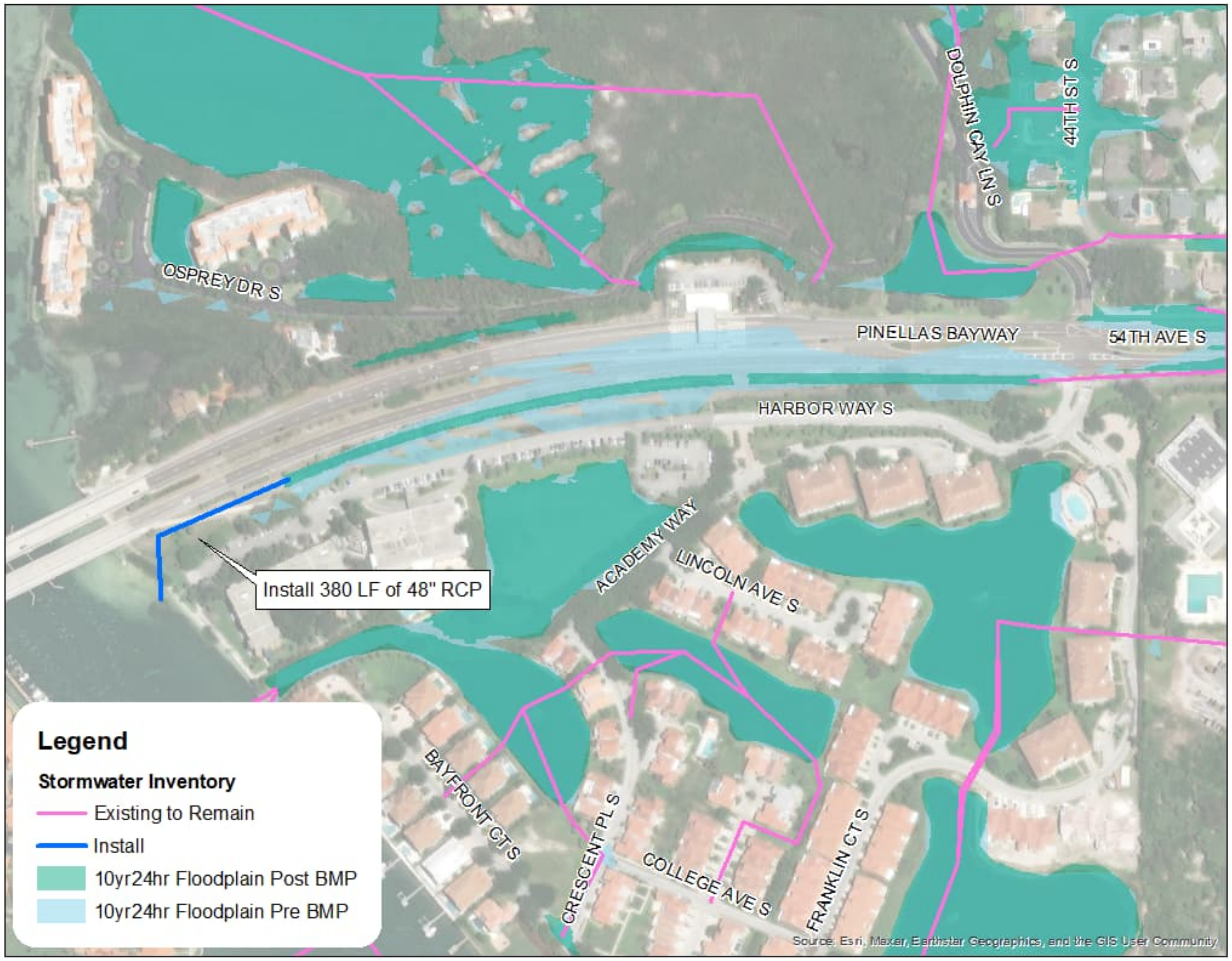


Node Reference Map - Project No. G7-2



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NQ00153	58th Avenue S	2.88	9.14'	6.13'	3.01'	10.05'	9'	1.05'
NQ00160	60th Avenue S	2.88	9.16'	6.41'	2.75'	10.06'	9.1'	0.96'
NQ00564	Channel parallel to 56th Avenue S	1.51	7.33'	5.57'	1.76'	9.19'	7.69'	1.5'
NQ00171	62nd Avenue S	3.32	9.89'	8.47'	1.42'	10.27'	9.49'	0.78'

Flooding Improvements at 54TH Avenue S and Osprey Dr S - Project No. G7-3



Problem

BMP G7-3 focuses lack of conveyance system along 54th avenue South (Figure G7-3-1). This area consists of road flooding taking both sides of the road. BMP G7-3 improvements includes adding an outfall structure for the channel south of 54th Avenue S.

This channel collects water from the east of the 54th Avenue S acting as a storage channel for the area. The existing conveyance system is not adequate for the rapid runoff resulting in flooding from the 10yr/24hr storm event.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

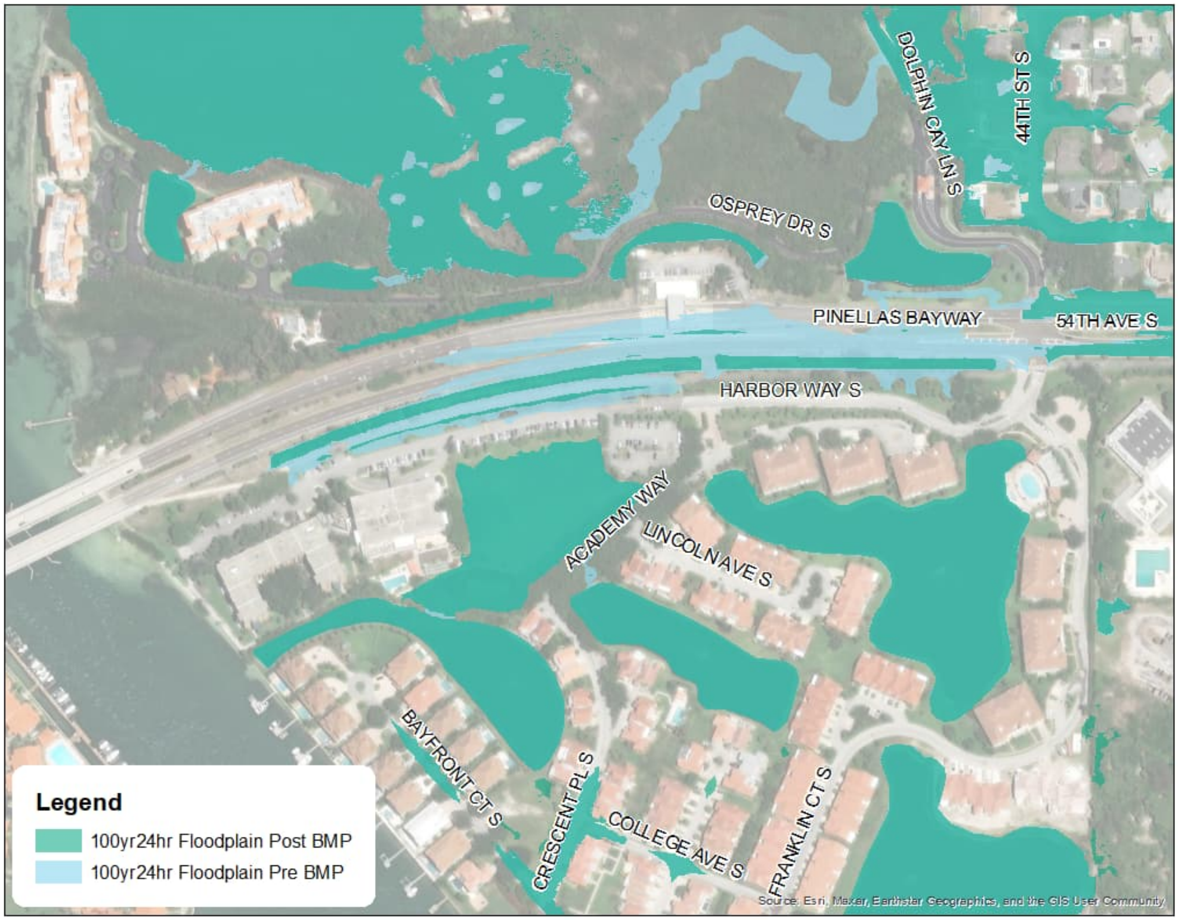
- Install 380 LF of 48-inch RCP connecting the existing channel to the boundary outfall.

This alternative removes approximately 2700 feet of roadway from the 10-year floodplain and 0 structures from the 100-year floodplain.

Estimated Cost:

Estimated cost for this project is approximately $966,397 including planning, engineering, and permitting fees..

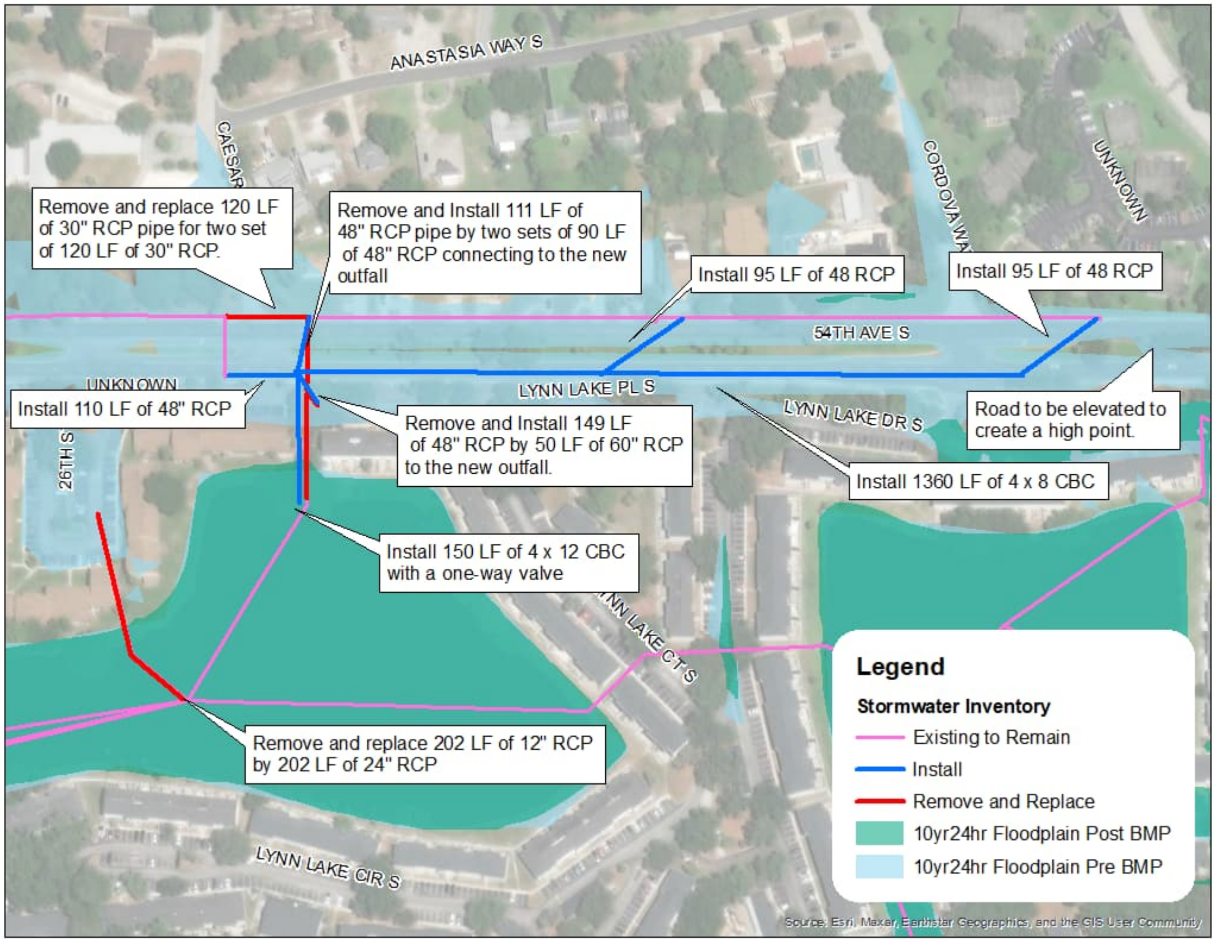
Flooding Improvements at 54TH Avenue S and Osprey Dr S - Project No. G7-3



Flooding Improvements at 54TH Avenue S and Osprey Dr S - Project No. G7-3

Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NU04160	Channel parallel to 54th Ave S	1	5.75’	3.88’	1.87’	5.85’	4.61’	1.24’
NU04193	54th Ave S	1	5.78’	4.73’	1.05’	5.87’	5.22’	0.65’
NU04194	54th Ave S	1	5.8’	4.99’	0.81’	5.89’	5.4’	0.49’
NU04192	54th Ave S	1	5.76’	4.97’	0.79’	5.86’	5.4’	0.46’

Flooding Improvements at 54TH Avenue S and Caesar Way S- Project No. G7-4



Problem

BMP G7-4 focuses on the conveyance of the 54th Ave S existing structures to the Stephenson Lake. Existing condition flooding extents show severe road flooding on both sides of the road and 26th St S.

Runoff collected from both sides 54th Ave S meet on the crossing of Caesar Way S out falling to Stepheson's lake. The existing structures are inadequate for the conveyance that this area needs. BMP G7-4 proposes the replacement of existing structures and installment of new structures to better transport runoff from 54th Avenue South.

Under current conditions, approximately LF of roadway inundated by flood waters by the 10yr/24hr storm event.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

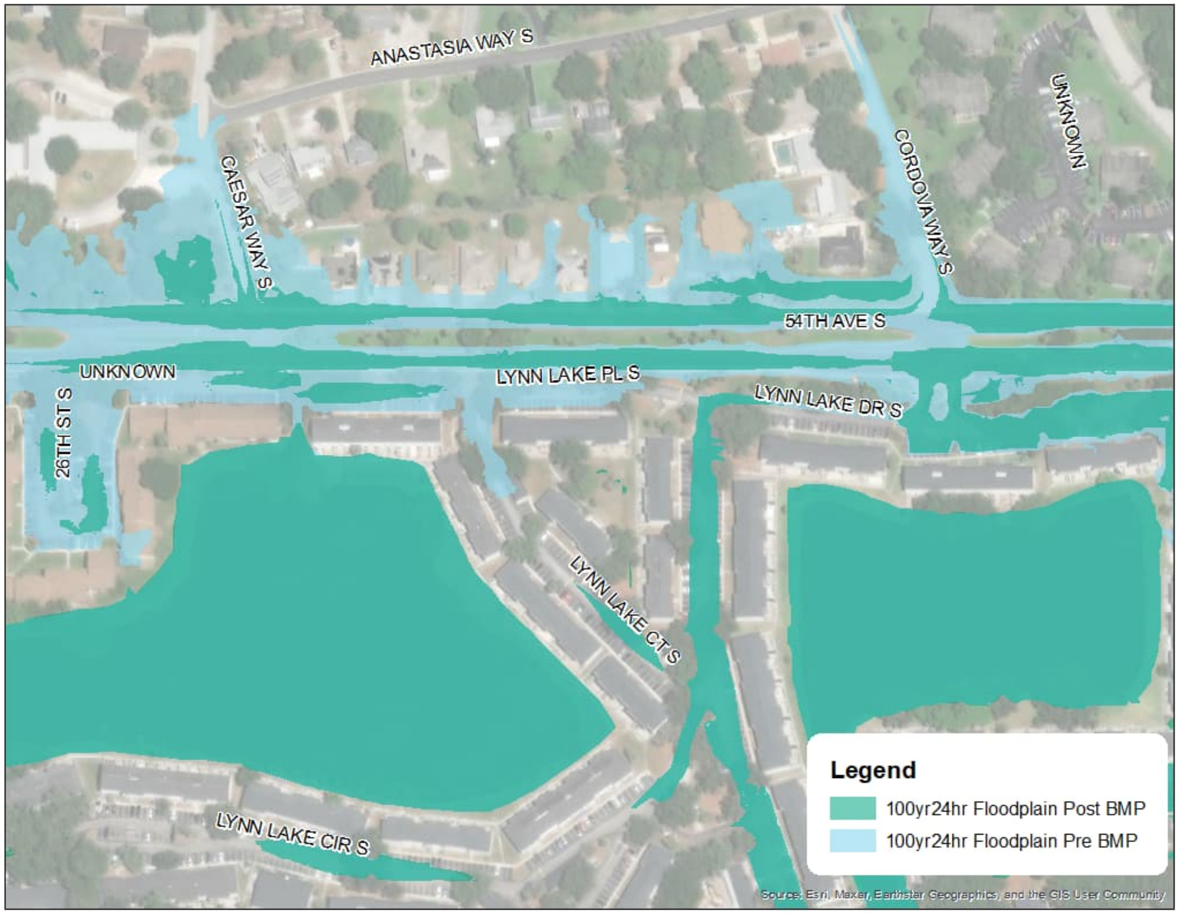
- Remove and replace 120 LF of 30" RCP pipe for two set of 120 LF of 30" RCP.
- Remove and Install 111 LF of 48" RCP pipe by two sets of 90 LF of 48" RCP connecting to the new outfall.
- Remove and Install 149 LF of 48" RCP by 50 LF of 60" RCP to the new outfall.
- Remove and replace 202 LF of 12" RCP by 202 LF of 24" RCP.
- Install 110 LF of 48" RCP
- Install 95 LF of 48 RCP.
- Install 95 LF of 48 RCP.
- Install 1360 LF of 4 x 8 CBC
- Install 150 LF of 4 x 12 CBC with a one-way valve.
- Road elevation along the East side is raised to present overland runoff to affect the area.

This alternative removes approximately 4594 feet of roadway from the 10-year floodplain and 4 structures from the 100-year floodplain.

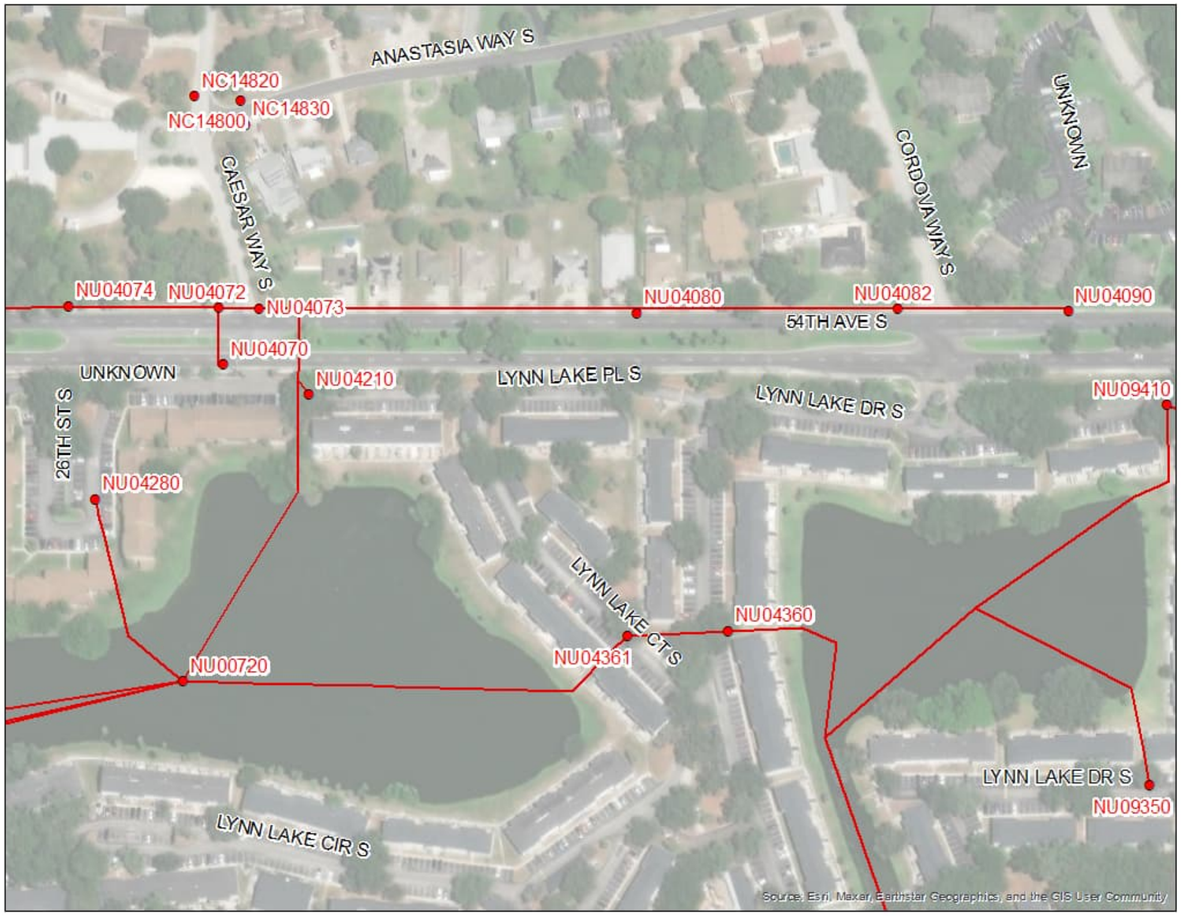
Estimated Cost:

Estimated cost for this project is approximately $8,123,495 including planning, engineering, and permitting fees..

Flooding Improvements at 54TH Avenue S and Caesar Way S- Project No. G7-4

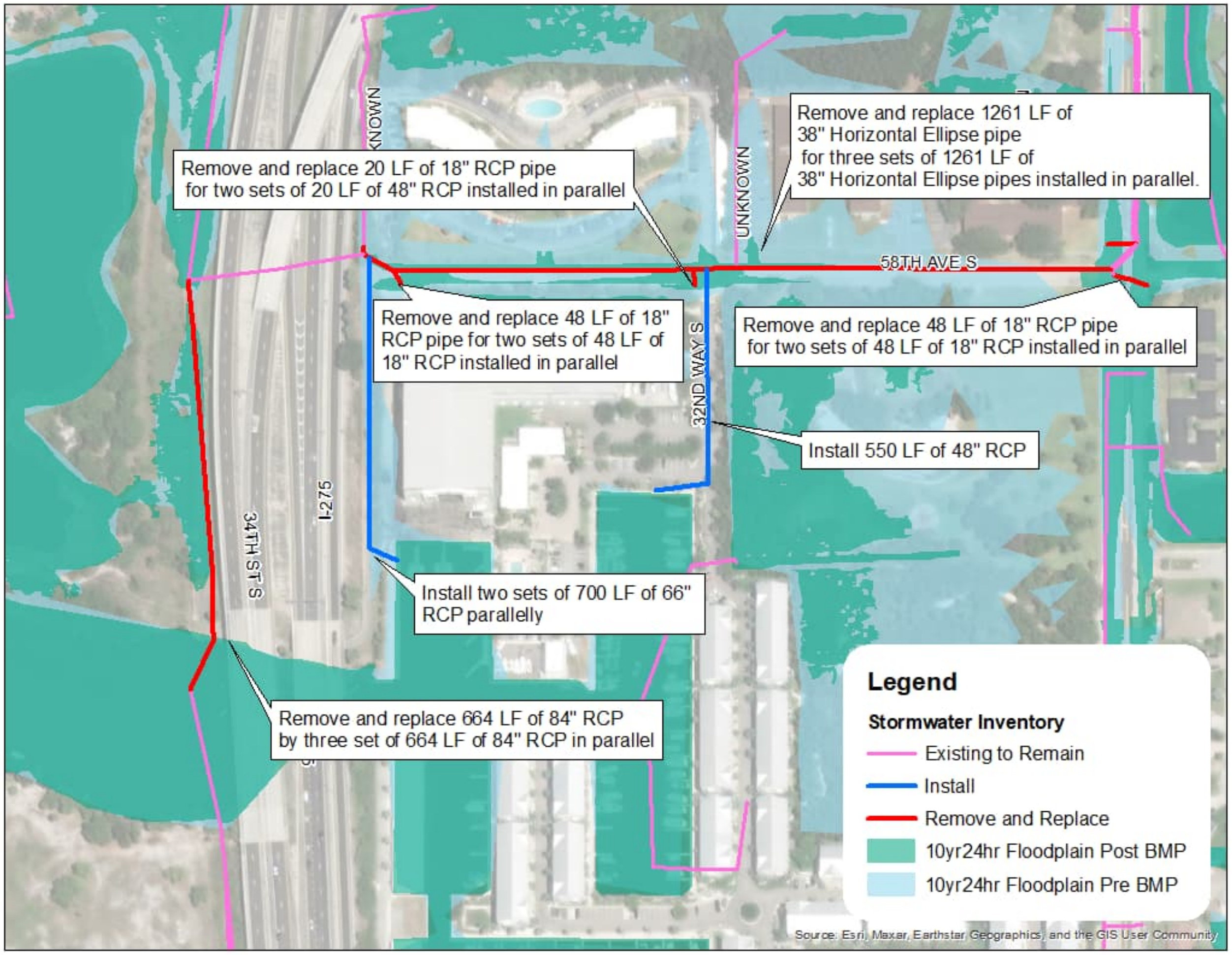


Node Reference Map - Project No. G7-4



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NU04071	54th Avenue North	1.19	10.88’	8.85’	2.03’	10.99’	9.92’	1.07’
NU04070	54th Avenue North	3.42	10.88’	8.86’	2.02’	11’	10.03’	0.97’
NU04082	54th Avenue North	4.12	10.95’	9.84’	1.11’	11.01’	10.18’	0.83’
NU00550	54th Avenue North	3.99	10.91’	9.87’	1.04’	11.04’	10.84’	0.2’

Flooding Improvements at 56TH Avenue S - Project No. G7-5



Problem

BMP G7-5 Focuses on conveyance system along 58th Ave South. The existing condition of the 10yr 24hr floodplain demonstrates severe road flooding long 58th Ave South also affecting north and south bound of 31st St South and structures south of 58th Avenue S as seen on Figure G7-5-1

This area consist of high level of water with the inadequate structure to properly discharge it. BMP G7-5 improvements includes new discharge areas to alleviate the runoff along 58th Avenue S and connecting pipe upgrades to correctly convey water to their correct discharge locations.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

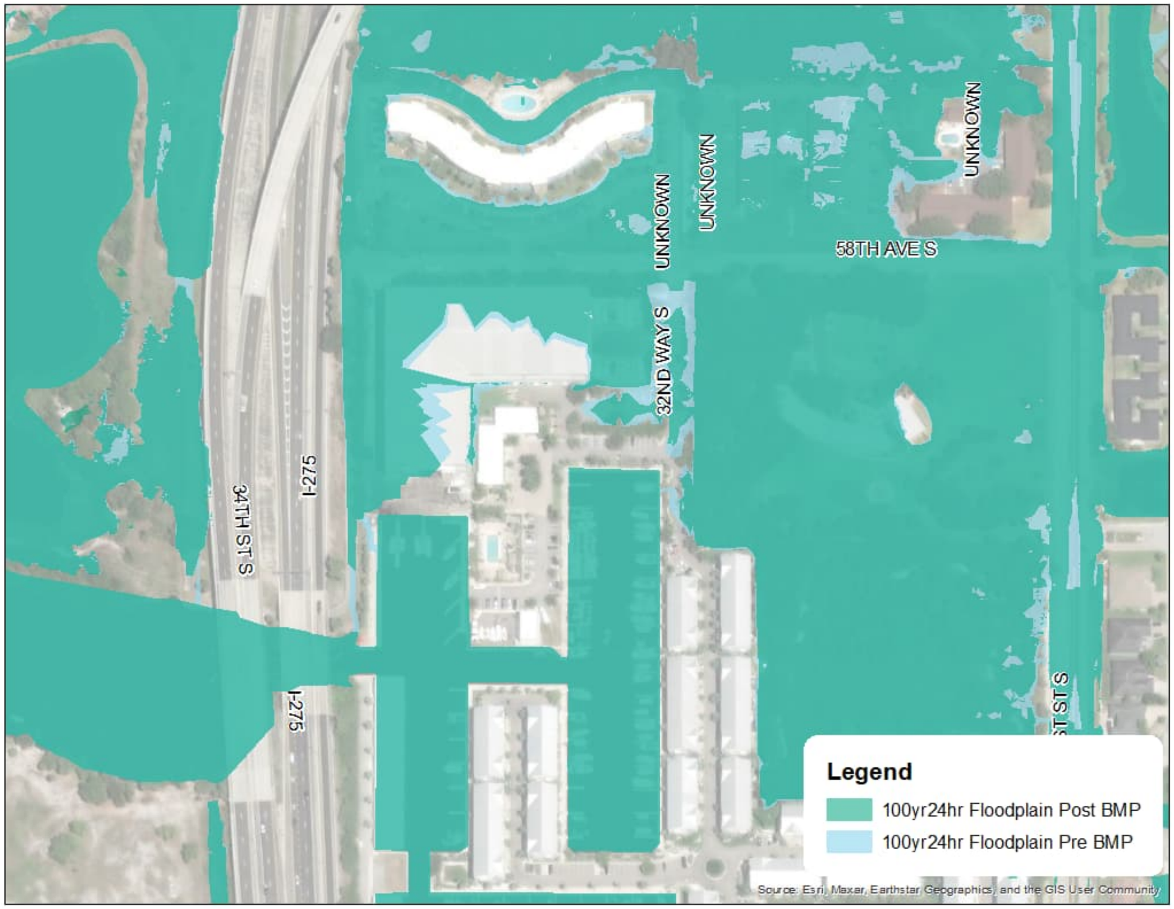
- Remove and replace 20 LF of 18" RCP pipe for two sets of 20 LF of 48" RCP installed in parallel.
- Remove and replace 1261 LF of 38" Horizontal Ellipse pipe for three sets of 1261 LF of 38" Horizontal Ellipse pipes installed in parallel.
- Remove and replace 48 LF of 18" RCP pipe for two sets of 48 LF of 18" RCP installed in parallel.
- Remove and replace 48 LF of 18" RCP pipe for two sets of 48 LF of 18" RCP installed in parallel
- Install 550 LF of 48" RCP
- Install two sets of 700 LF of 66" RCP parallelly.
- Remove and replace 664 LF of 84" RCP by three set of 664 LF of 84" RCP in parallel.

This alternative removes approximately 2320 feet of roadway from the 10-year floodplain and 0 structures from the 100-year floodplain.

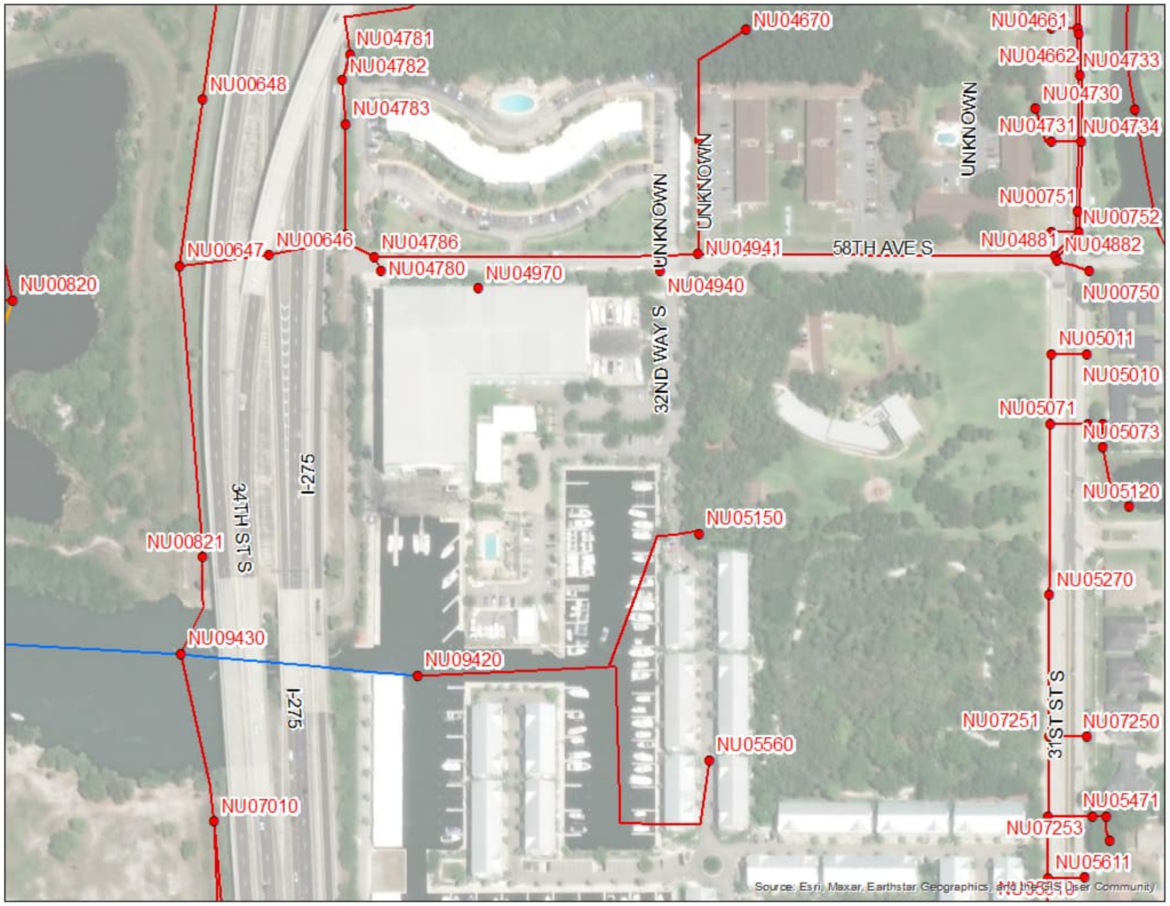
Estimated Cost:

Estimated cost for this project is approximately $19,777,551 including planning, engineering, and permitting fees..

Flooding Improvements at 56TH Avenue S - Project No. G7-5

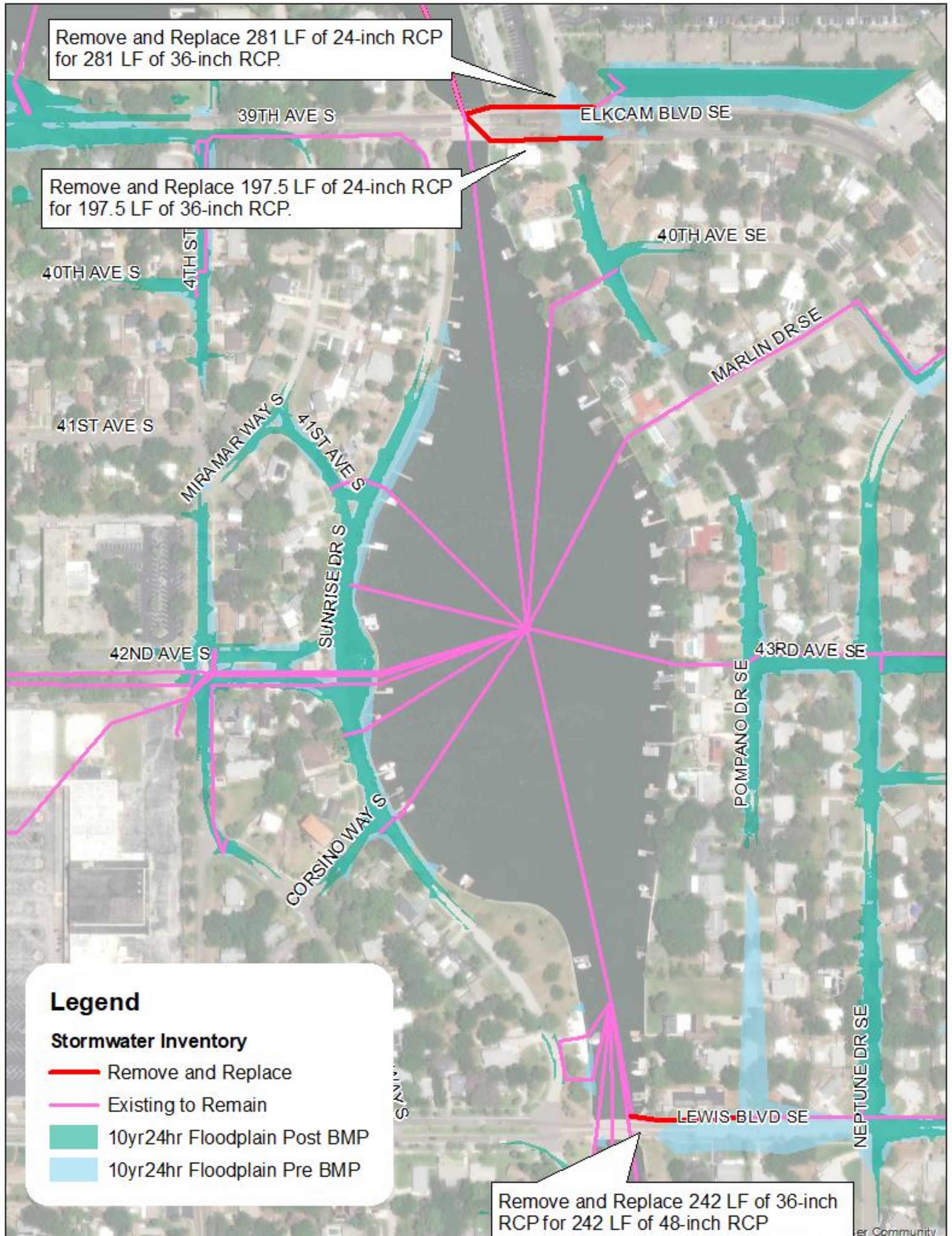


Node Reference Map - Project No. G7-5



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NU04784	58th avenue s	1	4.99’	2.48’	2.51’	5.47’	2.74’	2.73’
NU04670	58th avenue s	1	5.51’	3.06’	2.45’	6.3’	6.25’	0.05’
NU04943	Road along 58th avenue s	1	5.28’	3.02’	2.26’	5.98’	5.17’	0.81’
NU04881	58th avenue s	1	5.6’	3.42’	2.18’	6.05’	4.21’	1.84’

Flooding Improvements at Lewis Blvd SE and Elkcam Blvd SE - Project No. G7-6



Problem

BMP G7-6 focuses on conveyance system along adjacent road next to Little Bayou. BMP G7-6 Proposed solutions mainly focuses on solution along LEWIS BLVD SE and ELKCAM BLVD SE. The 10yr floodplain demonstrates road flooding along these streets.

The existing conveyance system LEWIS BLVD SE and ELKCAM BLVD SE is not sixed adequately for the amount discharge both of this ponds are out falling

Under current conditions, approximately LF of roadway inundated by flood waters by the 10yr/24hr storm event.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Remove and Replace 281 LF of 24-inch RCP for 281 LF of 36-inch RCP.
- Remove and Replace 197.5 LF of 24-inch RCP for 197.5 LF of 36-inch RCP.
- Remove and Replace 242 LF of 36-inch RCP for 242 LF of 48-inch RCP.

This alternative removes approximately 1545 feet of roadway from the 10-year floodplain and 0 structures from the 100-year floodplain.

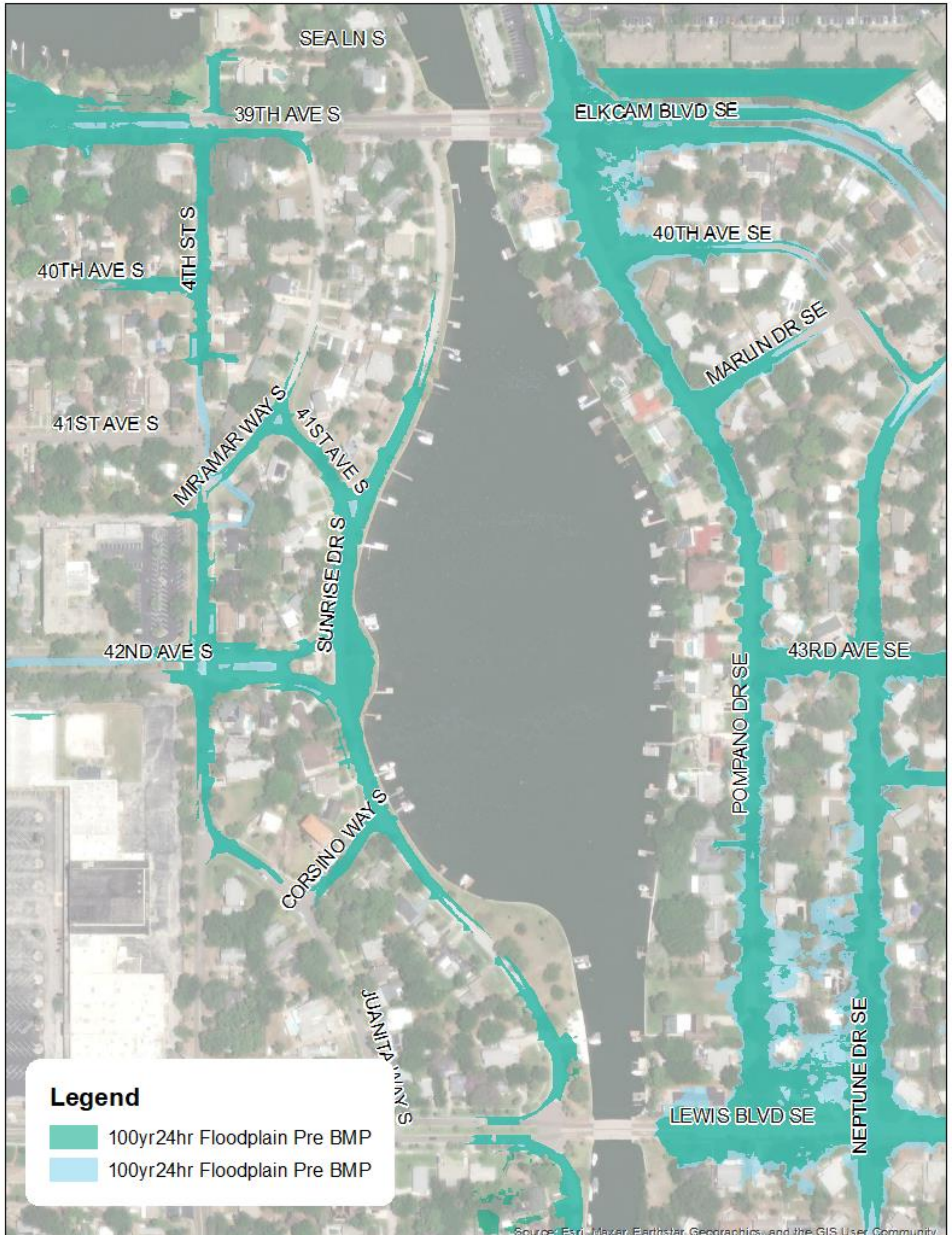
Estimated Cost:

Estimated cost for this project is approximately $2,185,302 including planning, engineering, and permitting fees..

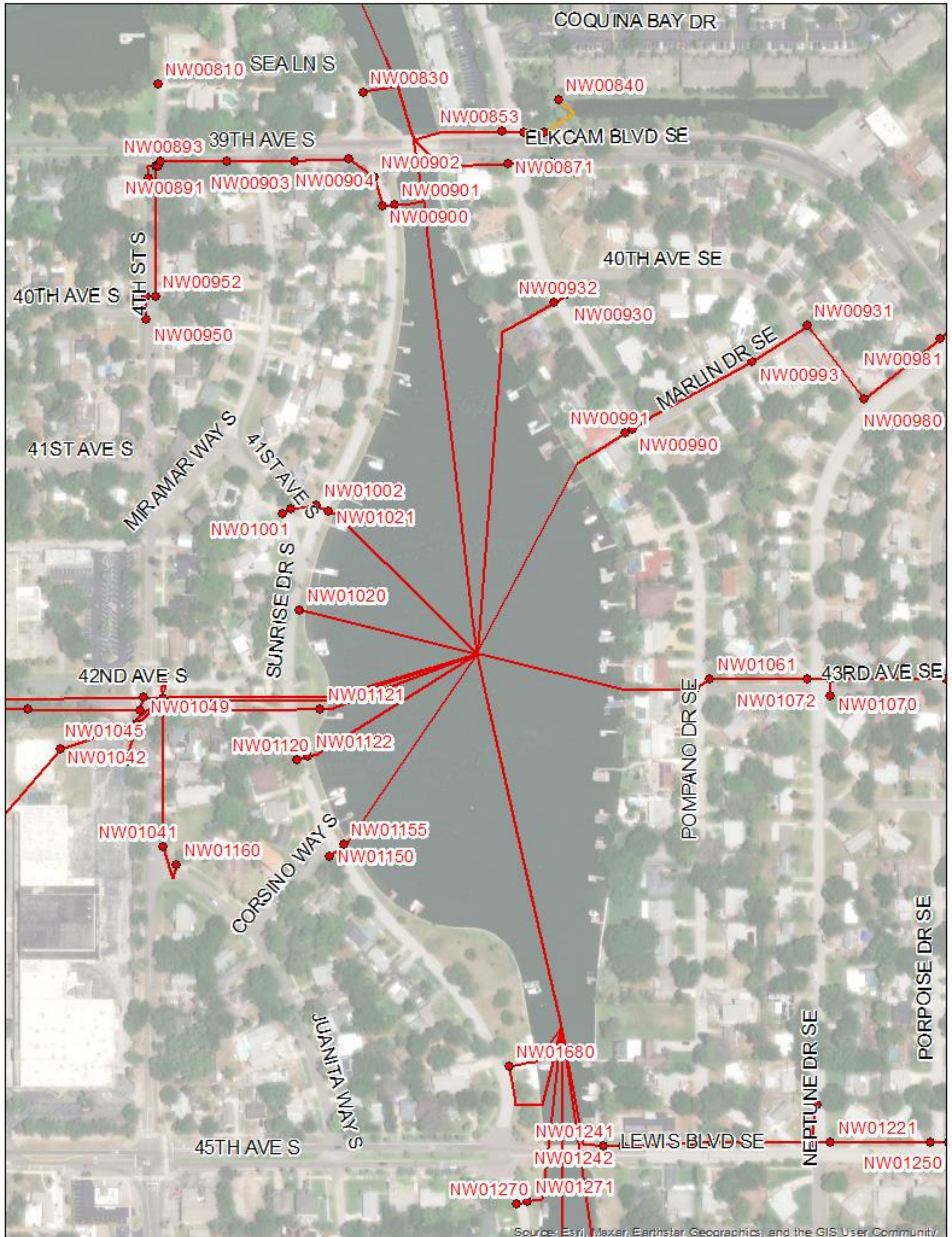
st.petersburg
www.stpete.org

Flooding Improvements at Lewis Blvd SE and Elkcam Blvd SE - Project No. G7-6

ch2m

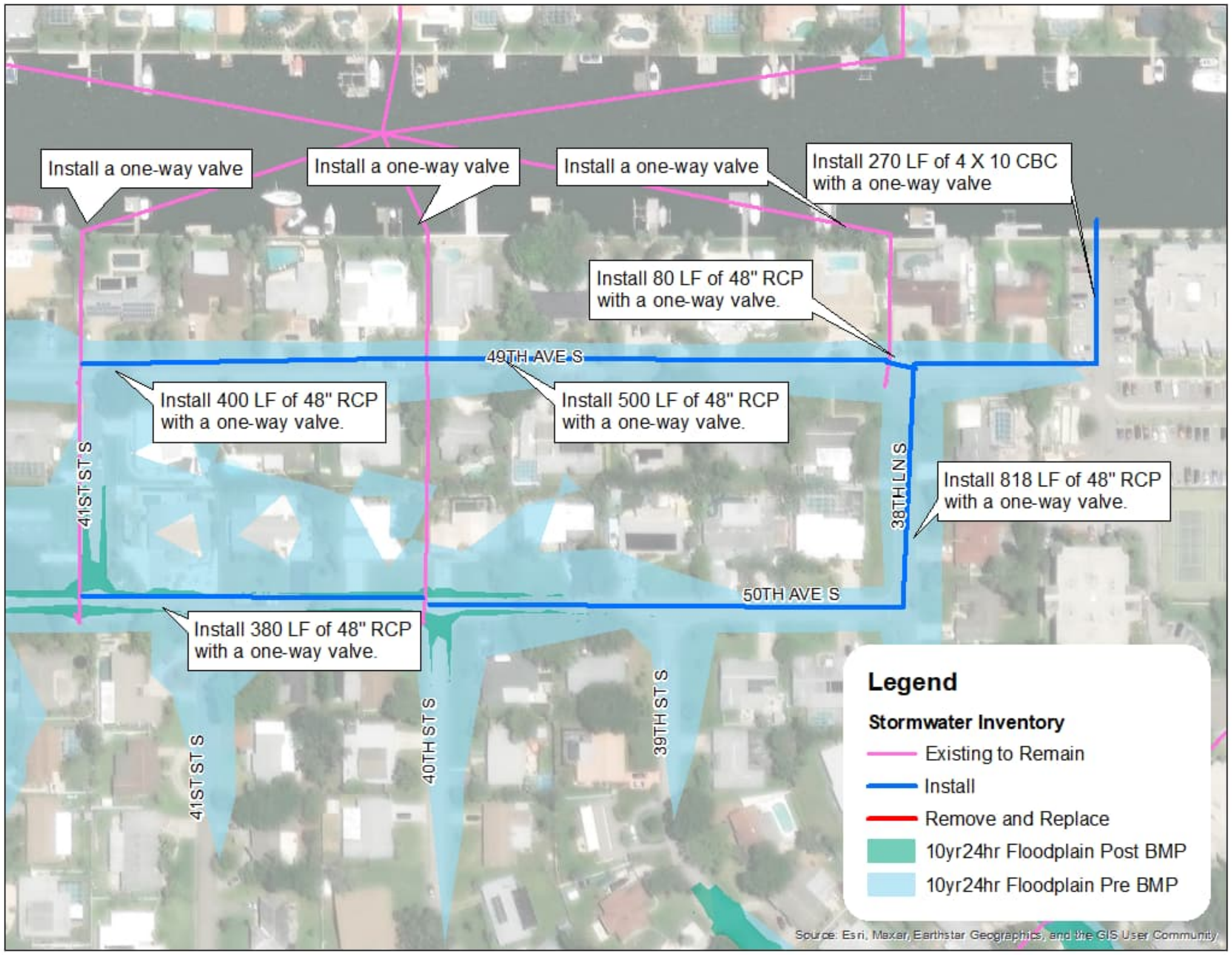


Node Reference Map - Project No. G7-6



Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NW00870	Elkcam blvd SE	1	3.98’	1.38’	2.6’	5.45’	5.1’	0.35’
NW00852	Elkcam blvd SE	1	4.55’	2.09’	2.46’	5.59’	5.14’	0.45’
NW00850	Elkcam blvd SE	1	4.35’	2.06’	2.29’	5.46’	5.11’	0.35’
NW01240	Lewis blvd SE	1	4.58’	2.84’	1.74’	5.23’	4.95’	0.28’
NW01242	Lewis blvd SE	1	3.49’	2.3’	1.19’	5.24’	3.78’	1.46’

Flooding Improvements at 56TH Avenue S - Project No. G7-7



Problem

BMP G7-7 focuses on the conveyance system along 49th Ave S. The existing conditions of the 10 yr 24hr flooding show severe roadway flooding 49th Ave S, 50th Ave S, 41st ST S and 38th Ln S. BMP G7-7 proposes a completely new system while still having the existing in place.

This area consist of high level of water with the inadequate structure to properly discharge it. BMP G7-7 improvements includes a new conveyance system that will help runoff along these areas with a more adequately sized structures.

Solution & Project Benefits:

The proposed improvements would include the following upgrades to the existing system:

- Install 400 LF of 48" RCP with a one-way valve.
- Install 380 LF of 48" RCP with a one-way valve.
- Install 500 LF of 48" RCP with a one-way valve.
- Install 818 LF of 48" RCP with a one-way valve.
- Install 80 LF of 48" RCP with a one-way valve.
- Install 270 LF of 4X10 CBC with a one-way valve.

This alternative removes approximately 4181 feet of roadway from the 10-year floodplain and 8 structures from the 100-year floodplain..

Estimated Cost:

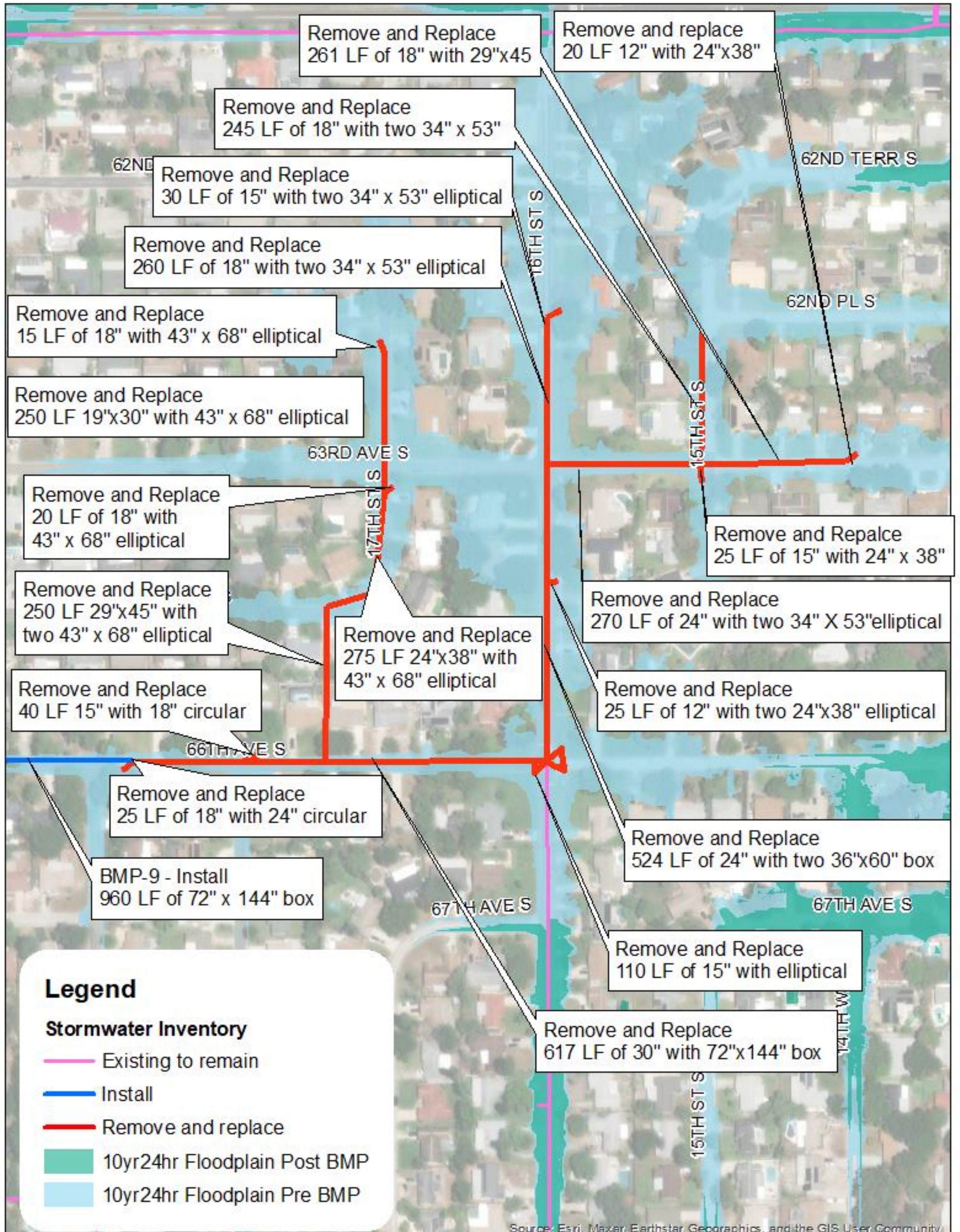
Estimated cost for this project is approximately $5,993,127 including planning, engineering, and permitting fees..

Flooding Improvements at 56TH Avenue S - Project No. G7-7

Node Reference Map - Project No. G7-7

Node Name	Location Description	Initial stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NU00420	49th Avenue North	1.18	5.4’	1.82’	3.58’	5.8’	4.11’	1.69’
NU03290	49th Avenue North	1	5.53’	2.04’	3.49’	5.84’	5.29’	0.55’
NU03300	49th Avenue North	1	5.41’	1.98’	3.43’	5.81’	4.79’	1.02’
NU03301	49th Avenue North	1	5.43’	2.29’	3.14’	5.81’	4.87’	0.94’
NU03291	49th Avenue North	1	4.58’	1.85’	2.73’	4.81’	4.4’	0.41’

Flooding Improvements at 63rd Avenue S and 16th Street S – Project No. G7-8



Problem

BMP 7-8 focuses on the conveyance system from 63rd Avenue S and 16th Street S towards Pinellas Point Drive S. Steet and residential flooding occur in the 63rd Avenue S and 16th Street S area.

Solution & Project Benefits:

BMP 7-8 proposes the following changes to alleviate roadway and residential flooding within the 63rd Avenue S and 16th Street S area.

- Increasing the capacities of existing pipes from 15th Street S to 16th Street S.
- Replacing existing pipes from 16th Street S and 63rd Avenue S to 16th Street S and 66th Avenue S intersection with 3'x5' box culverts. Upsizing of pipes connected to inlets along this corridor will connect to these box culverts.
- Replacing existing pipes with 6'x12' box culverts from the intersection of 16th Street S and 66th Avenue S to intersection of 18th Street S and 66th Avenue S. Upsizing of pipes connected to inlets along this corridor will connect to these box culverts.
- Creating a new 6'x12' box culvert from the intersection of 66th Avenue S and 18th Street S to manhole in front of 2030 66th Avenue S residence. This will connect BMP 7-9. This box culvert will reflect on BMP 7-9 cost estimate.
- Increasing the capacities of existing pipes from 17th Street S and 63rd Terrace S to 66th Avenue S.
- Construction of BMPs 7-8 and 7-9 must coincide to achieve anticipated results.

This is a high-density residential area. Impacts to vehicular and pedestrian traffic should be expected for the improvements listed above. The proposed solutions will provide more conveyance capacity and reduce street and and residential flooding in the impacted area.

This alternative removes approximately 7998 feet of roadway from the 10-year floodplain and 40 structures from the 100-year floodplain. (Note: BMP 7-8 requires implementation of BMP 7-9)

Existing drainage inlets at 15th Street S and 63rd Ave S

Existing drainage inlets at 63rd Terrace S and 17th Street S

Estimated Cost:

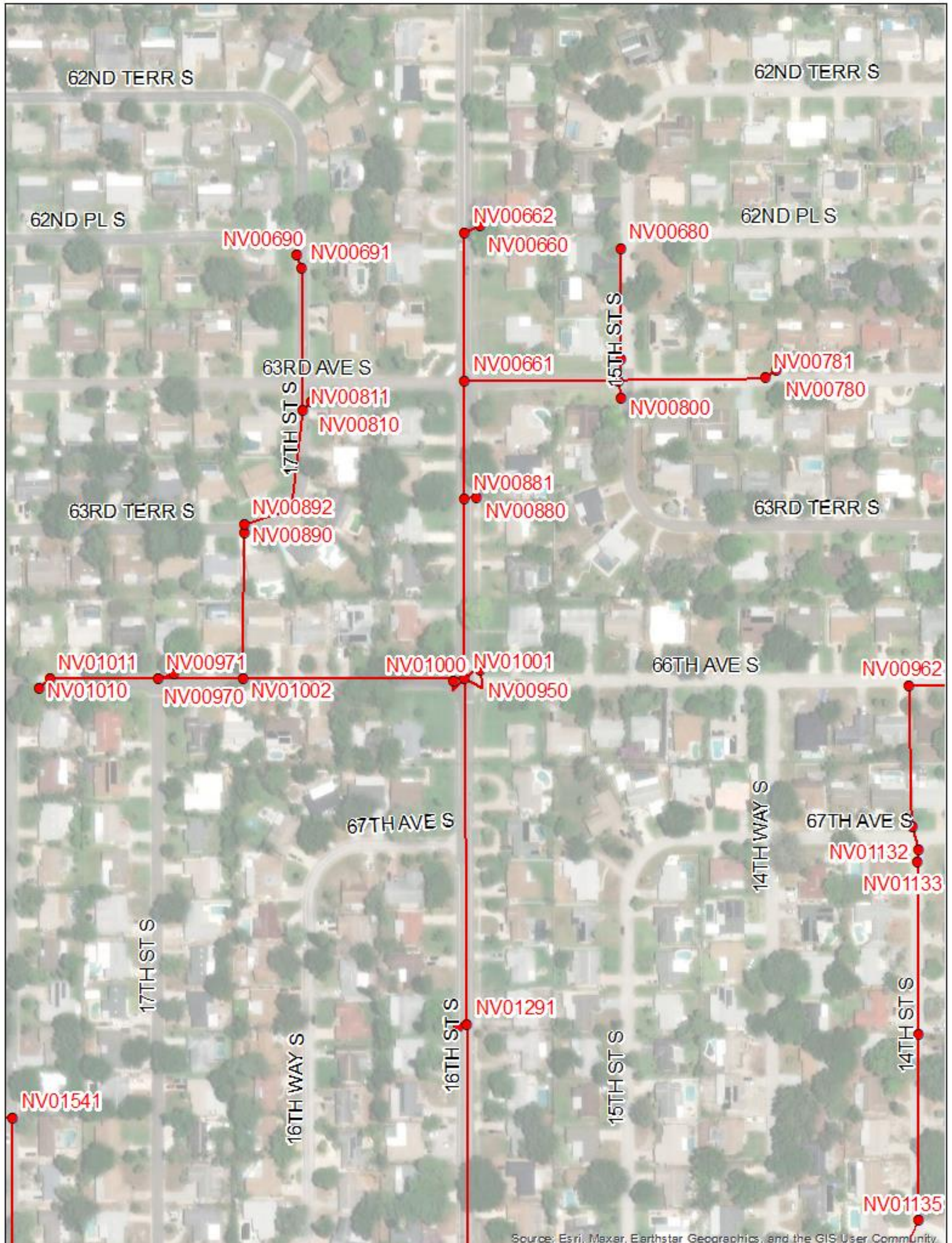
Estimated cost for this project is approximately $10,550,277 including planning, engineering, and permitting fees..

Flooding Improvements at 63rd Avenue S and 16th Street S – Project No. G7-8

Structures:

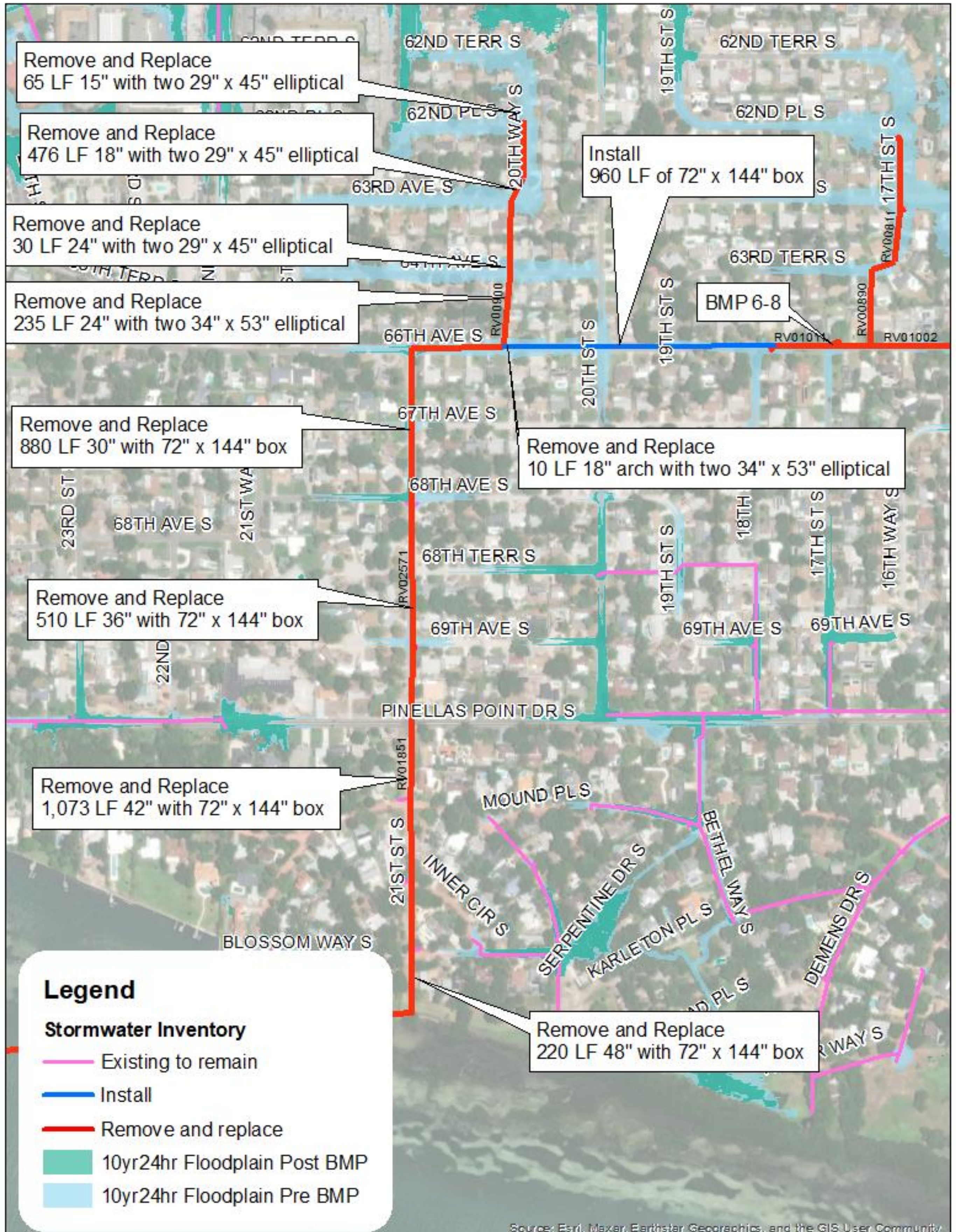
Total number of structures removed from the 100-year 24-hour floodplain = 40 structures . (Note: BMP 7-8 requires implementation of BMP 7-9)

Node Reference Map – Project No. G7-8



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NV01001	66th Ave S/16th Street S	3.68'	11.28'	8.62'	2.66'	11.58'	10.98'	0.6'
NV01011	66th Ave S/18th Street S	3.06'	12.26'	8.26'	4.00'	12.54'	10.75'	1.79'
NV00892	63rd Terrace S/17th Street S	6.73'	11.84'	8.94'	2.90'	12.04'	11.22	0.82'

Flooding Improvements at 63rd Avenue S and 20th Way S – Project No. G7-9



Problem

BMP 7-9 focuses on the conveyance system from 20th Way S and 63rd Avenue S to 21st Street S. Street and residential flooding occur in the 63rd Avenue S and 20th Way S area.

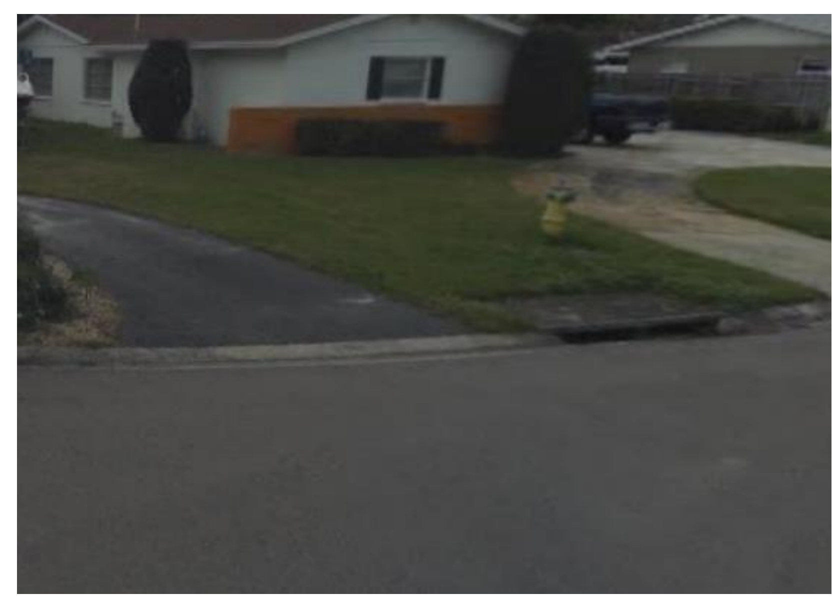
Solution & Project Benefits:

BMP 7-9 proposes the following changes to alleviate roadway and residential flooding within the 20th Way S and 63rd Avenue S to 21st Street S area.

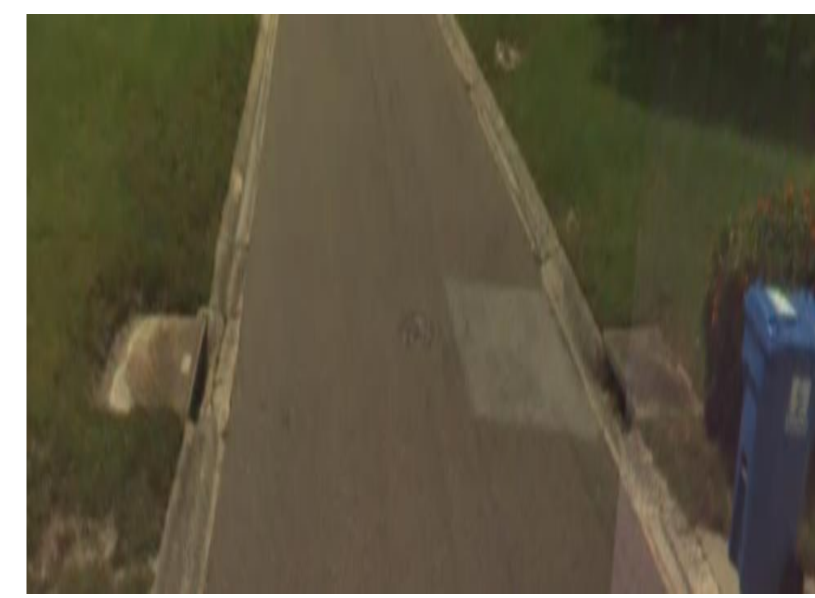
- Increasing the capacities of existing pipes from 20th Way S and 62nd Place S to 66th Avenue S.
- Creating a new 6'x12' box culvert from the intersection of 66th Avenue S and 18th Street S to manhole in front of 2030 66th Avenue S residence. This will connect BMP 7-8 and will help alleviate the existing flood conditions for that impacted area as well. Construction of BMP 7-8 and 7-9 must coincide to achieve anticipated results. This box culvert will reflect on BMP 7-9 cost estimate.
- Replacing the existing pipe with 6'x12' box culvert from manhole at 2030 66th Avenue S to intersection of 66th Avenue S and 21st Street S.
- Replacing the existing pipes with 6'x12' box culverts along 21st Street S from intersection of 66th Avenue S and 21st Street S to waterbody.

This is a high-density residential area. Impacts to vehicular and pedestrian traffic should be expected for the improvements listed above. The proposed solutions will provide more conveyance capacity and reduce street and and residential flooding in the impacted area.

This alternative removes approximately 4070 feet of roadway from the 10-year floodplain and 6 structures from the 100-year floodplain



Existing drainage inlet at 20th Way S and 63rd Ave S

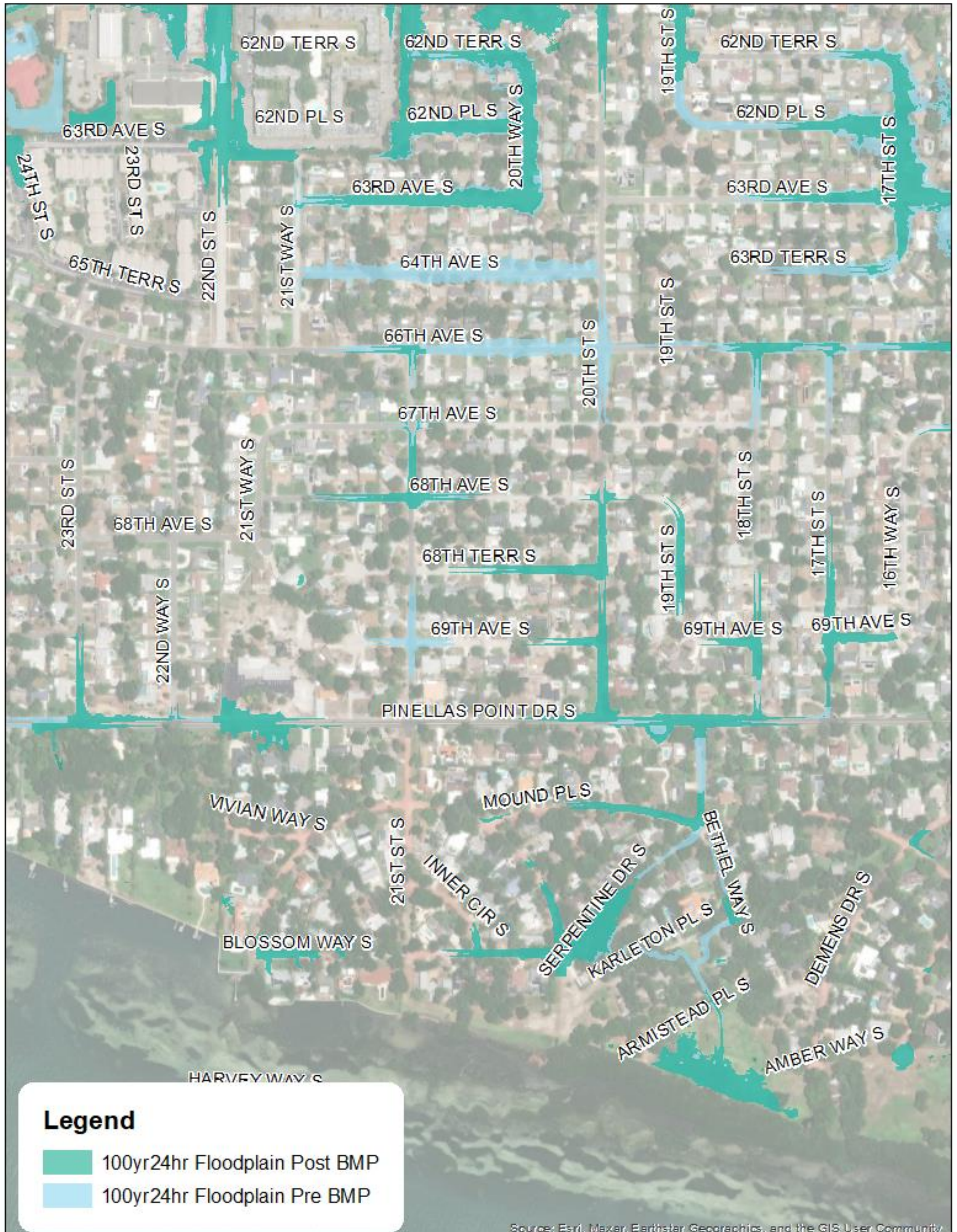


Existing drainage inlets at 63rd Avenue S

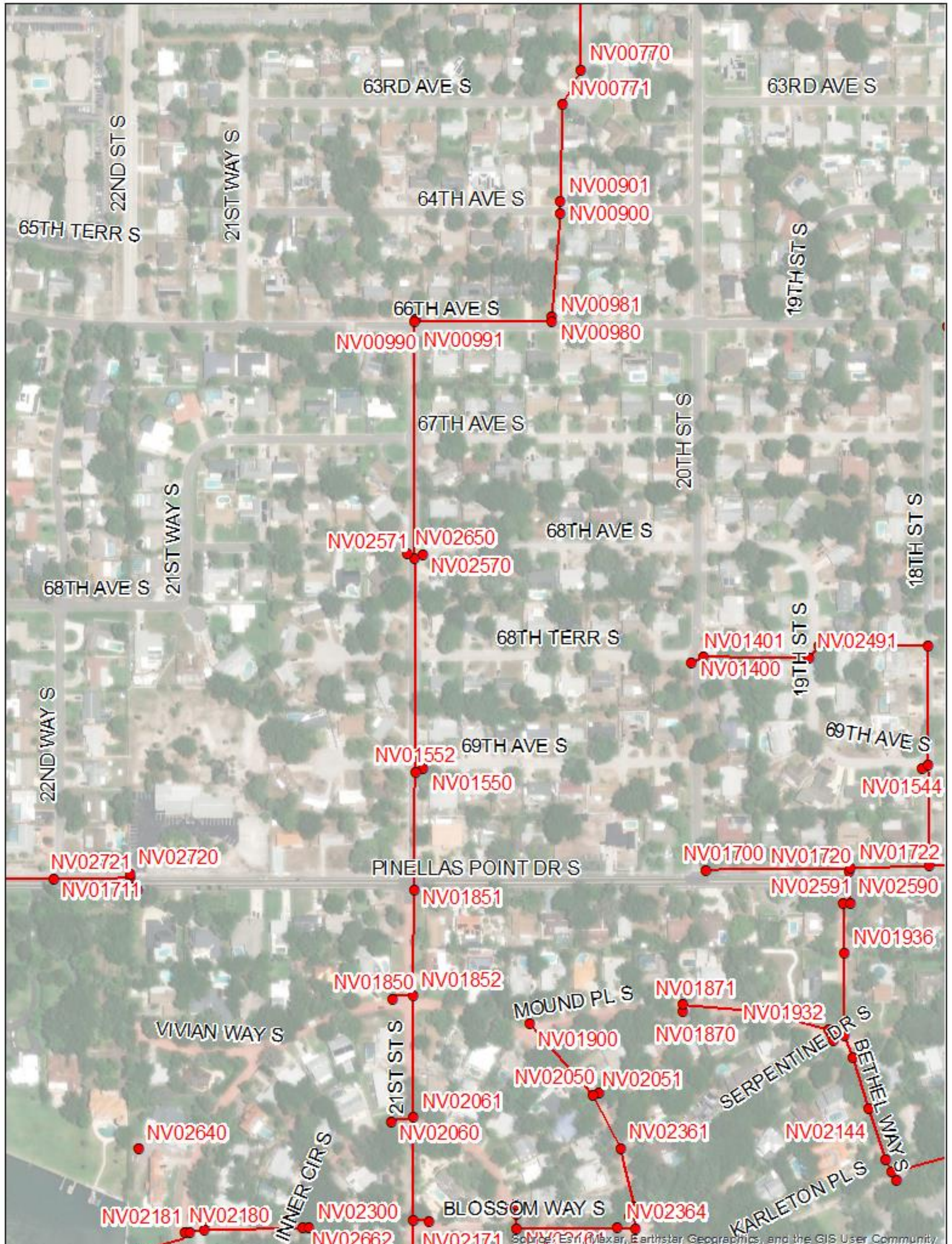
Estimated Cost:

Estimated cost for this project is approximately $19,807,247 including planning, engineering, and permitting fees..

Flooding Improvements at 63rd Avenue S and 20th Way S – Project No. G7-9



Node Reference Map – Project No. G7-9



Node	Location Description	Initial Stage	10-Year			100-Year		
			EX	PR	Δ	EX	PR	Δ
NV00771	63rd Ave S/20th Way S	8.95'	14.99'	11.48'	3.51'	15.25'	13.73'	1.52'
NV00671	20th Way S/62nd Pl S	9.25'	14.77'	12.09'	2.68'	14.95'	14.68'	0.27'
NV00900	64th Ave S	8.4'	15.42'	10.51'	4.91'	15.83'	12.02'	3.81'
NV00981	66th Ave S	2.11'	14.88'	7.95'	6.93'	15.43'	10.36'	5.07'

8. Benefit-Cost Multi-criteria Analysis and Prioritization Matrix

8.1 Multi-criteria Analysis

An MCA allows the investigator to objectively assess the ability of various alternatives to achieve key objectives (such as flood reduction and water quality improvements) and assign a scoring system to compare the overall benefit of projects. The MCA incorporates different criteria or factors and the capacity of each alternative to deliver on those criteria and applies a relative importance (weighting) to those factors. The criteria and their individual weightings for use in the stormwater MCA were developed in conjunction with the City. More specifically, the stormwater criteria include scoring to address the following:

- Street flooding reductions
- Structure flooding reductions
- Water quality improvements
- Preliminary engineer's opinion of construction cost
- Benefit area – regional, intermediate, or local
- The need for precedent projects
- Impaired water or total maximum daily load (TMDL) requirements

As agreed with the City, additional criteria such as repetitive loss areas and socioeconomic benefits can be added later at the City's discretion if additional consideration is required.

Each criterion is given a score of 1 to 5 based on how well a particular BMP alternative delivers on that criterion. A high-performing BMP would be assigned a score of 5, while a non-performing BMP would be assigned a score of 1. Further, each criterion is weighted on a score of 1 to 10 based on the importance that the City placed on that criterion. The more important the criterion is, the higher the weighting it receives. Top priority criteria are assigned a weighting of 10, while lower priorities receive lower weightings. The weighting does not change from BMP to BMP. For example, structural flood reductions have been weighted higher than street flooding reductions, which are both weighted higher than water quality improvements. The score for each BMP alternative is the sum of the criteria scores, multiplied by their individual weightings. An example of the MCA setup is shown in Table 8-1. The actual MCA ranks for each BMP are presented in the subsequent sections of this report.

Table 8-1. Example Multi-criteria Analysis

		Alternative and Score (1 - 5)			
Criteria	Weight (1 - 10)	BMP 1	BMP 2	BMP 3	Maximum Possible
Reduces Street Flooding	7	4	5	2	5
Reduces Structure Flooding	10	5	1	5	5
Repetitive Loss Area	8	3	4	5	5

		Alternative and Score (1 - 5)			
Criteria	**Weight (1 - 10)**	**BMP 1**	**BMP 2**	**BMP 3**	**Maximum Possible**
Requires Precedent Project	4	5	1	5	5
Has Previous CIP	6	1	5	1	5
Regional (high score) versus Local Benefits (low score)	4	5	3	1	5
Improves Water Quality	3	3	4	5	5
Impaired Water or TMDL	3	5	5	5	5
Cost	10	2	4	3	5
TOTAL		**192**	**190**	**194**	**275**

For purposes of this stormwater BMP analysis, the benchmarks listed in Table 8-2 were established to help define the score ranges for each criterion.

Table 8-2. Ranking Criteria Range Definitions

	Score				
Scoring Criteria	**1**	**2**	**3**	**4**	**5**
Reduces Street Flooding (feet of street removed from 10-year floodplain)	<250	250 to 500	500 to 1000	1,000 to 2,000	>2,000
Reduces Structure Flooding (number of structures removed from 100-year floodplain)	0	<10	<25	<75	>75
Repetitive Loss Area (% of repetitive loss area of the overall BMP area)	0	0 and ≤25	>25 and ≤50	>50 and ≤75	>75
Requires Precedent Project (number of projects)	>4	4	3	2	1
Has previous CIP	0				>0
Regional (high score) versus Local Benefits (low score)	Local		Intermediate		Regional
Improves Water Quality (Yes/No)	No				Yes
Impaired Water or TMDL (Yes/No)	No				Yes
Cost (based on $)	>$10M	$5M to $10M	$2M to $5M	$1M to $2M	<$1M

8.2 Prioritization Matrix and Ranking

The BMPs for each of the seven model groups were scored and ranked based on the MCA as discussed above. The results of the analysis show that the highest ranking BMPs (those with the highest scores) are typically ones that provide flood relief to the greatest number of structures and at a lower cost. However, due to the dense, urban nature of the City and the apparent need for high-capacity conveyances (for example, large diameter stormwater pipes and high-capacity pump stations), solutions to achieve the desired LOS can become expensive. Even so, there are a number of implementable alternatives that can provide some level of flood relief at lower costs.

Table 8-3 through Table 8-9 summarize the rankings of the BMPs for each of the seven groups.

Table 8-3. MCA Scoring for Group 1 BMPs

St Petersburg BMP Ranking Matrix	Weight (1 - 10)	Alternative and Score (1 - 5)							
Criteria	Weight (1 - 10)	G1-1	G1-2	G1-3	G1-4	G1-5	G1-6	G1-7	G1-8
Reduces Street Flooding	7	4	1	2	4	3	3	3	3
Reduces Structure Flooding	10	1	2	1	1	1	1	1	1
Repetitive Loss Area	8	1	1	1	1	1	1	1	1
Requires Precedent Project	4	5	5	5	5	5	5	5	5
Has Previous CIP	6	1	1	1	1	1	1	1	1
Regional (high score) vs Local Benefits (low score)	4	5	3	3	3	3	1	1	3
Improves Water Quality	3	1	1	1	1	1	1	1	1
Impaired Water or TMDL	3	1	1	1	1	1	1	1	1
Cost	10	3	2	5	3	2	2	3	1
TOTAL		**128**	**99**	**126**	**120**	**103**	**95**	**105**	**93**

Table 8-4. MCA Scoring for Group 2 BMPs

St Petersburg BMP Ranking Matrix		Alternative and Score (1 - 5)					
Criteria	Weight (1 - 10)	G2-1	G2-5	G2-6	G2-2	G2-3	G2-4
Reduces Street Flooding	7	3	3	3	2	3	1
Reduces Structure Flooding	10	3	2	3	2	1	1
Repetitive Loss Area	8	1	1	1	1	1	1
Requires Precedent Project	4	5	5	5	5	5	5
Has Previous CIP	6	1	1	1	1	1	1

St Petersburg BMP Ranking Matrix		Alternative and Score (1 - 5)					
Criteria	**Weight (1 - 10)**	**G2-1**	**G2-5**	**G2-6**	**G2-2**	**G2-3**	**G2-4**
Regional (high score) vs Local Benefits (low score)	4	5	3	5	3	3	1
Improves Water Quality	3	1	1	1	1	1	1
Impaired Water or TMDL	3	1	1	1	1	1	1
Cost	10	3	5	3	4	2	4
TOTAL		**141**	**143**	**141**	**126**	**103**	**101**

Table 8-5. MCA Scoring for Group 3 BMPs

St Petersburg BMP Ranking Matrix		Alternative and Score (1 - 5)															
Criteria	Weight (1 - 10)	G3-1	G3-2	G3-3	G3-5	G3-10	G3-6	G3-15	G3-7	G3-8	G3-9	G3-16	G3-17	G3-11	G3-12	G3-13	G3-14
Reduces Street Flooding	7	2	1	1	5	5	1	2	1	1	4	3	3	4	1	3	4
Reduces Structure Flooding	10	1	1	1	2	2	3	3	2	1	1	2	2	2	2	2	4
Repetitive Loss Area	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Requires Precedent Project	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Has Previous CIP	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Regional (high score) vs Local Benefits (low score)	4	1	1	1	5	5	5	5	1	3	3	3	5	5	3	3	5
Improves Water Quality	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Impaired Water or TMDL	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cost	10	1	1	5	1	1	5	1	2	3	3	5	1	5	4	3	1
TOTAL		**78**	**71**	**111**	**125**	**125**	**147**	**114**	**91**	**99**	**120**	**143**	**111**	**158**	**119**	**123**	**138**

Table 8-6. MCA Scoring for Group 4 BMPs

St Petersburg BMP Ranking Matrix		Alternative and Score (1 - 5)				
Criteria	Weight (1 - 10)	G4-1	G4-2	G4-3	G4-4	G4-5
Reduces Street Flooding	7	5	4	5	5	
Reduces Structure Flooding	10	5	4	3	2	
Repetitive Loss Area	8	Error	1	1	1	
Requires Precedent Project	4	1	5	5	5	
Has Previous CIP	6	5	1	1	1	
Regional (high score) vs Local Benefits (low score)	4	Error	1	5	5	
Improves Water Quality	3	1	1	1	1	
Impaired Water or TMDL	3	1	1	1	1	
Cost	10	1	1	1	2	
TOTAL		**135**	**122**	**135**	**135**	

Table 8-7. MCA Scoring for Group 5 BMPs

St Petersburg BMP Ranking Matrix		Alternative and Score (1 - 5)	
Criteria	Weight (1 - 10)	G5-2	G5-3
Reduces Street Flooding	7	3	5
Reduces Structure Flooding	10	2	3
Repetitive Loss Area	8	1	1
Requires Precedent Project	4	5	5
Has Previous CIP	6	1	1
Regional (high score) vs Local Benefits (low score)	4	1	5
Improves Water Quality	3	1	1
Impaired Water or TMDL	3	1	1
Cost	10	2	1
TOTAL		**105**	**135**

Table 8-8. MCA Scoring for Group 6 BMPs

St Petersburg BMP Ranking Matrix	Alternative and Score (1 - 5)																									
Criteria	**Weight (1 - 10)**	**BMP G6-3**	**BMP G6-27**	**BMP G6-13**	**BMP G6-26**	**BMP G6-9 & G6-24A**	**BMP G6-9 & G6-24B**	**BMP G6-14**	**BMP G6-8**	**BMP G6-2**	**BMP G6-5**	**BMP G6-11**	**BMP G6-22**	**BMP G6-15**	**BMP G6-16**	**BMP G6-12 G6-19**	**BMP G6-1**	**BMP G6-7**	**BMP G6-10**	**BMP G6-28**	**BMP G6-18 G6-21**	**BMP G6-4**	**BMP G6-23**	**BMP G6-17**	**BMP G6-25**	**BMP G6-20**
Reduces Street Flooding	7	5	5	4	5	4	4	5	4	5	4	5	5	4	5	5	5	5	4	5	4	5	4	3	5	3
Reduces Structure Flooding	10	4	1	2	3	4	3	3	2	2	2	4	4	2	3	2	2	4	3	4	3	1	4	1	4	3
Repetitive Loss Area	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Requires Precedent Project	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5	5	5	5	5	5	5	5
Has Previous CIP	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Regional (high score) vs Local Benefits (low score)	4	3	1	1	3	1	1	3	1	3	1	5	5	1	3	1	1	3	1	5	1	1	1	1	5	3
Improves Water Quality	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Impaired Water or TMDL	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cost	10	1	1	1	2	1	1	1	4	1	4	3	2	5	1	2	2	2	3	2	1	2	1	1	1	1
	TOTAL	**137**	**99**	**102**	**137**	**122**	**112**	**127**	**132**	**117**	**132**	**165**	**155**	**142**	**127**	**115**	**119**	**143**	**132**	**155**	**112**	**109**	**122**	**85**	**145**	**113**

Table 8-9. MCA Scoring for Group 7 BMPs

St Petersburg BMP Ranking Matrix		Alternative and Score (1 - 5)							
Criteria	**Weight (1 - 10)**	**BMP G7-2**	**BMP G7-3**	**BMP G7-4**	**BMP G7-5**	**BMP G7-6**	**BMP G7-7**	**BMP G7-8**	**BMP G7-9**
Reduces Street Flooding	7	5	5	5	5	4	5	5	5
Reduces Structure Flooding	10	4	1	2	1	1	2	4	2
Repetitive Loss Area	8	1	1	1	1	1	1	1	1
Requires Precedent Project	4	5	5	5	5	5	5	5	5
Has Previous CIP	6	1	1	1	1	1	1	1	1
Regional (high score) vs Local Benefits (low score)	4	5	1	1	1	1	1	3	5
Improves Water Quality	3	1	1	1	1	1	1	1	1
Impaired Water or TMDL	3	1	1	1	1	1	1	1	1
Cost	10	1	5	2	1	3	2	1	1
TOTAL		**145**	**139**	**119**	**99**	**112**	**119**	**137**	**125**

The MCA scores along with the costs and benefits of the BMPs are shown in Table 8-10.

Table 8-10. Best Management Practices Summary Table Showing Costs, Benefits, and MCA Score

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G6-11	Denver Street Northeast	6	X	6,853	54	165	$3,708,088
G3-11	Childs Park Pond Sump Removal	3	E	1,010	4	158	$210,000
G6-22	Arizona Avenue Northeast	6	X	6,075	45	155	$6,038,206
G6-28	88th Avenue North	6	O	3,064	46	155	$9,615,000
G6-6	62nd Avenue North	6	M	13,350	182	155	$49,733,406

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G3-6	Emerald Lake Outfall into Booker Pond	3	B	71	19	147	$600,000
G6-25	82nd Terrace North	6	O	4855	57	145	$158,003,165
G7-2	58th Avenue S and 11th Street South	7	Q	2,100	54	145	$53,039,059
G2-5	Crescent Lake Drawdown	2	J	765	4	143	$60,000
G3-16	34th Street Improvements	3	D	819	2	143	$643,000
G6-7	92nd Avenue	6	P	2,750	44	143	$6,600,000
G6-15	Brightwaters Boulevard Northeast Area	6	X	1,600	1	142	$698,081
G2-1	Crescent Lake 22nd Avenue Bypass	2	J	855	25	141	$4,020,000
G2-6	Crescent Lake 22nd Avenue Bypass with Smart Box	2	J	855	25	141	$4,100,000
G7-3	54th Avenue S and Osprey Drive South	7	U	2,700	0	139	$966,397
G3-14	17th Avenue South	3	C	1,500	56	138	$41,939,000

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G6-26	Walnut Street Northeast and 43rd Avenue Northeast Area	6	L	2,917	18	137	$6,974,054
G6-3	88th Avenue North	6	O	6,256	52	137	$24,364,776
G7-8	63rd Avenue South and 16th Street South	7	V	7,998	40	137	$10,550,277
G4-3	5th Avenue North Road	4	F	12,922	17	135	$49,500,000
G4-4	22nd Avenue and 43rd Street	4	F	9,815	30	135	$35,484,473
G5-3	36th Street North Flooding	5	I	2,491	18	135	$24,747,054
G6-10	Poplar Street	6	T	1,500	12	132	$3,605,000
G6-5	Oklahoma Avenue Northeast	6	X	1,324	6	132	$1,736,549
G6-8	116th Avenue North	6	T	1,319	6	132	$1,722,594
G1-1	Golf Creek 9th Avenue Bridge	1	G	1,960	0	128	$4,800,000
G4-1	Dartmouth Avenue North and 58th Street North	4	F	4267	14	127	$61,678,508
G6-14 Solution A	1st Street North	6	M	2,380	14	127	$55,376,188
G6-16	Appian Way Northeast Area	6	X	5,230	24	127	$17,719,439

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G1-3	Tyrone Boulevard Connection	1	R	400	0	126	$775,000
G2-2	Round Lake	2	A	397	2	126	$1,032,000
G3-10	Lake Maggiore West Outfall	3	C	3,281	7	125	$31,400,000
G3-5	Lake Maggiore East Outfall	3	C	3,281	7	125	$10,865,556
G7-9	63rd Avenue South and 20th Way South	7	V	4,070	6	125	$19,807,247
G3-13	26th Avenue South	3	Z	672	2	123	$3,054,000
G4-2	60th Street South	4	F	1,535	16	122	$24,308,455
G6-23	82nd Avenue	6	k	1,330	37	122	$11,773,523
G6-9 & G6-24	Dr Martin Luther King Jr Street North	6	N	1,250	45	122	$26,886,094
G1-4	Villagrande Avenue	1	S	1,101	0	120	$3,555,554
G3-9	49th Street Connection Pipes	3	Z	1,639	0	120	$2,172,000
G3-12	15th Avenue & 44th Street	3	E	130	2	119	$1,277,000
G6-1	1st Lane	6	T	3,600	1	119	$5,675,000
G7-4	54th Avenue S and Caesar Way South	7	U	4,594	4	119	$8,123,495
G7-7	49th and 50th Avenue South	7	U	4,181	8	119	$5,993,127

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G6-2	74th Avenue North	6	N	6,256	9	117	$10,916,464
G6-12 & G6-19	59th Avenue North & 62nd Avenue North	6	O	2,301	5	115	$8,008,330
G3-15	Emerald Lake Add Pump	3	B	321	21	114	$19,500,000
G6-20	Foch Street Northeast	6	M	787	19	113	$30,781,823
G6-18 & G6-21	3rd Street	6	L	1,930	17	112	$77,630,424
G6-9 & G6-24	Dr Martin Luther King Jr Street North	6	N	1,085	23	112	$158,366,591
G7-6	Lewis Boulevard Southeast and Elkcam Boulevard Southeast	7	W	1,545	0	112	$2,185,302
G3-17	34th Street Bypass	3	D	783	6	111	$12,390,000
G3-3	Booker Creek Water Quality Detention	3	B	0	0	111	$500,000
G6-4	70th Avenue North	6	O	3,251	0	109	$15,306,274
G1-7	Grevilla Avenue South	1	S	709	0	105	$2,387,000
G5-2	53rd Street North Flooding of Road	5	H	693	2	105	$8,237,411

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G1-5	22nd Avenue Alternative Outfall	1	R	930	0	103	$5,707,000
G2-3	1st Street Southeast	2	A	542	0	103	$6,245,000
G6-13	4th Street North & 38th Avenue North Area	6	L	1,330	2	102	$30,085,960
G2-4	2nd Avenue N Mirror Lake	2	A	243	0	101	$1,958,000
G1-2	5th Avenue Improvements	1	G	211	8	99	$8,300,000
G3-8	Campbell Park Creek Widening	3	B	250	0	99	$2,200,000
G6-27	42nd Avenue North	6	L	6,098	0	99	$24,439,929
G7-5	56th Avenue South and 31st Street South	7	U	2,320	0	99	$19,777,551
G1-6	26th Avenue North	1	R	855	0	95	$8,203,000
G1-8	Eagle Lake Outfall	1	G	643	0	93	$21,596,000
G3-7	2nd Avenue Bypass Pipe	3	B	0	3	91	$6,200,000
G6-17	54th Avenue	6	M	540	0	85	$16,168,093
G5-5	29th Avenue	5	I	0	2	81	$82,463,988
G3-1	Booker Creek Box Culvert Reroute	3	B	286	0	78	$21,960,000

BMP Number	BMP Name	Group Number	Basin	Roadway Length Improved (feet,10-year event)	Structures Removed (Quantity, 100-year event)	MCA Score	Cost Estimate
G3-2	Booker Creek Rail Easement Bypass	3	B	0	0	71	$20,515,000

9. Implementation Strategy

The purpose of an SWMP is to assist the City in identifying solutions to drainage or other stormwater-related problems and to provide a relative indication of their effectiveness. The LOS analysis and MCA ranking completed these objectives. However, the plan in itself is not a capital plan for the City. A CIP will be developed and implemented by the City using the SWMP to inform the decisions. Some BMPs may move forward as standalone projects, while other BMPs may be combined with other projects (street or parks). Funding from outside sources also helps justify which projects move forward. Funding limitations may require some BMPs to be implemented in phases. It is recommended that the BMP ranking be used to judge projects as higher or lower priority only. Opportunities may arise that make a particular project more feasible or funded sooner than other worthy BMPs.

The potential BMPs developed in this SWMP are considered conceptual, and there will be additional factors that will affect the final design, like land and easements availability, utility conflicts, or other unforeseen circumstances. Cost opinions for the BMPs have been developed based on historical construction cost information from past projects in the City, as well as relevant projects throughout the region. However, because of the conceptual nature of the projects, the final cost will vary and cannot be accurately assessed until well into the design phase. The general implementation process for municipal stormwater projects includes the following steps:

- Compare highly ranked BMPs with funding availability.
- Seek additional funding as needed.
- Place projects on the City's CIP.
- Procure design services (may include alternative delivery options like design-build).
- Go through permitting process (typically included in design).
- Obtain easements or rights-of-way, which may overlap the design phase.
- Procure construction services, including engineering support, inspections, and project closeout.

10. References

Jacobs. 2018. *Incorporating Climate Science into the City of St. Petersburg Stormwater Master Plan*. Prepared for City of St. Petersburg. May.

Jacobs. 2020. *City of St. Petersburg Stormwater Management Master Plan Update, Watershed Evaluation Report*. Prepared for City of St. Petersburg and Southwest Florida Water Management District. October.

Jacobs. 2023a. *City of St. Petersburg Stormwater Management Master Plan Update, Watershed Model Development, Verification and Floodplain Analysis Report*. Prepared for City of St. Petersburg and Southwest Florida Water Management District. April.

Jacobs. 2023b. *City of St. Petersburg Stormwater Management Master Plan Update, Level of Service Analysis Report*. Prepared for City of St. Petersburg and Southwest Florida Water Management District. April.

Southwest Florida Water Management District (District). 2017. *Watershed Management Program Guidelines and Specifications*. Revised 2020.

Streamline Technologies. 2020. Interconnected Pond Routing (ICPR4) Version 4 Guidance.

U.S. Department of Agriculture (USDA). 1986. Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55). June.

Appendix A. Watershed Evaluation Final Report

City of St. Petersburg Stormwater Management Master Plan Update

Watershed Evaluation Report

District Project N904

Final

October 2020

City of St. Petersburg

City Project No. 17037-110

District Project N904

Project No:	697448CH
Document Title:	Watershed Evaluation Report
Document No.:	PPS0805200815TPA
Revision:	Final
Date:	October 2020
Client Name:	City of St. Petersburg
Client Project No:	City Project No. 17037-110
Jacobs Project Manager:	Swamy Pati, Ph.D., P.E., CFM
Author:	Jacobs

Jacobs Engineering Group Inc. (CH2M HILL Engineers, Inc. is now a part of Jacobs)

One Tampa City Center
201 N. Franklin Street
Suite 1400
Tampa, Florida 33602
United States
T +1.813.676.2300
F +1.813.676.2301
www.jacobs.com

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
Draft	Aug 2020	Watershed Evaluation Report	Jacobs	Swamy Pati	Heather Hyde	Swamy Pati
Final	Oct 2020	Watershed Evaluation Report	Jacobs	Swamy Pati	Heather Hyde	Swamy Pati

Contents

Appendixes

Tables

Figures

Acronyms and Abbreviations

BMP	best management practices
City	City of St. Petersburg
DEM	digital elevation model
District	Southwest Florida Water Management District
EMC	event mean concentration
ERP	Environmental Resource Permit
FDOT	Florida Department of Transportation
GDB	geodatabase
GIS	geographic information system
GWIS	Geographic Watershed Information System
H&H	hydrologic and hydraulic
ICPR	Interconnected Pond Routing
ID	identification
Jacobs	Jacobs Engineering Group Inc.
LiDAR	light detection and ranging
NAVD88	North American Vertical Datum of 1988
NGVD29	National Geodetic Vertical Datum of 1929
PDF	portable document format
SWI	stormwater inventory
TP	total phosphorus

Executive Summary

Jacobs Engineering Group Inc. (as CH2M HILL Engineers, Inc.) is under contract with the City of St. Petersburg (City) to perform a Stormwater Management Master Plan Update for the City. The goal of developing the Stormwater Management Master Plan Update is to evaluate the capacity and performance of the watershed with regard to flood protection, water quality, and natural systems enhancement. The Stormwater Management Master Plan will ultimately be updated through various plans and reports. This Watershed Evaluation Report addresses the Stormwater Evaluation element of the Water Management Plan.

The City watershed is approximately 62 square miles, located within the city of St. Petersburg in southern Pinellas County, Florida. The watershed is located in a highly urbanized coastal community and is bound by water on three sides and shares boundaries on the northern side with the Pinellas County portion of Roosevelt Creek Basin, Joe's Creek Basin, and Long Bayou Basin. On the northwestern side, there is a shared boundary with the Pinellas County portion of Sawgrass Lake Basin. On the southwestern side, there is a shared boundary with the City of Gulfport's portion of the Clam Bayou Basin and Bear Creek Basin, and the Pinellas County portion of Bear Creek Basin.

The Southwest Florida Water Management District (District) process for watershed analysis consists of the following five elements that are performed as a Watershed Management Plan is developed:

1) Topographic information
2) Watershed evaluation
3) Watershed management plan
4) Implementation of best management practices (BMPs)
5) Maintenance of watershed parameters and models

The Stormwater Management Master Plan Update covers three of the five elements listed above: topographic information, watershed evaluation, and watershed management plan (floodplain analysis and alternative analysis). This study does not cover implementation of BMPs or maintenance of watershed parameters and models.

This Watershed Evaluation Report presents a summary of the data collected and work completed through the Watershed Evaluation element of the Watershed Management Plan. The Watershed Evaluation element has the following goals:

- Compile, review, and evaluate existing watershed data
- Develop watershed features that define watershed hydrology and hydraulics
- Identify survey requirements
- Perform data acquisition from existing sources, field verification, and survey
- Develop a watershed geographic information system (GIS) database

The watershed data collection and evaluation efforts were focused on obtaining the following information required to develop a watershed scale model and the Master Plan Update:

- Previous City watershed studies
- Stormwater inventory
- Neighborhood watershed studies
- Topographic data – digital elevation model (DEM)
- Environmental Resource Permit (ERP) plan sets
- Groundwater data
- Soils map
- Land use
- Historical water levels

Based on the data collected, initial GIS processing was conducted to develop a model-specific Geographic Watershed Information System (GWIS) geodatabase (GDB) that is compatible with Interconnected Pond Routing (ICPR) Version 4, which is the model chosen for this project. The GDB database structure includes HydroNetwork and Model features. The HydroNetwork includes sub-basins, links, nodes, and associated data tables. Initially, a GWIS GDB was developed for each of the City's 26 basins. However, these basin GDBs were later combined into one GDB after the data acquisition process was completed.

The topographic data through DEM were also analyzed to identify topographic voids. Topographic voids are areas within the populated DEM from captured light detection and ranging (LiDAR) information where there is no data, erroneous data, or elevations that do not correctly reflect the true ground elevation. These voids can result from post-processing of the raw data to create the DEM. The DEM was reviewed using the following: 2017 Florida Department of Transportation aerial imagery; 2018 aerial imagery provided by the City; and the District's GIS tool, Dual Maps, which uses Bird's Eye View aerial imagery and Google StreetView. The DEM was also reviewed against the District's ERP Polygon layer. A total of 330 topographic void points were located within the city limits. The following three types of voids were identified:

- Differences in aerial imagery and the DEM elevations
- Artificially high or low elevations based on DEM processing
- DEM cells without elevation data

The voids that would have had a significant impact on the modeling were corrected using available ERP plan sets, aerial imagery, and other surrounding topographic information around the void.

As the GWIS GDBs were being developed for the basins, the data were analyzed to determine the need for additional field reconnaissance and data acquisition. Field reconnaissance was focused on the team obtaining a better understanding of the sub-basin delineations and confirmation or detection of the structures that were questionable or missing in the available data. City personnel found several dozen as-built plans while searching City records, and most of the remaining undocumented facilities were surveyed by a professional land surveyor approved by the City as a subconsultant. Based on the field reconnaissance and the desktop data gap analysis, data to be obtained from the field survey were identified. Field data were acquired by a professional land surveyor for approximately 2,000 structures across the city.

Based on the information collected during the field reconnaissance and the survey data, the GWIS GDBs were refined to incorporate the collected information. During the data refinement phase, all the individual basin GWIS GDBs were combined into one Master GWIS GDB for the City watershed. Table ES-1 presents model features, the total number of sub-basins, links, and nodes (links represent hydrologic and hydraulic [H&H] connections between basins, and nodes represent junctions connecting links).

Table ES-1. Summary of Total Model Features

Model Features		Total
Basin		26
Sub-basins		11,867
Nodes	Stage/Area	15,906
	Time/ Stage	174
	Manhole	5,567
	TOTAL	21,647
Links	Pipe	20,217
	Weir	383
	Bridge	16
	Rating Curve	6
	Drop Structure	716
	Channel	550
	TOTAL	21,888

The completed GWIS GDB includes model features that can be used to develop the H&H parameters and the H&H model in the ICPR Version 4 model platform. The next steps include model parameterization, model calibration/verification, floodplain analysis, level of service analysis, surface water resource assessment, and a BMP alternatives analysis to develop projects for flood reduction and water quality improvements.

1. Introduction

1.1 Authorization and Purpose

Jacobs Engineering Group Inc. (Jacobs) (as CH2M HILL Engineers, Inc.) is under contract with the City of St. Petersburg (City) to perform the Stormwater Management Master Plan Update for the City. The goal of developing the Master Plan Update is to evaluate the capacity and performance of the watershed with regard to flood protection, water quality, and natural systems enhancement. The Stormwater Management Master Plan will be updated through various plans and reports. This Watershed Evaluation Report addresses the Stormwater Evaluation element of the Water Management Plan.

1.2 Project Location and General Description

The City watershed is approximately 62 square miles in size, located within the city of St. Petersburg in Southern Pinellas County, Florida. The watershed is located in a highly urbanized coastal community that is bound by water on three sides and shares boundaries on the northern side with the Pinellas County portion of Roosevelt Creek Basin, Joe's Creek Basin, and Long Bayou Basin. On the northwestern side, there is a shared boundary with the Pinellas County portion of Sawgrass Lake Basin. On the southwestern side, there is a shared boundary with the City of Gulfport's portion of Clam Bayou Basin and Bear Creek Basin, and the Pinellas County portion of Bear Creek Basin.

1.3 Purpose and Objectives

The District's process for watershed analysis consists of five elements that are performed as a Watershed Management Plan is developed:

1) Topographic information
2) Watershed evaluation
3) Watershed management plan
4) Implementation of best management practices (BMPs)
5) Development of watershed parameters and models

The Stormwater Management Master Plan Update covers three of the five elements listed above: topographic information, watershed evaluation, and watershed management plan (floodplain analysis and alternative analysis). This study does not cover implementation of BMPs or maintenance of watershed parameters and models.

This Watershed Evaluation Report presents a summary of the data collected and work completed through the Watershed Evaluation element of the Watershed Management Plan. The Watershed Evaluation element has the following goals:

- Compile, review, and evaluate existing watershed data
- Develop watershed features that define watershed hydrology and hydraulics (H&H)
- Identify survey requirements
- Perform data acquisition from existing sources, field verification, and survey
- Develop a watershed geographic information system (GIS) database

This report is intended to be used in conjunction with the concurrently submitted electronic data.

1.3.1 Task Breakdown

The Watershed Evaluation Task Breakdown includes the following:

- Task 2.1 – Collection and assembly of existing topographic and watershed features data
- Task 2.2 – Initial GIS processing
- Task 2.3 – Evaluation of GIS and topographic data for issues and voids
- Task 2.4 – Public notification of watershed work

- Task 2.5 – Pre-field reconnaissance evaluation
- Task 2.6 – Field reconnaissance and acquisition of data
- Task 2.7 – Data refinement and development
- Task 2.8 – Geodatabase of model features
- Task 2.9 – Surface water resource assessment analysis and approach
- Task 2.10 – Final watershed evaluation report and peer review

2. Watershed Data Collection and Evaluation

This section summarizes data collected for the development of the Watershed Master Plan. The data were collected from various sources, including the City, Pinellas County, Florida Department of Transportation (FDOT), and Southwest Florida Water Management District (District).

2.1 Data Requested and Received

2.1.1 Previous City Watershed Studies and Updates

The City provided the data from the 1994 City-Wide Master Plan Update along with the studies completed since 1994. Table 2-1 presents the data provided by the City with respect to previous watershed studies.

Table 2-1. Previous Watershed Studies Provided by the City

Task	Files Received
Stormwater Management Master Plan (PBS&J and Dames and Moore 1994)	1994 Version 4.03 SWMM computer files for certain basins. Volume 1: Overview Report. Volumes 2 to 7: Technical Supplement for Basins A and B; C, D and E; F, G and H; I, J, K, L and M; N, O, and P; Q, R, S, T, U, V, W, X, Y, Z.
Updated Basin Reports	Basins B, C, F, G, H, J, L, O, Q, and R have reports in PDF format.
Latest Stormwater Management Computer Files	Basins B, C, G, H, J, L, O, Q, and R have newer SWMM model files.
Latest GIS/PDF Projects	As-builts and record files for various City-wide projects.

Note: PDF = portable document format

2.1.2 System Inventory and Condition Assessments

The City provided the following items from the GIS-based stormwater asset inventory:

- Network junctions
- Network structures
- Inlet
- Manhole
- Fitting
- Discharge point
- Clean out
- Pressure pipes
- Gravity main
- Culvert
- Sub-basin
- Hydrobasin
- City limit
- Basin

The stormwater inventory (SWI) does not contain information regarding the condition assessments.

2.1.3 Neighboring Watershed Studies

The neighboring watersheds for the City include Sawgrass Lake, Long Bayou, the Gulfport and Pinellas County portion of Bear Creek, Joe's Creek, and the Pinellas County portion of Roosevelt Creek. The data for Bear Creek, Joe's Creek, and Roosevelt Creek watersheds were received from Pinellas County. For the other watersheds, data were not available.

2.1.4 Topographic Data for Digital Elevation Model

The aerially collected electronic topographic data were received from Pinellas County in three phases. The first preliminary version of the DEM was received in October 2018, and a second version was received in March 2019. The final version was received in May 2019. The source LiDAR was collected in 2018. The May 2019 version of the DEM is depicted on Figure 2-1.

Topographic data was provided in the High Accuracy Reference Network North American Datum of 1983 (feet) and was used for the horizontal coordinate system .The North American Vertical Datum (NAVD) of 1988 (feet) was used for the vertical coordinate system. Topographic data were projected in North American Datum 1983 High Accuracy Reference Network State Plane Florida West FIPS 0902 (U.S. Feet), in accordance with District requirements. The resolution of the DEM was a 2.5- by 2.5-foot grid cell.

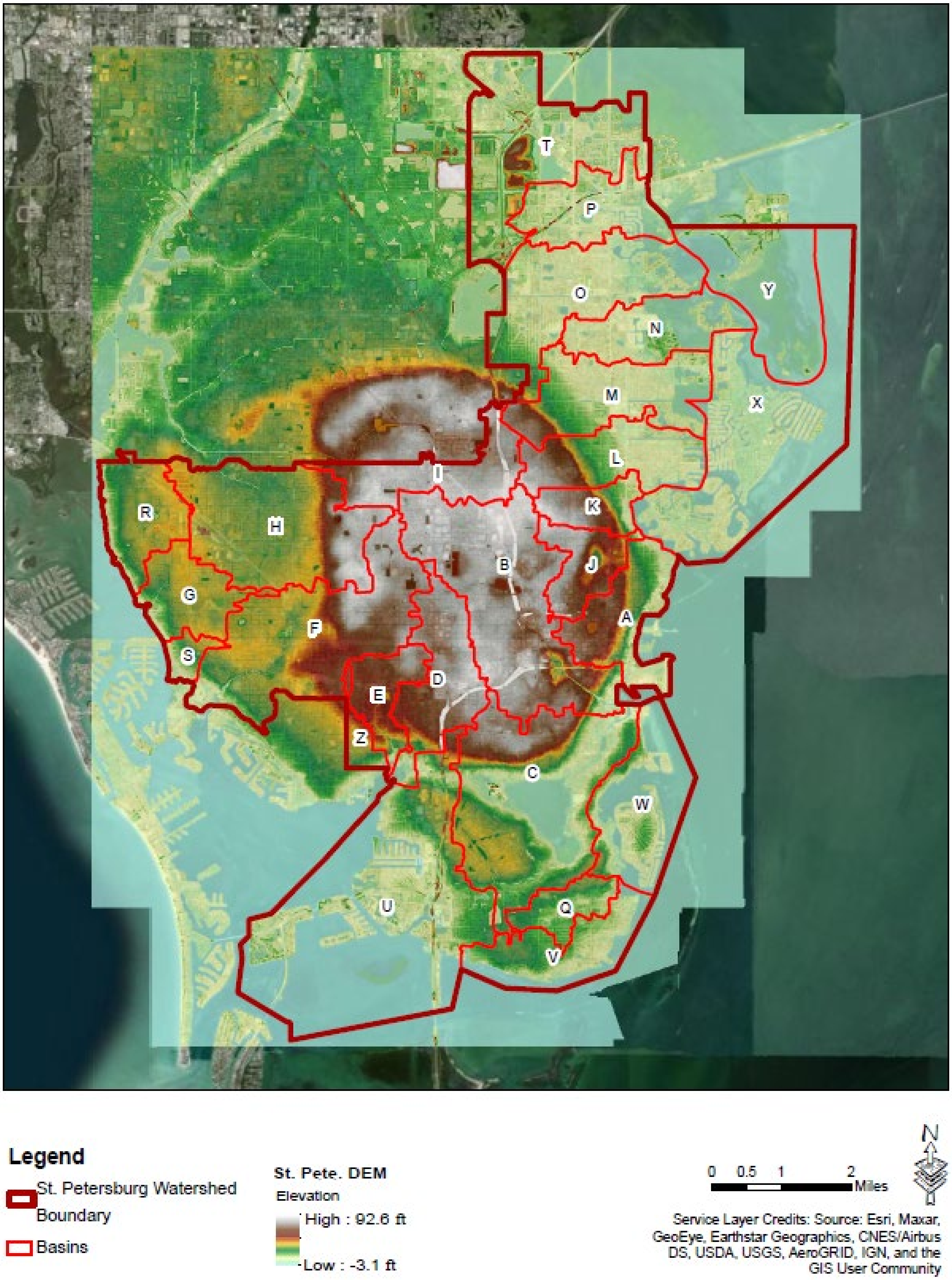


Figure 2-1. City's Basins and DEM Covering the City

2.1.5 Environmental Resource Permit Documents

Environmental resource permits (ERPs) were requested from the District based on the agreed cutoff date of March 30, 2018. ERP data were provided in two batches: the first batch was received May 2018, and the second batch was received November 2018 (approximately 3,700 PDFs). Additional ERP information was accessed electronically from the District's online ERP Vault (records file) for information needed to complete pertinent model features. Jacobs used the ERP polygon shapefile, which includes a data field with listed hyperlinks to the District's ERP Vault.

2.1.6 Groundwater Data

Groundwater data collected during the City's Wet Weather Overflow Mitigation Program-Phase II will be used for modeling updates. Jacobs (as CH2M HILL Engineers, Inc.) was the consultant for this program and therefore possesses the required data. The locations of the groundwater wells used to collect the data are shown on Figure 2-2. The data were collected between August and December 2016 and are presented in a spreadsheet (WWOMP_2016_GroundwaterData_w-LocationMap.xlsx) and will be provided in the deliverable package. Table 2-2 presents the range of groundwater elevations measured at the wells during the collection period. The groundwater data will be helpful during the hydrologic parameterization.

Table 2-2. Data Collected between August and December 2016

Groundwater Well ID	Minimum Water Level Elevation	Maximum Water Level Elevation
GW-01	1.51	5.79
GW-02	2.60	7.77
GW-03	-0.75	14.00
GW-04	34.64	40.37
GW-05	21.93	28.10
GW-06	11.83	17.44
GW-07	1.61	5.66
GW-08	8.19	21.91
GW-09	11.45	17.52
GW-10	44.41	48.46
GW-11	47.21	52.43
GW-12	46.72	51.62
GW-13	20.87	26.45
GW-14	-0.64	3.25
GW-15	1.95	6.26
GW-16	1.47	5.40
GW-17	37.99	45.14
GW-18	20.55	24.93
GW-19	1.79	5.47
GW-20	46.56	52.09
GW-21	1.14	4.54
GW-22	1.69	5.96
GW-23	1.11	3.66

Note: ID = identification

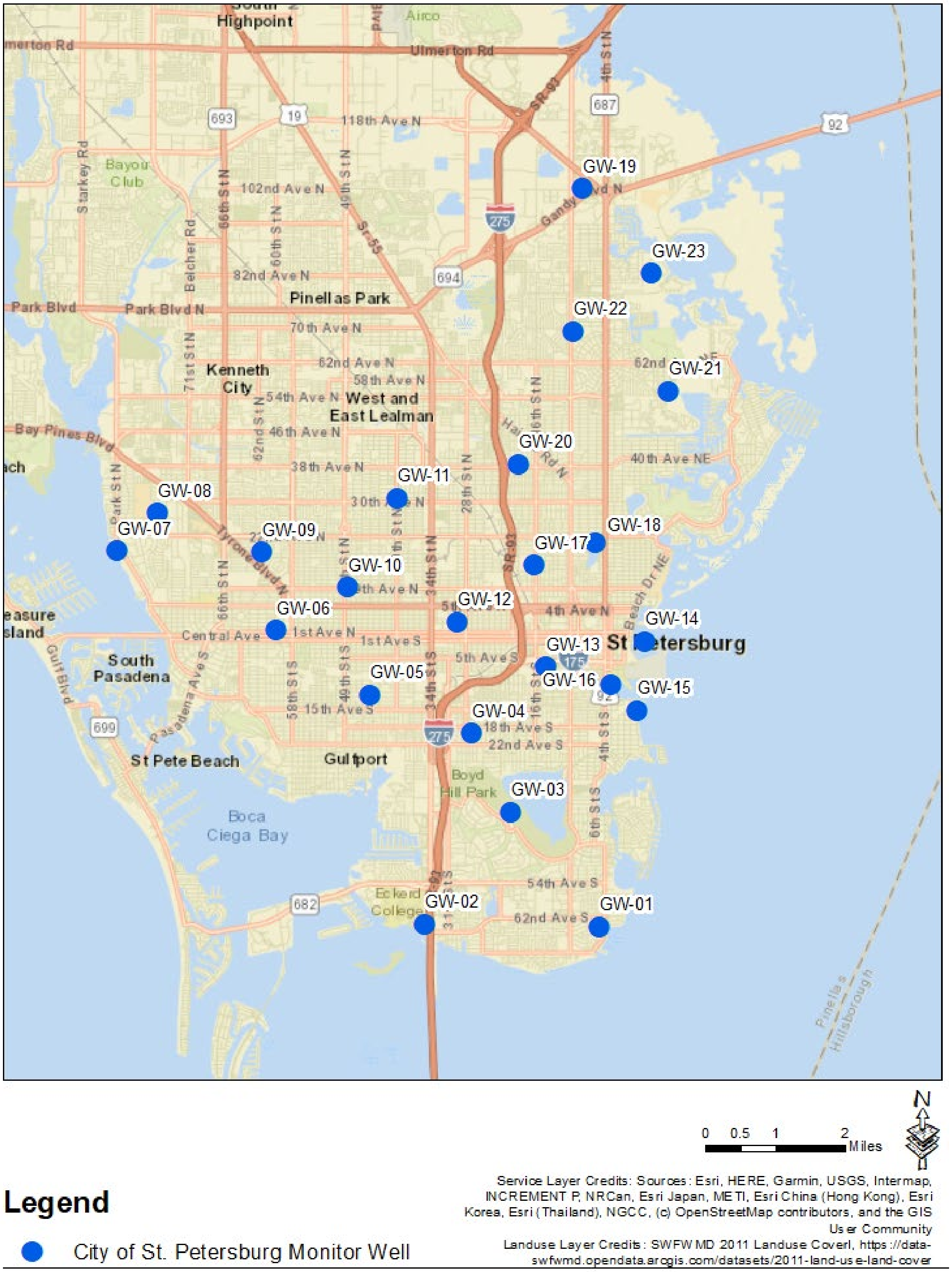


Figure 2-2. Summary of Soils in the Watershed

2.1.7 Soil Data

The latest soil information was downloaded from the National Resources Conservation Service website. The watershed consists of a mix of A, B/D, C, D, urban land, and water, with B/D soil types covering approximately 40 percent of the city. The B/D soils will be presumed to be performing under wet weather conditions and will be modeled as Type D soils for modeling purposes. The distribution of soil types in the watershed is presented on Figure 2-3. The soils map for the watershed is presented on Figure 2-4.

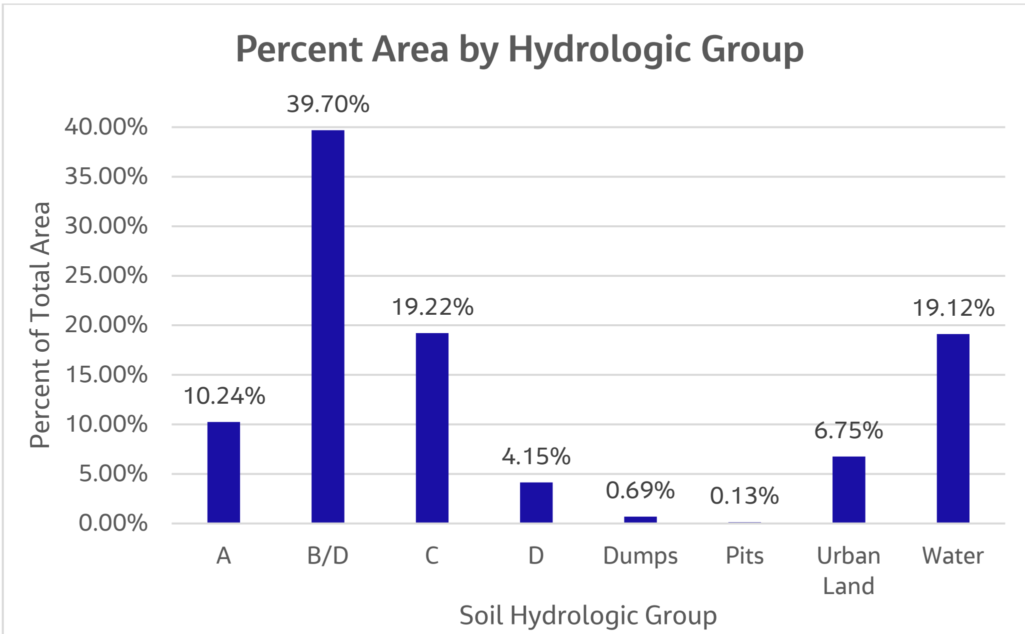


Figure 2-3. Summary of Soils in the Watershed

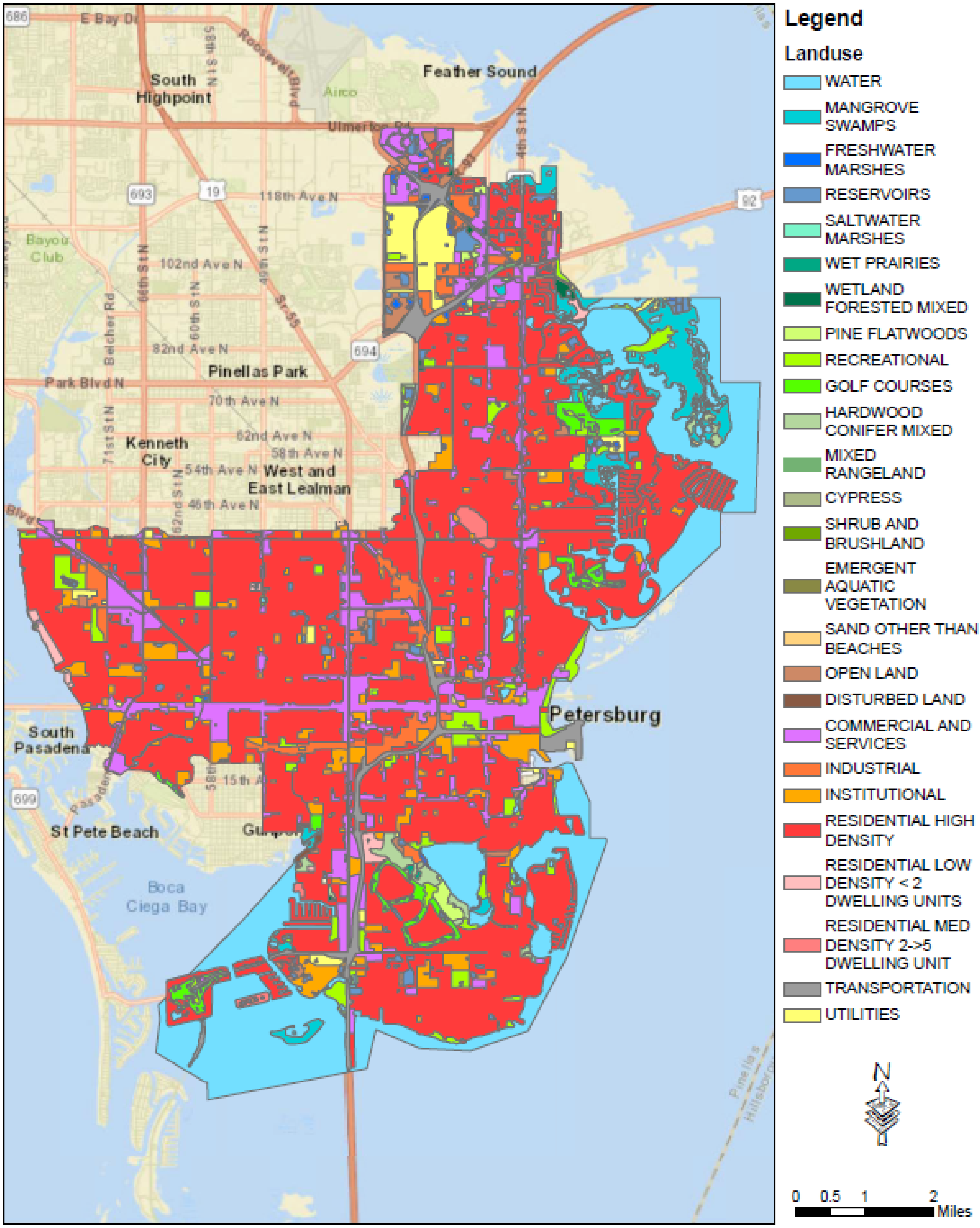
Figure 2-4. Watershed Soils Map

2.1.8 Land Use

The land use files are obtained from the District and the City. The city is highly urbanized, and approximately 50 percent of the city is categorized as Residential High-Density land use. The distribution of land use types in the watershed is presented in Table 2-3. The existing District land use map is presented on Figure 2-5, and the existing land use map from the City of St. Petersburg is presented on Figure 2-6. A combination of the two land uses will be used during the parameterization phase to define the model parameters, such as impervious area, and directly connected impervious area (DCIA).

Table 2-3. Summary of Land Uses in the Watershed

Land Use	Area (square feet)	Percent of Area
Bays and Estuaries	307,984,707.95	15.493%
Beaches other than Swimming Beaches	120,212.02	0.006%
Commercial and Services	171,841,929.48	8.645%
Communications	379,540.95	0.019%
Cypress	251,770.55	0.013%
Disturbed Land	1,081,261.38	0.054%
Emergent Aquatic Vegetation	779,557.87	0.039%
Freshwater Marshes	5,254,209.17	0.264%
Golf Courses	26,089,907.73	1.312%
Hardwood Conifer Mixed	14,097,341.51	0.709%
Industrial	44,523,391.47	2.240%
Institutional	84,918,440.37	4.272%
Intermittent Ponds	143,901.36	0.007%
Lakes	17,966,526.34	0.904%
Mangrove Swamps	59,862,302.21	3.011%
Mixed Rangeland	369,969.19	0.019%
Open Land	20,712,396.21	1.042%
Pine Flatwoods	6,048,777.15	0.304%
Recreational	53,966,247.28	2.715%
Reservoirs	37,484,190.54	1.886%
Residential Low Density < 2 Dwelling Units	8,533,775.96	0.429%
Residential Med Density 2->5 Dwelling Unit	7,113,030.08	0.358%
Residential High Density	998,192,822.21	50.215%
Saltwater Marshes	1,037,269.33	0.052%
Sand Other Than Beaches	158,386.04	0.008%
Shrub and Brushland	438,688.55	0.022%
Stream and Lake Swamps (Bottomland)	5,079,944.69	0.256%
Streams and Waterways	1,550,196.66	0.078%
Transportation	71,967,043.64	3.620%
Utilities	35,681,861.39	1.795%
Wet Prairies	592,745.31	0.030%
Wetland Forested Mixed	3,609,803.32	0.182%
Total	**1,987,832,147.91**	**100.00%**



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Landuse Layer Credits: SWFWMD 2011 Landuse Coverl, https://data-swfwmd.opendata.arcgis.com/datasets/2011-land-use-land-cover

Figure 2-5. 2011 District Watershed Land Use Map

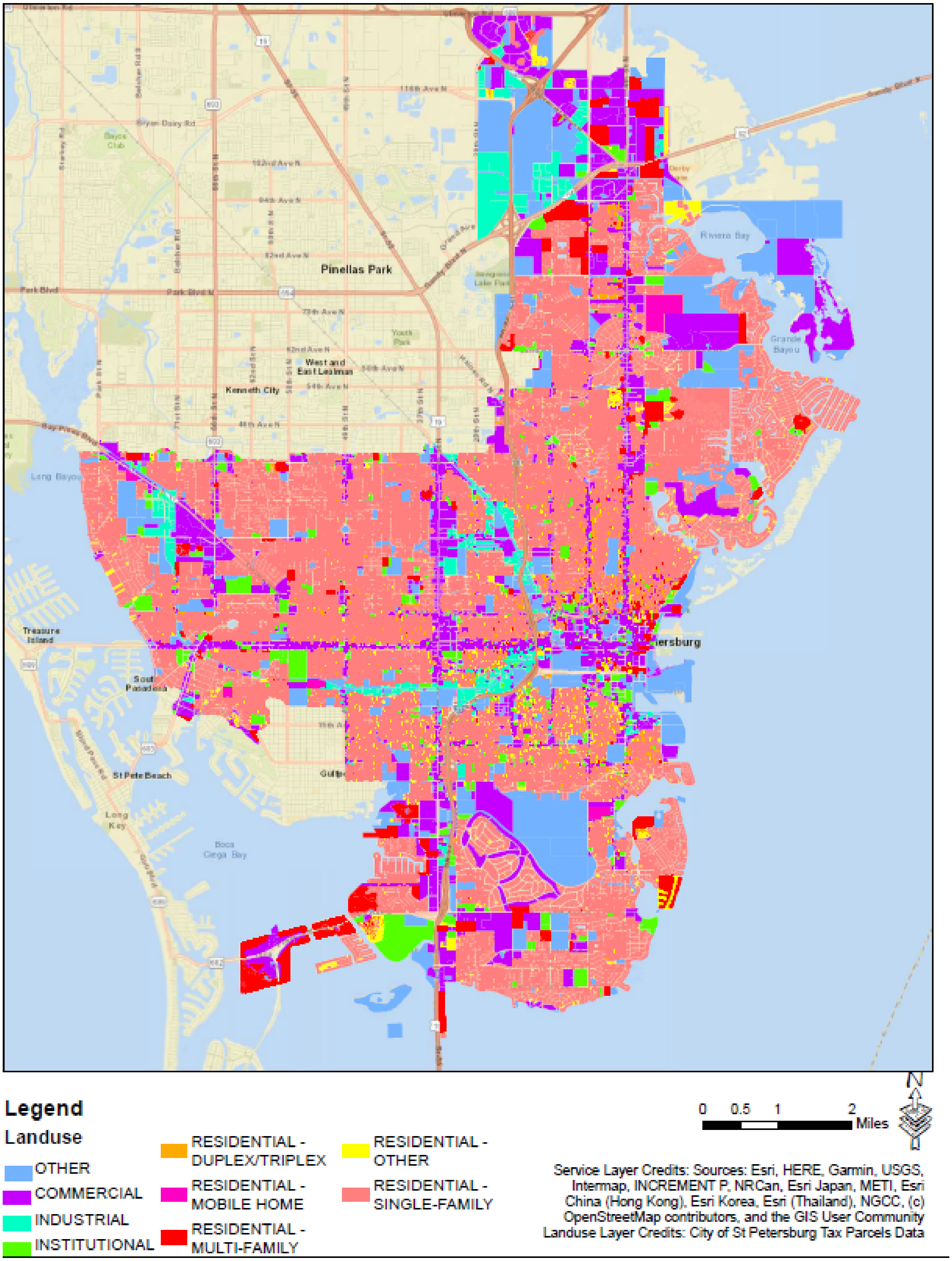


Figure 2-6. City of St. Petersburg Watershed Land Use Map

2.1.9 Building Footprints and Finished Floor Elevations

The District provided Jacobs with the following open-source link to the building footprint layer:

http://www.arcgis.com/home/item.html?id=86f6910fb56f4f3ca2d2cdc1383c77e5#overview

Pinellas County also provided Jacobs with a building footprint data geodatabase (GDB), but it does not have the finished floor elevation information. The building footprint layer provided by the County was clipped to the city limits and included in the deliverable as a geodatabase under *\GeoDatabase\General\Bfp_Data.gdb*.

2.1.10 Historical Water Levels

A historical water level GDB was provided by the District. It contains the historical water levels, flooding complaint locations, known flooding areas, and flood photos. In addition, the City's SeeClickFix website provided additional information on the recorded flooding-related issues. Lastly, during the City's review of ongoing watershed development, a few areas were identified as having flooding issues. These areas were logged by Jacobs for review during the model verification phase.

3. Initial GIS Processing Development of HydroNetwork

The initial GIS processing includes development of the HydroNetwork (existing stormwater infrastructure), Rapid Flood Inundation Assessment results using the Flood Modeler FAST tool, and existing model features developed in the District developed GIS mapping software called Geographic Watershed Information System (GWIS) Version 2.1 GDB. This section summarizes the development of the HydroNetwork and initial model features.

The original scope was to develop the existing Stormwater Management Computer Model software SWMM Version 4 to a newer SWMM Version 5. However, during the kickoff meeting, it was agreed to change the modeling software to Interconnected Pond Routing Version 4 (ICPR4) to allow the City to use two-dimensional and groundwater interaction modules, if needed. The GWIS Version 2.1 that is compatible with ICPR4 was used to develop the GDB.

The data required to develop the HydroNetwork and Model features were collected, as detailed in Section 2. Individual GWIS GDBs were developed for each of the 26 basins in the city.

3.1 Development of HydroNetwork

The HydroNetwork was developed in GWIS Version 2.1. The standard GWIS format provides the infrastructure data spreadsheet for watershed data. The HydroNetwork provides the infrastructure characteristics within the city and, in turn, provides a platform to delineate basins and develop the computer model link-node diagram. The GWIS GDB structure is shown on Figure 3-1. HydroNetwork along with associated data tables like PIPE_BARREL and WEIR tables carry the structural details of the network that will be used in the model.

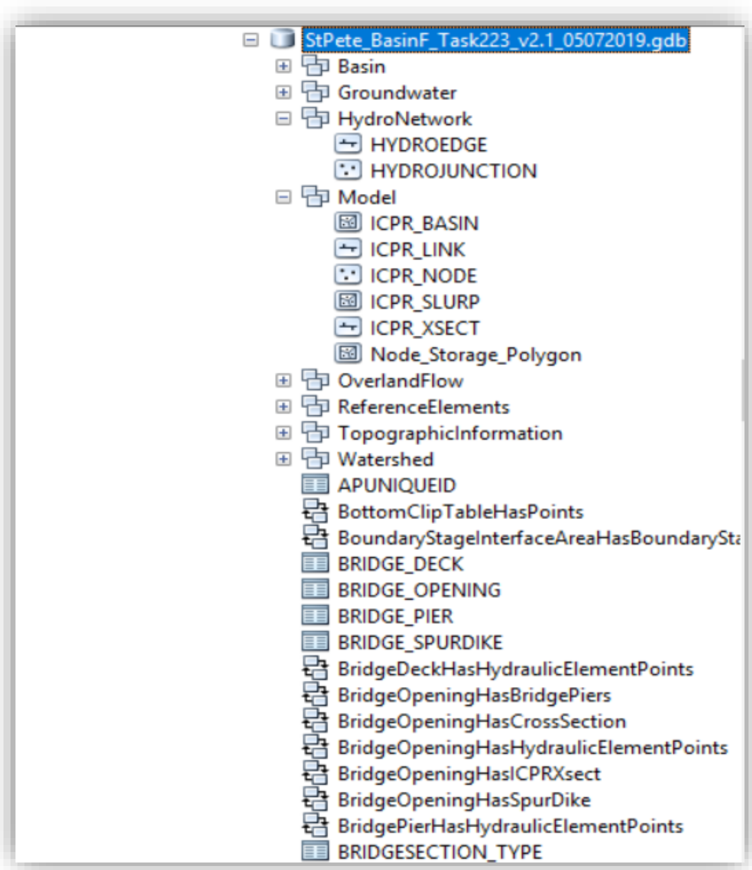


Figure 3-1. GWIS Version 2.1 Geodatabase Structure

The initial HydroNetwork was developed based on the following information:

- City SWI Database (May 2018)
- ERPs provided by the District
- Plans obtained from FDOT
- Desktop reconnaissance, including aerial imagery and Google StreetView, to identify feature locations to be confirmed through field reconnaissance and for survey needs

The City's graphic information system stormwater records were used to start the existing network development. If City data were not available, data were obtained from District ERPs, Pinellas County, FDOT, and supplemental surveys. The ERP or FDOT plan sources were considered the best available information and were incorporated into the model development if SWI features overlapped with ERPs and FDOT features, if there was a discrepancy between the two stormwater feature sources, and if the ERPs or FDOT plans were as-builts. If there was a significant discrepancy, the parcel stormwater information was verified through the field reconnaissance, and the source data that best represented the field reconnaissance observations were incorporated into the model development.

The following assumptions were made while evaluating the City's SWI shapefiles to allow for conversion into the GWIS Version 2.1 GDB. Estimated conduit elevations were determined by interpolation for the City's GIS stormwater infrastructure when data were missing from the City records, where possible. Those estimated elevations were entered into the GWIS Version 2.1 GDB. Another aspect of developing the GWIS Version 2.1 GDB was the incorporation of HydroIDs. HydroIDs are the key identifiers for a GWIS structure and are required to have unique numbers. Individual GWIS GDBs were developed for 26 basins within the city. Also, within each GWIS GDB, the HydroIDs were assigned based on a numbering convention that increased every 100,000 units per basin, sequentially and alphabetically, from Basin A to Basin Z. This numbering methodology was incorporated to eliminate potential HydroID duplication if a separate basin GDB were to be merged into a single GWIS GDB for a master model evaluation. The number ranges shown for each basin are detailed in Table 3-1.

Table 3-1. HydroIDs for HydroNetwork in Each Basin

Basin	Starting HydroID Value	Basin	Starting HydroID Value
A	100,000	N	1,400,000
B	200,000	O	1,500,000
C	300,000	P	1,600,000
D	400,000	Q	1,700,000
E	500,000	R	1,800,000
F	600,000	S	1,900,000
G	700,000	T	2,000,000
H	800,000	U	2,100,000
I	900,000	V	2,200,000
J	1,000,000	W	2,300,000
K	1,100,000	X	2,400,000
L	1,200,000	Y	2,500,000
M	1,300,000	Z	2,600,000

3.2 Sub-basin Delineation

The next step in the initial GIS processing was to delineate sub-basins in each City basin. The following data sources were used to delineate sub-basins:

1) Digital elevation model (DEM), provided by Pinellas County (July 2018 version)
2) Aerial imagery, FDOT's 2017 and 2018 Pinellas County aerial photos
3) Infrastructure data collected from the various sources listed in Section 3.1
4) Existing sub-basin delineations from the past updates of the basins, where available
5) Observations of sub-basin boundaries delineated by flooding contours identified in the Flood Modeler FAST computer model results

GIS-based watershed modeling computer tools (ArcHydro) were used to delineate the sub-basins using the DEM. The sub-basins produced by ArcHydro were manually reviewed and updated as needed based on review of the following: the City's GIS drainage infrastructure records, aerial mapping, and available GIS basin boundaries from the District's website. The City's original basins and the latest delineated sub-basins are shown over aerial imagery on Figure 3-2. The DEM, aerial imagery, and the delineated sub-basins are shown on Figure 3-3.

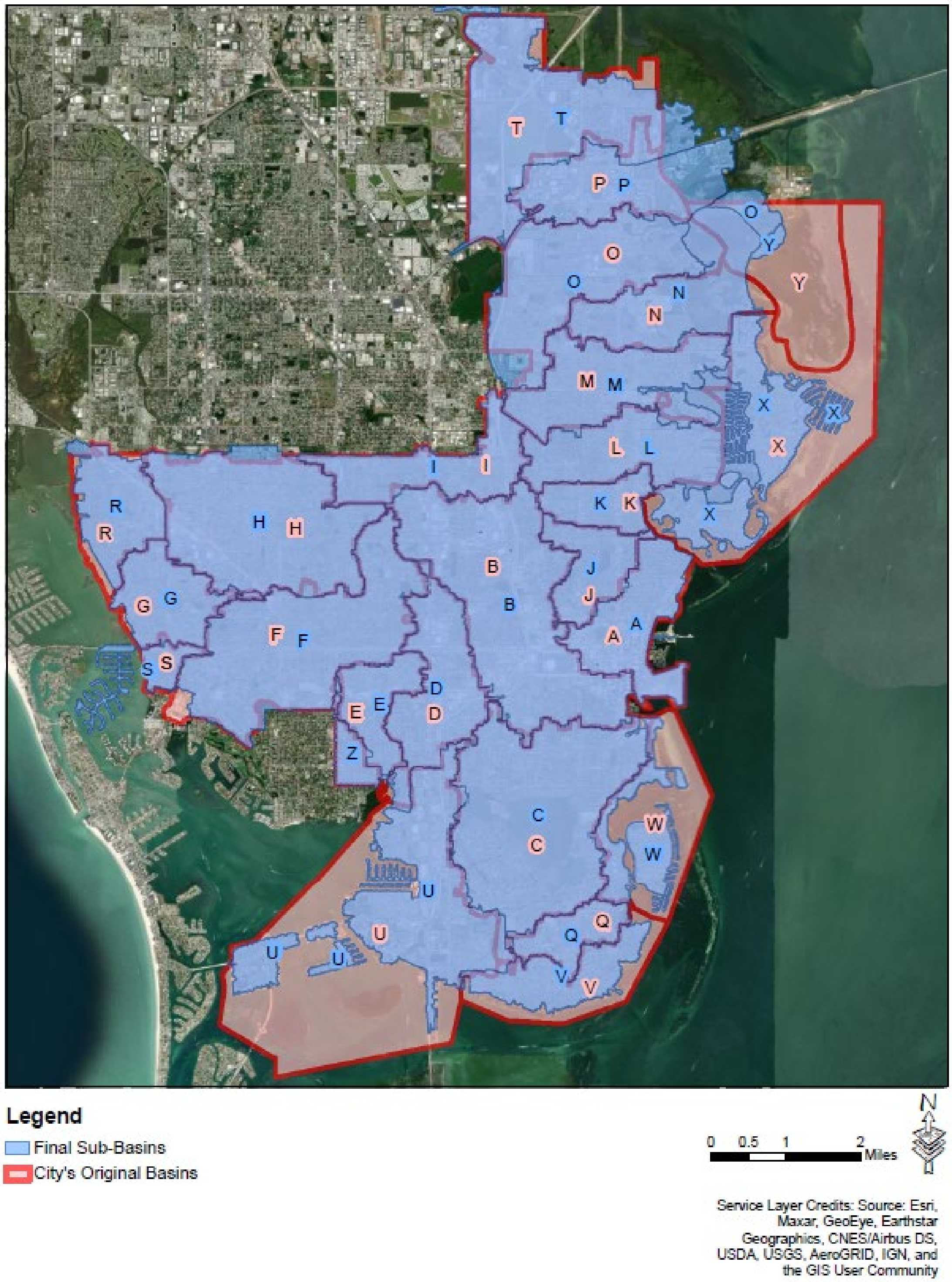


Figure 3-2. Sub-basin Delineation

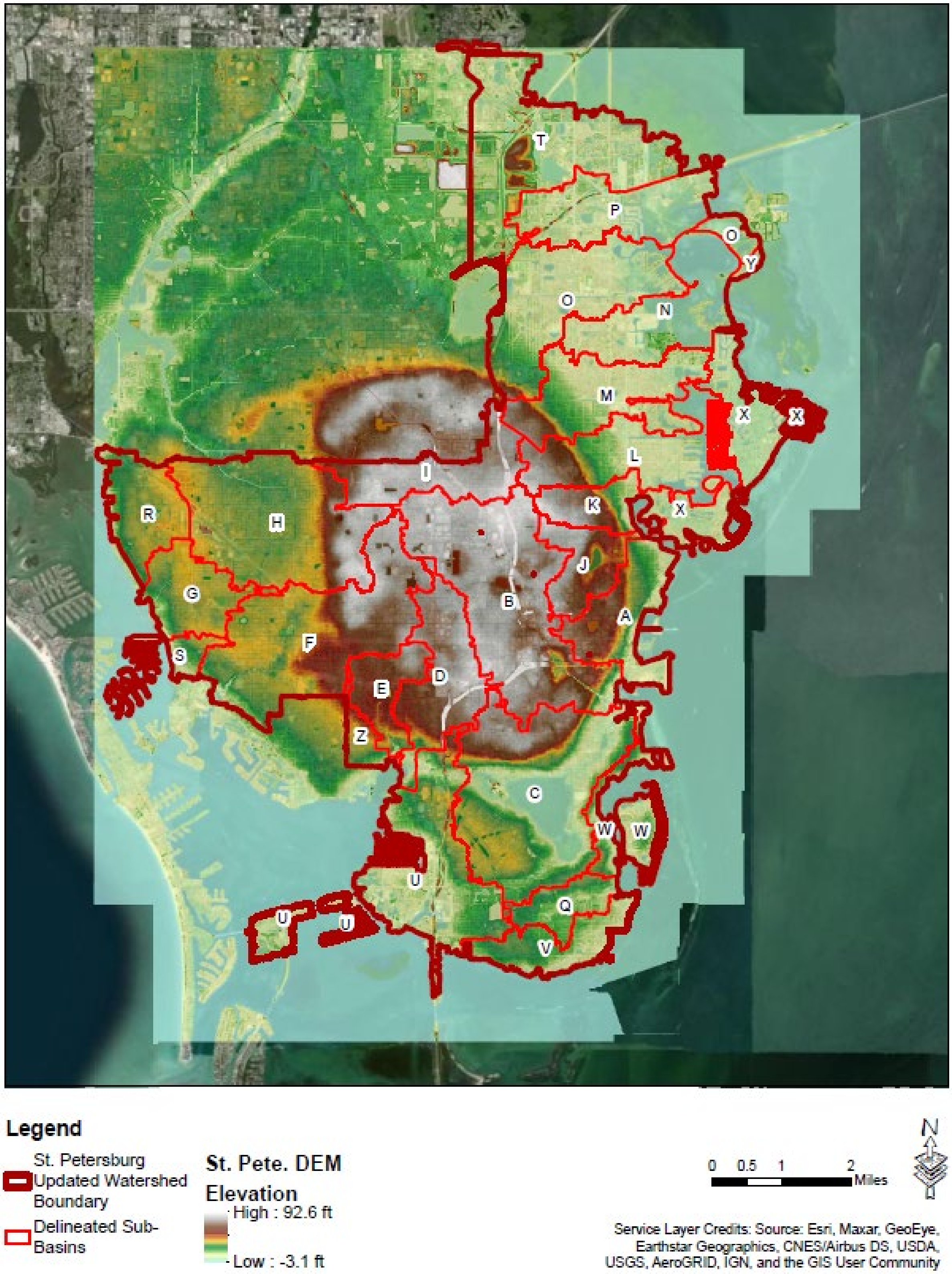


Figure 3-3. Delineated Sub-basins and DEM Covering the City

3.3 Model Features – Sub-basin Link/Node Network

The existing drainage infrastructure was input into the GWIS GDB (HydroNetwork) with information from the City GIS records, approved District permit plans (ERPs), FDOT plans, desktop reconnaissance, and the sub-basin delineation efforts detailed in Section 3.2. The GIS database input data included sub-basins, nodes, and links, which are described in Sections 3.4 through 3.6. These features were populated with information from various sources (see Section 2). The sub-basins created from Section 3.2 were added to the ICPR_BASIN feature class. Pipes, weirs, and drop structures were added to the ICPR-LINK feature class. Inlets, manholes, or basin nodes were added to ICPR_NODES, where the lowest point in a basin based on the DEM was included as the basin node. Where information was available, the WEIR (included weir characteristics) and PIPE_BARREL (includes conduit related characteristics) tables were populated with information from various sources as described in Section 2.

3.4 Sub-basin

As discussed in Section 3.2, sub-basins were delineated within 26 primary basins, except Basin Y. Basin Y was initially excluded because it has few stormwater features, little development, and insufficient reviewed coastal topography within the basin coverage. However, after further discussions with the City, the part of Basin Y that has development was delineated for sub-basins.

Sub-basin spread sheet data categories (layers) were filled with information (populated) from the ICPR_BASIN category (layer) in the GWIS GDB spread sheet. These sub-basins, or ICPR_BASINs, were adjusted and refined later with the findings of the field reconnaissance and data collected during the survey. ICPR_BASINs were named based on a naming convention associated with the primary basin lettering, such as A, B, C, etc., and a 5-digit numbering schematic starting with 00010 and increasing sequentially every 10 digits. For example, the sub-basins within primary Basin P were named P00010, P00020, P00030, etc.

3.5 Nodes

Computer model nodes were labeled under the ICPR_NODE category (feature class) within the GWIS GDB. These nodes were developed throughout the model and represent one of three types of model nodes: storage, manhole, or boundary conditions. Nodes representing storage capacity detail the node's stage/area and capture either the storage capacity of each sub-basin or the storage capacity for an inlet or manhole. Where a node represents the storage capacity of a sub-basin, the node was placed using ArcGIS tools at the lowest point of the sub-basin, based on processing the May 2019 DEM. Intermediate nodes that connect pipes and represent manholes or inlets are junction nodes and were assigned a stage/area for inlets or manholes. Junction node features were placed with the same geospatial location of the physical features they represent and are consistent with the City's SWI and HydroNetwork junctions representing the stormwater infrastructure.

Nodes representing a sub-basin and its stage/area capacity were reviewed for reasonable placement within the sub-basin. This review was done to eliminate incorrect placement from the ArcGIS tools because of topographic void issues observed within the DEM. Topographic void issues can be caused by residential pools, building loading dock wells, other types of DEM errors. Because the ArcGIS tools do not distinguish the type of low spot within each sub-basin, a manual review was conducted to confirm that each node was placed within the reasonably lowest point of the sub-basin.

Nodes representing basins were named using the sub-basin name to which each node was related but with the added prefix N, for node. All other nodes within the basin were named based on the sub-basin node but numbered sequentially in single digits increasing from the sub-basin node. For example, four nodes are assigned within the sub-basin P00010. The sub-basin node representing the storage capacity of the sub-basin P00010 is named NP00010, and the additional three nodes representing junction nodes are named NP00011, NP00012, and NP00013.

3.6 Links

The computer model infrastructure category (feature class) ICPR_LINK represents conduits, channels, bridges, or other conveyance structures in the database. The links were drawn connecting the nodes. Links representing control structures were modeled as a data field [TYPE] Drop Structure. Links representing pipes or culverts were assigned a data field [TYPE] PIPE. Links representing weir structures were assigned a data field [TYPE] WEIR. Links representing channels were assigned a data field [TYPE] CHANNEL. Links representing bridge structures were assigned a data field [TYPE] RATING CURVE. Links were named based on the naming convention of the upstream node but with the prefix R, for reach. Where multiple links had the same upstream node, the links were given unique names by adding a unique lettering suffix, increasing sequentially within the alphabet starting with "A." For example, for two pipes connecting sub-basin node NP0010 to another basin, the two pipes would be named RP0010A and RP0010B.

The associated PIPE_BARREL and WEIR tables were populated with the details acquired from the City's SWI, ERPs, or FDOT plans. Further details were added later based on field reconnaissance and completed surveys as discussed in Section 5.

4. Evaluation of GIS and Topographic Data for Issues and Voids

Evaluation of the GIS and topographic data for issues and voids was conducted prior to the development of the stormwater model. The evaluation included reviewing the DEM to identify irregularities or errors that might affect the modeling processes and final floodplain development for the 26 basins identified within the city. The identified topographic voids and locations of missing or outdated elevations were provided in a GDB (TopoVoids.gdb) as an electronic file and included in the deliverable package. This section summarizes the methodology used to address the topographic data issues and voids.

The original scope was to review the DEM used for the development of the HydroNetwork and Model features. However, three separate DEMs were provided to Jacobs while the finalized DEM was being processed and approved. The three DEMs were received from Pinellas County and were dated as follows:

- Initial, unapproved Pinellas County DEM, October 2018
- Revised, unapproved Pinellas County DEM, March 2019
- Revised, finalized Pinellas County DEM May 2019

The two earliest versions of the DEM were used to develop the HydroNetwork and Model features to avoid project delays in the schedules and were deemed sufficient for developing the HydroNetwork and Model features. Topographic voids identified during use of the two earliest versions were reviewed against the final DEM and were not included in the topographic void GDB if the issue or void was observed to be resolved. The topographic void GDB included those topographic data issues and voids identified when the final approved DEM was reviewed. The topographic void GDB will also be included in future deliverables under the District's standard deliverable folder format in the following path:\GeoDatabase\General\Topovoid.

4.1 Topographic Void Identification

The final DEM was reviewed for topographic data voids and issues using the 2017 FDOT aerial imagery; 2018 Pinellas County aerial imagery; and the District's GIS tool, Dual Maps, which uses Bird's Eye View aerial imagery and Google StreetView. The final DEM was also reviewed against the District's ERP Polygon layer. A total of 330 topographic void points was located within the city limits. The void points are shown on Figure 4-1.

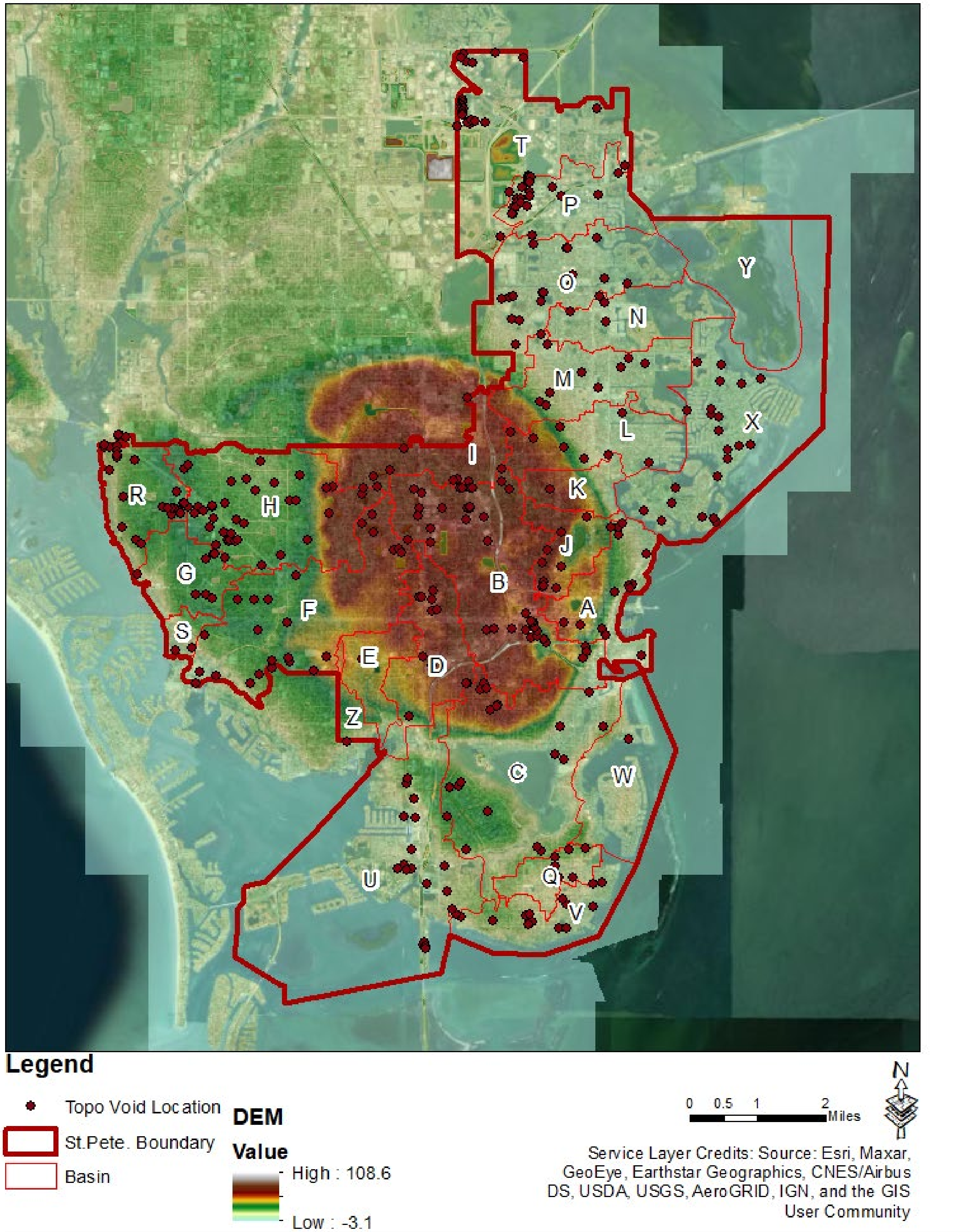


Figure 4-1. Topographic Void Locations within City

The following three primary examples of topographic data issues or voids were observed within the city:

- Differences in aerial imagery and the DEM elevations
- Artificially high or low elevations based on DEM processing
- DEM cells without elevation data

Examples of the voids identified are presented on Figures 4-2 to 4-7.

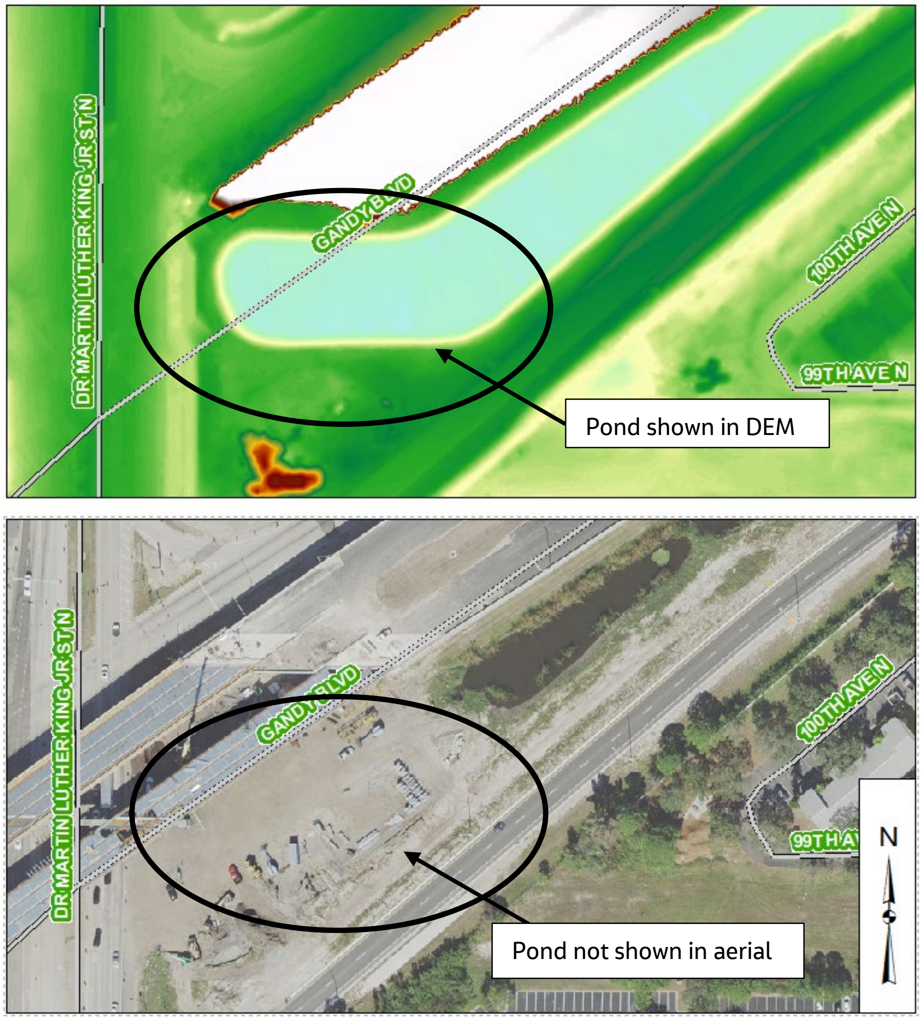


Figure 4-2. Discrepancy between DEM and Existing Conditions Shown in Aerial, Pond

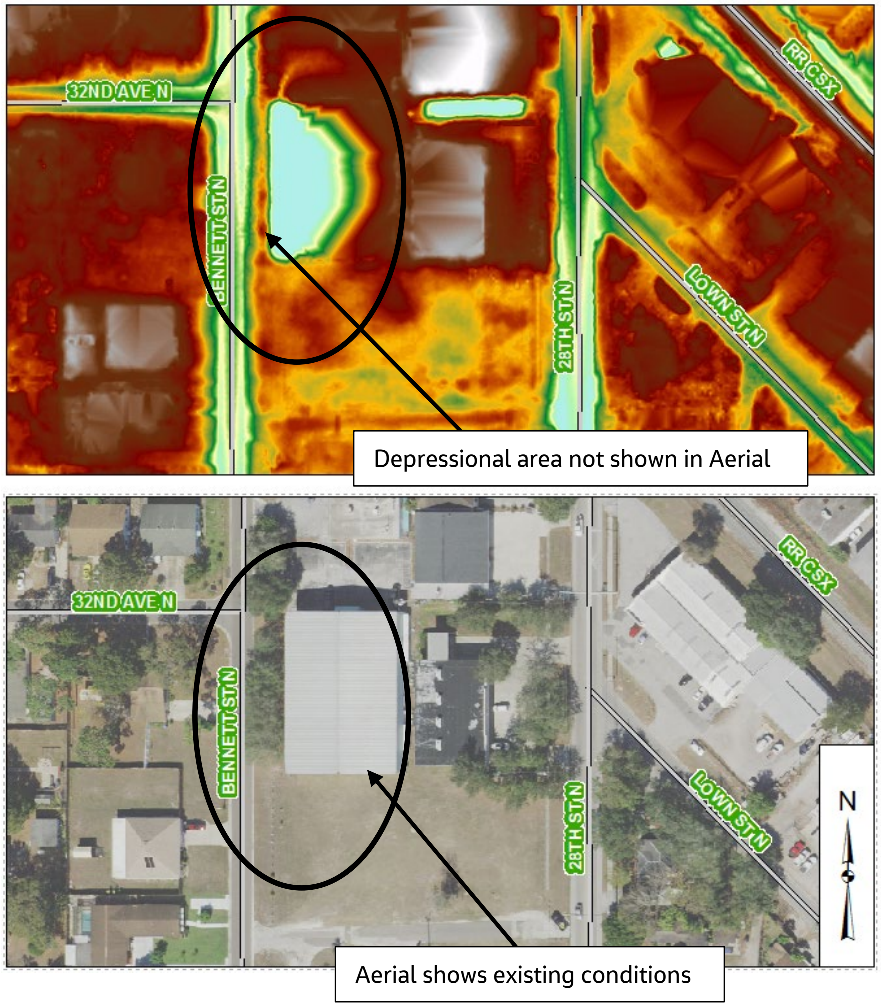


Figure 4-3. Discrepancy between DEM and Existing Conditions Shown in Aerial, Depressional Area

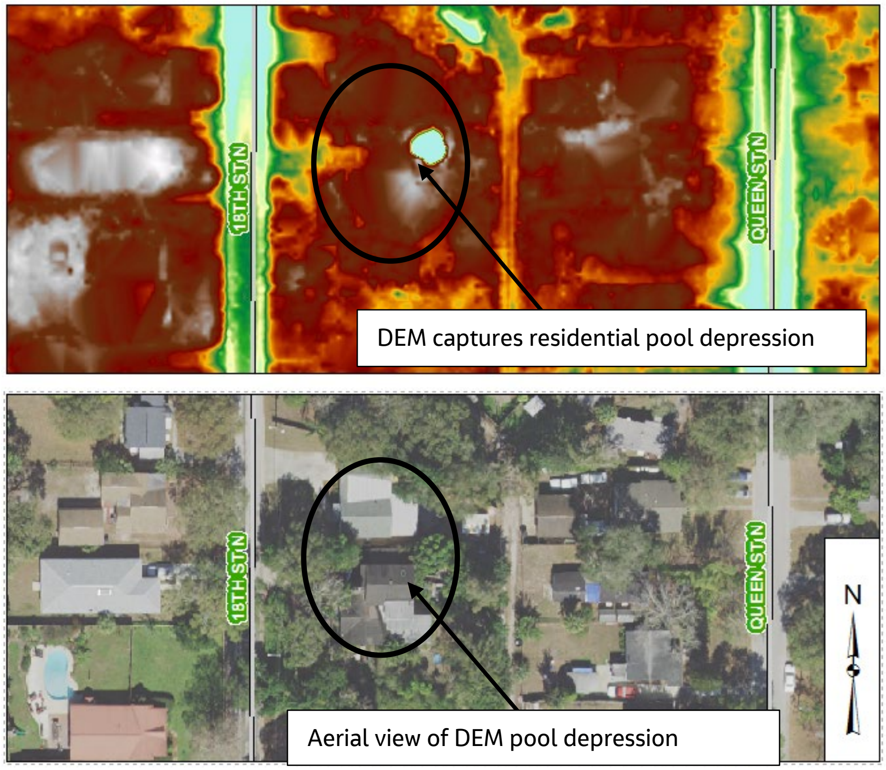


Figure 4-4. DEM Artificial Low Value from Unleveled Depression from a Residential Pool

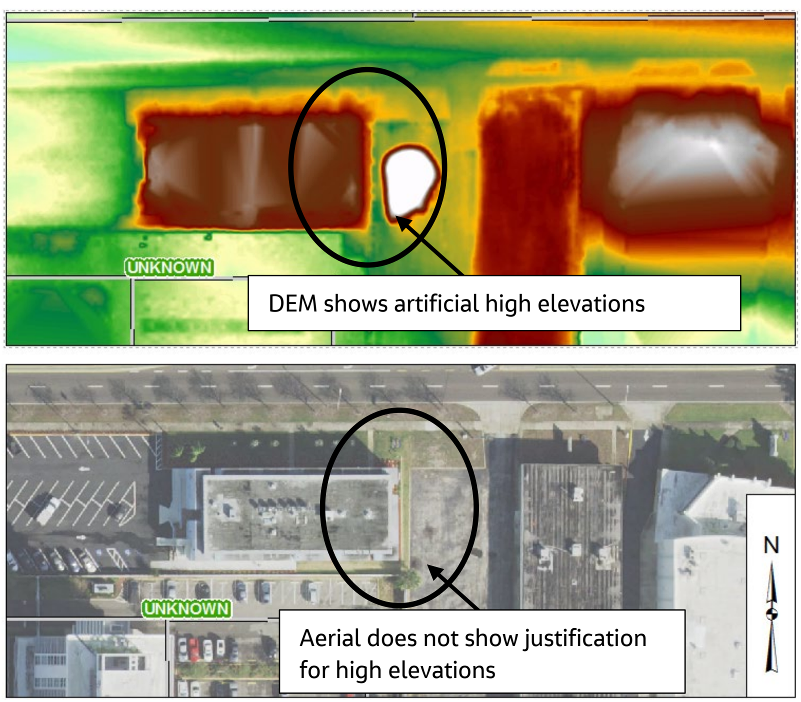


Figure 4-5. DEM Error with Artificially High Elevations

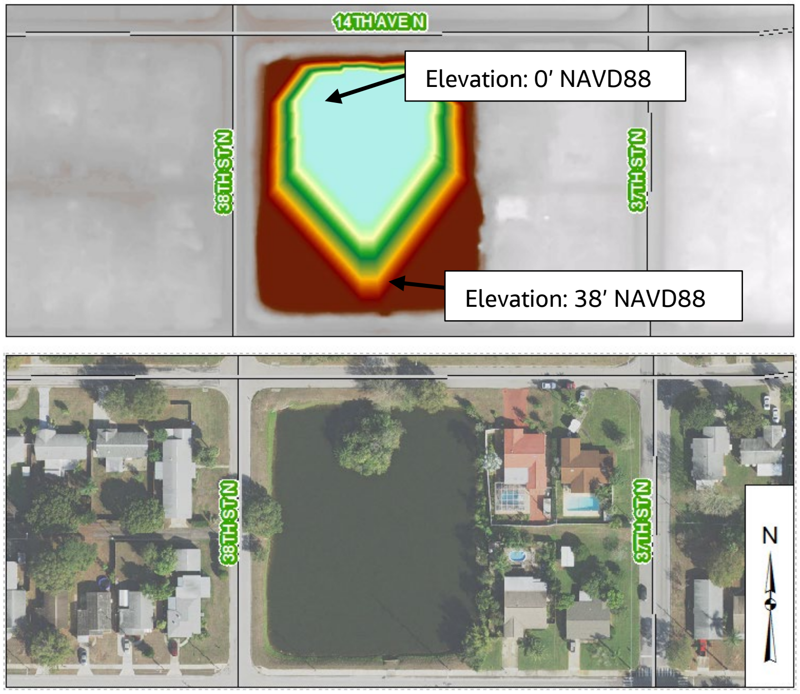


Figure 4-6. DEM Error with Artificially Low Elevations within a Pond, Excessive Elevation Difference

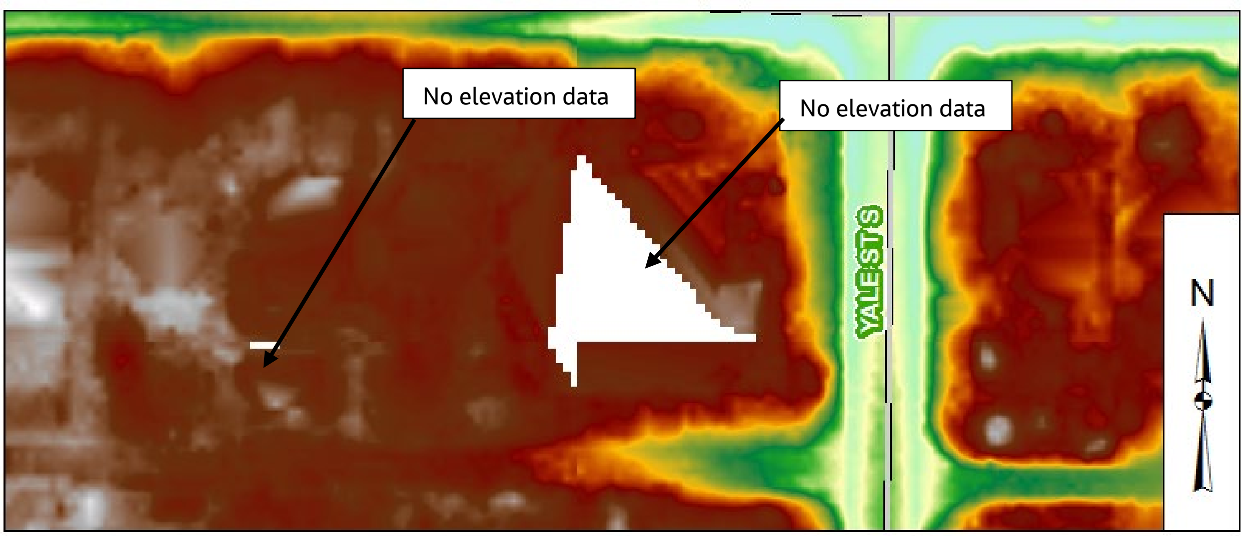


Figure 4-7. DEM Void, No Data

4.2 Topographic Void Corrections

All topographic voids identified were further analyzed to prioritize the need for rectification based on their significance in H&H modeling. Based on the prioritization, the following approach was used for various types of voids:

- For voids identified as artificially high, the approach varied. If the void was prioritized for correction, information was gathered using the ERP plan sets. If there was no additional information available, the surrounding DEM grid cell elevation information was used to interpolate and fill the void.

- For voids identified as artificially low, the approach varied depending on the type of void:
  - For residential pools and loading docks, the corrections were not made because these voids were small and did not significantly affect the modeling.
  - For voids on roadways, the voids were corrected to reasonably represent the roadway elevations by either reviewing the available ERP plan sets or using surrounding elevation information.
  - For clarifiers at wastewater facilities that were identified as voids, no corrections were made because these areas will be considered non-contributing to runoff and therefore excluded from stage or storage calculations during the parameterization phase.
- Other areas not represented appropriately in the DEM, including the channel system in Basin B, were corrected using the available information.
- For voids with missing elevation information, surrounding DEM grid cell elevations were used to interpolate and correct the void.

5. Field Reconnaissance and Survey

5.1 Field Reconnaissance

For unverified structures needing further investigation, field reconnaissance was performed from January 21 to February 21, 2019. Figure 5-1 shows the areas where locations were visited for field reconnaissance throughout the 26 basins.

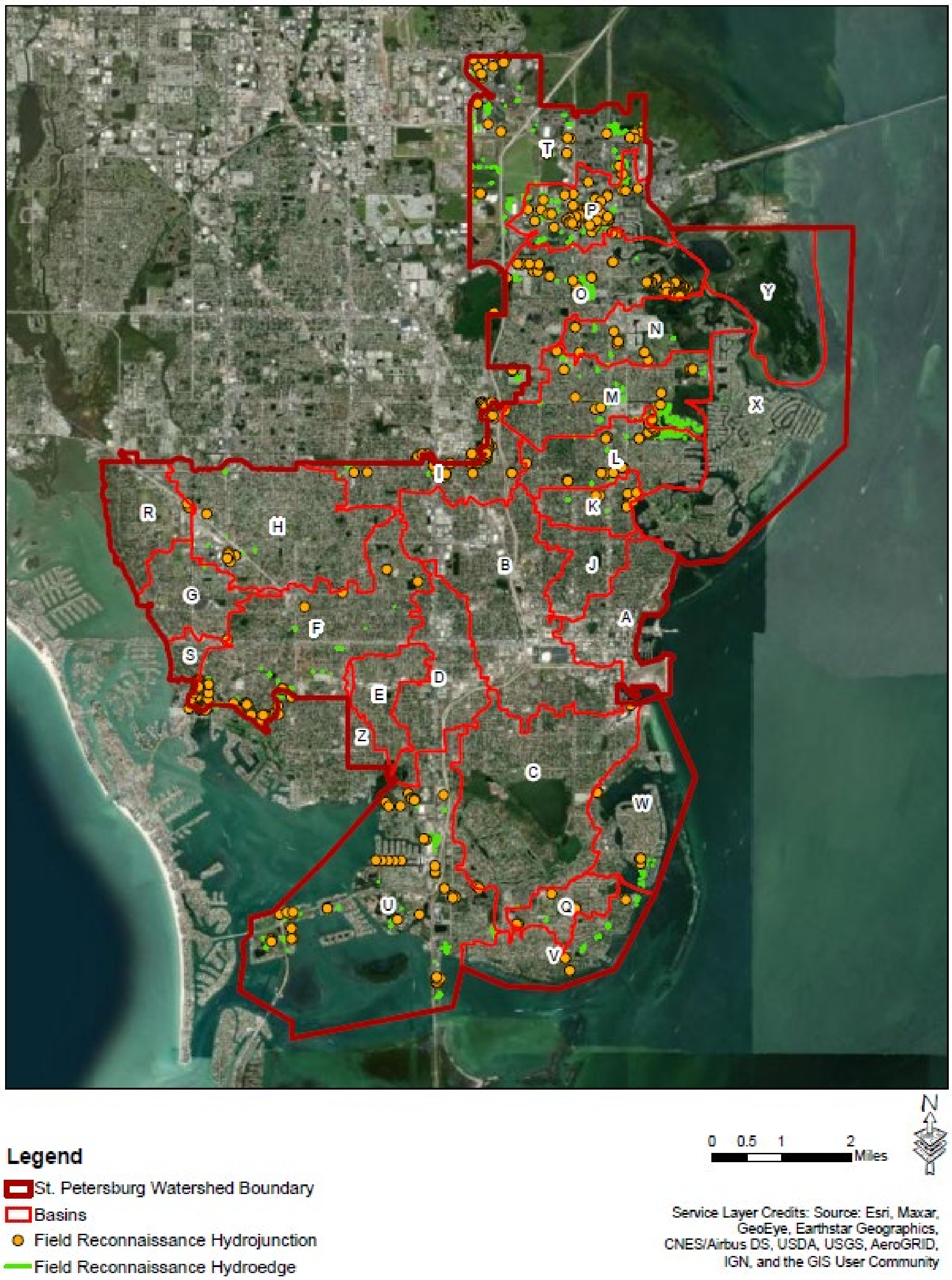


Figure 5-1. Field Reconnaissance Locations

In some circumstances, the elevation or size for pipe or culvert features was not found in information from the City GIS data, District permitting data, or other plans. With approval from the City and for certain features, the pipe inverts were reasonably interpolated based on known elevations from the directly connecting stormwater features. For example, where two pipes in a series had inverts for the uppermost upstream elevation of the upstream pipe and the lowermost downstream elevation of the downstream pipe, it was assumed that the two pipes maintained a consistent slope, and a middle invert was estimated based on a calculation using the upstream invert, downstream invert, and combined length of both pipes. The interpolated elevation between the two pipes was then assigned as the unknown downstream elevation of the upstream pipe and the unknown upstream elevation of the downstream pipe. For unknown pipe inverts, where either the upstream or downstream invert was known as well as the pipe length, an assumed 0.2 percent slope was used to calculate the unknown elevation, where appropriate. Elevations that were calculated based on these assumptions were detailed within the PIPE_BARREL table. Similar assumptions were made for unknown pipe sizing or material. These assumptions were made to greatly reduce the number of survey locations that otherwise would have been required, thereby benefiting the client in terms of costs and improving project schedules.

When the abovementioned assumptions could not be made for unknown pipe inverts, sizes, or dimensioning, survey points were identified and approximately 2,300 identified points needing survey were compiled into GDBs for each primary basin.

The assembled invert elevations with apparent discrepancies were rectified as required to account for different survey vertical datums. The datum for inverts is included in the PIPE_BARREL table. The datums are different for upstream and downstream inverts because elevations were sometimes collected from different data sources and therefore different datums. The three datums encountered during the invert acquisition was National Geodetic Vertical Datum of 1929 (NGVD29), City datum, and NAVD88. A final conversion was completed to convert all inverts to NAVD88. The conversion factor for NGVD29 to NAVD88 was -0.88. The conversion factor for City datum to NAVD88 was -97.88. A log of datum conversions is included in the PIPE_BARREL and WEIR tables detailing the conversion used, the original elevation, and the final conversion elevation and datum. Where the original datum was unknown, elevation callouts in ERP or FDOT plans were re-checked to evaluate reasonable datum assumptions. In addition, where the datum was not mentioned in ERP or FDOT plans, and the datum could not be confirmed by evaluating the DEM against development elevations listed in the plans, Jacobs assumed NGVD29 for the plans issued before the year 2010 and NAVD88 for plans issued during or after the year 2010.

Field reconnaissance locations and field investigation findings are saved in GIS files in the folder format under the deliverable package in the following path: \GeoDatabase\FieldRecon.

5.2 Field Data Acquisition – Survey

The survey locations identified based on the missing data and field survey are presented on Figure 5-2. The surveying team member, Suncoast Surveying, was retained to conduct the survey for the approximately 2,100 unverified structures. The Jacobs team coordinated with the surveyor, requesting that the survey be conducted and information obtained and reconciled in a format compatible with the GWIS GDB. The survey was conducted between October 2019 and May 2020. City staff has assisted the surveyor with access to approximately 340 hard top concrete structures to complete the survey of these structures.

The survey data underwent strict quality assurance and quality control measures and, if required, the surveyor revisited the structures that needed additional information or were missed in the initial data submittal. The updated data sheets and the photographs associated with the structures are saved under the District's standard deliverable folder format in the following path: \HTML\Survey.

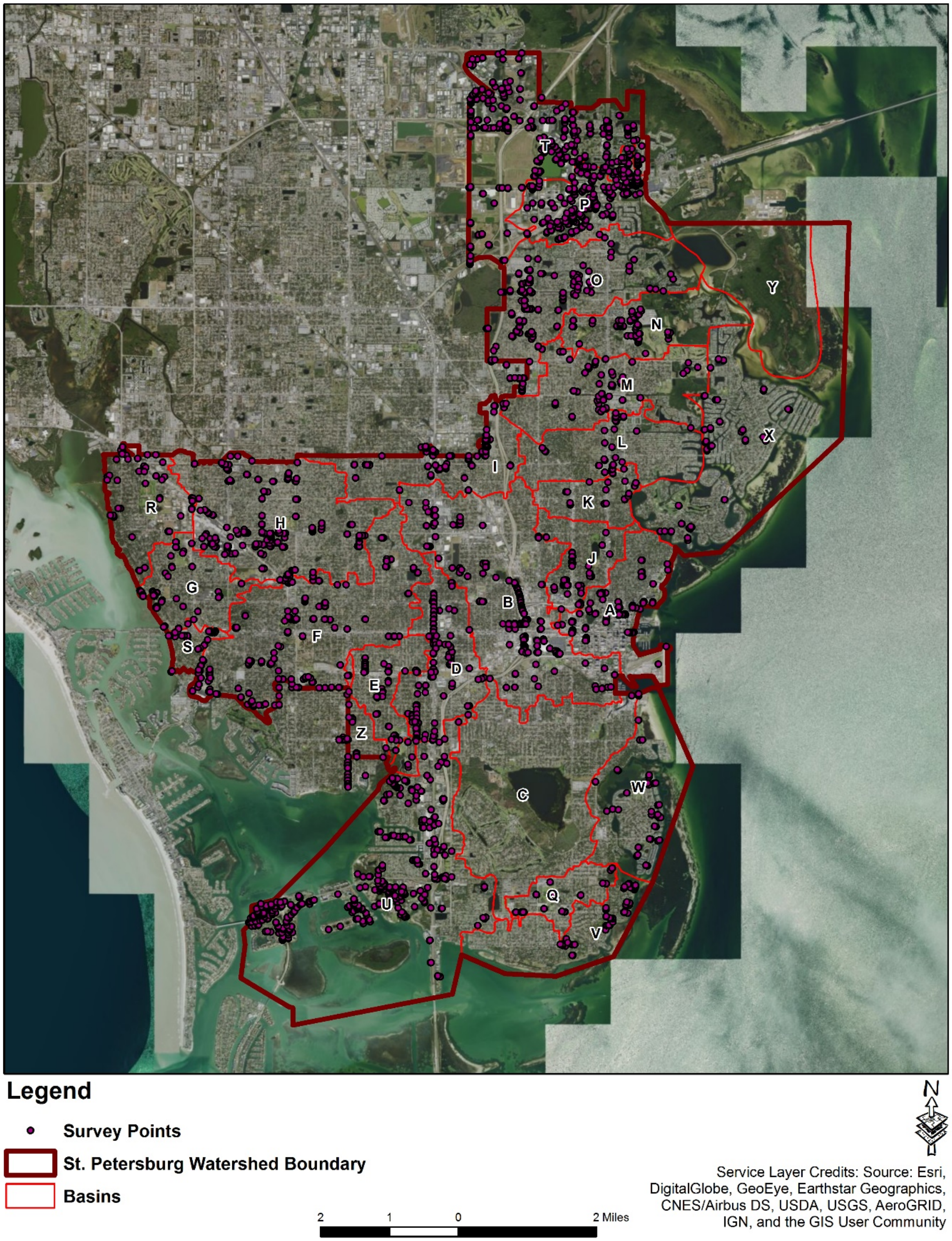


Figure 5-2. Requested Locations for Survey (there may be several points per location)

6. Data Refinement of GWIS Geodatabase

The data collected during the field reconnaissance and field data acquisition were reconciled and incorporated into the GWIS GDB to refine the data, including adjusting the sub-basin delineations and filling data gaps related to the pipes, weirs, and control structures. During the data acquisition phase, some structures (approximately 77 structures city-wide) were not accessible due to being in closed premises or private development or because the physical structure had a hard, fixed, concrete top that would be permanently damaged if removed to verify pipe information. In discussions with the City, it was agreed that for some structures, the data gaps would be filled using the following assumptions:

- For reviewing the DEM elevation, a minimum 3-foot cover was assumed, where the pipe invert would be the DEM elevation, minus the 3-foot cover, minus the pipe rise. This assumption was cross checked with available upstream or downstream inventory information or reasonably similar neighboring stormwater features or bottoms of channels and ponds to reflect a reasonable elevation in reference to outfall locations or upstream conditions.
- Where drop structure features could not be confirmed, the pond was relatively small (less than 1 acre), and aerial or Google StreetView provided reasonable support for the assumption, the standard FDOT Type C inlet was assumed. In addition, a 0.5-foot vertical offset from the DEM elevation below the top-of-bank elevation of the pond was assumed for the horizontal weir elevation of the drop structure. No additional weirs or orifices were assumed.
- Where drop structure features could not be confirmed and the pond was predominantly large in size (greater than 1 acre), an FDOT Type D inlet was assumed. In addition, a 0.5-foot vertical offset from the DEM elevation below the top-of-bank elevation of the pond was assumed for the horizontal weir elevation of the drop structure. No additional weirs or orifices were assumed.
- For unknown pipe sizes that could not be confirmed, the sizing of the pipe was assumed based on the contributing drainage area from the sub-basin delineations and, when necessary, included upsizing the pipe while moving downstream along the conveyance system, as would be typical in most stormwater design assumptions.

In the above circumstances, the most conservative assumptions were made and the smaller sizes were chosen. Areas where these assumptions have been applied are identified within the PIPE_BARREL and WEIR tables.

During the data refinement process, comments received from the City concerning various basins were addressed, and the responses were provided in a separate folder delivered to the City. The City's comments and Jacobs' team responses are provided under the District standard deliverable folder format in the following path: \Comments\RESPONSES.

7. Geodatabase of Computer Model Infrastructure Characteristics

7.1 Summary of Sub-basins, Links, and Nodes

The GWIS GDB includes all the model drainage characteristics for sub-basins, links (pipes, drop structures, weirs, and channels), and junction nodes. To these were added the hydrology (rainfall runoff) and hydraulic (conduit performance) computer attributes. The computer program was run and the results compared. It should be noted overland weir links were not drawn at this time, and these will be completed during the parameterization phase.

Table 7-1 summarizes the total number of drainage boundary sub-basins, conduit links, and junction nodes for each of the 26 major City drainage basins (watersheds). An exhibit with a watershed-scale sub-basin, link, and node diagram is presented in Appendix A. Appendix B details the DEM Hillshade and contouring in response to the City's request for a more pronounced way to review the change in elevations of the DEM.

Table 7-1. Summary of Model Features

Basin	Sub-basins	Nodes				Links							Area (acres)
		Stage/ Area	Time/ Stage	Manhole	TOTAL	Pipe	Weir	Bridge	Rating Curve	Drop Structure	Channel	TOTAL	
A	665	665	7	327	999	981	5	0	0	28	0	1014	1158.0
B	1839	1846	1	1169	3016	3044	6	10	2	80	6	3148	3368.3
C	456	459	2	152	613	573	18	0	0	19	17	627	3372.2
D	660	666	1	337	1004	979	6	0	0	28	7	1020	1393.4
E	374	395	0	167	562	550	6	0	0	12	19	587	672.6
F	833	1170	6	431	1607	1536	5	0	0	39	52	1632	2945.5
G	405	434	6	131	571	545	3	1	0	11	21	581	937.6
H	703	1448	3	324	1775	1424	238	0	0	75	71	1808	2884.4
I	389	608	8	314	930	887	12	0	0	16	0	915	1160.6
J	358	362	3	206	571	568	2	0	0	5	0	575	744.3
K	217	296	2	116	414	394	1	0	0	17	1	413	566.5
L	368	636	0	214	850	832	4	0	0	17	10	863	1757.5
M	548	833	2	248	1083	1078	8	2	0	22	4	1114	1651.3
N	259	369	0	100	469	432	0	0	0	13	8	453	1561.6
O	558	895	2	256	1153	1055	0	0	4	36	66	1161	2396.7
P	384	597	1	75	673	507	7	0	0	85	58	657	1484.1
Q	136	257	2	48	307	274	4	0	0	14	6	298	538.8
R	337	338	22	119	479	434	9	1	0	26	4	474	958.4
S	152	203	15	33	251	235	0	0	0	2	0	237	352.1
T	626	1059	31	116	1206	982	16	1	0	77	172	1248	2901.1
U	601	894	11	206	1111	987	23	1	0	68	26	1105	2577.0
V	228	318	37	191	546	504	1	0	0	6	2	513	814.1
W	170	281	1	81	363	345	4	0	0	3	0	352	759.2
X	419	693	5	133	831	823	4	0	0	11	0	838	1554.7
Y	2	2	0	0	2	0	0	0	0	0	0	0	56.1
Z	180	182	6	73	261	248	1	0	0	6	0	255	260.7
TOTAL	**11867**	**15906**	**174**	**5567**	**21647**	**20217**	**383**	**16**	**6**	**716**	**550**	**21888**	**38826.8**

7.2 Geodatabase File Organization

The GWIS GDB file organization is presented on Figure 7-1. Figure 7-1 identifies where the particular computer model physical attributes data are located. The GWIS GDB is saved under the District's standard folder format in the following path: \GeoDatabase\GWIS.

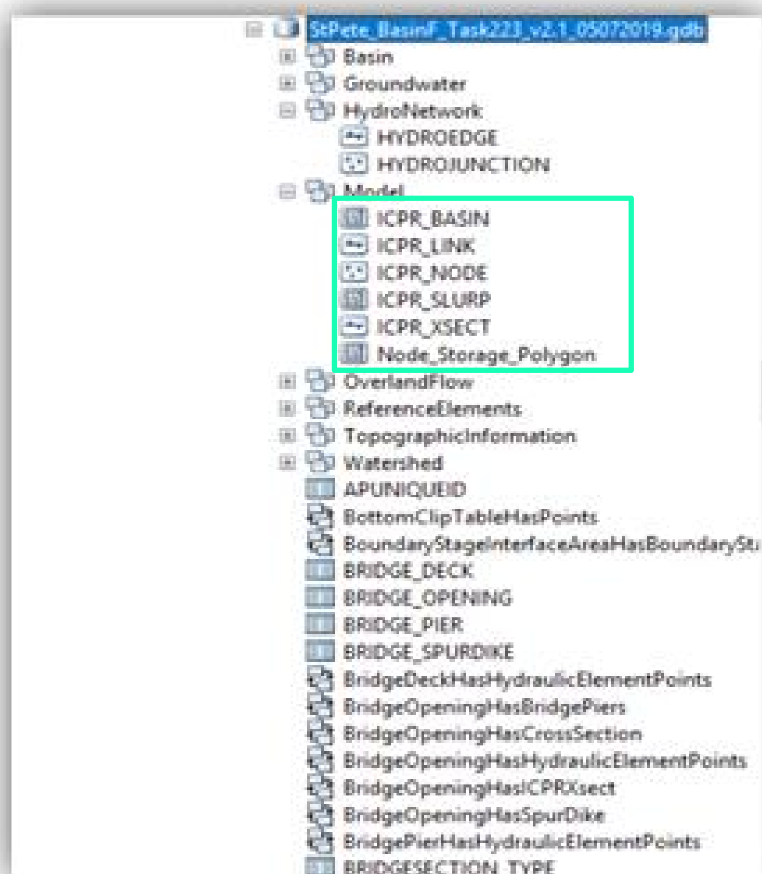


Figure 7-1. Geodatabase Computer Data Organization

8. Surface Water Resource Assessment Analysis and Approach (This title refers to the Water Quality of the Surface Runoff.)

The surface water resource assessment analysis will be focused on identifying the significant sources of pollutant loading to the surface water within the watershed on a sub-basin scale. Sub-basins developed under the master GWIS GDB will be used for this analysis. The Spatially Integrated (Computer) Model for Pollutant Loading Estimates (SIMPLE-Seasonal), developed by the District, will be used to set up and run this analysis to estimate the annual load on a (individual small) sub-basin scale. The model operates in a GIS framework to calculate pollutant loading from non-point and point-source pollution. Annual loads for this project will be calculated for the following constituents: total nitrogen, total phosphorus, and total suspended solids.

The SIMPLE-Seasonal Model includes three modules: 1-Direct Runoff Model, 2-Infiltration-Recharge Model, and 3-Percolation Model. These modules are used to assess pollutant loads within the watershed. The direct runoff model calculates the pollutant load to surface water bodies within the sub-basin and direct runoff pollution from septic tanks. The infiltration-recharge model calculates the pollutant load to groundwater from rainfall that infiltrates the ground (i.e., does not run off or evapotranspire) and the pollution infiltration from point sources (such as septic tanks and wastewater facilities). The percolation model calculates the pollutant load to groundwater from direct runoff that is retained in natural depressions or retention areas and percolates into the ground. Given the nature of the City watershed, it is anticipated that a majority of the pollutant loads will be contributed to the sub-basins by direct runoff.

For this analysis, the primary inputs are land use along with an associated runoff coefficient and event mean concentrations (EMCs). The runoff coefficients and the EMCs used during the Basin C analysis under Phase I of the project will be used for this analysis. The EMCs were extracted from Joe's Creek Watershed Management Plan (AECOM 2017) data received from Pinellas County. The EMCs used for the Basin C analysis are presented in Table 8-1. These data will be further discussed with the City to determine their applicability and whether any updated information is available.

Table 8-1. Event Mean Concentrations for Various Land Use Categories

Florida Land Use, Cover, and Forms Classification System Description	Total Suspended Solids	Total Phosphorus	Total Nitrogen
BAYS AND ESTUARIES	11.1	0.015	0.9
COMMERCIAL AND SERVICES	94.3	0.43	1.73
CYPRESS	11.1	0.015	0.9
EMERGENT AQUATIC VEGETATION	11.1	0.015	0.9
FRESHWATER MARSHES	11.1	0.015	0.9
GOLF COURSES	11.1	0.053	1.25
HARDWOOD CONIFER MIXED	8.4	2.3	0.7
INDUSTRIAL	93.9	0.14	1.57
INSTITUTIONAL	71	0.14	1.06
LAKES	0	0	0
MANGROVE SWAMPS	11.1	0.015	0.9
OPEN LAND	11.1	0.053	1.25
PINE FLATWOODS	8.4	2.3	0.7
RECREATIONAL	11.1	0.053	1.25
RESERVOIRS	0	0	0
RESIDENTIAL HIGH DENSITY	41.24	0.31	1.57

Table 8-1. Event Mean Concentrations for Various Land Use Categories

Florida Land Use, Cover, and Forms Classification System Description	Total Suspended Solids	Total Phosphorus	Total Nitrogen
RESIDENTIAL LOW DENSITY < 2 DWELLING UNITS	23	0.178	1.51
STREAM AND LAKE SWAMPS (BOTTOMLAND)	11.1	0.015	0.9
TRANSPORTATION	37.3	0.34	1.67
UTILITIES	93.9	0.14	1.57
WET PRAIRIES	11.1	0.015	0.9

The other input, including septic tank and wastewater facility information, will be obtained from the City and other sources, including Pinellas County, Florida Department of Health. As part of Phase I of the project (Basin C study), Jacobs collected septic tank information from the Jacobs' Wet Weather Overflow Program Study conducted for the City. The known septic tank locations are summarized in a spreadsheet (SAN septic tank list 20171128.xlsx) and included in the deliverable package. Jacobs will coordinate with the City to collect any additional known septic tanks that were not included in this list. The collected data will be used to develop inputs in the required format for the SIMPLE model to estimate annual pollutant loads on a sub-basin scale.

9. Next Steps

This draft Watershed Evaluation Report and the associated GWIS GDBs will be reviewed by City Engineering, the peer review consultant, and the District. The review comments will be addressed and a final Watershed Evaluation Report and associated GWIS GDBs will be submitted to the City.

Following the completion of the final Watershed Evaluation Report, the project will move to the following tasks:

1) Model Parameterization. Defining and assigning the computer model drainage basins runoff attributes and infrastructure attributes.
2) Watershed Computer Model Development and Calibration. The comparison and perfection of computer runs and results with known peak water marks.
3) Floodplain Analysis. The analysis of the areas and depths where flooding occurs in the sub-basins.
4) Level of Service Analysis. Measuring the level of flooding occurring for various storm events in each sub-basin.
5) Surface Water Resource (Quality) Assessment. The analysis of the quality of surface water runoff by sub-basin.
6) BMP Alternatives Analysis. The development of the recommended new drainage system infrastructure (BMPs) to serve the City.

10. References

AECOM. 2017. *Joe's Creek Watershed Surface Water Resource Assessment*. Prepared by URS for Pinellas County, City of St. Petersburg and Southwest Florida Water Management District. April.

Post, Buckley, Schuh & Jernigan, Inc. (PBS&J) and Dames and Moore. 1994. *Stormwater Management Master Plan*.

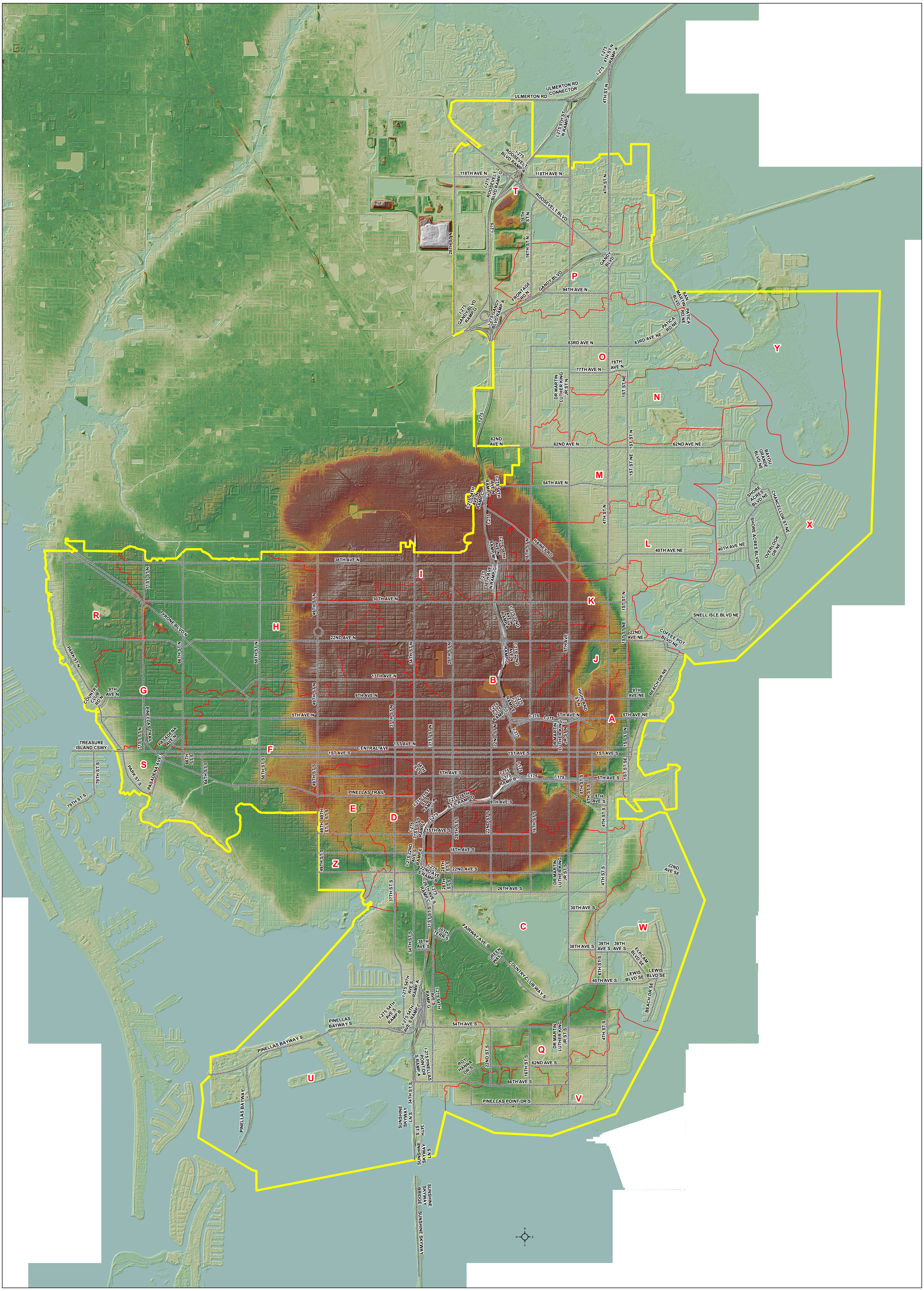
Southwest Florida Water Management District. 2017. Watershed Management Program Guidelines and Specifications. Revised 2020.

Streamline Technologies. 2020. Interconnected Pond Routing (ICPR4) Version 4.

Appendix A
Watershed-scale Model Features


Legend
CityLimits
ICPR_BASIN
ICPR_NODE
TIME/STAGE
STAGE/AREA
MANHOLE
MajorStreets
ICPR_LINK
BRIDGE
CHANNEL
DROP STRUCTURE
PIPE
WEIR
DEM
Elevation (ft)
High : 87.0
Low : -2.2
Miles
0 0.5 1 2 3
N
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Appendix B
Watershed Sub-basin Features with DEM Contoured and Hillshade



Legend

St.Pete. Boundary

Basin

MajorStreets

St. Pete. HillShade

Value

High : 254

Low : 0

DEM

Value

High : 108.6

Low : -3.1

N

0 0.5 1 2 Miles

Service Layer Credits:

Appendix B. Watershed Model Development and Floodplain Analysis Final Report

City of St. Petersburg Stormwater Management Master Plan

Watershed Model Development, Verification and Floodplain Analysis Report
City Project No 17037-110 - SWFWMD Project No N904

Final Report

April 2023

City of St. Petersburg

City of St. Petersburg Stormwater Management Master Plan

Project No:	697448CH
Document Title:	Watershed Model Development, Verification and Floodplain Analysis Report City Project No 17037-110 - SWFWMD Project No N904
Document No.:	PPS0910210909TPA
Revision:	Final
Date:	April 2023
Client Name:	City of St. Petersburg
Author:	Swamy Pati
File Name:	230410_Draft_floodplain_justification_report_StPete.docx

CH2M HILL Engineers, Inc.

One Tampa City Center
201 N. Franklin Street
Suite 1400
Tampa, FL 33602
United States
T +1.813.676.2300
F +1.813.676.2301
www.jacobs.com

Document History and Status

Revision	Date	Description	By	Review	Approved
0	9/10/2021	Draft	Swamy Pati		
1	2/4/2022	Revised Draft	Swamy Pati		
2	3/15/2022	Final	Swamy Pati		
3	4/10/2023	Final-revised	Swamy Pati		

Contents

Tables

Figures

Acronyms and Abbreviations

cfs	cubic foot (feet) per second
CH2M	CH2M HILL Engineers, Inc.
City	City of St. Petersburg
DCIA	directly connected impervious area
DEM	digital elevation model
District	Southwest Florida Water Management District
ERP	Environmental Resource Permit
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FLMOD	Florida Modified
GDB	Generic Database
GIS	geographic information system
GWIS	Geographical Watershed Information System
HEC-RAS	Hydraulic Engineering Center River Analysis System
HSG	hydrologic soil group
ISE	Integral Square Error
LiDAR	light detection and ranging
LWES	Land and Water Engineering
MC Initial	initial moisture content
MHHW	mean higher high water
NAVD	North American Vertical Datum
NOAA	National Ocean and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NSE	Nash-Sutcliffe Efficiency
RFHA	rapid flood hazard assessment
SSURGO	Soil Survey Geographic
SWFWMD	Southwest Florida Water Management District
SWMP	Stormwater Management Master Plan
Tc	time of concentration
USDA	U.S. Department of Agriculture
WT Initial	initial water table depth
WTA	water table aquifer

1. Introduction

CH2M HILL Engineers, Inc. (CH2M) is under contract with the City of St. Petersburg (City) to complete a City-wide Stormwater Management Master Plan (SWMP) Update. The SWMP incorporates Watershed Evaluation and Watershed Management Plan elements from the Southwest Florida Water Management District (District) Guidelines – Watershed Evaluation, Watershed Management Plan, Watershed Alternative Analysis. CH2M completed the Watershed Evaluation element in October 2020, and the corresponding Watershed Evaluation Report is included in this deliverable package.

CH2M has conducted the Watershed Management Plan element under Task 3 of the project. This justification report documents the Watershed Management Plan phase, including watershed model development, floodplain delineation, and justification.

2. Watershed Description

The City watershed is approximately 62 square miles in size, located within the City of St. Petersburg in Southern Pinellas County, Florida. St. Petersburg is highly urbanized, and approximately 50 percent of it is categorized as Residential High-Density land use. Approximately 16 percent of the land area is made up of bays and estuaries; as such, the watershed is located in a coastal community that is bound by water on three sides, and shares boundaries with Pinellas County watersheds on other sides. On the northern side, there is shared boundary with the Pinellas County portion of Roosevelt Creek Basin, Joe's Creek Basin, and Long Bayou Basin. On the northwestern side, there is a shared boundary with the Pinellas County portion of Sawgrass Lake Basin. On the southwestern side, there is a shared boundary with the City of Gulfport's portion of Clam Bayou Basin and Bear Creek Basin, and the Pinellas County portion of Bear Creek Basin. St. Petersburg consists of 26 primary basins, named from A to Z, as shown on Figure 2-1. All the basins are updated as a part of this project.

The latest soil information was downloaded from the National Resources Conservation Service website. The watershed consists of a mix of A, B/D, C, D, urban land, and water, with B/D soil types covering approximately 40 percent of the city. The B/D soils will be presumed to be performing under wet weather conditions and will be modeled as Type D soils for modeling purposes. The soils coverage in the watershed is presented on Figure 2-2.

Topographic data were provided in the High Accuracy Reference Network North American Datum of 1983 (feet) and were used for the horizontal coordinate system. The North American Vertical Datum of 1988 (NAVD88) (feet) was used for the vertical coordinate system. Topographic data were projected in North American Datum 1983 High Accuracy Reference Network State Plane Florida West FIPS 0902 (U.S. feet), in accordance with District requirements. The resolution of the digital elevation model (DEM) was a 2.5-by-2.5-foot grid cell.

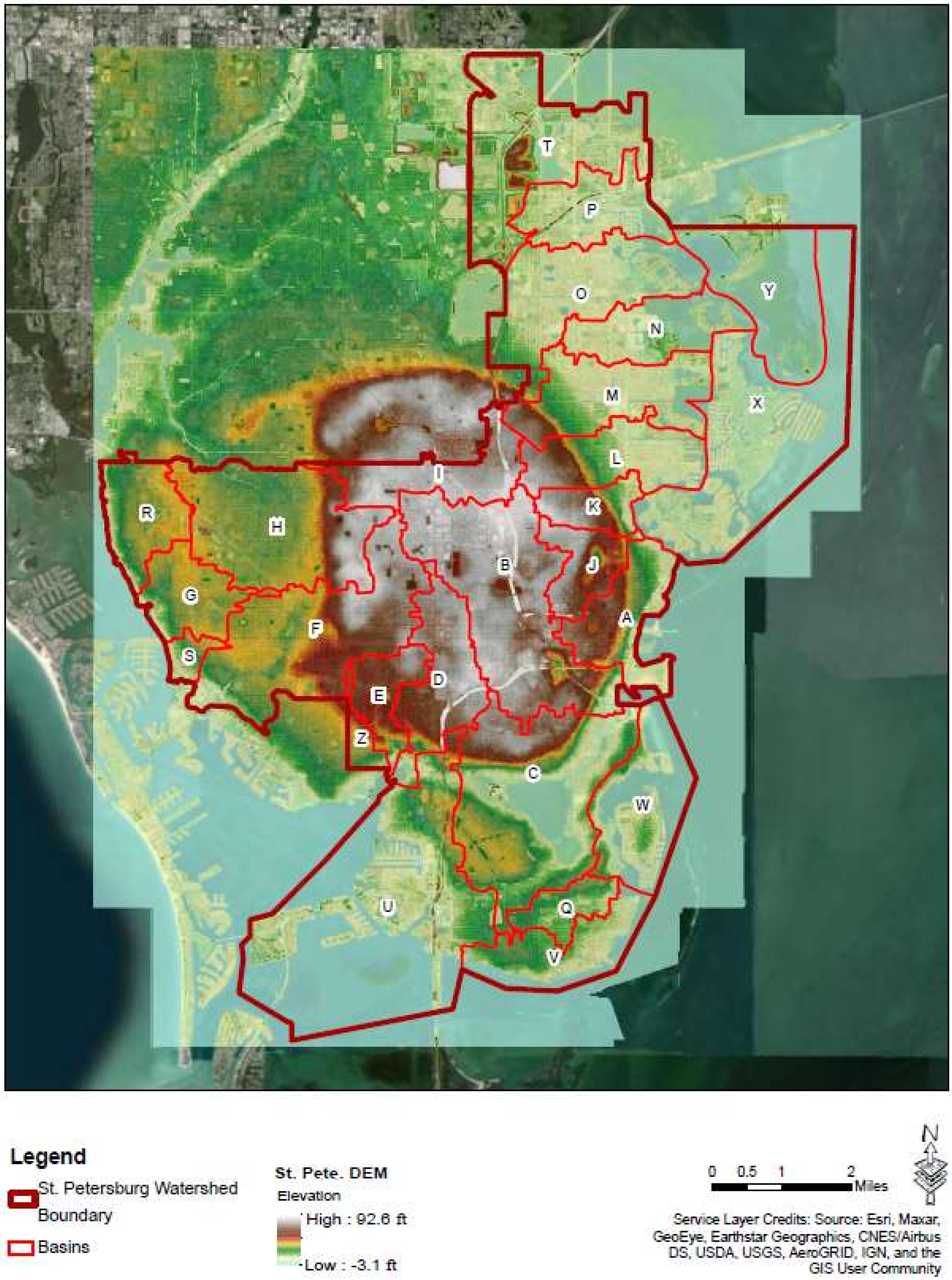


Figure 2-1. Stormwater Basins

Figure 2-2. Hydrologic Soil Groups within the St. Petersburg Watershed

3. Watershed Evaluation

During the Watershed Evaluation phase of the project, CH2M developed features and processed data to establish the Watershed Management Plan framework for the City of St. Petersburg Watershed. These steps included:

- Collection and assembly of existing topographic and watershed feature data
- Geographic information system (GIS) processing, for hydraulic inventory based on the City's stormwater inventory and Atlas sheets, Environmental Resource Permits (ERPs), As-Built Plans, existing inventory data management, and initial model features
- Topographic data voids and issues evaluation and corrections for the voids
- Pre-field reconnaissance evaluation, data acquisition methods and survey
- Data refinement and development
- Geodatabase of initial model features
- Watershed Evaluation Report

A detailed Watershed Evaluation Report was submitted to the City in October 2020. Where necessary, further refinements to the model features were performed during the Watershed Model Development phase as described in the following sections.

4. Watershed Model Parameterization

CH2M conducted the hydrologic and hydraulic model parametrization for the model features, sub-basins, links, and nodes developed during the Watershed Evaluation phase. The model parameters were stored and populated in appropriate data tables in the Geographical Watershed Information System (GWIS) geodatabase that was developed for the watershed. The model-ready GWIS geodatabase was imported into the ICPR4 model interface after the parameterization was completed.

4.1 Hydrologic Parameters

The hydrologic parameters used to estimate runoff from the sub-basins include Green-Ampt Infiltration parameters, which are based on the soils and land use characteristics of the watershed and time of concentration (Tc).

4.1.1 Green-Ampt Infiltration Methodology

In discussions with the City, District, and the peer reviewer, the Green-Ampt Infiltration methodology was the agreed-upon methodology for rainfall-runoff estimation for the City of St. Petersburg watershed. The Green-Ampt methodology requires soils and land use information to develop parameters required to estimate rainfall runoff.

4.1.1.1 Soils

The watershed soil information was obtained from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database (NRCS 2020). These data have been clipped to the watershed boundary. While Curve Number methodology is not being employed for this project, hydrologic soil group descriptions across the watershed are good indicators of locations of high infiltration or runoff potential. The soil group descriptions will provide an excellent check early in the project to gain an understanding of watershed runoff potential. Soils across the watershed were classified into the following four main hydrologic soil groups (HSGs):

- Group A – Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. These soils typically contain less than 10 percent clay and more than 90 percent sand or gravel. HSG A comprises 16 percent of the watershed.
- Group B – Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is generally unimpeded. These soils typically contain 10 to 20 percent clay and 50 to 90 percent sand. HSG B comprises 14 percent of the watershed.
- Group C – Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission in the soil is somewhat restricted. These soils typically contain 20 to 40 percent clay and less than 50 percent sand. No HSG C was classified within the watershed.
- Group D – Soils in this group have high runoff potential when thoroughly wet. Water transmission in the soil is restricted or very restricted. These soils typically contain greater than 40 percent clay and less than 50 percent sand. No HSG D was classified within the watershed.

Some soils may have dual classifications, such as Groups A/D (31 percent), B/D (2 percent), and C/D (10 percent) soils, if they can be adequately drained. The first letter denotes the soil's condition when adequately drained, and the second letter denotes the soil's condition when undrained. Typically, soils in the project area are wet under natural conditions and should be classified as Group D, based on a constraining layer or water table restricting the hydraulic conductivity. Additional soils identified within the watershed include Water (19 percent), as well as Dumps and Urban Land (combined 8 percent), which do not include an HSG.

Based on the NRCS soil types, the required soil parameters for ICPR4 for this methodology are as follows:

- Vertical Saturated Hydraulic Conductivity (Kv)
- Field Capacity (θfc)
- Residual Moisture Content (θr)
- Saturated Moisture Content (θsat)
- Wilting Point (θwp)
- Pore Size Index (λ)
- Bubbling Pressure (ψb)
- Initial Depth to Water Table (Zi)

These parameters have been developed using both the NRCS SSURGO database information and the District's *Soil Data Retrieval and Processing Tool* was used to populate the above listed required soil parameters for ICPR4 simulations. The soils spatial extents and physical properties information are stored in the GWIS_SOIL feature class and related table ICPR4_GREEN_AMPT_ZONES in the GWIS geodatabase. The District's soil tool allows the user to select -1/3rd-bar or -1/10th bar matric potential for the estimation of Field Capacity, θFC, and is based on the initial depth to the water table aquifer (WTA). The current model has been assigned Green-Ampt soil moisture parameters, specifically Field Capacity, θFC, using the results from the -1/10th bar matric potential option, as the vast majority of the watershed soils (88 percent) show depth to WTA less than 3 feet below the ground surface. Soil moisture and Green-Ampt parameters may be revisited during calibration, as needed. Appendix A presents a table of Green-Ampt parameters as populated from the soil processing tool, and includes the representative HSG for illustrative purposes.

4.1.1.2 Land Use Classification

The land use files were obtained from both the District and the City. The land use categories under the two land use files differ in residential classifications. Jacobs reconciled the two land use files and appropriately assigned the land use classification and parameters for all land use polygons in the City. Appendix A presents the resulting land use of combining City's and District land uses.

The following two land use parameters are required for the Green-Ampt methodology:

- Directly connected impervious area (DCIA)
- Percent impervious

Jacobs developed the DCIA and impervious area parameters primarily based on the District's land use lookup table. However, after further review with the City's input, the values are modified as appropriate and provided in the comments field. These values were submitted to the City to get approval before incorporating them into the GWIS geodatabase. Table 4-1 presents the approved land use parameters, DCIA, and percent impervious to be used in the model.

Table 4-1. Land Use Lookup Table for City of St. Petersburg Master Plan Update

Primary source of Percent Impervious and Percent DCIA is District Land use lookup table. These parameters are further reviewed and updated as needed per the updated land use file

FLUCCS CODE	Land Use Description	Percent Impervious	Percent DCIA	Comment
1100	RESIDENTIAL LOW DENSITY < 2 DWELLING UNITS PER ACRE	25	15	
1200	Residential Medium Density 2-5 dwelling units	40	22	Per email conversations with the City, Single Family land use category per City's land use file is represented as Residential Medium Density in the updated land use GIS layer. *Although the FLUCCS map and City land use map shows most of the residential area in the city as high-density, for the purposes of the watershed master plan these were considered medium density with a DCIA of 22*
1300	RESIDENTIAL HIGH DENSITY	60	50	
1330	Residential high density - Duplex/Triplex	69	35	
1320	Residential high density - Mobile Home	32	32	Changed DCIA % from 25 to 32 per email conversation with the City
1310	RESIDENTIAL/MULTI-FAMILY	60	50	
1400	COMMERCIAL AND SERVICES	85	80	
1500	INDUSTRIAL	70	60	
1700	INSTITUTIONAL	60	50	
1800	RECREATIONAL	1	0	
1820	GOLF COURSES	1	0	
1900	OPEN LAND	1	0	
2140	AGRICULTURAL	0	0	
3200	SHRUB AND BRUSHLAND	0	0	
4100	UPLAND HARDWOOD - CONIFEROUS MIX	0	0	
4110	PINE FLATWOODS	1	0	
5100	STREAMS AND WATERWAYS	100	100	
5200	LAKES	100	100	
5300	RESERVOIRS	100	100	

Table 4-1. Land Use Lookup Table for City of St. Petersburg Master Plan Update

Primary source of Percent Impervious and Percent DCIA is District Land use lookup table. These parameters are further reviewed and updated as needed per the updated land use file

FLUCCS CODE	Land Use Description	Percent Impervious	Percent DCIA	Comment
5400	BAYS AND ESTUARIES	100	100	
6104	WETLAND HARDWOOD FORESTS	100	100	
6120	MANGROVE SWAMPS	100	100	
6150	STREAM AND LAKE SWAMPS (BOTTOMLAND)	100	100	
6210	CYPRESS	100	100	
6300	WETLAND FORESTED MIXED	100	100	
6400	VEGETATED NON-FORESTED WETLANDS	100	100	
6410	FRESHWATER MARSHES	100	100	
6420	SALTWATER MARSHES	100	100	
6430	WET PRAIRIES	100	100	
6440	EMERGENT AQUATIC VEGETATION	100	100	
6530	INTERMITTENT PONDS	100	100	
6600	SALT FLATS	100	100	
7100	BEACHES OTHER THAN SWIMMING	100	100	
7200	SAND OTHER THAN BEACHES	100	100	
8100	TRANSPORTATION	70	60	
8200	COMMUNICATION	5	2	
8300	UTILITIES	70	60	

In the GWIS geodatabase, land use type and FLUCCSCODE information were populated in the GWIS_LANDUSE feature class. The associated ICPR4_IMPERVIOUS_ZONES data table was populated as follows: Impervious [pct], which represents the percentage of impervious area; DCIA [pct], which represents the percentage of DCIA.

4.1.1.3 Green-Ampt Parameter Processing

The ICPR4_IMPERVIOUS_ZONES data table represents the DCIA's imperviousness per sub-basin. The ICPR4_GREEN_AMPT_ZONES data table captures the soil parameters. Within GIS and before importing to ICPR4, the representative spatial features GWIS_SOIL and GWIS_LANDUSE will be intersected per sub-basin to account for the varying combinations of soils and land use properties.

The land use and soil layers were incorporated into the model using the data tables ICPR4_GREEN_AMPT_ZONES and ICPR4_IMPERVIOUS_ZONES. These data tables will be populated based on the soil groups and land use types discussed in Sections 2.2.1 and 2.1.2, respectively, to estimate runoff for each area and composite runoff for the sub-basin area. Infiltration ceases once the soil is saturated and water table at land surface.

4.1.2 Time of Concentration

Methodology from USDA's *Urban Hydrology for Small Watershed Technical Release 55 (TR-55)* (USDA 1986) was used to calculate Tc. Tc was estimated by analyzing the longest possible flow path of combined overland flow, shallow concentrated flow (curb flow), and pipe conveyance for each basin. When considering pipe conveyance, Jacobs stopped calculating Tc as it is assumed water has left the sub-basin if Tc lines terminate at a pipe or other conveyance system out of the sub-basin.

The ArcHydro tool ("Compute Time of Concentration" Tool) was used to develop the longest flow path and other preprocessing aspects of the Tc calculations. The tool-produced longest flow path was reviewed and was used to develop a spreadsheet to estimate the Tc by calculating the following three components: sheet flow, shallow concentrated flow, pipe conveyance and/or channel flow. Elevation data required for these calculations was extracted from the DEM, and Manning's n was estimated per the land use characteristics along the flow path. Manning's n used for the calculations was based on the land use type and these are presented in the Tc calculation spreadsheets provided in the submittal. The "paved or unpaved" for shallow concentrated flow portion was assigned based on the land use type. The land uses, such as, agricultural, open land, flatwoods, that are with natural cover were considered "unpaved" and the land uses, such as, commercial, institutional, residential were considered 'paved' for shallow concentration flow portion estimation. It is assumed that once the Tc longest flow path hits the edge of a pond or other "wet area," such as wetlands or channels, the flow path will stop. Additionally, it is assumed that once a Tc flow path becomes either a pipe conveyance or channel flow, the Tc will remain that component type until the end of the longest flow path, regardless of change in conveyance. Lastly, if the longest flow path segment is found to have a negative slope, the longest flow path was re-evaluated to identify reasonable modifications or to determine whether the longest flow path should end before this segment.

The ICPR_Basin feature class contains the calculated Tc values that was included to the nearest 10th place. All Tc values less than 10 minutes were adjusted to a standard 10 minutes per Florida Department of Transportation (FDOT) drainage guidance. All Tc values greater than 120 minutes from the initial calculations were re-evaluated for reasonableness and updated as needed. The final Tc values were added to the ICPR_BASIN feature class.

4.2 Hydraulic Parameters

The hydraulic parameters are developed for all the model links and nodes. Sections 3.1 through 3.3 provide the details of the feature classes and their related data tables in the GWIS geodatabase that store these parameters.

4.2.1 Model Nodes

Model nodes are stored in ICPR_NODEs within the GWIS geodatabase. The primary parameters required for model nodes are initial stages and the stage/area or time/stage relationship, depending on type of the node.

4.2.2 Node Initial Stages

The node initial stages have been populated in the ICPR_NODE feature class based on the following known information:

- Seasonal high water tables for the water bodies, such as ponds and lakes, to be obtained from ERP documents; City Atlas information; or desktop vegetation/terrain evaluations of wetland areas using the DEM and aerial imagery
- Pipe inverts for the inlets, drop structures, and/or manholes representing pipe nodes
- DEM elevation data where seasonal high water table information is not available
- Tailwater condition (Mean High Water [MHHW], Datum: NAVD88) near the tidal areas where applicable was obtained from the Station ID: 8726520, St. Petersburg, Tampa Bay, FL – National Ocean and Atmospheric Administration (NOAA) website (https://tidesandcurrents.noaa.gov/datums.html?datum=NAVD88&units=0&epoch=0&id=8726520&name=St.+Petersburg&state=FL)

4.2.3 Node Stage/Area and Time/Stage Relationship

Basin collection nodes and junction nodes, represented as STAGE/AREA, in the ICPR_NODE feature class require that the Stage/Area relationship be defined for each node. The Stage/Area relationship is stored in the ICPR_NODE_STORAGE data table in the GWIS geodatabase.

4.2.3.1 Stage/Area

STAGE/AREA nodes represent either basins or junction nodes, such as inlets, control structures, or outfalls. If the STAGE/AREA node represents a basin's storage capacity, the STAGE/AREA was created based on "slices" of the DEM in increments of 0.25-foot slices. A 0.25-foot slice increment is reasonable considering the size of the watershed and the level of detail included in sub-basin delineation.

If the STAGE/AREA node representing a basin has a directly connected inlet, an additional STAGE/AREA value was added to capture the area within the structure. Additionally, to ensure that the STAGE/AREA of a node representing a basin does not extrapolate beyond the highest stage values and incorrectly see additional storage in the basin, the largest STAGE/AREA value will be duplicated at an additional STAGE value of elevation + 0.25 foot above the highest elevation and where the AREA value remains the same.

4.2.3.2 Manhole

Nodes representing manhole stormwater features (GWIS MANHOLE type) were modeled as STAGE/AREA nodes. ICPR4 does not have a provision to explicitly model MANHOLE structure. For these nodes, stage/area was not explicitly assigned, instead, ICPR4 defaults the area within the structure to 100 square feet.

4.2.3.3 Time/Stage

TIME/STAGE nodes represent boundary condition nodes and will either have a fixed TIME/STAGE value or will have a varying TIME/STAGE value. The TIME/STAGE nodes were populated from either tidal or gauge information or neighboring model results, depending on what is applicable to that node. Results from Joe's Creek, Bear Creek, and Roosevelt Creek watershed models, provided by the County, were used to populate time/stage data at the City's shared boundary with these watersheds. The data was not available for other watersheds, such as Sawgrass Lake. Where data is not available, Jacobs assumed the top of pipe elevation for the fixed TIME/STAGE value. In this part, ICPR_NODE_TIMESTAGE tables was populated.

4.2.4 Model Links

The model links are stored in the ICPR_LINK feature class. The associated parameters described in Sections 4.2.1 through 4.2.5 are stored in appropriate data tables. The City's watershed primarily contains link types of pipes, weirs, channels, and drop structures.

4.2.4.1 Pipe

The pipe link parameters are developed and stored in the data table PIPE_BARREL with the following required parameters:

- **Upstream/Downstream Invert Elevations**: Populated based on City- and District-provided information, survey, FDOT or ERP plans, and assumptions.
- **Upstream/Downstream Shape Description**: Populated based on the shape description on the end type of the pipe. However, not all end type descriptions are available in the ICPR4, and the best suitable within the available selection will be used.
- **Upstream/Downstream Rises and Spans**: Populated based on City- and District-provided information, survey, FDOT or ERP plans, field reconnaissance, and assumptions.
- **Upstream/Downstream Inlet Description**: Populated based on the inlet description. However, not all descriptions are available in the ICPR4, and the best suitable within the available selection will be used.
- **Upstream/Downstream Manning's N**: Populated based on pipe material. Polyvinyl chloride = 0.1, reinforced concrete pipe = 0.012, and corrugated metal pipe = 0.022.
- **Pipe Length**: Populated based on City- and District-provided information, survey, FDOT or ERP plans, GIS and aerial, and assumptions.
- **Entrance Loss, Exit Loss**: Populated based on ICPR4 guidance.
- **Material Type Description**: Populated based on City- and District-provided information, survey, FDOT or ERP plans, field reconnaissance, and assumptions.
- **Bend Losses:** In large scale regional models with significant detail included, as is the case here, it is not a common practice to include these losses. However, we evaluated the pipes that require bend losses and assumed a constant 0.5. We further reviewed these during the calibration phase and adjusted as necessary.
- **Federal Highway Administration (FHWA) Culvert Code:** FHWA codes are not used in the model. Per ICPR guidance, these codes may not be required if all other pipe coefficients are appropriately defined.

4.2.4.2 Channel

The channel links were parameterized and stored in the data table CHANNEL. Within the CHANNEL table, the data fields were populated with details of the source of information, as follows:

- **Channel Length**: Populated based on aerial and DEM review.

- **GWIS Material Type Description**: Populated as either concrete or natural, based on aerial review. Material Type Description is not necessarily an ICPR4 model parameter, but it helped guide with assigning appropriate Manning's n for the channel.
- **Upstream/Downstream Shape Description**: Populated as an "irregular" shape description and has correlating ICPR_XSECT features with cross-section station/elevation data (for almost all channel features).
- **Upstream/Downstream Invert Elevation***:* Populated based on data received from the City or District or acquired from the DEM value and modified appropriately, if necessary. Modifications will occur by connecting upstream and downstream conveyance features, such as concrete box culverts, which should have inverts that match the channel bottom elevations.
- **Upstream/Downstream Manning's N***:* Populated based on channel type, either concrete or natural material coverage.
- **Entrance/Exit Loss Coefficient***:* From ICPR4 guidance, channel entrance loss was considered negligible and was set to 0. For exit loss, if a channel discharges to a pond, lake, or reservoir, the exit loss was set to 1. For all other discharging sources where the flow carries into the next link, the exit loss was set to 0.
- **Bend Loss Coefficient***:* Bend losses were applied to those bends that are greater than or approximate to a 90-degree angle using ICPR4 guidance. For smaller channels, an angle less than 90 degrees is considered negligible.

4.2.4.3 Weir

The weir type links are parameterized and stored in the data table WEIR. The information related to the WEIR table was populated based on City- and District-provided information, survey, FDOT or ERP plans, field reconnaissance, and assumptions. Within the WEIR table, the following data fields will be populated with details of the source of information, depending on whether the WEIR table entry represents a structural weir or an overland flow weir, as follows:

- **Weir Shape**: "Irregular" for all overland flow weirs. "Rectangular," "trapezoidal," "circular," etc. for all structural weirs applicable.
- **Weir Type Description**: "Sharp" for all structural weirs. "Broad" for all overland flow weirs that are not associated with overtopping a roadway. "Paved" or "gravel roads" for overland flow weirs that represent overtopping roads.
- **Weir Span/Rise**: Only populated for structural weirs because overland flow weirs will have dimensioning from cross-sections.
- **Weir Invert Elevation**: Assigned based on the structural weir information or assigned based on the overtopping lowest elevation for overland flow weirs.
- **Weir Discharge Coefficient**: 3.2 for all structural weirs, and varying coefficients for overland flow weirs, which will be determined based on land use types at the overland flow weirs' overtopping lowest elevation for the correlating cross-section.
- **Orifice Discharge Coefficient**: 0.6 for all values.
- **Material Type Description**: Assigned as "concrete," "natural," or "paved."
- **Weir Orientation**: "Vertical" for all overland flow weirs with appropriate attention to type of overtopping land use. Either "vertical" or "horizontal" for structural weirs, as appropriate.

4.2.4.4 Drop Structure

The drop structure types are parameterized using data tables WEIR and PIPE_BARREL. As discussed in Sections 3.2.1 and 3.2.3, drop structures represent a conveyance where the weir attributes are recognized by the ICPR4 model first and followed by the pipe details. These features may represent control structures or inlet structures at a higher elevation than the correlated basin's lowest elevation.

4.2.4.5 Rating Curve

The rating curve link type represents bridges, pumps, or forced flow of water at an identified flow rate. These features were parameterized and stored in the ICPR4_RATINGCURVE data table. The data fields that were populated accordingly are ELEV_ON, ELEV_ON_NODE, ELEV_OFF, and ELEV_OFF_NODE and the related operating tables (pumps, or other prescribed inflow) were developed and incorporated in the model. Bridge rating curves have been developed in Hydraulic Engineering Center River Analysis System (HEC-RAS) and the resulting "family of rating curves" from HEC-RAS have been copied directly into the ICPR4 model; all other rating curves have been developed based on either ERP- or City-provided data.

Sixteen rating curve links were identified throughout the watershed; of those identified, the following have been parameterized into the model based on available ERP (as-built data), other plan information, or field work.

- 6 pump type rating curves
- 10 bridge type rating curves

For pump stations where data were available, the previous SWMM4 models were reviewed and compared to pump design documentation provided by the City. The pump design documentation provided by the city established the operating conditions for each pump, including:

- Pump-on elevations
- Pump-off elevations
- Upstream and downstream seasonal high and low water elevations
- Original pump design size horsepower and RPM
- Original pump design normal operating head

Upon gathering the information, pump manufacturers were contacted to obtain cataloged pump curve data that was used to establish expected flow rates under minimum and maximum head conditions. The following Figure 4-1 is an example of a pump curve obtained from Cascade Pump Company for the pumps located at 85th Ave. NE.

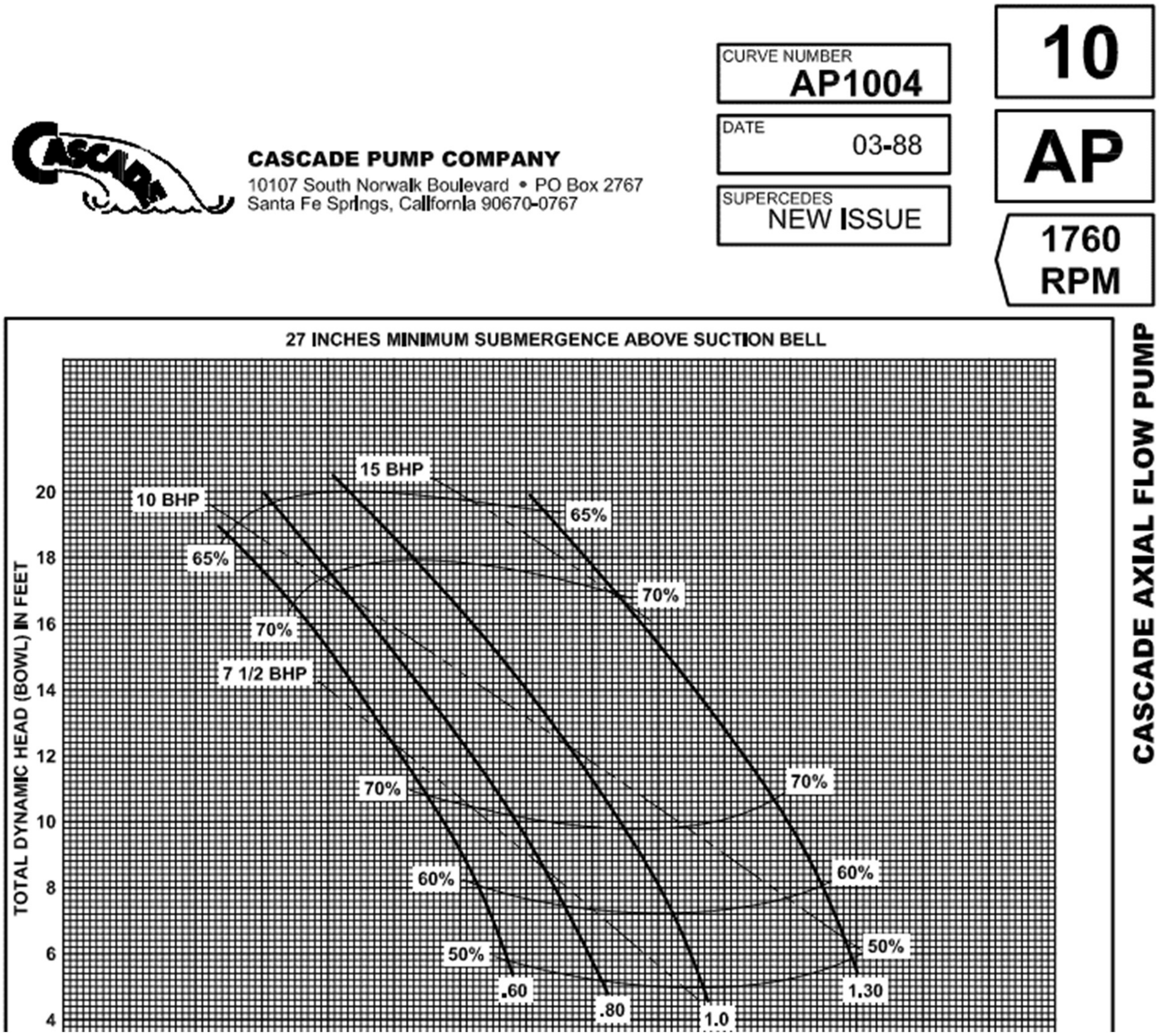


Figure 4-1. An Example of a Pump Curve, Obtained from Cascade Pump Company for the Pumps Located at 85th Avenue Northeast

The information was reviewed and put in the appropriate GWIS format with the appropriate number of pumps represented at each location as established by the design documentation.

For rating curves identified as bridges, with piers or other known obstructions within the channel, HEC-RAS models were built at each crossing to develop GWIS/ ICPR inputs referred to as the Family of Rating Curves, which provide a range of flow rates over variable headwater (HW)/tailwater (TW) conditions.

The following methodology was used to build the representative HEC-RAS model per bridge crossing.

- Representative cross-sections were cut from light detection and ranging (LiDAR) DEM and where plan data were available, channel inverts were modified per as-built or plan information.
- Cross-section spacing including meanders and bends was represented as the distances between the left of bank, right of bank, and main channel.

- Constrictions and expansions were represented in the cross-sections, where appropriate.
- Internal bridge cross-sections were developed including revisions to Manning's n coefficient where riprap or other rubble used for scour control/abatement.
- Channel Manning's n of 0.035 was standardized to represent a natural maintained condition.
- Bridge information including deck width, thickness/height, pier size and spacing was developed from plans/as-builts.
- The HEC-RAS modeling approach was either the standard energy equation or a combination of available low-flow calculation methods with the highest energy answer used in Family of Rating Curve calculations.

The following figures (Figures 4-2 through 4-5), showing an example at La Plaza Avenue South bridge, present the general data and HEC-RAS input variables employed for the Family of Rating Curve calculations input to the GWIS Generic Database (GDB) and ultimately used for model development.

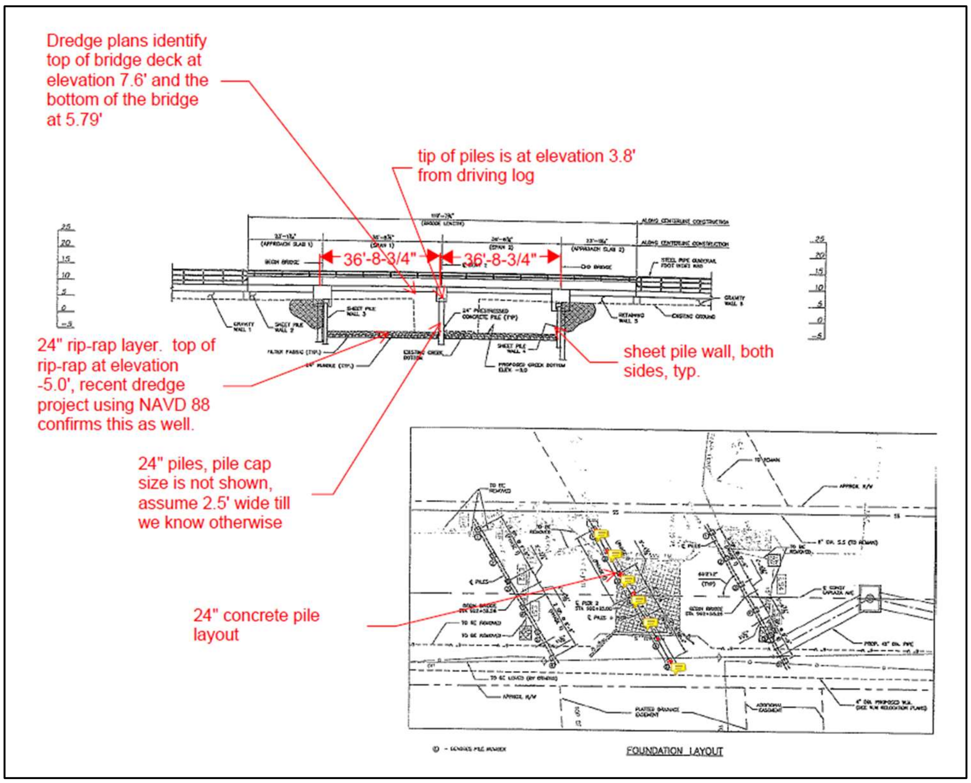


Figure 4-2. As-built Plan for RF11461 Crossing Over Bear Creek at La Plaza Avenue South

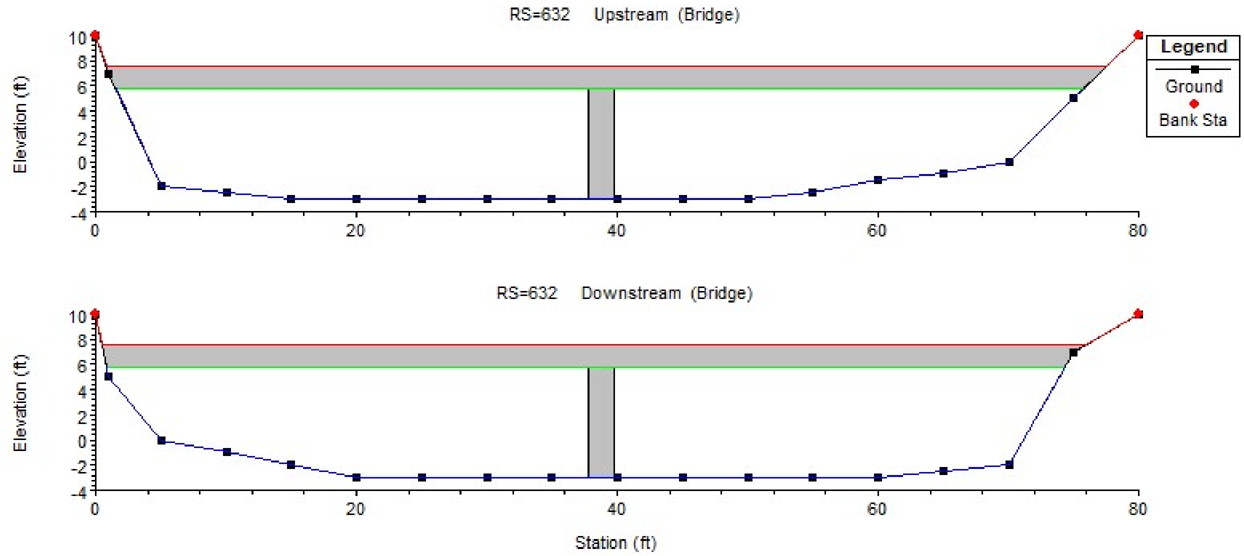


Figure 4-3. HEC-RAS Parameterization of La Plaza Avenue South Bridge

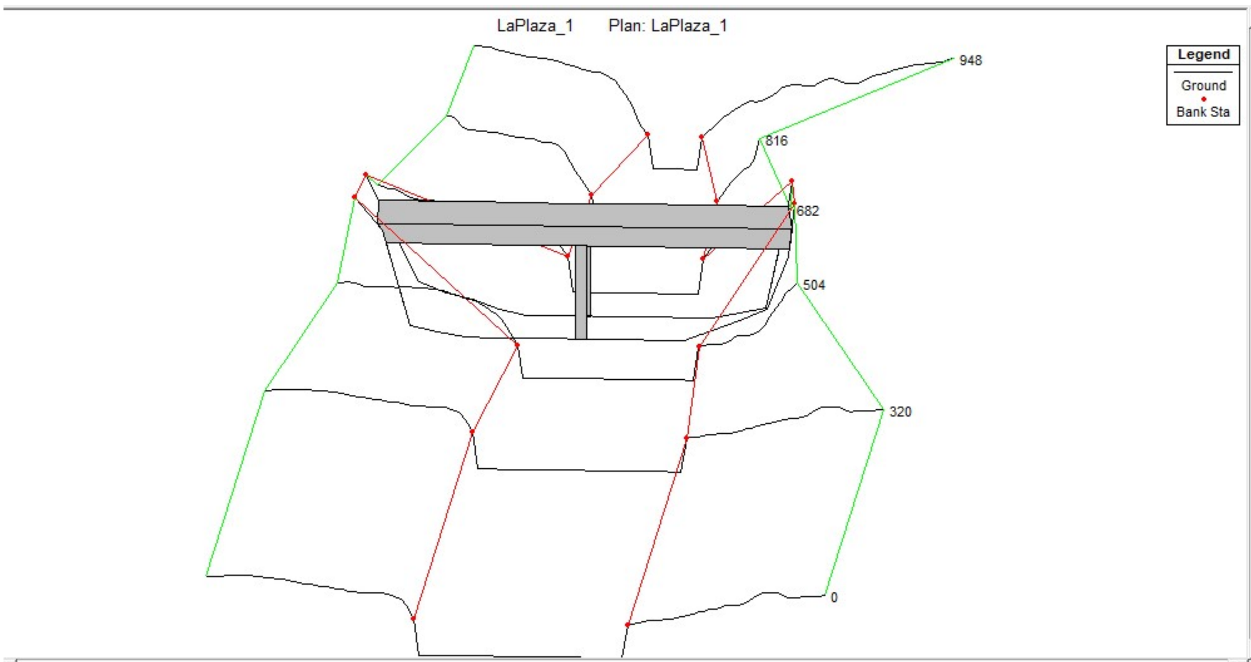
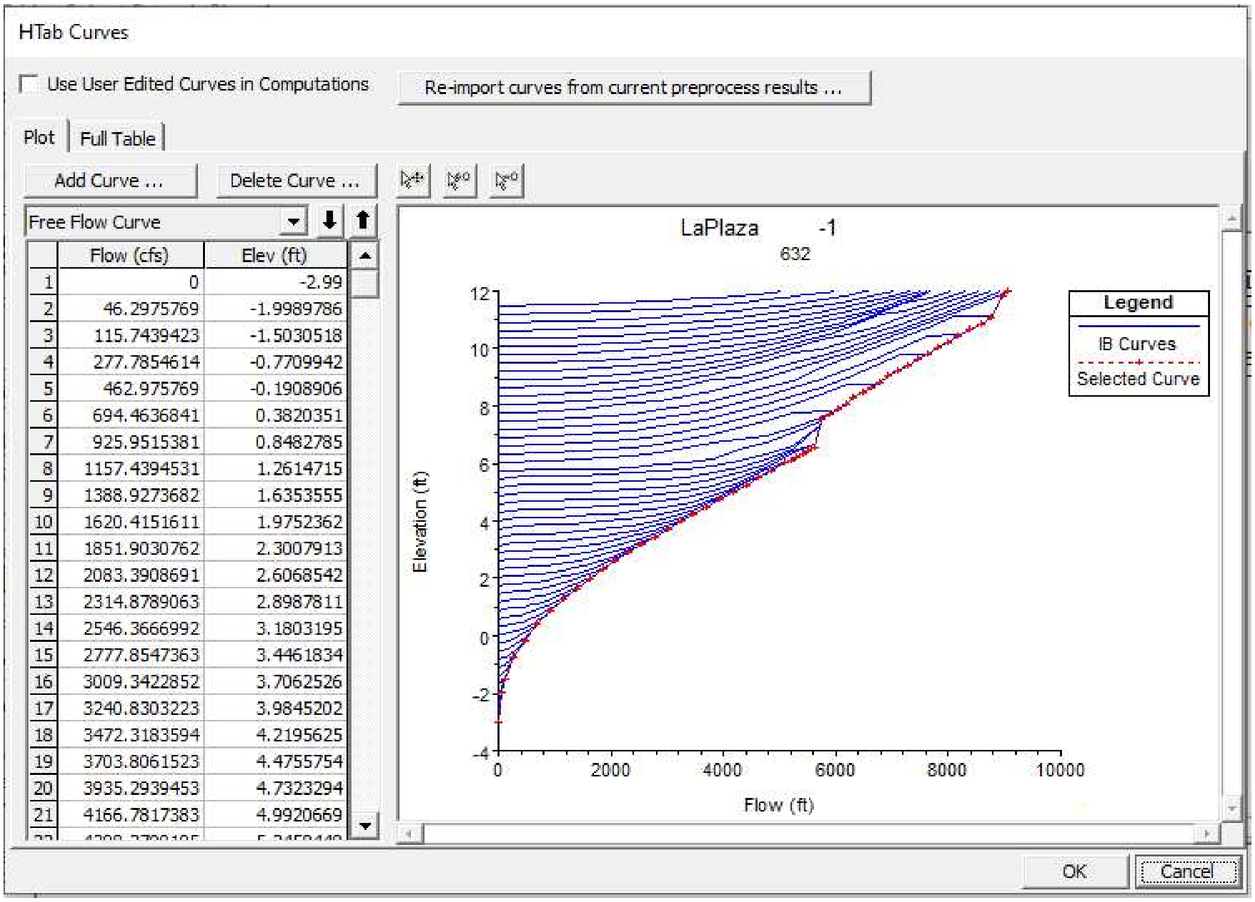


Figure 4-4. HEC-RAS X Y Z Perspective Plot for La Plaza Avenue South Bridge



	Flow (cfs)	Elev (ft)
1	0	-2.99
2	46.2975769	-1.9989786
3	115.7439423	-1.5030518
4	277.7854614	-0.7709942
5	462.975769	-0.1908906
6	694.4636841	0.3820351
7	925.9515381	0.8482785
8	1157.4394531	1.2614715
9	1388.9273682	1.6353555
10	1620.4151611	1.9752362
11	1851.9030762	2.3007913
12	2083.3908691	2.6068542
13	2314.8789063	2.8987811
14	2546.3666992	3.1803195
15	2777.8547363	3.4461834
16	3009.3422852	3.7062526
17	3240.8303223	3.9845202
18	3472.3183594	4.2195625
19	3703.8061523	4.4755754
20	3935.2939453	4.7323294
21	4166.7817383	4.9920669

Figure 4-5. HEC-RAS Family of Rating Curve Output for ICPR4 Model

Several rating curves identified as bridges did not have piers within the channel and have been modeled as a trapezoidal cross-section with a top clip to represent pressurized flow once simulated water levels dictate, or as box culverts. An example of field work confirming the assumption of a link not being a bridge is the link RF11561 modeled as a cross-section with top clip; generally located south of Gulfport Boulevard along Royal Palm Drive within the Pelican Creek golf course as presented on Figure 4-6.

Figure 4-6. Field View of Crossing at Royal Palm Dr. Looking North

An example of plan set review in combination with aerial/Google Earth review, confirming the justification of this bridge link at RT03640 to a pipe link, which is generally located north of 114th Ave N. and flowing under 28th St. N. Google imagery confirmed the box culvert and the corresponding plan set shown on Figure 4-7 confirms the same.

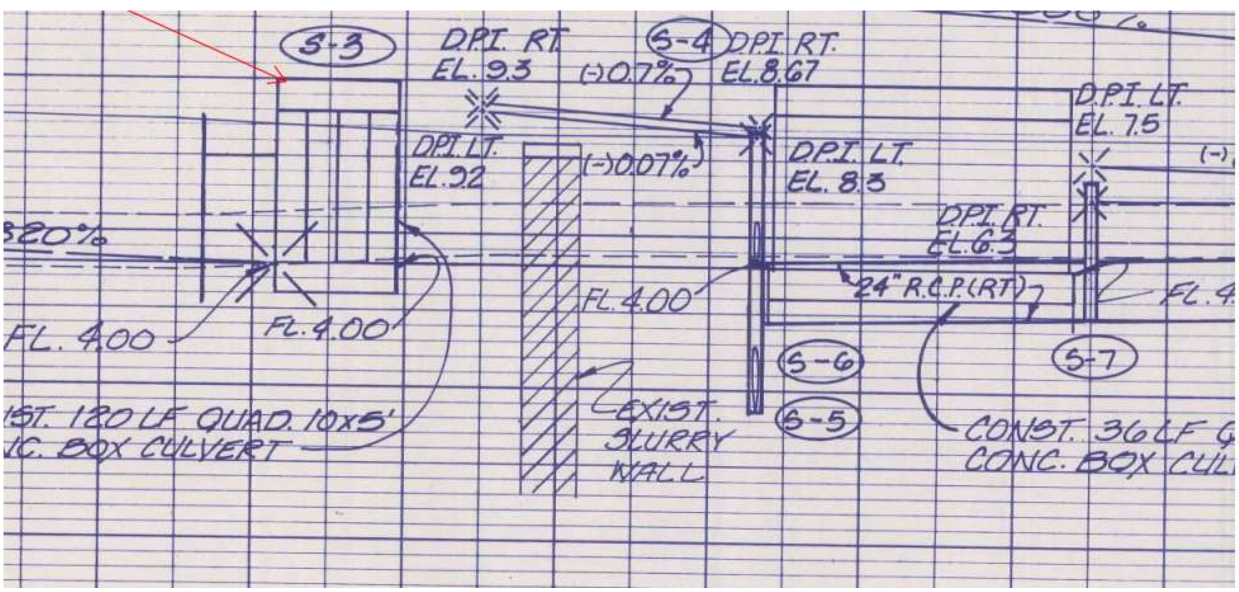


Figure 4-7. Plan Set of RT03460 Confirming Box Culvert

4.2.4.6 Percolation Links

At this time, no percolation links or areas of percolation have been identified as part of this Stormwater Master Plan update. However, with further review, percolation links may be re-evaluated in areas of significant percolation, or in areas where percolation might significantly impact floodplain delineation or node stages. Due to the highly urbanized nature of the watershed, combined with limited areas of percolation (i.e., dry pond or dry retention/detention), it is highly unlikely a significant loss would be present.

4.2.5 Channel and Overland Weir Cross-sections

The cross-sectional lines and data were developed for channel and overland weirs and stored in the ICPR_XSECT feature class and the ICPR_XSECT_STATIONS table, respectively. The cross-section data table presents cross-section dimensions and roughness coefficients in the data fields STATION, ELEV, and MANNINGS_N for the cross-section stations. These values were acquired from City- or District-provided information, survey, or extraction from the DEM.

For channel links in series, the cross-section used for the downstream portion of one channel link is the same cross-section used for the upstream portion of the next consecutive channel link in the series. Cross-sections were drawn left to right, looking downstream from the channel. Cross-sections for channel links were also drawn to capture the full extent of the channel to the uniform top of bank extents and were drawn to capture the following: channel flow changes; significant changes in channel depth, width, or shape; and changes in every upstream shape and downstream shape. Manning's n values for cross-sections were either applied within the CHANNEL data table for regularly shaped channels or within the ICPR_XSECT_STATIONS data table for irregularly shaped channels.

For weir links, the cross-sections were drawn along the sub-basin boundary representing the overland flow from one sub-basin to the other; these were drawn looking downstream. Manning's n values for irregular weir cross-sections were applied within the WEIR data table for regularly shaped channels or within the ICPR_XSECT_STATIONS data table for irregularly shaped channels.

Manning's n values were assigned based on the channel lining. Channel cross-sections often have different channel lining conditions (e.g., vegetation) between the channel bed, banks, and overbank areas. Our typical channel cross-section was developed from left top of bank to right top of bank. The Manning's n was applied based on the channel lining conditions within the channel. Table 4-2 includes various roughness values for these overbank flow areas depending on the vegetation present.

Table 4-2. Manning's Value Selection

Segment Code	Type of Channel and Description	n value	Notes:
a) Lined or Built-Up Channels:			
a	Concrete with trowel finish	0.013	Smooth concrete
b	Gravel bottom with sides of formed concrete	0.020	Fabriform
c	Gravel bottom with sides of rubble riprap	0.033	Loose rocks
b) Excavated or Dredged:			
Earth, straight and uniform:			
d	Clean	0.022	
e	Gravel	0.025	

Table 4-2. Manning's Value Selection

Segment Code	Type of Channel and Description	n value	Notes:
f	With short grass, few weeds	0.027	Maintained roadside swales
Earth, winding and sluggish:			
g	No vegetation	0.025	
h	Grass, some weeds	0.030	
i	Dense weeds or aquatic plants in deep channels	0.035	
Channels not maintained, weeds and brush uncut:			
j	Clean bottom, brush on sides	0.050	
k	Dense weeds, high as flow depth	0.080	
l	Dense weeds, high as flow depth and brush in the channel	0.120	
c) Natural Streams - Minor Streams (top width at flood stage < 100 feet):			
m	Clean, straight, full stage, no rifts or deep pools	0.030	
n	Same as above, but more stones and weeds	0.035	
o	Clean, winding, some pools and shoals	0.040	
p	Same as above, but some stones and weeds	0.045	
q	Sluggish reaches, weedy, deep pools	0.070	
r	Very weedy reaches, deep pools	0.100	
d) Natural Streams - Flood Plains:			
Pasture, no brush:			
s	Short grass	0.030	May also be used for overbank flow areas in developed areas.
t	High grass	0.035	
Cultivated areas:			
u	No crop	0.030	
v	Mature row crops	0.035	
w	Mature field crops	0.040	
	Brush:		
x	Scattered brush, heavy weeds	0.050	
y	Light brush and trees	0.060	Note the significant increase between y and z. A value of 0.150, z, should only be used in extremely overgrown sections.
z	Medium to dense brush	0.150	
e) Natural Streams - Major Streams (top width at flood stage > 100 feet):			
aa	Regular section with no boulders or brush	0.043	
bb	Irregular and rough section	0.068	

Source: Chow (1959).

Overland weir coefficients were developed based on the ground cover type identified from land use where the weir crosses the sub-basin boundary. Table 4-3 provides the typical overland weir coefficients used for various ground cover type.

Table 4-3. Typical Weir Coefficients Used for Various Ground Cover Types

Ground Cover Type	Weir Coefficient
Woods Dense Overbank	1.8
Woods Light Overbank	2.1
Dense Grass Overbank	2.1
Woods / Grass Mixed Overbank	2.2
Residential Grass Overbank	2.4
Graveled Surface Overbank	2.6
Concrete Overbank	2.8
Asphalt Overbank	2.8

5. Watershed Model Development

The City-wide watershed modeling data developed and discussed in previous sections were used to develop the City-wide model. Initially, major efforts were put in to export the City-wide GWIS GDB into ICPR4 model. However, due to the size of the GDB with more than 6 million data points, it was getting difficult to import the data into ICPR4. Both Streamline Technologies (ICPR4 developer) and the District were contacted on this matter and their suggestions were incorporated into the GDB to be able to import into ICPR4. After spending a few weeks on this process, the City, District, Jacobs, and Jacobs' team member Land and Water Engineering (LWES) agreed that continuing with the City-wide model would be inefficient and would impact the schedule significantly. Jacobs proposed dividing the watershed into seven groups as listed below and shown on Figure 5-1.

- LWES Groups
  - Group 1 (G, R & S) – Western Bayfront
  - Group 2 (A & J) – Downtown and Crescent Lake
  - Group 3 (B, C, D, E and Z) – Booker Creek, Lake Maggiore, and Clam Bayou
- Jacobs Groups
  - Group 4 (F) – Bear Creek
  - Group 5 (H & I) – Joes Creek
  - Group 6 (K, L, N, O, P, T, X, Y, M) – Northern Basins
  - Group 7 (Q, U, V, W) – Southern Basins

These groups were divided based on the hydrology. Availability of water level loggers in each group was also taken into consideration to be able to calibrate and verify each group. The interactions between the groups along the shared boundaries were captured along with boundary time/stage inputs from corresponding shared adjacent group ICPR model results. A few iterations were conducted by inputting results from one group to the other until a reasonable stage balance was obtained between the groups along the boundary. Boundary stage time series were input using the ICPR_TIME_STAGE table for Groups 4 to 7 and the BOUNDARY_STAGE_SET table for Groups 1 to 3.

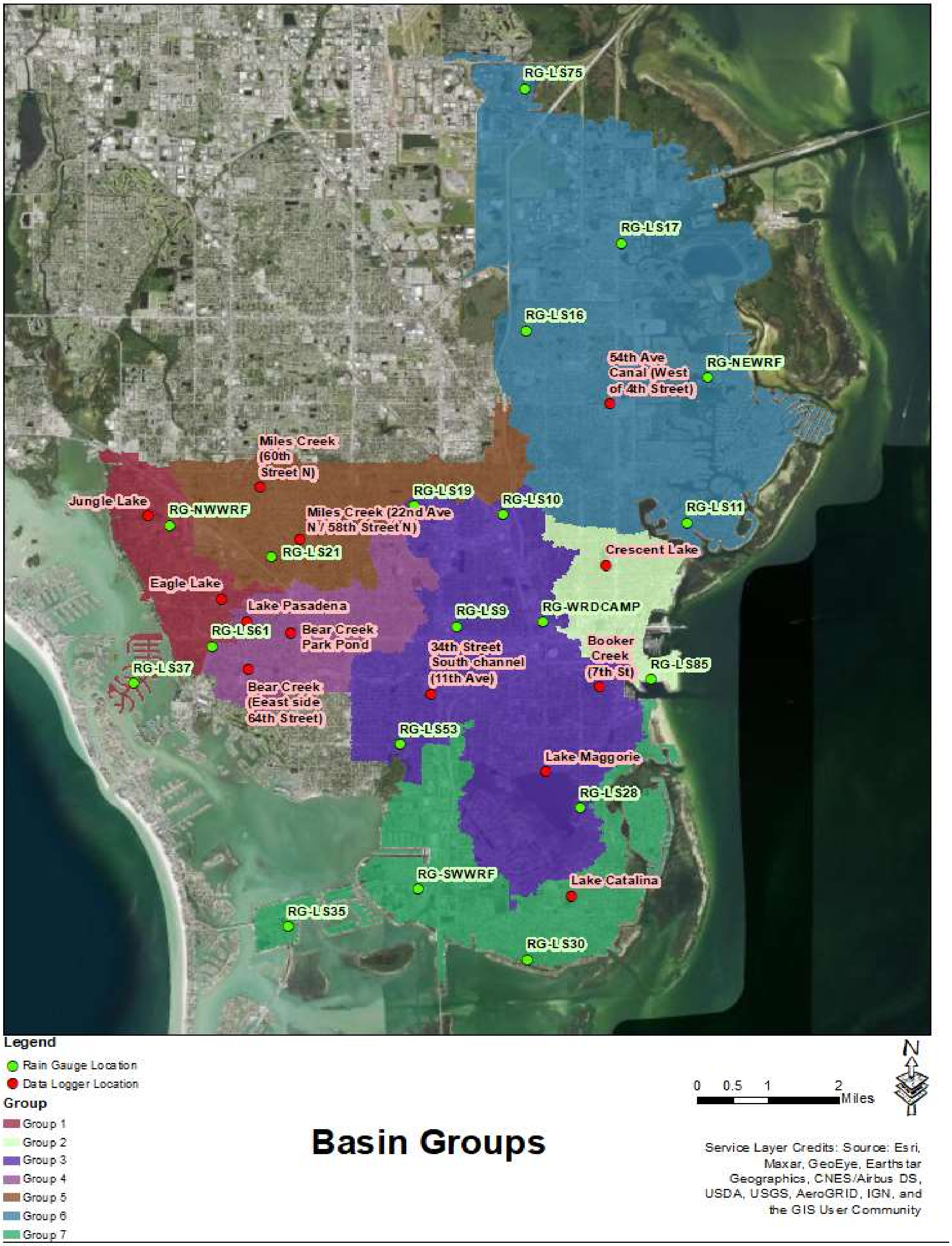


Figure 5-1. Basin Groups, Water Level Data Logger Locations, and City's Rain Gauge Locations

5.1 Grouped GDB Extractions

Following the decision to divide the City-wide model into groups, the full City-wide GDB was used to extract the GDB for each group, including model features, hydro network, and associated tables. In each group, nodes from other groups that are connected to the boundary links were also extracted and established as time/stage boundary nodes.

5.2 GDB to ICPR4 Transfer

Watershed model features in GWISv2.1 GDB were transferred into ICPR, Version 4 (ICPR4) using the ICPR 4 GWISv2.1 Data exchange/Migration Tools developed by Streamline Technologies, Inc. A snapshot of the toolset is shown on Figure 5-2. Upon importing into ICPR 4, testing was completed to ensure the proper transfer of data. A comparison between the total number of features in the ICPR 4 Model and the GWIS geodatabase was made to ensure all features transferred properly.

Figure 5-2. GWIS 2.1 GDB to ICPR4 Data Exchange/Migration Tools

5.3 Rainfall Data

The Florida Modified (FLMOD) rainfall distribution was used for the 100-year design storm events. The rainfall totals were extracted from District guidance and are presented in Table 5-1.

Table 5-1. Design Storm Events Rainfall Amounts

Design Storm Event	Rainfall Total (inches)	Data Source
100-year/1-day	12.00	District
August 2019	N/A	City/NEXRAD
November 2020	N/A	City/NEXRAD

For calibration and verification events, the City's rain gauge data and NEXRAD (where rain gauge data were not available or faulty) were used (meaning NEXRAD data was used to replace all rain gauge data for the particular event and at specific gauges). Based on the spatial spread of the 19 available rain gauges (shown on Figure 5-1), Theissen Polygons were developed and each sub-basin in the watershed was assigned a rain gauge based on the Theissen Polygon that the sub-basin intersects. The NEXRAD data was used in the November 2020 event simulation for gauges LS28, LS35, LS53, LS61, and LS85 due to missing information from the gauges during this time. NEXRAD data were compared with the respective rain gauge data to check for a known event where gauge data was not missing (such as the August 2019 event) to validate substituting the November 2020 event in lieu of missing data. Comparison analysis suggested, as shown in an example plot for LS28 on Figure 5-3, that using NEXRAD data is reasonable in lieu of missing data. Additional comparison of the rainfall data is presented on the following figures, where cumulative rainfall depths are shown across the watershed. As evidenced on Figure 5-4, the NEXRAD data (where available) compares very well to the City gauges, further supporting the use of NEXRAD data for modeling purposes.

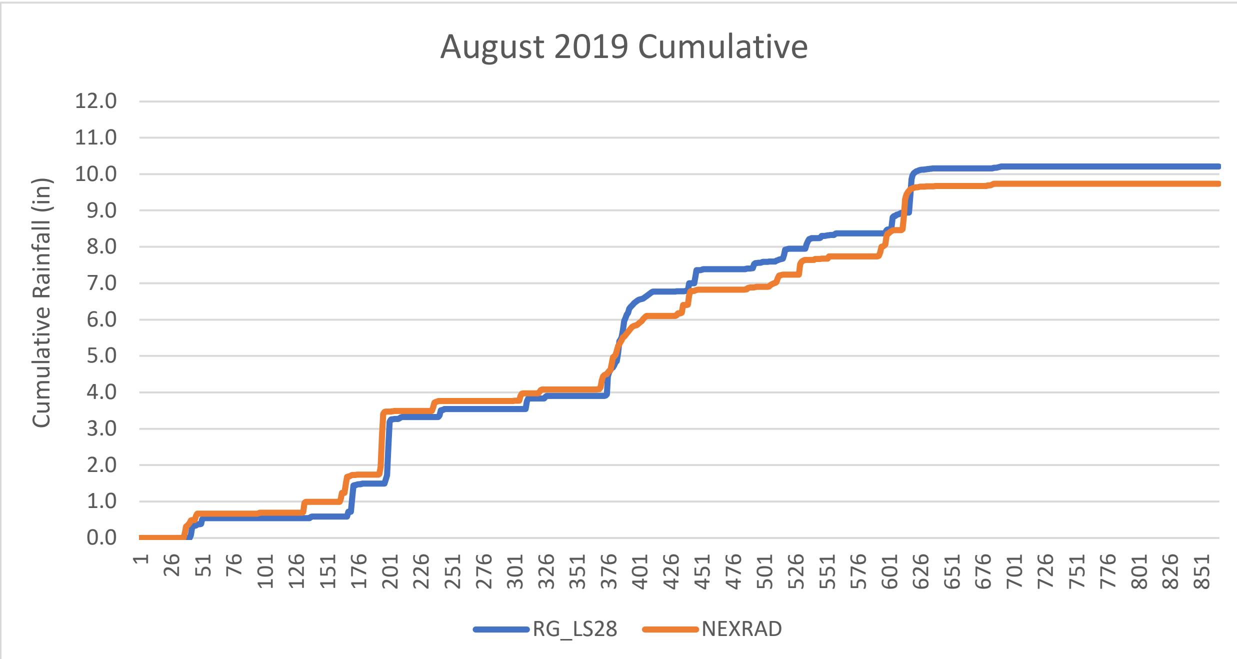


Figure 5-3. Comparison Plot of Rain Gauge LS28 with Corresponding NEXRAD Data for August 2019 Event

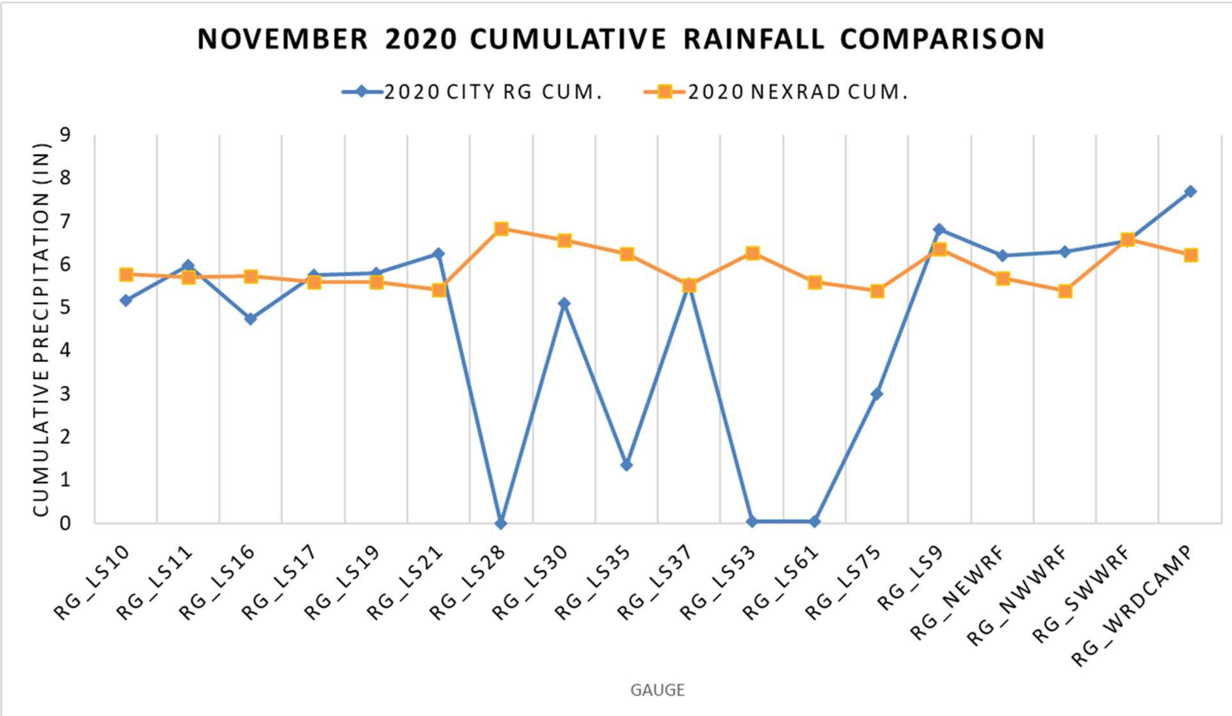
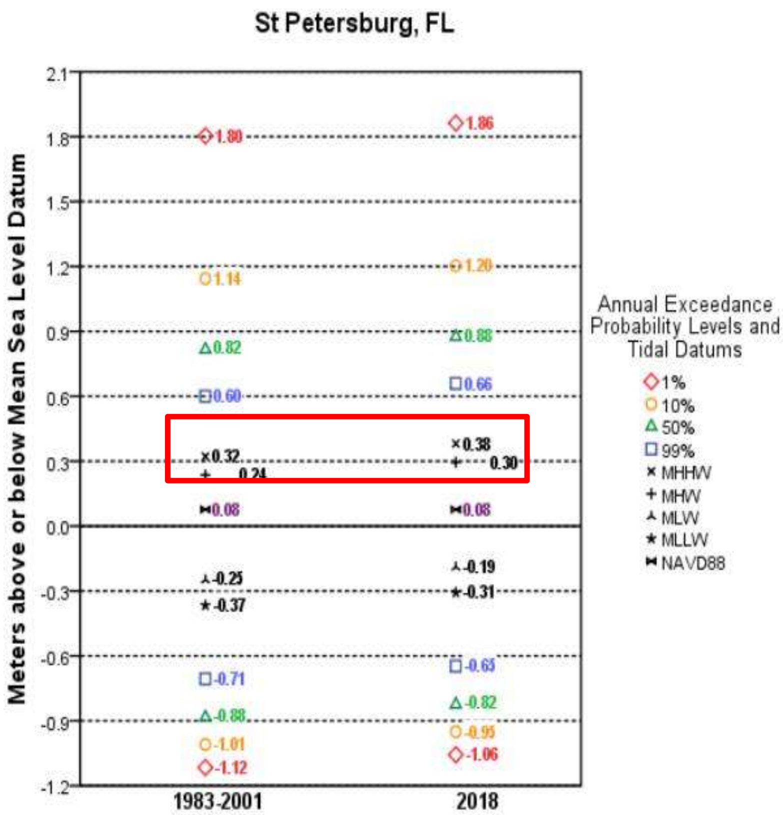


Figure 5-4. Comparison of Cumulative Precipitation from NEXRAD and City Gauge Data for November 2020 Event

Section 7 provides further details on the 100-year design storm that was used to delineate the 100-year floodplains. Though rainfall data was collected for multi-day events, due to the nature of the watershed the 100-year/1-day design storm was used for floodplain analysis, which is further justified in Section 6.

5.4 Tidal Information for Boundary Conditions

For the boundary nodes in the tidal areas, tidal boundary conditions were extracted from NOAA tidal gauge - 8726520 St. Petersburg, Tampa Bay, FL (https://tidesandcurrents.noaa.gov/stationhome.html?id=8726520). For design storm simulation, MHHW was used as a fixed stage boundary condition. The reported MHHW at the station is 0.78 foot NAVD88; however, the reported MHHW was based on the 01/01/1983 to 12/31/2001 epoch. To update the MHHW to the current conditions, NOAA analysis from the data from 2002 to 2018 was referenced, a comparison of MHHW based on previous epoch and updated data are shown here. As such, based on the confirmation by the City, the MHHW used for the design storm simulation is 1.0 foot NAVD88.



Approximate increase in MHHW since the 1983-2001 epoch is estimated as 0.22 foot

Figure 5-5. Figure Showing the Increase in MHHW Since the Last Epoch of 1983-2001

For calibration and verification events, 11/11/2020 to 11/15/2020 and 8/11/2019 to 8/18/2019 tidal data timeseries were downloaded for the St. Petersburg tidal gauge (https://tidesandcurrents.noaa.gov/waterlevels.html?id=8726520). Figures 5-6 and 5-7 show the tidal water level plot for both events. The timeseries were input in the model for tidal boundary nodes.

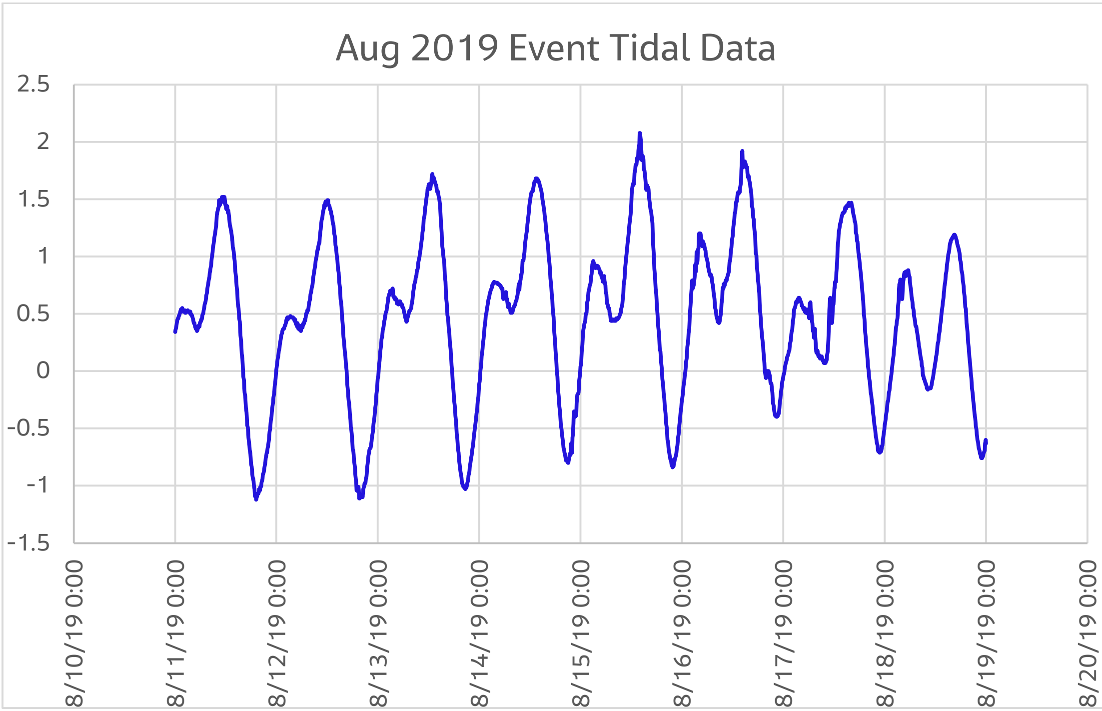


Figure 5-6. August 2019 Event Tidal Information

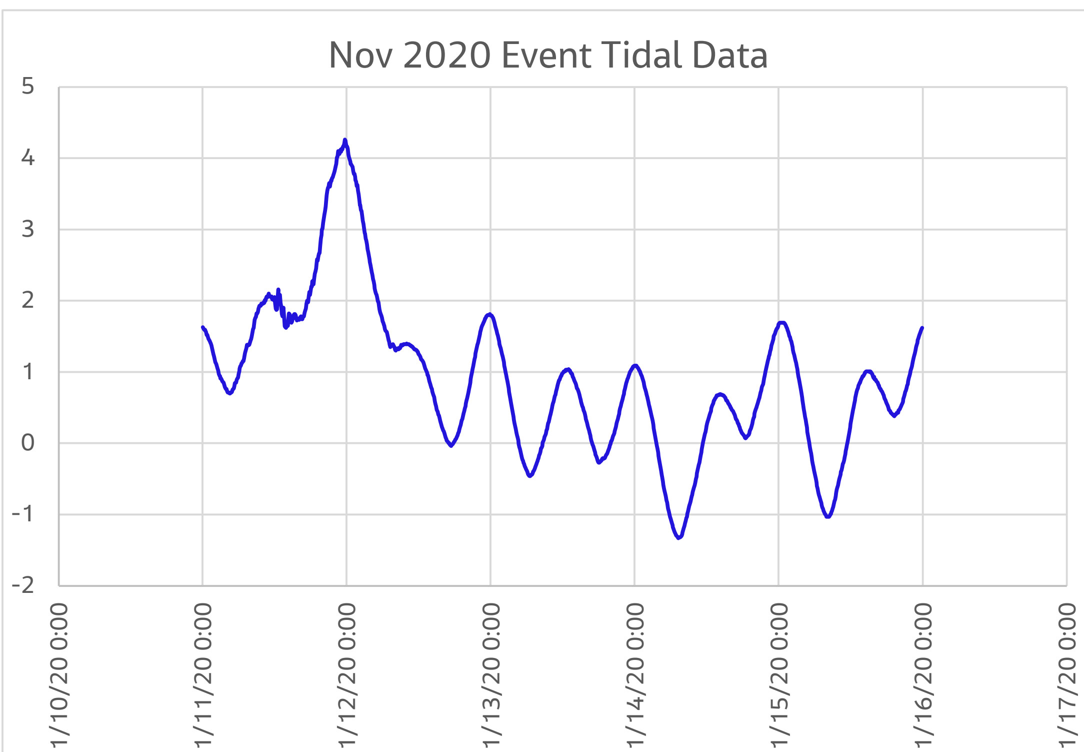


Figure 5-7. November 2020 Event Tidal Information

5.5 Model Testing

Each of the grouped models, once exported to the ICPR4, were initially simulated for a 100-year/1-day event. The errors and warnings that came out of the initial simulation were reviewed in detail. Nodes and links associated with these errors were reassessed and addressed in the GDB. The updated GDB was then re-exported from the GDB into ICPR 4. This step was completed as an iterative process until all model errors and warnings were eliminated. The runtime warning for nodes exceeding the maximum dz (change in stage between time steps) tolerance appears when the stages in a node change by more than the specified dz tolerance and cannot converge. All nodes with runtime warnings, as shown here, were reviewed on a case-by-case basis to resolve all convergence issues.

Runtime Warning [8888,NH07780]: -Node NH07780 exceeded maxdz (dz=45.352, t=0.000028, flowsum=45352.229, surfarea=100.000 log_wd=0 log_vchk=0)

The model results were reviewed for mass balance and instabilities. The total inflow and outflow at each node were reviewed, and locations of egregious differences were analyzed and resolved. After all the errors and warnings were resolved the models were used for calibration and verification event simulations, which are discussed in Section 6.

Additional checks were made to increase the model stability that included model initial flows, pipe and drop structure links with zero flows in the initial model simulations, and links with a significant amount of flow reversals. Model initial flows were checked for all the groups to eliminate any initial flows. The process included correcting any initial stages influenced by the boundary conditions or the control elevations at the connecting ponds.

Checks for initial flows – The initial flows were eliminated for a majority of the links, with a few exceptions where the nodes are influenced by the boundary conditions from other groups. For these nodes, checks were made and confirmed that the initial condition is not impacting the peak stage results.

Checks for zero flow pipes and drop structure links – Pipes and drop structure links with zero flows from the initial model simulations were reviewed for any inconsistencies in the input data. Where it was needed, corrections were made to the pipe inverts. Some of the pipes may be not flowing due to runoff and are completely contained within the basin.

Checks for links with flow reversals – Links with flow reversals were closely checked and eliminated where appropriate. However, there are some pipe links that still have flow reversal due to the short pipe along the pipe network in series or due to pipe links with parallel overland weirs that take over the flow once the stage is above the weir control elevation, where a flow reversal in the pipe matching the weir flow pattern is seen. An example plot (Figure 5-8) for RQ00124 and a parallel overland weir (RQ00120OW) shows the flow pattern, showing the timing of overland weir matching the flow reversal in pipe link.

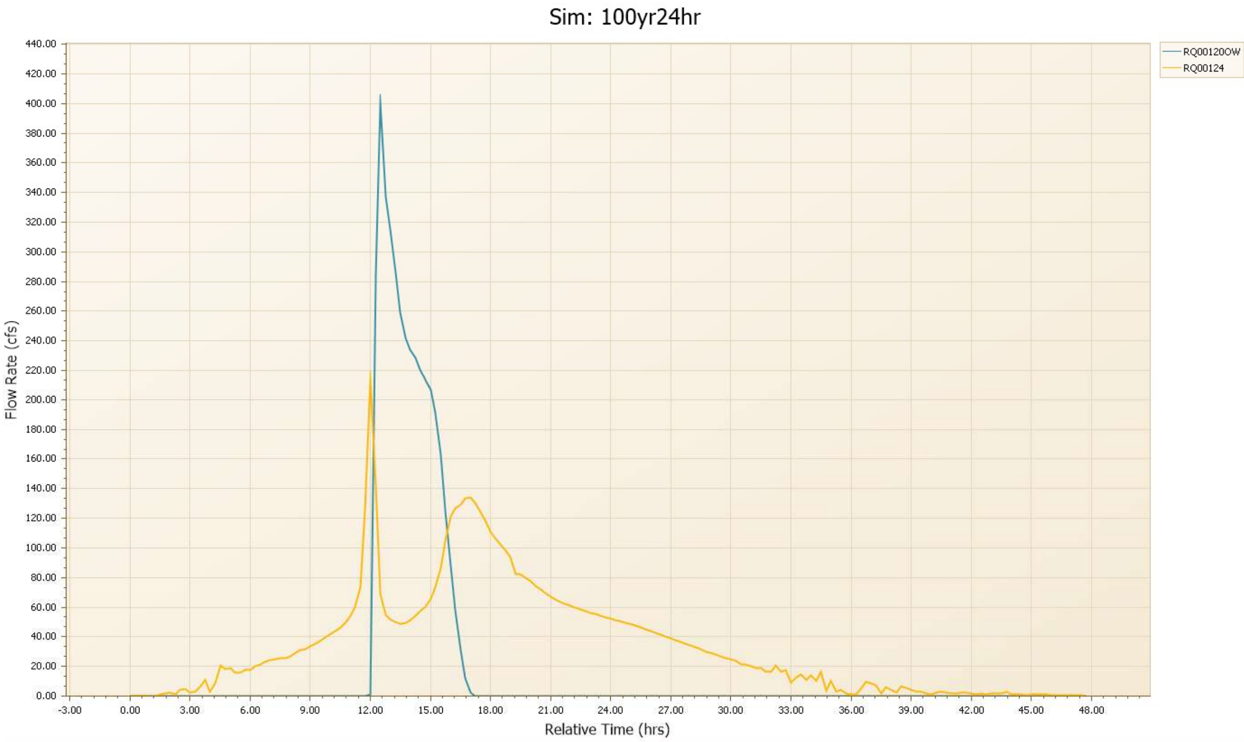


Figure 5-8. Flow Hydrograph for RQ00124 showing Flow Reversals and Parallel Overland Weir RQ00120OW Presenting Timing of Pipe Link Flow reversals and Overland Weir Flows

Checks for links with instabilities – Any link instabilities in the links were reviewed thoroughly for the model setup. If needed, the model setup was simplified in terms of pipe network. If the model setup seems reasonable, the dampening factor in the model is adjusted within the range recommended by the ICPR4 Help System. This parameter is used to help smooth out instabilities. Typically, when used, values range from 0.0001 to 0.01 and rarely exceed 0.1. In general, stability improves as the threshold increases, allowing for larger computational time increments than would otherwise be possible. An example of improvement of instabilities at link RO03300AB is shown on Figures 5-9 and 5-10.

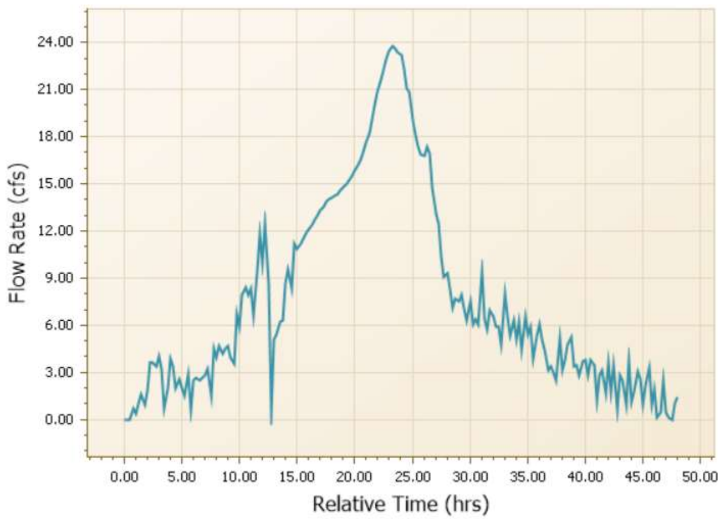


Figure 5-9. Flow Hydrograph Before Adjusting the Dampening Factor at Link RO03300AB

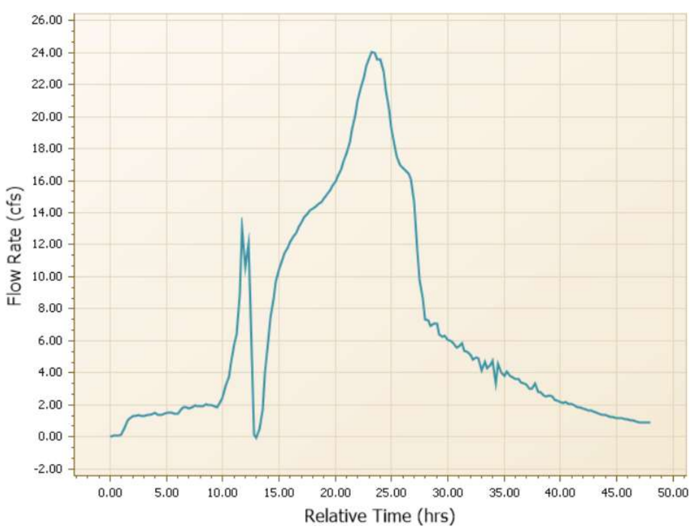


Figure 5-10. Flow Hydrograph After Adjusting the Dampening Factor at Link RO03300AB

6. Watershed Model Calibration and Verification

The measured rainfall and surface water data (gauges) collected by the City as part of the project were used to select the appropriate events used for calibration and verification of the model. Rainfall and surface water stage reviews were focused on 1-day and multi-day events along with comparison of named storms during the period of available data. The emphasis was to find an event between August 2018 to end of 2020 that had a storm total depth (12-inches) similar to that of the 100-year 24-hour design storm, as defined by the District. However, there were no events in this time period that replicated the total depth, associated with the District 100-year-24-hour design storm event. Based on the detailed review of the rainfall data at various gauges, the August 2019 event (from August 11 to 18), with an average rainfall of more than 9 inches, provided a reasonable event for calibration/verification. Additionally, Tropical Storm Eta, which occurred from November 11 to 15, 2020 (the November 2020 event), provided a reasonably high intensity named storm event that can be used for calibration/verification. Both of these events provided a hydrologic and hydraulic response over the entire watershed, when the data from each of the surface water level gauges per grouped model was reviewed.

The following steps document what the team has done as part of the ICPR4 simulations for both calibration and verification events and provide information for each model grouping developed under this task. Table 6-1 presents events used for calibration and verification simulations for various groups.

Table 6-1. Events used for Calibration and Verification Simulations

Group	Calibration Event	Verification Event
Group 1	August 11 to 18, 2019	November 11 to 15, 2020
Group 2	November 11 to 15, 2020	August 11 to 18, 2019
Group 3	November 11 to 15, 2020	August 11 to 18, 2019
Group 4	August 11 to 18, 2019	November 11 to 15, 2020
Group 5	August 11 to 18, 2019	November 11 to 15, 2020
Group 6	August 11 to 18, 2019	November 11 to 15, 2020
Group 7	August 11 to 18, 2019	November 11 to 15, 2020

In general, the base GDB were those employed for design storm simulations, upon which the event-specific (2019, 2020) tidal data were gathered from NOAA and applied to all appropriate boundary conditions. Additionally, the appropriate storm event rainfall files were applied within the model. Typically, the hydraulics of the models did not change, only the rainfall and tidal forcing conditions within ICPR4. As needed, the initial stages along the tidal boundary were updated to reflect the tidal initial stages.

For the calibration/verification event, the metrics used were based on the model predicting the observed and to make sure the hydrograph shape is reasonable, and the peak is within the 10 percent range or within approximately 0.5 foot. Any deviation from these metrics is explained in the following subsections, where individual gauge calibration/verification is discussed.

6.1 Group 1 – Basins R, S and G

Group 1 consists of Basins R, S, and G and has two gauges available for calibration and verification, which are as follows:

- Jungle Lake – Node NR03270 in Basin R
- Eagle Lake – Node NG03080 in Basin G

For Jungle Lake, the initial lake level gauge record for the November 2020 storm was unreliable and not suitable for model calibration purposes. A portion of the gauge elevation record drops by about 1 foot in a single time step, then jumps back up about 12 hours later but not as much as the drop (Figure 6-2). There is a similar, smaller jump in the record before the storm peak and a similar, larger drop another 12 hours later. Because of the discrepancies in the gauge record jumps, it is not clear if the gauge record could be simply adjusted up or down to fix the record. Therefore, the 2019 storm was used for calibration of the Group 1 model results (Figure 6-1). Subsequently, the raw data for the 2020 gauge record was reprocessed after the model was calibrated to the 2019 storm. The reprocessed 2020 gauge data was replotted and used for verification. The model tracks the rising curve and peak of the storm well except for the receding limb.

In general, initial test runs for each of the groups showed that the models overpredicted the storm peaks. Also, the models tended to show faster recovery after the storm peaks. To address this, the initial water table depth (WT Initial) in the ICPR4 Green-Ampt parameters was adjusted down. To test model sensitivity to the water table, the Green-Ampt water table depths were increased to 6 feet for all soils. The WT Initial has a significant influence on the modeled water levels; as such, the model plots came in closer to the measured gauge levels. However, the 6-foot water table depths were not in line with the soils strata within the basin and were subsequently revised to stay within acceptable ranges for model calibration and verification. The initial moisture content (MC Initial) in Green-Ampt data was set to 70% saturated (MC Field plus 70% of the difference between MC Field and MC Saturated). The recreational land use in Impervious Data was modified for % Impervious from 1 to 60 and % DCIA from 0 to 50.

Comparison of the model results to the measured gauge records (Figure 6-1) shows a good correlation between the peak water levels (-0.19 foot lower for the largest peak), although the model recovers faster than the lake. The model also nearly matches the three smaller peaks. Additionally, the difference between the model results and the gauge record at the beginning of 8/15/2019 is only about –3.72%, which is well within the acceptable range. The shape and timing of the modeled hydrograph closely resemble the measured values. For the November 2020 validation event (Figure 6-2), the modeled results fit well with the updated gauge record, missing the peak by -0.31 foot and recovering faster than the gauge, same as for the calibration event.

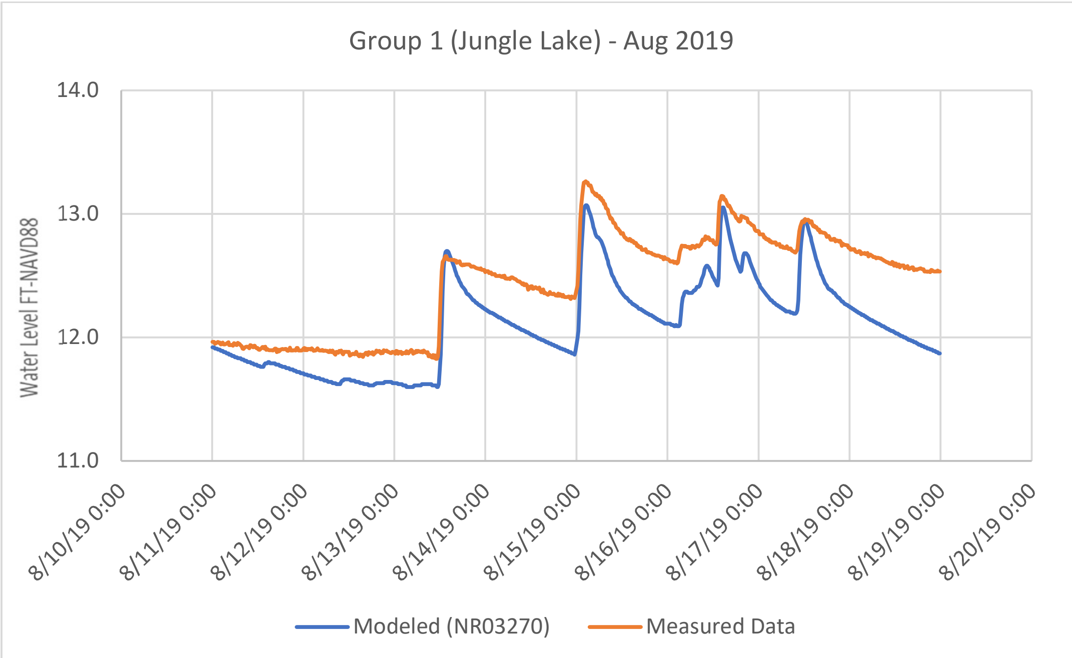


Figure 6-1. Group 1 (Jungle Lake) – Calibration Event August 2019

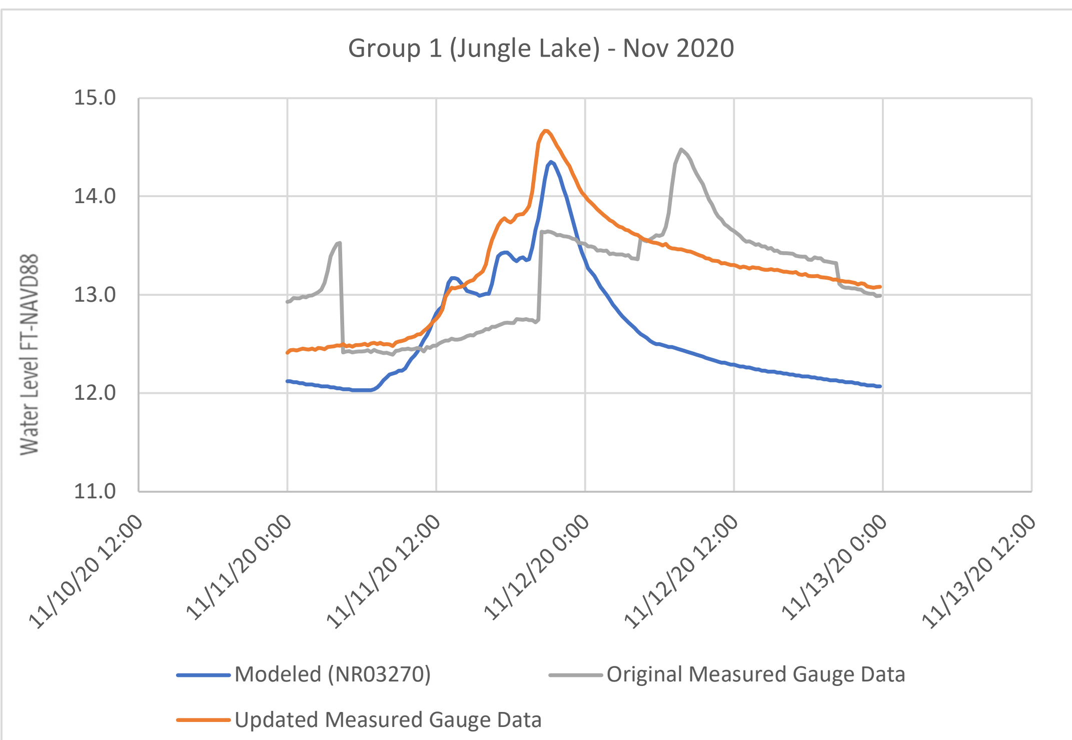


Figure 6-2. Group 1 (Jungle Lake) – Verification Event November 2020

For Eagle Lake, the model slightly underpredicted the peak for the 2019 calibration event (Figure 6-3) by –0.27 foot and by –0.60 foot for the 2020 verification event (Figure 6-4). In both cases, the model recovers faster than the measured water levels, but the shapes are consistent between modeled and measured.

The Eagle Lake weir is configured as a horizontal weir with a weir discharge coefficient of 3.2 and an orifice discharge coefficient of 0.6 to ensure that it functions as an orifice when flood stages increase. The weir in Eagle Lake is set to 13.30 feet, although the gauge record for the August 2019 storm (Figure 6-3) is seen to recover below this elevation, indicating a potential sink, groundwater interaction, or leakage through a control structure. However, this same recovery in the gauge record is not seen in the November 2020 event. This is slightly counterintuitive because the groundwater would normally be expected to be higher in August than in November.

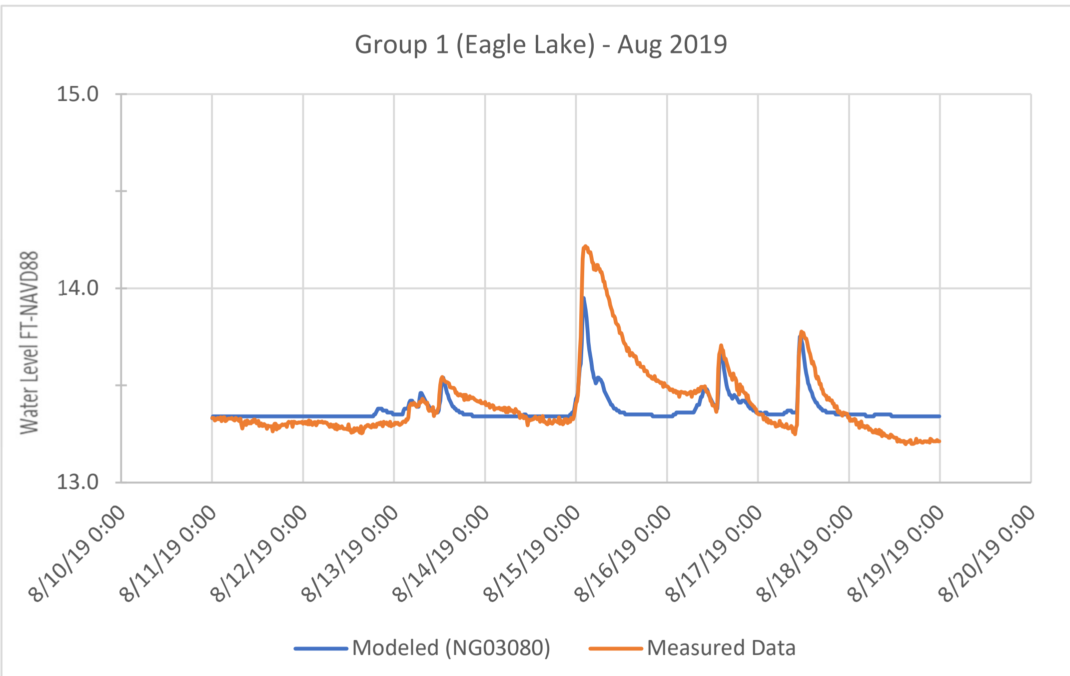


Figure 6-3. Group 1 (Eagle Lake) – Calibration Event August 2019

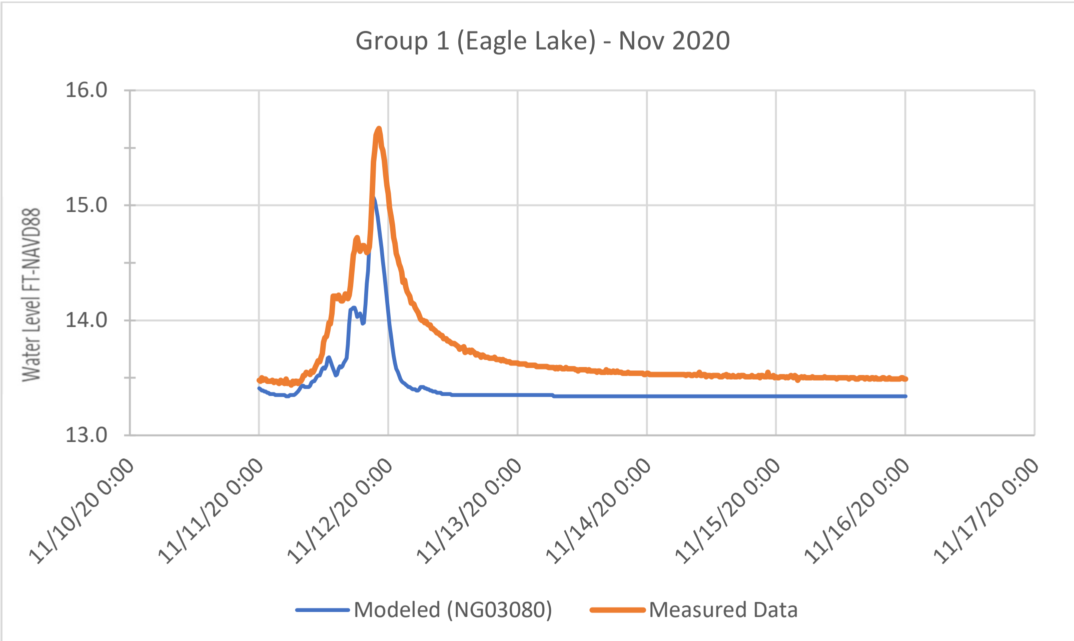


Figure 6-4. Group 1 (Eagle Lake) – Verification Event November 2020

6.2 Group 2 – Basins A and J

Group 2 consists of Basins A (downtown St. Petersburg) and J (Crescent Lake) and has one gauge available for calibration and verification:

- Crescent Lake – NJ03340 – in Basin J

The Crescent Lake model was calibrated using the November 2020 gauge record (Figure 6-5) and verified against the August 2019 gauge record (Figure 6-6). This lake has multiple inflow points and two main outflow locations, one of which can also serve as an inflow up to a certain level. The Crescent Lake model overpredicts the measured peak water level for the 2020 storm by about 3.1% and by 4.0% for the 2019 storm. Both are well within the acceptable range. The shape of the modeled hydrographs closely resembles the measured water levels and the modeled values recover at about the same rate as the measured values for the 2019 event. The model also tracks the 2019 storm gauge record with multiple peaks very well, but tends to overpredict the smaller measured peaks.

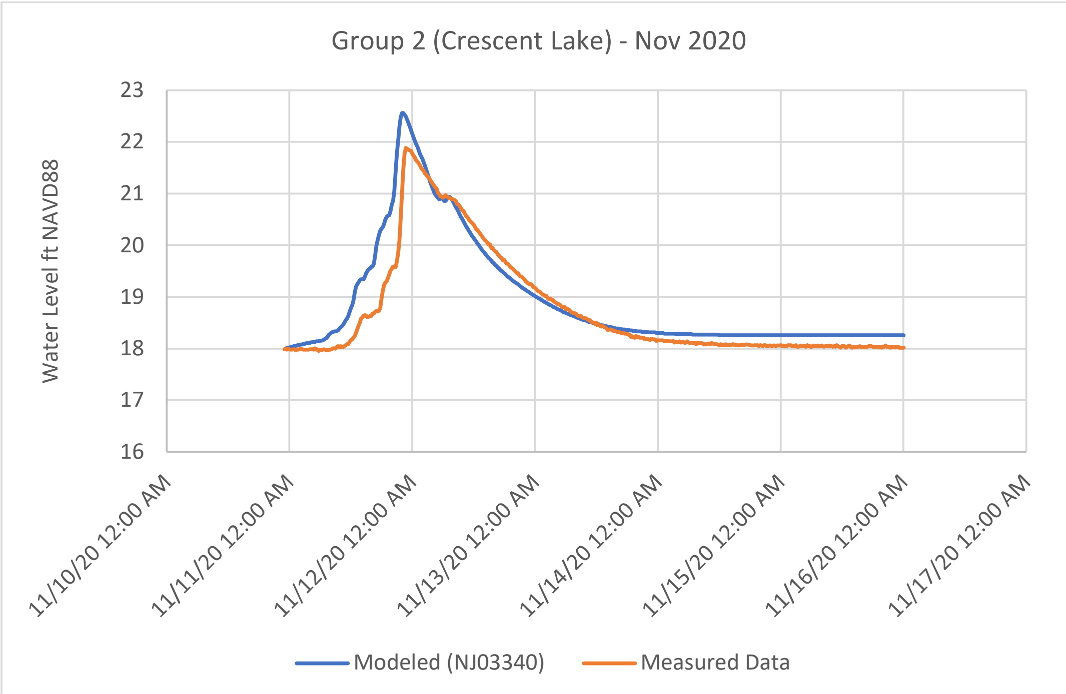


Figure 6-5. Group 2 (Crescent Lake) – Calibration Event November 2020

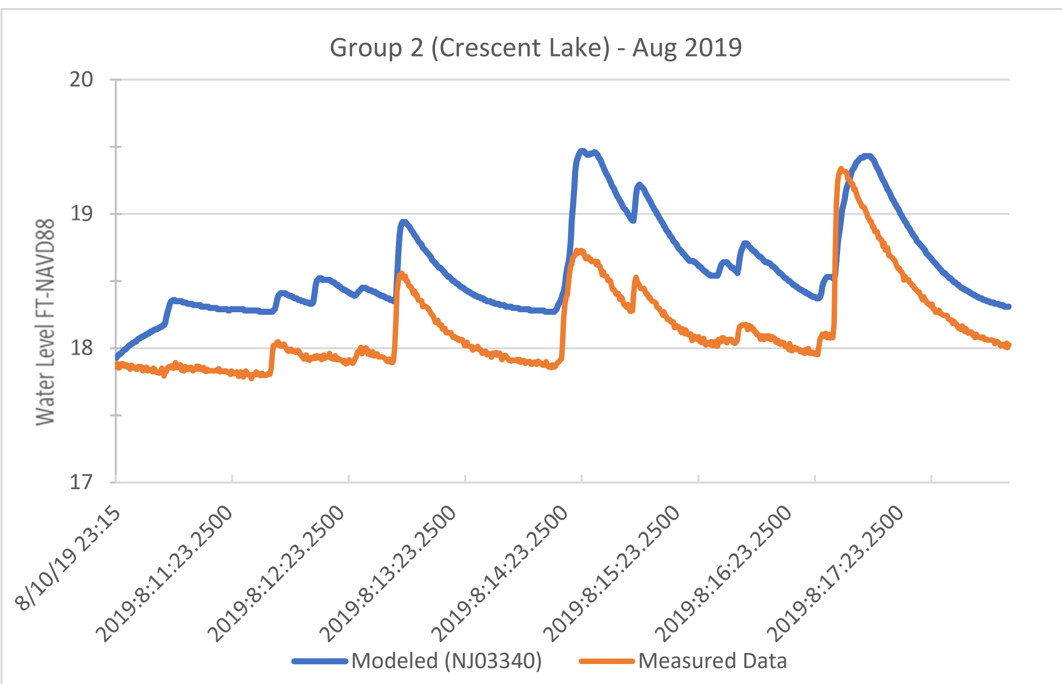


Figure 6-6. Group 2 (Crescent Lake) – Verification Event August 2019

6.3 Group 3 – Basins B, C, D, E, and Z

Group 3 consists of Basins B (Booker Creek), C (Lake Maggiore), and D, E, and Z (Clam Bayou) and has three gauges available for calibration and verification, which are as follows:

- NC03000 – Lake Maggiore in Basin C
- NB06840 – Booker Creek at 7th Street in Basin B
- ND02120 – 34th Street South Channel at 11th Avenue in Basin D

The gauge on Booker Creek (Figure 6-7) is located just upstream of a box culvert bridge on the left bank. The stream along this section is a rectangular concrete channel. Two aerial pipe crossings are located just downstream of the bridge that intersect the channel diagonally. In addition, a low concrete weir is located just downstream of the bridge in the bottom of the channel. The hydraulic interactions between the bridge, weir, and pipes at this location are believed to complicate flow patterns and influence the water levels measured by the gauge, making the Booker Creek model difficult to calibrate.

Figure 6-7. Booker Creek Gauge

(Retrieved from Google Maps on 27 August 2021, https://www.google.com/maps/@27.7606378,-82.6420587,3a,64.4y,339.57h,81.33t/data=!3m6!1e1!3m4!1sxTohvjPdD_7beZCJZFbK-g!2e0!7i16384!8i8192)

The Brooker Creek segment was calibrated by adjusting the rating curve for the bridge at node NB06841, which is about 310 feet downstream of the gauge. The gauge record is compared to the adjacent node NB06843 for the 2020 calibration event (Figure 6-8) and the 2019 verification event (Figure 6-9). For the 2020 event, the model curve very closely matches the gauge record in shape and magnitude and is within 5.9% of the measured peak. For the August 2019 verification event, the model overpredicts the spike peaks early in the gauge record and nearly matches the last largest peak of the storm. This is likely due to antecedent saturated conditions in the middle of the summer causing nearly instantaneous runoff in a heavily urbanized catchment, which includes the large impervious parking areas of Tropicana Field. The model also overpredicts intermediate peaks, although the shape and timing are well represented. The modeled channel cross-sections were initially based on the DEM but have been adjusted to match the bottom of the stream channel at the up- and downstream bridges. It is believed that surveyed channel cross-section data would drop the resulting model water levels and help obtain better results.

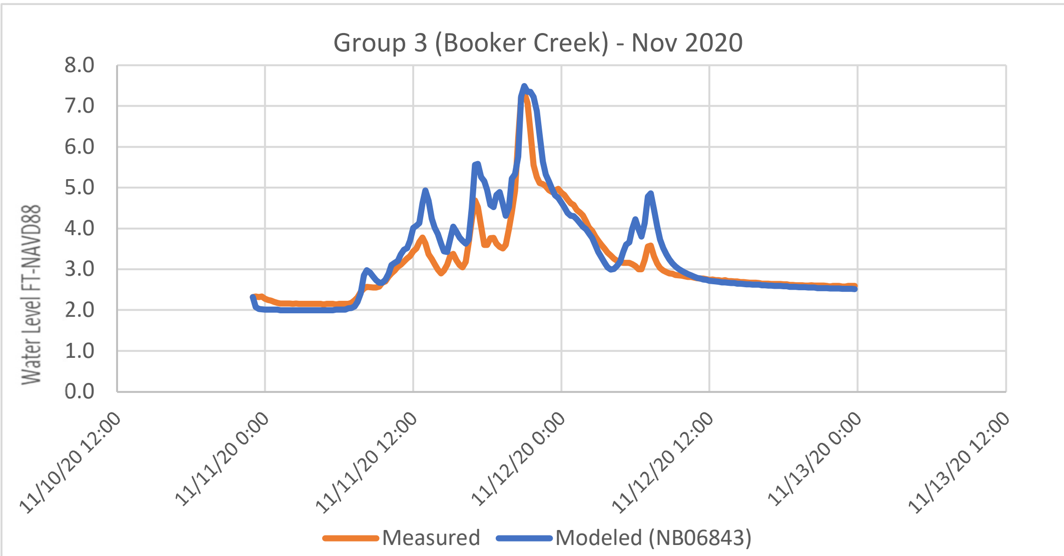


Figure 6-8. Group 3 (Booker Creek) – Calibration Event November 2020

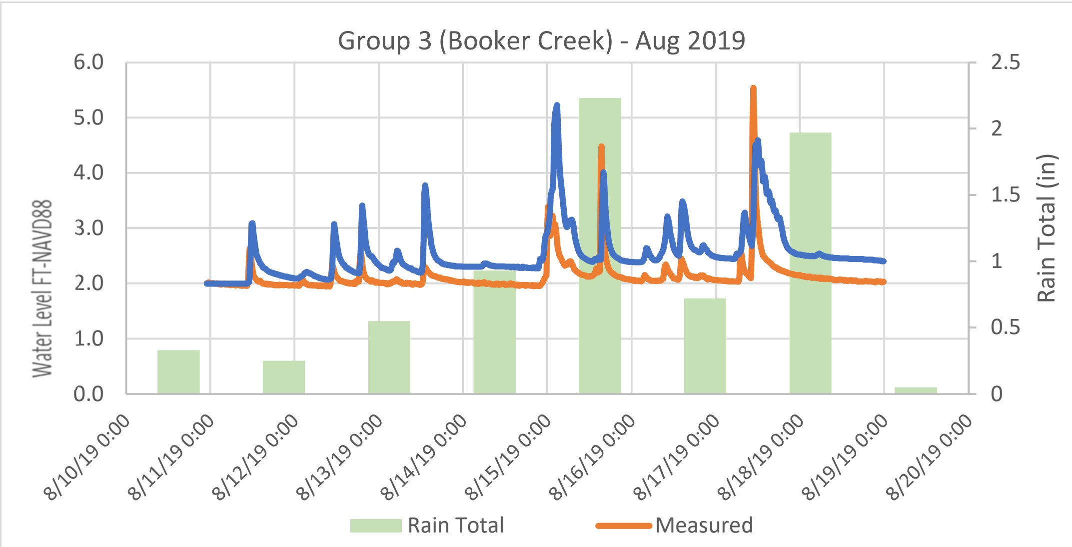


Figure 6-9. Group 3 (Booker Creek) – Verification Event August 2019

For 34th Street South Channel at 11th Avenue, only slight adjustments to the initial stages in the model were needed to calibrate the model. The model record closely matches the gauge record for both the 2020 calibration event (Figure 6-10) and the 2019 verification event (Figure 6-11). The peaks and the hydrographs match up very well, particularly the intermediate peaks, but the model slightly underpredicts the large peaks by about -8.5% for the 2020 event and by -7.4% for the 2019 event.

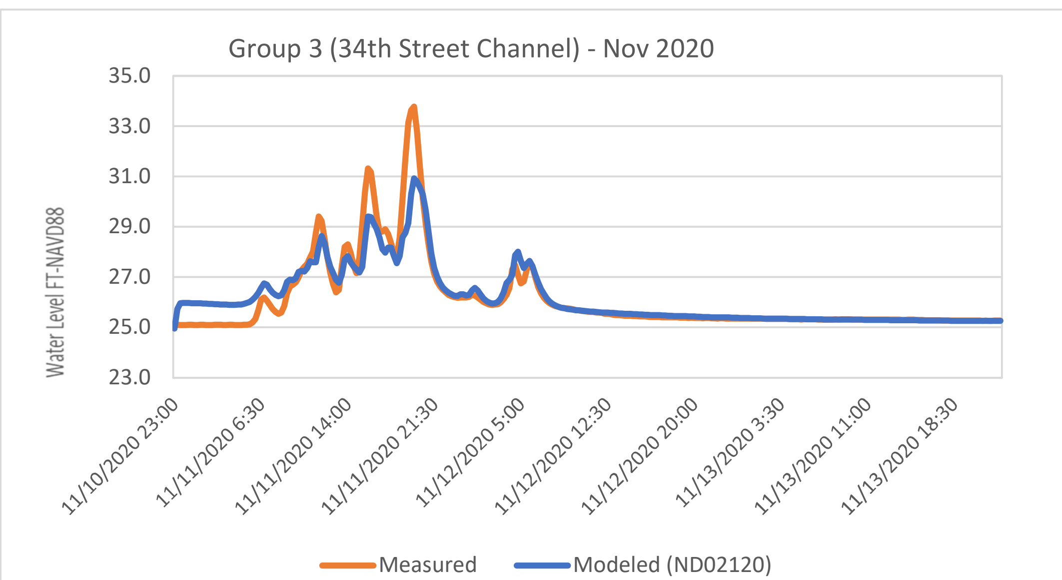


Figure 6-10. Group 3 (34th Street Channel) – Calibration Event November 2020

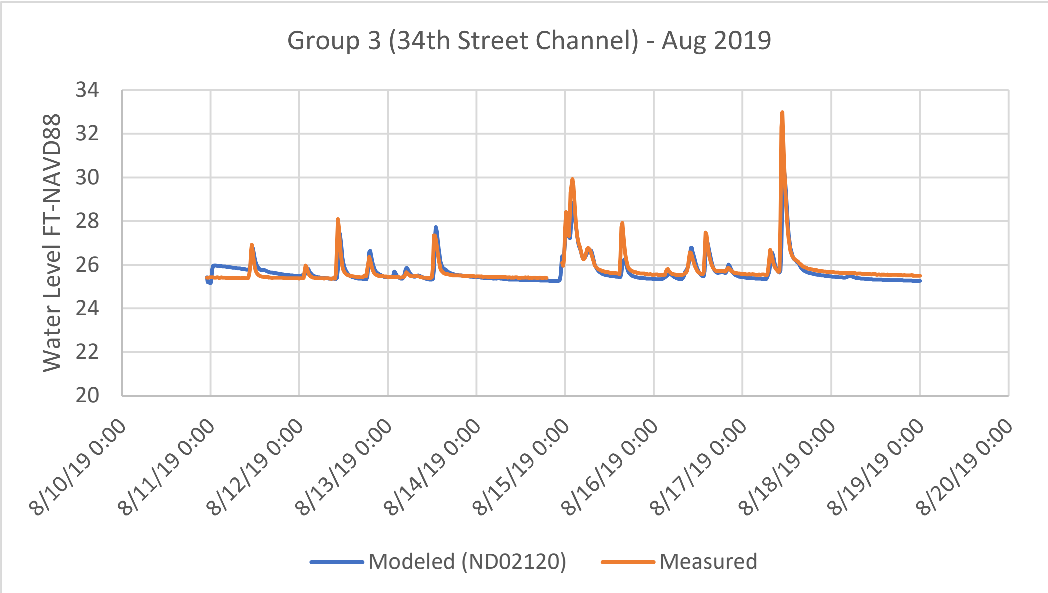


Figure 6-11. Group 3 (34th Street Channel) – Verification Event August 2019

For Lake Maggiore, the initial model runs were conducted without lake level control gates (i.e., gates open), which yielded water levels inconsistent with the gauge record. Subsequently, we confirmed with the City that the operable gates on Lake Maggiore were closed for both the 2020 calibration event (Figure 6-12) and the 2019 verification event (Figure 6-13). The City also provided survey data for the gate structures, which were added to the model as a weir with a crest elevation of 3.08 feet. Water from the bay overtopped the gates and flowed into the lake during the 2020 event but not the 2019 event, and this is well represented in the model results. Initial model runs indicated accrual of water with Lake Maggiore during the 2019 event when compared to the gauge record. Accordingly, 60 cubic feet per second (cfs) outflow was added to the lake node (NC03000) to represent the water leaving the lake (likely through groundwater interactions, which are not modeled) and to reduce the accumulation in the lake.

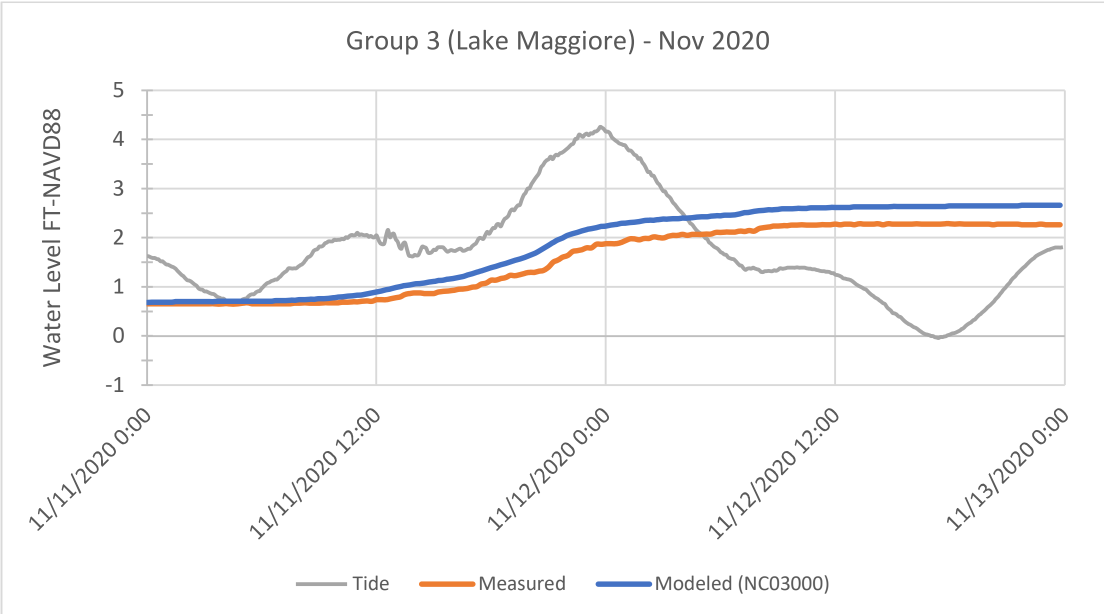


Figure 6-12. Group 3 (Lake Maggiore) – Calibration Event November 2020

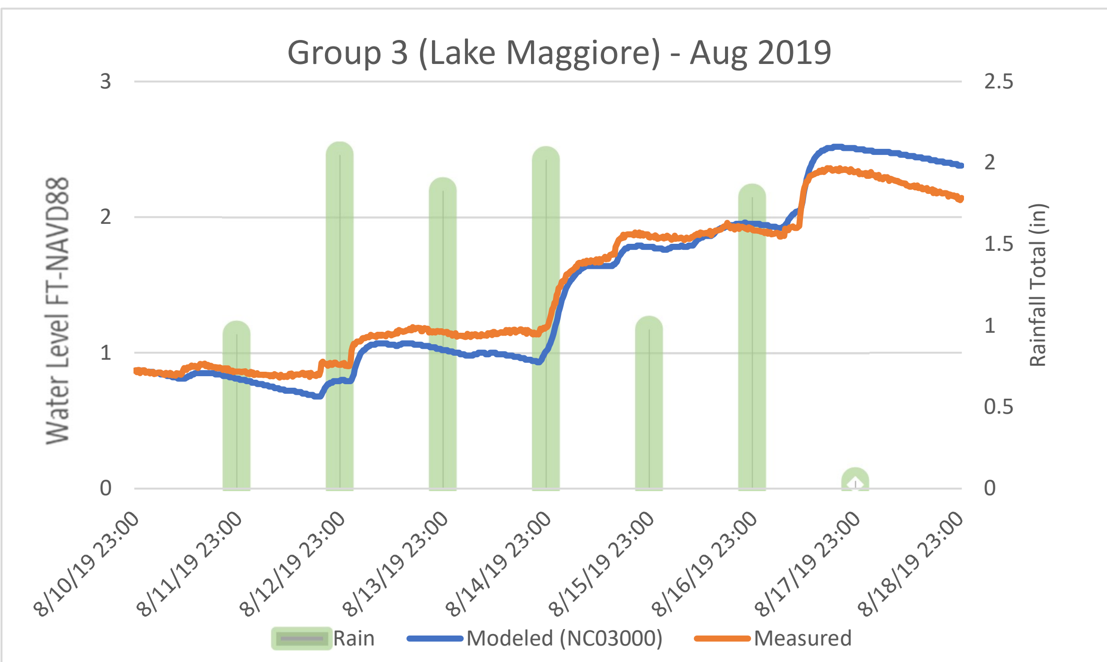


Figure 6-13. Group 3 (Lake Maggiore) – Verification Event August 2019

In addition, for Groups 1, 2, and 3, the 100-year/24-hour storm results from a rapid flood hazard assessment (RFHA) developed by Pinellas County in 2020 was used to further verify the model results. The RFHA modeling approach does not entail detailed modeling of subsurface infrastructure but instead involves using a less detailed 2D overland flow modeling approach in ICPR4. The 2D model involves developing a 2D flexible triangulated mesh that derives elevation data from the DEM to approximate overland flow and incorporates traditional 1D features (i.e., pipes at least 42 inches in diameter and channels) to represent major conveyance ways. NOAA's Atlas 14 was the source for the 100-year/24-hour rainfall total of 13.7 inches, which exceeds the Southwest Florida Water Management District (SWFWMD) design storm amount of 12 inches. The result of this modeling approach is a conservative estimate of flooding since most of the subsurface infrastructure is not considered.

The preliminary 100-year floodplain maps for Groups 1, 2, and 3 were compared to the RFHA results. In general, the 100-year floodplains compare well to the RFHA results. The modeled flood extents around Crescent Lake and Lake Maggiore (Figure 6-14) are almost identical to the RFHA results. Around Jungle Lake and Eagle Lake, the 100-year floodplain model shows larger flood extents than the RFHA, but it is in general agreement with the RFHA results. This supplementary verification provides an added level of confidence in the model conceptualization, setup, and results.

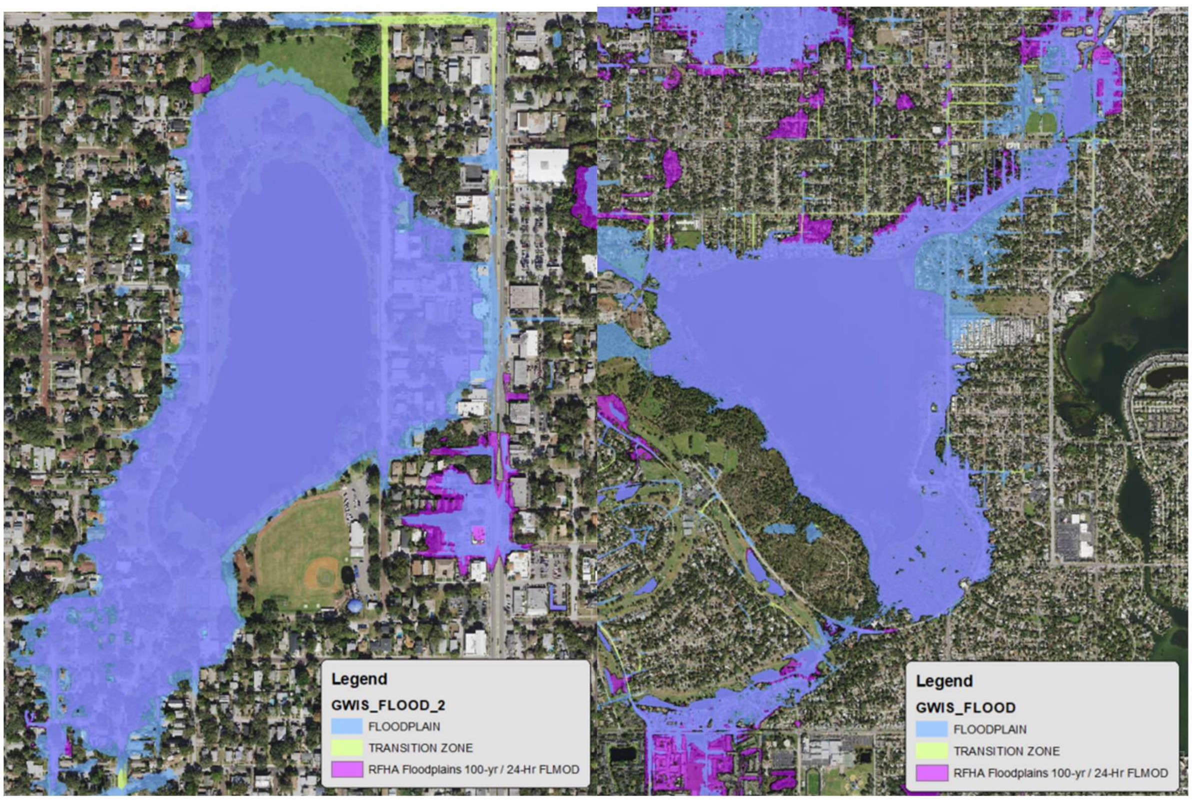


Figure 6-14. Crescent Lake and Lake Maggiore 100-Year Floodplain vs. RFHA Floodplain

6.4 Group 4 – Basin F

Group 4 has 3 water level data logger gauges that can be used for calibration and verification, which are at Bear Creek at 64th Street (Node NF08689 in Basin F), Bear Creek Pond (Node NF11303 in Basin F), and Lake Pasadena (NF04110).

After the initial simulation of the August 2019 event, the resulting plots were compared between the observed data and modeled results. Based on the initial findings, hydrologic and hydraulic parameters from the contributing areas are reviewed further for each of the gauges in Group 4. One common theme observed from all three gauges in Group 4 is that the peaks exceeded model simulations by a substantial margin. From reviewing the antecedent rainfall depths, as well as available groundwater data within Pinellas County, it was determined that the ICPR4 Green-Ampt Parameters of Initial Moisture content and

Depth to Water Table should be adjusted to accurately reflect the event conditions. As such, the Green-Ampt parameters were adjusted within the NRCS published ranges and have provided a more reasonable agreement between simulated and observed data for the August 2019 event, as shown on Figures 6-15 to 6-16. Soil series were individually revised for MC Initial by adjusting the ICPR values, which were set equal to Field Capacity. Additionally, the Depth to Water Table parameters were adjusted within a range of published values between the upper and lower limits of the observed water table depth. These revisions were undertaken in an iterative process, with the first attempts at revisions within 10% of the originally developed values from the District Soil Processing tool. The final Green-Ampt parameters adjusted and employed for the grouped models are all within the published ranges provided by NRCS, specifically the Water Features Report (NRCS, 2020).

For Bear Creek pond, additional changes were made to the outfall control structure based on the as-built information. The changes included changing the notch width to 9 inches and control elevation to 7.82 feet NAVD88. For Bear Creek at 64th Street gauge, channel cross-sections were further reviewed, and cross-section bottom elevations were revised based on the nearest culvert crossings along the creek and available information from previous models.

As shown in the figures below, the comparison plots show reasonable match between the observed and modeled results, the shape is similar and the peak stages match reasonably.

Bear Creek at 64th Street gauge comparison for August 2019 shows some of the smaller peaks predicting higher; however, the higher peaks are matching better. For November 2020 event, the peak stages match within 0.4 foot. It should be noted that November 2020 represents a more intense storm similar to the design storm events that the model will be used to simulate and obtaining a good correlation between observed and modeled results provides confidence in model conceptualization and setup.

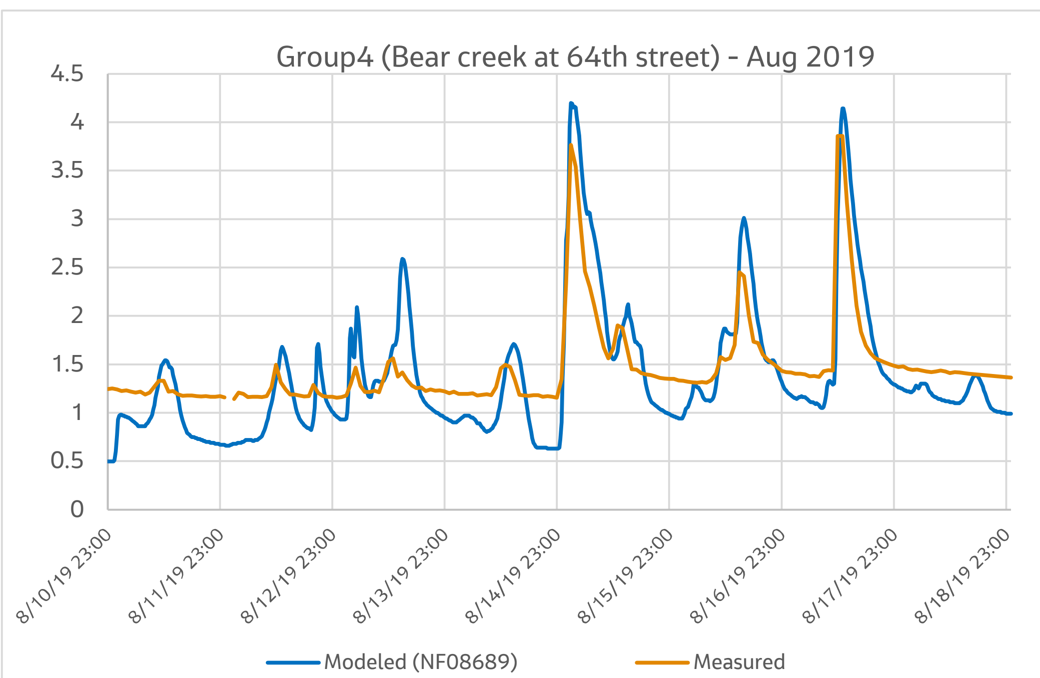


Figure 6-15. Group 4 (Bear Creek – 64th Street) – Calibration Event August 2019

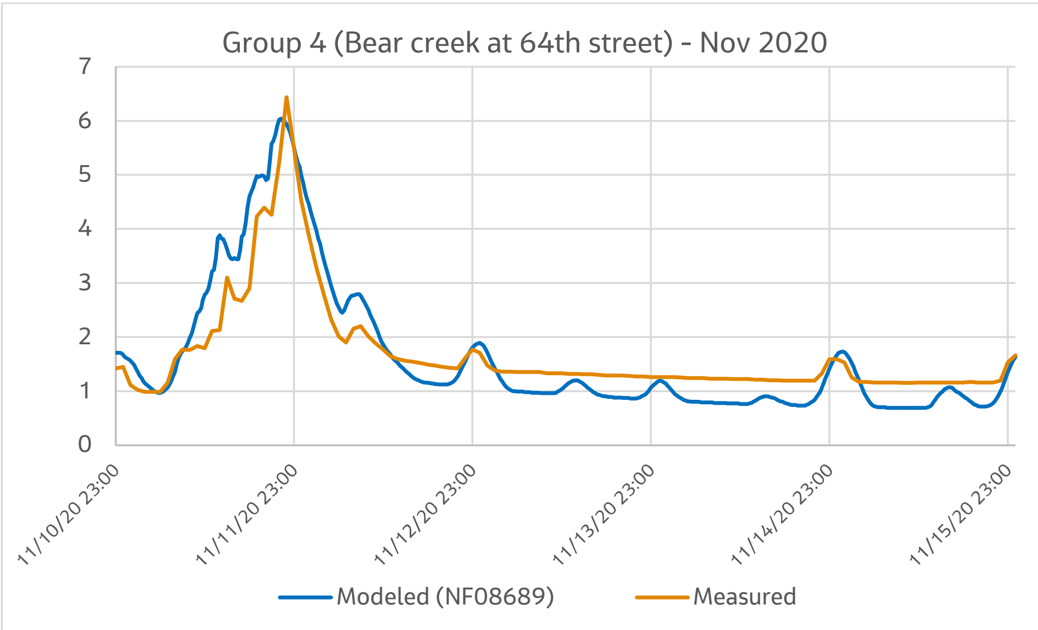


Figure 6-16. Group 4 (Bear Creek – 64th Street) – Verification Event November 2020

Bear Creek Pond gauge comparison for August (presented on Figures 6-17 and 6-18) shows some of the smaller peaks predicting higher; however, the higher peaks are matching better. For November 2020 event, the peak stages match within 0.4 foot. It should be noted that November 2020 represents a more intense storm similar to the design storm events that the model will be used to simulate and obtaining a good correlation between observed and modeled results provides confidence in model conceptualization and setup.

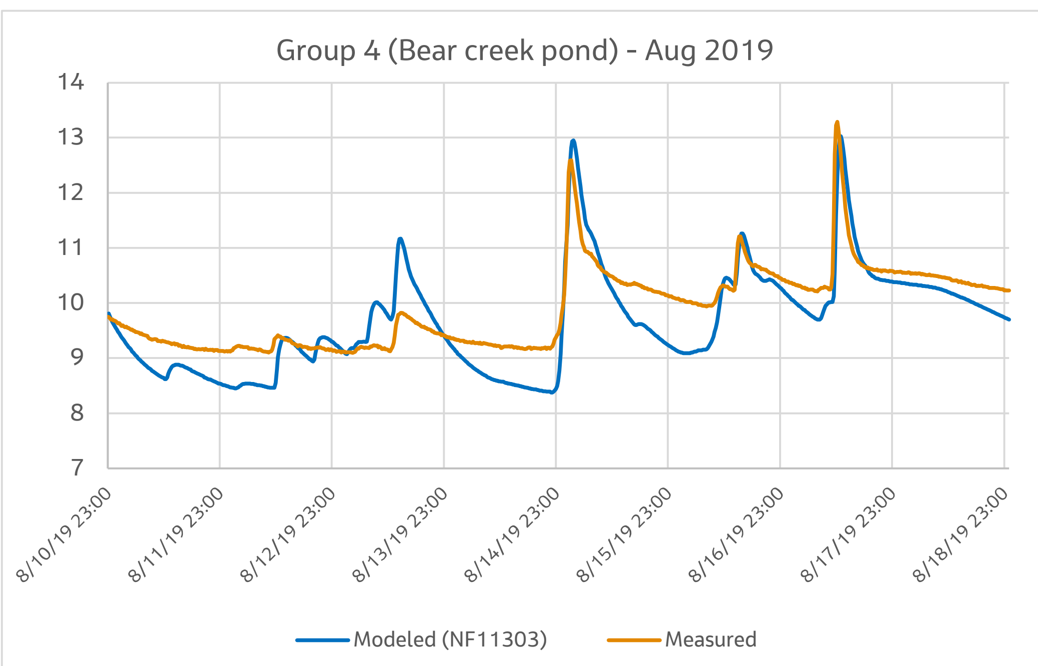


Figure 6-17. Group 4 (Bear Creek Pond) – Calibration Event August 2019

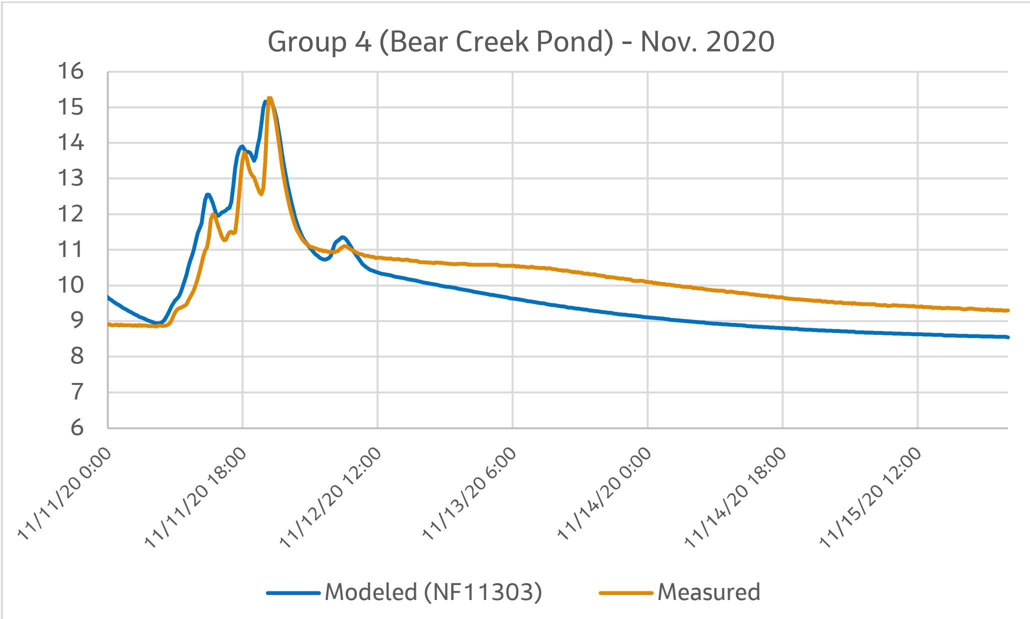


Figure 6-18. Group 4 (Bear Creek Pond) – Verification Event November 2020

The Lake Pasadena gauge comparison plot (presented on Figures 6-19 and 6-20) shows a match between observed and predicted for both August 2019 and November 2020 events. It should be noted that November 2020 represents a more intense storm similar to the design storm events that the model will be used to simulate, and obtaining a good correlation between observed and modeled results provides confidence in model conceptualization and setup.

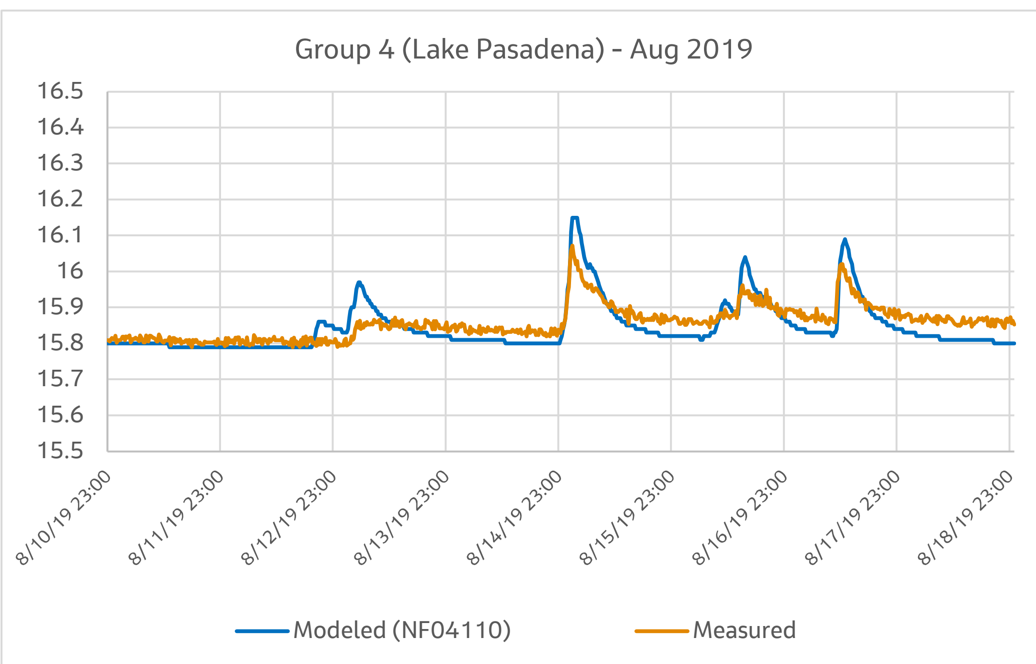


Figure 6-19. Group 4 (Lake Pasadena) – Calibration Event August 2019

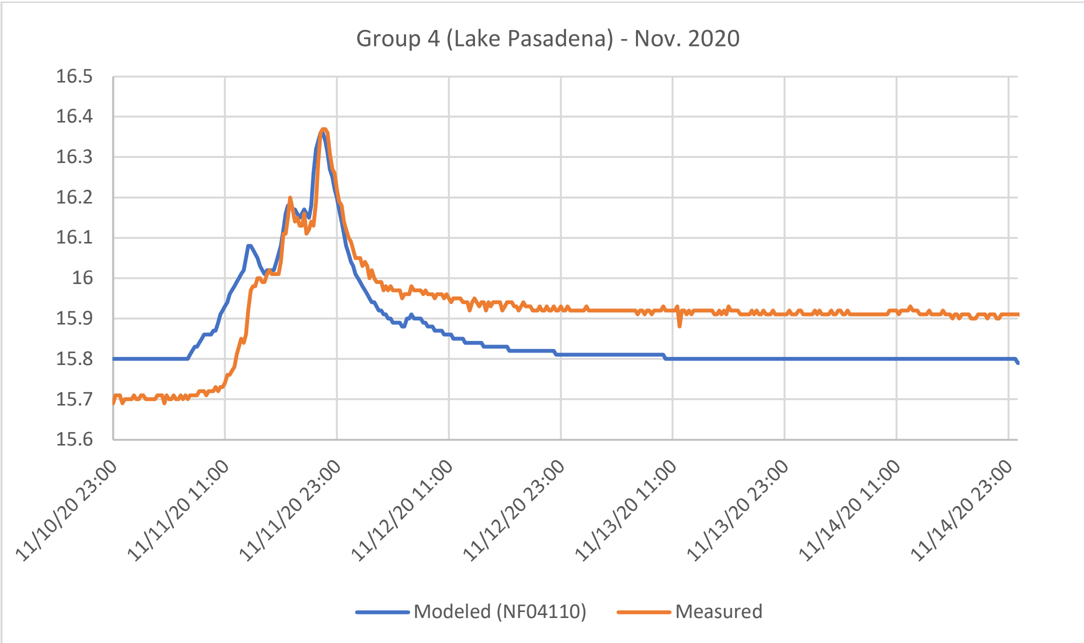


Figure 6-20. Group 4 (Lake Pasadena) – Verification Event November 2020

6.5 Group 5 – Basins H and I

For Group 5, there are two gauges available for calibration and verification, which are Miles Creek at 22nd Avenue North (Node NH02170 in Basin H) and Miles Creek at 60th Street North (Node NH03520 in Basin H).

After the initial simulation of August 2019 event, the resulting comparison plot between the observed data and modeled results were analyzed. Based on the initial findings, hydrologic and hydraulic parameters from the contributing areas are reviewed further for each of the gauges in Group 5. One common theme observed from all gauges in Group 5 is that the modeled peaks were exceeding observed gauge values by a substantial margin. From reviewing the antecedent rainfall depths, as well as available groundwater data within Pinellas County, it was determined that the ICPR4 Green-Ampt Parameters of MC Initial and Depth to Water table should be adjusted to accurately reflect the event conditions. As such, the Green-Ampt parameters were adjusted within the NRCS published ranges and have provided a more reasonable agreement between simulated and observed data for the August 2019 event, as shown on Figures 6-21 to 6-22. Soil series were individually revised for MC Initial by adjusting the ICPR values, which were set equal to Field Capacity. Additionally, the Depth to Water Table parameters were adjusted within a range of published values between the upper and lower limits of the observed water table depth. These revisions were undertaken in an iterative process, with the first attempts of revisions within 10% of the originally developed values from the District Soil Processing tool. The final Green-Ampt parameters adjusted and employed for the grouped models are all within the published ranges provided by NRCS, specifically the Water Features Report (NRCS, 2020) .

Miles Creek at 22nd Avenue North for August 2019 shows a reasonable match of the shape of the hydrograph, except for the initial time steps. The match is especially good for the intense peaks that were noticed on August 13, 15, and 17. Similarly, for the November 2020 event, the peak stages match within <0.1 foot. It should be noted that November 2020 represents a more intense storm similar to the design storm events that the model will be used to simulate, and obtaining a good correlation between observed and modeled results provides confidence in model conceptualization and setup.

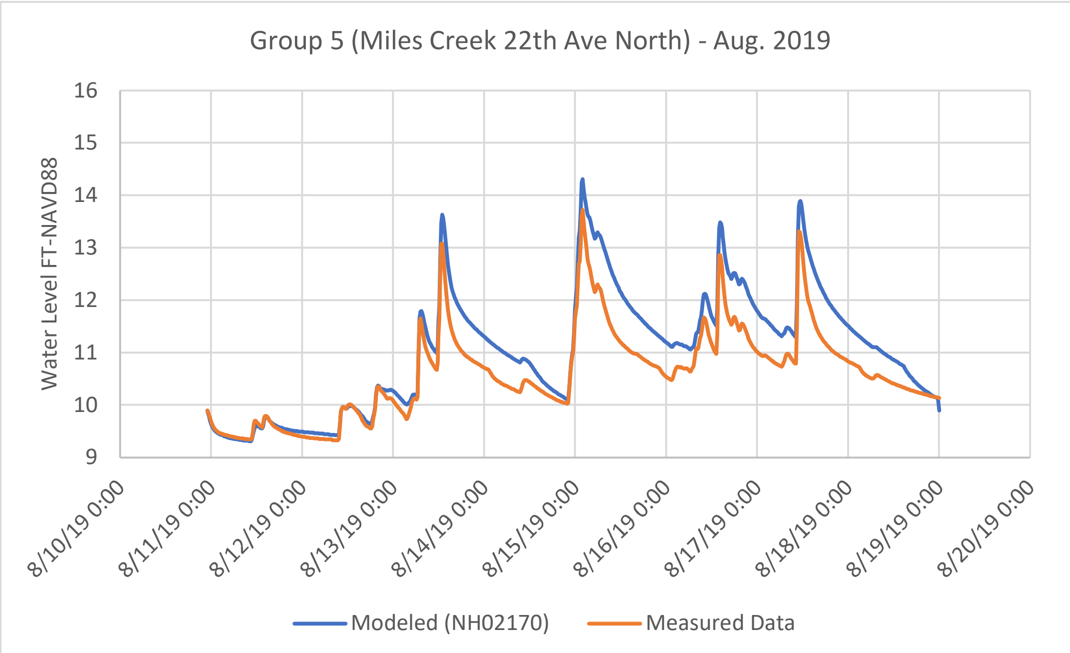


Figure 6-21. Group 5 (Miles Creek – 22nd Avenue North) – Calibration Event August 2019

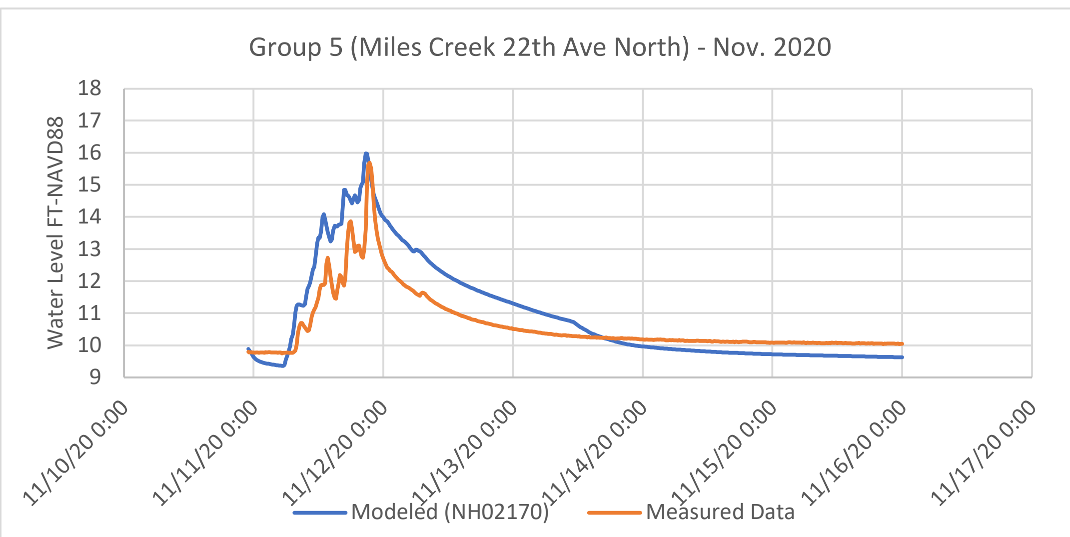


Figure 6-22. Group 5 (Miles Creek – 22nd Avenue North) – Verification Event November 2020

Miles Creek at 60th Street North gauge shows underprediction of peak stages significantly, as shown in Figures 6-23 and 6-24. Further analyzing the model, the primary reason for this deviation is that this gauge is impacted by the boundary node BNDRYH00030, which is the node in Joes Creek system. This node was set up as a fixed stage node due to unavailability of stage results from the Pinellas County Joes Creek Model for August 2019 and November 2020 events. This issue may not arise for design storm simulation because of the availability of stage results from Pinellas County Joes Creek Model.

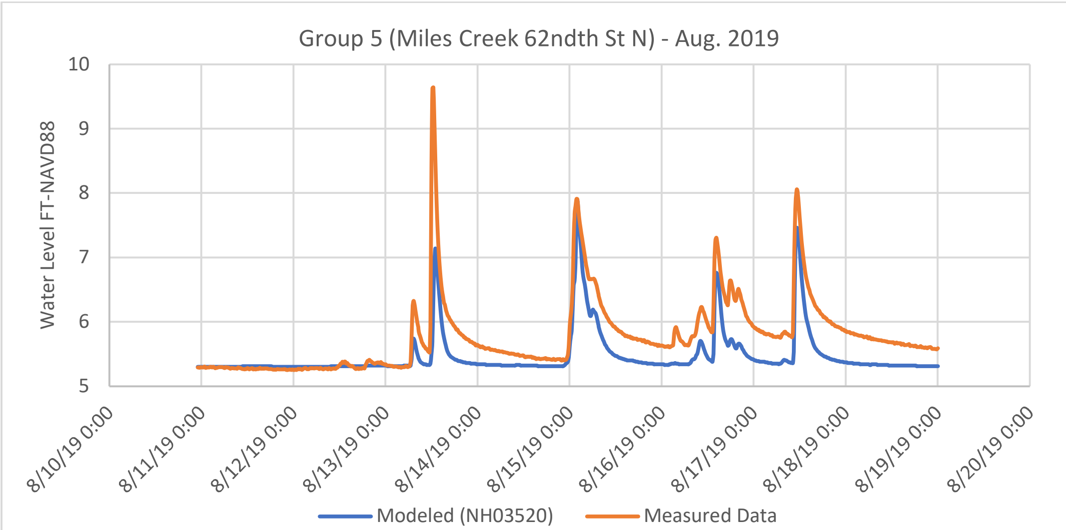


Figure 6-23. Group 5 (Miles Creek – 60th Street North) – Calibration Event August 2019

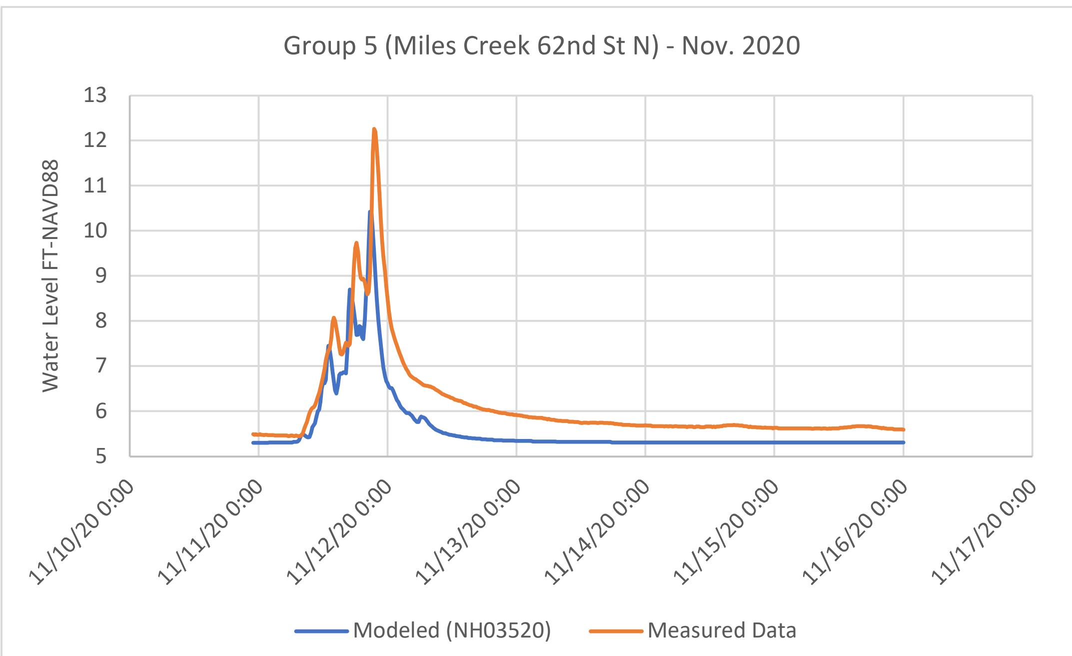


Figure 6-24. Group 5 (Miles Creek – 60th Street North) – Verification Event November 2020

6.6 Group 6 – Basins K, X, L, X, N, Y, O, P, T

Group 6 is the largest of the grouped models and has a single gauge within the 54th St. Canal (Node NM07710 in Basin M). The gauge is tidally influenced, so the model needed to replicate both the tidal signature as well as the additional runoff volumes above tide stage.

During the calibration process, it was noted that the 54th St. Canal (NM07710) was not controlled as expected from field reconnaissance and ERP data. The best available data from Atlas Drainage Sheet E-28 was downloaded and reviewed from SWFMWD. From the Atlas Drainage Sheet, hydraulic features and attributes were confirmed, as well as the downstream hydraulics including all conveyance features and bottom elevation of the channel.

For the 54th St. Canal gauge, it was noted that the modeled peaks were exceeding observed gauge peaks by a substantial margin and that the hydrograph shapes were not consistent or showed resemblance to one another. It was noticed that initial stages were the main cause of issues at this particular gauge. The model was run with similar Green-Ampt refinements as adopted in other groups; however, simulating the model with original “as-is” Green-Ampt parameters from the SWFWMD soils tool provided a better hydrograph response for the calibration and verification events presented on Figures 6-25 and 6-26. This may be due to the position of the gauge in a coastal/low-lying area as well as the vast majority of the Group 6 model domain being in low-lying areas while other groups are near the observed dome that is higher in elevation and near the center of the entire City of St. Petersburg watershed. Due to the coastal/low-lying topography of the group, this physiography may be influencing the soil moisture characteristics and likely contributed to a higher water table condition for the Group 6 model area during the calibration/verification events.

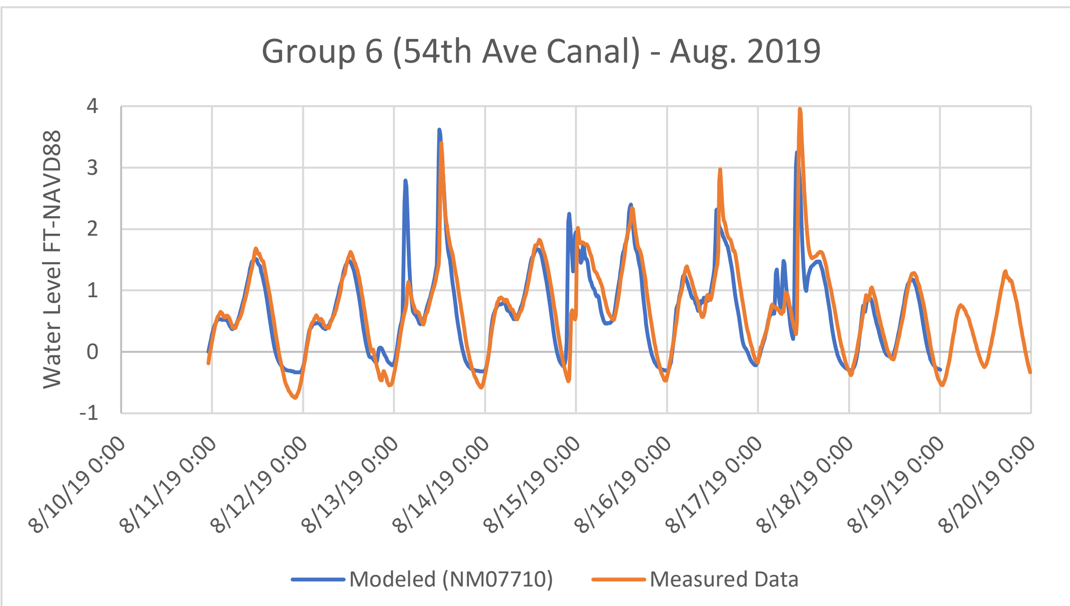


Figure 6-25. Group 6 (54th Avenue Canal) – Calibration Event August 2019

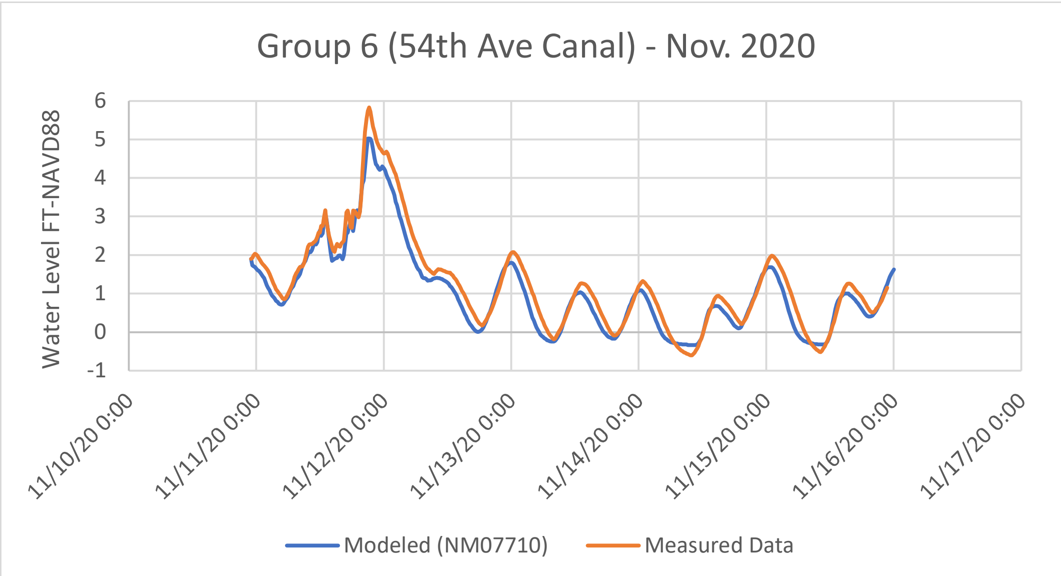


Figure 6-26. Group 6 (54th Avenue Canal) – Verification Event November 2020

The peak stages for both August and November events show good agreement with respect to peak timing. The August calibration shows peaks slightly higher with under predictions starting around 8/17/2020, but the tidal signature is an almost exact match. For the November event the peak shown on 11/11 is under predicted. Significant effort was undertaken to ensure the volume of water was getting to the node/gauge for each simulated event. Additionally, during the calibration process it was noticed that RG_LS16 was considerably underrepresenting the rainfall during both the August 2019 and November 2020 events. Currently the results presented employed RG_NEWRF data in place of RG_LS16 for the RG_LS16, which provide a very good match with the observed results.

6.7 Group 7 – Basins U, V, Q, and W

For Group 7, there is one gauge available for calibration and verification, located at the Lake Catalina outfall structure. During the calibration process, it was noted that Lake Catalina (Node NQ00100 in Basin Q) was not controlled as expected from field reconnaissance and ERP data. The best available data from as-built plans (ERP 0011426.006) was downloaded and reviewed from the District. From the as-built plan sets, Lakes Catalina and Coronado control structures were confirmed, as well as the downstream hydraulics including all conveyance features through to Little Bayou. The measured data at Lake Catalina showed that the stop-logs were not removed for either of the events considered herein. As such a single weir elevation and control was employed for Calibration and verification events.

For the Lake Catalina gauge, it was noted that the peaks were being over-simulated by a substantial margin. From reviewing the Lake Catalina, Crescent Lake, antecedent rainfall depths, as well as available groundwater data within Pinellas County, it was determined that the ICPR4 Green-Ampt Parameters of MC Initial and Depth to Water table should be adjusted to accurately reflect the event conditions. As such, the Green-Ampt parameters were adjusted within the NRCS published ranges and have provided a more reasonable agreement between simulated and observed data for the August 2019 event, as shown on Figures 6-27 to 6-28. Soil series were individually revised for MC Initial by adjusting the ICPR values, which were set equal to Field Capacity. Additionally, the Depth to Water Table parameters were adjusted within a range of published values between the upper and lower limits of the observed water table depth. These revisions were undertaken in an iterative process, with first attempts of revisions within 10% of the originally developed values from the District Soil Processing tool. The final Green-Ampt parameters adjusted and employed for the grouped models are all within the published ranges provided by NRCS, specifically the Water Features Report (NRCS, 2020).

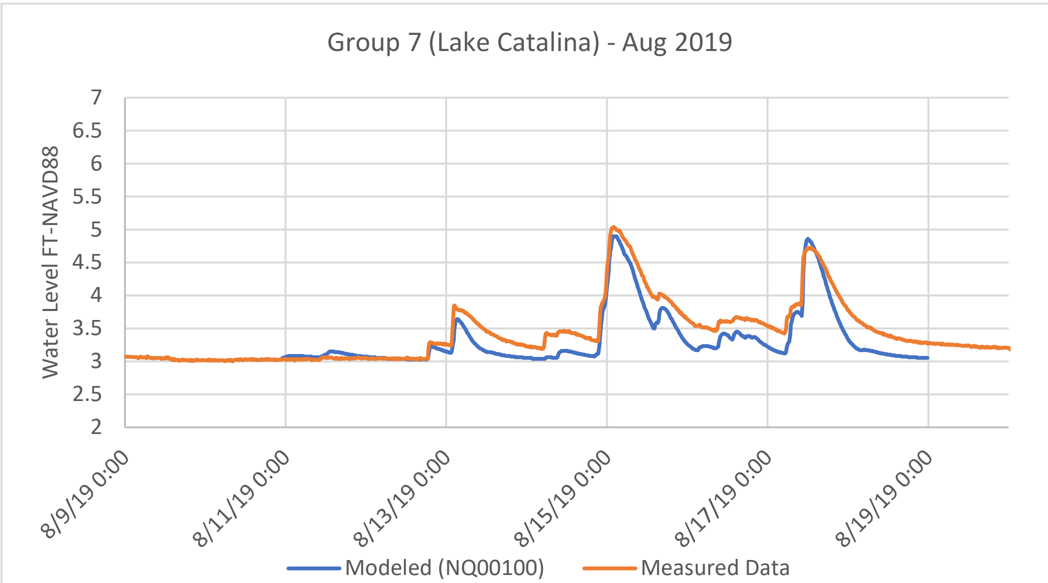


Figure 6-27. Group 7 (Lake Catalina) – Calibration Event August 2019

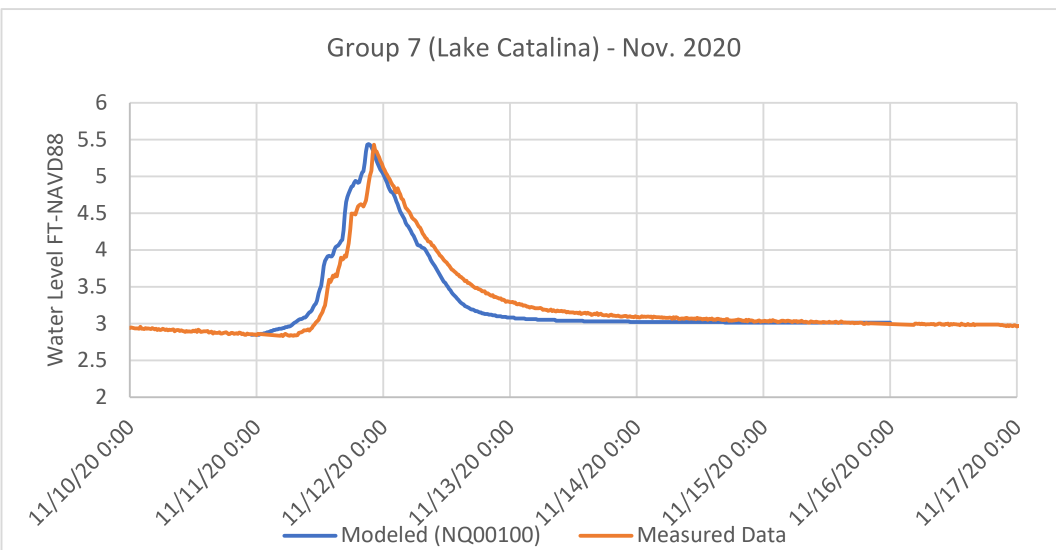


Figure 6-28. Group 7 (Lake Catalina) – Verification Event November 2020

Overall, the calibration and verification for Group 7 at Lake Catalina shows excellent agreement at peaks stages, with marginal overprediction of 0.4 foot during the second peak of the August 2019 calibration event, while the verification event shows an almost exact match of peak stage with a slight overprediction of 0.1 foot and excellent hydrograph shape prediction. For both calibration and verification events, the hydrograph shapes may be representing groundwater contributions between rainfall events. That is to say a baseflow contribution between rainfall events may be present and shown in the rather constant elevation of 3 feet NAVD88 and small jumps in stage over the calibration event, as well as the longer recession limb of the hydrograph for both calibration and verification peak events.

Based on the peer review comments received, additional metrics were looked into: Integral Square Error (ISE) and Nash-Sutcliffe Efficiency (NSE). Per our research, these metrics appear more applicable for longer-term simulations. However, to address the peer review comments, the statistics were run between the observed data and modeled results for all the gauges for both August 2019 and November 2020 events. As indicated in Tables 6-2 to 6-4, ISE shows excellent rating for all gauges and NSE shows fair to excellent ratings for all the gauges, except for a couple of them that show a poor rating for NSE statistics. These gauges include Jungle Lake, Crescent Lake, and Booker Creek. The model parameters were rechecked at these gauges and they all looked reasonable. Given the other metrics show reasonable match, it should be considered that the calibration and verification is acceptable.

Table 6-2. Integral Square Error Calibration Ratings[1]

ISE (%)	Calibration Rating	Model Application
0 – 3	Excellent	Planning, Preliminary Design, Final Design
3.1 – 6	Very Good	Planning, Preliminary Design, Final Design
6.1 – 10	Good	Planning, Preliminary Design
10.1 – 25	Fair	Planning
➢ 25	Poor	Screening

[1] Adapted from Shamsi, U. and J. Koran. 2017. “Continuous Calibration.” *Journal of Water Management Modeling 25:C414*. doi: 10.14796/JWMM.C414.

Table 6-3. Nash-Sutcliffe Efficiency Calibration Ratings[1]

NSE	Calibration Rating	Model Application
0.5 – 1.0	Excellent	Planning, Preliminary Design, Final Design
0.4 – 0.49	Very Good	Planning, Preliminary Design, Final Design
0.3 – 0.39	Good	Planning, Preliminary Design
0.2-0.29	Fair	Planning
<0.2	Poor	Screening

[1] Adapted from Shamsi, U. and J. Koran. 2017. “Continuous Calibration.” *Journal of Water Management Modeling 25:C414*. doi: 10.14796/JWMM.C414.

Table 6-4. Nash-Sutcliffe Efficiency and Integral Square Error Metrics for the Calibration and Verification Simulations

Group	Gauge Location – Model Node	ISE (%)		NSE	
		Aug 2019	Nov 2020	Aug 2019	Nov 2020
1	Jungle Lake - NR03270	0.19	-3.91	0.1	0.34
	Eagle Lake - NG03080	0.4	0.27	0.04	0.12
2	Crescent Lake - NJ03340	-0.75	0.85	0.01	0.01
3	Booker Creek 7th St - B06843	0.91	0.53	-2.17	0.78
	34th St South Channel - D02120	0.05	0.13	0.59	0.73
	Lake Maggiore - C03000	0.96	0.06	0.96	1.23
4	Bear Creek 64th St - NF08689	0.37	0.75	1.87	2.58
	Bear Creek Pond - NF11303	0.5	0.46	0.18	0.35
	Lake Pasadena - NF04110	0.31	-0.24	0.09	0.03
5	Miles Creek - NH02170	0.61	0.33	0.18	0.35
	Miles Creek - NH03520	0.44	0.57	0.27	0.51
6	54th Ave Canal - NM07710	0.69	0.93	2.07	1.19
7	Lake Catalina - NQ00100	0.73	0.91	0.25	0.23

7. Floodplain Delineation and Justification

The calibrated and verified models were used to simulate the 100-year/1-day event. The soils parameters (Depth to Water table and MC Initial) updated for the calibration and verification event were reverted to original setup, which will provide more conservative parameters for initial soil moisture and Depth to Water Table, appropriate for design storm simulations.

Currently, only a 100-year/1-day design storm was simulated to develop the floodplain delineation. This is because the city's watersheds are highly urbanized and there are no closed basins in the watershed. All the basins are connected to either channelized systems or by extensive interconnected pipe systems eventually draining to Tampa Bay. Additionally, compelling evidence exists to show the response to single-day events governs peak responses. Specifically, the gauge data, as presented in Section 6, shows an almost instantaneous response to rainfall events at the water level gauges around the city, per event (calibration/verification). That is to say, the hydrograph comparisons from measured data show a hydraulic response almost immediately from the rainfall event being considered as part of this SWMP.

The rainfall amount for the 100-year/1-day storm of 12 inches was obtained from the District's Isohyetal plots provided in their ERP Application Handbook Appendix A. Initially, multi-day events including 100-year/3-day, 100-year/5-day, and 100-year/7-day were considered. However, as described previously, the 100-year/1-day storm is deemed more reasonable for this watershed.

The 100-year/1-day floodplain is delineated for each group and presented on Figures 7-1 to 7-7.

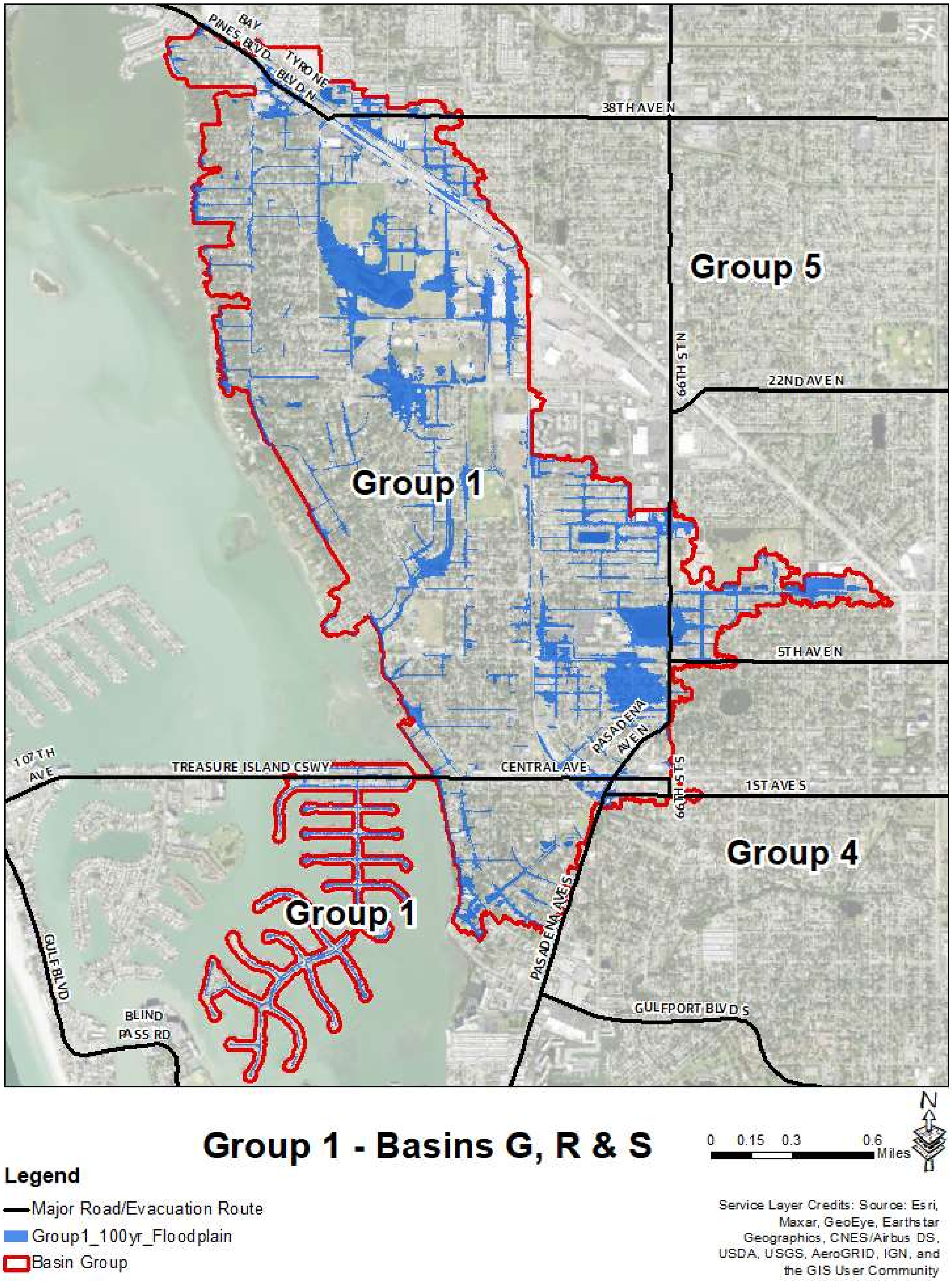


Figure 7-1. Floodplain Map for Group 1

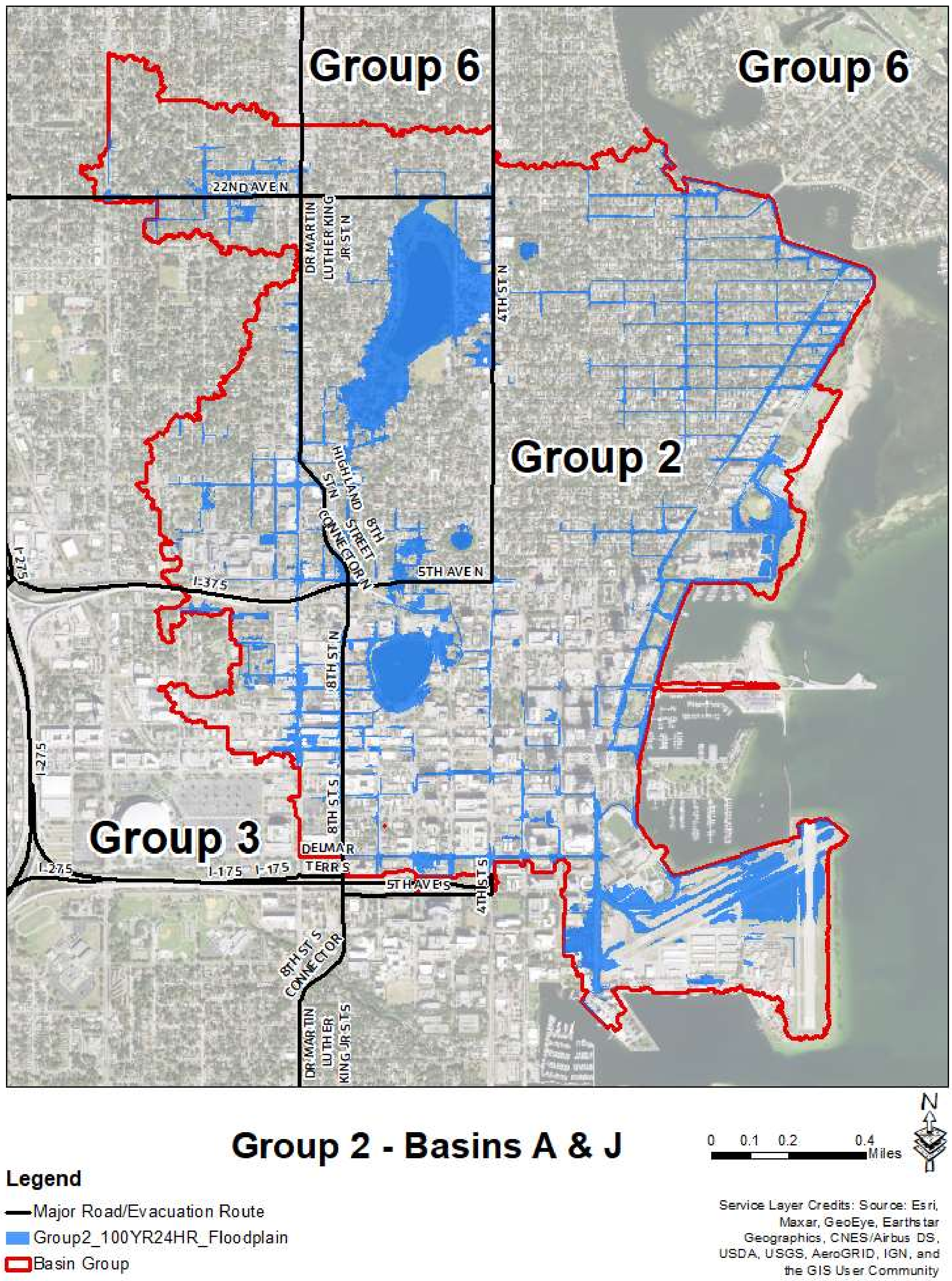


Figure 7-2. Floodplain Map for Group 2

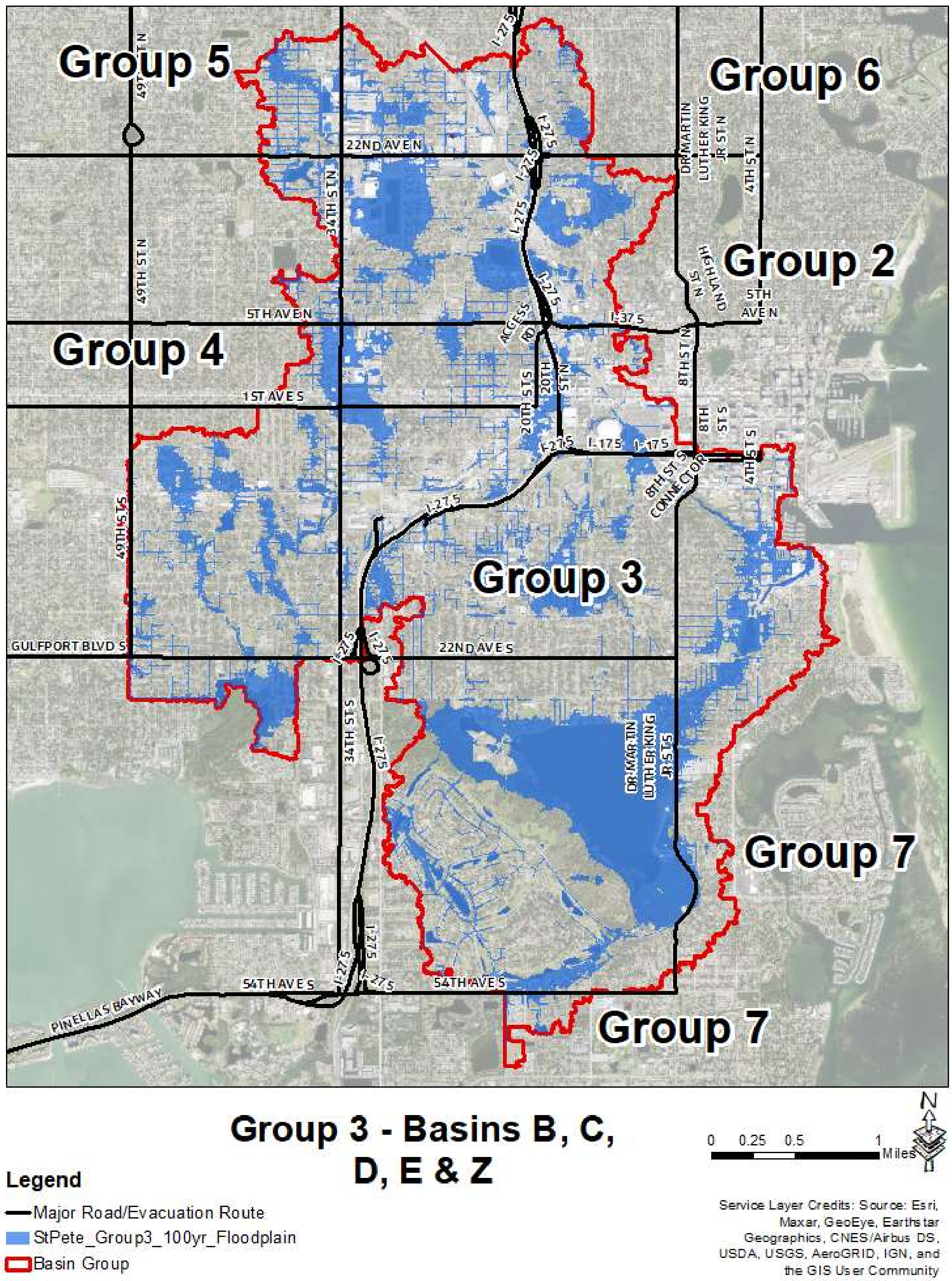


Figure 7-3. Floodplain Map for Group 3

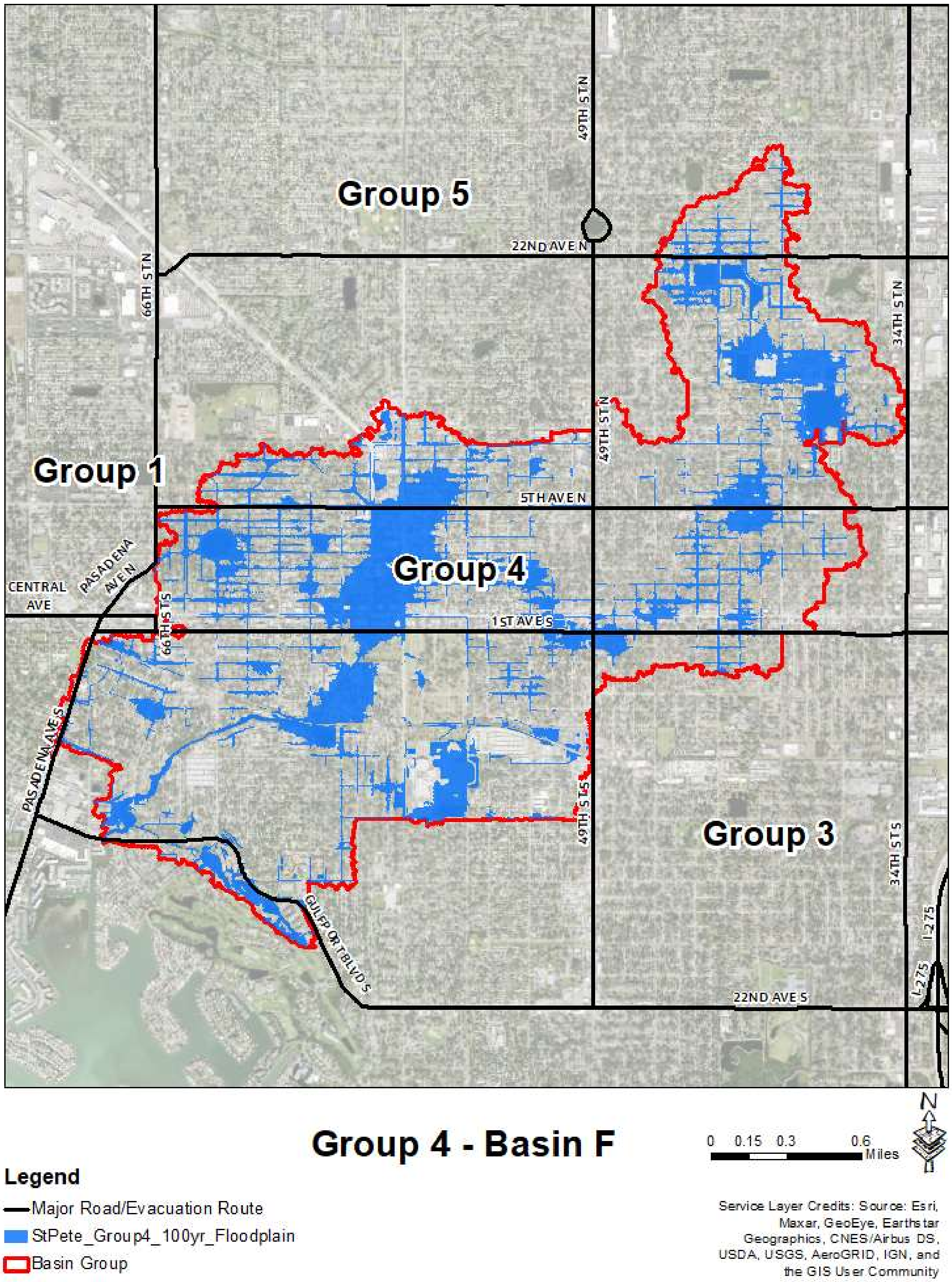


Figure 7-4. Floodplain Map for Group 4

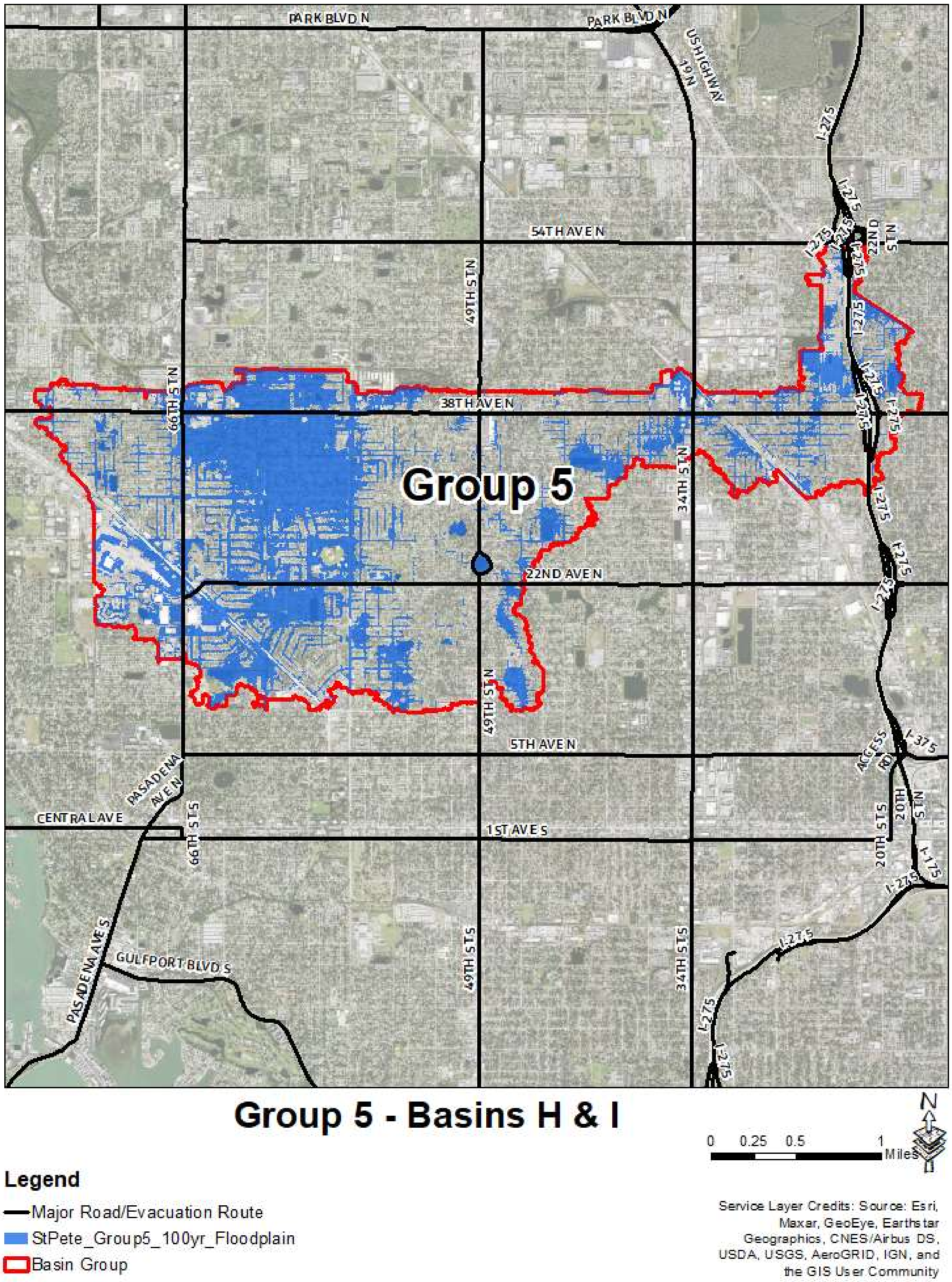


Figure 7-5. Floodplain Map for Group 5

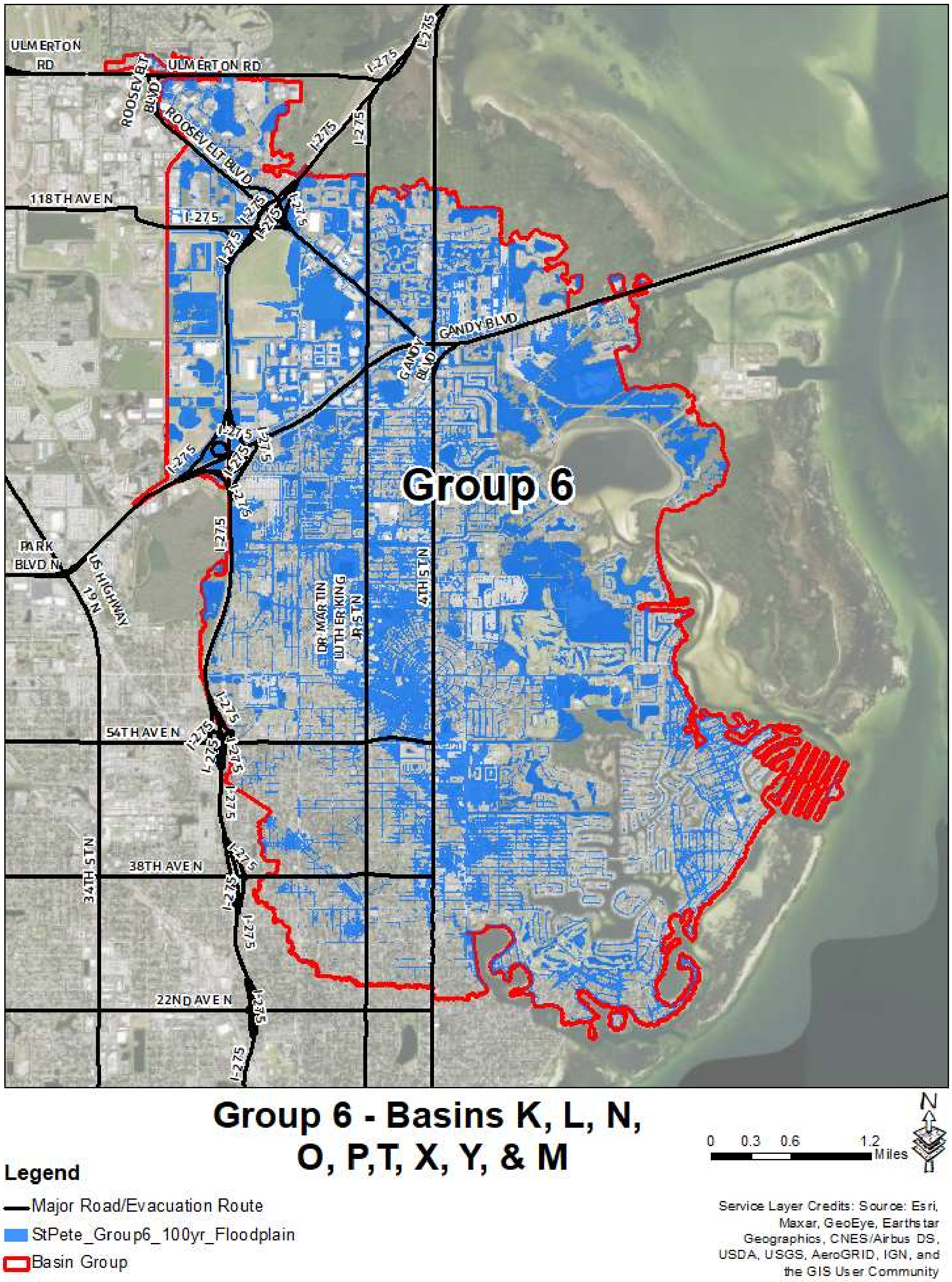


Figure 7-6. Floodplain Map for Group 6

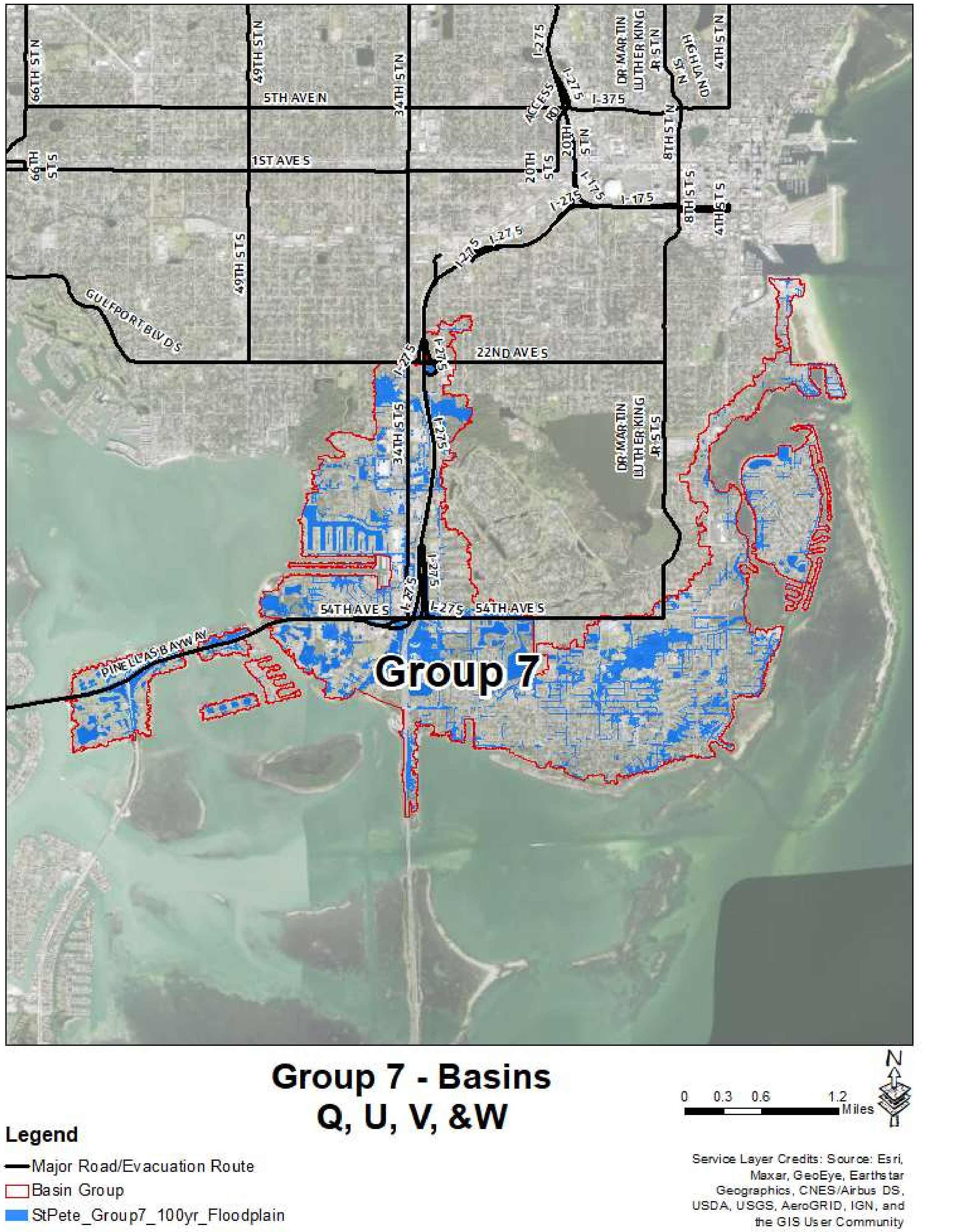


Figure 7-7. Floodplain Map for Group 7

7.1 Transition Zones

Transition zones were developed by reviewing the overland weirs with flow and show glass wall issues in the floodplain along the sub-basin boundary:

- Selected all the overland weir links that have flows greater than 10 cfs (absolute value).
- Reviewed and removed from selection all the selected links that were in the floodplain.
- Reviewed the remaining selected links to identify if there is a “glass wall” location where the floodplain crosses the sub-basin boundary and the floodplain elevation is greater than the weir invert crossing the boundary. If a glass wall issue was not encountered, the link was removed from selected links.
- For the remaining selected links, transition zones were developed along the overland weirs connecting the upstream and downstream floodplains.

7.2 Federal Emergency Management Agency Floodplain

The effective Federal Emergency Management Agency (FEMA) floodplain layer obtained from FEMA Map Center for the City of St. Petersburg was used to compare with the 100-year/1-day floodplain for each of the seven Groups. Figures 7-8 to 7-14 show the comparison of the 100-year/1-day floodplain with the FEMA floodplains (Flood Zones A, AE, and VE). For most of the groups, the comparison shows a significant difference in floodplain area, especially the coastal areas. The differences could be attributed to several factors including:

- For coastal regions, FEMA mapping includes VE zones that take into account surge-related flooding; however, Group model results are primarily based on rainfall based flooding.
- Another significant factor for both coastal and region differences could be the differences in level of detail in the modeling between the Group model and the models that were used to develop effective FEMA floodplain layer.
- Other factors could be the changes in land use and DEM since the existing FEMA maps were generated.

A floodplain comparison in total area is provided in Table 7-1.

Table 7-1. Floodplain Comparison with FEMA Floodplains

Floodplain	Area (acres)	Area (square miles)
Group 1		
FEMA	411.59	0.64
Updated Modeled Floodplains	409.16	0.64
Group 2		
FEMA	334.966	0.52
Updated Modeled Floodplains	291.44	0.46
Group 3		
FEMA	1,376.34	2.15
Updated Modeled Floodplains	2,501.28	3.91
Group 4		
FEMA	8.34	0.01
Updated Modeled Floodplains	679.84	1.06
Group 5		
FEMA	602.81	0.94
Updated Modeled Floodplains	1,391.28	2.17
Group 6		
FEMA	10867	16.98
Updated Modeled Floodplains	4 731.74	7.39
Group 7		
FEMA	2,480.39	3.88
Updated Modeled Floodplains	1,106.11	1.73

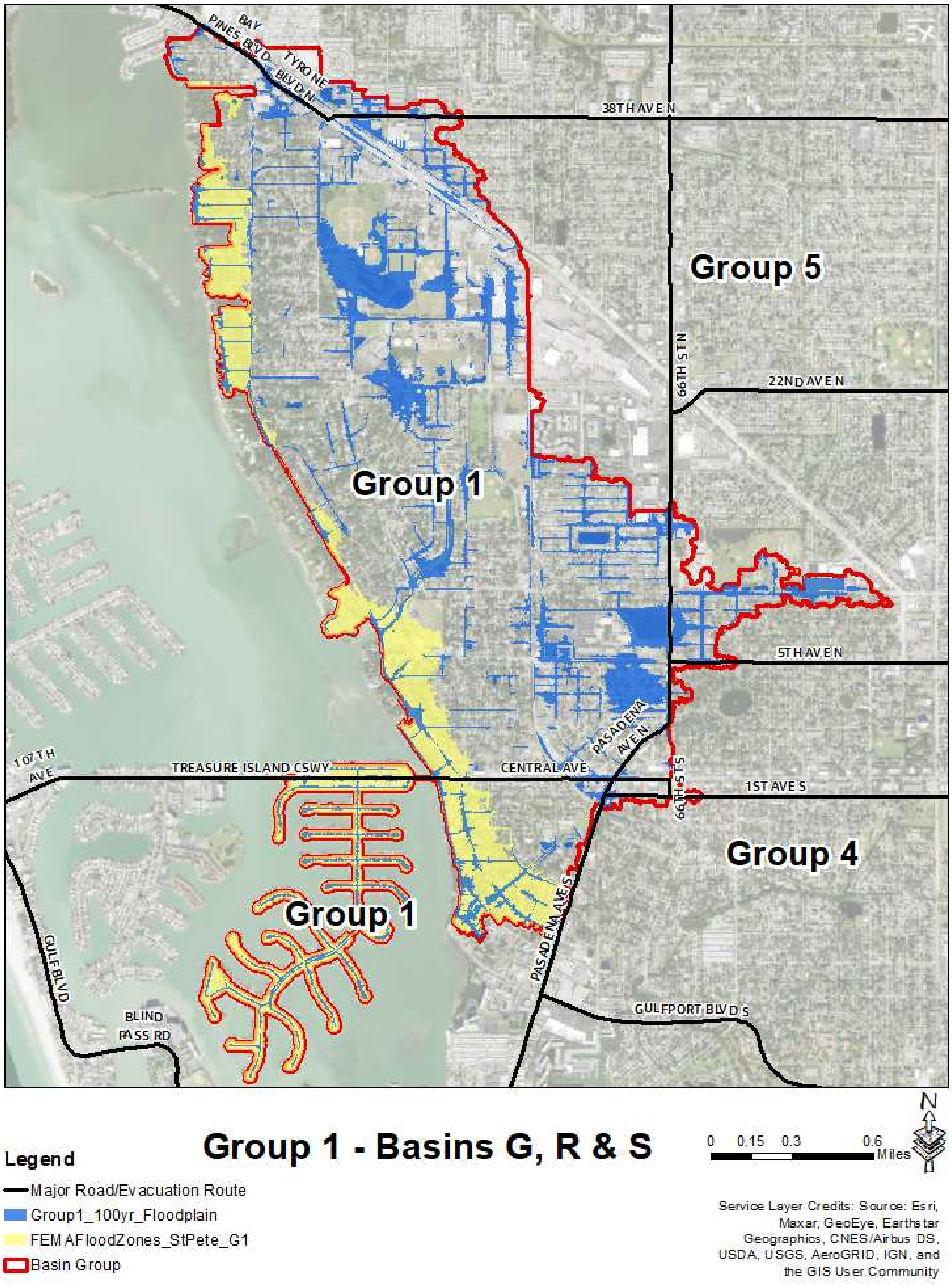


Figure 7-8. Modeled and FEMA Floodplain Map for Group 1

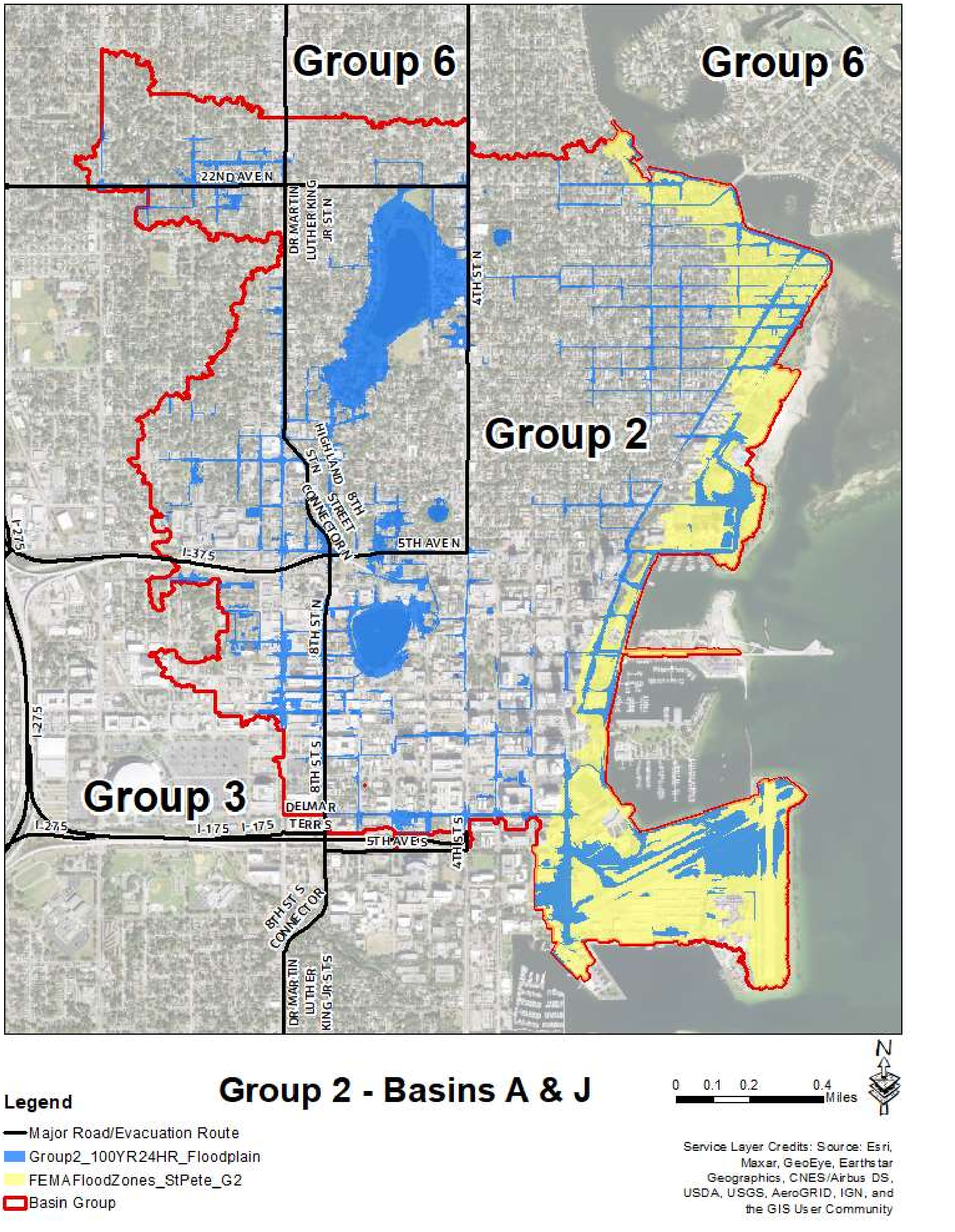


Figure 7-9. Modeled and FEMA Floodplain Map for Group 2

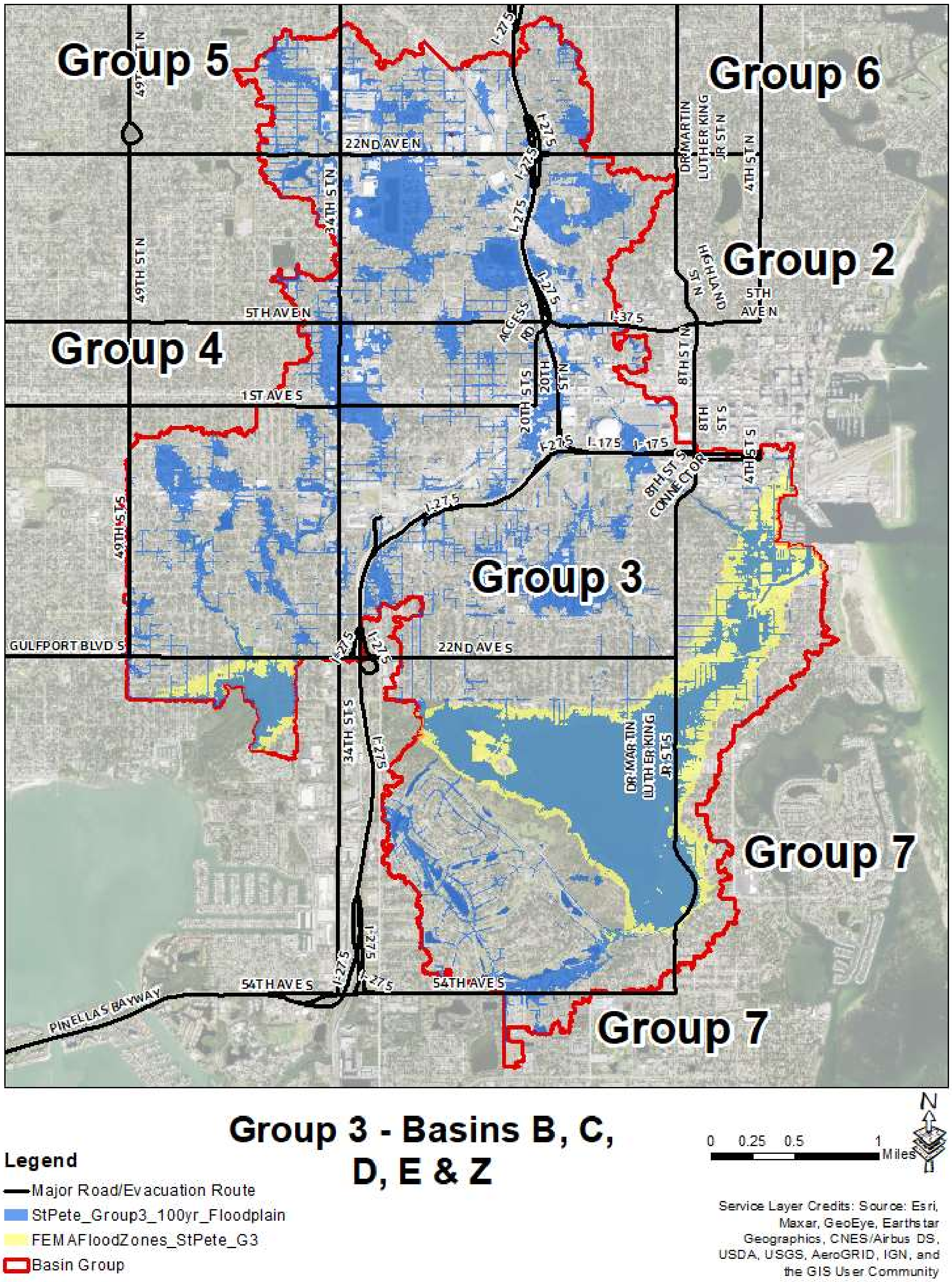


Figure 7-10. Modeled and FEMA Floodplain Map for Group 3

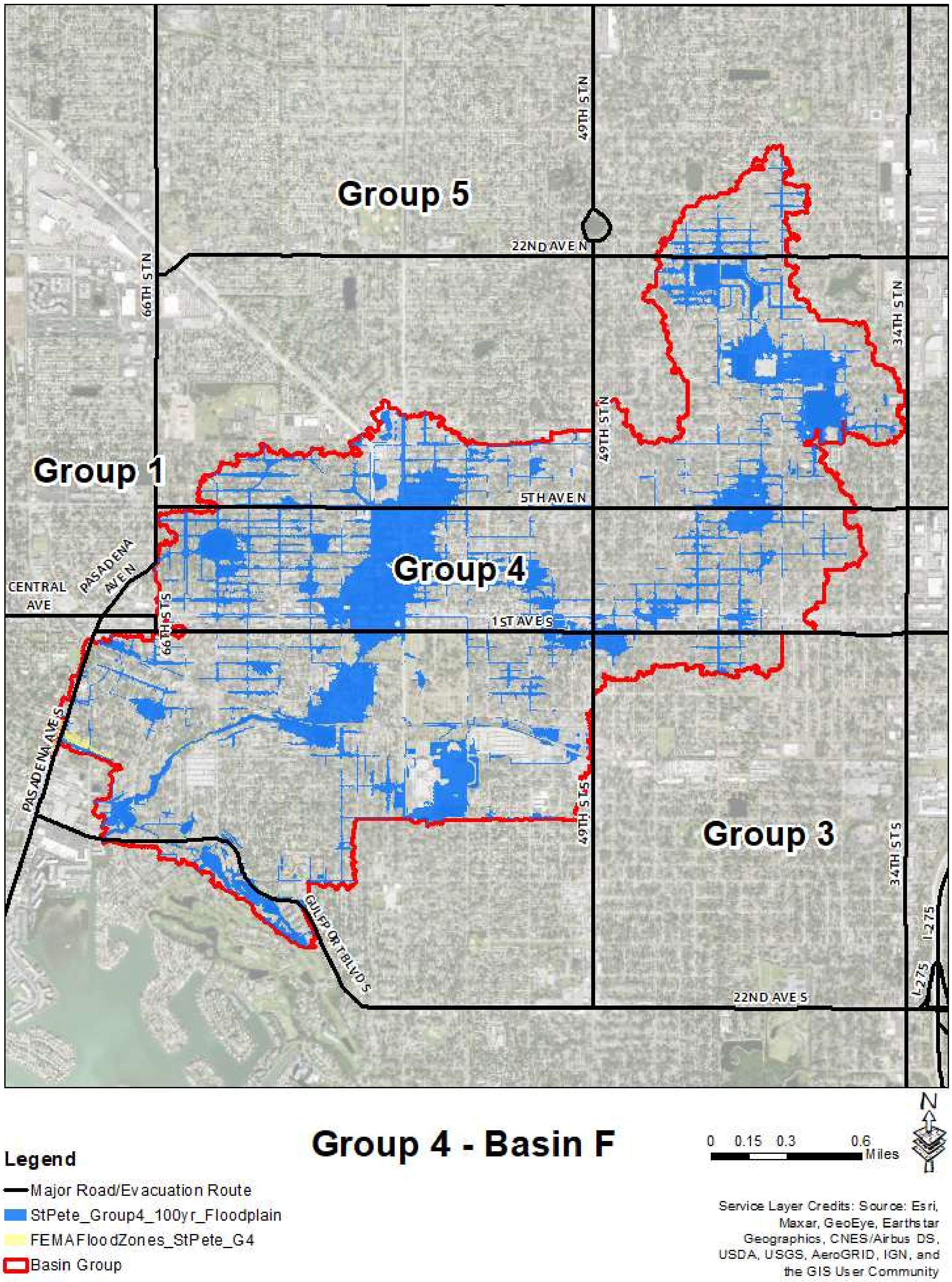


Figure 7-11. Modeled and FEMA Floodplain Map for Group 4

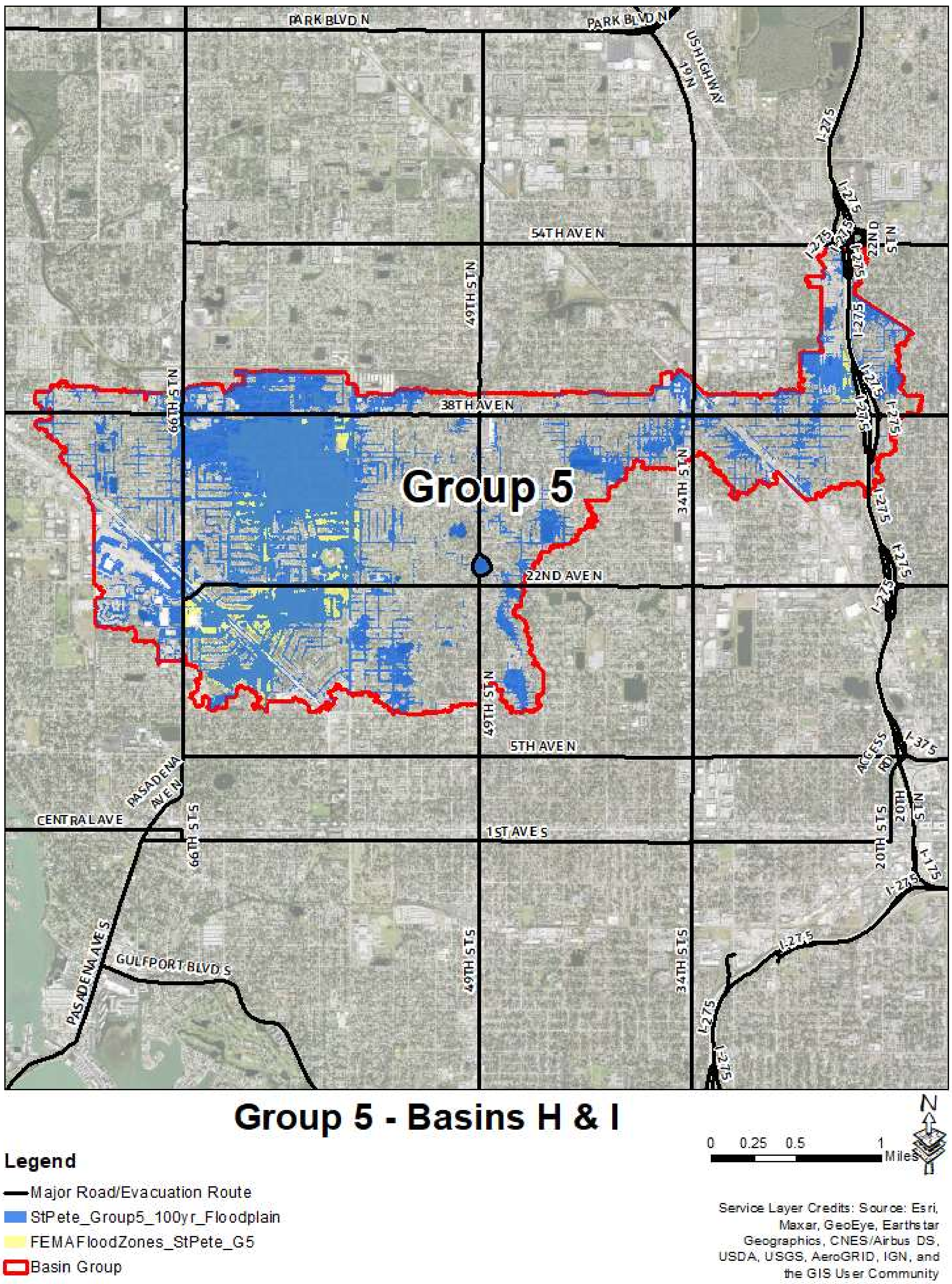


Figure 7-12. Modeled and FEMA Floodplain Map for Group 5

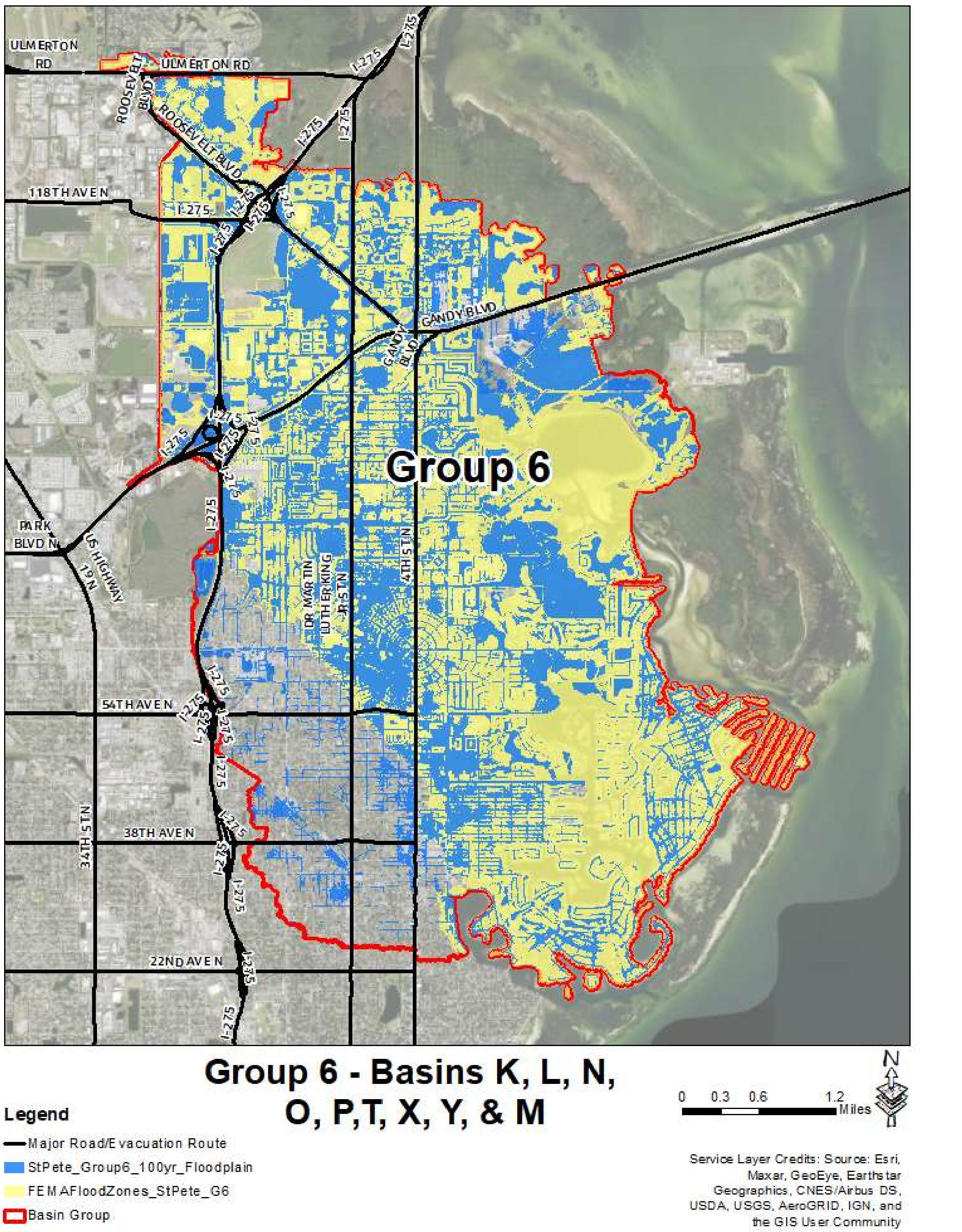


Figure 7-13. Modeled and FEMA Floodplain Map for Group 6

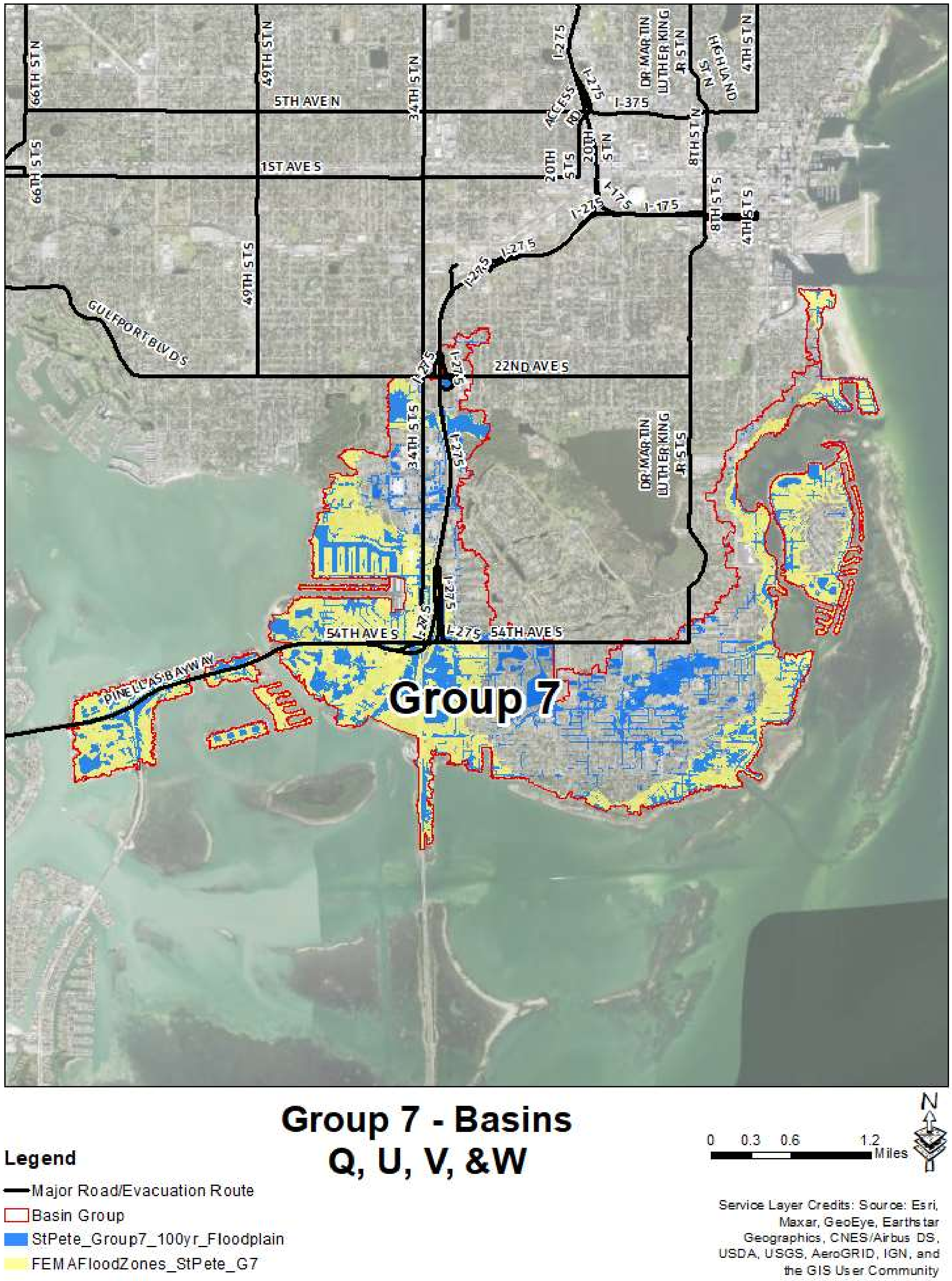


Figure 7-14. Modeled and FEMA Floodplain Map for Group 7

8. Peer Review

The Draft Floodplain Analysis Justification Report and associated data deliverables, and preliminary 100-year floodplain maps were submitted to the peer reviewer, the City, and the District for review on 9/13/2021. Preliminary peer review comments were provided to Jacobs on 11/18/2021. The City and District also provided review comments on 10/14/2021 and 10/28/2021, respectively. All the review comments were addressed, and responses are being provided with the revised deliverables under the "\Comments\" folder in the deliverable structure. In general, the model performance was improved based on the revisions made per the comments; however, the revisions did not have significant impact on the preliminary 100-year floodplain delineations submitted under the draft deliverables.

8.1 Second Round Peer Review

After addressing the first round of peer review comments, the revised Draft Floodplain Analysis Justification Report and associated data deliverables, and preliminary 100-year floodplain maps were submitted to the peer reviewer, the City, and the District for review on 2/5/2022. The second round of peer review comments and District comments were received on 3/4/2022 and 2/28/2022, respectively. The City's comments were received on 3/9/2022. All the review comments were addressed, and responses are being provided with the revised deliverables under the "\Comments\" folder in the deliverable structure.

9. References

Chow, V.T. 1959. *Open-Channel Hydraulics*. New York: McGraw-Hill.

ICPR4 guidance.

Natural Resources Conservation Service, United States Department of Agriculture (NRCS). 2020. Web Soil Survey. http://websoilsurvey.sc.egov.usda.gov/. Accessed November 3, 2020.

Post, Buckley, Schuh & Jernigan, Inc. and Dames & Moore, Inc., City of St. Petersburg, Florida. 1994. Stormwater Management Master Plan.

Southwest Florida Water Management District (SFWMD). 2017 (Revised 2020). Watershed Management Program Guidelines and Specifications.

URS, Pinellas County, 2016. Joe's Creek Watershed Management Plan – Floodplain Analysis Tasks 3.1.4 – 3.1.5.

U.S. Department of Agriculture (USDA). 1986. *Urban Hydrology for Small Watersheds*. Natural Resources Conservation Service and Conservation Engineering Division. Technical Release 55. June.

Appendix A
SWFWMD Soil Data Retrieval and Processing Green-Ampt Soil Parameters

SWFWMD Soil Data Retrieval and Processing Green-Ampt Soil Parameters

Soil Name	Soil Zone	HSG	Kv Saturated	MC Saturated	MC Residual	MC Initial	MC Field	MC Wilting	Pore Size Index	Bubble Pressure	Allow Recharge	WT Initial
ADAMSVILLE SOILS AND URBAN LAND, 0 TO 5 PERCENT SLOPES	1017080	A	18.286	0.371	0.006	0.328	0.077	0.011	0.608	2.102	No	2.592
TAVARES SOILS AND URBAN LAND, 0 TO 5 PERCENT SLOPES	1017082	A	24.058	0.372	0.006	0.244	0.078	0.012	0.599	1.954	No	4.593
ANCLOTE FINE SAND, DEPRESSIONAL	1017083	A/D	3.401	0.386	0.036	0.386	0.24	0.086	0.595	1.909	No	0.033
PINEDA SOILS AND URBAN LAND	1017085	C/D	4.053	0.393	0.045	0.393	0.24	0.092	0.422	2.348	No	0.033
FELDA FINE SAND, DEPRESSIONAL	1017086	A/D	5.39	0.384	0.023	0.383	0.243	0.037	0.541	1.954	No	0.262
FELDA SOILS AND URBAN LAND	1017087	B/D	5.39	0.384	0.023	0.383	0.243	0.037	0.541	1.954	No	0.262
DUMPS	1017088	UND	6.567	0.415	0.024	0.398	0.187	0.04	0.56	1.638	No	1.017
MANATEE LOAMY FINE SAND	1017089	B/D	9.73	0.459	0.053	0.456	0.332	0.105	0.435	1.432	No	0.262
MYAKKA SOILS AND URBAN LAND	1017090	A/D	23.485	0.372	0.013	0.368	0.102	0.025	0.6	1.879	No	1.181
OKEECHOBEE MUCK	1017091	A/D	11.531	0.449	0.027	0.449	0.217	0.046	0.535	1.261	No	0.033
EAUGALLIE SOILS AND URBAN LAND	1017092	A/D	5.829	0.424	0.031	0.415	0.297	0.149	0.386	3.03	No	1.181
SEFFNER SOILS AND URBAN LAND	1017093	A	23.485	0.372	0.013	0.336	0.102	0.025	0.6	1.879	No	2.362
MATLACHA AND ST. AUGUSTINE SOILS AND URBAN LAND	1017094	B	6.567	0.415	0.024	0.364	0.187	0.04	0.56	1.638	No	2.264
PAOLA AND ST. LUCIE SOILS AND URBAN LAND	1017096	A	27.864	0.413	0.006	0.256	0.061	0.01	0.595	1.47	No	4.757
PINELLAS SOILS AND URBAN LAND	1017097	B/D	9.48	0.422	0.037	0.409	0.227	0.074	0.519	1.396	No	0.951
PLACID FINE SAND, DEPRESSIONAL	1017098	A/D	10.987	0.371	0.012	0.371	0.175	0.027	0.591	2.059	No	0.295
POMELLO SOILS AND URBAN LAND, 0 TO 5 PERCENT SLOPES	1017099	A	16.235	0.39	0.008	0.335	0.089	0.015	0.597	1.753	No	2.592
BASINGER SOILS AND URBAN LAND	1017100	A/D	42.864	0.395	0.014	0.394	0.1	0.028	0.588	1.639	No	0.262
PAOLA AND ST. LUCIE SOILS AND URBAN LAND, 5 TO 12 PERCENT SLOPES	1017101	A	27.864	0.413	0.006	0.256	0.061	0.01	0.595	1.47	No	4.757
KESSON FINE SAND, VERY FREQUENTLY FLOODED	1017104	A/D	6.567	0.415	0.024	0.415	0.187	0.04	0.56	1.638	No	0.033
URBAN LAND	1017105	UND	6.567	0.415	0.024	0.365	0.187	0.04	0.56	1.638	No	2.231
ASTATULA SOILS AND URBAN LAND, 0 TO 5 PERCENT SLOPES	1017106	A	35.813	0.386	0.004	0.285	0.061	0.008	0.605	1.758	No	3.543
IMMOKALEE SOILS AND URBAN LAND	1017107	A/D	19.394	0.379	0.013	0.373	0.104	0.026	0.609	1.922	No	1.181
WABASSO SOILS AND URBAN LAND	1017108	C/D	7.447	0.41	0.054	0.395	0.25	0.113	0.396	2.659	No	1.181
WATER	1017109	W	6.567	0.415	0.024	0.415	0.187	0.04	0.56	1.638	No	0
PITS	1017110	W	6.567	0.415	0.024	0.393	0.187	0.04	0.56	1.638	No	1.247
WATERS OF THE GULF OF MEXICO	1017111	W	23.485	0.372	0.013	0.372	0.102	0.025	0.6	1.879	No	0
BASINGER FINE SAND, DEPRESSIONAL	1017112	A/D	27.287	0.609	0.03	0.607	0.508	0.083	0.566	0.948	No	0.295
Wulfert muck, tidal, 0 to 1 percent slopes	3102917	A/D	9.41	0.459	0.072	0.459	0.38	0.147	0.334	1.993	No	0

Notes:
HSG of "UND" are undefined by NRCS.
Parameter values are weighted by layer thickness based on Vertical Layer soil parameter values.
Kv Saturated is in units of ft/day.
MC Saturated, MC Residual, MC Initial, MC Field and MC Wilting are volumetric moisture contents.
Brooks-Corey Pore Size Index has no unit.
Bubble Pressure is in units of inches.
Allow Recharge set in default value. Users can adjust as needed.
WT Initial or Initial Water Table Depth in units of feet, adopted by default from the Sept 2018 NRCS soil data unless users specified otherwise.

Adjusted Green-Ampt Parameters for Calibration/Verification Event Simulations

Soil Zone	Kv Saturated	MC Saturated	MC Residual	Mc Initial	MC Field	MC Wilting	Pore Size Index	Bubble Pressure	Allow Recharge	WT Initial
Adamsville soils and Urban land, 0 to 5 percent slopes	18.286	0.371	0.006	0.077	0.077	0.011	0.608	2.102	No	2.592
Anclote fine sand, depressional	3.401	0.386	0.036	0.24	0.24	0.086	0.595	1.909	No	0.5
Astatula soils and Urban land, 0 to 5 percent slopes	35.813	0.386	0.004	0.061	0.061	0.008	0.605	1.758	No	4
Basinger fine sand, frequently ponded, 0 to 1 percent slopes	27.287	0.609	0.03	0.508	0.508	0.083	0.566	0.948	No	0.295
Basinger fine sand-Urban land complex, 0 to 2 percent slopes	42.864	0.395	0.014	0.1	0.1	0.028	0.588	1.639	No	0.262
Dumps	6.567	0.415	0.024	0.187	0.187	0.04	0.56	1.638	No	1.017
EauGallie soils and Urban land	5.829	0.424	0.031	0.297	0.297	0.149	0.386	3.03	No	1.181
Felda fine sand, frequently ponded, 0 to 1 percent slopes	5.39	0.384	0.023	0.243	0.243	0.037	0.541	1.954	No	0.262
Felda soils and Urban land	5.39	0.384	0.023	0.243	0.243	0.037	0.541	1.954	No	0.262
Immokalee soils and Urban land	19.394	0.379	0.013	0.104	0.104	0.026	0.609	1.922	No	1.5
Kesson fine sand, very frequently flooded	6.567	0.415	0.024	0.187	0.187	0.04	0.56	1.638	No	0.033
Manatee loamy fine sand, frequently ponded, 0 to 1 percent slopes	9.73	0.459	0.053	0.332	0.332	0.105	0.435	1.432	No	0.5
Matlacha and St. Augustine soils and Urban land	6.567	0.415	0.024	0.187	0.187	0.04	0.56	1.638	No	2.5
Myakka soils and Urban land	23.485	0.372	0.013	0.102	0.102	0.025	0.6	1.879	No	2.5
Okeechobee, frequently ponded, 0 to 1 percent slopes	11.531	0.449	0.027	0.217	0.217	0.046	0.535	1.261	No	0.033
Paola and St. Lucie soils and Urban land	27.864	0.413	0.006	0.061	0.061	0.01	0.595	1.47	No	4.757
Paola and St. Lucie soils and Urban land, 5 to 12 percent slopes	27.864	0.413	0.006	0.061	0.061	0.01	0.595	1.47	No	4.757
Pineda soils and Urban land	9.48	0.422	0.037	0.227	0.227	0.074	0.519	1.396	No	1.5
Pinellas soils and Urban land	4.053	0.393	0.045	0.24	0.24	0.092	0.422	2.348	No	0.5
Pits	6.567	0.415	0.024	0.187	0.187	0.04	0.56	1.638	No	1.247
Placid fine sand, frequently ponded, 0 to 1 percent slopes	10.987	0.371	0.012	0.175	0.175	0.027	0.591	2.059	No	0.295
Pomello soils and Urban land, 0 to 5 percent slopes	16.235	0.39	0.008	0.089	0.089	0.015	0.597	1.753	No	3
Seffner soils and Urban land	23.485	0.372	0.013	0.102	0.102	0.025	0.6	1.879	No	2.362
Tavares fine sand-Urban land complex, 0 to 5 percent slopes	24.058	0.372	0.006	0.078	0.078	0.012	0.599	1.954	No	5
Urban land, 0 to 2 percent slopes	6.567	0.415	0.024	0.187	0.187	0.04	0.56	1.638	No	2.5
Wabasso soils and Urban land	7.447	0.41	0.054	0.25	0.25	0.113	0.396	2.659	No	1.181
Water	6.567	0.415	0.024	0.187	0.187	0.04	0.56	1.638	No	0
Waters of the Gulf of Mexico	23.485	0.372	0.013	0.102	0.102	0.025	0.6	1.879	No	0
Wulfert muck, tidal, 0 to 1 percent slopes	9.41	0.459	0.072	0.38	0.38	0.147	0.334	1.993	No	0

Appendix C. Level of Service Analysis Results

C.1 Existing Conditions Level of Service Analysis Results

C.1.1 Structures

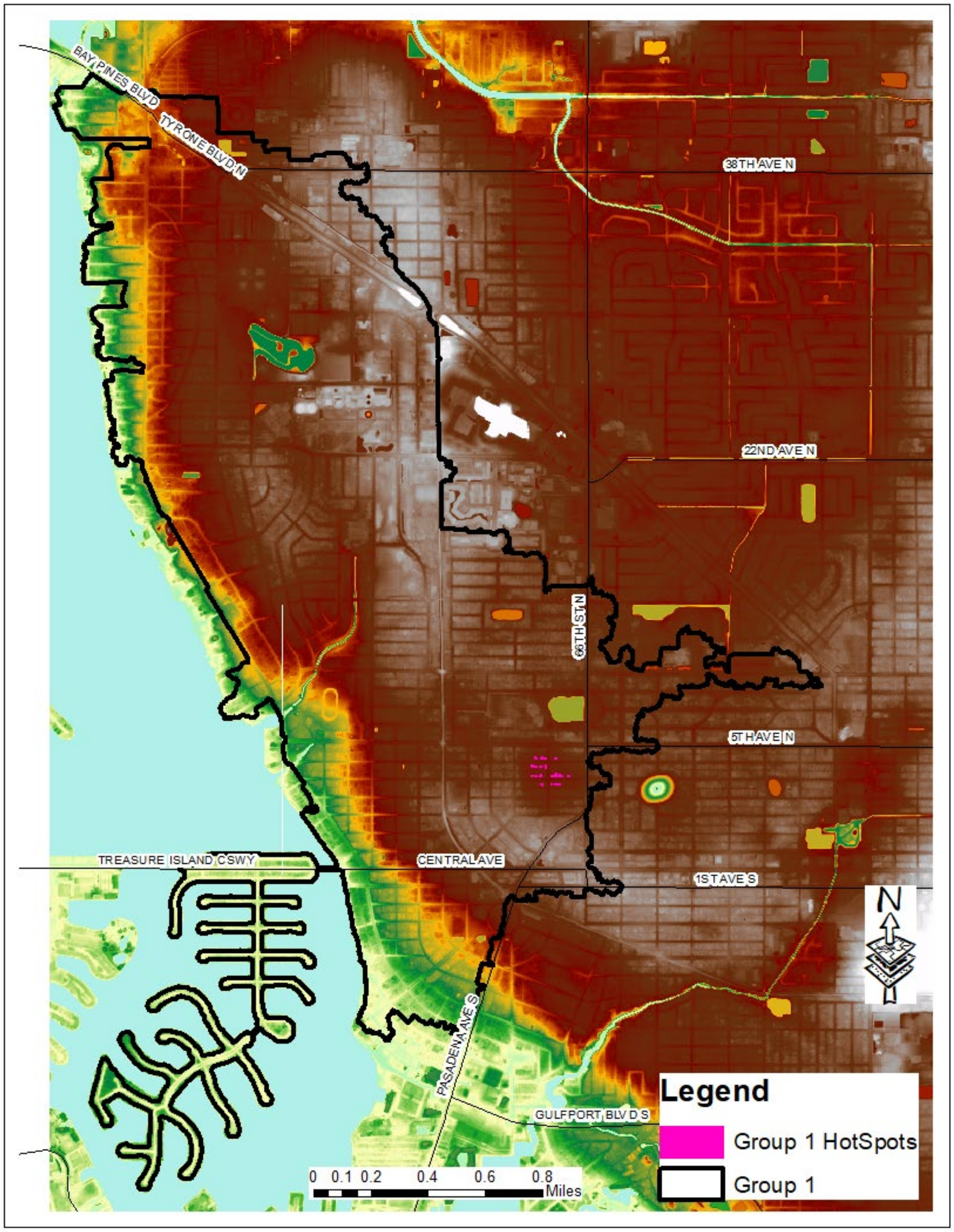


Figure C-1. Group 1 Structure Flooding Hotspots that Do Not Meet LOS Criteria

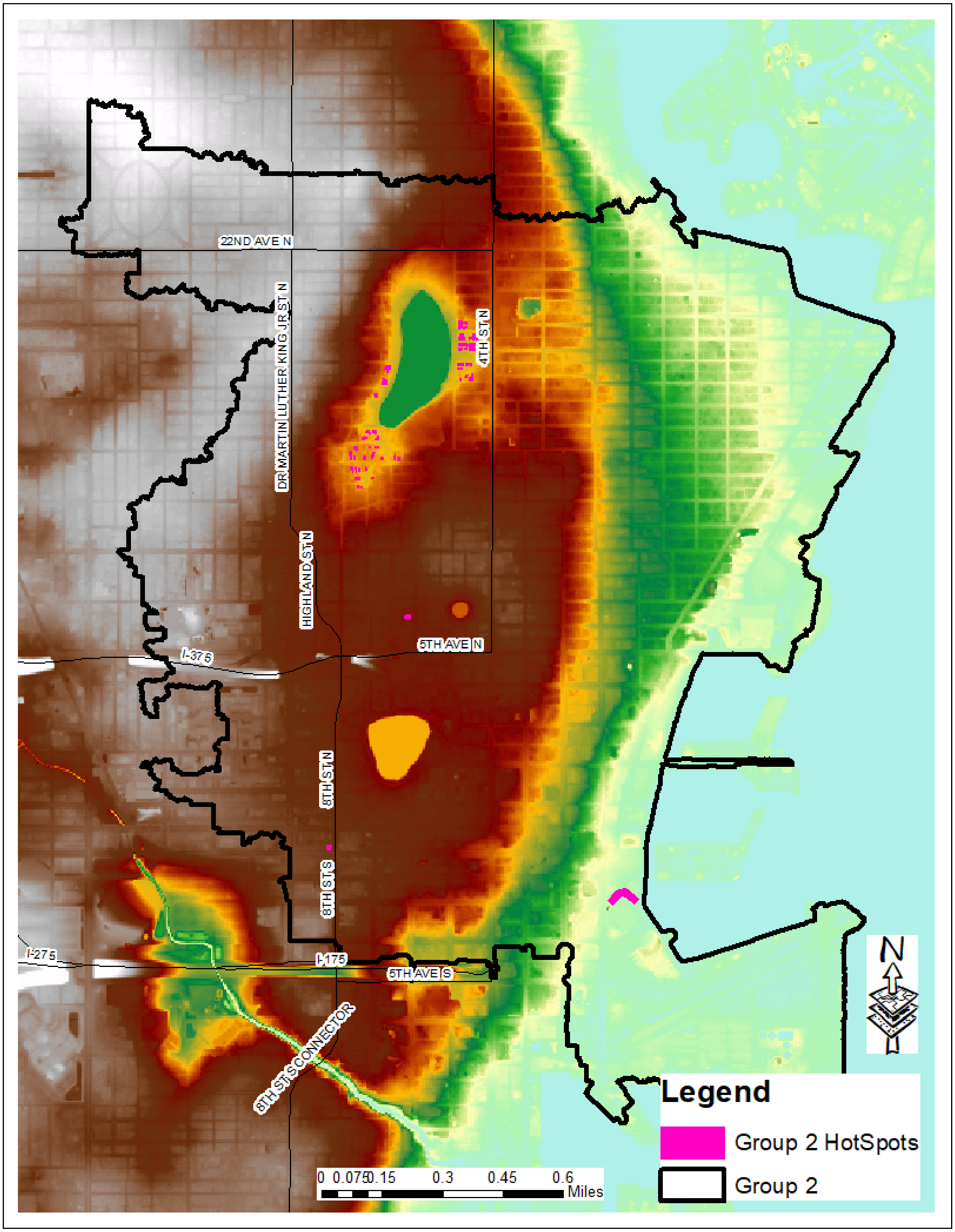


Figure C-2. Group 2 Structure Flooding Hotspots that Do Not Meet LOS Criteria

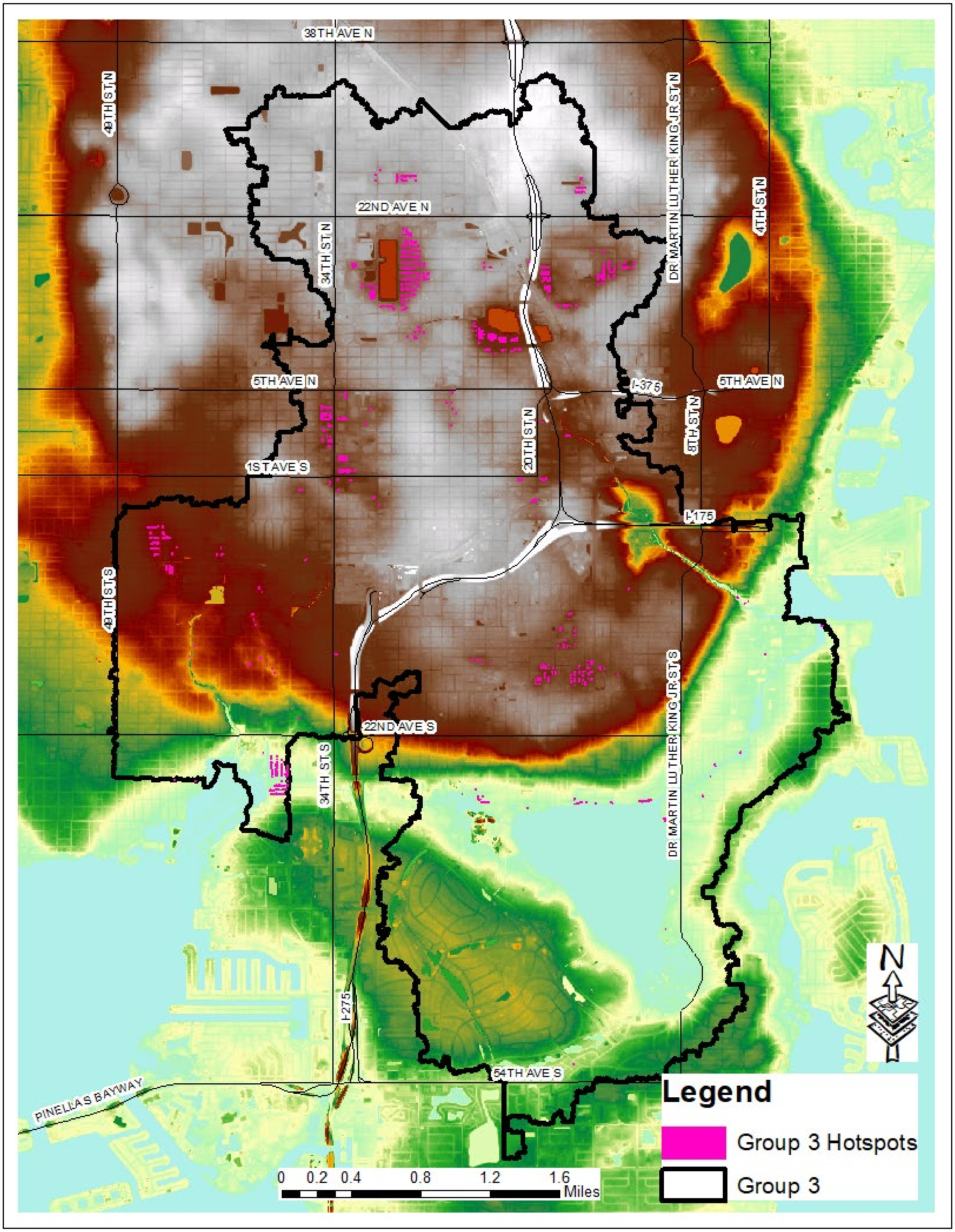


Figure C-3. Group 3 Structure Flooding Hotspots that Do Not Meet LOS Criteria

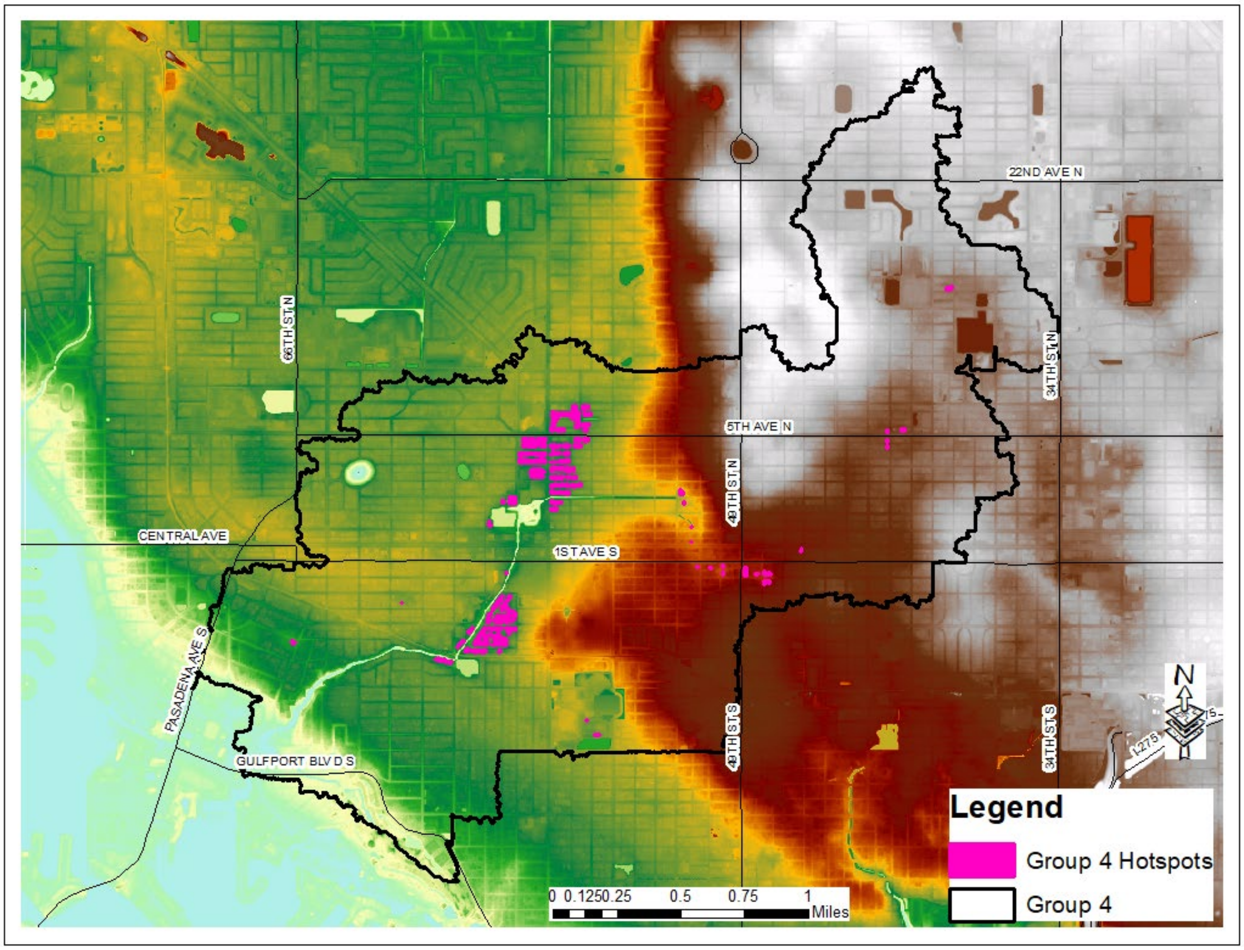


Figure C-4. Group 4 Structure Flooding Hotspots that Do Not Meet LOS Criteria

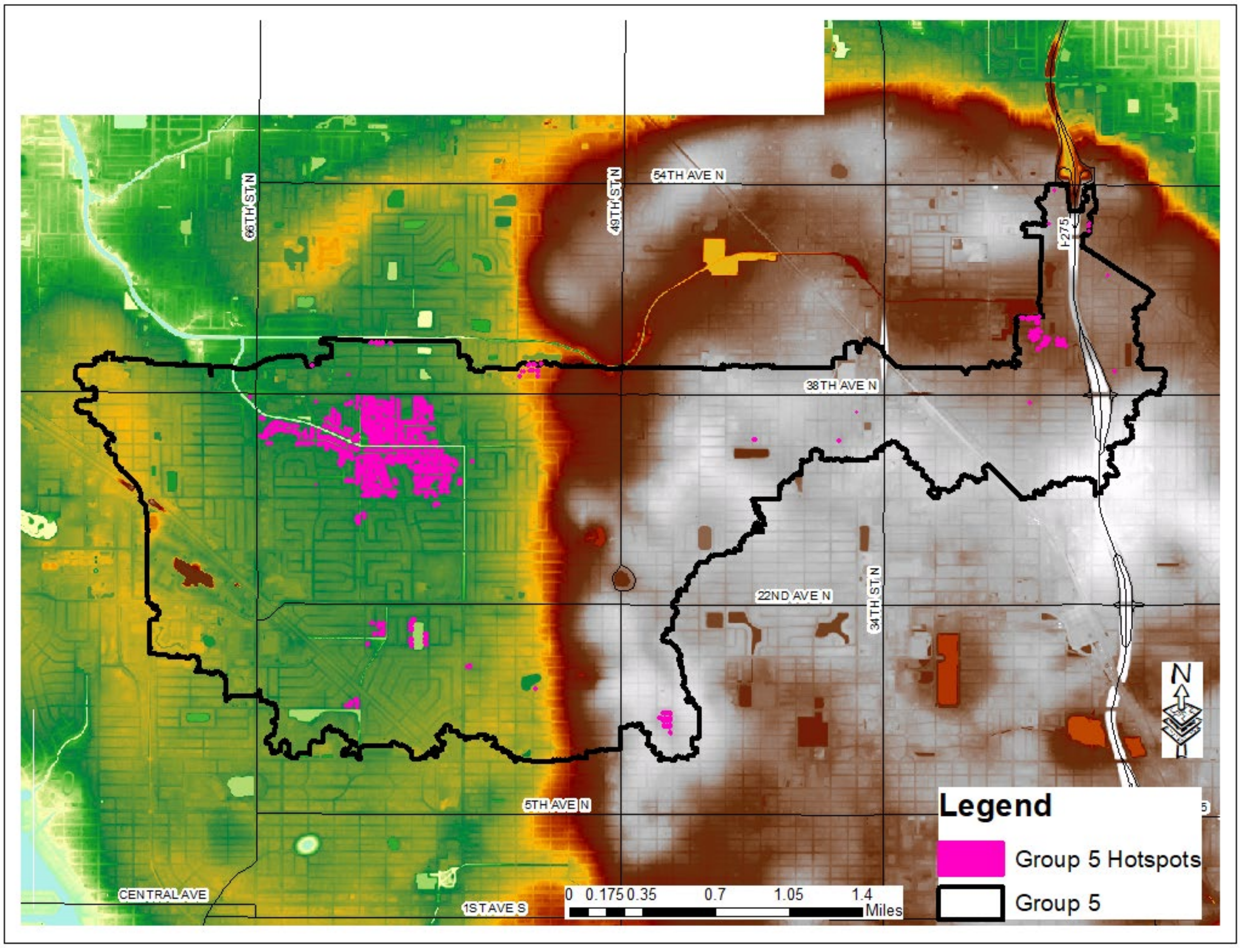


Figure C-5. Group 5 Structure Flooding Hotspots that Do Not Meet LOS Criteria

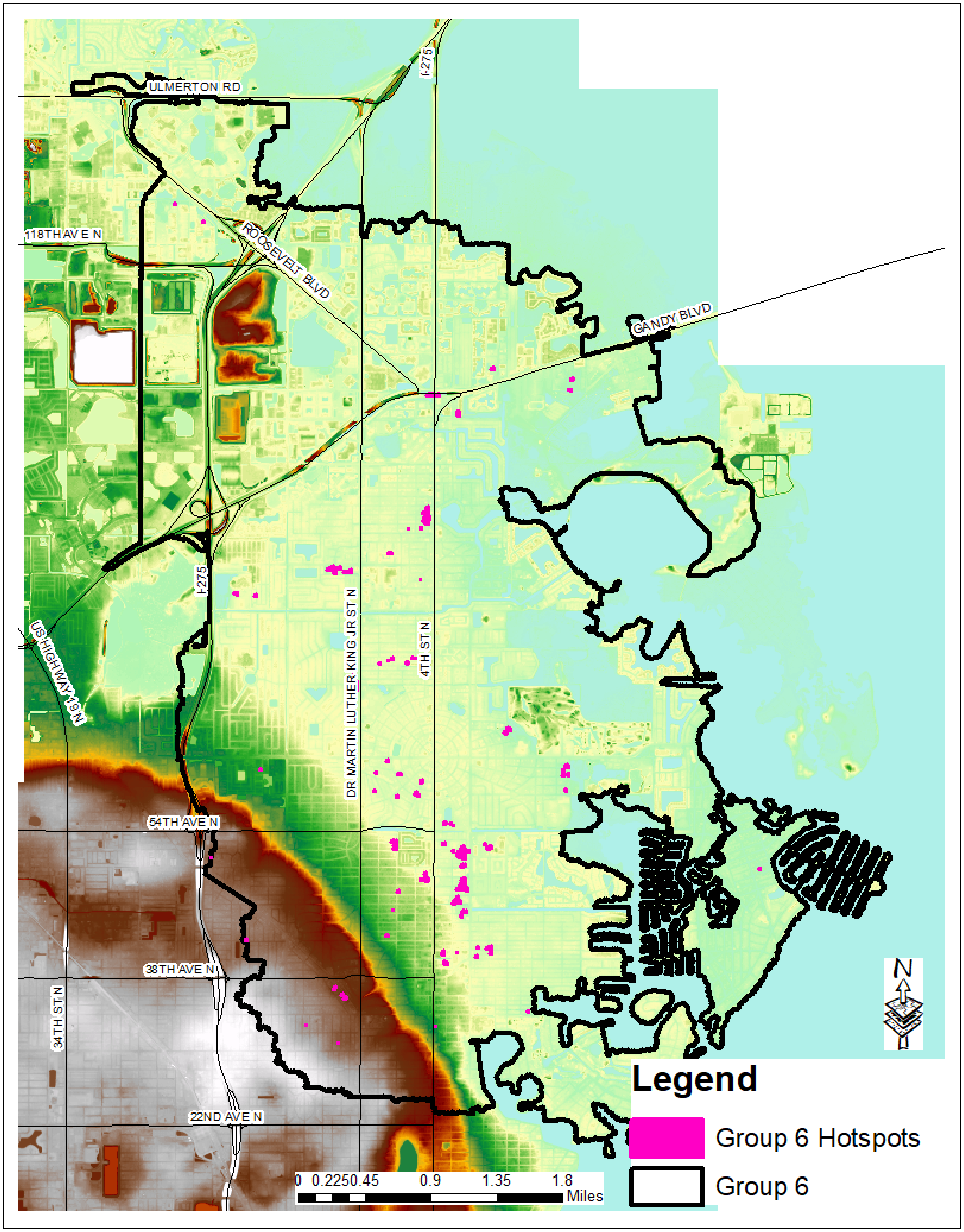


Figure C-6. Group 6 Structure Flooding Hotspots that Do Not Meet LOS Criteria

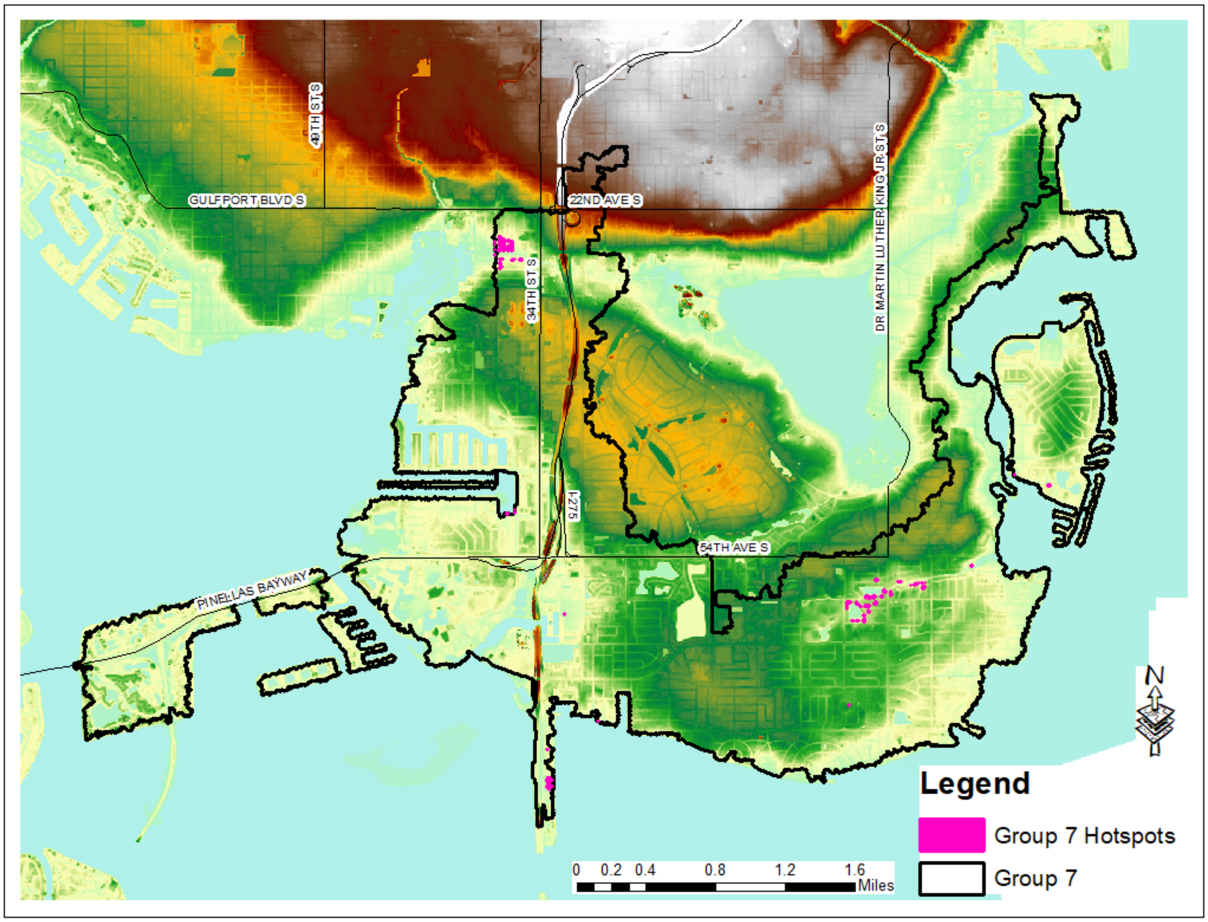


Figure C-7. Group 7 Structure Flooding Hotspots that Do Not Meet LOS Criteria

C.1.2 Roadways

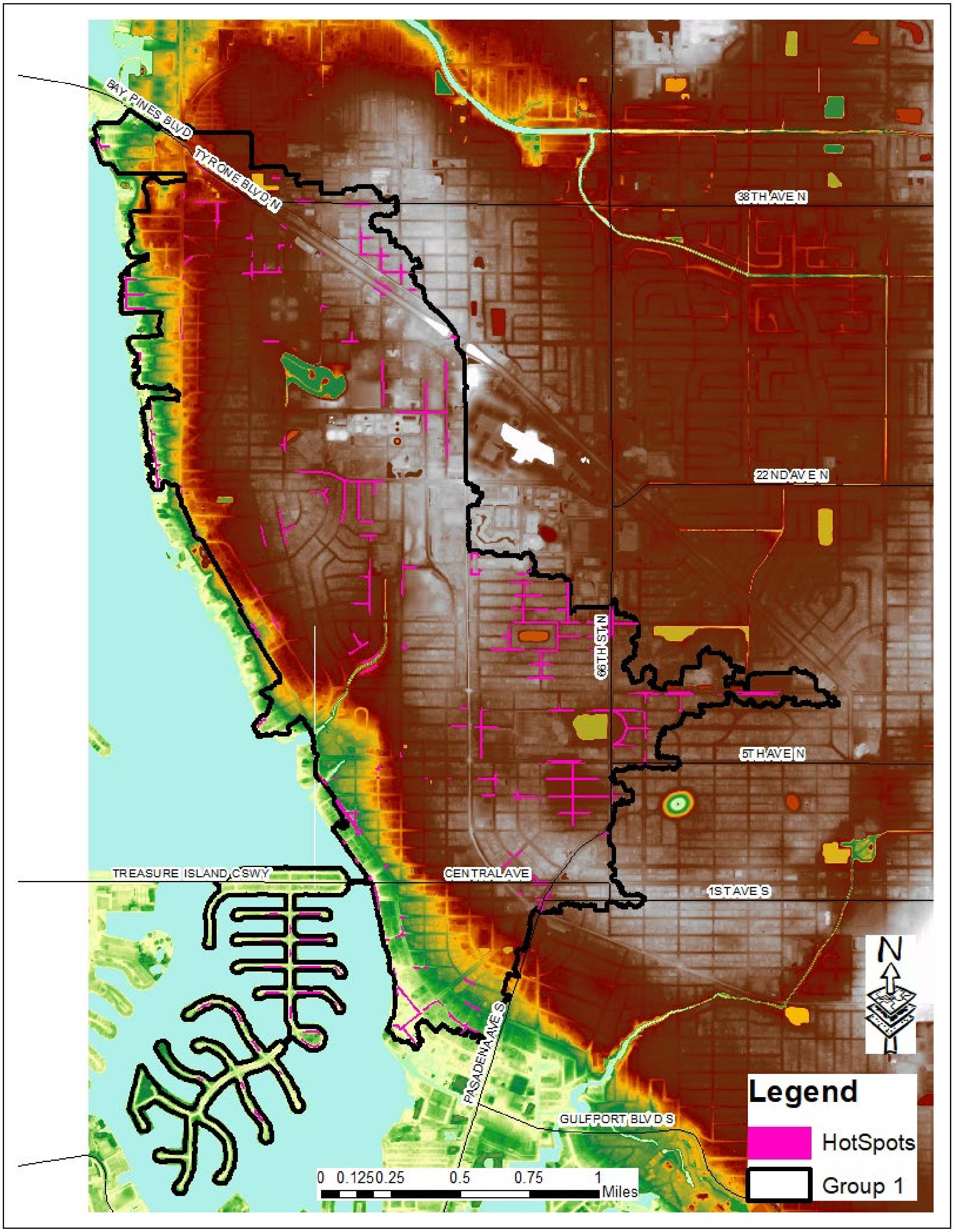


Figure C-8. Group 1 Road Flooding Hotspots that Do Not Meet LOS Criteria

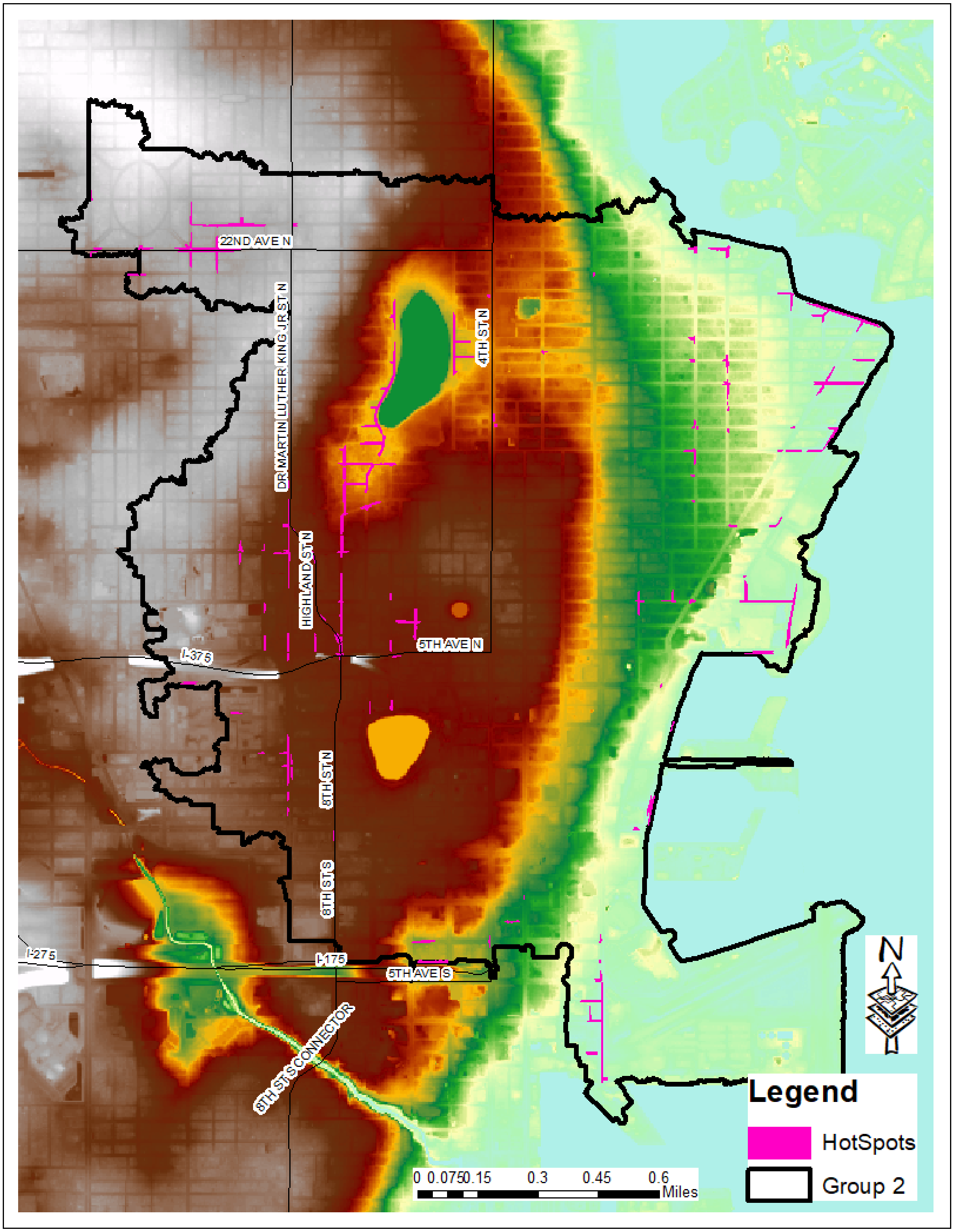


Figure C-9. Group 2 Road Flooding Hotspots that Do Not Meet LOS Criteria

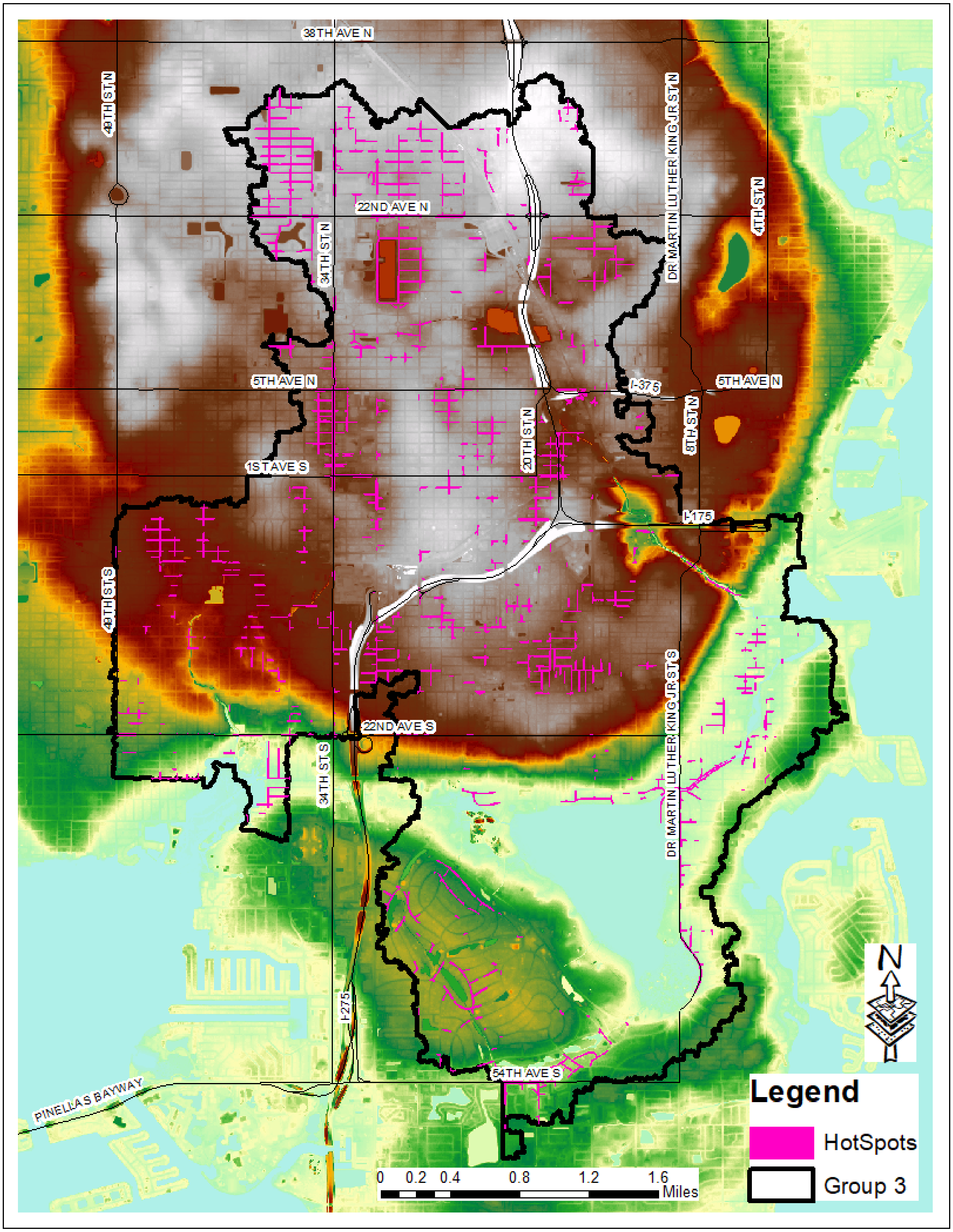


Figure C-10. Group 3 Road Flooding Hotspots that Do Not Meet LOS Criteria

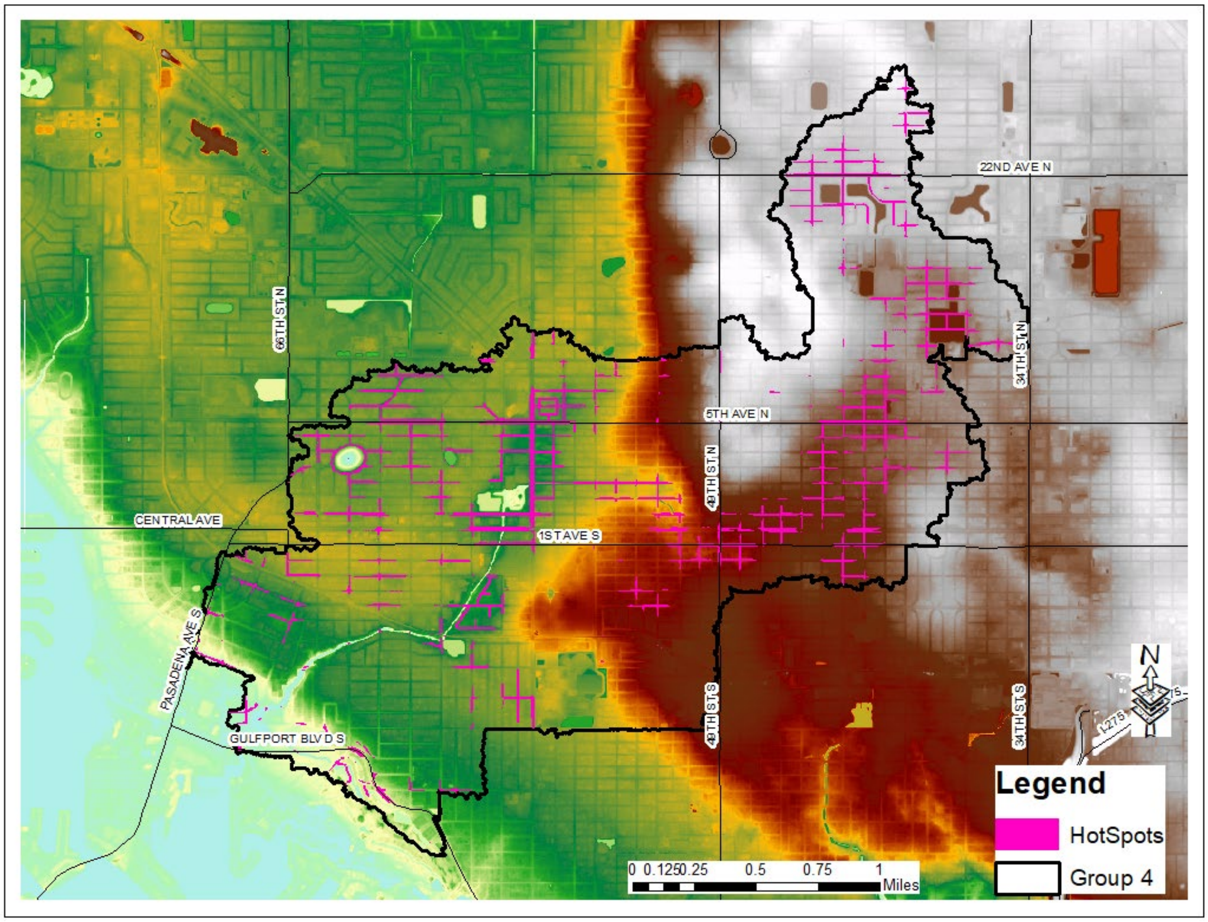


Figure C-11. Group 4 Road Flooding Hotspots that Do Not Meet LOS Criteria

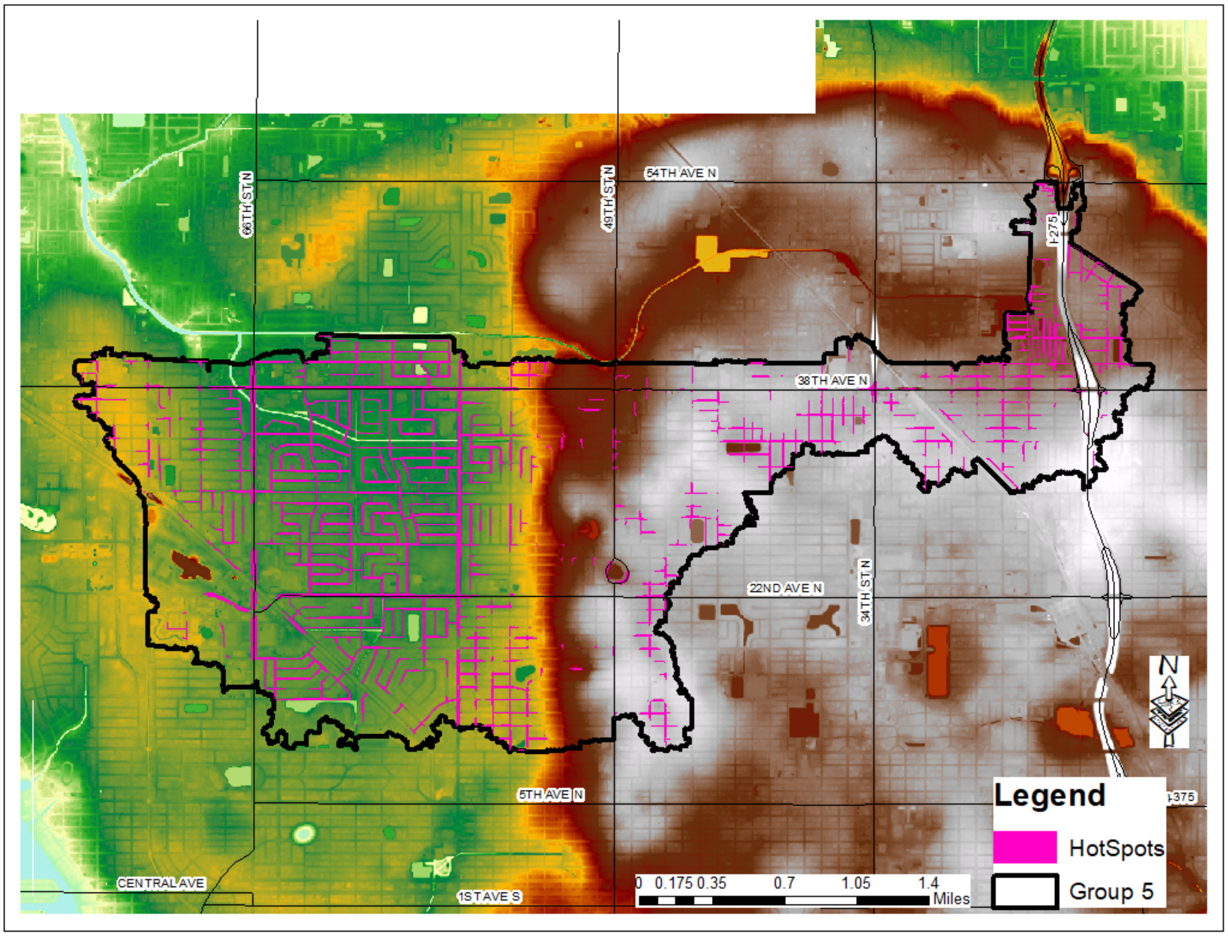


Figure C-12. Group 5 Road Flooding Hotspots that Do Not Meet LOS Criteria

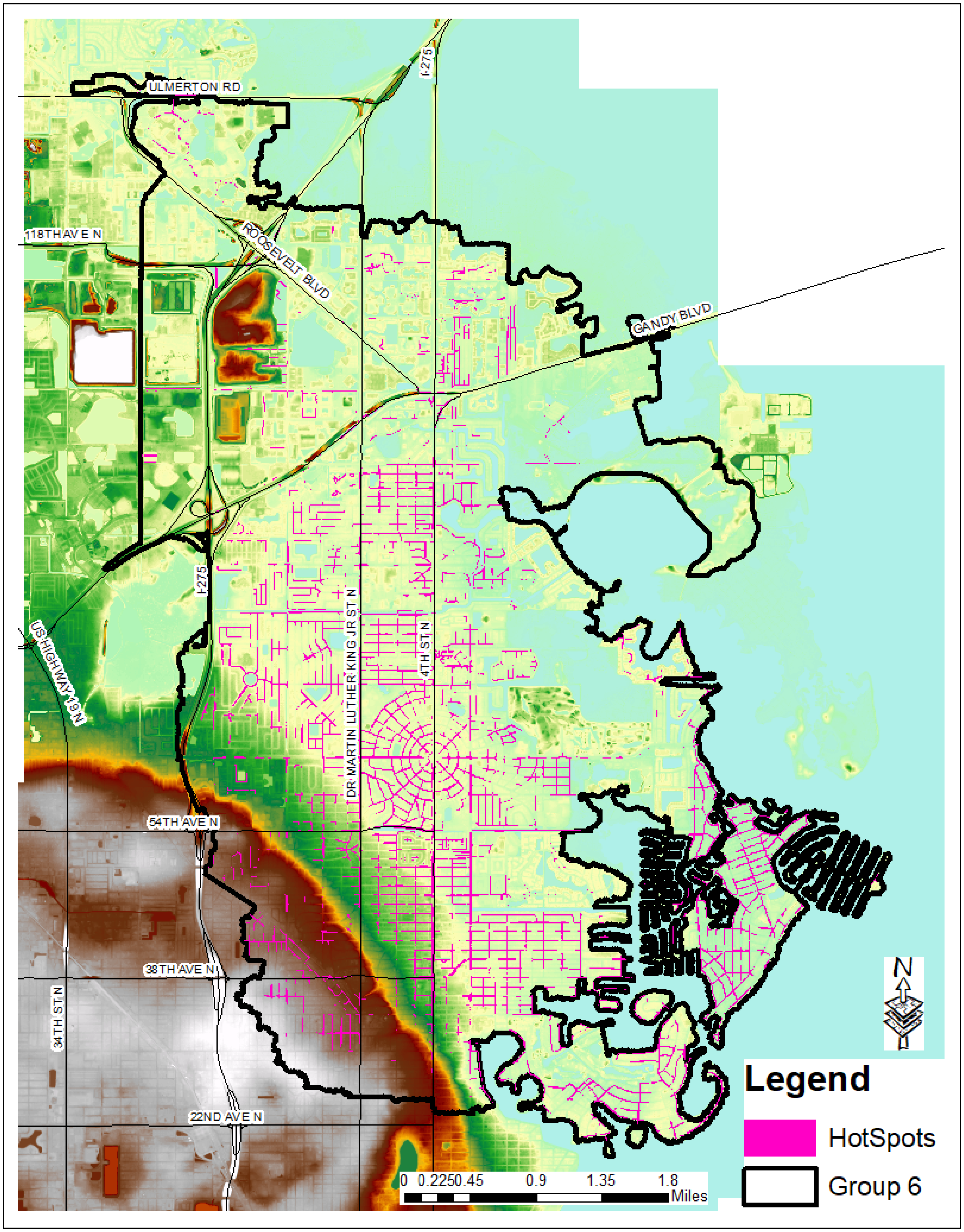


Figure C-13. Group 6 Road Flooding Hotspots that Do Not Meet LOS Criteria

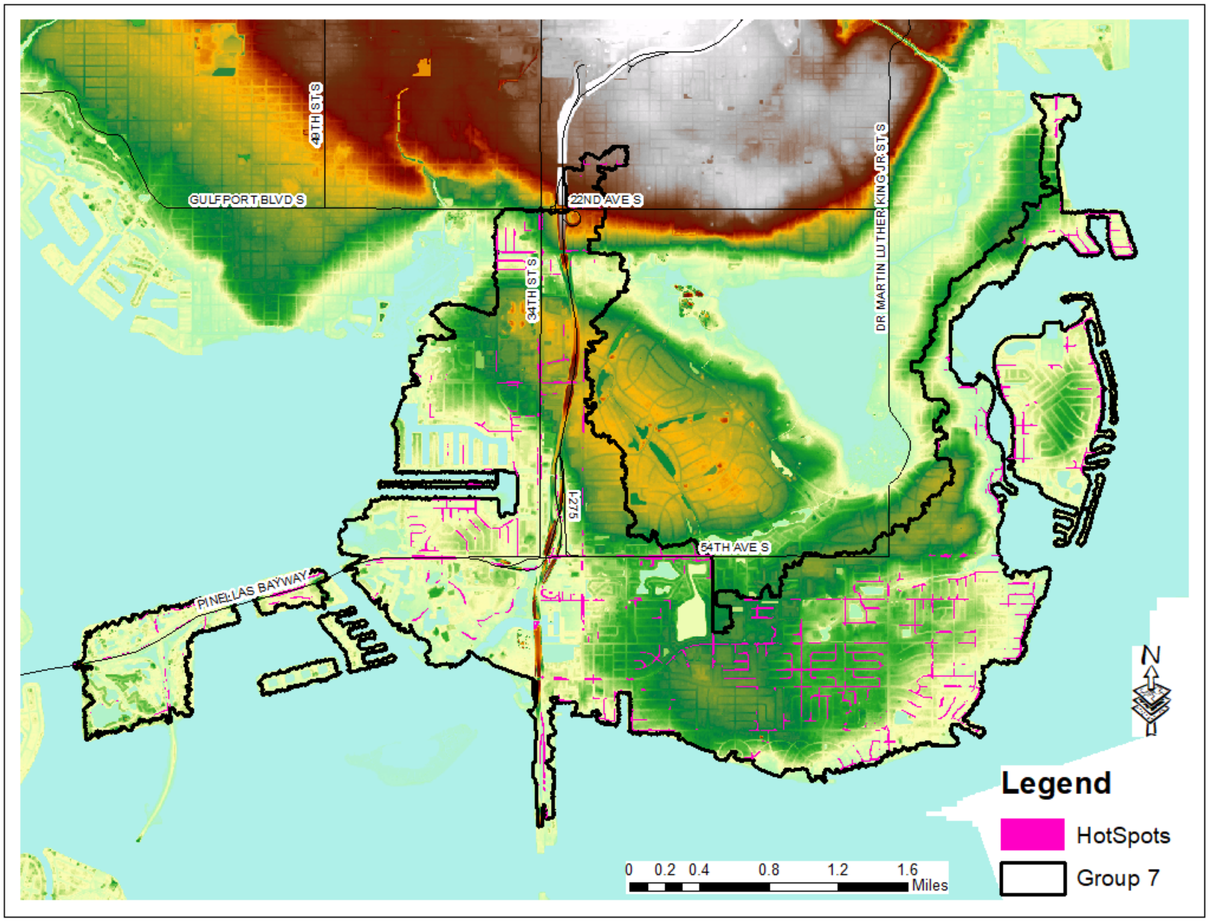


Figure C-14. Group 7 Road Flooding Hotspots that Do Not Meet LOS Criteria.

C.2 Future Conditions Year 2050 Level of Service Analysis Results

C.2.1 Structures

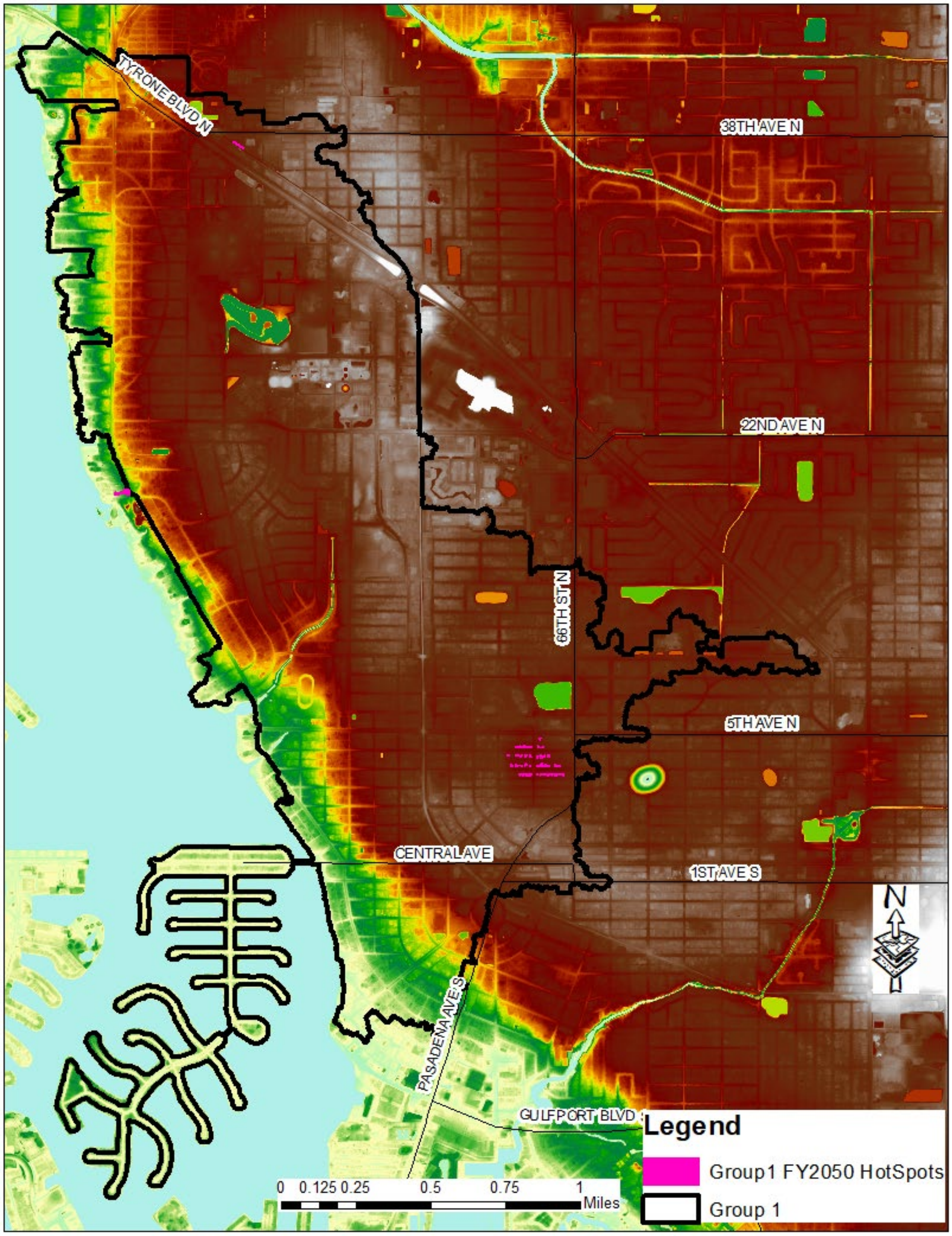


Figure C-15. Future Year 2050 - Group 1 Structure Flooding Hotspots that Do Not Meet LOS Criteria

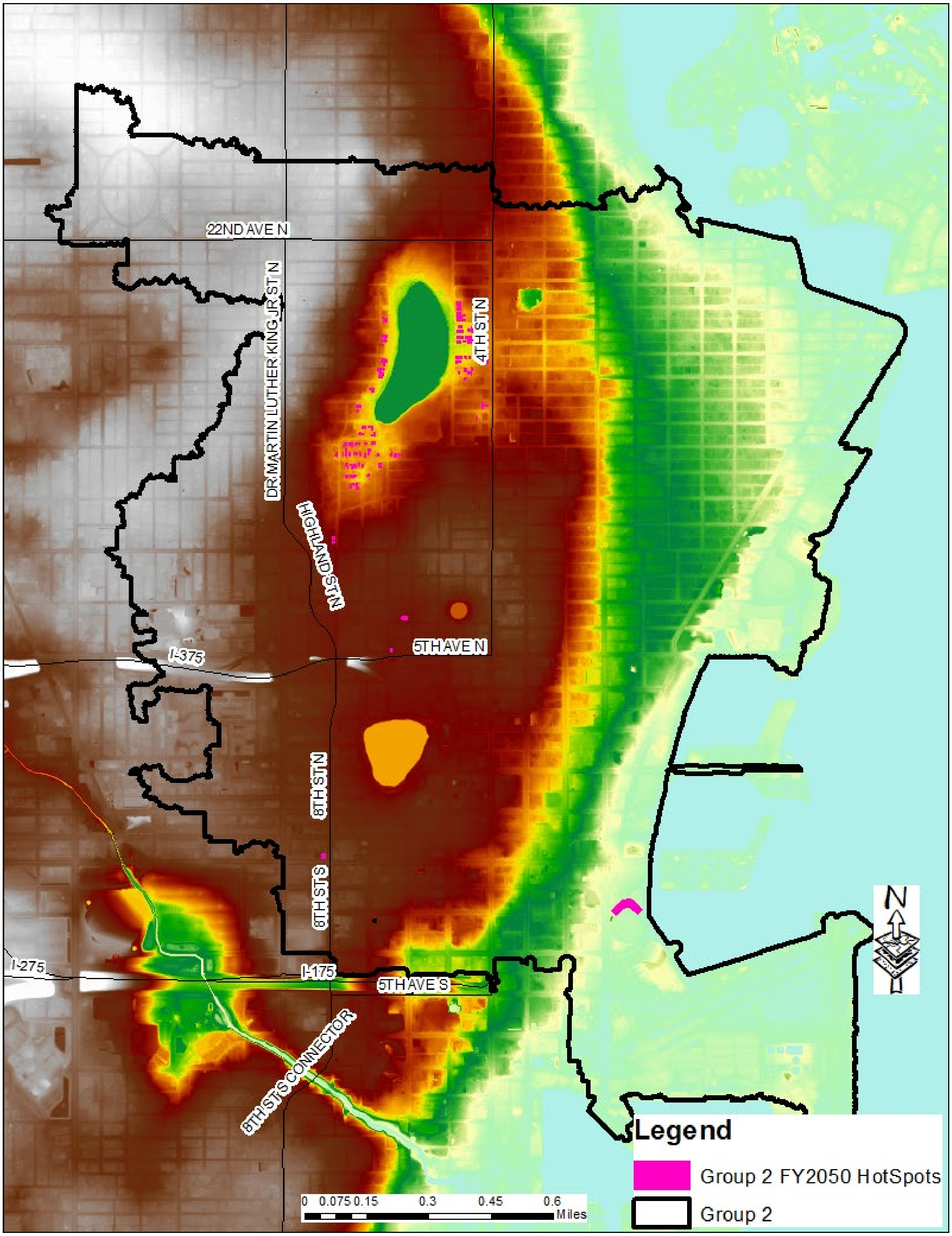


Figure C-16. Future Year 2050 - Group 2 Structure Flooding Hotspots that Do Not Meet LOS Criteria

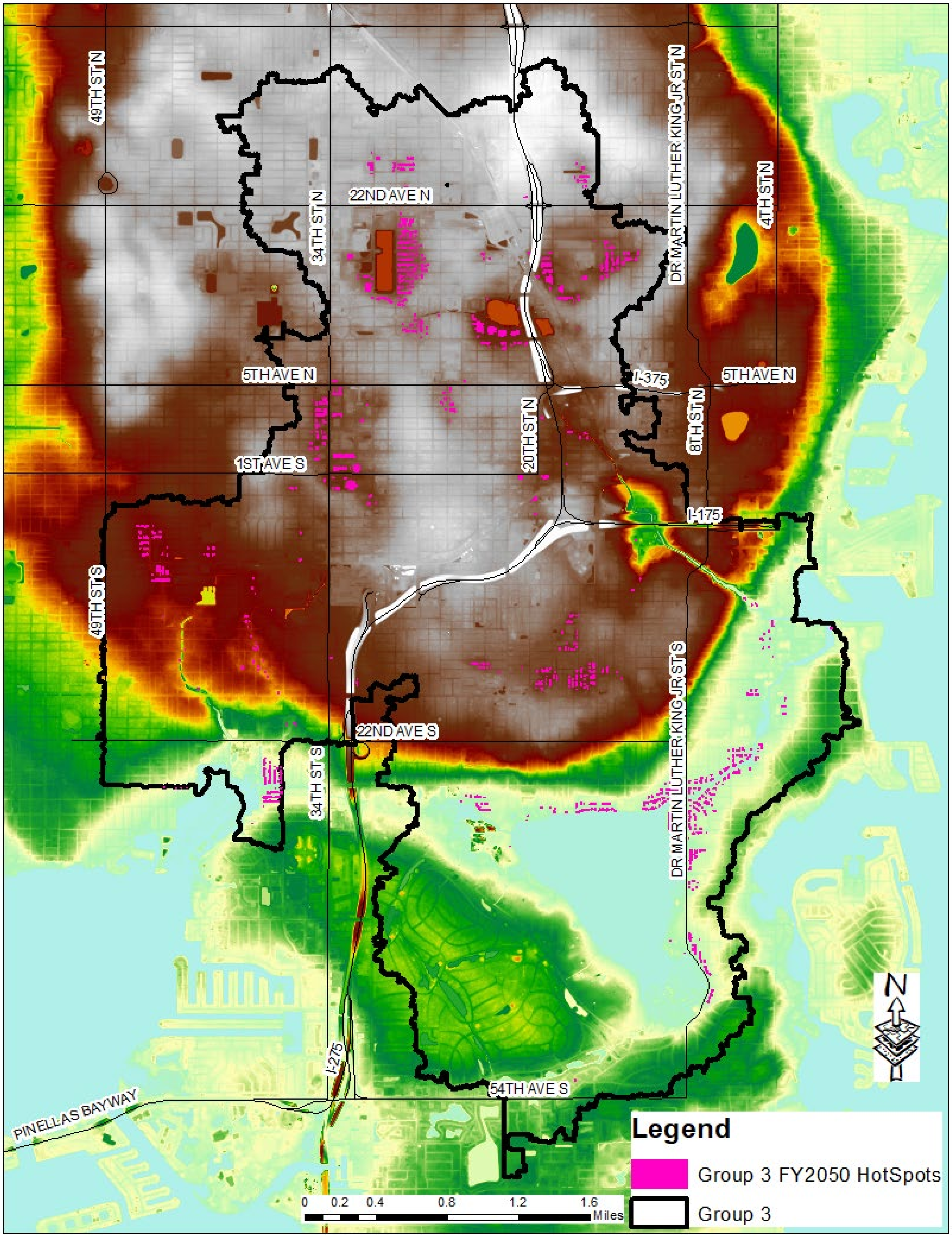


Figure C-17. Future Year 2050 - Group 3 Structure Flooding Hotspots that Do Not Meet LOS Criteria

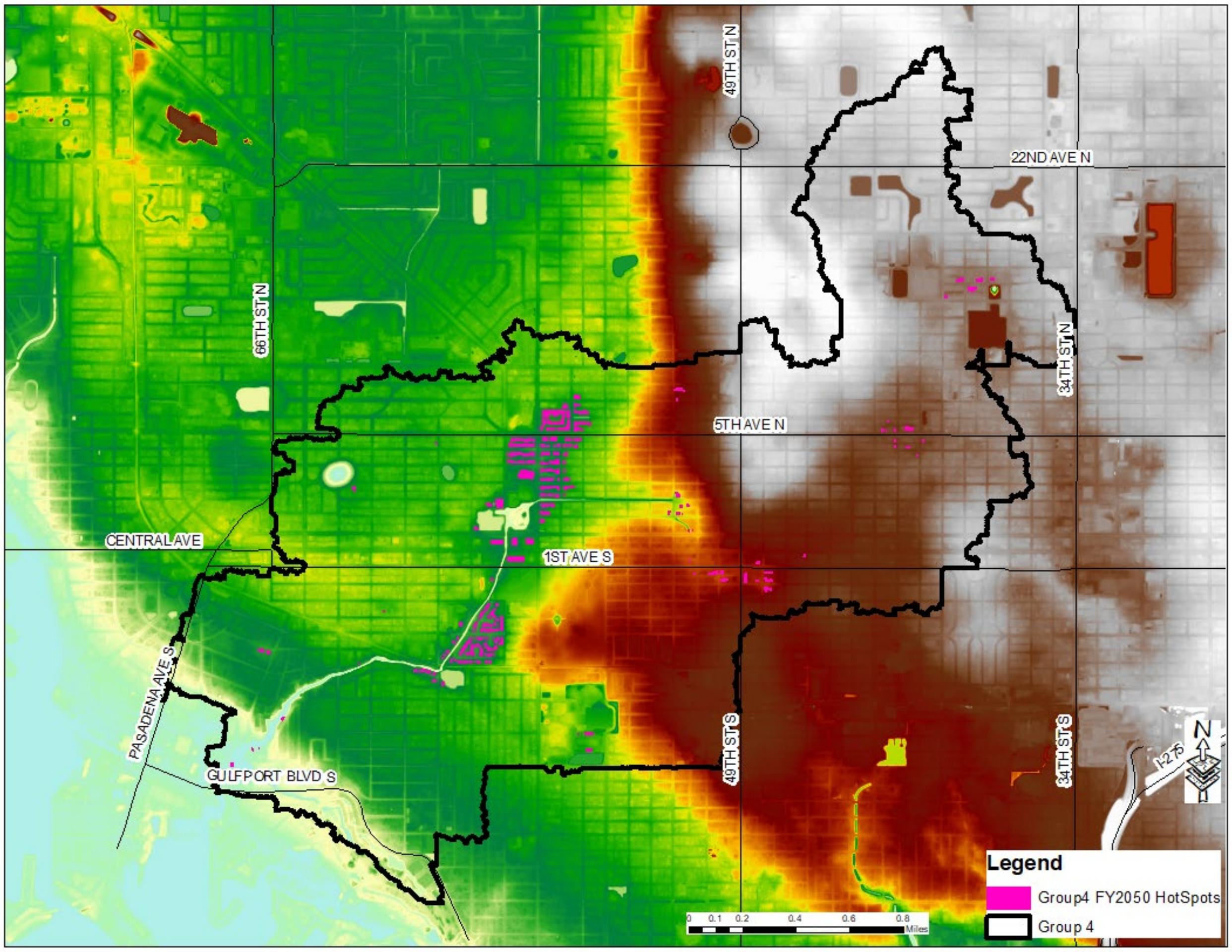


Figure C-18. Future Year 2050 - Group 4 Structure Flooding Hotspots that Do Not Meet LOS Criteria

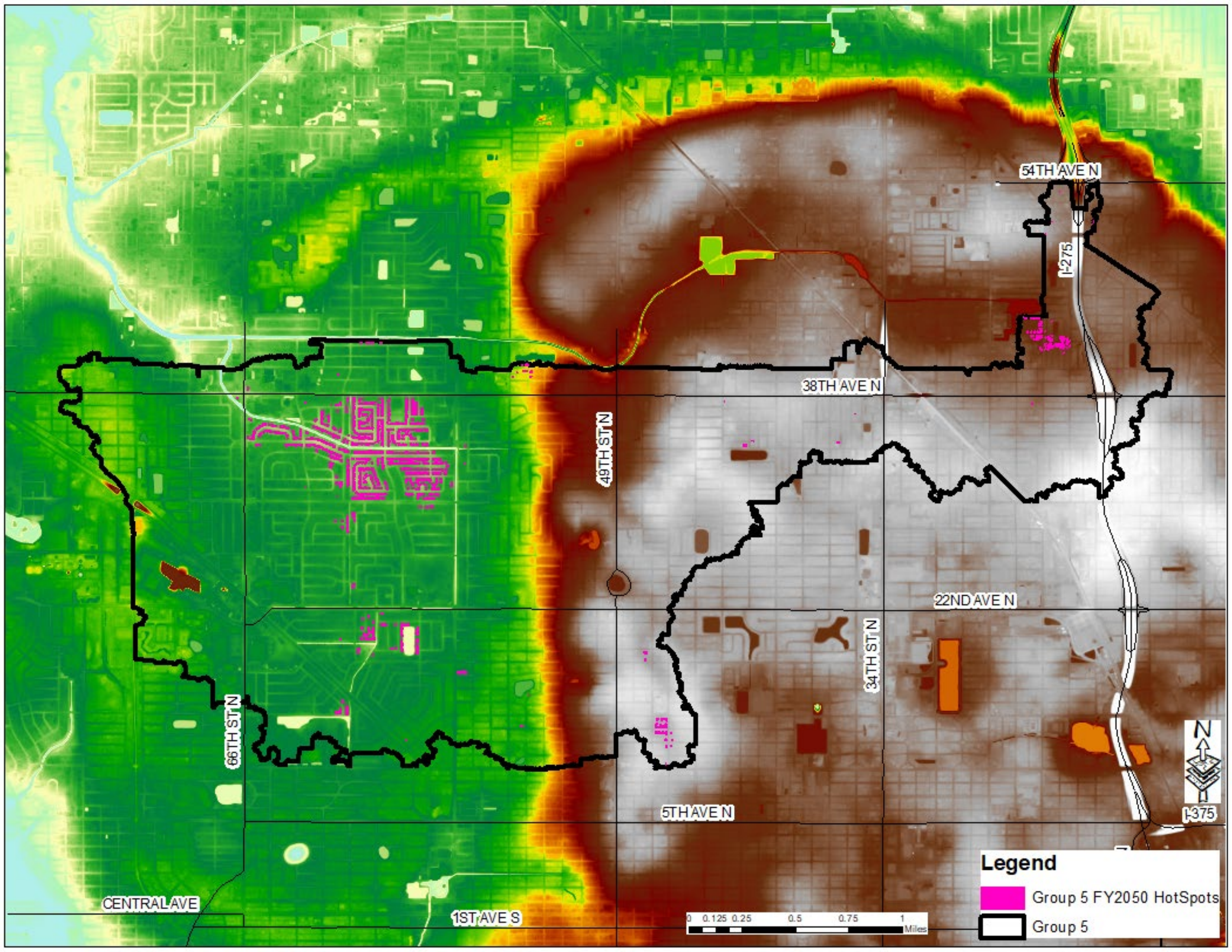


Figure C-19. Future Year 2050 - Group 5 Structure Flooding Hotspots that Do Not Meet LOS Criteria

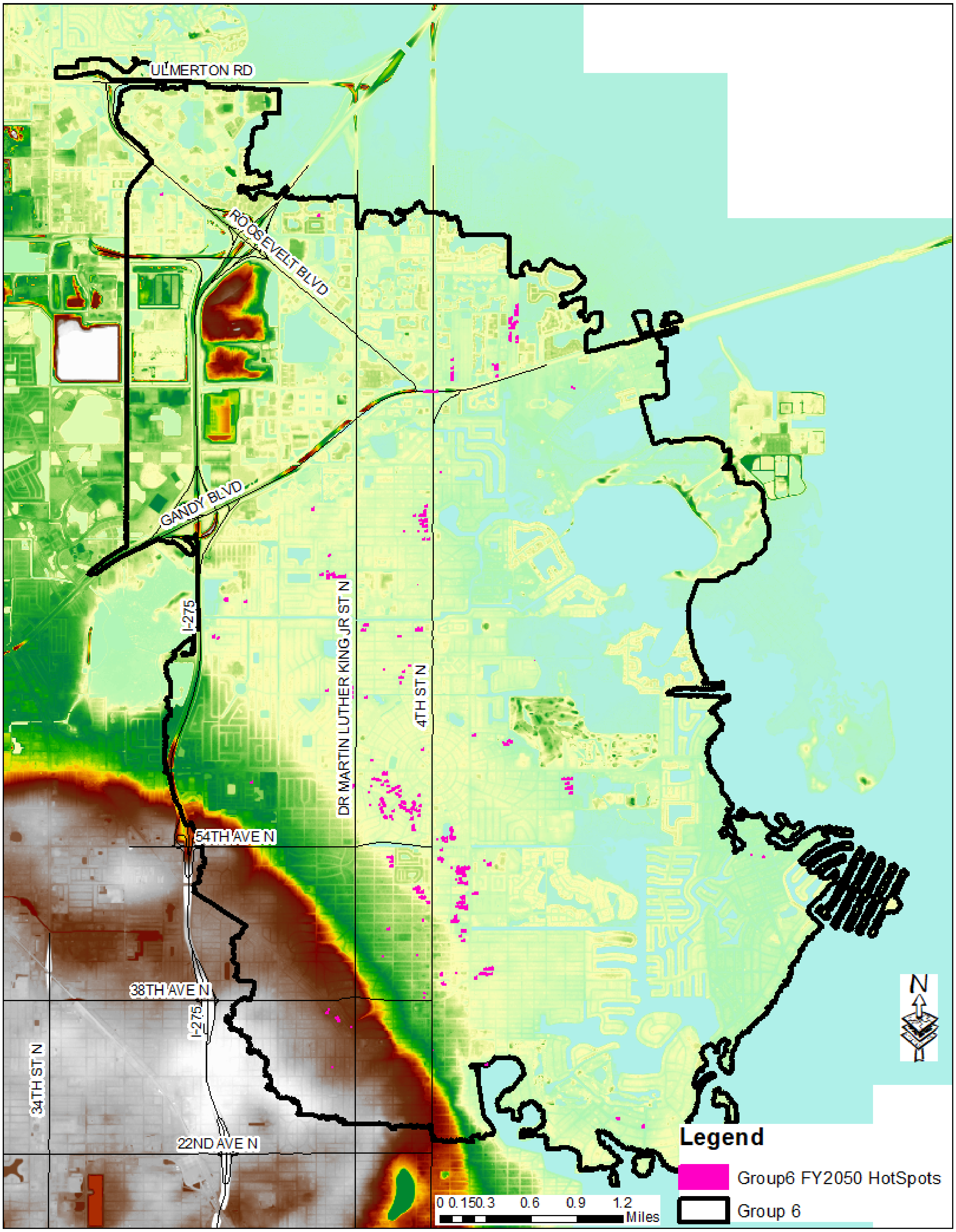


Figure C-20. Future Year 2050 - Group 6 Structure Flooding Hotspots that Do Not Meet LOS Criteria

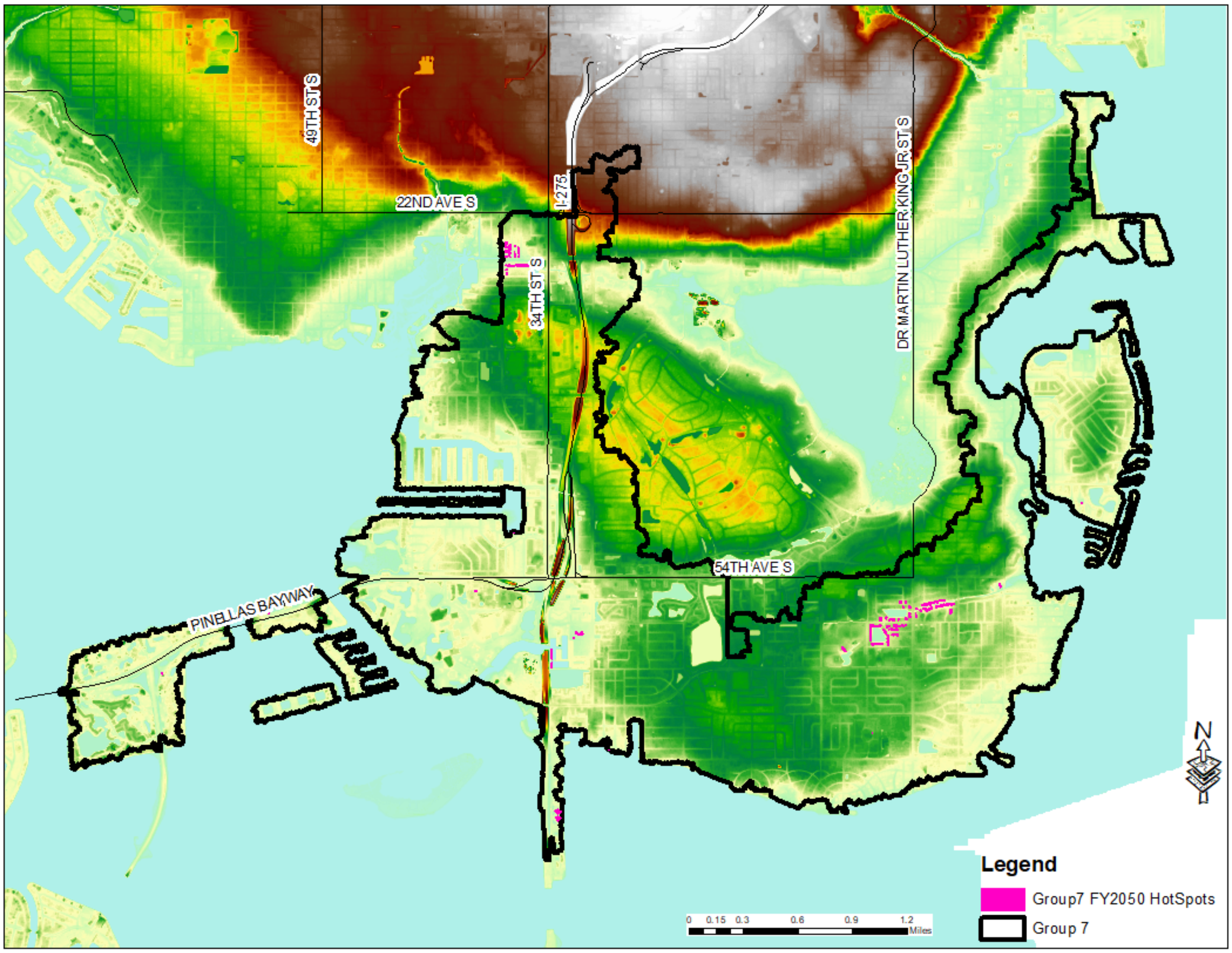


Figure C-21. Future Year 2050 - Group 7 Structure Flooding Hotspots that Do Not Meet LOS Criteria

C.2.2 Roadways

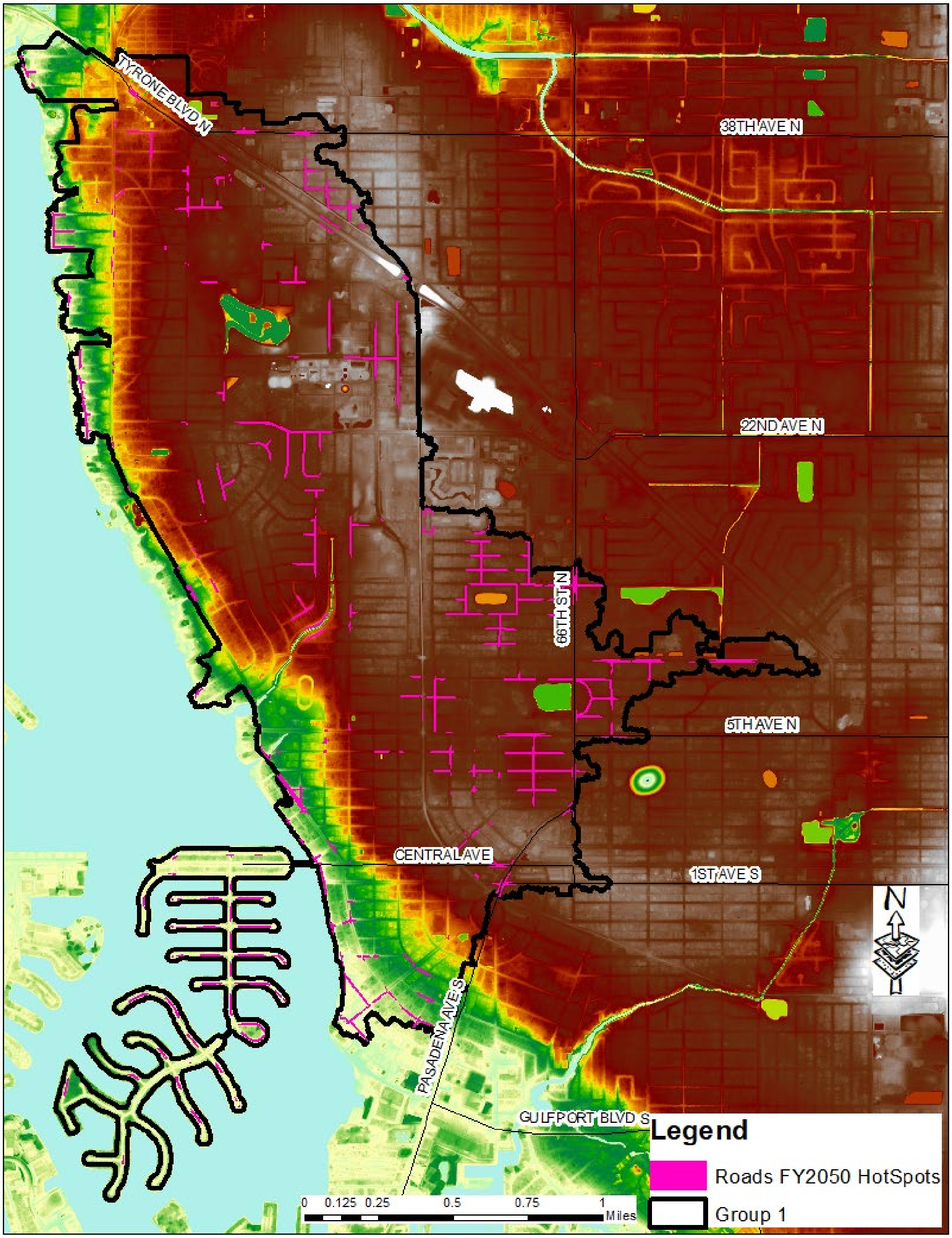


Figure C-22. Future Year 2050 - Group 1 Road Flooding Hotspots that Do Not Meet LOS Criteria

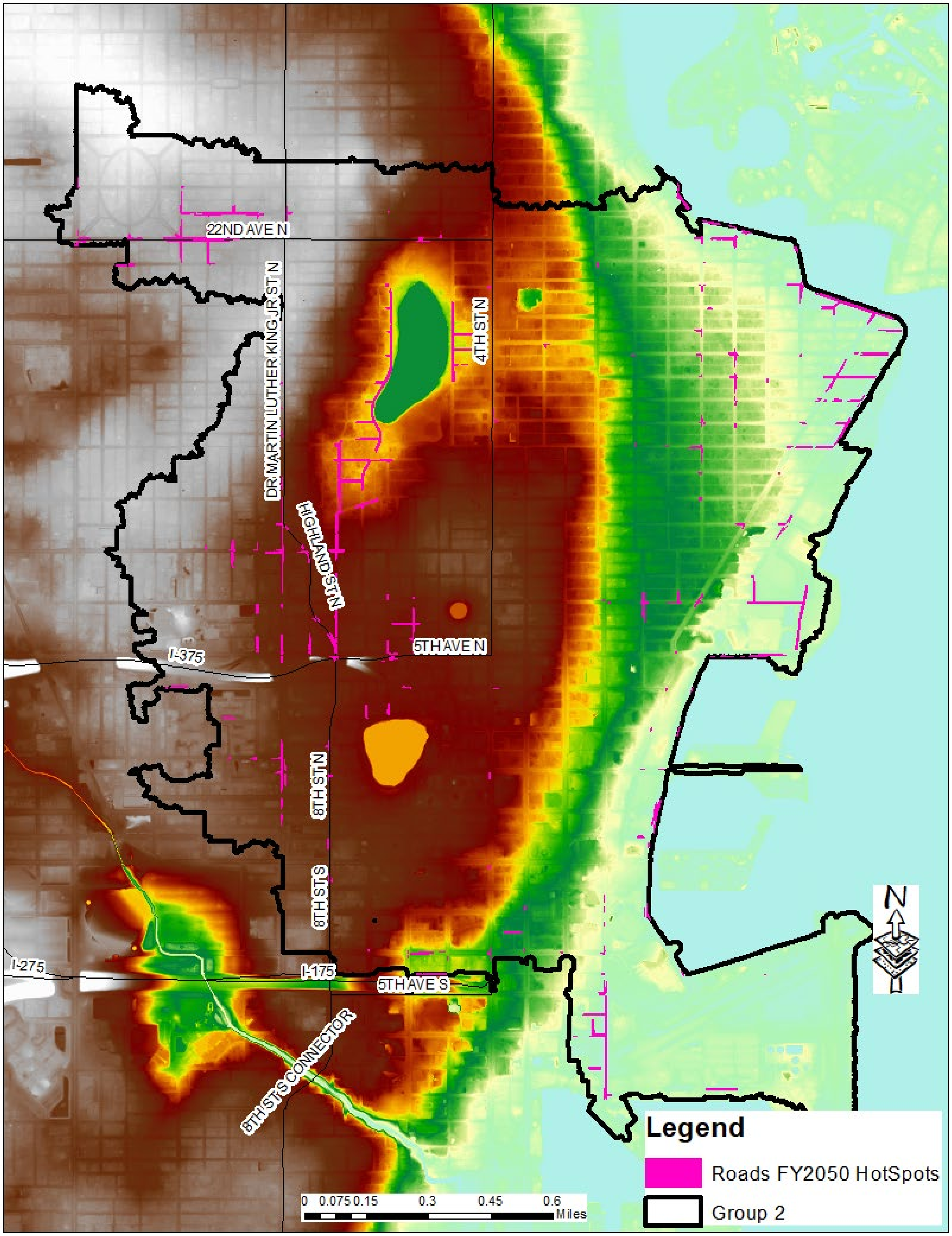


Figure C-23. Future Year 2050 - Group 2 Road Flooding Hotspots that Do Not Meet LOS Criteria

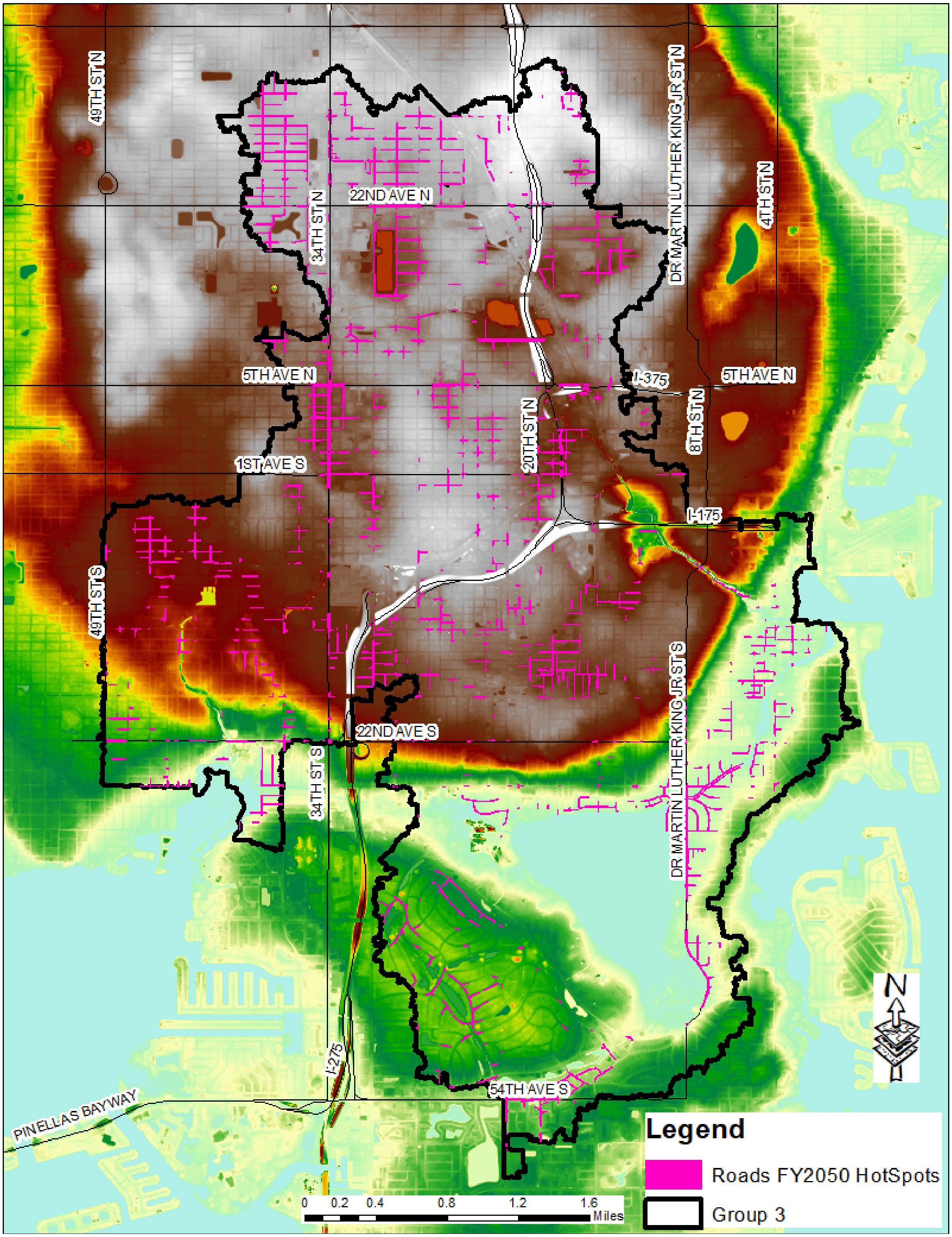


Figure C-24. Future Year 2050 - Group 3 Road Flooding Hotspots that Do Not Meet LOS Criteria

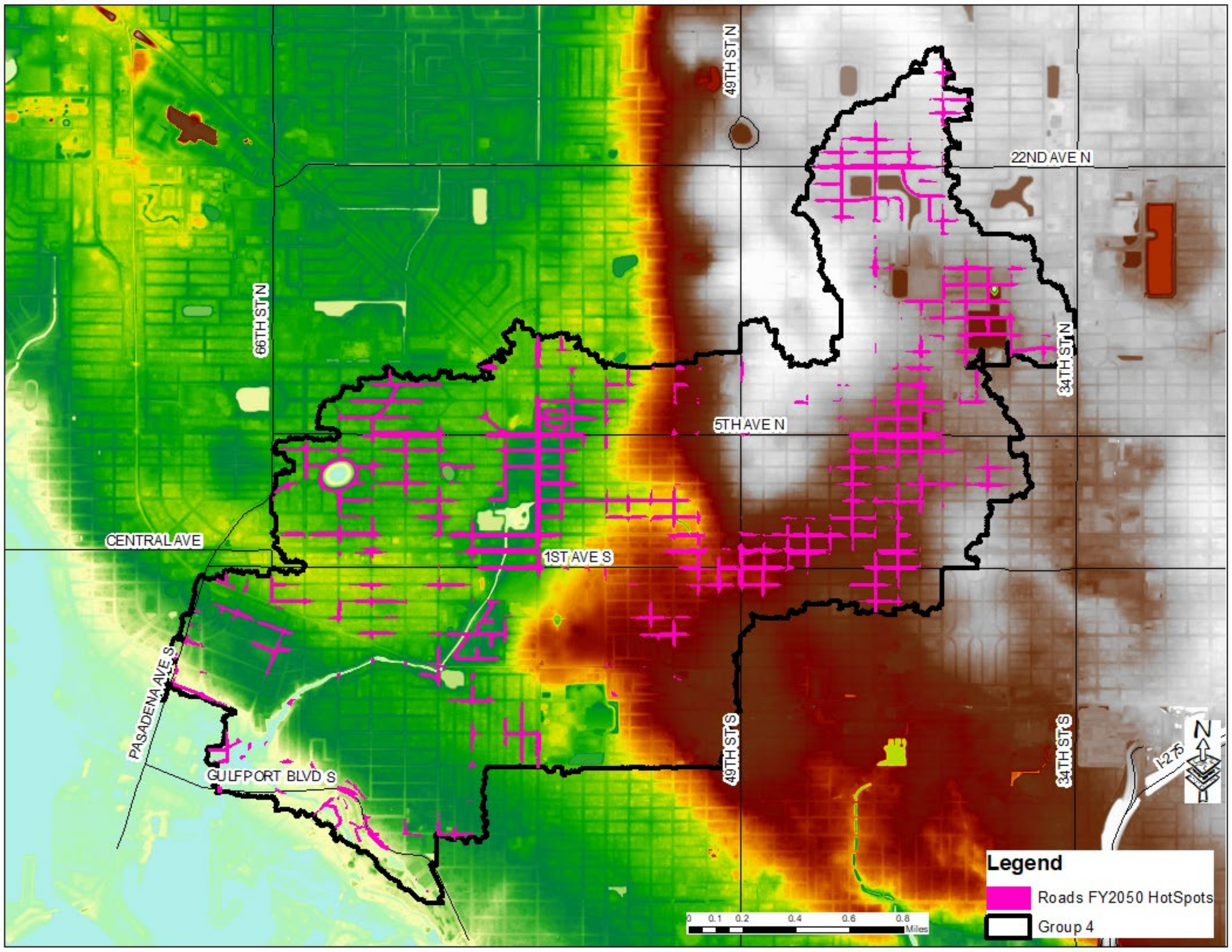


Figure C-25. Future Year 2050 - Group 4 Road Flooding Hotspots that Do Not Meet LOS Criteria

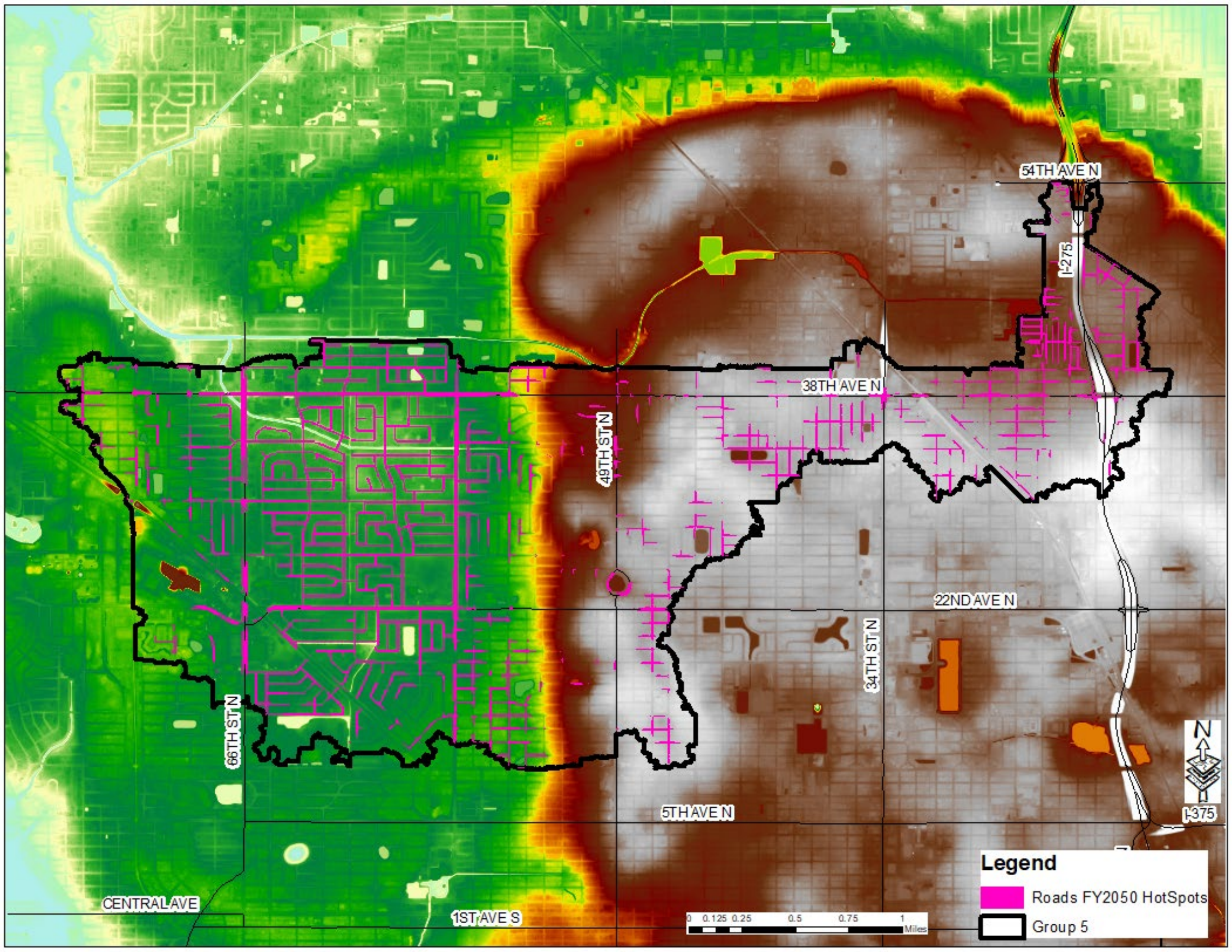


Figure C-26. Future Year 2050 - Group 5 Road Flooding Hotspots that Do Not Meet LOS Criteria

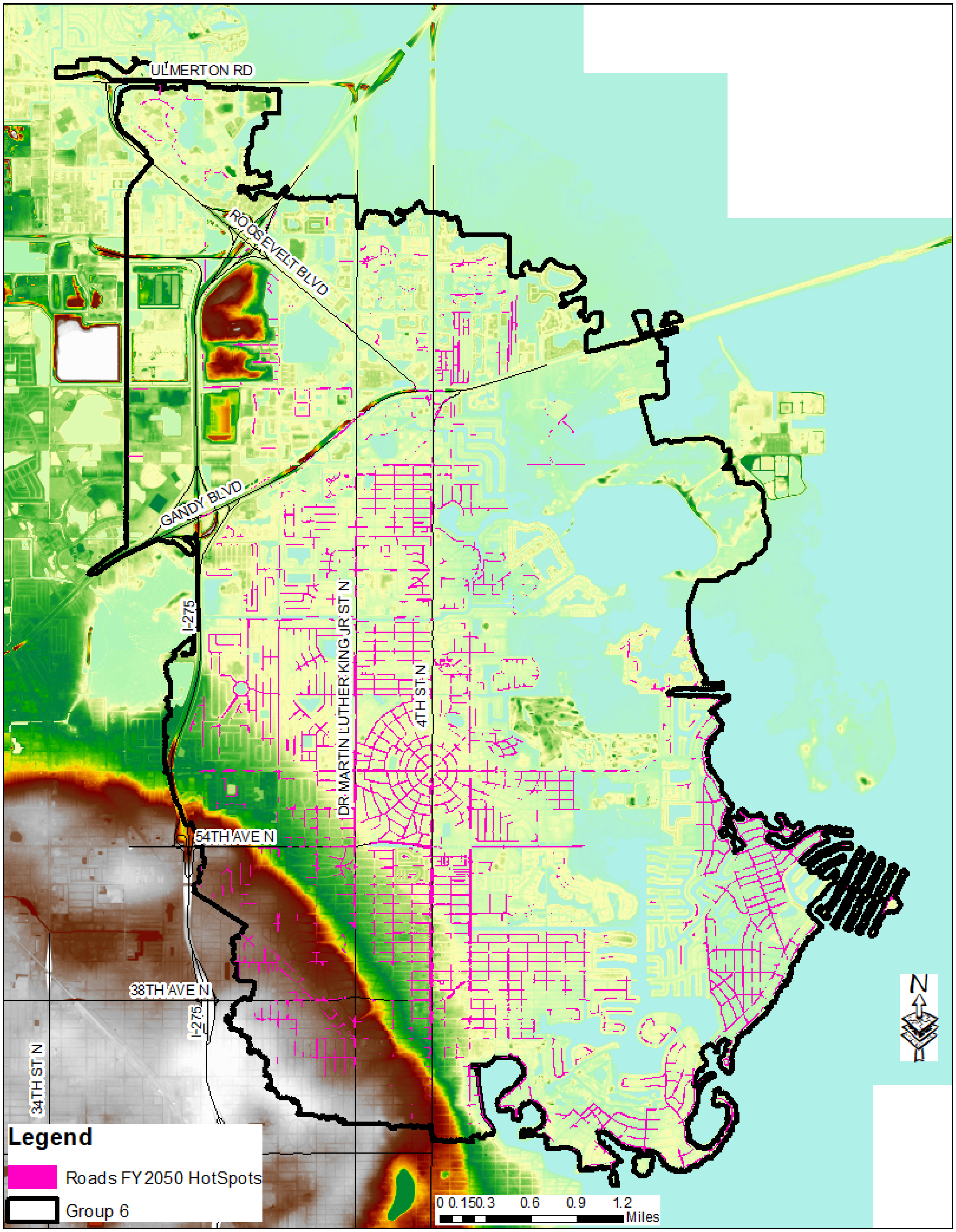


Figure C-27. Future Year 2050 - Group 6 Road Flooding Hotspots that Do Not Meet LOS Criteria

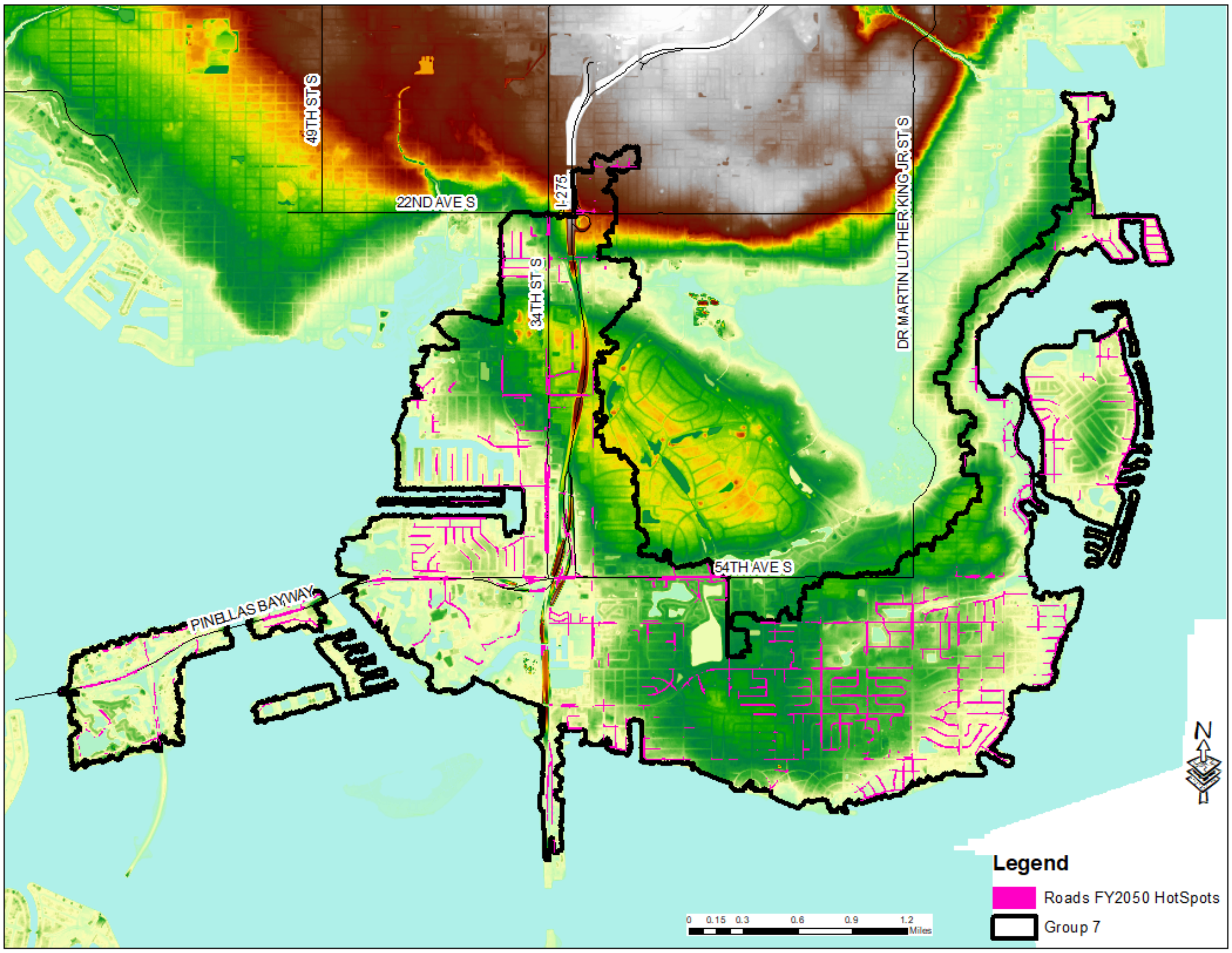


Figure C-28. Future Year 2050 - Group 7 Road Flooding Hotspots that Do Not Meet LOS Criteria

Appendix D. Climate Science Review

Memorandum

Incorporating Climate Science into the City of St. Petersburg Stormwater Master Plan

PREPARED BY: Erica Harris and Jason Bird

DATE: May 16, 2018

PROJECT: Stormwater Management Master Plan Update

Introduction

Climate change and extreme storm events are already impacting the St. Petersburg coastline. Sea levels will continue to rise and the City will experience storm events with a greater potential to impact city services and operations. Consideration of these potential impacts will allow the City to make sound, science-based decisions as they invest in future capital planning efforts and prioritize their resource allocations in a way that considers near-term and long-term climate change vulnerabilities and risks.

This memorandum provides a guide to incorporate forward-thinking climate change information into planning and modeling of the City's Stormwater Management Master Plan. An initial inundation analysis of stormwater assets was performed to provide an assessment of vulnerable areas of the stormwater system that may be exposed to future flood conditions. Potential adaptation strategies and project considerations were introduced to provide a preliminary screening of flood resilience options for the City's stormwater system. A more detailed assessment of alternatives will be conducted in a later phase of this effort.

The following climate stressors were evaluated: sea level rise and precipitation.

Relating climate change to stormwater management

Stormwater management systems in St. Petersburg are designed to divert storm water away from low-lying development to ponds, canals, and ultimately, Tampa Bay and the Gulf of Mexico. Stormwater infrastructure has historically been designed based on the underlying assumption that precipitation and coastal water level extremes are stationary through time. Changes in climate conditions call this assumption into question, resulting in uncertainty about the future performance of stormwater systems constructed based on standards that do not reflect advances in science or the best available technology. The vulnerability of stormwater management systems to future climate conditions such as sea level rise and increased rainfall intensity, frequency and duration depends on the system's existing storage and flow capacity, the elevation and location of outfalls and electrical components, and whether the system is gravity drained or pumped.

Stormwater systems have a reliance on uninterrupted power and many of the components are sensitive to water and salt exposure. Therefore, the capacity to collect, convey, treat, and discharge excess flows may be reduced by an increase in rainfall intensity and/or higher sea levels.

Potential changes in the local climate pose the following threats to the stormwater system and adjacent areas:

- **Urban flooding-** Many stormwater systems in St. Petersburg are gravity systems. Excess stormwater is conveyed from higher elevations to lower elevations at the Tampa Bay or the Gulf of Mexico outfalls. As low-lying stormwater outfalls become partially or completely inundated/submerged by rising coastal water levels, drainage of stormwater will be impeded, resulting in inland urban flooding. Inland urban flooding may also be caused or exacerbated by elevated coastal water levels during storm events. Outfalls located below the future high tide or storm event water level may need to be elevated, have check valves installed to prevent backflow, or be pumped rather than gravity drained. Reduced discharge capacity and/or the failure of pump stations may cause flooding of adjacent properties and disrupt access to homes, jobs, and critical facilities, leading to potentially significant consequences.

- **Saltwater intrusion to stormwater system-** During large tide and storm events, saltwater may enter the stormwater system through open outfalls, leaky tide gates, overflow weirs, and through catch basins located in areas where coastal waters have exceeded the shoreline elevation. Backflow of high tides into the stormwater system may cause surface flooding in low-lying areas located below the hydraulic grade line, even if shoreline protection measures are constructed at an elevation sufficient to prevent shoreline overtopping. Saltwater has the potential to cause premature corrosion of exposed steel in pipes, inlets, gates, electrical and other equipment in the system sensitive to salt.

- **Elevated groundwater levels-** Sea level rise causes a concurrent increase in groundwater levels at a distance inland from the coast depending on factors such as surficial geology, aquifer permeability and rainfall recharge. An increase in sea levels also cause saltwater to intrude into underground aquifers, potentially contaminating groundwater supplies. The incoming saltwater also alters the freshwater reservoir chemistry, having the potential to increase corrosion rates of underground utilities. Elevated groundwater levels can affect stormwater system capacity and function as submerged systems require higher head to convey stormwater, usually resulting in higher flood stages upstream.

Recommended Scenario Selection

This section provides information to support the selection of climate scenarios (sea level rise and precipitation) used for the City's stormwater modeling and project planning. It includes considerations for selecting appropriate climate scenarios for stormwater assets based on typical stormwater system lifespans with a consideration of risk tolerance.

Project Considerations

As discussed in the Climate Science Memorandum (provided in Appendix A), selection of the most appropriate climate change scenarios should consider project lifespan and risk tolerance. Although the design life of stormwater systems is typically 30 years, the service life is often up to 100 years. Therefore, a planning time horizon of **2070** is recommended for developing flood modeling and design criteria. Recognizing that functional stormwater systems are necessary to protect flooding of roads, communities, and critical infrastructure, it is reasonable to plan based on a **low risk tolerance** of flood events. Low risk tolerance planning will rely on high future emission scenarios, such as RCP8.5.

Precipitation

Future rainfall conditions based on the RCP8.5 emission scenario projected for the year 2070 are recommended for the City's stormwater modeling efforts under Phase I and II of the Stormwater Master Plan project. Use of this scenario aligns with the anticipated service life of stormwater infrastructure improvements while also accounting for the continued influence of increases in greenhouse gas emissions on future rainfall intensity. The projected rainfall data from the 2017 WW I&I study are determined appropriate for the City's Stormwater Master Plan because they encompass the best-available science and are consistent with existing local GHG emission recommendations.

Sea Level Rise

Based on the stormwater system's sensitivity to flooding and the criticality of the assets in protecting the community from flood damage, planning based on a low risk tolerance is recommended. Using Table 3 as a guide, NOAA 2017 SLR scenarios with an exceedance probability significantly lower than 50%, such as the intermediate to intermediate-high, are recommended for stormwater flood modeling and system design criteria. Use of NOAA 2017 SLR projections also align with climate scenarios used in the ongoing Pinellas County Restore Act vulnerability assessment. To be consistent with rainfall projections and the anticipated service life of the stormwater assets, it is recommended that the year 2070 be used as the planning time frame, as shown in Table 1.

Table 1. Recommended sea level rise scenarios for stormwater planning and design

Year	Low (feet, NAVD88)	Int-Low (feet, NAVD88)	Intermediate (feet, NAVD88)	Int-High (feet, NAVD88)	High (feet, NAVD88)	Extreme (feet, NAVD888)
2017	1.01	1.01	1.01	1.01	1.01	1.01
2040	1.35	1.43	1.67	1.89	2.16	2.40
2060	1.68	1.86	2.46	3.10	3.87	4.47
2070	1.84	2.06	2.92	3.86	4.95	5.78
2100	2.20	2.61	4.49	6.65	8.89	10.90

Sea Level Rise Exposure Assessment

This section provides initial inundation mapping due to sea level rise flooding and/or inundation. A high-level exposure assessment was also performed for the City's stormwater assets to provide insight on future flood risk and timelines for intervention.

Evaluation of Sea Level Rise Scenarios

Consideration of a range of potential sea level rise scenarios in project planning is recommended due to the uncertainty associated with future climate conditions. For the initial exposure assessment of the stormwater system, six sea level rise depths – 1, 2, 3, 4, 5 and 6 feet – were evaluated. This range of sea level increases captures the NOAA 2017 projections though 2070, which is the recommended planning time horizon for the City's stormwater system. These inundation scenarios also represent possible storm surge impacts for events generating between 1 and 6 feet of surge today.

Each sea level rise scenario was added to the MHHW tidal datum to create six future water level conditions. The MHHW level is significant, as it is the elevation experiencing daily inundation in the City area. The MHHW is also the elevation used as the tailwater condition for stormwater system modeling.

Each future condition can be used to represent either (1) permanent inundation by daily high tides or (2) temporary flooding from a combination of sea level rise and storm tides. Table 2 describes the sea level rise scenarios corresponding to permanent and temporary flooding conditions.

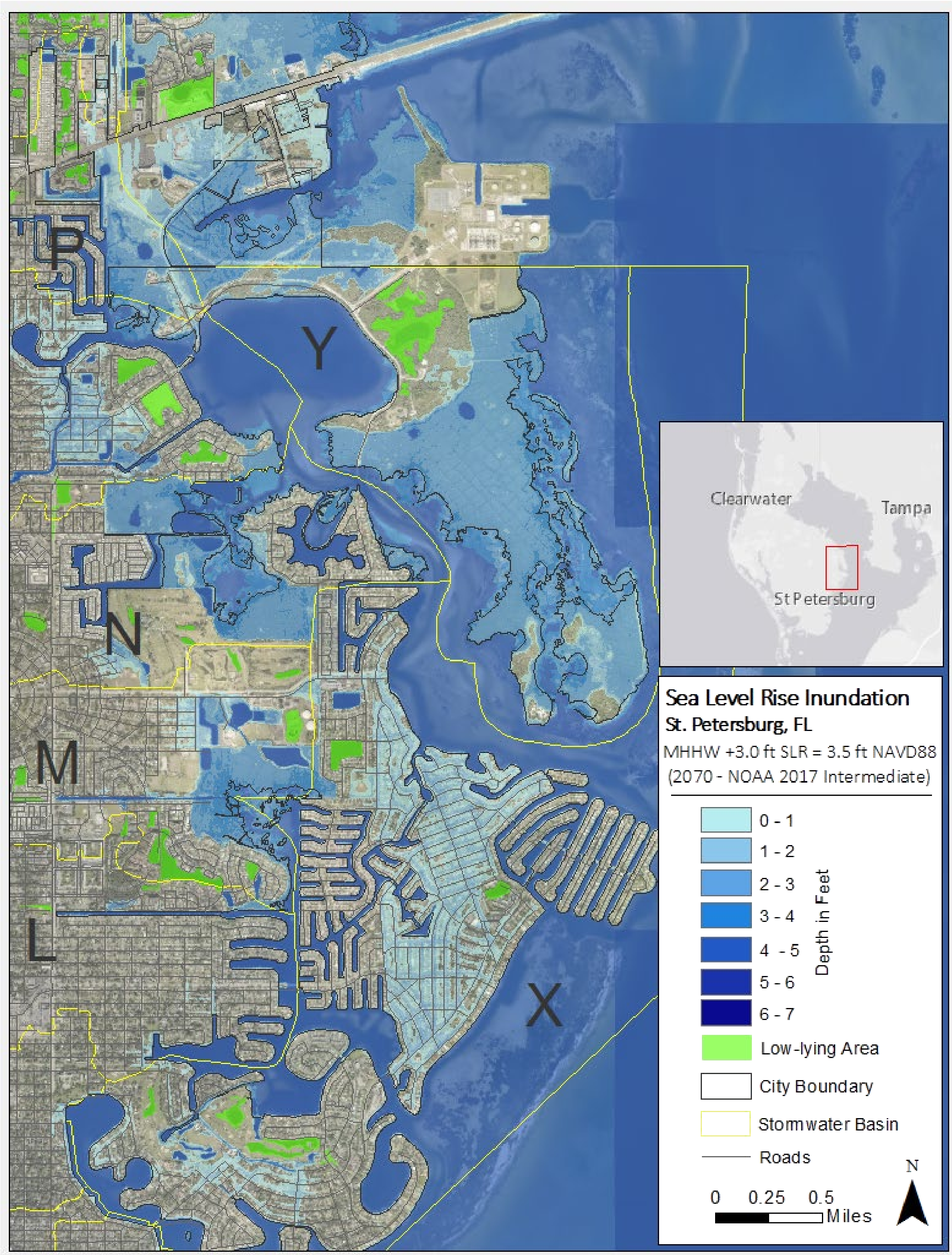
Table 2. Future water level scenarios and representations

Water Level Scenario	Permanent Inundation	Temporary Flooding
+1 ft	MHHW + 1 ft SLR	King Tide
+2 ft	MHHW + 2 ft SLR (2070 intermediate-low)	King Tide + 1 ft SLR
+3 ft	MHHW + 3 ft SLR (2070 intermediate)	King Tide + 2 ft SLR or 10-year storm tide
+4 ft	MHHW + 4 ft SLR (2070 intermediate-high)	King Tide + 3 ft SLR or 10-year storm tide + 1 ft SLR
+5ft	MHHW + 5 ft SLR (2070 high)	King Tide + 4 ft SLR or 10-year storm tide + 2 ft SLR or 100-year storm tide
+6 ft	MHHW + 6 ft SLR (2070 extreme)	King Tide + 5 ft SLR or 10-year storm tide + 3 ft SLR or 100-year storm tide + 1 ft SLR

Inundation/Flooding Maps

Inundation maps are a valuable tool for evaluating potential exposure of assets to future water level conditions. The maps are a useful tool to evaluate the timing and extent of flooding assets are expected to experience. Inundation maps are also useful to identify flooding thresholds where the entire system may be compromised.

Future inundation layers for sea level rise scenarios available from the NOAA Sea Level Rise Viewer were downloaded and used to understand potential future flood exposure of the City's stormwater system. NOAA's depth of inundation layers were created by subtracting the land surface digital elevation model (DEM) from the MHHW + sea level rise water surface DEM. The result provides both the inland extent and the depth of inundation. The maps also differentiate between low-lying areas that have a direct pathway to the flood source and low-lying hydraulically disconnected areas. Low-lying disconnected areas may experience drainage issues due to stormwater backflow by high tides through the stormwater collection system, due to elevated groundwater levels, or from ponding during heavy rain events. Figure 1 shows an example area of the sea level rise inundation mapping based on the MHHW + 3-foot sea level rise scenario. Flood inundation maps for each stormwater basin based on the MHHW + 3 foot sea level rise scenario are attached.



Note: Letters correspond to stormwater basin names in St. Petersburg

Figure 1. Example area of sea level rise inundation mapping

It should be noted that the inundation maps do not account for wave height, rainfall, or other potential variations in conditions that could affect the depth of flooding at any given location. The maps also rely on a 2007 Florida Division of Emergency Management LiDAR dataset, which is the most recent dataset currently available for the City. A new, higher resolution DEM is being developed and is expected to be released in 2018. While this climate science memo will not include this updated information, the stormwater modeling phase of the study will incorporate the 2017 DEM when available.

Summary of Potential Sea Level Rise Exposure

An initial sea level rise exposure assessment was performed using inundation maps to evaluate potential vulnerability of the stormwater system. Additional vulnerability components, such as adaptive capacity and sensitivity, were not considered in this mapping exercise. The sections below provide details of the exposure for the system's pump stations, inlets, and outfalls. Exposure to sea level rise flooding and inundation were evaluated for the six scenarios described in Section 1.7.1; however, the analysis focuses on scenarios of MHHW + 3 ft, + 4ft, and + 5ft to align with the NOAA 2017 intermediate, intermediate-high, and high sea level rise projections. It should also be noted that this assessment does not evaluate the combined effects of precipitation and high tides, which will be completed in a later phase of this study.

Pump stations

There are seven stormwater pump stations that serve the City's stormwater collection system and are used to convey excess stormwater to channels, Tampa Bay or the Gulf. Flooding at any station has the potential to impact the overall level of service to the City's stormwater system. Many critical facilities (e.g., hospitals, fire stations, etc.) businesses, and residences rely on pump stations to prevent backup, overflows, and flooding in the immediate area. Pump stations are especially vulnerable to flooding because they rely on electrical and mechanical components, which are sensitive to water inundation. If saltwater inundates electrical or mechanical components, they will likely need replacement due to corrosion.

A preliminary assessment of each pump station's exposure to sea level rise flooding and inundation was conducted using the adjacent ground elevation at each pump station relative to future flood water levels. The assessment revealed that no pump stations are expected to be exposed to flooding or inundation based on the evaluated flood scenarios for sea level rise alone.

<u>Data Gaps</u>

A review of potential data gaps was performed for the pump stations to evaluate additional analysis that may increase the understanding of flood vulnerabilities.

- The analysis has not incorporated survey, design or as-built drawings from each pump station. Incorporation of details from drawings will provide more specific information about flood vulnerabilities.
- The analysis has not reviewed the impacts to pump station power supply, such as buried utilities or substations, which may result in loss of power if they are flooded.
- The number and location of pump stations is based on GIS data layers of drainage control structures provided by the City. If additional pump stations exist, they should be included as a part of this analysis to evaluate for flood risk.

Outfalls

The St. Petersburg stormwater system has 3,307 outfalls and endwall structures that discharge stormwater away from low-lying developed areas. Outfalls are vulnerable to sea level rise because they often discharge into tidally-influenced waters. As sea levels rise, outfalls may become partially or fully submerged by high tides, inhibiting the ability of the structure to convey inland floodwater via gravity.

Table 3 shows the number of coastal outfalls within each stormwater basin that are subject to coastal flood exposure.

Table 3. Outfalls exposed to future coastal flooding and/or inundation for each stormwater basin

Stormwater Basin Name	MHHW + 1 ft	MHHW + 2 ft	MHHW + 3 ft	MHHW + 4ft	MHHW + 5 ft
A	17	23	25	33	38
B	2	2	4	18	18
C	35	51	63	67	69
D	5	7	8	8	9
E	1	1	1	1	1
F	0	1	2	4	4
G	7	7	8	8	9
H	0	0	0	0	0
I	0	0	0	0	0
J	4	4	6	4	4
K	6	7	7	7	7
L	23	30	36	44	46
M	9	14	22	27	35
N	17	29	45	62	67
O	93	118	144	164	199
P	45	89	147	233	290
Q	4	6	9	15	21
R	6	8	9	9	9
S	42	54	60	62	62
T	65	89	141	245	307
U	53	93	130	172	199
V	18	24	32	36	42
W	62	82	87	94	97
X	151	221	259	266	268
Y	0	0	0	0	0

Z	0	0	0	0	1

Most basins contain outfalls that are projected to experience coastal flooding initially due to the MHHW + 1-foot sea level rise scenario. Stormwater basins O, P, T, U, and X have the largest number of outfalls that may be subject to flooding (Figures 2). With the exception of Basin U, all of these basins are located on the northeast side of the city along Tampa Bay.

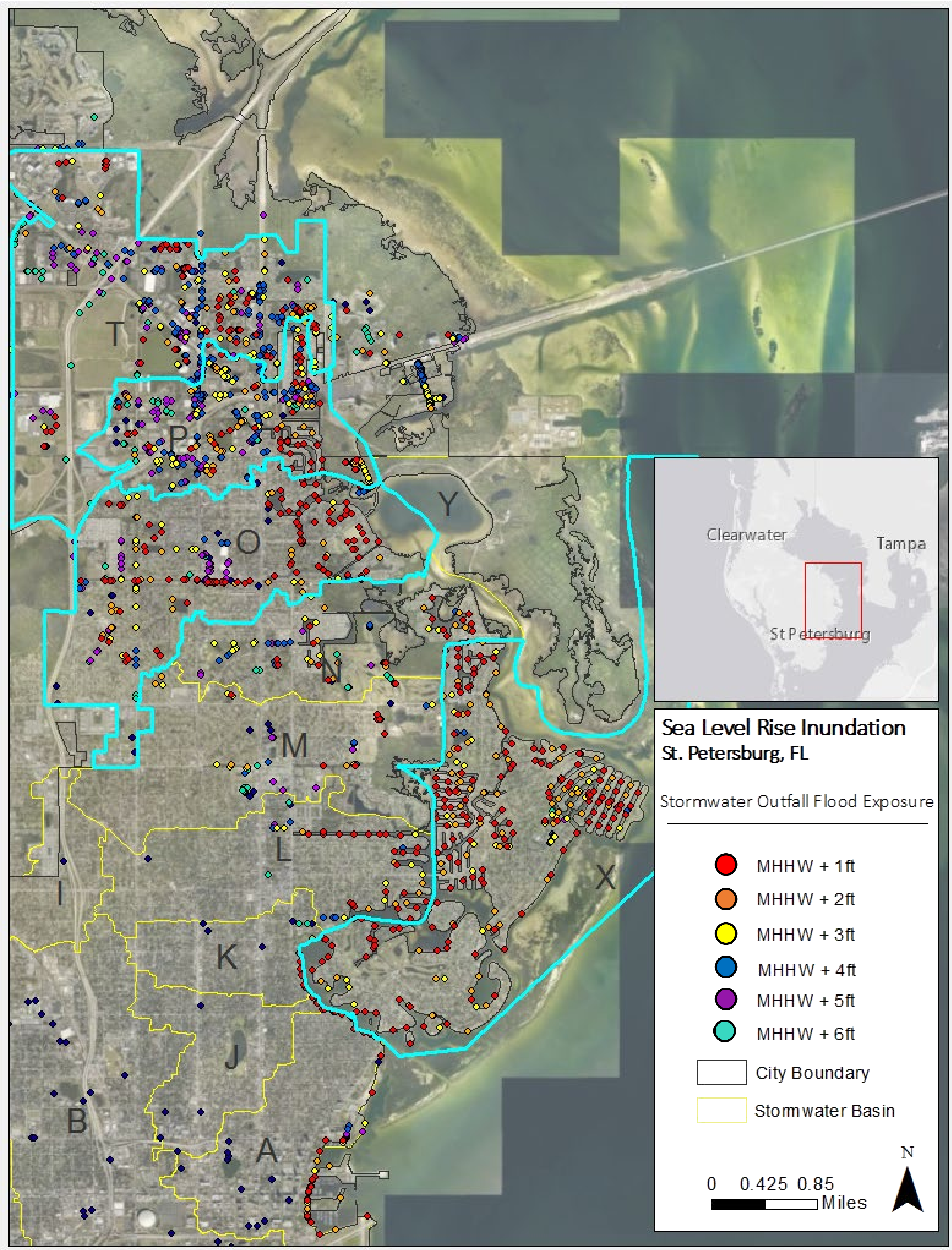


Figure 2. Stormwater Outfall/Endwall locations experiencing the greatest coastal flood exposure

Data Gaps

- The South Causeway Islands are a part of the City of St. Petersburg, but a stormwater basin was not included in the GIS layers provided by the City. All of the 58 outfalls are projected to be exposed to future flood impacts with the initial flood scenario being MHHW +1 ft of sea level rise.
- The initial exposure analysis did not consider invert elevations of outfalls. Inverts will be considered for the stormwater modeling phase of this project.

Inlets

Stormwater inlets can be a potential source of surface flooding if they have open connections to tidal waters. High tides or storm surge can backflow into the storm drain system and temporarily flood low-lying areas if outfalls are not equipped with backflow prevention devices. Potential areas exposed to backflow flooding were identified by overlaying stormwater inlet locations with low-lying hydraulically disconnected areas from the sea level rise inundation mapping. This analysis considers the role of inlets in contributing to sea level rise vulnerability of neighborhoods by acting as conduits for surface flooding in adjacent streets and neighborhoods.

Figure 3 shows an example of the inlet exposure analysis. In the example, inlets located in the Snell Isle area may experience backflow flooding due to the MHHW + 2ft scenario, shown in orange. Meanwhile, inlets located on Venetian Isles may experience backflow flooding due to the MHHW + 4ft scenario, shown in blue.

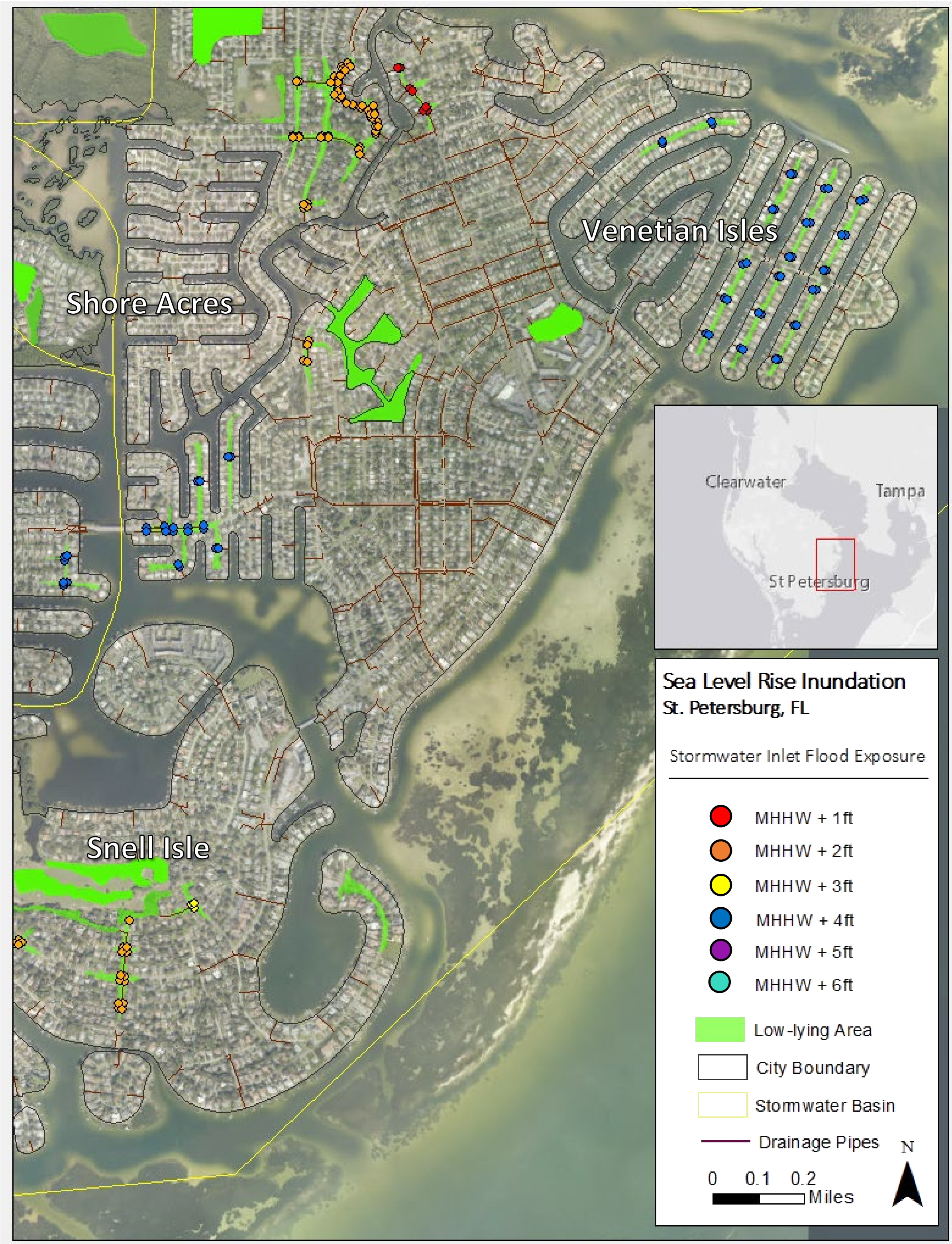


Figure 3. Example inlet exposure analysis

Table 4 lists the number of inlets within each basin that may experience backflow flooding without intervention. In general, the MHHW + 3 ft and MHHW + 4 ft scenarios experience the greatest increase in the number of potentially flooded inlets. Basins C, O, T, and X have the highest number of potentially exposed inlets.

Table 4. Number of inlets located in low-lying areas that may be subject to backflow flooding based on future water levels.

Stormwater Basin Name	MHHW + 1	MHHW + 2	MHHW + 3	MHHW + 4	MHHW + 5	MHHW + 6
A	0	0	9	20	22	22
B	0	8	10	13	17	17
C	0	46	152	152	152	153
D	0	0	0	0	0	0
E	0	0	0	0	0	0
F	0	0	0	0	0	0
G	0	0	0	0	0	0
H	0	0	0	0	0	0
I	0	0	0	0	0	0
J	0	0	0	0	0	0
K	0	0	0	0	0	0
L	0	0	0	31	31	32
M	2	4	8	44	68	68
N	0	0	12	45	74	74
O	1	4	38	267	298	298
P	4	11	33	62	64	64
Q	0	0	0	0	1	3
R	0	0	0	0	0	0
S	0	0	0	32	32	32
T	4	9	22	73	102	110
U	1	4	14	48	78	81
V	0	0	3	3	5	5
W	0	0	3	22	24	24
X	7	87	90	148	148	148
Y	0	0	0	0	0	0
Z	0	0	0	0	0	0

Data Gaps

- Tide gates and backflow prevention valves on outfalls may reduce backflow flooding. The influence of drainage control points will be taken into consideration during the stormwater modeling phase of this project.

Potential Adaptation Strategies

Adaptation consists of actions to reduce the vulnerability of natural and built systems to increase resilience to climate change or extreme weather events. Strategies to increase resilience should be robust, yet flexible, with short- and long-term approaches. The following are common categories of physical and non-infrastructural sea level rise adaptation measures to reduce flood risk in coastal communities:

Physical

Physical or structural adaptation strategies refer to modifications to infrastructure that can be grouped into three overarching categories – protect, accommodate, and retreat.

Protect refers to the concept of preventing infrastructure from being exposed to flood hazards. Examples include building a seawall or levee to prevent flood waters from impacting an asset or site.

Accommodate allows some degree of flooding to occur for assets that may be less sensitive or lower risk to flooding. For example, a flood-proofing electrical equipment will increase resilience to occasional flooding during storm tides. Accommodating flooding is a viable solution for water-dependent infrastructure, such as stormwater pump stations, assuming the structure is designed to tolerate flood conditions.

Retreat refers to the concept of moving vulnerable infrastructure out of harm's way. For example, moving a low-lying electrical box to a higher elevation will remove the asset from anticipated flood conditions.

Following are several examples of physical adaptation strategies:

- **Pumping, piping, and storage:** Improving drainage systems is a key adaptation technology to consider when protecting an urban environment against sea level rise effects. Coastal cities are often at or near sea level with large areas of impervious surface. Structurally updating pipe and pump capacity to convey excess flow away from low-lying areas and with outfall elevations that consider future sea levels can help manage future flood risk.

  Water plazas, detention basins, and underground stormwater storage are also useful features of stormwater systems to reduce urban flooding.

  The introduction of more pump stations in low-lying areas or in areas where the outfalls are located below future coastal water levels will also improve the stormwater system function. During storm or heavy rainfall events, pump stations, when paired with backflow preventers, can be activated to convey stormwater through outfalls even if they are inundated.

- **Green infrastructure:** Green infrastructure uses natural features (vegetation and natural ecosystem processes) to achieve on-site treatment of stormwater quality and, depending on the design, may lower downstream flows to reduce localized ponding of stormwater. Opportunities for green infrastructure include rain gardens, tree wells, green roofs, and permeable pavement. Green infrastructure provides numerous co-benefits including nutrient removal, groundwater recharge, creation of habitat, augmenting green space, neighborhood beautification, and climate change mitigation through carbon dioxide intake.

- **Flood-proofing:** The objective of flood-proofing is to reduce the impacts of flooding to structures or assets. There are two main types of flood-proofing—wet or flood-resilient (allowing water to pass through quickly to minimize flood damage or using flood-damage resistant materials) and dry or flood-resistant measures (making a building watertight up to the expected flood height). Outfalls located below future coastal water levels will also benefit from check valves installed to prevent backups that may cause flooding in streets and neighborhoods Flood-proofing will become increasingly important for assets vulnerable to sea level rise as more individual structural adaptation measures are needed.
- **Barriers:** Barriers increase the coastal edge elevation, thus preventing elevated seas from inundating low-lying landward areas. Barriers are commonly designed for future conditions in such a way that they can be adapted, or raised at some point in the future—for example, by adding more fill onto a berm or adding additional height to a seawall. For stormwater assets, they can be a useful strategy to protect pump stations during storm events. Barriers can be either fixed or operable to maximize their integration into a coastal environment or to protect critical built assets.

Non-structural

Non-structural adaptation strategies can also be used to increase resilience to future sea level rise hazards. These strategies typically are referred to as governance, planning, or informational strategies. Examples include building code and policy updates, disaster response plans, floodplain ordinance updates, or city-wide adoption of sea level rise planning guidance that can improve community resilience to future flood hazards.

- **Regulatory/Governance:** Regulatory tools can also be used in accordance with a land use plan to promote the long-term reduction of the City's exposure to flooding by placing limitations on redevelopment, such as rebuilding restrictions set forth in building codes. Zoning that enforces limitations on the ability to rebuild once a structure has been substantially damaged are also an effective means to implement restrictions on development in flood vulnerable areas. By addressing sea level rise in overarching policies and in technical guidelines, planners and designers consider sea level rise adaptation from the start of a project.
- **Planning:** Planning documents such as master plans, strategic plans, or comprehensive plans, although not necessarily legal documents, are often implemented through enforceable zoning ordinances and maps. The addition of sea level rise language can serve as evidence to support the need to amend zoning ordinances to prepare for future sea level rise projections.
- **Informational:** By introducing initiatives such as addressing informational gaps and developing monitoring programs, stakeholders evaluate sea level rise impacts on operations and physical damages associated specifically because of flooding.

Additional Considerations

The following factors should be considered when selecting the most appropriate adaptation strategy and/or sea level rise scenario to prepare for future conditions:

Adaptive Management

Climate projections developed for St. Petersburg are the product of the best available climate science. The City also continually reviews the latest climate projections recommended for the Tampa Bay region. However, as with all model projections, there is embedded uncertainty to consider regarding the precise magnitude and timing of impacts.

If a project is constrained from incorporating high-end sea level rise scenarios in the initial project design, an adaptive management framework provides an alternative approach. Adaptive management incorporates the flexibility and capacity to adapt a project over time. For example, a project may be designed for a moderate amount of sea level rise, but planned with enough flexibility that phased adaptation measures can be implemented to minimize impacts from future water levels. Therefore, the flood risk is reduced to acceptable levels during the initial phases of the asset's useful life, but it can be re-evaluated as risk levels change. This approach is especially useful for projects with a useful life that extends beyond 50 years, after which the uncertainty of climate projections increases. The adaptive management approach should include regular monitoring to ensure timely implementation of adaptation measures.

Scale of Protection

Before planning and implementing adaptation strategies, the scale of protection should be considered. Strategies can be either asset-specific or regional in nature. For example, a flood barrier around an electrical box may be used to provide short-term protection from storm tides. However, individual stormwater assets are typically a part of a larger system and interruptions at any one of many points can cause impacts throughout the entire network. Therefore, for longer-term protection, a regional flood barrier may be required along with updates to policy and building codes that improve the resilience to the entire community over time.

Regional Coordination

Impacts of sea level rise will transcend jurisdictional boundaries. Improvements to the stormwater system will require collaboration and coordination among neighboring jurisdictions. As many stakeholders within the Tampa Bay area begin to address sea level rise risks, efforts should be coordinated to ensure that consistent scenarios are being considered across city departments, external agencies, and local legislative requirements and that co-benefits are sought where possible.

Public Engagement

Partnerships and collaboration with local and regional stakeholders, including the public, are necessary for effective sea level rise adaptation. Throughout the sea level rise planning process, it is important to engage local residents, share information about impacts and risks, and provide opportunities for collaboration and co-creation of adaptation strategies. Early and consistent public engagement can impact peoples' ability and willingness to process, accept, and act on enhancing local resilience to future flood hazards.

Appendix A

Climate Science Memorandum

Memorandum

Climate Science and Projections for St. Petersburg, Florida

PREPARED BY: Erica Harris and Jason Bird

DATE: May 16, 2018

PROJECT: Stormwater Management Master Plan Update and Integrated Water Resources Master Plan

Background and Setting

Located on an eight-mile wide and 14-mile long peninsula between the Gulf of Mexico and Tampa Bay, the City of St. Petersburg is surrounded by water, providing flood pathways from three sides. Historically, marshes and mangroves lined the margins of the peninsula, serving as a sponge for excess water and a buffer against coastal storm conditions. To accommodate the area's rapid population growth, many of these habitats have been drained, filled, and replaced with development and homes now extending to the water's edge. With its predominately low-lying landscape that has been greatly altered by development over the past century, the City already experiences the impacts of flooding from storm events and predictable tidal inundation. Like most coastal cities, St. Petersburg is tasked with balancing the demand for increasing development and protection of fragile environmental resources that attract residents and visitors to the area. Adding to the challenge is the threat that an evolving climate poses to existing development, ecological systems, and future planning efforts.

The purpose of this memo is to assess the potential effects of climate change hazards that could have consequences for City water and stormwater services. It will be used to inform the flooding/inundation mapping, exposure analysis, and potential adaptation strategies for the Stormwater Management Master Plan and Integrated Water Resources Master Plan.

The following climate stressors are discussed: sea level rise, precipitation, and coastal storms.

1.1.1. Existing Daily and Storm Water Levels

Tide elevations are measured relative to a vertical datum—a baseline starting position against which other elevations may be related. There are two types of vertical datums: orthometric and tidal. Tidal datums are elevations defined by a certain phase of the tide, such as mean sea level.

An orthometric datum is a referenced plane of zero elevation that historically attempted to approximate the average elevation of the surface of global oceans or "sea level" (such as the North American Vertical Datum of 1988 (NAVD88), which is the current national standard reference datum.

Tidal datums are estimated by the National Oceanographic and Atmospheric Administration (NOAA) using observed water level data at tide stations. Each tidal datum is calculated over the National Tidal Datum Epoch, which is currently 1983 through 2001. Commonly referenced tidal datums for the Tampa Bay Area are presented in Table 1 relying on the St. Petersburg tide station (#8726520) near the Port of St. Petersburg. Datums are presented relative to the North American Vertical Datum of 1988 (NAVD88), the national standard for approximating global sea level, and the mean higher high water (MHHW), which represented the average high tide.

NOAA also provides estimates of storm tides at the St. Petersburg tide station. Storm tides include the effects of the astronomical tide, storm surge (due to atmospheric pressure and meteorological effects), and runoff. The existing storm tide levels were estimated by NOAA using a statistical analysis of 72 years of measured annual maximum water level data.

Table 1. Daily tide levels for the NOAA St. Petersburg tide station (#8726520)

	St. Petersburg Tide Station (#8726520)	
Datum	**NAVD88 (feet)**	**MHHW (feet)**
100-year Storm Tide Level	5.63	4.85
10-year Storm Tide Level	3.46	2.68
Highest Astronomical Tide	1.64	0.86
Mean Higher High Water (MHHW)	0.78	0
Mean High Water (MHW)	0.50	-0.28
North American Vertical Datum of 1988 (NAVD88)	0	-0.78
Mean Tide Level (MTL)	-0.30	-1.08
Mean Sea Level (MSL)	-0.28	-1.06
Mean Low Water (MLW)	-1.09	-1.87
Mean Lower Low Water (MLLW)	-1.48	-2.26

Notes:
-Source: https://tidesandcurrents.noaa.gov/datums.html?id=8726520
-Definitions are available at https://tidesandcurrents.noaa.gov/datum_options.html
- The North American Vertical Datum of 1988 is the current national standard to approximate the average elevation of the global surface elevation or "sea level."

The largest annual tides, commonly referred to as King Tides, occur approximately four or five times each year when the moon is in its closest position (perigee) to the earth. King Tides typically occur during the fall and spring months in Florida. Although King Tides typically only increase sea levels several inches above spring tide levels, they can cause flooding to low-lying coastlines, particularly if coinciding with a storm event or onshore wind that elevates tides above normal levels. For example, the King Tide event in October 2017 increased observed tides two feet above their predicted levels. Because King Tides often cause nuisance flooding and drainage issues, consideration of typical King Tide elevations is important in understanding high tide impacts to the St. Petersburg stormwater system and inland flooding.

1.2. Modeling Climate Change

A considerable amount of uncertainty surrounds future climate conditions and the effects of increasing greenhouse gas (GHG) emissions. Scientists have overcome uncertainties in climate change projections through evaluation of a variety of climate models to capture a multitude of different processes. Numerical models known as general circulation models (GCMs) incorporate the inter-related physical processes of the atmosphere, ocean, and land surface to simulate the response of the climate systems to changing GHG and sulfate aerosol emissions. These models are based on well-established physical principles and have been demonstrated to reproduce observed changes of recent and past climates. Because the level of future emissions will be affected by population, economic development, environmental changes, technology, and policy decisions, the Intergovernmental Panel on Climate Change (IPCC) developed a range of possible future emission scenarios based on a combination of these driving factors[1]. IPCC scenarios provide consistent baseline parameters, which can be used by researchers and modelling teams anywhere in the world.

The most recent models from IPCC are described in the Fifth Assessment Report on Climate Change (AR5), which was released in 2014[2]. The new scenarios for GHG emissions are called representative concentration pathways (RCP) and they represent the change between incoming and outgoing radiation to the atmosphere caused by differences in atmospheric composition. The four RCPs—RCP2.6, RCP4.5, RCP6, and RCP8.5 – are named after a possible range of radiative forcing in the year 2100 (+2.6, +4.5, +6.0, and +8.5 watts per square meter, respectively). Figure 1 describes the characteristics of each RCP scenario.

RCP8.5	RCP6	RCP4.5	RCP2.6
• Describes a world characterized by rapid economic growth. Carbon dioxide equivalent concentrations reach ~1370 parts per million (ppm) by the end of the century. It is often referred to as the "business-as-usual" scenario.	• Represents a stabilization scenario. Carbon dioxide equivalent concentrations reach ~850 ppm by the end of the century, followed by stabilization.	• Represents a stabilization scenario where carbon dixoide equivalent concentrations reach ~650 ppm by the end of the century, followed by stabilization.	• Signifies a peak and decline scenario where carbon dioxide equivalent concentrations peak at ~490 ppm by mid-century, followed by rapid GHG emission reduction.

Figure 1. Representative Concentration Pathways scenario characteristics

Once the numeric GCM models are finished running for each combination of select future forcing conditions, the results can be used as input for researchers to assess the influence on climate factors such as future temperature, precipitation patterns, and sea levels (Figure 2).

[1] Intergovernmental Panel on Climate Change (IPCC). 2000. Special Report on Emission Scenarios: A Special Report of Working Group III of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, U.K. Available at: https://www.ipcc.ch/pdf/special-reports/emissions_scenarios.pdf

[2] Intergovernmental Panel on Climate Change (IPCC). 2013. Climate Change 2013: The Physical Science Basis. Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Available at: www.ipcc.ch/report/ar5/wg1/

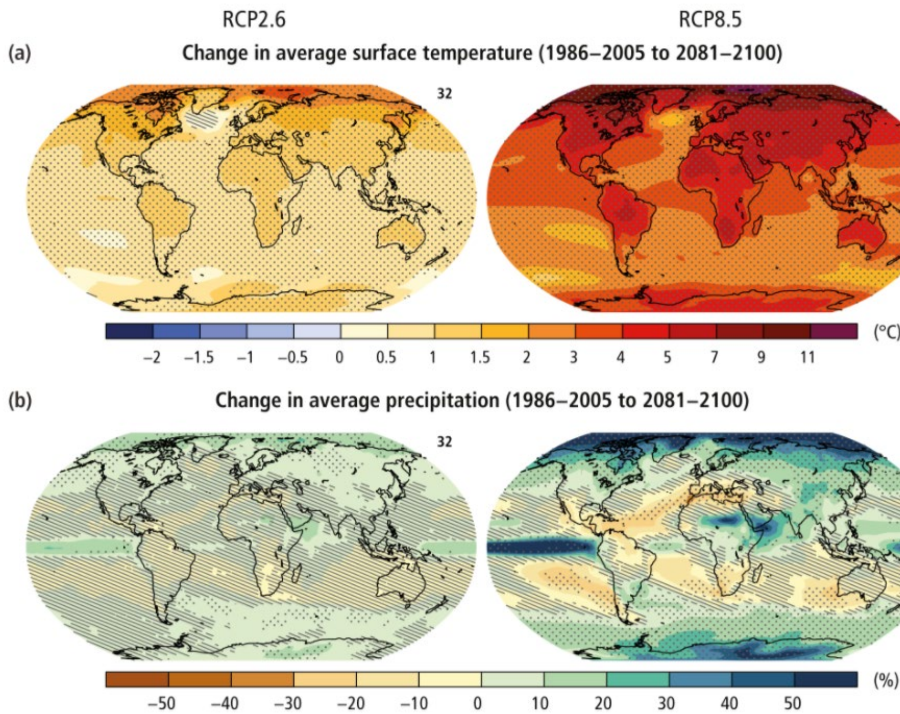


Figure 2. Graphical output of projected changes in average surface temperature and average precipitation based on RCP2.6 and RCP8.5 emission scenarios. *Source: IPCC AR5*

GCMs provide estimates of climate change at a global level because the resolution—approximately 200 kilometers (km)—is typically too coarse for detailed regional climate projections. Therefore, models are often "downscaled" to allow for more place-based projections of climate change at the local level. Using GCM results as input, downscaling models generate locally relevant data by connecting global scale projections and regional dynamics.

1.3. Sea Level Changes

Increasing atmospheric temperatures influence global sea levels through two primary processes:

- Melting of land-based ice masses (glaciers and continental ice sheets) increases the volume of ocean water, thereby elevating sea levels.
- Atmospheric warming transfers heat to oceans, causing the water to expand and increases sea levels through a process referred to as thermal expansion.

Although these two factors increase global sea levels, the effects are not experienced uniformly. There is considerable spatial variability in the rate of sea level rise across the globe as ocean and atmosphere conditions can have a large influence on water distribution and uneven ocean temperatures. Additionally, vertical land movement (i.e., subsidence or uplift) plays a large role in local sea level variability along shorelines.

A considerable amount of uncertainty surrounds the response of sea level to future climate change. Unknowns in greenhouse gas emissions due to potential changes in future population growth patterns, land use practices, global policies, and new technologies are the primarily cause of the uncertainties in predicting future sea levels. The inability for precision in the amount and timing of sea level rise also stems from the complex feedback mechanism between elevated greenhouse gas concentrations and changes to the climate system. Therefore, the science of climate change and affiliated sea level rise is continuously being revised as models are updated with new observations.

Sea level rise trends are recorded by tide stations, and more recently, globally by satellite altimetry. During the 20th century, global ocean levels have increased at an average rate of 0.07 inches/year (1.8 mm/year)[3]. Recent satellite altimetry observations show that this rate continues to accelerate every year due to enhanced melting of ice sheets in Greenland and Antarctica[4]. Over the past 20 years, the rate has increased to 0.13 inches/year (3.3 mm/year), roughly twice the average rate of the preceding 80 years [3, 4].

1.3.1. Local Sea Level Rise Trends

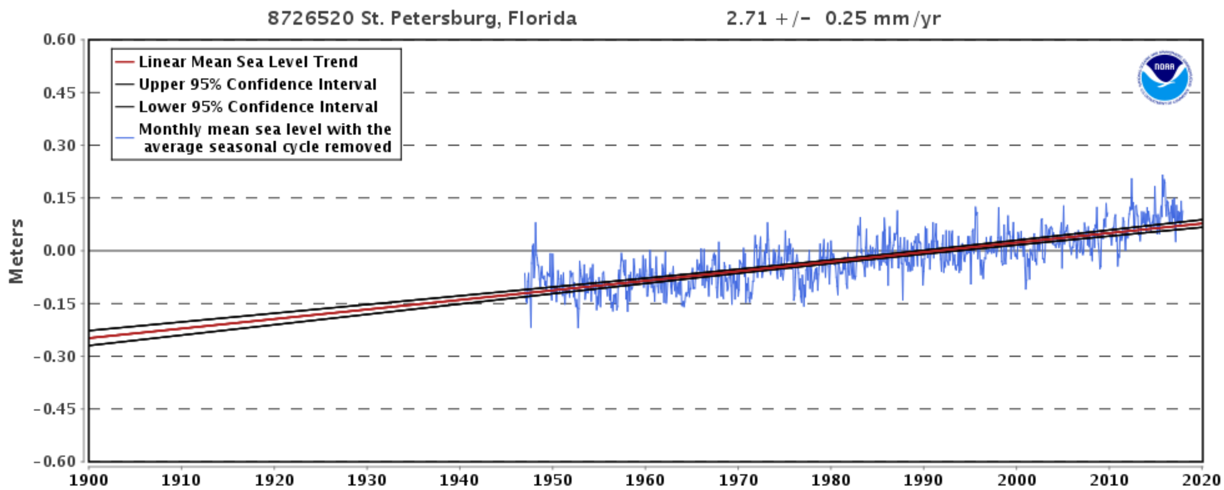
Since installation of the St. Petersburg tide station, local water levels have increased by 0.89 feet over the past century, which equates to approximately one inch per decade (Figure 3). The local average historical sea level rise rate is faster than the global average rate, which is a subject of active research. Studies suggest that large atmospheric patterns of the El Niño Southern Oscillation cycle and North Atlantic Oscillation may be interacting to cause water to pile up along the U.S. Southeast coastline[5]. Other studies have also suggested the local rise in sea level could be due, in part, to a slowing of the Atlantic Ocean's Meridional Overturning Circulation (AMOC), including the Gulf Stream current[6]. Regardless of the cause of acceleration, as sea levels continue to rise, public and private shoreline assets, including the St. Petersburg water and stormwater system, will become more vulnerable to the increase in high tide and coastal flood events.

[3] Parris, A., P. Bromirski, V. Burkett, D. Cayan, M. Culver, J. Hall, R. Horton, K. Knuuti, R. Moss, J. Obeysekera, A. Sallenger, and J. Weiss. 2012. Global Sea Level Rise Scenarios for the US National Climate Assessment. NOAA Tech Memo OAR CPO-1. 37 pp.

[4] Nerem, R.S., B.D. Beckley, J.T. Fasullo, B.D. Hamlington, D. Masters, and G.T. Mitchum. 2018. Climate-Change-Driven Accelerated Sea-level Rise Detected in the Altimeter Era. Proceedings of the National Academy of Sciences of the United States of America. Available at: https://doi.org/10.1073/pnas.1717312115

[5] Valle-Levinson, A., A. Dutton, and J.B. Marin. 2017. Spatial and Temporal Variability of Sea Level Rise Hot Spots Over the Eastern United States. Geophysical Research Letters. Volume 44, Issue 15. Pages 7876-7882. Available at: http://onlinelibrary.wiley.com/doi/10.1002/2017GL073926/abstract

[6] Smeed, G. McCarthy, S.A. Cunningham, E. Frajka-Williams, D. Rayner, W.E. Johns, C.S. Meinen, M.O. Baringer, B.I. Moat, A. Duchez, H.L. Bryden Observed decline of the Atlantic meridional overturning circulation 2004 to 2012. 2013. Ocean Sci. Discuss., 10 (5) (2013), pp. 1619-1645



Source: NOAA Sea Level Trends Online https://tidesandcurrents.noaa.gov/sltrends

Figure 3. Mean Sea Level Trend in St. Petersburg

1.3.2. Sea Level Rise Projections

In 2014, the Tampa Bay Climate Science Advisory Panel (CSAP) formed as an ad hoc network of scientists and resource managers in the Tampa Bay region (Pinellas, Hillsborough, Manatee, and Pasco counties). The primary goal of the group is to develop consistent sea level rise recommendations based on the best available science for local governments to inform climate-based adaptation for infrastructure and natural resource planning. The CSAP recommends consideration of four sea level rise scenarios based on the 2012 National Oceanic and Atmospheric Administration (NOAA) Technical Report, *Global Sea Level Rise Scenarios for the United States National Climate Assessment*[7]. The projections, described as low, intermediate low, intermediate high, and high, are consistent with IPCC emission scenarios and can be regionally adjusted using local tide station information.

Since the release of the 2012 NOAA report and 2015 CSAP recommendations, climate change modeling and sea level rise projections have continued to evolve with significant advances in the understanding of changes in the cryosphere and regional factors that contribute to local sea level rise. In 2017, NOAA released revised sea level rise projections in the report, *Global and Regional Sea Level Rise Scenarios for the United States*[8]. The report reflects the latest published and peer-reviewed science to expand to six global sea level rise scenarios (low, intermediate low, intermediate, intermediate high, high, and extreme) to examine the full range of plausible future water levels. Although it has a low probability of occurrence, addition of the extreme scenario allows for the option to plan for critical infrastructure that may have a high consequence of failure.

The updated NOAA projections have the added advantage of providing risk-based (probabilistic) planning capabilities. Table 2 shows the probability of future sea levels exceeding each projection of

[7] Parris, A., P. Bromirski, V. Burkett, D. Cayan, M. Culver, J. Hall, R. Horton, K. Knuuti, R. Moss, J. Obeysekera, A. Sallenger, and J. Weiss. 2012. Global Sea Level Rise Scenarios for the US National Climate Assessment. NOAA Tech Memo OAR CPO-1. 37 pp. Available at: https://scenarios.globalchange.gov/sites/default/files/NOAA_SLR_r3_0.pdf

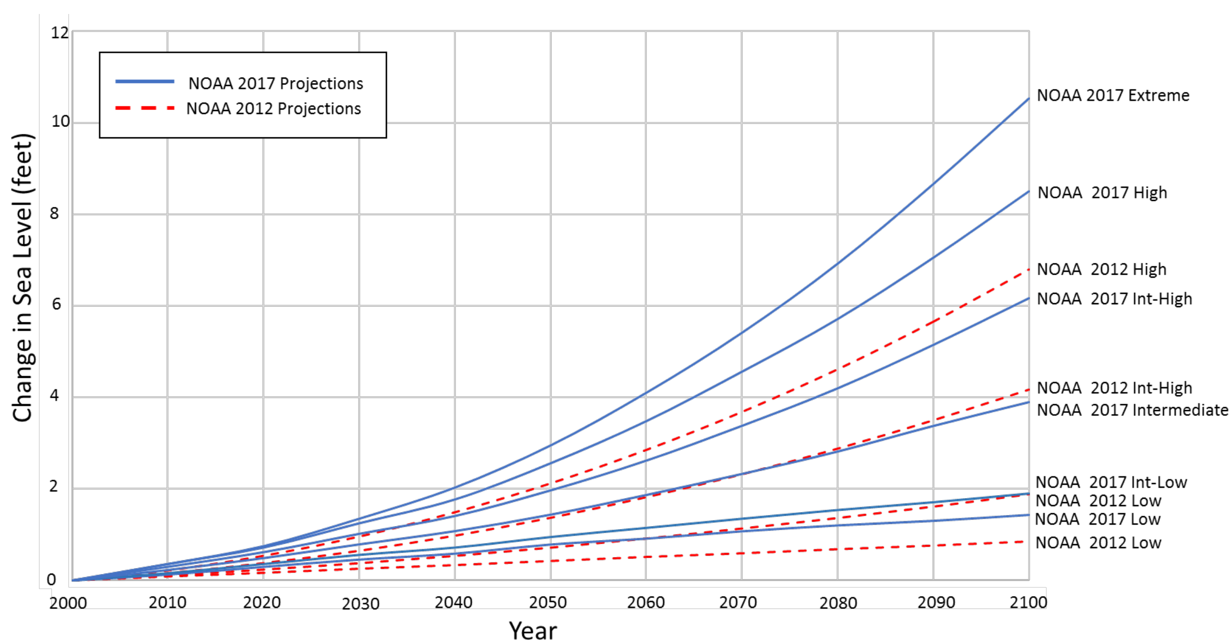
[8] USGCRP, 2017: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 470 pp, doi: 10.7930/J0J964J6. Available at: https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf

global mean sea level (GMSL) for the scenarios. For example, the intermediate scenario (3.3 feet) has a 2 to 17 percent chance of being exceeded by future global sea levels by the year 2100. Refer to Section 1.6. Selecting Climate Change Projections for more information on how to select the most appropriate projection based on project risk tolerance.

Table 2. Probability of exceeding GMSL scenarios (median value) in 2100 based upon Kopp et al. (2014)[9].

Global Mean Sea Level Rise Scenario	RCP2.6	RCP4.5	RCP8.5
Low (1 ft)	94%	98%	100%
Intermediate-Low (1.6 ft)	49%	73%	96%
Intermediate (3.3 ft)	2%	3%	17%
Intermediate-High (4.9 ft)	0.4%	0.5%	1.3%
High (6.6 ft)	0.1%	0.1%	0.3%
Extreme (8.2 ft)	0.05%	0.05%	0.1%

Figure 4 and Table 3 show a comparison of the NOAA sea level rise projections for the Tampa Bay area. In all scenarios, the NOAA 2017 projection range is higher than the NOAA 2012 range. By 2100, the range of likely sea level rise scenarios described in the 2017 NOAA study is 1.4 to 8.5 feet, with an extreme scenario extending the upper range to 10.5 feet.



Notes:
-Projections are relative to the year 2000.

---

[9] Kopp RE, et al. (2014) Probabilistic 21st and 22nd century sea-level projections at a global network of tide gauge sites. Earths Future 2(8):383–406.

-Data retrieved from the USACE Sea Level Change Curve Calculator for the St. Petersburg tide station: http://www.corpsclimate.us/ccaceslcurves.cfm

Figure 4. Comparison of NOAA 2012 and 2017 local mean sea level rise projections for Tampa Bay Region.

Table 3. Comparison of NOAA 2012 and 2017 local mean sea level rise projections for Tampa Bay Region

	Low		**Intermediate - Low**		**Intermediate**		**Intermediate - High**		**High**		**Extreme**	
Year	*NOAA 2012*	*NOAA 2017*	*NOAA 2012*	*NOAA 2017*	*NOAA 2012*	*NOAA 2017*	*NOAA 2012*	*NOAA 2017*	*NOAA 2012*	*NOAA 2017*	*NOAA 2012*	*NOAA 2017*
2000	0	0	0	0		0	0	0	0	0	0	0
2040	0.34	0.59	0.54	0.72		1.08	0.98	1.41	1.49	1.77		2.03
2060	0.52	0.92	0.92	1.15	NA	1.87	1.82	2.62	2.85	3.48	NA	4.1
2070	0.6	1.08	1.14	1.35		2.33	2.32	3.38	3.68	4.56		5.41
2100	0.86	1.44	1.89	1.9		3.9	4.17	6.17	6.79	8.5		10.53

Note: Sea level rise projections are measured in feet and relative to the year 2000.

Future sea level rise will increase the existing baseline elevations upon which daily tidal variations are measured. To evaluate future flood exposure, the average high tide elevation, represented by the mean higher high water (MHHW), is adjusted to reflect future sea level projections (Table 4). The MHHW level is significant, as it is the elevation experiencing daily inundation in the City.

Table 4. Future MHHW elevations in St. Petersburg

Year	**Low (feet, NAVD88)**	**Int-Low (feet, NAVD88)**	**Intermediate (feet, NAVD88)**	**Int-High (feet, NAVD88)**	**High (feet, NAVD88)**	**Extreme (feet, NAVD888)**
2017	1.01	1.01	1.01	1.01	1.01	1.01
2040	1.35	1.43	1.67	1.89	2.16	2.40
2060	1.68	1.86	2.46	3.10	3.87	4.47
2070	1.84	2.06	2.92	3.86	4.95	5.78
2100	2.20	2.61	4.49	6.65	8.89	10.90

Note: The MHHW datum has been adjusted to be relative to 2017, assuming the existing local sea level rise rate of 0.009 feet/year derived from the St. Petersburg tide station. The MHHW for 2017 was calculated as 0.78ft + (0.009ft/yr * (2017-1992)) = 1.01ft NAVD88. Future sea level projections were also adjusted for the 2017 baseline.

1.4. Precipitation Changes

Precipitation trends are primarily controlled by the amount of heat in the atmosphere, cloud cover, and large-scale ocean-atmosphere phenomena such as the North Atlantic Oscillation (NAO) and El Niño Southern Oscillation (ENSO)[10]. Although precipitation has been recorded over land areas for more than a century, interpreting trends has been difficult due to high spatial variability. For example, it can rain several inches in St. Petersburg, while being a sunny day in Tampa. Overall, studies suggest that there

---

[10] Wuebbles, D.J., D.R. Easterling, K. Hayhoe, T. Knutson, R.E. Kopp, J.P. Kossin, K.E. Kunkel, A.N. LeGrande, C. Mears, W.V. Sweet, P.C. Taylor, .S. Vose, and M.F. Wehner, 2017: Our globally changing climate.In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 35-72, doi: 10.7930/J08S4N35.

has been little to no change in globally-averaged precipitation since 1900[10]. However, strong changes in regional rainfall amounts are detected with a general tendency of high latitudes and equatorial areas becoming wetter and the subtropics becoming drier[2] .

Although there is lack of a strong historical trend in global mean precipitation, the frequency and intensity of extreme rainfall events has increased through time[Error! Bookmark not defined.] . A warming climate allows for an increase in the amount of atmospheric water vapor, which often causes a larger amount of precipitation during rainfall events. As a result, extreme rainfall is becoming more frequent in nearly all regions of the world[11]. Globally, annual-maximum daily precipitation has increased by 8.5% over the past 110 years[12].

1.5.2. Local Precipitation Trends

Located in a subtropical climate, Florida receives an average of 55 inches of rain each year[13]. However, Florida rainfall is highly variable, both spatially and temporally. The highest annual precipitation occurs in the Panhandle while the lowest occurs in the Keys. The Florida wet season spans May through October and the dry season occurs November through April. Table 5 shows the average total monthly rainfall from data collected at the St. Petersburg area. The wet season is also characterized by episodic thunderstorms, squalls, and tropical cyclones.

Table 5. Average Rainfall (inches) in St. Petersburg, FL (1981-2010)

					WET SEASON								
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Totals	2.93	3.03	3.56	2.58	2.74	7.51	9.30	8.29	6.99	2.79	2.05	2.93	54.70

Source: Florida Climate Center, The Florida State University, https://climatecenter.fsu.edu/products-services/data/1981-2010-normals/st-petersburg

Recent studies suggest that local average precipitation patterns may be changing in the St. Petersburg area. Analysis of long-term precipitation records (1892-2008) indicates a delay in the onset of the wet season and an overall decrease in summer precipitation[14]. The seasonal shift of the wet season may result in localized drought conditions, particularly when combined with high atmospheric temperatures.

Consistent with global trends, the St. Petersburg area has historically experienced an increasing trend of extreme rainfall events. Since the 1950s, the Southwest Florida region, including St. Petersburg, has experienced a pattern of increasing extreme 1-, 2-, 3-, 6-, 12- and 24-hour precipitation events [15].

---

[11] Donat, M.G., A.L. Lowry, L.V. Alexander, P.A. Ogorman, and N. Maher, 2016: More extreme precipitation in the world's dry and wet regions. Nature Climate Change, 6, 508-513. http://dx.doi.org/10.1038/nclimate2941

[12] Easterling, D.R., K.E. Kunkel, J.R. Arnold, T. Knutson, A.N. LeGrande, L.R. Leung, R.S. Vose, D.E. Waliser, and M.F. Wehner, 2017: Precipitation change in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 207-230, doi: 10.7930/J0H993CC.

[13] Florida Climate Center, The Florida State University, https://climatecenter.fsu.edu/products-services/data/1981-2010-normals/st-petersburg

[14] Irizarry-Ortiz, M., J. Obeysekera, J. Park, P. Trimble, J. Barnes, W. Park-Said, and E. Gadzinski, 2011. Historical trends in Florida temperature and precipitation. Hydrological Processes, Volume 27, Issue 16, 2225-2246. https://doi.org/10.1002/hyp.8259

[15] Mahjabin, Tasnuva, "Long-term Trends in Magnitude and Frequency of Extreme Rainfall Events in Florida" (2015). FIU Electronic Theses and Dissertations. 2257. http://digitalcommons.fiu.edu/etd/2257

1.4.1. Future Precipitation Trends

As with sea level rise, there is uncertainty surrounding the effects of climate change on precipitation. Rainfall is one of the least certain aspects of global climate models at the local level, as the models do not resolve many of the fine-scale and complex interactions that produce rainfall over Florida, such as tropical storms and sea breeze-driven convective thunderstorm activity. Precipitation trends are further complicated by the influence of soil moisture and changes in land use[Error! Bookmark not defined.] [12].

As a part of the St. Petersburg Wastewater Wet Weather Inflow and Infiltration (WW I&I) project, an analysis was performed based on rainfall data at the St. Petersburg International Airport (KSPG) to develop Intensity Duration Frequency (IDF) curves for various rainfall events ranging from 2- to 500-year return period storms.

Historical IDF curves were generated to resolve a 24-hour storm magnitude, which was used as a baseline for future conditions. Projected changes in 24-hour rainfall were derived using results from GCMs for 2040 and 2070 using medium and high greenhouse gas emission scenarios (RCP6.0 and 8.5, respectively). The SimCLIM tool, a computer model system for examining spatiotemporal effects of climate variability, was used to statistically downscale global projections to reflect local climate characteristics at a 1-kilometer resolution and obtain a percent increase in the 24-hour event.

Figure 6 and Table 6 show the results of the historical and projected 24-hour rainfall amounts for a range of recurrence intervals from 2-year to 500-year storms.

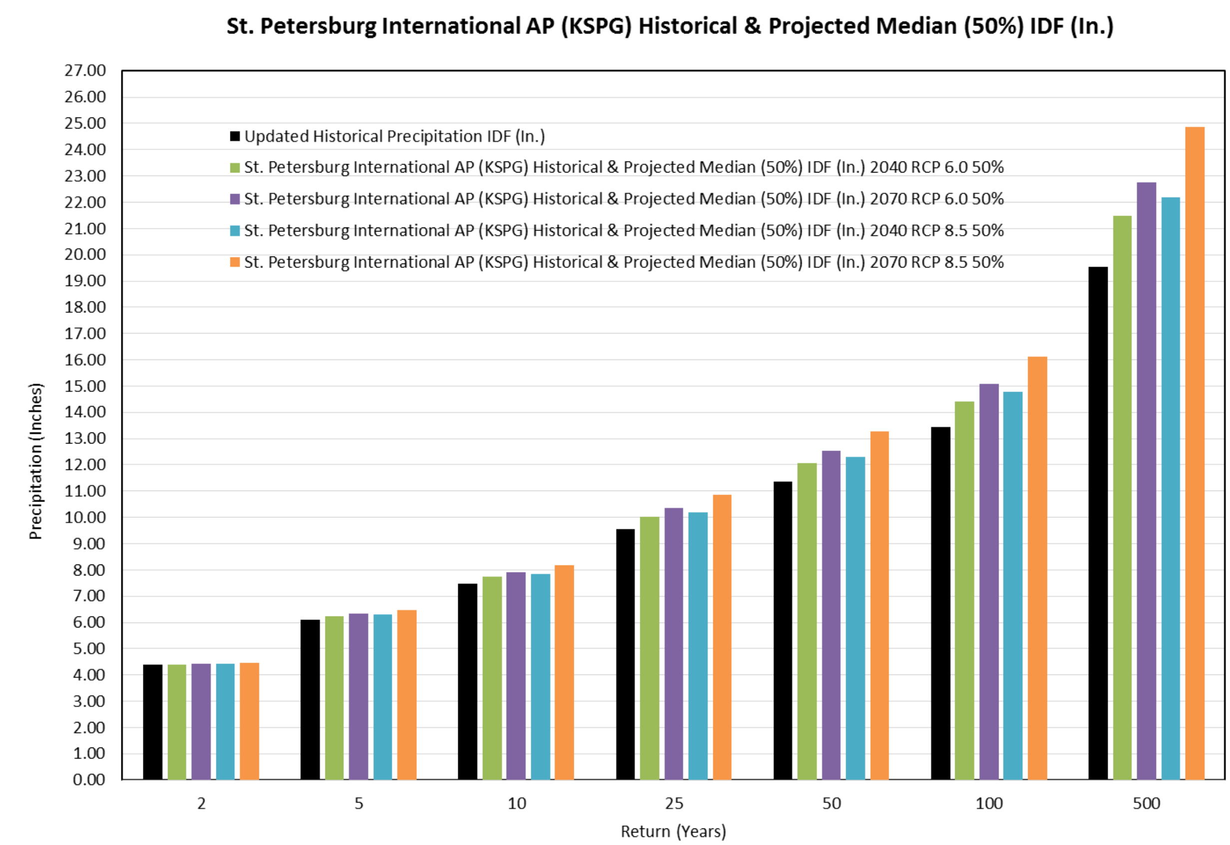


Figure 6. 24-hour precipitation comparison for return periods ranging from 2 to 100 years the for St. Petersburg.

Table 6. St. Petersburg International Airport (KSPC) historical and projected median (50%) 24-hour rainfall.

Return Period (Years)	Historical Precipitation (inches)	2040 RCP6.0 Median (50%)	2070 RCP6.0 Median (50%)	2040 RCP8.5 Median (50%)	2070 RCP8.5 Median (50%)
2	4.39	4.41	4.42	4.42	4.44
5	6.11	6.24	6.34	6.29	6.49
10	7.48	7.74	7.91	7.83	8.19
25	9.56	10.03	10.34	10.20	10.85
50	11.37	12.07	12.53	12.32	13.27
100	13.45	14.43	15.07	14.78	16.12
500	19.53	21.47	22.77	22.17	24.88

1.5. Coastal Storms

Tropical storms and hurricanes are the leading cause of major flood damage in Florida. Coastal storms in Florida typically develop in the summer months (June-November), but nearly 75 percent affect the state between August and October when equatorial Atlantic Ocean waters are the warmest[16]. Storm surge, an abnormal rise in water level due to low atmospheric pressure and winds associated with an offshore storm system, is the primary storm component responsible for large-scale flooding in low-lying coastal areas. Storm surge can reach 25 feet above average sea level for the strongest hurricanes[17]. The destructive power of storm surge, combined with large waves, can travel several miles inland on Florida's very low topography, damaging or destroying infrastructure, eroding beaches, and inundating coastal assets for up to several days.

More storms make landfall in Florida than any other state in the United States[17]. The most recent occurred in September 2017 when Hurricane Irma made landfall in southwest Florida as a category 4 storm with maximum sustained windspeeds of 130 MPH. In addition to the hurricane's intensity, Irma was an extensive storm with a wind field extending 415 miles from the center of the storm. Hurricane force winds and heavy rainfall stretched across the entire Florida peninsula and storm surge effects were observed along both the Gulf and Atlantic coastlines. After making landfall, Irma slowly weakened as it continued north through the Florida and decayed to a category 2 storm by the time it reached the Tampa Bay Area (National Weather Service, 2017).

[16] *Florida Climate Center. Hurricanes. Retrieved from: http://climatecenter.fsu.edu/topics/hurricanes. Accessed August 8. 2016.*

[17] *National Hurricane Center. U.S. Mainland Hurricane Strikes by State, 1851-2004. Retrieved from: http://www.nhc.noaa.gov/paststate.shtml*

Since the early 1980s, when high-resolution satellite data became available, there has been an increase in the intensity, frequency, and duration of Atlantic hurricanes[18 19]. Although hurricane development is influenced by multiple factors, studies suggest the recent increases in activity and storm intensity are linked to higher sea surface temperatures in the region[20]. End-of-century model projections suggest that although the overall number of storms may decrease in Florida, the proportion of storms rated as severe may increase[20 21]. In particular, the strongest hurricanes (Category 4 and 5) are estimated to increase in frequency[22]. Taking into account the increase in severe storms, the number of Category 3 and below storms are expected to decrease by 38%.

Sea level rise is projected to yield large changes in the frequency and intensity of coastal flooding, even if the large coastal storms do no exhibit an increasing trend. It is estimated that today's 100-year (1-percent annual chance of occurring) magnitude flood elevation will begin to occur every 20 years at the projected mean sea level in 2050[21].

1.6. Selecting Climate Change Projections

This section provides information to support the selection of climate scenarios (sea level rise and precipitation) used for the City's stormwater and water utility planning. It includes an overview of regional sea level planning efforts in the Central-South Florida area and considerations for selecting appropriate climate scenarios.

1.6.1. Ongoing Regional Sea Level Rise Planning Efforts

Although Florida does not have state sea level rise guidance for project planning, there are a variety of federal studies that serve as the basis for design and planning projects throughout the state. Table 7 lists several planning efforts in the Central and South Florida region. Due to the range in sea level rise projections, many local planning efforts rely on a combination of multiple projection sources. For example, the Southeast Florida Regional Climate Compact's Unified Sea Level Rise Projection guidance references projections provided by the IPCC, U.S. Army Corps of Engineers and NOAA, depending on project planning timeline.

---

[18] *Bell, G. D., E. S. Blake, C. W. Landsea, T. B. Kimberlain, S. B. Goldenberg, J. Schemm, and R. J. Pasch, 2012: [Tropical cyclones] Atlantic basin [in "State of the Climate in 2011"]. Bulletin of the American Meteorological Society, 93, S99-S105, doi:10.1175/2012BAMSStateoftheClimate.1*

[19] *Landsea, C. W., and J. L. Franklin, 2013: Atlantic hurricane database uncertainty and presentation of a new database format. Monthly Weather Review, 141, 3576-3592, doi:10.1175/MWR-D-12-00254.1.*

[20] *Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2*

[21] *Tebaldi, C., Strauss, B.H., Zervas, C. E. 2012. Modelling sea level rise impacts on storm surges along US coasts. Environ. Res. Lett. 7 (2012) 11 pp*

[22] *Bender, M.A., T.R. Knutson, R.E. Tuleya, J.J. Sirutis, G.A. Vecchi, S.T. Garner, and I.M. Held, 2010: Modeled impact of anthropogenic warming on the frequency of intense Atlantic hurricanes. Science, 327, 454-458.*

Table 7. Sea level rise projections used in Central and South Florida

Lead Agency ***2100 Projections***	**Study Description**	**Florida Agency/Study Using Projections**
National Oceanic and Atmospheric Administration (2017) ***SLR*: *12-98 inches relative to 2000 global mean sea level***	As an update to the 2012 NOAA projections, the 2017 report described six scenarios to explore the full range of potential sea level rise scenarios. The latest report also provides the option of probabilistic-based planning capabilities for selection of sea level rise projections. This report serves as the basis for the 4th National Climate Assessment (NCA), an effort led by a federal interagency collaboration to synthesize the latest climate change science and impacts.	Pinellas County RESTORE ACT Vulnerability Assessment (ongoing)
U.S. Army Corps of Engineers (2013) ***SLR: 8 – 60 inches relative to 1992 global mean sea level***	The U.S. Army Corps of Engineers (USACE) issued guidance in 2009 and 2011 for taking SLR into account for coastal defense projects. The guidance presents three scenarios: a low scenario that projects the historical trend; and an intermediate and high scenario, which includes modified NRC sea level projections and vertical land movement. SLR projections are relative to 1992 mean sea level.	Collier County/ Collier County Floodplain Management Plan (2015) Southeast Florida Regional Climate Compact / Unified Sea Level Rise Projection (2011)
Intergovernmental Panel on Climate Change (1990-2013) ***SLR: 10 – 39 inches relative to 1986-2005 global mean sea level***	The Intergovernmental Panel on Climate Change (IPCC) is heavily relied on in climate change planning, as the group is responsible for developing a range of possible future emissions scenarios that are used in climate models. Since 1990, the group has released a series of reports, including the most recent in 2013, which includes their most recent future sea level rise projections.	Lee County Climate Change Vulnerability Assessment (4th Annual Report, 2010)
National Oceanic and Atmospheric Administration (2012) ***SLR: 8 to 79 inches relative to 1992 global mean sea level***	The 2012 report, *Global Sea Level Rise Scenarios for the United States,* described four scenarios, which relied on extrapolation of existing sea level trends, the IPCC AR4 report, and a calculation of the maximum possible glacier and ice sheet loss by the end of the century. This report serves as the basis for the 3rd National Climate Assessment (NCA), an effort led by a federal interagency collaboration to synthesize the latest climate change science and impacts.	Southeast Florida Regional Climate Compact / Unified Sea Level Rise Projection (2011) Tampa Bay Climate Science Advisory Panel (2015)
U.S. Environmental Protection Agency (2008)	In 2008, the Environmental Protection Agency (EPA) conducted an analysis of the effects that climate stressors, including SLR, may have on the	Southwest Florida Regional Planning Council / The Comprehensive Southwest

SLR: 10 – 46 inches relative to 1990 global mean sea level	southwest region of Florida. Three "severity" scenarios were initially considered: least case (90% probability of occurrence), moderate case (50% probability of occurrence), and worst case (5% probability of occurrence). The scenarios rely on the historical SLR rate at St. Petersburg, FL and the normalized future projections developed by the EPA relative to 1990 mean sea level[23].	Florida / Charlotte Harbor Climate Change Vulnerability Assessment (2009) Tampa Bay Regional Planning Council / Sea Level Rise in the Tampa Bay Region (2006) Lee County Climate Change Vulnerability Assessment (2010)
National Research Council (2010) ***SLR: 20-40 inches***	In 2010, the National Research Council (NRC) released a report quantifying the possible outcomes of different emissions scenarios using the latest scientific literature. The future sea levels described in the study relied on earlier projections from the IPCC and were supplemented by additional scientific studies that account for accelerated melting of glacial ice.	Florida Oceans and Coastal Council / Climate Change and Sea-Level Rise in Florida (2010)

1.6.2. Project Considerations

Selection of the most appropriate climate change scenario to prepare for future conditions should consider the following factors:

1) Project lifespan

It is important to select a planning horizon based on the design and useful lifespan of system assets and the community assets they serve. The useful life of an asset is typically a longer period of time than the design life, and more accurately represents the actual service time for most types of infrastructure. For example, a stormwater system may have a design life of 30 years, but in practice the underground structures often remain in use for more than 100 years.

2) Risk tolerance

To support planning decisions, it is important to consider a range of projections and to evaluate the consequences associated with each scenario. This approach allows decision makers to evaluate tradeoffs and determine an appropriate tolerance for risk. In general, shorter lifespan or minimal consequence projects are associated with a higher risk tolerance and it may be appropriate to plan for a low-end sea level rise scenario. However, longer-lasting projects with a high consequence of impact typically have a low risk tolerance and should be planned based on a high-end sea level rise scenario.

In addition to planning for a scenario that is probabilistically most likely to occur during the asset design life, it is also beneficial to consider a plausible worse-case scenario as an upper bound, particularly for assets that are expected to be in place and in service for a long period of time (e.g., 50-100 years). Using the upper bound serves as a guide for overall system risk and long-term adaptation strategies.

---

[23] Titus, J. and V. Narayanan. 1995. Washington, D.C.: U.S. Environmental Protection Agency. 186 pp. EPA 230-R95-008.

Appendix E. Preliminary Engineer's Opinion of Probable Construction Costs

Golf Creek 9th Ave Bridge - Project No. G1-1 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 92,644.13	$ 92,644.13
	Maintenance of Traffic	1.00	LS	$ 39,704.63	$ 39,704.63
	Temporary Erosion Control Measures	1.00	LS	$ 13,234.88	$ 13,234.88
	Activity SubTotal				$145,584
	Proposed Conveyance Improvements				
	Pavement Replacement	5,872.00	SY	$ 90.00	$ 528,480.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	2.00	EA	$ 12,070.00	$ 24,140.00
	Inlets / Manholes (>24" pipe connections)	6.00	EA	$ 15,100.00	$ 90,600.00
	Inlets / Manholes (>48" pipe connections)	3.00	EA	$ 20,868.00	$ 62,604.00
	Excavation and Disposal	739.56	CY	$ 56.00	$ 41,415.11
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	724.00	LF	$292.89	$ 212,050.15
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	524.00	LF	$514.85	$ 269,781.25
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

Golf Creek 9th Ave Bridge - Project No. G1-1
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	430.00	LF	$818.03	$ 351,751.03
	Concrete Box Culvert (12x10)	64.00	LF	$ 2,838.13	$ 181,640.02
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	1,742.00	LF	$ 31.25	$ 54,437.50
	Dewatering System Operation	6.00	Months	$ 25,846.00	$ 155,076.00
	Flow Bypass	6.00	Months	$ 100,000.00	$ 600,000.00
	Utility Conflict Allowance	1.00	LS	$ 75,000.00	$ 75,000.00
	Activity SubTotal				$2,646,975
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

Golf Creek 9th Ave Bridge - Project No. G1-1
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$2,792,559
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 418,884
	Contractor Profit			10%	$ 279,256
	Engineering / Design			15%	$ 418,884
	Class 4 Estimate Contingency			25%	$ 872,675
	Total Including Contingencies				$4,782,257
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$4,782,257

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

5th Avenue Improvements - Project No. G1-2 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 160,815.06	$ 160,815.06
	Maintenance of Traffic	1.00	LS	$ 68,920.74	$ 68,920.74
	Temporary Erosion Control Measures	1.00	LS	$ 22,973.58	$ 22,973.58
	Activity SubTotal				$252,709
	Proposed Conveyance Improvements				
	Pavement Replacement	4,957.33	SY	$ 90.00	$ 446,160.00
	Remove & Dispose of Existing Pipes	1,900.00	LF	$ 75.00	$ 142,500.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	10.00	EA	$ 20,868.00	$ 208,680.00
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

5th Avenue Improvements - Project No. G1-2
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$896.60	$ -
	84" Stormwater Pipe	1,567.00	LF	$1,900.00	$ 2,977,300.00
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	6.00	Months	$ 25,846.00	$ 155,076.00
	Flow Bypass	6.00	Months	$ 100,000.00	$ 600,000.00
	Utility Conflict Allowance	1.00	LS	$ 65,000.00	$ 65,000.00
	Activity SubTotal				$4,594,716
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -

5th Avenue Improvements - Project No. G1-2
Engineer's Opinion of Probable Construction Cost

	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$4,847,425
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 727,114
	Contractor Profit			10%	$ 484,743
	Engineering / Design			15%	$ 727,114
	Class 4 Estimate Contingency			25%	$ 1,514,820
	Total Including Contingencies				$8,301,216
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$8,301,216

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Tyrone Blvd Connection - Project No. G1-3
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 12,979.42	$ 12,979.42
	Maintenance of Traffic	1.00	LS	$ 5,562.61	$ 5,562.61
	Temporary Erosion Control Measures	1.00	LS	$ 1,854.20	$ 1,854.20
	Activity SubTotal				$20,396
	Proposed Conveyance Improvements				
	Pavement Replacement	1,280.00	SY	$ 90.00	$ 115,200.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	4.00	EA	$ 12,070.00	$ 48,280.00
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	284.44	CY	$ 56.00	$ 15,928.89
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	480.00	LF	$292.89	$ 140,585.74
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

Tyrone Blvd Connection - Project No. G1-3
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	480.00	LF	$ 31.25	$ 15,000.00
	Dewatering System Operation	1.00	Months	$ 25,846.00	$ 25,846.00
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	1.00	LS	$ 10,000.00	$ 10,000.00
	Activity SubTotal				$370,841
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

Tyrone Blvd Connection - Project No. G1-3
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$391,237
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 58,686
	Contractor Profit			10%	$ 39,124
	Engineering / Design			15%	$ 58,686
	Class 4 Estimate Contingency			25%	$ 122,262
	Total Including Contingencies				$669,993
	Property Acquisition				
	4021 Park Street North	1.00	LS	$ 32,500.00	$ 32,500.00
	3994 Tyron Blvd. N	1.00	LS	$ 22,500.00	$ 22,500.00
	Acquisition Costs (Attorney fees, surveying, recording, etc.)	1.00	LS	$ 50,000.00	$ 50,000.00
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$105,000
				Total Cost w/ Property Acquisition	$774,993

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Villagrande Avenue - Project No. G1-4 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 68,879.87	$ 68,879.87
	Maintenance of Traffic	1.00	LS	$ 29,519.94	$ 29,519.94
	Temporary Erosion Control Measures	1.00	LS	$ 9,839.98	$ 9,839.98
	Activity SubTotal				$108,240
	Proposed Conveyance Improvements				
	Pavement Replacement	4,528.00	SY	$ 90.00	$ 407,520.00
	Remove & Dispose of Existing Pipes	1,698.00	LF	$ 75.00	$ 127,350.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	11.00	EA	$ 15,100.00	$ 166,100.00
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	24.00	LF	$292.89	$ 7,029.29
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	1,674.00	LF	$514.85	$ 861,858.41
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

Villagrande Avenue - Project No. G1-4
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	1,698.00	LF	$ 31.25	$ 53,062.50
	Dewatering System Operation	6.00	Months	$ 25,846.00	$ 155,076.00
	Flow Bypass	6.00	Months	$ 25,000.00	$ 150,000.00
	Utility Conflict Allowance	1.00	LS	$ 40,000.00	$ 40,000.00
	Activity SubTotal				$1,967,996
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

Villagrande Avenue - Project No. G1-4
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$2,076,236
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 311,435
	Contractor Profit			10%	$ 207,624
	Engineering / Design			15%	$ 311,435
	Class 4 Estimate Contingency			25%	$ 648,824
	Total Including Contingencies				$3,555,554
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$3,555,554

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

22nd Avenue Alternative Outfall - Project No. G1-5 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 110,555.18	$ 110,555.18
	Maintenance of Traffic	1.00	LS	$ 47,380.79	$ 47,380.79
	Temporary Erosion Control Measures	1.00	LS	$ 15,793.60	$ 15,793.60
	Activity SubTotal				$173,730
	Proposed Conveyance Improvements				
	Pavement Replacement	3,813.33	SY	$ 90.00	$ 343,200.00
	Remove & Dispose of Existing Pipes	1,007.00	LF	$ 75.00	$ 75,525.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	2,860.00	LF	$ 49.06	$ 140,311.60
	Sidewalk Replacement	2,860.00	LF	$ 41.67	$ 119,176.20
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	1,694.81	CY	$ 56.00	$ 94,909.63
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	2,860.00	LF	$514.85	$ 1,472,470.17
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

22nd Avenue Alternative Outfall - Project No. G1-5
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	1,007.00	LF	$818.03	$ 823,751.84
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	2,860.00	LF	$ 31.25	$ 89,375.00
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				$3,158,719
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

22nd Avenue Alternative Outfall - Project No. G1-5
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$3,332,449
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 499,867
	Contractor Profit			10%	$ 333,245
	Engineering / Design			15%	$ 499,867
	Class 4 Estimate Contingency			25%	$ 1,041,390
	Total Including Contingencies				$5,706,819
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$5,706,819

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

26th Avenue North - Project No. G1-6
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 158,906.96	$ 158,906.96
	Maintenance of Traffic	1.00	LS	$ 68,102.98	$ 68,102.98
	Temporary Erosion Control Measures	1.00	LS	$ 22,700.99	$ 22,700.99
	Activity SubTotal				$249,711
	Proposed Conveyance Improvements				
	Pavement Replacement	321.33	SY	$ 90.00	$ 28,920.00
	Remove & Dispose of Existing Pipes	1,871.00	LF	$ 75.00	$ 140,325.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	241.00	LF	$ 49.06	$ 11,823.46
	Sidewalk Replacement	241.00	LF	$ 41.67	$ 10,042.47
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	142.81	CY	$ 56.00	$ 7,997.63
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	211.00	LF	$292.89	$ 61,799.15
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	30.00	LF	$514.85	$ 15,445.49
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

26th Avenue North - Project No. G1-6
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	8'x5' Concrete Box Culvert (list size from calc tab)	1,630.00	LF	$ 2,611.24	$ 4,256,314.29
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	241.00	LF	$ 31.25	$ 7,531.25
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				$4,540,199
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

26th Avenue North - Project No. G1-6
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$4,789,910
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 718,486
	Contractor Profit			10%	$ 478,991
	Engineering / Design			15%	$ 718,486
	Class 4 Estimate Contingency			25%	$ 1,496,847
	Total Including Contingencies				$8,202,720
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$8,202,720

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Grevilla Avenue - Project No. G1-7
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 46,232.00	$ 46,232.00
	Maintenance of Traffic	1.00	LS	$ 19,813.72	$ 19,813.72
	Temporary Erosion Control Measures	1.00	LS	$ 6,604.57	$ 6,604.57
	Activity SubTotal				$72,650
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	578.00	LF	$ 75.00	$ 43,350.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

Grevilla Avenue - Project No. G1-7
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	6'x5' Concrete Box Culvert (list size from calc tab)	578.00	LF	$ 2,210.32	$ 1,277,564.41
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				$1,320,914
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

Grevilla Avenue - Project No. G1-7
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$1,393,565
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 209,035
	Contractor Profit			10%	$ 139,356
	Engineering / Design			15%	$ 209,035
	Class 4 Estimate Contingency			25%	$ 435,489
	Total Including Contingencies				$2,386,480
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$2,386,480

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Eagle Lake Outfall - Project No. G1-8
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 418,361.42	$ 418,361.42
	Maintenance of Traffic	1.00	LS	$ 179,297.75	$ 179,297.75
	Temporary Erosion Control Measures	1.00	LS	$ 59,765.92	$ 59,765.92
	Activity SubTotal				$657,425
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	2,632.00	LF	$ 75.00	$ 197,400.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

Eagle Lake Outfall - Project No. G1-8
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	8'x5' Concrete Box Culvert (list size from calc tab)	4,502.00	LF	$ 2,611.24	$ 11,755,783.40
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				$11,953,183
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

Eagle Lake Outfall - Project No. G1-8
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$12,610,608
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 1,891,591
	Contractor Profit			10%	$ 1,261,061
	Engineering / Design			15%	$ 1,891,591
	Class 4 Estimate Contingency			25%	$ 3,940,815
	Total Including Contingencies				$21,595,667
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$21,595,667

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Crescent Lake 22nd Ave Bypass - Project No. G2-1
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 77,876.04	$ 77,876.04
	Maintenance of Traffic	1.00	LS	$ 33,375.45	$ 33,375.45
	Temporary Erosion Control Measures	1.00	LS	$ 11,125.15	$ 11,125.15
	Activity SubTotal				$122,377
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

Crescent Lake 22nd Ave Bypass - Project No. G2-1
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	2,720.00	LF	$818.03	$ 2,225,029.80
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				$2,225,030
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

Crescent Lake 22nd Ave Bypass - Project No. G2-1
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$2,347,406
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 352,111
	Contractor Profit			10%	$ 234,741
	Engineering / Design			15%	$ 352,111
	Class 4 Estimate Contingency			25%	$ 733,565
	Total Including Contingencies				$4,019,934
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$4,019,934

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Round Lake - Project No. G2-2 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 19,984.31	$ 19,984.31
	Maintenance of Traffic	1.00	LS	$ 8,564.71	$ 8,564.71
	Temporary Erosion Control Measures	1.00	LS	$ 2,854.90	$ 2,854.90
	Activity SubTotal				$31,404
	Proposed Conveyance Improvements				
	Pavement Replacement	1,024.00	SY	$ 90.00	$ 92,160.00
	Remove & Dispose of Existing Pipes	384.00	LF	$ 75.00	$ 28,800.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	2.00	EA	$ 12,070.00	$ 24,140.00
	Inlets / Manholes (>24" pipe connections)	2.00	EA	$ 15,100.00	$ 30,200.00
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	227.56	CY	$ 56.00	$ 12,743.11
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	81.00	LF	$168.12	$ 13,617.74
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	24.00	LF	$276.90	$ 6,645.70
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	279.00	LF	$384.55	$ 107,289.86
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

Round Lake - Project No. G2-2
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	384.00	LF	$ 31.25	$ 12,000.00
	Dewatering System Operation	4.00	Months	$ 25,846.00	$ 103,384.00
	Flow Bypass	4.00	Months	$ 25,000.00	$ 100,000.00
	Utility Conflict Allowance	1.00	LS	$ 40,000.00	$ 40,000.00
	Activity SubTotal				$570,980
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

Round Lake - Project No. G2-2
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$602,384
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 90,358
	Contractor Profit			10%	$ 60,238
	Engineering / Design			15%	$ 90,358
	Class 4 Estimate Contingency			25%	$ 188,245
	Total Including Contingencies				$1,031,583
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$1,031,583

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

1st Street SE - Project No. G2-3 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 120,965.69	$ 120,965.69
	Maintenance of Traffic	1.00	LS	$ 51,842.44	$ 51,842.44
	Temporary Erosion Control Measures	1.00	LS	$ 17,280.81	$ 17,280.81
	Activity SubTotal				$190,089
	Proposed Conveyance Improvements				
	Pavement Replacement	78.67	SY	$ 90.00	$ 7,080.00
	Remove & Dispose of Existing Pipes	606.00	LF	$ 75.00	$ 45,450.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	59.00	LF	$ 49.06	$ 2,894.54
	Sidewalk Replacement	59.00	LF	$ 41.67	$ 2,458.53
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	34.96	CY	$ 56.00	$ 1,957.93
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	59.00	LF	$514.85	$ 30,376.13
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

1st Street SE - Project No. G2-3
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	8'x8' Concrete Box Culvert (list size from calc tab)	415.00	LF	$ 3,329.34	$ 1,381,674.34
	12'x8' Concrete Box Culvert (list size from calc tab)	472.00	LF	$ 4,200.06	$ 1,982,427.42
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	59.00	LF	$ 31.25	$ 1,843.75
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				$3,456,163
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -

1st Street SE - Project No. G2-3
Engineer's Opinion of Probable Construction Cost

	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$3,646,252
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 546,938
	Contractor Profit			10%	$ 364,625
	Engineering / Design			15%	$ 546,938
	Class 4 Estimate Contingency			25%	$ 1,139,454
	Total Including Contingencies				$6,244,206
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$6,244,206

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

2nd Avenue North, Mirror Lake - Project No. G2-4
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 37,916.04	$ 37,916.04
	Maintenance of Traffic	1.00	LS	$ 16,249.73	$ 16,249.73
	Temporary Erosion Control Measures	1.00	LS	$ 5,416.58	$ 5,416.58
	Activity SubTotal				$59,582
	Proposed Conveyance Improvements				
	Pavement Replacement	1,530.67	SY	$ 90.00	$ 137,760.00
	Remove & Dispose of Existing Pipes	1,265.00	LF	$ 75.00	$ 94,875.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	1,148.00	LF	$ 49.06	$ 56,320.88
	Sidewalk Replacement	1,148.00	LF	$ 41.67	$ 47,837.16
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	680.30	CY	$ 56.00	$ 38,096.59
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	64.00	LF	$292.89	$ 18,744.76
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	1,084.00	LF	$514.85	$ 558,097.08
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

2nd Avenue North, Mirror Lake - Project No. G2-4
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	117.00	LF	$818.03	$ 95,709.00
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 3,150.74	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	1,148.00	LF	$ 31.25	$ 35,875.00
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				$1,083,315
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

2nd Avenue North, Mirror Lake - Project No. G2-4
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$1,142,898
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 171,435
	Contractor Profit			10%	$ 114,290
	Engineering / Design			15%	$ 171,435
	Class 4 Estimate Contingency			25%	$ 357,156
	Total Including Contingencies				$1,957,213
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$1,957,213

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Crescent Lake Drawdown - Project No. G2-5 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ -	$ -
	Maintenance of Traffic	1.00	LS	$ -	$ -
	Temporary Erosion Control Measures	1.00	LS	$ -	$ -
	Activity SubTotal				$0
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

Crescent Lake Drawdown - Project No. G2-5
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				$0
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

Crescent Lake Drawdown - Project No. G2-5
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$0
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ -
	Contractor Profit			10%	$ -
	Engineering / Design			15%	$ -
	Class 4 Estimate Contingency			25%	$ -
	Total Including Contingencies				$0
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$0

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Booker Creek Box Culvert Reroute - Project No. G3-1 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 425,434.66	$ 425,434.66
	Maintenance of Traffic	1.00	LS	$ 182,329.14	$ 182,329.14
	Temporary Erosion Control Measures	1.00	LS	$ 60,776.38	$ 60,776.38
	Activity SubTotal				$668,540
	Proposed Conveyance Improvements				
	Pavement Replacement	626.67	SY	$ 90.00	$ 56,400.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	470.00	LF	$ 49.06	$ 23,058.20
	Sidewalk Replacement	470.00	LF	$ 41.67	$ 19,584.90
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	278.52	CY	$ 56.00	$ 15,597.04
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	470.00	LF	$292.89	$ 137,656.87
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

Booker Creek Box Culvert Reroute - Project No. G3-1
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (list size from calc tab)	1,625.00	LF	$ 7,315.87	$ 11,888,291.55
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	470.00	LF	$ 31.25	$ 14,687.50
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				$12,155,276
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

Booker Creek Box Culvert Reroute - Project No. G3-1
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$12,823,816
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 1,923,572
	Contractor Profit			10%	$ 1,282,382
	Engineering / Design			15%	$ 1,923,572
	Class 4 Estimate Contingency			25%	$ 4,007,443
	Total Including Contingencies				$21,960,785
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$21,960,785

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Booker Creek Rail Easement Bypass - Project No. G3-2
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 397,423.47	$ 397,423.47
	Maintenance of Traffic	1.00	LS	$ 170,324.34	$ 170,324.34
	Temporary Erosion Control Measures	1.00	LS	$ 56,774.78	$ 56,774.78
	Activity SubTotal				$624,523
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	1,146.30	CY	$ 56.00	$ 64,192.59
	Steel Sheet Piling Walls, 12' Height, 1/2" Thickness	4,420.00	LF	$622.30	$ 2,750,566.00
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -

Booker Creek Rail Easement Bypass - Project No. G3-2
Engineer's Opinion of Probable Construction Cost

	48" Elliptical Pipe	-	LF	$ 808.94	$ -
	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	72" Stormwater Pipe	690.00	LF	$1,000.00	$ 690,000.00
	Concrete Box Culvert (12'x10')	1,665.00	LF	$ 3,337.02	$ 5,556,135.42
	Concrete Box Culvert (10'x8')	855.00	LF	$ 2,683.11	$ 2,294,062.14
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				$11,354,956
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -

Booker Creek Rail Easement Bypass - Project No. G3-2
Engineer's Opinion of Probable Construction Cost

	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$11,979,479
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 1,796,922
	Contractor Profit			10%	$ 1,197,948
	Engineering / Design			15%	$ 1,796,922
	Class 4 Estimate Contingency			25%	$ 3,743,587
	Total Including Contingencies				$20,514,857
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$20,514,857

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Lake Maggiore East Outfall - Project No. G3-5
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 207,667.56	$ 207,667.56
	Maintenance of Traffic	1.00	LS	$ 89,000.38	$ 89,000.38
	Temporary Erosion Control Measures	1.00	LS	$ 29,666.79	$ 29,666.79
	Activity SubTotal				$326,335
	Proposed Conveyance Improvements				
	Pavement Replacement	6,720.00	SY	$ 90.00	$ 604,800.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	13.00	EA	$ 12,070.00	$ 156,910.00
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -
	54" Stormwater Pipe	-	LF	$747.16	$ -

Lake Maggiore East Outfall - Project No. G3-5
Engineer's Opinion of Probable Construction Cost

	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (list size from calc tab)	2,520.00	LF	$ 1,869.91	$ 4,712,179.51
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	2.00	EA	$ 38,042.67	$ 76,085.34
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	2.00	Months	$ 25,846.00	$ 51,692.00
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	2.00	LS	$ 25,000.00	$ 50,000.00
	Activity SubTotal				$5,651,667
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	2.00	Months	$ 25,846.00	$ 51,692.00
	Seawall Outfall Structure	2.00	EA	$ 62,500.00	$ 125,000.00
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	500.00	Ton	$ 210.00	$ 105,000.00
	Activity SubTotal				$281,692
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -

Lake Maggiore East Outfall - Project No. G3-5
Engineer's Opinion of Probable Construction Cost

	Activity SubTotal				$0
	Overall Subtotal				$6,259,694
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 938,954
	Contractor Profit			10%	$ 625,969
	Engineering / Design			15%	$ 938,954
	Class 4 Estimate Contingency			25%	$ 1,956,154
	Total Including Contingencies				$10,719,725
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$10,719,725

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Emerald Lake Outfall into Booker Pond - Project No. G3-6
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 11,179.42	$ 11,179.42
	Maintenance of Traffic	1.00	LS	$ 4,791.18	$ 4,791.18
	Temporary Erosion Control Measures	1.00	LS	$ 1,597.06	$ 1,597.06
	Activity SubTotal				$17,568
	Proposed Conveyance Improvements				
	Pavement Replacement	120.00	SY	$ 90.00	$ 10,800.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	2.00	EA	$ 12,070.00	$ 24,140.00
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -
	54" Stormwater Pipe	-	LF	$747.16	$ -

Emerald Lake Outfall into Booker Pond - Project No. G3-6
Engineer's Opinion of Probable Construction Cost

	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (10x8)	45.00	LF	$ 2,284.00	$ 102,779.97
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	2.00	Months	$ 25,846.00	$ 51,692.00
	Flow Bypass	2.00	Months	$ 60,000.00	$ 120,000.00
	Utility Conflict Allowance	1.00	LS	$ 10,000.00	$ 10,000.00
	Activity SubTotal				$319,412
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0

Emerald Lake Outfall into Booker Pond - Project No. G3-6
Engineer's Opinion of Probable Construction Cost

	Overall Subtotal				$336,980
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 50,547
	Contractor Profit			10%	$ 33,698
	Engineering / Design			15%	$ 50,547
	Class 4 Estimate Contingency			25%	$ 105,306
	Total Including Contingencies				$577,078
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$577,078

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

2nd Avenue Bypass Pipe - Project No. G3-7
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 120,067.47	$ 120,067.47
	Maintenance of Traffic	1.00	LS	$ 51,457.49	$ 51,457.49
	Temporary Erosion Control Measures	1.00	LS	$ 17,152.50	$ 17,152.50
	Activity SubTotal				$188,677
	Proposed Conveyance Improvements				
	Pavement Replacement	2,277.33	SY	$ 90.00	$ 204,960.00
	Remove & Dispose of Existing Pipes	131.00	LF	$ 75.00	$ 9,825.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	4.00	EA	$ 12,070.00	$ 48,280.00
	Inlets / Manholes (>24" pipe connections)	4.00	EA	$ 15,100.00	$ 60,400.00
	Inlets / Manholes (>48" pipe connections)	3.00	EA	$ 20,868.00	$ 62,604.00
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	72" Stormwater Pipe	64.00	LF	$1,090.00	$ 69,760.00
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

2nd Avenue Bypass Pipe - Project No. G3-7
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	72" Stormwater Pipe	-	LF	$981.63	$ -
	Concrete Box Culvert (10x8)	790.00	LF	$ 2,284.00	$ 1,804,359.40
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	1.00	EA	$ 38,042.67	$ 38,042.67
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	64.00	LF	$ 31.25	$ 2,000.00
	Dewatering System Operation	6.00	Months	$ 25,846.00	$ 155,076.00
	Flow Bypass	6.00	Months	$ 100,000.00	$ 600,000.00
	Utility Conflict Allowance	1.00	LS	$ 250,000.00	$ 250,000.00
	Activity SubTotal				$3,305,307
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	2.00	Months	$ 25,846.00	$ 51,692.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	350.00	Ton	$ 210.00	$ 73,500.00
	Activity SubTotal				$125,192
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -

2nd Avenue Bypass Pipe - Project No. G3-7
Engineer's Opinion of Probable Construction Cost

	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$3,619,177
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 542,876
	Contractor Profit			10%	$ 361,918
	Engineering / Design			15%	$ 542,876
	Class 4 Estimate Contingency			25%	$ 1,130,993
	Total Including Contingencies				$6,197,840
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$6,197,840

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Campbell Park Creek Widening - Project No. G3-8 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 42,951.22	$ 42,951.22
	Maintenance of Traffic	1.00	LS	$ 18,407.67	$ 18,407.67
	Temporary Erosion Control Measures	1.00	LS	$ 6,135.89	$ 6,135.89
	Activity SubTotal				$67,495
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	21,913.89	CY	$ 56.00	$ 1,227,177.78
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

Campbell Park Creek Widening - Project No. G3-8
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				$1,227,178
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

Campbell Park Creek Widening - Project No. G3-8
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$1,294,673
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 194,201
	Contractor Profit			10%	$ 129,467
	Engineering / Design			15%	$ 194,201
	Class 4 Estimate Contingency			25%	$ 404,585
	Total Including Contingencies				$2,217,127
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$2,217,127

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

49th St Connection Pipes - Project No. G3-9
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 42,081.90	$ 42,081.90
	Maintenance of Traffic	1.00	LS	$ 18,035.10	$ 18,035.10
	Temporary Erosion Control Measures	1.00	LS	$ 6,011.70	$ 6,011.70
	Activity SubTotal				$66,129
	Proposed Conveyance Improvements				
	Pavement Replacement	1,560.00	SY	$ 90.00	$ 140,400.00
	Remove & Dispose of Existing Pipes	50.00	LF	$ 75.00	$ 3,750.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	620.00	LF	$ 49.06	$ 30,417.20
	Sidewalk Replacement	620.00	LF	$ 41.67	$ 25,835.40
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	5.00	EA	$ 12,070.00	$ 60,350.00
	Inlets / Manholes (>24" pipe connections)	1.00	EA	$ 15,100.00	$ 15,100.00
	Inlets / Manholes (>48" pipe connections)	2.00	EA	$ 20,868.00	$ 41,736.00
	Excavation and Disposal	693.33	CY	$ 56.00	$ 38,826.67
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	550.00	LF	$194.13	$ 106,771.50
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	620.00	LF	$514.85	$ 319,206.82
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

49th St Connection Pipes - Project No. G3-9
Engineer's Opinion of Probable Construction Cost

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	1,170.00	LF	$ 31.25	$ 36,562.50
	Dewatering System Operation	4.00	Months	$ 25,846.00	$ 103,384.00
	Flow Bypass	4.00	Months	$ 60,000.00	$ 240,000.00
	Utility Conflict Allowance	1.00	LS	$ 40,000.00	$ 40,000.00
	Activity SubTotal				$1,202,340
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

49th St Connection Pipes - Project No. G3-9
Engineer's Opinion of Probable Construction Cost

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$1,268,469
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 190,270
	Contractor Profit			10%	$ 126,847
	Engineering / Design			15%	$ 190,270
	Class 4 Estimate Contingency			25%	$ 396,396
	Total Including Contingencies				$2,172,253
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$2,172,253

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Lake Maggiore West Outfall - Project No. G3-10
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 607,819.30	$ 607,819.30
	Maintenance of Traffic	1.00	LS	$ 260,493.98	$ 260,493.98
	Temporary Erosion Control Measures	1.00	LS	$ 86,831.33	$ 86,831.33
	Activity SubTotal				**$955,145**
	Proposed Conveyance Improvements				
	Pavement Replacement	10,666.67	SY	$ 90.00	$ 960,000.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	21.00	EA	$ 12,070.00	$ 253,470.00
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	36,296	CY	$ 56.00	$ 2,032,592.59
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (12x10)	4,000.00	LF	$ 3,337.02	$ 13,348,073.08
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	2.00	EA	$ 38,042.67	$ 76,085.34
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	5,500.00	LF	$ 31.25	$ 171,875.00
	Dewatering System Operation	6.00	Months	$ 25,846.00	$ 155,076.00
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	1.00	LS	$ 150,000.00	$ 150,000.00
	Activity SubTotal				**$17,147,172**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	2.00	Months	$ 25,846.00	$ 51,692.00
	Weir	1.00	LS	$ 37,401.57	$ 37,401.57
	Baffle	1.00	EA	$ 25,000.00	$ 25,000.00
	Rip-Rap	500.00	Ton	$ 210.00	$ 105,000.00
	Activity SubTotal				**$219,094**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**

	Overall Subtotal				**$18,321,410**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 2,748,212
	Contractor Profit			10%	$ 1,832,141
	Engineering / Design			15%	$ 2,748,212
	Class 4 Estimate Contingency			25%	$ 5,725,441
	Total Including Contingencies				**$31,375,415**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$31,375,415**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	Childs Park Pond Sump Removal - Project No. G3-11 Engineer's Opinion of Probable Construction Cost				
	General Construction Measures				
	Mobilization	1.00	LS	$ 4,055.47	$ 4,055.47
	Maintenance of Traffic	1.00	LS	$ 1,738.06	$ 1,738.06
	Temporary Erosion Control Measures	1.00	LS	$ 579.35	$ 579.35
	Activity SubTotal				**$6,373**
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose Weir at the end of CBC (75' width, 6' height)	450.00	SF	$ 75.00	$ 33,750.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				**$33,750**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	1,350.00	SF	$ 60.83	$ 82,120.50
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$82,121**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**

	Overall Subtotal				**$122,243**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 18,337
	Contractor Profit			10%	$ 12,224
	Engineering / Design			15%	$ 18,337
	Class 4 Estimate Contingency			25%	$ 38,201
	Total Including Contingencies				**$209,342**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$209,342**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

15th Ave & 44th St - Project No. G3-12
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 24,721.25	$ 24,721.25
	Maintenance of Traffic	1.00	LS	$ 10,594.82	$ 10,594.82
	Temporary Erosion Control Measures	1.00	LS	$ 3,531.61	$ 3,531.61
	Activity SubTotal				**$38,848**
	Proposed Conveyance Improvements				
	Pavement Replacement	544.00	SY	$ 90.00	$ 48,960.00
	Remove & Dispose of Existing Pipes	176.00	LF	$ 75.00	$ 13,200.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	408.00	LF	$ 49.06	$ 20,016.48
	Sidewalk Replacement	408.00	LF	$ 41.67	$ 17,001.36
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	241.78	CY	$ 56.00	$ 13,539.56
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	408.00	LF	$514.85	$ 210,058.68
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	8'x5' Concrete Box Culvert (list size from calc tab)	142.00	LF	$ 2,611.24	$ 370,795.48
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	408.00	LF	$ 31.25	$ 12,750.00
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				**$706,322**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$0**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**

	Overall Subtotal				**$745,169**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 111,775
	Contractor Profit			10%	$ 74,517
	Engineering / Design			15%	$ 111,775
	Class 4 Estimate Contingency			25%	$ 232,865
	Total Including Contingencies				**$1,276,102**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$1,276,102**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

26th Ave South - Project G3-13
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 59,155.00	$ 59,155.00
	Maintenance of Traffic	1.00	LS	$ 25,352.14	$ 25,352.14
	Temporary Erosion Control Measures	1.00	LS	$ 8,450.71	$ 8,450.71
	Activity SubTotal				**$92,958**
	Proposed Conveyance Improvements				
	Pavement Replacement	770.67	SY	$ 90.00	$ 69,360.00
	Remove & Dispose of Existing Pipes	954.00	LF	$ 75.00	$ 71,550.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	534.00	LF	$ 49.06	$ 26,198.04
	Sidewalk Replacement	534.00	LF	$ 41.67	$ 22,251.78
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	342.52	CY	$ 56.00	$ 19,181.04
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	44.00	LF	$194.13	$ 8,541.72
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	534.00	LF	$514.85	$ 274,929.74
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	662.00	LF	$818.03	$ 541,532.99
	8'x6' Concrete Box Culvert (list size from calc tab)	224.00	LF	$ 2,850.60	$ 638,534.94
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	578.00	LF	$ 31.25	$ 18,062.50
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				**$1,690,143**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$0**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**

	Overall Subtotal				**$1,783,101**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 267,465
	Contractor Profit			10%	$ 178,310
	Engineering / Design			15%	$ 267,465
	Class 4 Estimate Contingency			25%	$ 557,219
	Total Including Contingencies				**$3,053,560**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$3,053,560**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

17th Ave S - Project No. G3-14
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 812,450.31	$ 812,450.31
	Maintenance of Traffic	1.00	LS	$ 348,192.99	$ 348,192.99
	Temporary Erosion Control Measures	1.00	LS	$ 116,064.33	$ 116,064.33
	Activity SubTotal				**$1,276,708**
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	5,007.00	LF	$ 75.00	$ 375,525.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	12'x8' Concrete Box Culvert (list size from calc tab)	3,271.00	LF	$ 4,200.06	$ 13,738,390.01
	10'x8' Concrete Box Culvert (list size from calc tab)	689.00	LF	$ 3,764.70	$ 2,593,876.18
	8'x6' Concrete Box Culvert (list size from calc tab)	2,282.00	LF	$ 2,850.60	$ 6,505,074.74
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				**$23,212,866**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$0**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -

	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**
	Overall Subtotal				**$24,489,574**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 3,673,436
	Contractor Profit			10%	$ 2,448,957
	Engineering / Design			15%	$ 3,673,436
	Class 4 Estimate Contingency			25%	$ 7,652,992
	Total Including Contingencies				**$41,938,395**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$41,938,395**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Emerald Lake Add Pump - Project No. G3-15
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 7,413.01	$ 7,413.01
	Maintenance of Traffic	1.00	LS	$ 3,177.00	$ 3,177.00
	Temporary Erosion Control Measures	1.00	LS	$ 1,059.00	$ 1,059.00
	Activity SubTotal				**$11,649**
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	86.00	LF	$ 75.00	$ 6,450.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	1.00	EA	$ 135,000.00	$ 135,000.00
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	86.00	LF	$818.03	$ 70,350.21
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				**$211,800**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$0**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	1.00	LS	$ 941,000.00	$ 941,000.00
	Pump Station	1.00	LS	$ 7,076,000.00	$ 7,076,000.00
	Electrical, Instrumentation & Controls	1.00	LS	$ 2,900,000.00	$ 2,900,000.00
	Landscaping / Screening and Aethetics Allowance	1.00	LS	$ 250,000.00	$ 250,000.00
	Activity SubTotal				**$11,167,000**

	Overall Subtotal				**$11,390,449**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 1,708,567
	Contractor Profit			10%	$ 1,139,045
	Engineering / Design			15%	$ 1,708,567
	Class 4 Estimate Contingency			25%	$ 3,559,515
	Total Including Contingencies				**$19,506,144**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$19,506,144**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

34th Street Improvements - Project No. G3-16 Engineer's Opinion of Probable Construction Cost					
Line Item	**Activity**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
	General Construction Measures				
	Mobilization	1.00	LS	$ 12,452.17	$ 12,452.17
	Maintenance of Traffic	1.00	LS	$ 5,336.64	$ 5,336.64
	Temporary Erosion Control Measures	1.00	LS	$ 1,778.88	$ 1,778.88
	Activity SubTotal				**$19,568**
	Proposed Conveyance Improvements				
	Pavement Replacement	480.00	SY	$ 90.00	$ 43,200.00
	Remove & Dispose of Existing Pipes	120.00	LF	$ 75.00	$ 9,000.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	2.00	EA	$ 20,868.00	$ 41,736.00
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (8x10)	60.00	LF	$ 3,318.65	$ 199,119.28
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	60.00	LF	$ 31.25	$ 1,875.00
	Dewatering System Operation	1.00	Months	$ 25,846.00	$ 25,846.00
	Flow Bypass	1.00	Months	$ 25,000.00	$ 25,000.00
	Utility Conflict Allowance	1.00	LS	$ 10,000.00	$ 10,000.00
	Activity SubTotal				**$355,776**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$0**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**

	Overall Subtotal				**$375,344**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 56,302
	Contractor Profit			10%	$ 37,534
	Engineering / Design			15%	$ 56,302
	Class 4 Estimate Contingency			25%	$ 117,295
	Total Including Contingencies				**$642,777**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$642,777**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

34th Street Bypass - Project No. G3-17
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 240,036.51	$ 240,036.51
	Maintenance of Traffic	1.00	LS	$ 102,872.79	$ 102,872.79
	Temporary Erosion Control Measures	1.00	LS	$ 34,290.93	$ 34,290.93
	Activity SubTotal				**$377,200**
	Proposed Conveyance Improvements				
	Pavement Replacement	14,709.33	SY	$ 90.00	$ 1,323,840.00
	Remove & Dispose of Existing Pipes	1,818.00	LF	$ 75.00	$ 136,350.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	13.00	EA	$ 12,070.00	$ 156,910.00
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	8.00	EA	$ 20,868.00	$ 166,944.00
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	60" Stormwater Pipe	1,504.00	LF	$981.63	$ 1,476,371.52
	72" Stormwater Pipe	420.00	LF	$ 1,214.99	$ 510,295.80
	84" Stormwater Pipe	1,774.00	LF	$1,446.92	$ 2,566,836.08
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	3,698.00	LF	$ 31.25	$ 115,562.50
	Dewatering System Operation	6.00	Months	$ 25,846.00	$ 155,076.00
	Flow Bypass	6.00	Months	$ 25,000.00	$ 150,000.00
	Utility Conflict Allowance	4.00	LS	$ 25,000.00	$ 100,000.00
	Activity SubTotal				**$6,858,186**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$0**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**

	Overall Subtotal				**$7,235,386**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 1,085,308
	Contractor Profit			10%	$ 723,539
	Engineering / Design			15%	$ 1,085,308
	Class 4 Estimate Contingency			25%	$ 2,261,058
	Total Including Contingencies				**$12,390,599**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$12,390,599**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
58th Street N and Burlington Avenue- Project No. G4-1 Engineer's Opinion of Probable Construction Cost					
	General Construction Measures				
	Mobilization	1.00	LS	$ 313,215.90	$ 313,215.90
	Maintenance of Traffic	1.00	LS	$ 134,235.38	$ 134,235.38
	Temporary Erosion Control Measures	1.00	LS	$ 44,745.13	$ 44,745.13
	Activity SubTotal				**$492,196**
	Proposed Conveyance Improvements				
	Pavement Replacement	12,996.00	SY	$ 90.00	$ 1,169,640.00
	Remove & Dispose of Existing Pipes	3,019.00	LF	$ 75.00	$ 226,425.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	7.00	EA	$ 92,500.00	$ 647,500.00
	Concrete curb and gutter	3,594.00	LF	$ 49.06	$ 176,321.64
	Sidewalk Replacement	320.00	LF	$ 41.67	$ 13,334.40
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	1,071.00	CY	$ 56.00	$ 59,976.00
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	51.00	LF	$168.12	$ 8,574.14
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	6,972.00	LF	$ 403.22	$ 2,811,243.04
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	1,284.00	LF	$514.85	$ 661,067.03
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	66"Stormwater pipe	-	LF	$575.00	$ -
	84"Stormwater pipe	-	LF	$2,900.00	$ -
	Concrete Box Culvert (list size from calc tab)(4x8)	1,920.00	LF	$ 1,476.91	$ 2,835,676.42
	Concrete Box Culvert (list size from calc tab)(5x12)	-	LF		$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	12.00	EA	$ 10,000.00	$ 120,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	400.00	LF	$ 31.25	$ 12,500.00
	Dewatering System Operation	4.00	Months	$ 25,846.00	$ 103,384.00
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				**$8,845,642**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	4.00	Months	$ 25,846.00	$ 103,384.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$103,384**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -

	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**
	Overall Subtotal				**$9,441,222**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 1,416,183
	Contractor Proffit			10%	$ 944,122
	Engineering / Design			15%	$ 1,416,183
	Class 4 Estimate Contingency			25%	$ 2,950,382
	Total Including Contingencies				**$16,168,093**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$16,168,093**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

60th Street South – Project No. G4-2 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 36,967.44	$ 36,967.44
	Maintenance of Traffic	1.00	LS	$ 15,843.19	$ 15,843.19
	Temporary Erosion Control Measures	1.00	LS	$ 5,281.06	$ 5,281.06
	Activity SubTotal				**$58,092**
	Proposed Conveyance Improvements				
	Pavement Replacement	1,893.59	SY	$ 90.00	$ 170,423.10
	Remove & Dispose of Existing Pipes	1,320.00	LF	$ 75.00	$ 99,000.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	682.00	LF	$ 49.06	$ 33,458.92
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	668.00	CY	$ 56.00	$ 37,408.00
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	81.00	LF	$194.13	$ 15,724.53
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	410.00	LF	$276.90	$ 113,530.65
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	829.00	LF	$292.89	$ 242,803.28
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	66"Stormwater pipe	-	LF	$575.00	$ -
	84"Stormwater pipe	-	LF	$2,900.00	$ -
	Concrete Box Culvert (list size from calc tab)(4x12)	-	LF	$ 2,137.95	$ -
	Concrete Box Culvert (list size from calc tab)(Twin 4x12)	-	LF		
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	1,320.00	LF	$ 31.25	$ 41,250.00
	Dewatering System Operation	9.00	Months	$ 25,846.00	$ 232,614.00
	Flow Bypass	-	Months	$ 25,846.00	$ -
	Utility Conflict Allowance	7.00	LS	$ 10,000.00	$ 70,000.00
	Activity SubTotal				**$1,056,212**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work		SF	$ 60.83	$ -
	Dewatering Measures at Outfall		Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap		Ton	$ 210.00	$ -
	Activity SubTotal				**$0**
	Pump Station Improvement				
	Piping, Valves, Fittings	2.00	LS	$ 1,560,000.00	$ 3,120,000.00
	Generator System	2.00	LS	$ 941,000.00	$ 1,882,000.00
	Pump Station	4.00	LS	$ 7,076,000.00	$ 28,304,000.00

	Electrical, Instrumentation & Controls	2.00	LS	$ 2,900,000.00	$ 5,800,000.00
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$39,106,000**
	Overall Subtotal				**$40,220,304**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 6,033,046
	Contractor Proffit			10%	$ 4,022,030
	Engineering / Design			15%	$ 6,033,046
	Class 4 Estimate Contingency			25%	$ 12,568,845
	Total Including Contingencies				**$68,877,271**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$68,877,271**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

5th Avenue North - Project No. G4-3 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 958,144.54	$ 958,144.54
	Maintenance of Traffic	1.00	LS	$ 410,633.38	$ 410,633.38
	Temporary Erosion Control Measures	1.00	LS	$ 136,877.79	$ 136,877.79
	Activity SubTotal				**$1,505,656**
	Proposed Conveyance Improvements				
	Pavement Replacement	4,932.00	SY	$ 90.00	$ 443,880.00
	Remove & Dispose of Existing Pipes	7,159.00	LF	$ 75.00	$ 536,925.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	1.00	EA	$ 92,500.00	$ 92,500.00
	Concrete curb and gutter	2,110.00	LF	$ 49.06	$ 103,516.60
	Sidewalk Replacement	500.00	LF	$ 41.67	$ 20,835.00
	Driveway Replacement	24.00	EA	$ 10,035.50	$ 240,852.00
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	11.00	EA	$ 15,100.00	$ 166,100.00
	Inlets / Manholes (>48" pipe connections)	5.00	EA	$ 20,868.00	$ 104,340.00
	Excavation and Disposal	64.00	CY	$ 56.00	$ 3,584.00
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	39.00	LF	$168.12	$ 6,556.69
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	190.00	LF	$194.13	$ 36,884.70
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	10.00	LF	$276.90	$ 2,769.04
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	883.00	LF	$292.89	$ 258,619.18
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	135.00	LF	$384.55	$ 51,914.45
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	1,227.00	LF	$514.85	$ 631,720.59
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	236.00	LF	$818.03	$ 193,054.06
	72" Stormwater Pipe	979.00	LF	$945.00	$ 925,155.00
	Concrete Box Culvert 1 (list size from calc tab) 6x10	10,000.00	LF	$ 1,992.71	$ 19,927,103.56
	Concrete Box Culvert 2 (list size from calc tab) 4x10	20.00	LF	$ 1,701.42	$ 34,028.43
	Concrete Box Culvert 3 (list size from calc tab) 6x6	433.00	LF	$ 1,501.52	$ 650,157.71
	Concrete Box Culvert 4 (list size from calc tab) 4x4	1,486.00	LF	$ 990.50	$ 1,471,877.93
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	1.00	EA	$ 38,042.67	$ 38,042.67
	Pipe Connections	20.00	EA	$ 10,000.00	$ 200,000.00
	Bedding Stone	100.00	CY	$ 210.00	$ 21,000.00
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	2,484.00	LF	$ 31.25	$ 77,625.00
	Dewatering System Operation	12.00	Months	$ 25,846.00	$ 310,152.00
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	70.00	LS	$ 10,000.00	$ 700,000.00
	Activity SubTotal				**$27,249,194**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	625.00	SF	$ 60.83	$ 38,018.75
	Dewatering Measures at Outfall	1.00	Months	$ 25,846.00	$ 25,846.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	1.00	EA	$ 62,500.00	$ 62,500.00
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	30.00	Ton	$ 210.00	$ 6,300.00
	Activity SubTotal				**$126,365**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -

	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**
	Overall Subtotal				**$28,881,214**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 4,332,182
	Contractor Proffit			10%	$ 2,888,121
	Engineering / Design			15%	$ 4,332,182
	Class 4 Estimate Contingency			25%	$ 9,025,379
	Total Including Contingencies				**$49,459,079**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$49,459,079**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

22nd Ave and 43rd St – Project No. G4-4
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 405,940.07	$ 405,940.07
	Maintenance of Traffic	1.00	LS	$ 173,974.32	$ 173,974.32
	Temporary Erosion Control Measures	1.00	LS	$ 57,991.44	$ 57,991.44
	Activity SubTotal				**$637,906**
	Proposed Conveyance Improvements				
	Pavement Replacement	8,611.87	SY	$ 90.00	$ 775,068.00
	Remove & Dispose of Existing Pipes	6,458.90	LF	$ 75.00	$ 484,417.50
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	6,458.90	LF	$ 49.06	$ 316,873.63
	Sidewalk Replacement		LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	36.00	EA	$ 15,100.00	$ 543,600.00
	Inlets / Manholes (>48" pipe connections)	8.00	EA	$ 20,868.00	$ 166,944.00
	Excavation and Disposal	70,180.00	CY	$ 56.00	$ 3,930,080.00
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe		LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe		LF	$276.90	$ -
	30" Elliptical Pipe	1,453.30	LF	$ 310.14	$ 450,722.48
	36" Stormwater Pipe	3,415.90	LF	$292.89	$ 1,000,472.54
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	31.70	LF	$384.55	$ 12,190.28
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	118.00	LF	$818.03	$ 96,527.03
	66"Stormwater pipe	-	LF	$899.83	$ -
	72"Stormwater pipe	1,440.00	LF	$981.64	$ 1,413,561.60
	Concrete Box Culvert (list size from calc tab)(4x12)	-	LF	$ 2,137.95	$ -
	Concrete Box Culvert (list size from calc tab)(Twin 4x12)	-	LF		
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	12.00	EA	$ 10,073.05	$ 120,876.55
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	6.00	EA	$ 15,733.18	$ 94,399.10
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	6,476.90	LF	$ 31.25	$ 202,403.13
	Dewatering System Operation	12.00	Months	$ 25,846.00	$ 310,152.00
	Flow Bypass	-	Months	$ 25,846.00	$ -
	Utility Conflict Allowance	28.00	LS	$ 10,000.00	$ 280,000.00
	Activity SubTotal				**$10,198,288**
	Outfall Improvements				
	Operable Controls Structure	2.00	LS	$ 300,000.00	$ 600,000.00
	SCADA Control System	2.00	LS	$ 200,000.00	$ 400,000.00
	Mechanical Actuators and Electrical Connections	2.00	LS	$ 200,000.00	$ 400,000.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$1,400,000**
	Pump Station Improvement				
	Piping, Valves, Fittings	2.00	LS	$ 520,000.00	$ 1,040,000.00
	Generator System	2.00	LS	$ 313,666.67	$ 627,333.33
	Pump Station	2.00	LS	$ 2,358,666.67	$ 4,717,333.33

	Electrical, Instrumentation & Controls	2.00	LS	$ 966,666.67	$ 1,933,333.33
	Landscaping / Screening and Aethetics Allowance	2.00	LS	$ 83,333.33	$ 166,666.67
	Activity SubTotal				**$8,484,667**
	Overall Subtotal				**$20,720,860**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 3,108,129
	Contractor Proffit			10%	$ 2,072,086
	Engineering / Design			15%	$ 3,108,129
	Class 4 Estimate Contingency			25%	$ 6,475,269
	Total Including Contingencies				**$35,484,473**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$35,484,473**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

53rd Street N - Project No. G5-2 Engineer's Opinion of Probable Construction Cost					
Line Item	**Activity**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
	General Construction Measures				
	Mobilization	1.00	LS	$ 159,579.00	$ 159,579.00
	Maintenance of Traffic	1.00	LS	$ 68,391.00	$ 68,391.00
	Temporary Erosion Control Measures	1.00	LS	$ 22,797.00	$ 22,797.00
	Activity SubTotal				**$250,767**
	Proposed Conveyance Improvements				
	Pavement Replacement	3,231.00	SY	$ 90.00	$ 290,790.00
	Remove & Dispose of Existing Pipes		LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	1.00	EA	$ 92,500.00	$ 92,500.00
	Concrete curb and gutter	2,316.00	LF	$ 49.06	$ 113,622.96
	Sidewalk Replacement		LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal		CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	66"Stormwater pipe	-	LF	$575.00	$ -
	84"Stormwater pipe	-	LF	$2,900.00	$ -
	Concrete Box Culvert (list size from calc tab)(4x8)	2,700.00	LF	$ 1,476.91	$ 3,987,669.96
	Concrete Box Culvert (list size from calc tab)(5x12)	-	LF		$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	2.00	EA	$ 10,000.00	$ 20,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	100.00	LF	$ 31.25	$ 3,125.00
	Dewatering System Operation	1.00	Months	$ 25,846.00	$ 25,846.00
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				**$4,533,554**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	1.00	Months	$ 25,846.00	$ 25,846.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$25,846**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -

	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**
	Overall Subtotal				**$4,810,167**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 721,525
	Contractor Proffit			10%	$ 481,017
	Engineering / Design			15%	$ 721,525
	Class 4 Estimate Contingency			25%	$ 1,503,177
	Total Including Contingencies				**$8,237,411**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$8,237,411**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

36th Street N - Project No. G5-3 Engineer's Opinion of Probable Construction Cost					
Line Item	**Activity**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
	General Construction Measures				
	Mobilization	1.00	LS	$ 479,411.56	$ 479,411.56
	Maintenance of Traffic	1.00	LS	$ 205,462.10	$ 205,462.10
	Temporary Erosion Control Measures	1.00	LS	$ 68,487.37	$ 68,487.37
	Activity SubTotal				**$753,361**
	Proposed Conveyance Improvements				
	Pavement Replacement	18,083.97	SY	$ 90.00	$ 1,627,557.30
	Remove & Dispose of Existing Pipes		LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	2.00	EA	$ 92,500.00	$ 185,000.00
	Concrete curb and gutter	6,015.00	LF	$ 49.06	$ 295,095.90
	Sidewalk Replacement		LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal		CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	66"Stormwater pipe	-	LF	$575.00	$ -
	84"Stormwater pipe	-	LF	$2,900.00	$ -
	Concrete Box Culvert (list size from calc tab)(4x8)	7,700.00	LF	$ 1,476.91	$ 11,372,243.96
	Concrete Box Culvert (list size from calc tab)(5x12)	-	LF		$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	5.00	EA	$ 10,000.00	$ 50,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	400.00	LF	$ 31.25	$ 12,500.00
	Dewatering System Operation	3.00	Months	$ 25,846.00	$ 77,538.00
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				**$13,619,935**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	3.00	Months	$ 25,846.00	$ 77,538.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$77,538**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -

	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**
	Overall Subtotal				**$14,450,834**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 2,167,625
	Contractor Proffit			10%	$ 1,445,083
	Engineering / Design			15%	$ 2,167,625
	Class 4 Estimate Contingency			25%	$ 4,515,886
	Total Including Contingencies				**$24,747,054**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$24,747,054**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	1st Way North Mobile Home Subdivision - Project No. G6-1				
	Engineer's Opinion of Probable Construction Cost				
	General Construction Measures				
	Mobilization	1.00	LS	$ 98,310.47	$ 98,310.47
	Maintenance of Traffic	1.00	LS	$ 42,133.06	$ 42,133.06
	Temporary Erosion Control Measures	1.00	LS	$ 14,044.35	$ 14,044.35
	Activity SubTotal				**$154,488**
	Proposed Conveyance Improvements				
	Pavement Replacement	3,187.00	SY	$ 90.00	$ 286,830.00
	Remove & Dispose of Existing Pipes	465.00	LF	$ 75.00	$ 34,875.00
	Abandon / Plug Existing Pipe	1.00	CY	$ 434.00	$ 434.00
	Flap Gate / Check Valves (<24" pipe)	1.00	EA	$ 10,000.00	$ 10,000.00
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	3.00	EA	$ 15,100.00	$ 45,300.00
	Inlets / Manholes (>48" pipe connections)	5.00	EA	$ 20,868.00	$ 104,340.00
	Excavation and Disposal	14,204.44	CY	$ 56.00	$ 795,448.89
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	3,055.00	LF	$292.89	$ 894,769.64
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert 4'x6'	-	LF	$ 1,227.47	$ -
	Concrete Box Culvert 4'x8'	-	LF	$ 1,464.45	$ -
	Concrete Box Culvert 4'x10'	-	LF	$ 1,701.42	$ -
	Concrete Box Culvert 4'x12'	-	LF	$ 1,938.40	$ -
	Concrete Box Culvert 4'x14'	-	LF	$ 2,175.37	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	4.00	EA	$ 10,073.05	$ 40,292.18
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	8.00	EA	$ 10,000.00	$ 80,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	3,055.00	LF	$ 31.25	$ 95,468.75
	Dewatering System Operation	5.00	Months	$ 25,846.00	$ 129,230.00
	Flow Bypass	5.00	Months	$ -	$ -
	Utility Conflict Allowance	4.00	LS	$ 10,000.00	$ 40,000.00
	Activity SubTotal				**$2,556,988**
	Outfall Improvements				
	Desilting Existing Pipe	600.00	CY	$ 333.65	$ 200,190.00
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	2.00	Months	$ 25,846.00	$ 51,692.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	4,071.11	Ton	$ 210.00	$ 854,933.33
	Activity SubTotal				**$251,882**
	Pump Station Improvement				
	Piping, Valves, Fittings	-	LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -

	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**
	Overall Subtotal				**$2,963,358**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 444,504
	Contractor Proffit			10%	$ 296,336
	Engineering / Design			15%	$ 444,504
	Class 4 Estimate Contingency			25%	$ 926,049
	Total Including Contingencies				**$5,074,751**
	Property Acquisition				
	Mobile Home Relocation	2.00	EA	$ 300,000.00	$ 600,000.00
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$600,000**
				Total Cost w/ Property Acquisition	**$5,674,751**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

74th Avenue North – Project No. G6-2 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 211,478.88	$ 211,478.88
	Maintenance of Traffic	1.00	LS	$ 90,633.81	$ 90,633.81
	Temporary Erosion Control Measures	1.00	LS	$ 30,211.27	$ 30,211.27
	Activity SubTotal				$332,324
	Proposed Conveyance Improvements				
	Pavement Replacement	3,086.00	SY	$ 90.00	$ 277,740.00
	Remove & Dispose of Existing Pipes	2,398.00	LF	$ 75.00	$ 179,850.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	2,056.00	LF	$ 49.06	$ 100,867.36
	Sidewalk Replacement	130.00	LF	$ 41.67	$ 5,417.10
	Driveway Replacement	4.00	EA	$ 10,035.50	$ 40,142.00
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	9.00	EA	$ 15,100.00	$ 135,900.00
	Inlets / Manholes (>48" pipe connections)	8.00	EA	$ 20,868.00	$ 166,944.00
	Excavation and Disposal	3,020.44	CY	$ 56.00	$ 169,144.89
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	663.00	LF	$276.90	$ 183,587.37
	30" Elliptical Pipe	60.00	LF	$ 310.14	$ 18,608.24
	36" Stormwater Pipe	1,571.00	LF	$292.89	$ 460,125.40
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	60.00	LF	$384.55	$ 23,073.09
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -

	48" Elliptical Pipe	1,165.00	LF	$	808.94	$	942,416.99
	54" Stormwater Pipe	-	LF		$747.16	$	-
	54" Elliptical Pipe	-	LF	$	1,055.12	$	-
	60" Stormwater Pipe	-	LF		$818.03	$	-
	60" Elliptical Pipe	-	LF		$1,327.00	$	-
	Concrete Box Culvert 1 (list size from calc tab)	1,000.00	LF	$	1,938.40	$	1,938,396.43
	Concrete Box Culvert 2 (list size from calc tab)	578.00	LF	$	1,938.40	$	1,120,393.13
	18" Concrete End Treatment	-	EA	$	6,519.12	$	-
	24" Concrete End Treatment	-	EA	$	7,745.97	$	-
	30" Concrete End Treatment	-	EA	$	8,909.51	$	-
	36" Concrete End Treatment	-	EA	$	10,073.05	$	-
	42" Concrete End Treatment	-	EA	$	12,903.11	$	-
	48" Concrete End Treatment	-	EA	$	15,733.18	$	-
	54" Concrete End Treatment	-	EA	$	21,310.56	$	-
	60" Concrete End Treatment	-	EA	$	26,887.93	$	-
	Box Culvert end Treatment	2.00	EA	$	38,042.67	$	76,085.34
	Pipe Connections	5.00	EA	$	10,000.00	$	50,000.00
	Bedding Stone	-	CY	$	210.00	$	-
	Concrete Ditch Pavement	-	SY	$	315.00	$	-
	Dewatering System Installation	2,354.00	LF	$	31.25	$	73,562.50
	Dewatering System Operation	-	Months	$	25,846.00	$	-
	Flow Bypass	-	Months	$	-	$	-
	Utility Conflict Allowance	8.00	LS	$	10,000.00	$	80,000.00
	Activity SubTotal						$6,042,254
	Outfall Improvements						
	Desilting Existing Pipe		CY	$	333.65	$	-
	Temporary sheet pile for coastal work	-	SF	$	60.83	$	-
	Dewatering Measures at Outfall	-	Months	$	25,846.00	$	-
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$	62,500.00	$	-
	Three-Chamber Baffle Box > 36"	-	EA	$	172,178.00	$	-
	Rip-Rap	-	Ton	$	210.00	$	-
	Activity SubTotal						$0
	Pump Station Improvement						
	Piping, Valves, Fittings		LS	$	1,560,000.00	$	-

	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$6,374,578
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 956,187
	Contractor Proffit			10%	$ 637,458
	Engineering / Design			15%	$ 956,187
	Class 4 Estimate Contingency			25%	$ 1,992,056
	Total Including Contingencies				$10,916,464
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$10,916,464

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	Poplar Street NE Mobile Home Subdivision - Project No. G6-10				
	Engineer's Opinion of Probable Construction Cost				
	General Construction Measures				
	Mobilization	1.00	LS	$ 66,349.61	$ 66,349.61
	Maintenance of Traffic	1.00	LS	$ 28,435.55	$ 28,435.55
	Temporary Erosion Control Measures	1.00	LS	$ 9,478.52	$ 9,478.52
	Activity SubTotal				**$104,264**
	Proposed Conveyance Improvements				
	Pavement Replacement	927.00	SY	$ 90.00	$ 83,430.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	695.00	LF	$ 49.06	$ 34,096.70
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	6.00	EA	$ 10,035.50	$ 60,213.00
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	2.00	EA	$ 15,100.00	$ 30,200.00
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	1,001.48	CY	$ 56.00	$ 56,082.96
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	330.00	LF	$ 266.20	$ 87,844.92
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	1,360.00	LF	$ 310.14	$ 421,786.68
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert 4'x6'	-	LF	$ 1,227.47	$ -
	Concrete Box Culvert 4'x8'	-	LF	$ 1,464.45	$ -
	Concrete Box Culvert 4'x10'	-	LF	$ 1,701.42	$ -
	Concrete Box Culvert 4'x12'	365.00	LF	$ 1,938.40	$ 707,514.70
	Concrete Box Culvert 4'x14'	-	LF	$ 2,175.37	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	2.00	EA	$ 38,042.67	$ 76,085.34
	Pipe Connections	1.00	EA	$ 10,000.00	$ 10,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	2,055.00	LF	$ 31.25	$ 64,218.75
	Dewatering System Operation	4.00	Months	$ 25,846.00	$ 103,384.00
	Flow Bypass	4.00	Months	$ -	$ -
	Utility Conflict Allowance	1.00	LS	$ 10,000.00	$ 10,000.00
	Activity SubTotal				**$1,744,857**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	1.00	Months	$ 25,846.00	$ 25,846.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	2.00	EA	$ 62,500.00	$ 125,000.00
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$150,846**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -

	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**
	Overall Subtotal				**$1,999,967**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 299,995
	Contractor Proffit			10%	$ 199,997
	Engineering / Design			15%	$ 299,995
	Class 4 Estimate Contingency			25%	$ 624,990
	Total Including Contingencies				**$3,424,943**
	Property Acquisition				
	Mobile Home Relocation	6.00	EA	$ 30,000.00	$ 180,000.00
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$180,000**
				Total Cost w/ Property Acquisition	**$3,604,943**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Denver Street NE – Project No. G6-11 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 71,834.83	$ 71,834.83
	Maintenance of Traffic	1.00	LS	$ 30,786.35	$ 30,786.35
	Temporary Erosion Control Measures	1.00	LS	$ 10,262.12	$ 10,262.12
	Activity SubTotal				$112,883
	Proposed Conveyance Improvements				
	Pavement Replacement	554.00	SY	$ 90.00	$ 49,860.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	601.00	LF	$ 49.06	$ 29,485.06
	Sidewalk Replacement	53.00	LF	$ 41.67	$ 2,208.51
	Driveway Replacement	1.00	EA	$ 10,035.50	$ 10,035.50
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	10.00	EA	$ 20,868.00	$ 208,680.00
	Excavation and Disposal	950.52	CY	$ 56.00	$ 53,229.04
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -

	48" Elliptical Pipe	-	LF	$ 808.94	$ -
	54" Stormwater Pipe	405.00	LF	$747.16	$ 302,601.38
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	512.00	LF	$818.03	$ 418,829.14
	72" Stormwater Pipe	687.00	LF	$930.00	$ 638,910.00
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	1,604.00	LF	$ 31.25	$ 50,125.00
	Dewatering System Operation	10.00	Months	$ 25,846.00	$ 258,460.00
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	3.00	LS	$ 10,000.00	$ 30,000.00
	Activity SubTotal				$2,052,424
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -

	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$2,165,307
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 324,796
	Contractor Proffit			10%	$ 216,531
	Engineering / Design			15%	$ 324,796
	Class 4 Estimate Contingency			25%	$ 676,658
	Total Including Contingencies				$3,708,088
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$3,708,088

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

62nd Avenue S and 16th Street N - Project No. G6-12 & 19 Engineer's Opinion of Probable Construction Cost					
Line Item	**Activity**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
	General Construction Measures				
	Mobilization	1.00	LS	$ 155,141.13	$ 155,141.13
	Maintenance of Traffic	1.00	LS	$ 66,489.06	$ 66,489.06
	Temporary Erosion Control Measures	1.00	LS	$ 22,163.02	$ 22,163.02
	Activity SubTotal				**$243,793**
	Proposed Conveyance Improvements				
	Pavement Replacement	5,819.00	SY	$ 90.00	$ 523,710.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	3.00	EA	$ 37,625.00	$ 112,875.00
	Flap Gate / Check Valves (>48" pipe)	1.00	EA	$ 92,500.00	$ 92,500.00
	Concrete curb and gutter	1,150.00	LF	$ 49.06	$ 56,419.00
	Sidewalk Replacement		LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	3,394.00	CY	$ 56.00	$ 190,064.00
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	600.00	LF	$292.89	$ 175,732.17
	36" Elliptical Pipe	103.00	LF	$ 403.22	$ 41,531.56
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe		LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	88.00	LF	$818.03	$ 71,986.26
	66"Stormwater pipe	-	LF	$575.00	$ -
	84"Stormwater pipe	-	LF	$2,900.00	$ -
	Concrete Box Culvert (list size from calc tab)(4x12)	1,558.00	LF	$ 1,876.00	$ 2,922,808.00
	Concrete Box Culvert (list size from calc tab)(5x12)	-	LF		$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	12.00	EA	$ 10,000.00	$ 120,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	691.00	LF	$ 31.25	$ 21,593.75
	Dewatering System Operation	4.00	Months	$ 25,846.00	$ 103,384.00
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				**$4,432,604**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$0**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -

	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**
	Overall Subtotal				**$4,676,397**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 701,460
	Contractor Profit			10%	$ 467,640
	Engineering / Design			15%	$ 701,460
	Class 4 Estimate Contingency			25%	$ 1,461,374
	Total Including Contingencies				**$8,008,330**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$8,008,330**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

4th Street N & 38th Avenue N – Project No. G6-13 Engineer's Opinion of Probable Construction Cost					
Line Item	**Activity**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
	General Construction Measures				
	Mobilization	1.00	LS	$ 582,839.36	$ 582,839.36
	Maintenance of Traffic	1.00	LS	$ 249,788.30	$ 249,788.30
	Temporary Erosion Control Measures	1.00	LS	$ 83,262.77	$ 83,262.77
	Activity SubTotal				**$915,890**
	Proposed Conveyance Improvements				
	Pavement Replacement	11,226.67	SY	$ 90.00	$ 1,010,400.00
	Remove & Dispose of Existing Pipes	720.00	LF	$ 75.00	$ 54,000.00
	Abandon / Plug Existing Pipe	70.00	CY	$ 434.00	$ 30,380.00
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	7,810.00	LF	$ 49.06	$ 383,158.60
	Sidewalk Replacement	3,500.00	LF	$ 41.67	$ 145,845.00
	Driveway Replacement	6.00	EA	$ 10,035.50	$ 60,213.00
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	21.00	EA	$ 20,868.00	$ 438,228.00
	Excavation and Disposal	2,494.81	CY	$ 56.00	$ 139,709.63
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	260.00	LF	$514.85	$ 133,860.92
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert Twin 4'x10'	3,600.00	LF	$ 3,484.97	$ 12,545,884.13
	Concrete Box Culvert 4'x10'	350.00	LF	$ 1,900.98	$ 665,342.53
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	2.00	EA	$ 38,042.67	$ 76,085.34
	Pipe Connections	4.00	EA	$ 10,000.00	$ 40,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	4,210.00	LF	$ 31.25	$ 131,562.50
	Dewatering System Operation	18.00	Months	$ 25,846.00	$ 465,228.00
	Flow Bypass		Months	$ -	$ -
	Utility Conflict Allowance	4.00	LS	$ 10,000.00	$ 40,000.00
	Activity SubTotal				**$16,359,898**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	2,250.00	SF	$ 60.83	$ 136,867.50
	Dewatering Measures at Outfall	3.00	Months	$ 25,846.00	$ 77,538.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	1.00	EA	$ 62,500.00	$ 62,500.00
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	75.00	Ton	$ 210.00	$ 15,750.00
	Activity SubTotal				**$292,656**
	Pump Station Improvement				
	Piping, Valves, Fittings	-	LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -

	Activity SubTotal				**$0**
	Overall Subtotal				**$17,568,444**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 2,635,267
	Contractor Proffit			10%	$ 1,756,844
	Engineering / Design			15%	$ 2,635,267
	Class 4 Estimate Contingency			25%	$ 5,490,139
	Total Including Contingencies				**$30,085,960**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$30,085,960**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

52nd Ave Mobile Home Subdivision - Project No. G6-14A
Engineer's Opinion of Probable Construction Cost

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 781,186.56	$ 781,186.56
	Maintenance of Traffic	1.00	LS	$ 334,794.24	$ 334,794.24
	Temporary Erosion Control Measures	1.00	LS	$ 111,598.08	$ 111,598.08
	Activity SubTotal				**$1,227,579**
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	2,922.00	LF	$ 75.00	$ 219,150.00
	Abandon / Plug Existing Pipe	1.00	CY	$ 434.00	$ 434.00
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	354,578.40	CY	$ 56.00	$ 19,856,390.40
	Embankment	275.20	CY	$ 26.00	$ 7,155.17
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	600.00	LF	$514.85	$ 308,909.83
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (list size from calc tab)	500.00	LF	$ 2,537.07	$ 1,268,533.99
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment		EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	4.00	EA	$ 15,733.18	$ 62,932.74
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	4.00	EA	$ 10,000.00	$ 40,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	600.00	LF	$ 31.25	$ 18,750.00
	Dewatering System Operation	8.00	Months	$ 25,846.00	$ 206,768.00
	Flow Bypass	8.00	Months	$ -	$ -
	Utility Conflict Allowance	1.00	LS	$ 10,000.00	$ 10,000.00
	Activity SubTotal				**$21,999,024**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	2.00	Months	$ 25,846.00	$ 51,692.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	4.00	EA	$ 62,500.00	$ 250,000.00
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	90.00	Ton	$ 210.00	$ 18,900.00
	Activity SubTotal				**$320,592**
	Pump Station Improvement				
	Piping, Valves, Fittings	-	LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	1.00	LS	$ 250,000.00	$ 250,000.00
	Activity SubTotal				**$250,000**

	Overall Subtotal				**$23,797,195**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 3,569,579
	Contractor Proffit			10%	$ 2,379,720
	Engineering / Design			15%	$ 3,569,579
	Class 4 Estimate Contingency			25%	$ 7,436,623
	Total Including Contingencies				**$40,752,696**
	Property Acquisition				
	06-31-17-00000-120-0100	1.00	LS	$ 2,100,000.00	$ 2,520,000.00
	06-31-17-45756-000-0010	1.00	LS	$ 1,800,000.00	$ 1,800,000.00
	06-31-17-45738-002-0200	1.20	LS	$ 385,500.00	$ 462,600.00
	06-31-17-45738-002-0120	1.20	LS	$ 300,000.00	$ 360,000.00
	06-31-17-45738-002-0110	1.20	LS	$ 124,260.00	$ 149,112.00
	06-31-17-45738-002-0100	1.20	LS	$ 75,499.00	$ 90,598.80
	06-31-17-45738-002-0090	1.20	LS	$ 110,788.00	$ 132,945.60
	06-31-17-45738-002-0080	1.20	LS	$ 278,539.00	$ 334,246.80
	06-31-17-45738-002-0070	1.20	LS	$ 81,657.00	$ 97,988.40
	06-31-17-43738-002-0010	1.20	LS	$ 230,000.00	$ 276,000.00
	06-31-17-00000-120-0400	1.20	LS	$ 7,000,000.00	$ 8,400,000.00
		-	LS	$ -	$ -
	Activity SubTotal				**$14,623,492**
				Total Cost w/ Property Acquisition	**$55,376,188**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	52nd Ave Mobile Home Subdivision - Project No. G6-14B Engineer's Opinion of Probable Construction Cost				
	General Construction Measures				
	Mobilization	1.00	LS	$ -	$ -
	Maintenance of Traffic	1.00	LS	$ -	$ -
	Temporary Erosion Control Measures	1.00	LS	$ -	$ -
	Activity SubTotal				**$0**
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	-	CY	$ 56.00	$ -
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert (list size from calc tab)	-	LF	$ 2,537.07	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment		EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	-	LF	$ 31.25	$ -
	Dewatering System Operation	-	Months	$ 25,846.00	$ -
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				**$0**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$0**
	Pump Station Improvement				
	Piping, Valves, Fittings	-	LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**

	Overall Subtotal				**$0**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ -
	Contractor Proffit			10%	$ -
	Engineering / Design			15%	$ -
	Class 4 Estimate Contingency			25%	$ -
	Total Including Contingencies				**$0**
	Property Acquisition				
	06-31-17-00000-120-0100	1.00	LS	$ 2,100,000.00	$ 2,520,000.00
	06-31-17-45756-000-0010	1.00	LS	$ 1,800,000.00	$ 1,800,000.00
	06-31-17-45738-002-0200	1.20	LS	$ 385,500.00	$ 462,600.00
	06-31-17-45738-002-0120	1.20	LS	$ 300,000.00	$ 360,000.00
	06-31-17-45738-002-0110	1.20	LS	$ 124,260.00	$ 149,112.00
	06-31-17-45738-002-0100	1.20	LS	$ 75,499.00	$ 90,598.80
	06-31-17-45738-002-0090	1.20	LS	$ 110,788.00	$ 132,945.60
	06-31-17-45738-002-0080	1.20	LS	$ 278,539.00	$ 334,246.80
	06-31-17-45738-002-0070	1.20	LS	$ 81,657.00	$ 97,988.40
	06-31-17-43738-002-0010	1.20	LS	$ 230,000.00	$ 276,000.00
	06-31-17-00000-120-0400	1.20	LS	$ 7,000,000.00	$ 8,400,000.00
		-	LS	$ -	$ -
	Activity SubTotal				**$14,623,492**
				Total Cost w/ Property Acquisition	**$14,623,492**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	Brightwaters Blvd NE Area – Project No. G6-15 Engineer's Opinion of Probable Construction Cost				
	General Construction Measures				
	Mobilization	1.00	LS	$ 13,523.55	$ 13,523.55
	Maintenance of Traffic	1.00	LS	$ 5,795.81	$ 5,795.81
	Temporary Erosion Control Measures	1.00	LS	$ 1,931.94	$ 1,931.94
	Activity SubTotal				**$21,251**
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	400.00	LF	$ 75.00	$ 30,000.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	2.00	EA	$ 37,625.00	$ 75,250.00
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	40.00	LF	$ 49.06	$ 1,962.40
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	2.00	EA	$ 15,100.00	$ 30,200.00
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	106.00	CY	$ 56.00	$ 5,936.00
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	400.00	LF	$292.89	$ 117,154.78
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert Twin 4'x10'	-	LF	$ 3,484.97	$ -
	Concrete Box Culvert 4'x10'	-	LF	$ 1,900.98	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	400.00	LF	$ 31.25	$ 12,500.00
	Dewatering System Operation	2.00	Months	$ 25,846.00	$ 51,692.00
	Flow Bypass		Months	$ -	$ -
	Utility Conflict Allowance	1.00	LS	$ 10,000.00	$ 10,000.00
	Activity SubTotal				**$334,695**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	2.00	Months	$ 25,846.00	$ 51,692.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$51,692**
	Pump Station Improvement				
	Piping, Valves, Fittings	-	LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -

	Activity SubTotal				**$0**
	Overall Subtotal				**$407,638**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 61,146
	Contractor Proffit			10%	$ 40,764
	Engineering / Design			15%	$ 61,146
	Class 4 Estimate Contingency			25%	$ 127,387
	Total Including Contingencies				**$698,081**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$698,081**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Appian Way NE Area – Project No. G6-16 Engineer's Opinion of Probable Construction Cost					
Line Item	**Activity**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
	General Construction Measures				
	Mobilization	1.00	LS	$ 110,428.07	$ 110,428.07
	Maintenance of Traffic	1.00	LS	$ 47,326.31	$ 47,326.31
	Temporary Erosion Control Measures	1.00	LS	$ 15,775.44	$ 15,775.44
	Activity SubTotal				**$173,530**
	Proposed Conveyance Improvements				
	Pavement Replacement	1,160.00	SY	$ 90.00	$ 104,400.00
	Remove & Dispose of Existing Pipes	100.00	LF	$ 75.00	$ 7,500.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	1.00	EA	$ 92,500.00	$ 92,500.00
	Concrete curb and gutter	950.00	LF	$ 49.06	$ 46,607.00
	Sidewalk Replacement	850.00	LF	$ 41.67	$ 35,419.50
	Driveway Replacement	4.00	EA	$ 10,035.50	$ 40,142.00
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	9.00	EA	$ 20,868.00	$ 187,812.00
	Excavation and Disposal	106.00	CY	$ 56.00	$ 5,936.00
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	1,500.00	LF	$514.85	$ 772,274.56
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	1,750.00	LF	$818.03	$ 1,431,544.91
	Concrete Box Culvert Twin 4'x10'	-	LF	$ 3,484.97	$ -
	Concrete Box Culvert 4'x10'	-	LF	$ 1,900.98	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	1.00	EA	$ 15,733.18	$ 15,733.18
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	1.00	EA	$ 26,887.93	$ 26,887.93
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	3.00	EA	$ 10,000.00	$ 30,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	3,250.00	LF	$ 31.25	$ 101,562.50
	Dewatering System Operation	7.00	Months	$ 25,846.00	$ 180,922.00
	Flow Bypass		Months	$ -	$ -
	Utility Conflict Allowance	5.00	LS	$ 10,000.00	$ 50,000.00
	Activity SubTotal				**$3,129,242**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	1.00	Months	$ 25,846.00	$ 25,846.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$25,846**
	Pump Station Improvement				
	Piping, Valves, Fittings	1.00	LS	$ 1,560,000.00	$ 1,560,000.00
	Generator System	0.50	LS	$ 941,000.00	$ 470,500.00
	Pump Station	0.50	LS	$ 7,076,000.00	$ 3,538,000.00
	Electrical, Instrumentation & Controls	0.50	LS	$ 2,900,000.00	$ 1,450,000.00
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -

	Activity SubTotal				**$7,018,500**
	Overall Subtotal				**$10,347,117**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 1,552,068
	Contractor Proffit			10%	$ 1,034,712
	Engineering / Design			15%	$ 1,552,068
	Class 4 Estimate Contingency			25%	$ 3,233,474
	Total Including Contingencies				**$17,719,439**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$17,719,439**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

54th Ave N - Project No. G6-17 Engineer's Opinion of Probable Construction Cost					
Line Item	**Activity**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
	General Construction Measures				
	Mobilization	1.00	LS	$ 313,215.90	$ 313,215.90
	Maintenance of Traffic	1.00	LS	$ 134,235.38	$ 134,235.38
	Temporary Erosion Control Measures	1.00	LS	$ 44,745.13	$ 44,745.13
	Activity SubTotal				**$492,196**
	Proposed Conveyance Improvements				
	Pavement Replacement	12,996.00	SY	$ 90.00	$ 1,169,640.00
	Remove & Dispose of Existing Pipes	3,019.00	LF	$ 75.00	$ 226,425.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	7.00	EA	$ 92,500.00	$ 647,500.00
	Concrete curb and gutter	3,594.00	LF	$ 49.06	$ 176,321.64
	Sidewalk Replacement	320.00	LF	$ 41.67	$ 13,334.40
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	1,071.00	CY	$ 56.00	$ 59,976.00
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	51.00	LF	$168.12	$ 8,574.14
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	6,972.00	LF	$ 403.22	$ 2,811,243.04
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	1,284.00	LF	$514.85	$ 661,067.03
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	66"Stormwater pipe	-	LF	$575.00	$ -
	84"Stormwater pipe	-	LF	$2,900.00	$ -
	Concrete Box Culvert (list size from calc tab)(4x8)	1,920.00	LF	$ 1,476.91	$ 2,835,676.42
	Concrete Box Culvert (list size from calc tab)(5x12)	-	LF		$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	12.00	EA	$ 10,000.00	$ 120,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	400.00	LF	$ 31.25	$ 12,500.00
	Dewatering System Operation	4.00	Months	$ 25,846.00	$ 103,384.00
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	-	LS	$ 10,000.00	$ -
	Activity SubTotal				**$8,845,642**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	4.00	Months	$ 25,846.00	$ 103,384.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$103,384**
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -

	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**
	Overall Subtotal				**$9,441,222**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 1,416,183
	Contractor Proffit			10%	$ 944,122
	Engineering / Design			15%	$ 1,416,183
	Class 4 Estimate Contingency			25%	$ 2,950,382
	Total Including Contingencies				**$16,168,093**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$16,168,093**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	1st Street N and 49th Avenue N - Project No. G6-18 & 21 Engineer's Opinion of Probable Construction Cost				
	General Construction Measures				
	Mobilization	1.00	LS	$ 441,286.45	$ 441,286.45
	Maintenance of Traffic	1.00	LS	$ 189,122.77	$ 189,122.77
	Temporary Erosion Control Measures	1.00	LS	$ 63,040.92	$ 63,040.92
	Activity SubTotal				**$693,450**
	Proposed Conveyance Improvements				
	Pavement Replacement	5,000.00	SY	$ 90.00	$ 450,000.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	2,200.00	LF	$ 49.06	$ 107,932.00
	Sidewalk Replacement	2,000.00	LF	$ 41.67	$ 83,340.00
	Driveway Replacement	7.00	EA	$ 10,035.50	$ 70,248.50
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	2,607.41	CY	$ 56.00	$ 146,014.81
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert: 4'x12'	4,400.00	LF	$ 2,537.07	$ 11,163,099.08
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	3.00	EA	$ 38,042.67	$ 114,128.02
	Pipe Connections	2.00	EA	$ 10,000.00	$ 20,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	4,400.00	LF	$ 31.25	$ 137,500.00
	Dewatering System Operation	6.00	Months	$ 25,846.00	$ 155,076.00
	Flow Bypass	6.00	Months	$ -	$ -
	Utility Conflict Allowance	1.00	LS	$ 10,000.00	$ 10,000.00
	Activity SubTotal				**$12,457,338**
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	1.00	Months	$ 25,846.00	$ 25,846.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	2.00	EA	$ 62,500.00	$ 125,000.00
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$150,846**
	Pump Station Improvement				
	Piping, Valves, Fittings	2.00	LS	$ 1,560,000.00	$ 3,120,000.00
	Generator System	2.00	LS	$ 941,000.00	$ 1,882,000.00
	Pump Station	3.00	LS	$ 7,076,000.00	$ 21,228,000.00
	Electrical, Instrumentation & Controls	2.00	LS	$ 2,900,000.00	$ 5,800,000.00
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$32,030,000**

	Overall Subtotal				**$45,331,635**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 6,799,745
	Contractor Proffit			10%	$ 4,533,163
	Engineering / Design			15%	$ 6,799,745
	Class 4 Estimate Contingency			25%	$ 14,166,136
	Total Including Contingencies				**$77,630,424**
	Property Acquisition				
			LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$77,630,424**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	62nd Ave NE and Foch St NE – Project No. G6-20 Engineer's Opinion of Probable Construction Cost				
	General Construction Measures				
	Mobilization	1.00	LS	$ 174,097.20	$ 174,097.20
	Maintenance of Traffic	1.00	LS	$ 74,613.09	$ 74,613.09
	Temporary Erosion Control Measures	1.00	LS	$ 24,871.03	$ 24,871.03
	Activity SubTotal				**$273,581**
	Proposed Conveyance Improvements				
	Pavement Replacement	-	SY	$ 90.00	$ -
	Remove & Dispose of Existing Pipes	150.00	LF	$ 75.00	$ 11,250.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	55,000.00	CY	$ 56.00	$ 3,080,000.00
	Embankment	3,200.00	CY	$ 26.00	$ 83,200.00
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	300.00	LF	$818.03	$ 245,407.70
	66"Stormwater pipe	-	LF	$575.00	$ -
	84"Stormwater pipe	-	LF	$2,900.00	$ -
	Concrete Box Culvert (list size from calc tab)(4x12)	-	LF	$ 2,137.95	$ -
	Concrete Box Culvert (list size from calc tab)(Twin 4x12)	-	LF		
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	1,200.00	LF	$ 31.25	$ 37,500.00
	Dewatering System Operation	9.00	Months	$ 25,846.00	$ 232,614.00
	Flow Bypass	-	Months	$ 25,846.00	$ -
	Utility Conflict Allowance	4.00	LS	$ 10,000.00	$ 40,000.00
	Activity SubTotal				**$3,729,972**
	Outfall Improvements				
	Desilting Existing Pipe	100.00	CY	$ 333.65	$ 33,365.00
	Temporary sheet pile for coastal work	4,500.00	SF	$ 60.83	$ 273,735.00
	Dewatering Measures at Outfall	4.00	Months	$ 25,846.00	$ 103,384.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	2.00	EA	$ 62,500.00	$ 125,000.00
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	3,375.00	Ton	$ 210.00	$ 708,750.00
	Activity SubTotal				**$1,244,234**
	Pump Station Improvement				
	Piping, Valves, Fittings	1.00	LS	$ 1,560,000.00	$ 1,560,000.00
	Generator System	1.00	LS	$ 941,000.00	$ 941,000.00
	Pump Station	1.00	LS	$ 7,076,000.00	$ 7,076,000.00

	Electrical, Instrumentation & Controls	1.00	LS	$ 2,900,000.00	$ 2,900,000.00
	Landscaping / Screening and Aethetics Allowance	1.00	LS	$ 250,000.00	$ 250,000.00
	Activity SubTotal				**$12,727,000**
	Overall Subtotal				**$17,974,787**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 2,696,218
	Contractor Proffit			10%	$ 1,797,479
	Engineering / Design			15%	$ 2,696,218
	Class 4 Estimate Contingency			25%	$ 5,617,121
	Total Including Contingencies				**$30,781,823**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$30,781,823**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Arizona Avenue NE – Project No. G6-22 Engineer's Opinion of Probable Construction Cost					
Line Item	Activity	Quantity	Unit	Unit Cost	Total Cost
	General Construction Measures				
	Mobilization	1.00	LS	$ 116,974.97	$ 116,974.97
	Maintenance of Traffic	1.00	LS	$ 50,132.13	$ 50,132.13
	Temporary Erosion Control Measures	1.00	LS	$ 16,710.71	$ 16,710.71
	Activity SubTotal				$183,818
	Proposed Conveyance Improvements				
	Pavement Replacement	1,493.00	SY	$ 90.00	$ 134,370.00
	Remove & Dispose of Existing Pipes	1,564.00	LF	$ 75.00	$ 117,300.00
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	732.00	LF	$ 49.06	$ 35,911.92
	Sidewalk Replacement	60.00	LF	$ 41.67	$ 2,500.20
	Driveway Replacement	5.00	EA	$ 10,035.50	$ 50,177.50
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	3.00	EA	$ 15,100.00	$ 45,300.00
	Inlets / Manholes (>48" pipe connections)	3.00	EA	$ 20,868.00	$ 62,604.00
	Excavation and Disposal	973.63	CY	$ 56.00	$ 54,523.26
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	108.00	LF	$276.90	$ 29,905.64
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	31.00	LF	$292.89	$ 9,079.50
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -

	48" Elliptical Pipe	-	LF	$ 808.94	$ -
	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	60" Elliptical Pipe	93.00	LF	$1,327.00	$ 123,411.00
	72" Stormwater Pipe	291.00	LF	$930.00	$ 270,630.00
	72" Elliptical Pipe	-		$1,810.00	$ -
	Concrete Box Culvert 1 (list size from calc tab)	192.00	LF	$ 1,378.72	$ 264,714.45
	Concrete Box Culvert 2 (list size from calc tab)	38.00	LF	$ 1,378.72	$ 52,391.40
	Concrete Box Culvert 3 (list size from calc tab)	53.00	LF	$ 1,378.72	$ 73,072.22
	Concrete Box Culvert 4 (list size from calc tab)	283.00	LF	$ 1,747.11	$ 494,433.45
	Concrete Box Culvert 5 (list size from calc tab)	62.00	LF	$ 1,747.11	$ 108,321.11
	Concrete Box Culvert 6 (list size from calc tab)	259.00	LF	$ 1,747.11	$ 452,502.70
	Concrete Box Culvert 7 (list size from calc tab)	48.00	LF	$ 1,378.72	$ 66,178.61
	Concrete Box Culvert 8 (list size from calc tab)	185.00	LF	$ 1,378.72	$ 255,063.40
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	6.00	EA	$ 38,042.67	$ 228,256.03
	Pipe Connections	1.00	EA	$ 10,000.00	$ 10,000.00
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	1,643.00	LF	$ 31.25	$ 51,343.75
	Dewatering System Operation	12.00	Months	$ 25,846.00	$ 310,152.00
	Flow Bypass	-	Months	$ -	$ -
	Utility Conflict Allowance	4.00	LS	$ 10,000.00	$ 40,000.00
	Activity SubTotal				$3,342,142
	Outfall Improvements				
	Desilting Existing Pipe		CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	-	Months	$ 25,846.00	$ -

	Seawall Outfall Structure w/ check valve / flap gate > 36"	-	EA	$ 62,500.00	$ -
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				$0
	Pump Station Improvement				
	Piping, Valves, Fittings		LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				$0
	Overall Subtotal				$3,525,960
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 528,894
	Contractor Proffit			10%	$ 352,596
	Engineering / Design			15%	$ 528,894
	Class 4 Estimate Contingency			25%	$ 1,101,862
	Total Including Contingencies				$6,038,206
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				$0
				Total Cost w/ Property Acquisition	$6,038,206

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

32nd Ave North – Project No. G6-23 Engineer's Opinion of Probable Construction Cost					
Line Item	**Activity**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
	General Construction Measures				
	Mobilization	1.00	LS	$ 259,005.33	$ 259,005.33
	Maintenance of Traffic	1.00	LS	$ 111,002.28	$ 111,002.28
	Temporary Erosion Control Measures	1.00	LS	$ 37,000.76	$ 37,000.76
	Activity SubTotal				**$407,008**
	Proposed Conveyance Improvements				
	Pavement Replacement	8,040.00	SY	$ 90.00	$ 723,600.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	280.00	LF	$ 41.67	$ 11,667.60
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Excavation and Disposal	3,585.19	CY	$ 56.00	$ 200,770.37
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$ 276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	650.00	LF	$ 292.89	$ 190,376.52
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$ 384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$ 514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$ 747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	72" Stormwater Pipe	5,400.00	LF	$ 981.64	$ 5,300,856.00
	Concrete Box Culvert (6'x12')	-	LF	$ 3,136.31	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	6,050.00	LF	$ 31.25	$ 189,062.50
	Dewatering System Operation	24.20	Months	$ 25,846.00	$ 625,473.20
	Flow Bypass	24.20	Months	$ -	$ -
	Utility Conflict Allowance	7.00	LS	$ 10,000.00	$ 70,000.00
	Activity SubTotal				**$7,311,806**
	Outfall Improvements				
	Desilting Existing Pipe	-	CY	$ 333.65	$ -
	Temporary sheet pile for coastal work	-	SF	$ 60.83	$ -
	Dewatering Measures at Outfall	1.00	Months	$ 25,846.00	$ 25,846.00
	Seawall Outfall Structure w/ check valve / flap gate > 36"	1.00	EA	$ 62,500.00	$ 62,500.00
	Three-Chamber Baffle Box > 36"	-	EA	$ 172,178.00	$ -
	Rip-Rap	-	Ton	$ 210.00	$ -
	Activity SubTotal				**$88,346**
	Pump Station Improvement				
	Piping, Valves, Fittings	-	LS	$ 1,560,000.00	$ -
	Generator System	-	LS	$ 941,000.00	$ -
	Pump Station	-	LS	$ 7,076,000.00	$ -
	Electrical, Instrumentation & Controls	-	LS	$ 2,900,000.00	$ -
	Landscaping / Screening and Aethetics Allowance	-	LS	$ 250,000.00	$ -
	Activity SubTotal				**$0**

	Overall Subtotal				**$7,807,161**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 1,171,074
	Contractor Proffit			10%	$ 780,716
	Engineering / Design			15%	$ 1,171,074
	Class 4 Estimate Contingency			25%	$ 2,439,738
	Total Including Contingencies				**$13,369,762**
	Property Acquisition				
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$0**
				Total Cost w/ Property Acquisition	**$13,369,762**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

78th Street – Project No. G6-25 Engineer's Opinion of Probable Construction Cost					
Line Item	**Activity**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
	General Construction Measures				
	Mobilization	1.00	LS	$ 353,786.04	$ 353,786.04
	Maintenance of Traffic	1.00	LS	$ 151,622.59	$ 151,622.59
	Temporary Erosion Control Measures	1.00	LS	$ 50,540.86	$ 50,540.86
	Activity SubTotal				**$555,949**
	Proposed Conveyance Improvements				
	Pavement Replacement	1,600.00	SY	$ 90.00	$ 144,000.00
	Remove & Dispose of Existing Pipes	-	LF	$ 75.00	$ -
	Abandon / Plug Existing Pipe	-	CY	$ 434.00	$ -
	Flap Gate / Check Valves (<24" pipe)	-	EA	$ 10,000.00	$ -
	Flap Gate / Check Valves (24" - 36" pipe)	-	EA	$ 27,275.00	$ -
	Flap Gate / Check Valves (36" - 48" pipe)	-	EA	$ 37,625.00	$ -
	Flap Gate / Check Valves (>48" pipe)	-	EA	$ 92,500.00	$ -
	Concrete curb and gutter	-	LF	$ 49.06	$ -
	Sidewalk Replacement	-	LF	$ 41.67	$ -
	Driveway Replacement	-	EA	$ 10,035.50	$ -
	Inlets / Manholes (12" - 24" pipe connections)	-	EA	$ 12,070.00	$ -
	Inlets / Manholes (>24" pipe connections)	-	EA	$ 15,100.00	$ -
	Inlets / Manholes (>48" pipe connections)	-	EA	$ 20,868.00	$ -
	Channel Excavation / Sediment Removal	33,333.00	CY	$ 56.00	$ 1,866,648.00
	Embankment	-	CY	$ 26.00	$ -
	Imported Fill	-	CY	$ 56.00	$ -
	18" Stormwater Pipe	-	LF	$168.12	$ -
	18" Elliptical Pipe	-	LF	$ 233.41	$ -
	24" Stormwater Pipe	-	LF	$194.13	$ -
	24" Elliptical Pipe	-	LF	$ 266.20	$ -
	30" Stormwater Pipe	-	LF	$276.90	$ -
	30" Elliptical Pipe	-	LF	$ 310.14	$ -
	36" Stormwater Pipe	-	LF	$292.89	$ -
	36" Elliptical Pipe	-	LF	$ 403.22	$ -
	42" Stormwater Pipe	-	LF	$384.55	$ -
	42" Elliptical Pipe	-	LF	$ 562.76	$ -
	48" Stormwater Pipe	-	LF	$514.85	$ -
	48" Elliptical Pipe	-	LF	$ 808.94	$ -

	54" Stormwater Pipe	-	LF	$747.16	$ -
	54" Elliptical Pipe	-	LF	$ 1,055.12	$ -
	60" Stormwater Pipe	-	LF	$818.03	$ -
	Concrete Box Culvert Twin 8'x12'	600.00	LF	$ 3,484.97	$ 2,090,980.69
	Concrete Box Culvert 4'x10'	-	LF	$ 3,445.76	$ -
	18" Concrete End Treatment	-	EA	$ 6,519.12	$ -
	24" Concrete End Treatment	-	EA	$ 7,745.97	$ -
	30" Concrete End Treatment	-	EA	$ 8,909.51	$ -
	36" Concrete End Treatment	-	EA	$ 10,073.05	$ -
	42" Concrete End Treatment	-	EA	$ 12,903.11	$ -
	48" Concrete End Treatment	-	EA	$ 15,733.18	$ -
	54" Concrete End Treatment	-	EA	$ 21,310.56	$ -
	60" Concrete End Treatment	-	EA	$ 26,887.93	$ -
	Box Culvert end Treatment	-	EA	$ 38,042.67	$ -
	Pipe Connections	-	EA	$ 10,000.00	$ -
	Bedding Stone	-	CY	$ 210.00	$ -
	Concrete Ditch Pavement	-	SY	$ 315.00	$ -
	Dewatering System Installation	600.00	LF	$ 31.25	$ 18,750.00
	Dewatering System Operation	18.00	Months	$ 25,846.00	$ 465,228.00
	Flow Bypass	12.00	Months	$ 55,000.00	$ 660,000.00
	Utility Conflict Allowance	8.00	LS	$ 10,000.00	$ 80,000.00
	Activity SubTotal				**$5,325,607**
	Outfall Improvements				
	Steel Sheet Pile	3,000.00	SF	$ 60.83	$ 182,490.00
	Dewatering Measures at Outfall	6.00	Months	$ 25,846.00	$ 155,076.00
	Box Culvert Operable Structure (gates, actuators, SCADA & Electrical)	1.00	EA	$ 3,500,000.00	$ 3,500,000.00
	Rip-Rap	4,500.00	Ton	$ 210.00	$ 945,000.00
	Activity SubTotal				**$4,782,566**
	Pump Station Improvement				
	Piping, Valves, Fittings	1.00	LS	$ 10,140,000.00	$ 10,140,000.00
	Generator System	1.00	LS	$ 6,116,500.00	$ 6,116,500.00
	Pump Station	1.00	LS	$ 45,994,000.00	$ 45,994,000.00
	Electrical, Instrumentation & Controls	1.00	LS	$ 18,850,000.00	$ 18,850,000.00
	Landscaping / Screening and Aethetics Allowance	1.00	LS	$ 500,000.00	$ 500,000.00
	Activity SubTotal				**$81,600,500**

	Overall Subtotal				**$92,264,622**
	Markups				
	Contractors Overhead, General Conditions, Temp Facilities			15%	$ 13,839,693
	Contractor Proffit			10%	$ 9,226,462
	Engineering / Design			15%	$ 13,839,693
	Class 4 Estimate Contingency			25%	$ 28,832,694
	Total Including Contingencies				**$158,003,165**
	Property Acquisition				
	Pump Station Property	6.00	AC	$ 2,000,000.00	$ 12,000,000.00
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
		-	LS	$ -	$ -
	Activity SubTotal				**$12,000,000**
				Total Cost w/ Property Acquisition	**$170,003,165**

This is not an offer for construction and/or project execution.
These AACE Classification Class 4 cost estimates are assumed to represent the actual total installed cost within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site-specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.