Watershed Management Program Consulting Services
in the Big Slough Watershed (K883)

Best Management Practices (BMP) Analysis
Final Report

Prepared for

Southwest Florida Water Management District
&
City of North Port

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1.0 INTRODUCTION

As described in the Southwest Florida Water Management District's Watershed Management Program Guidelines and Specifications, Best Management Practice (BMP) Alternatives Analysis involves modification of the existing model condition to evaluate best management practices, to address the enhancement and protection of natural systems, recharge, and water quality while achieving flood protection.

BMP alternatives analysis involves the use and modification of the existing model condition to evaluate BMPs, to address habitual flooding conditions while ensuring no adverse impact.

Best management practices (BMP) is a phrase which means the best available techniques to reduce harmful environmental impacts. Usually, BMPs for urban watershed management are storage devices that temporarily store and/or treat urban runoff to reduce flooding and/or remove pollutants. For this task, the following alternative methods were evaluated with the unique purpose of reducing flooding: flow diversion, conveyance improvements, detention, exclusion of all existing drop structures and water control structures (WCS), and modification of gated structure and raising road elevations.

1.1 Authorization

Ardaman and Associates was contracted by the Southwest Florida Water Management District to conduct specific tasks of a Watershed Management Program for the North Port/Big Slough Watershed. The project was initiated in July 2003 and a series of work orders were issued. Work order number 4, issued in August 2005, included BMP alternative analysis for the North Port/Big Slough watershed.

1.2 Project Location and General Description

The Big Slough Watershed is located in southeastern Sarasota County, and the slough is tributary to the Myakka River. Portions of the incorporated City of North Port (those areas east of the Myakka) are located within the southern portion of the watershed. The 195.5 square mile watershed encompasses numerous depressional features, including wetlands and water bodies, the most prominent of which is the Big Slough Canal (also called Myakkahatchee Creek in its lower reaches). The Big Slough Canal passes from north to south through the City of North Port, and receives inflows from an internal system of waterways which provide surface drainage throughout the City, before discharging beneath U.S. Highway 41 toward its confluence with the Myakka River. The Big Slough Watershed and portions of the City of North Port are traversed from east to west by Interstate Highway 75.

1.3 Purpose and Objectives

The objective of this study is to evaluate BMP alternatives that would solve flooding conditions within the City of North Port. Existing condition model results and Floodplain

Level of Service (LOS) were used to identify present watershed flooding condition. Various BMP concepts and alternatives were evaluated for their effectiveness in solving flooding problems, permitablity, and economic viability.

1.4 Previous Reports

Over the course of the project, numerous interim reports have been submitted along with supporting data to SWFWMD and City of North Port. Those prior reports contain additional details and supporting documentation regarding these tasks completion, and include the following:

WO#1 – Watershed Evaluation

Task 1.1.2.1 – Existing Watershed Feature Data Evaluation and Assembly
Task 1.1.2.2 – Sub-basin delineations and landuse inventory

WO#2 – Watershed Evaluation

Task 1.1.2 – Watershed Evaluation
- 1.1.2.2 Hydrologic Feature Inventory
- 1.1.2.3 Hydraulic Feature Inventory
- 1.1.2.4 Field Reconnaissance
- 1.1.2.5 ID of Surveys to be Completed by a PLS
- 1.1.2.6 Preliminary Junction/Reach Coverage Development
- 1.1.2.7 SW Assessment Inventory and Approach Development
- 1.1.2.9 Watershed Evaluation Deliverables

WO#3 – Watershed Evaluation

Task 2.3.1 – Surveys by a Professional Land Surveyor

WO#4 – Watershed Management Plan

Task 1.1.3.2 – Watershed Parameterization
Task 1.1.3.3 – Watershed Model Development & Verification
Task 1.1.3.4 – Floodplain Analysis and Delineation Report
Task 1.1.3.5a – Level of Service Determination – original analysis
Task 1.1.3.5b – Level of Service Determination – with model maintenance
Task 1.1.3.7a – BMP Alternative Formulation Report – original analysis
Task 1.1.3.7a – BMP Evaluation of Four Crossings
Task 1.1.3.7b – BMP Evaluation Price Boulevard
Task 1.1.3.7b – BMP Evaluation WCS-162
Task 1.1.3.7b – Final BMP Report

WO#7 – Maintenance of Watershed Parameters and Models

Task 2.2.1 – 2004-2007 LiDAR Comparison
Task 2.3.1.1 – Collect and Evaluate Environmental Resource Permit (ERP) Information
Task 2.3.4 – Limited Field Reconnaissance

Task 2.3.6 and 2.3.7 – Generic Hydrologic Features and Generic Hydraulic Features
Task 2.3.6, 2.3.7, and 2.4.1 – Generic Hydrologic Features, Generic Hydraulic Features, and Refined Generic and Semi-generic Geodatabase and Parameterization
Task 2.4.1, 2.4.2, 2.4.3 – Refined Generic and Semi-generic Geodatabase and Parameterization, Watershed Computer Simulation Model Development and Verification, and Floodplain Analysis and Delineation
Task 2.4.3 – Floodplain Analysis and Delineation
Task N/A – Justification Report and Peer Review Presentation

WO#8 – Maintenance of Watershed Parameters and Models

Task 2.2.2 – 2007 LiDAR Review

WO#12 – Maintenance of Watershed Parameters and Models

Task 2.4.11 - Floodway Analysis Report

2.0 CHARACTERIZATION OF FLOOD PRONE AREAS

The Big Slough watershed is located in the Gulf coastal lowlands of southwestern Florida, characterized by flat topography and sandy, shelly and silty sand soils with little organic matter. Its headwaters are rural, consisting primarily of agricultural and undeveloped lands. A vast majority of urban and built up lands occur in the southern portion of the watershed, within in the City of North Port. Commercial development is generally limited to main thoroughfares within the city, especially along the US 41 corridor. Myakkahatchee Creek/Big Slough Canal begins in the southeastern part of Manatee County (near Edgeville) and flows approximately 21 miles through the City of North Port and ultimately empties to the estuarine portion of the Myakka River.

2.1 Hydrologic Inventory

2.1.1 *Subbasin Delineation Process*

Subbasin delineations were performed to support watershed parameterization and modeling. The subbasins were delineated using Arc Hydro Tools with LiDAR-based terrain data, where available. The surface model was prepared for “automated” subbasin delineation by combining the large terrain models with highly detailed secondary flow path information. The secondary flow paths were digitized based on scanned and orthorectified as-built information, terrain model features, and field observations of drainage patterns.

A set of protocols was developed for assigning subbasin break points, to allow for batch processing of the watershed using the delineation tools. As a result of pre-processing the surface model in the manner described here, the Arc Hydro tools were better able to recognize surface drainage characteristics and provide accurate subbasin delineations for use in model parameterization. In those areas where LiDAR was not available, other topographic and drainage delineation information was employed to support automated and manual delineations.

2.1.2 *Tributary Subbasins and Characterization.*

Tributary areas were defined primarily by grouping surface storage features according to their connectivity (via culverts) or primary overflow paths (across topographic saddles). Open channel conveyance systems were also used to identify unique tributary areas. Each tributary area could then be summarized using GIS to describe unique characteristics, as discussed below.

Subbasin sizes range throughout the study area from 0.33 to 1,673.79 acres. Table 2-1 summarizes subbasin size by tributary area.

Table 2-1: Subbasin Size Summary per Tributary

Tributary ID	Count	Minimum	Maximum	Average
A	60	0.33	36.00	9.17
B	1282	0.06	1244.70	30.97
C	339	0.12	61.14	9.91
D	67	1.23	75.40	26.24
E	210	0.19	151.42	10.30
F	54	0.32	83.20	20.68
G	130	0.32	66.63	11.58
H	42	0.77	35.93	11.87
I	58	0.86	71.29	21.11
J	153	0.60	69.53	14.49
K	188	0.63	79.83	10.53
L	33	0.70	70.08	24.53
M	84	1.38	1040.82	133.85
N	119	0.16	28.22	8.22
O	76	0.88	82.72	15.89
P	38	0.11	120.69	13.19
Q	288	1.04	167.71	25.23
R	263	0.42	234.44	21.53
S	361	0.28	1139.68	21.10
T	65	0.28	45.34	13.73
U	799	0.03	410.92	24.79
V	116	0.42	89.73	14.68
W	29	15.55	1673.79	320.55
X	42	0.36	32.10	9.11
Y	84	0.24	47.38	12.87
Z	36	0.41	54.12	17.78

2.1.3 *Tributary Land Use Characterization*

While the headwaters of the Big Slough Watershed remain predominantly undeveloped or agricultural, changes in land uses throughout the City of North Port reflect significant population growth, with continued commercial and industrial growth along the US 41 corridor and the Price Boulevard intersections with Sumter Boulevard and Toledo Blade Boulevard.

Land use types were acquired as a GIS coverage from the SWFWMD and updated using 2004 aerial photography. Table 2-2 summarizes generalized land use encountered and respective percent areas of coverage, by tributary.

Table 2-2: Generalized Land Use Summary per Tributary

Tributary ID	Residential	Com/Industrial	Upland/Open	Water/Wetland
A	10.55	0.00	86.54	2.91
B	9.06	1.41	66.33	23.19
C	51.87	6.30	34.51	7.32
D	97.99	0.06	0.18	1.77
E	64.02	2.86	24.11	9.02
F	89.64	2.37	5.43	2.56
G	85.46	0.19	10.80	3.56
H	24.47	0.51	33.01	42.01
I	73.04	3.46	16.82	6.68
J	76.21	3.39	16.98	3.42
K	34.18	3.62	58.39	3.81
L	65.17	0.48	25.84	8.51
M	2.02	0.22	75.29	22.47
N	0.32	4.18	88.79	6.71
O	85.80	0.15	11.00	3.04
P	67.31	2.43	11.53	18.73
Q	0.00	0.75	71.86	27.39
R	32.98	0.78	40.77	25.48
S	16.20	2.33	56.24	25.22
T	57.69	5.05	27.44	9.82
U	1.18	1.95	62.64	34.23
V	35.95	7.19	36.04	20.82
W	1.49	0.27	79.92	18.32
X	76.68	2.32	8.57	12.42
Y	85.27	4.58	9.13	1.03
Z	98.90	0.00	0.00	1.10

2.1.4 *Tributary Soil Characterization.*

Low permeability, hydric soils associated with depressional areas and flood plains are predominant within the study area.

Soil types were identified using soil survey data for Sarasota, Charlotte, Manatee and DeSoto Counties acquired as a GIS coverage from SWFWMD. Individual soil types were categorized according to their runoff potential. In order to perform that categorization, the hydrologic soil group of each soil was defined according to the relevant soil survey reports. A brief discussion of each hydrologic soil group's characteristics is provided below.

HYDROLOGIC SOIL GROUP A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively well drained sands or gravelly sands. These soils have a high rate of water transmission.

HYDROLOGIC SOIL GROUP B. Soils having a moderate infiltration when thoroughly wet. These consist mainly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

HYDROLOGIC SOIL GROUP C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

HYDROLOGIC SOIL GROUP D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have high shrink-swell potential, soils that have a permanent high water table, soils that have a clay pan or clay layer at or near the surface, and soils that are shallow over nearly impervious material.

Some soil types are classified as belonging to dual hydrologic soil groups, such as A/D, B/D, or C/D. These ratings mean that, under natural conditions, the soil is classified as belonging to hydrologic soil group D, but by artificial methods the water table could be lowered sufficiently so that the soil would fit into a lower runoff potential category.

Table 2-3 presents a summary of hydrologic soil groups encountered (with dual classified groups assigned to the un-drained condition “D”) and respective percent areas of coverage.

Table 2-3: Hydrologic Soil Group Summary per Tributary

Tributary	Hydrologic Soil Coverage Area %								
	A	A/D	B	B/D	C	C/D	D	UND	W
A	0.00	0.00	0.00	70.01	0.36	0.88	28.75	0.00	0.00
B	0.00	0.00	0.09	70.30	1.07	0.04	28.16	0.23	0.10
C	0.00	0.06	0.00	61.51	7.64	0.87	25.03	0.00	4.89
D	0.00	0.00	0.00	71.73	0.09	0.21	27.98	0.00	0.00
E	0.00	0.00	0.00	77.85	0.71	0.91	18.81	0.00	1.73
F	0.00	0.00	0.00	63.79	0.00	1.48	34.73	0.00	0.00
G	0.00	0.00	0.00	50.55	0.04	0.00	49.41	0.00	0.00
H	0.00	0.00	0.00	90.15	5.12	0.00	4.73	0.00	0.00
I	0.00	0.00	0.00	66.44	0.06	0.77	32.73	0.00	0.00
J	0.00	0.00	0.00	65.84	0.00	0.85	33.09	0.00	0.22
K	0.00	0.00	0.00	70.16	0.08	1.21	28.08	0.00	0.47
L	0.00	0.00	0.00	50.53	0.00	1.90	47.57	0.00	0.00
M	0.38	0.00	0.36	77.05	4.82	0.00	17.38	0.01	0.00
N	0.00	0.00	0.00	68.48	0.00	0.45	29.89	0.00	1.18
O	0.00	0.00	0.00	67.36	0.00	0.00	32.50	0.14	0.00
P	0.00	0.00	0.00	75.24	0.00	0.12	24.64	0.01	0.00
Q	0.00	0.00	0.00	64.78	0.00	0.13	35.09	0.00	0.00
R	0.00	0.00	0.00	65.45	0.00	0.90	33.62	0.02	0.00
S	0.00	0.00	0.00	63.35	0.00	0.07	36.57	0.00	0.00
T	0.00	0.00	0.00	70.31	0.00	0.52	29.17	0.00	0.00
U	0.00	0.00	0.00	64.62	0.00	0.01	34.98	0.00	0.39
V	0.00	0.00	0.00	48.77	0.00	0.00	51.23	0.00	0.00
W	0.61	0.00	0.25	75.03	11.94	0.00	12.17	0.00	0.00
X	0.00	0.00	0.00	56.73	0.00	0.00	42.64	0.00	0.64
Y	0.00	0.00	0.00	70.24	0.00	0.15	29.61	0.00	0.00
Z	0.00	0.00	0.00	73.02	0.00	3.30	23.69	0.00	0.00

2.1.5 *Tributary Hydrologic Parameterization*

Subbasin parameterization was performed in order to assign values for hydrologic model development, including: Time of Concentration (Tc), Runoff Curve Number (CN), Percentages of imperviousness, and Peak Rate Factor (K').

Time of Concentration (Tc) is generally defined as the amount of time it takes for a drop of water to travel from the most hydrologically distant point in a basin to the point where that basin discharges to a receiving water body (represented in the model as a node). It is used as a parameter in the computation of a runoff hydrograph, when using the SCS Unit Hydrograph method for hydrograph generation.

The Tc computation was made according to techniques recommended in TR-55 by the National Resource Conservation Service. According to that methodology, runoff generally moves along the surface of a basin as sheet flow, shallow concentrated flow, open channel flow, or some combination of these until it is intercepted by a storage or conveyance system. Travel times for each flow segment are computed and summed, yielding a time of concentration for the basin. Further adjustments can be made to account for movement through ponds, storm sewers and the like in order to account for additional travel time, when not accounted for in the modeled conveyance system.

Travel segment data for this study was developed using aerial photography, one foot SWFWMD 1”=200’ scale aerial imagery, 2-foot SWFWMD digital photogrammetric contours and the digital terrain model to define travel paths, lengths, slopes and land cover for sheet and shallow concentrated flow segments. For open channel segments, cross sectional geometry and roughness values were estimated, and lengths and slopes taken from the terrain model. For conveyance systems (such as pipes, channels, embedded ponds and wetlands) a velocity method was employed to adjust times of concentration.

Runoff Curve Numbers were developed for each subbasin, based on land use and hydrologic soil group designations. Using GIS, basin, land use and soils polygon coverages were intersected with one another, resulting in the creation of a single composite polygon coverage. Each polygon in the composite coverage contains a land use code, a hydrologic soil group, and a basin assignment. Combinations of land use and soils were then used, along with a lookup table of curve number values, to define area-weighted runoff curve numbers within each basin. Percentages of imperviousness were developed in a like manner, based on land use within each subbasin area. Runoff curve numbers that were employed in this analysis were representative of average antecedent moisture conditions (AMC-II) and were adapted from tables provided in the NRCS publication, TR-55.

The peak rate factor (K’) is a numeric value used to describe the shape of a unit hydrograph for a basin. The peak rate factor varies from one basin to another. Throughout the state, typical values applied by hydrologists range from 256 to 484, with even lower values applied in flat, swampy areas. A peak rate factor of 256 was used for all subbasins within the Big Slough watershed. That value is most appropriate in basins that exhibit little topographic relief, which includes the vast majority of all subbasins delineated in the study area.

2.2 Hydraulic Feature Inventory

2.2.1 *Hydraulic Feature Inventory*

An inventory of hydraulic features within the watershed area was initially performed using digital aerial photography, as-built and ERP data, in order to identify conveyance structures, open channels, SMSAs, lakes and wetlands greater than one acre in area throughout the watershed. Each feature was assigned a unique HYD-ID, as an identifier for subsequent field reconnaissance and survey. The hydraulic feature inventory served as an initial database of features to be incorporated into a model database for simulation.

2.2.2 *Summary of Water Body Features by Tributary and Type*

Wetlands and water bodies of varying size are located throughout the watershed area. Named water bodies include: Big Slough Canal or Myakkahatchee Creek, Cocoplum Water Way, Snover Water Way and a series of named internal water ways providing surface drainage for the City of North Port. Area lakes range in size from 1.0 to 125 acres. In addition, numerous retention and detention ponds are present, providing stormwater attenuation and water quality treatment throughout the area. Table 2-4 presents a summary of water bodies and their sizes in each tributary.

Table 2-4: Water Body Size Summary per Tributary

Tributary	Count	Minimum Area (acres)	Maximum Area (acres)	Average Area (acres)
A	0	0.00	0.00	0.00
B	386	0.20	110.46	4.90
C	9	0.60	2.77	1.72
D	0	0.00	0.00	0.00
E	37	0.19	25.93	3.06
F	1	3.99	3.99	3.99
G	9	1.26	17.93	3.93
H	10	0.77	12.99	3.98
I	11	0.07	12.23	2.79
J	5	0.40	2.39	1.20
K	3	2.21	11.54	5.96
L	3	2.86	5.06	3.88
M	18	1.01	6.89	3.13
N	6	1.22	13.75	4.75
O	3	1.05	3.04	1.73
P	1	75.40	75.40	75.40
Q	121	1.03	36.57	4.72
R	77	1.22	60.85	9.02
S	112	0.35	35.30	5.72
T	20	1.08	19.34	5.93
U	363	0.13	125.04	5.61
V	12	1.12	30.60	12.98
W	0	0.00	0.00	0.00
X	5	1.18	15.20	7.16
Y	0	0.00	0.00	0.00
Z	0	0.00	0.00	0.00

2.2.3 *Summary of Conveyance Features by Tributary and Type*

Surface drainage throughout the watershed consists largely of natural sloughs, creeks and numerous manmade ditches and canals. Manmade storage features (SMSA) and natural depressional features (lakes and wetlands) are interconnected by drainage culverts or joined across natural topographic saddles. Table 2-5 summarizes number of conveyance features and Table 2-6 presents lengths of open channels in each tributary.

Table 2-5: Conveyance Features per Tributary

Tributary	Bridge	Channel	Culvert	Riser Pipes	Weir
A	1	23	10	50	175
B	16	382	210	39	3631
C	16	156	108	129	1028
D	0	43	9	3	194
E	0	67	67	50	616
F	0	27	13	1	175
G	1	63	42	28	384
H	2	17	9	13	138
I	0	27	10	17	195
J	0	87	51	1	427
K	4	75	51	77	531
L	0	19	6	0	103
M	0	9	18	0	202
N	2	49	27	69	316
O	0	39	19	13	218
P	0	24	15	0	95
Q	1	65	18	0	867
R	0	114	72	0	752
S	6	104	44	49	1050
T	0	27	19	10	197
U	3	47	116	62	2316
V	1	51	50	5	345
W	1	15	18	0	48
X	0	28	11	0	94
Y	0	49	23	0	239
Z	0	19	11	0	97

Table 2-6: Open Channel Lengths per Tributary

Tributary ID	Count	Minimum (feet)	Maximum (feet)	Average (feet)
A	23	267	1600	780
B	382	124	4819	1173
C	155	193	3674	1011
D	44	252	1896	1067
E	67	221	2110	855
F	27	185	1977	1053
G	64	243	1985	801
H	16	361	2261	908
I	28	293	2347	1179
J	87	255	2844	956
K	75	265	1935	897
L	19	491	2443	1167
M	10	723	5785	2052
N	49	231	2501	882
O	39	260	2186	973
P	24	88	2890	1070
Q	65	367	2677	1300
R	110	384	2878	1449
S	103	257	2309	932
T	26	260	2021	996
U	47	500	4442	1623
V	51	255	2202	786
W	15	1137	4578	2372
X	32	257	2421	1254
Y	49	224	2426	896
Z	19	443	2191	1044

2.2.4 *Tributary Hydraulic Connectivity*

Connectivity within tributary areas was determined through review of aerial photographs, as-built and construction drawings, topographic data and field investigation. That connectivity is defined and stored in the project database as a node-reach topological relationship.

2.3 Magnitude of Present Flooding

The magnitude of present flooding in the watershed was identified by using the results of floodplain and flood protection level of service (LOS) analyses.

2.3.1 *Identification of Flooded Areas*

The City of North Port experiences three distinct types of flooding problems. The most severe and the least common problem is a small number of habitable structures near Big Slough that experience flooding in the 100 year event. Also significant and very isolated is major road flooding in 25-year and 100-year events. Finally extensive local road flooding is common even during a smaller storm event. While inconvenient, this local road flooding poses little risk of damage to the citizens' property.

As shown in Figure 2-1, 2-2, and 2-3 (10, 25, and 100-year LOS figures), the majority of flooding within the City is related to street flooding. An arterial street/emergency route (West Price Boulevard), which provides access to the City's emergency facilities, will flood in 10-year or higher storm events.

Most of the habitable structures that flood in a 100-year storm event are located in the neighborhood located adjacent to Big Slough/Myakkahatchee Creek between Cocoplum Waterway and Tropicaire Boulevard. Locations of the houses that would flood (model predicted) in a 100-year storm event are shown in Figure 2-3 (100-year LOS figure).

2.3.2 *Estimated Number of Structures Flooded (10-, 25-, and 100-year)*

Based on the model results, it is estimated that ~5 structures will flood in a 10-year storm event; ~ 7 structures will flood in a 25-year storm event; and ~75 structures will flood in a 100-year storm event within the City of North Port.

Habitable structures were identified by visually inspecting 2008 aerial imagery in the City of North Port, and placing a point in GIS on the topographical high of the 2004/2007 hybrid LiDAR DTM. The elevation of the 2004/2007 hybrid LiDAR DTM at the point was compared with 10-year, 25-year and 100-year modeled maximum stages. Where maximum stages were higher than the habitable structure, it was reported as a flooded structure. Since the surveyed house pad elevations (finished floor elevations) data was not available, the method applied in estimating the number of flooded structures is very approximate.

2.3.3 *Emergency and Evacuation Route Inundation (10-, 25-, and 100-year)*

Estimated lengths of emergency and evacuation route inundation are presented in Table 2-7. As stated earlier, the majority of flooding within the City is associated with street/road flooding.

Evacuation routes were received from the City of North Port, and emergency routes were identified by Ardaman as the shortest route from an emergency facility to an evacuation route. Street centerlines were acquired from Sarasota County. The positions of all lines were verified in GIS as on the centerline of the road, and moved to the centerline if necessary. Any portion of the centerline of the road that overlapped with the 10-year, 25-year or 100-year floodplain was reported as inundated.

Table 2-7: Estimated Lengths of Road Inundation

Storm Event	Length of Emergency Route Inundation (feet)	Length of Evacuation Route Inundation (feet)
10-year	6,403	1,464
25-year	7,758	3,077
100-year	19,625	7,218

3.0 ALTERNATIVE BMP FORMULATION

According to Southwest Florida Water Management District's Watershed Management Program Guidelines and Specifications (SWFWMD G&S), the generation of best management practices (BMP) alternatives must take into account many watershed management issues in order to formulate an alternative that is permittable, economically viable, and is supported by the public. This study is mainly focused in addressing storm event flooding conditions within the City of North Port.

3.1 BMP Development Process

As described in the SWFWMD G&S, alternatives analysis involves the use and modification of the existing model condition to evaluate BMPs, to address habitual flooding conditions while ensuring no adverse impact.

Best management practice is a phrase which means the best available techniques to reduce harmful environmental impacts. Usually, BMPs for urban watershed management are storage devices that temporarily store and/or treat urban runoff to reduce flooding and/or remove pollutants. For this task, the following alternative methods were evaluated with the unique purpose of reducing flooding: Flow diversion, conveyance improvements, detention and exclusion of all existing drop structures and water control structures (WCS), modification of gated structure and raising road elevations.

3.2 Alternative BMP Concepts

Various BMP alternative concepts evaluated in this study include conveyance improvements, stormwater management storage areas, flood proofing, and flow diversions.

3.3 Alternative BMP Evaluation

BMP alternative evaluations were performed using the existing watershed model and updating it to reflect various BMP scenarios. The following sections provide a brief description of each evaluated BMP alternative and a summary of the evaluation outcome.

3.3.1 *Regional BMPs:*

BMP alternatives that could potentially improve flooding condition in a large area are considered as regional BMPs. These alternatives could significantly alter the hydrodynamics of the drainage system. Although the alternatives presented in this report might not be permittable or economically viable, they provide a better understanding of the hydraulic response when applying the BMPs to further understand improvement limitations.

Six different regional BMPs were evaluated. Results from each BMP evaluation were compared to a benchmark scenario to evaluate the impact of the BMP. The benchmark scenario used was the 24-hour-100 year existing condition model previously submitted. The storm event used for the evaluations was the 24-hour, 100 year event with a Type II, Florida modified rainfall distribution.

For these analyses, the following GIS procedures were used when comparing the existing condition (Benchmark) and the proposed scenario (BMP):

Three potential analyses were considered when comparing each BMP scenario to the Benchmark Scenario.

- For the first analysis, the geoprocessing tool “Symmetric Difference” was applied with the BMP floodplain and benchmark floodplain as inputs, resulting in flooded area reduction and flooded area increase polygons for each scenario. Flooded area reduction represents area that flooded in the benchmark scenario, but not in the BMP scenario, and flooded area increase represents area that did not flood in the benchmark scenario, but did flood in the BMP scenario. Results were then summarized by sub-watershed in acres.

- The second analysis compared the length of street flooding in the BMP scenarios to length of street flooding in the benchmark scenario. The BMP scenario floodplain shapefile was intersected with the streets shapefile, and the total length of flooding was summarized by sub-watershed. Benchmark flooded street data was obtained from previous analysis per LOS (Level of Service) requirements.

- The final analysis compared the number of flooded parcels in the benchmark scenario to the number of flooded parcels in the BMP scenarios. To determine which parcels were flooded we used the parcels polygon shapefile downloaded from Sarasota County. Elevations were extracted from the LiDAR-based terrain data utilizing the centroid of the parcel as a calculation point, and one foot was added to the calculated elevation to represent buildings on fill material. Parcels in waterways or ponds were eliminated and not considered in these analyses. These elevations were then compared to the maximum stages from the CHAN model output for the BMP and benchmark simulation. Any parcels with elevations less than the maximum stage were considered flooded. The comparisons of the BMP scenario to the benchmark scenario were then broken down by sub-watershed for better understanding of local response to the BMP.

3.3.1.1 *BMP #1: Remove Structures throughout City of North Port Waterways*

Objective:

The objective of this BMP is to understand current primary drainage system capacity assuming no losses due to water control structures or drop structures within several waterways. Also, additional connectivity was provided among a few R canals southwest of the I-75 corridor to evaluate the response when transferring some of the existing load throughout less compromised areas.

Description:

Water control structures (WCS) and drop structures (DS) depicted in Figure 3-1 were removed and replaced with an equivalent channel section that mimics the immediate upstream canal's section. Also, and as stated before, additional connections were provided between a few existing secondary manmade R canals. Specifically, canal R-36 was hydraulically connected to the R-43 canal via a weir with equivalent channel geometry. Similarly, the R-43 canal was also connected with the R-24 and R-32 (See Figure 3-1).

Results:

Overall results indicate general improvements immediately north of Price Blvd and along Bass Point waterway while increasing flooding between S Toledo Blvd and S Sumter Blvd. Also, improvements are observed southwest of I-75 where supplemental canal connectivity was provided. An initial evaluation suggests that this BMP may not be feasible due to potential loss of potable water supply, fish and wildlife habitat, and wetlands. Please refer to Figure 3-1 and Table 3-1 for a summary of BMP#1 analysis results.

Table 3-1: BMP#1 Results Summary

Sub-Watershed	Bench Mark Total Flooded Area (Acres)	BMP1 Total Flooded Area (Acres)	BMP1 Total Flooded Area Change (%)	Bench Mark Flooded Street Length (Feet)	BMP1 Flooded Street Length (Feet)	BMP1 Flooded Street Length Change (%)	Bench Mark Flooded Parcels (Units)	BMP1 Flooded Parcels (Units)	BMP1 Flooded Parcels Change (%)
A	58	59	0.8	7,959	8,124	2.1	2	2	0.0
B	15,839	15,881	0.3	304,750	306,791	0.7	665	655	-1.5
C	724	745	2.8	118,951	124,883	5.0	38	40	5.3
D	150	172	14.5	38,510	47,969	24.6	15	17	13.3
E	407	446	9.5	47,961	65,534	36.6	2	2	0.0
F	98	124	25.7	22,234	34,741	56.3	1	1	0.0
G	250	208	-16.7	53,687	36,920	-31.2	17	9	-47.1
H	199	186	-6.4	1,082	548	-49.3	2	2	0.0
I	165	165	0.2	21,519	25,051	16.4	2	1	-50.0
J	335	298	-11.2	84,088	57,952	-31.1	15	15	0.0
K	240	237	-1.3	45,022	44,366	-1.5	5	5	0.0
L	69	67	-1.5	11,354	11,267	-0.8	0	0	0.0
M	2,426	2,475	2.0	0	0	0.0	0	0	0.0
N	150	146	-2.7	14,407	14,101	-2.1	1	1	0.0
O	189	177	-6.2	56,008	49,468	-11.7	9	8	-11.1
P	191	192	0.5	11,134	11,173	0.4	6	6	0.0
Q	3,733	3,735	0.1	0	0	0.0	0	0	0.0
R	2,294	2,320	1.1	86,929	99,236	14.2	43	60	39.5
S	2,489	2,454	-1.4	23,286	20,576	-11.6	74	74	0.0
T	206	190	-8.1	14,915	9,256	-37.9	5	2	-60.0
U	9,907	9,888	-0.2	8,973	8,934	-0.4	19	19	0.0
V	553	545	-1.5	20,054	18,184	-9.3	6	6	0.0
W	1,207	1,207	0.0	0	0	0.0	0	0	0.0
X	92	92	0.4	7,471	7,445	-0.3	2	2	0.0
Y	189	179	-5.1	70,162	63,890	-8.9	11	11	0.0
Z	51	48	-5.9	14,978	14,783	-1.3	0	0	0.0
Total	42,211	42,236	0.1	1,085,434	1,081,192	-0.4	940	938	-0.2

3.3.1.2 *BMP #2: Constrain Flow Entering City Of North Port at Big Slough Canal*

Objective:

The objective of this BMP is to constrain the volume of water coming from offsite areas through the Big Slough canal prior to entering the City in the Estates area.

The BMP would involve real estate acquisition, maintenance activities, dam construction and removal of existing hydraulic structures (culverts).

Description:

On the northwest City boundary, at the intersection of Big Slough canal with R-36 and R-580 waterways, all existing earthen weirs were raised to limit runoff from offsite areas, leaving the Big Slough canal as the only conveyance system into the western portion of the City (see Figure 3-2). All earthen weirs farther north, at the intersection of Big Slough canal and Power Line Road were raised as well.

Results:

This BMP results in approximately 0.5 feet flood stage reduction within the vicinity of the Big Slough canal from the City's northern border to just south of I-75. Likewise, results indicate that flood stages increase approximately 1.0 foot in the offsite areas north of R-36 and R-580 waterways. Table 3-2 summarizes BMP#2 analysis results.

Table 3-2: BMP#2 Results Summary

Sub-Watershed	Bench Mark Total Flooded Area (Acres)	BMP2 Total Flooded Area (Acres)	BMP2 Total Flooded Area Change (%)	Bench Mark Flooded Street Length (Feet)	BMP2 Flooded Street Length (Feet)	BMP2 Flooded Street Length Change (%)	Bench Mark Flooded Parcels (Units)	BMP2 Flooded Parcels (Units)	BMP2 Flooded Parcels Change (%)
A	58	58	0.0	7,959	7,958	0.0	2	2	0.0
B	15,839	16,092	1.6	304,750	260,559	-14.5	665	458	-31.1
C	724	725	0.0	118,951	118,959	0.0	38	38	0.0
D	150	150	0.0	38,510	38,460	-0.1	15	15	0.0
E	407	407	0.0	47,961	47,969	0.0	2	2	0.0
F	98	98	0.0	22,234	22,241	0.0	1	1	0.0
G	250	250	0.0	53,687	53,666	0.0	17	17	0.0
H	199	199	-0.1	1,082	1,078	-0.4	2	2	0.0
I	165	165	0.0	21,519	21,514	0.0	2	2	0.0
J	335	314	-6.4	84,088	72,205	-14.1	15	12	-20.0
K	240	240	0.0	45,022	45,020	0.0	5	5	0.0
L	69	69	0.0	11,354	11,354	0.0	0	0	0.0
M	2,426	2,421	-0.2	0	0	0.0	0	0	0.0
N	150	150	0.0	14,407	14,407	0.0	1	1	0.0
O	189	189	0.0	56,008	55,994	0.0	9	9	0.0
P	191	179	-6.1	11,134	10,124	-9.1	6	4	-33.3
Q	3,733	3,742	0.2	0	0	0.0	0	0	0.0
R	2,294	2,302	0.3	86,929	86,186	-0.9	43	45	4.7
S	2,489	2,486	-0.2	23,286	20,530	-11.8	74	73	-1.4
T	206	206	0.0	14,915	14,904	-0.1	5	5	0.0
U	9,907	9,907	0.0	8,973	8,973	0.0	19	19	0.0
V	553	552	-0.2	20,054	20,043	-0.1	6	6	0.0
W	1,207	1,207	0.0	0	0	0.0	0	0	0.0
X	92	87	-5.1	7,471	5,780	-22.6	2	2	0.0
Y	189	188	-0.5	70,162	69,877	-0.4	11	11	0.0
Z	51	51	-0.1	14,978	14,952	-0.2	0	0	0.0
Total	42,211	42,434	0.5	1,085,434	1,022,753	-5.8	940	729	-22.4

3.3.1.3 *BMP #3: Diversion Alternative*

Objective:

The purpose of this BMP is to divert flows from offsite areas via the existing R-36 canal, by increasing its capacity and improving its hydraulic connectivity with Deer Prairie Slough canal.

This BMP would involve construction of new structures, maintenance activities, real estate acquisition, and detailed hydrologic and hydraulic evaluation of the western boundary (Deer Prairie Slough watershed).

Description:

On the northwest boundary, along R-36 canal, two earthen overflow weirs were provided to enhance the R-36 waterway connectivity with Deer Prairie Slough canal (See Figure 3). Weir location and parameters were selected based on terrain and hydraulic constraints. The weirs were located on the northwest corner to address flooding in the Estates area and along Big Slough canal. Weir lengths and elevation used are as follows: Weir 1, L: 300 feet at EL:22.0 feet, NAVD88 and Weir 2, L:450 feet at EL:21.0 feet, NAVD88. The R-36 canal capacity was also doubled by replacing the existing cross-section with a 60 feet bottom width trapezoidal channel with 4:1 side slopes. The current model assumes no tailwater influence from Deer Prairie Slough.

Results:

As anticipated, simulation results indicate flood reduction throughout the Estates area, along the Big Slough Canal between the R-36 canal and I-75 corridor as well as in the localized area along Big Slough south of I-75 (See Figure 3-3). Overall results indicate a flood stage reduction between 0.1 foot and 1.0 foot throughout the aforementioned areas.

As mentioned before, these results were obtained assuming no increase in stages in the Deer Prairie Slough Canal since a fixed tailwater condition was used for modeling purposes. Further consideration of impacts of additional flow into the Deer Prairie Slough watershed should be taken into account during final evaluation of BMP's. Table 3-3 summarizes BMP#3 analysis results.

Table 3-3: BMP#3 Results Summary

Sub-Watershed	Bench Mark Total Flooded Area (Acres)	BMP3 Total Flooded Area (Acres)	BMP3 Total Flooded Area Change (%)	Bench Mark Flooded Street Length (Feet)	BMP3 Flooded Street Length (Feet)	BMP3 Flooded Street Length Change (%)	Bench Mark Flooded Parcels (Units)	BMP3 Flooded Parcels (Units)	BMP3 Flooded Parcels Change (%)
A	58	58	0.0	7,959	7,958	0.0	2	2	0.0
B	15,839	15,720	-0.8	304,750	282,118	-7.4	665	568	-14.6
C	724	724	-0.1	118,951	118,890	-0.1	38	38	0.0
D	150	150	-0.2	38,510	38,348	-0.4	15	15	0.0
E	407	407	-0.1	47,961	47,880	-0.2	2	2	0.0
F	98	98	-0.3	22,234	22,141	-0.4	1	1	0.0
G	250	250	0.0	53,687	53,663	0.0	17	17	0.0
H	199	198	-0.3	1,082	1,065	-1.5	2	2	0.0
I	165	165	0.0	21,519	21,463	-0.3	2	2	0.0
J	335	316	-5.7	84,088	73,854	-12.2	15	13	-13.3
K	240	240	0.0	45,022	45,022	0.0	5	5	0.0
L	69	69	0.0	11,354	11,354	0.0	0	0	0.0
M	2,426	2,426	0.0	0	0	0.0	0	0	0.0
N	150	150	0.0	14,407	14,407	0.0	1	1	0.0
O	189	189	0.0	56,008	55,998	0.0	9	9	0.0
P	191	184	-3.4	11,134	10,572	-5.0	6	4	-33.3
Q	3,733	3,731	-0.1	0	0	0.0	0	0	0.0
R	2,294	2,199	-4.1	86,929	64,689	-25.6	43	27	-37.2
S	2,489	2,486	-0.1	23,286	20,653	-11.3	74	73	-1.4
T	206	206	0.0	14,915	14,892	-0.2	5	5	0.0
U	9,907	9,907	0.0	8,973	8,973	0.0	19	19	0.0
V	553	552	-0.2	20,054	19,978	-0.4	6	6	0.0
W	1,207	1,207	0.0	0	0	0.0	0	0	0.0
X	92	86	-5.6	7,471	6,029	-19.3	2	2	0.0
Y	189	184	-2.4	70,162	68,020	-3.1	11	9	-18.2
Z	51	51	-0.2	14,978	14,924	-0.4	0	0	0.0
Total	42,211	41,953	-0.6	1,085,434	1,022,891	-5.8	940	820	-12.8

3.3.1.4 *BMP #4: R-580 Improvements*

Objective:

The objective of this alternative is to induce additional flows through Creighton waterway by improving current conveyance capacity in the R-580 waterway.

Description:

Waterway R-580's bottom profile was reset assuming a flat ditch at its lower elevation of 15.0 feet, NAVD along the entire stretch. The current bottom configuration of the R-580 waterway transitions between 17.71 feet, NAVD88 bottom elevation on the most western end to 23.0 feet, NAVD88 bottom elevation at the most eastern end and sags between these ends at elevation 15.0 feet, NAVD88 (see Figure 3-4).

Results:

This alternative results in small improvements within the vicinity of Big Slough. However, and as intended, additional flows were induced towards Creighton waterway. Inducing additional flow through Creighton waterway will result in additional flooding near I-75 for this particular rainfall event as shown on Figure 3-4. A summary of BMP#4 analysis results is presented in Table 3-4.

Table 3-4: BMP#4 Results Summary

Sub-Watershed	Bench Mark Total Flooded Area (Acres)	BMP4 Total Flooded Area (Acres)	BMP4 Total Flooded Area Change (%)	Bench Mark Flooded Street Length (Feet)	BMP4 Flooded Street Length (Feet)	BMP4 Flooded Street Length Change (%)	Bench Mark Flooded Parcels (Units)	BMP4 Flooded Parcels (Units)	BMP4 Flooded Parcels Change (%)
A	58	58	-0.1	7,959	7,953	-0.1	2	2	0.0
B	15,839	15,806	-0.2	304,750	298,627	-2.0	665	638	-4.1
C	724	725	0.1	118,951	119,411	0.4	38	38	0.0
D	150	151	0.2	38,510	38,526	0.0	15	15	0.0
E	407	408	0.1	47,961	48,223	0.6	2	2	0.0
F	98	99	0.4	22,234	22,517	1.3	1	1	0.0
G	250	250	0.1	53,687	53,782	0.2	17	17	0.0
H	199	199	-0.1	1,082	1,077	-0.4	2	2	0.0
I	165	165	0.1	21,519	21,636	0.6	2	2	0.0
J	335	329	-1.9	84,088	80,578	-4.2	15	15	0.0
K	240	240	0.0	45,022	45,026	0.0	5	5	0.0
L	69	69	0.0	11,354	11,354	0.0	0	0	0.0
M	2,426	2,426	0.0	0	0	0.0	0	0	0.0
N	150	150	0.0	14,407	14,412	0.0	1	1	0.0
O	189	189	0.1	56,008	56,041	0.1	9	9	0.0
P	191	189	-0.7	11,134	11,005	-1.2	6	5	-16.7
Q	3,733	3,720	-0.4	0	0	0.0	0	0	0.0
R	2,294	2,288	-0.3	86,929	85,260	-1.9	43	43	0.0
S	2,489	2,489	0.0	23,286	22,823	-2.0	74	74	0.0
T	206	206	0.0	14,915	14,957	0.3	5	5	0.0
U	9,907	9,910	0.0	8,973	8,973	0.0	19	19	0.0
V	553	577	4.3	20,054	23,139	15.4	6	10	66.7
W	1,207	1,207	0.0	0	0	0.0	0	0	0.0
X	92	90	-1.3	7,471	7,215	-3.4	2	2	0.0
Y	189	188	-0.4	70,162	69,897	-0.4	11	11	0.0
Z	51	51	-0.1	14,978	14,939	-0.3	0	0	0.0
Total	42,211	42,179	-0.1	1,085,434	1,077,371	-0.7	940	916	-2.6

3.3.1.5 *BMP #5: Increase Capacity on Southern Boundary*

Objective:

The objective of this alternative is to evaluate the system response when doubling the southern boundary discharge capacity into Charlotte Harbor area.

The BMP would involve conveyance improvements, construction of new structures and/ or reconditioning of existing structures, maintenance activities, real estate acquisition, and detailed evaluation of the southern boundary through hydrology and hydraulic modeling.

Description:

All structures discharging from Cocoplum waterway into the Charlotte Harbor area under Hillsborough Blvd and their upstream weirs were doubled in capacity. A total of 13 structures under Hillsborough Blvd were double in the model and a total of 6 lateral weirs along Cocoplum waterway were doubled in size (see Figure 3-5).

Results:

This alternative was evaluated for information purposes only, as it is understood that inducing additional flows into Charlotte Harbor would not be desirable. Results indicate that improvements relative to house flooding were not significant; however roads experienced a considerable flood reduction between S Sumter Blvd and Atwater Dr. (see Figure 3-5). A summary of BMP#5 analysis results is presented in Table 3-5.

Table 3-5: BMP#5 Results Summary

Sub-Watershed	Bench Mark Total Flooded Area (Acres)	BMP5 Total Flooded Area (Acres)	BMP5 Total Flooded Area Change (%)	Bench Mark Flooded Street Length (Feet)	BMP5 Flooded Street Length (Feet)	BMP5 Flooded Street Length Change (%)	Bench Mark Flooded Parcels (Units)	BMP5 Flooded Parcels (Units)	BMP5 Flooded Parcels Change (%)
A	58	58	0.1	7,959	8,001	0.5	2	1	-50.0
B	15,839	15,836	0.0	304,750	304,487	-0.1	665	665	0.0
C	724	612	-15.6	118,951	75,331	-36.7	38	25	-34.2
D	150	121	-19.8	38,510	20,694	-46.3	15	7	0.0
E	407	395	-3.1	47,961	42,761	-10.8	2	2	0.0
F	98	76	-22.7	22,234	8,236	-63.0	1	1	-11.8
G	250	245	-2.1	53,687	51,993	-3.2	17	15	0.0
H	199	196	-1.4	1,082	1,000	-7.6	2	2	-50.0
I	165	143	-13.1	21,519	8,237	-61.7	2	1	0.0
J	335	335	0.0	84,088	84,042	-0.1	15	15	0.0
K	240	238	-0.8	45,022	44,688	-0.7	5	5	0.0
L	69	67	-2.1	11,354	11,317	-0.3	0	0	0.0
M	2,426	2,426	0.0	0	0	0.0	0	0	0.0
N	150	149	-0.6	14,407	14,407	0.0	1	1	0.0
O	189	180	-4.6	56,008	51,322	-8.4	9	9	0.0
P	191	191	0.0	11,134	11,133	0.0	6	6	0.0
Q	3,733	3,733	0.0	0	0	0.0	0	0	0.0
R	2,294	2,293	-0.1	86,929	86,339	-0.7	43	43	0.0
S	2,489	2,489	0.0	23,286	23,282	0.0	74	74	0.0
T	206	206	-0.3	14,915	14,756	-1.1	5	5	0.0
U	9,907	9,907	0.0	8,973	8,973	0.0	19	19	0.0
V	553	553	0.0	20,054	20,047	0.0	6	6	0.0
W	1,207	1,207	0.0	0	0	0.0	0	0	0.0
X	92	92	0.0	7,471	7,471	0.0	2	2	0.0
Y	189	189	0.0	70,162	70,161	0.0	11	11	0.0
Z	51	51	0.0	14,978	14,976	0.0	0	0	0.0
Total	42,211	41,988	-0.5	1,085,434	983,655	-9.4	940	915	-2.7

3.3.1.6 *BMP #6: Upstream Detention Alternative*

Objective:

The objective of this analysis is to examine the effects when attenuating peak flow rates in agricultural areas along the Big Slough canal with a series of new detention facilities.

This BMP would involve construction of stormwater management storage areas, maintenance activities and real estate acquisition.

Description:

In offsite areas, seven detention facilities were added to the model. Each detention area has a 100 acre footprint and is more than 10 feet deep. These areas were located on upland sites along Big Slough canal where feasible (see Figure 3-6). The bottom elevations of these detention areas were set at the adjacent canal initial elevation. Each of these ponds was linked to the Big Slough canal by a 500 feet weir. The crest elevations were set at the bottom of the pond. The total anticipated detained volume is 600 acre-ft per detention site, a total of 4,200 acre-ft.

Results:

Results indicate that the supplemental detention area alternative produces little reduction in peak water surface elevations. Elevations along Big Slough were reduced by only 0.1 to 0.6 feet, making this option less attractive. The extent of flooding for this BMP is essentially the same as the existing scenario with few flood reduction areas along the Big Slough canal (see Figure 3-6). Initial evaluation suggests that the costs associated with purchasing the proposed detention areas from private landowners will likely be high. In addition the complexity of building reservoirs will make it a less attractive solution; e.g. runup wave analysis will increase the height of the perimeter berm. Total costs include an initial cost of location, proper land acquisition and construction, in addition to recurring maintenance and operation costs. A summary of BMP#6 analysis results is presented in Table 3-6.

Table 3-6: BMP#6 Results Summary

Sub-Watershed	Bench Mark Total Flooded Area (Acres)	BMP6 Total Flooded Area (Acres)	BMP6 Total Flooded Area Change (%)	Bench Mark Flooded Street Length (Feet)	BMP6 Flooded Street Length (Feet)	BMP6 Flooded Street Length Change (%)	Bench Mark Flooded Parcels (Units)	BMP6 Flooded Parcels (Units)	BMP6 Flooded Parcels Change (%)
A	58	58	0.0	7,959	7,959	0.0	2	2	0.0
B	15,839	15,645	-1.2	304,750	280,497	-8.0	665	563	-15.3
C	724	724	-0.1	118,951	118,818	-0.1	38	38	0.0
D	150	150	-0.5	38,510	38,067	-1.2	15	15	0.0
E	407	407	-0.1	47,961	47,827	-0.3	2	2	0.0
F	98	98	-0.6	22,234	22,019	-1.0	1	1	0.0
G	250	250	0.0	53,687	53,659	-0.1	17	17	0.0
H	199	197	-0.8	1,082	1,021	-5.6	2	2	0.0
I	165	165	-0.1	21,519	21,418	-0.5	2	2	0.0
J	335	311	-7.2	84,088	72,123	-14.2	15	13	-13.3
K	240	240	0.0	45,022	45,022	0.0	5	5	0.0
L	69	69	0.0	11,354	11,354	0.0	0	0	0.0
M	2,426	2,426	0.0	0	0	0.0	0	0	0.0
N	150	150	0.0	14,407	14,407	0.0	1	1	0.0
O	189	189	-0.1	56,008	55,961	-0.1	9	9	0.0
P	191	183	-3.8	11,134	10,588	-4.9	6	4	-33.3
Q	3,733	3,723	-0.3	0	0	0.0	0	0	0.0
R	2,294	2,268	-1.2	86,929	80,023	-7.9	43	42	-2.3
S	2,489	2,485	-0.2	23,286	20,307	-12.8	74	73	-1.4
T	206	206	0.0	14,915	14,866	-0.3	5	5	0.0
U	9,907	9,907	0.0	8,973	8,973	0.0	19	19	0.0
V	553	550	-0.5	20,054	19,833	-1.1	6	6	0.0
W	1,207	1,207	0.0	0	0	0.0	0	0	0.0
X	92	88	-4.4	7,471	6,413	-14.2	2	2	0.0
Y	189	187	-0.7	70,162	69,679	-0.7	11	11	0.0
Z	51	51	-0.4	14,978	14,887	-0.6	0	0	0.0
Total	42,211	41,934	-0.7	1,085,434	1,035,721	-4.6	940	832	-11.5

3.3.2 *BMP Evaluation of Four Crossings*

Under this evaluation, as requested by the City of North Port, hydraulic performance and the effects of potential conveyance improvements at four sites, including: R-36 Canal at I-75, Myakkahatchee Creek at I-75, R-36 Canal at Tropicaire Boulevard, and Myakkahatchee Creek at Tropicaire Boulevard were analyzed.

A systematic evaluation was conducted to first understand the existing hydraulic behavior of each of the four crossings under various synthetic storm events. Head differences across each structure, flow conditions at peak discharge, and hydraulic connectivity (including flow patterns in adjacent areas) were assessed to understand unique conditions at each crossing.

In order to evaluate effectiveness of potential BMP improvements at these locations (including any resulting flood reduction and/or downstream flood increase), conveyance capacity at each site was increased by doubling the number of existing structures. This was achieved by adding a duplicate set of model reach elements at each location. A description of existing crossings and the applied BMP for evaluation are provided in Table 3-7.

Table 3-7: Location and Description of Existing and BMP Conditions

Crossing Location	Existing Crossing	BMP Condition
R-36 Canal at I-75	Two (2) 7.5' x 6' box culverts	Two (2) identical 7.5' x 6' box culverts were added in parallel to existing structure
Myakkahatchee Creek at I-75	Two (2) parallel bridges with 8 piers and a total span of 540 feet	Two (2) identical parallel bridges were added in parallel to existing structure
R-36 Canal at Tropicaire Blvd	Two (2) 5' diameter RCP culverts	Two (2) identical 5' diameter RCP culverts were added in parallel to existing structure
Myakkahatchee Creek at Tropicaire Blvd	One (1) bridge with 4 piers and a total span of 150 feet	One (1) identical bridge was added in parallel to existing structure

3.3.2.1 *R-36 Canal at I-75 Evaluation*

Existing condition model results indicate that more than two feet of head difference occurs across this structure during the 100-year storm event (see Table 3-8 and Figures 3-7 & 3-8). Under the proposed BMP condition, model results indicate that a peak stage reduction of up to 0.6 feet occurs upstream of the crossing, while a stage increase of approximately 0.6 feet occurs in the downstream areas. It is notable that reduced discharges are observed from the R-36 Canal westward into the adjacent Deer Prairie Slough watershed for the proposed BMP condition. This overflow connection with the adjacent watershed to the west is located north of I-75. The reduced overflow results in an increased total volume remaining within the North Port area, by virtue of the improved conveyance capacity of the proposed BMP. In summary, increasing the crossing capacity of the R-36 Canal at I-75 may reduce water levels upstream of the crossing, but also raises flood elevations in the downstream areas. Mitigation of flooding in downstream areas was beyond the scope of this evaluation.

Table 3-8: R-36 Canal at I-75 Crossing Evaluation Results Summary

Table 3-8 (a): Existing Condition Upstream and Downstream Node Maximum Stages and Flows

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)*	NR3210	17.47	19.57	20.38	20.99	21.69	22.30
D/S Node Max Stage (ft)*	NR3220	16.82	18.33	18.86	19.20	19.56	19.92
Difference in Stage (ft)	n/a	0.65	1.24	1.52	1.78	2.14	2.38
Flow (cfs)	n/a	424	586	654	710	779	846

Table 3-8 (b): With BMP Upstream and Downstream Node Maximum Stages and Flows

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)*	NR3210	17.05	18.97	19.74	20.34	21.08	22.08
D/S Node Max Stage (ft)*	NR3220	16.88	18.61	19.25	19.69	20.19	20.74
Difference in Stage (ft)	n/a	0.17	0.36	0.49	0.65	0.90	1.34
Flow (cfs)	n/a	433	631	735	845	997	1223

Table 3-8 (c): Difference in Flows and Stages between BMP and Existing Condition

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)	NR3210	-0.42	-0.60	-0.64	-0.65	-0.61	-0.22
D/S Node Max Stage (ft)	NR3220	0.06	0.28	0.39	0.49	0.63	0.82
Flow (cfs)	n/a	9	45	82	135	218	377

*Vertical datum of stage reported in the table is with reference to NAVD88 Datum.

3.3.2.2 *Myakkahatchee Creek at I-75 Evaluation*

Existing condition model results indicate that approximately one foot of head difference occurs across this structure during extreme storm events (see Table 3-9 and Figures 3-9 & 3-10). This head difference is relatively small considering the magnitude of flow that arrives from the upstream contributing watershed (up to 8000 cubic feet per second). The applied BMP at this location assumes that the conveyance capacity of the bridge crossing was doubled. In other words, an identical, parallel 540-foot bridge span was added to investigate the benefit of increasing bridge capacity. Under this hypothetical scenario, model results indicate that a localized stage reduction of 0.7 feet is observed immediately at the upstream end of the crossing. However, peak stage reductions decrease further upstream of the crossing along the creek. No significant change in peak elevations is observed 1,200 feet upstream of the crossing. Also, no significant change to flooding conditions is observed in areas downstream of the crossing. In summary, increasing the crossing capacity of the bridge over Myakkahatchee Creek at I-75 may reduce water levels immediately upstream of the crossing, but does not generally improve flooding conditions north of I-75. The area impacted by this improvement is very localized and would not justify the cost of the improvement.

3.3.2.3 *R-36 Canal at Tropicaire Boulevard Evaluation*

Existing condition model results indicate that up to three feet of head difference occurs across this structure during various storm events (see Table 3-10 and Figures 3-11 & 3-12). Under the proposed BMP conditions, model results indicate a peak stage reduction of approximately 0.8 feet upstream of the crossing, while a stage increase of up to 1.1 feet occurs downstream of Tropicaire. During all events, discharges from the R-36 canal into Deer Prairie Slough watershed are observed north of Tropicaire Boulevard. The proposed BMP results in a reduction of those discharges to Deer Prairie Slough and a resulting increased total volume remaining within the North Port area. In summary, while increasing the crossing capacity of the R-36 Canal at Tropicaire Boulevard may reduce water levels upstream of the crossing, it also raises flood elevations in downstream areas. Mitigation of flooding in downstream areas was beyond the scope of this evaluation.

3.3.2.4 *Myakkahatchee Creek at Tropicaire Boulevard Evaluation*

Existing condition model results indicate that the maximum calculated head difference for the various storm events is 0.2 feet; therefore the bridge is not causing a flow restriction (see Table 3-11 and Figures 3-13 & 3-14). Regardless, a BMP was applied for evaluation and assumes that the conveyance capacity was increased (doubled) by adding an identical bridge element in parallel to the existing structure. Under this scenario, model results indicate that a maximum localized stage reduction of approximately 0.1 feet was calculated, yet no significant change is observed further upstream nor downstream of the crossing. In summary, increasing the crossing capacity of the bridge over Myakkahatchee Creek at Tropicaire Boulevard does not substantially improve flooding conditions north of I-75.

Model results (maximum stages and maximum flows) for various storm events (Mean Annual, 5-year, 10-year, 25-year, 50-year, and 100-year) are provided in tabular form within the accompanying geodatabase.

Table 3-9: Myakkahatchee Creek at I-75 Crossing Evaluation Results Summary

Table 3-9 (a): Existing Condition Upstream and Downstream Node Maximum Stages and Flows

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)*	NB0750	20.40	21.89	22.19	22.46	22.82	23.93
D/S Node Max Stage (ft)*	NB0780	19.81	20.86	21.13	21.37	21.79	22.83
Difference in Stage (ft)	n/a	0.59	1.03	1.07	1.09	1.02	1.10
Flow (cfs)	n/a	1306	3045	3640	4236	5290	7816

Table 3-9 (b): With BMP Upstream and Downstream Node Maximum Stages and Flows

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)*	NB0750	19.97	21.16	21.45	21.71	22.14	23.35
D/S Node Max Stage (ft)*	NB0780	19.82	20.87	21.14	21.39	21.83	23.02
Difference in Stage (ft)	n/a	0.16	0.29	0.31	0.32	0.30	0.33
Flow (cfs)	n/a	1311	3601	3673	4291	5175	8509

Table 3-9 (c): Difference in Flows and Stages between BMP and Existing Condition

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)	NB0750	-0.43	-0.72	-0.75	-0.75	-0.68	-0.58
D/S Node Max Stage (ft)	NB0780	0.00	0.01	0.01	0.02	0.04	0.20
Flow (cfs)	n/a	5	556	33	55	-115	692

*Vertical datum of stage reported in the table is with reference to NAVD88 Datum.

Table 3-10: R-36 Canal at Tropicaire Boulevard Crossing Evaluation Results Summary

Table 3-10 (a): Existing Condition Upstream and Downstream Node Maximum Stages and Flows

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)*	NR0170	21.57	21.99	22.08	22.15	22.22	22.33
D/S Node Max Stage (ft)*	NR3190	18.15	19.74	20.48	21.07	21.73	22.31
Difference in Stage (ft)	n/a	3.42	2.25	1.61	1.08	0.49	0.01
Flow (cfs)	n/a	414	420	420	420	421	420

Table 3-10 (b): With BMP Upstream and Downstream Node Maximum Stages and Flows

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)*	NR0170	20.77	21.77	21.94	22.06	22.18	22.32
D/S Node Max Stage (ft)*	NR3190	19.29	20.68	21.11	21.49	21.90	22.32
Difference in Stage (ft)	n/a	1.48	1.10	0.83	0.57	0.28	0.00
Flow (cfs)	n/a	550	575	576	578	578	577

Table 3-10 (c): Difference in Flows and Stages between BMP and Existing Condition

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)	NR0170	-0.80	-0.21	-0.14	-0.09	-0.04	0.00
D/S Node Max Stage (ft)	NR3190	1.14	0.94	0.63	0.42	0.17	0.01
Flow (cfs)	n/a	136	156	156	157	158	157

*Vertical datum of stage reported in the table is with reference to NAVD88 Datum.

Table 3-11: Myakkahatchee Creek at Tropicaire Boulevard Crossing Evaluation Results Summary

Table 3-11(a): Existing Condition Upstream and Downstream Node Maximum Stages and Flows

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)*	NB0700	22.79	24.28	24.51	24.71	24.99	26.13
D/S Node Max Stage (ft)*	NB0710	22.70	24.08	24.31	24.52	24.83	26.07
Difference in Stage (ft)	n/a	0.09	0.19	0.20	0.20	0.16	0.06
Flow (cfs)	n/a	1332	2582	2785	2890	2973	2756

Table 3-11(b): With BMP Upstream and Downstream Node Maximum Stages and Flows

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)*	NB0700	22.73	24.17	24.41	24.63	24.94	26.11
D/S Node Max Stage (ft)*	NB0710	22.71	24.12	24.35	24.57	24.88	26.09
Difference in Stage (ft)	n/a	0.02	0.05	0.06	0.06	0.05	0.02
Flow (cfs)	n/a	1353	2712	3001	3167	3278	3031

Table 3-11(c): Difference in Flows and Stages between BMP and Existing Condition

Location	Node Name	Mean Annual	1 Day 10YR	1 Day 25YR	1 Day 50YR	1 Day 100YR	5 Day 100YR
U/S Node Max Stage (ft)	NB0700	-0.06	-0.10	-0.10	-0.09	-0.06	-0.02
D/S Node Max Stage (ft)	NB0710	0.01	0.04	0.04	0.05	0.05	0.02
Flow (cfs)	n/a	21	131	217	277	305	275

*Vertical datum of stage reported in the table is with reference to NAVD88 Datum.

3.3.3 *WCS-162 Evaluation*

WCS-162 is located on the R-36 Canal, north of Interstate 75, and immediately upstream of Tropicaire Boulevard (refer to Figure 3-15). This is the only gated weir structure on the R-36 Canal, with one 2.25 feet high by 2 feet wide pull up slide gate. The City generally operates this structure by fully opening the gate in anticipation of a storm event to lower the water level in the R-36 canal to minimize potential upstream flooding; otherwise, the gate remains closed. The City staff would like to determine if adding gates would help draw down the canal more quickly and increase conveyance capacity.

3.3.3.1 *R-36 Canal Drawdown Evaluation*

To reduce impacts downstream of WCS-162 while improving peak conditions upstream of the structure, an evaluation was performed to determine the benefits of adding additional gates. The evaluation included calculating the drawdown time for the R-36 canal and the additional conveyance capacity provided by the additional gates.

To evaluate BMPs at WCS-162, Ardaman requested to survey the structure to better understand the geometry of the structure and canal with the purpose of assessing availability of adequate space for additional gates. The survey data provided by Van Buskirk/Fish & Associates, Inc. is included in Appendix A, and the structure pictures are provided in Appendix B. The existing condition model was revised using the latest (2014) survey information for this BMP Evaluation. The update model simulated results rendered no change in model results compared to the May 2012 Governing Board approved model.

The benefits of reducing time required to lower R-36 canal elevation by adding gates at WCS-162 upstream of the structure were assessed by performing a drawdown analysis. For the drawdown evaluation, the R-36 canal upstream of WCS-162 was assumed to be at the control elevation of the weir (elevation 18.3 feet NAVD88). The water level at the canal was simulated by fully opening the existing gate with no additional flows coming into the canal. The existing condition drawdown simulation results indicates that it would take approximately 18 hours to lower the canal to elevation 15 feet (refer to Figure 3-16).

The canal drawdown simulation was repeated for one and two additional gates scenarios. The canal stage hydrographs upstream of the structure with additional gates are also plotted in Figure 3-16. As shown in Figure 3-16, the time required to drawdown R-36 canal will decrease to 11 hours by adding an identical gate. When 2 additional matching gates are provided, the time require to drawdown R-36 canal would decrease to 9 hours. Therefore, the total time required to drawdown R-36 canal (to elevation 15 feet) upstream of WCS-162 will be reduced by 7 and 9 hours by adding one and two additional gates respectively.

3.3.3.2 *Storm Events Simulation Results*

The mean annual, 5-year, and 10-year storm events were simulated using the updated existing condition model with 2014 survey information. The City’s water control structure operation criteria were employed in these simulations. The gates are closed at the beginning of the simulation, and they will be fully open when Big Slough Canal stage at Tropicaire rises to Elevation 15.88 feet NAVD88.

Benefits of flood control at the upstream of WCS-162 during a storm event were evaluated by simulating the mean annual storm event starting at the drawdown stage levels (Elevation 15 feet NAVD88). For this evaluation, initial stages in R-36 Canal upstream of WCS-162 were set to the drawdown levels, i.e. simulated canal stages after 18 hours of drawdown simulation. The lower initials at the canal will account for the additional canal storage capacity available upstream of WCS-162. During the lower initial condition simulation, the WCS-162 gate was assumed to be opened throughout the simulation. Model results with lowered initials were compared to the results with the normal initial stage, which is at the invert elevation (at elevation 18.29 feet NAVD88) of WCS-162 weir. Table 3-12 presents model results and comparison of max stages of R-36 canal upstream of WCS-162 weir with normal and lowered initial stage at the canal for the mean annual storm event. As indicated in the table, simulated results suggest that there will be no difference in peak stages in R-36 canal due to the lower initial canal stage. It should be noted that model results suggest the 50-foot wide weir at WCS-162 overtops by 2.6 feet conveying 328 cfs of peak flow across the structure during the mean annual storm event. The R-36 Canal upstream of WCS-162 holds approximately 30 acre-feet of storage capacity behind the gate, whereas more than 3,000 acre-feet of runoff volume is conveyed by the canal during the mean annual storm event. The additional available storage seems to be insignificant compared to the runoff conveyed by the canal during the storm event.

In addition, benefits of having one additional gate with the lowered R-36 canal stages upstream of WCS-162 were also evaluated. For this scenario, both gates (one existing and one additional BMP gate) were assumed to be fully opened throughout the simulation. The model results for mean annual storm event for this scenario are also presented in Table 3-12. The simulated results suggest that there will be no difference in R-36 canal max stages upstream of WCS-162 with an additional gate at the structure. As no difference in peak stages were predicted for the mean annual storm event, no other higher return period storm events (5-year and 10-year) were analyzed with additional gates.

In conclusion, providing one or two additional gates at WCS-162 will help to reduce the time required to drawdown canal levels at the upstream of the structure; however the model results suggest that lower initial levels in R-36 canal upstream of the structure will provide no benefits in terms of reducing flooding at the upstream areas even for small storm events such as mean annual storm event. Also, the modeling results suggest that there would be no adverse impacts in the downstream of WCS-162 due to the additional gate.

Table 3-12: Mean Annual Event Simulated Maximum Stages in R-36 Canal Upstream of WCS-162

Model Node+	Existing Condition Max Stage (ft, NAVD88)	Scenario 1: Existing with Lowered Initials		Scenario 2: One Additional Gate BMP with Lowered Initials	
		Max Stage (ft, NAVD88)	Difference in Max Stage (ft)	Max Stage (ft, NAVD88)	Difference in Max Stage(ft)
NR0170*	21.55	21.55	0.00	21.56	0.01
Water Control Structure WCS-162					
NR3160**	21.86	21.86	0.00	21.85	0.00
NR3150	21.87	21.86	0.00	21.86	0.00
NR3140	22.09	22.09	0.00	22.09	0.00
NR3130	22.23	22.23	0.00	22.23	0.00
NR3125	22.42	22.41	-0.01	22.41	-0.01
NR3120	22.58	22.57	-0.01	22.57	-0.01
NR3110	22.76	22.76	-0.01	22.76	-0.01
NR3100	22.85	22.84	-0.01	22.84	-0.01
NR3090	22.94	22.94	0.00	22.94	0.00
NR3080	23.01	23.01	0.00	23.01	0.00
NR3070	23.09	23.09	0.00	23.08	0.00
NR3060	23.20	23.20	0.00	23.20	0.00
NR3050	23.40	23.40	0.00	23.40	0.00
NR3040	23.44	23.44	0.00	23.44	0.00
NR3030	23.51	23.51	0.00	23.51	0.00
NR3025	23.58	23.58	0.00	23.58	0.00
NR3020	23.59	23.59	0.00	23.59	0.00
NR3010	23.62	23.62	0.00	23.62	0.00
NB5695	23.65	23.65	0.00	23.65	0.00

+ Model nodes are presented from downstream to upstream location at R-36 canal

* Model Node Downstream of WCS-162

** Model Node Upstream of WCS-162

3.3.4 *Price Boulevard LOS Improvements*

Existing condition model results (May 2012 Governing Board approved model) predict that West Price Boulevard would intermittently flood between Locher Road and the Big Slough Canal during the 10, 25, and 100-year, 24-hour storm events. The currently designated City of North Port Level of Service (LOS) is shown in Figure 3-17. As shown on this figure, the West Price Boulevard stretch is identified as an arterial street that floods during the 100-year, 24-hour design storm event. This arterial street is critical to stormwater emergency response since it provides access to emergency facilities such as North Port Utilities Building, North Port High School and Heron Creek Middle School. Therefore, the City of North Port requested further evaluation of the stretch of West Price Boulevard between North Biscayne Boulevard and the Big Slough Canal to provide BMP recommendations to meet the City of North Port LOS criteria. City Unified Land Development Code Chapter 18 Level of Service criteria for arterial roads states that flooding must be less than 6 inches, as measured at the outside edge of pavement in a 100-year, 24-hour design storm event.

Ardaman staff reviewed the May 2012 Governing Board approved model setup within the area of interest (AOI) to verify whether the current model adequately represents the 2014 condition. With desktop and field reconnaissance of the area, it was observed that a section of the surface and sub-surface drainage systems near the North Port High School had been recently updated. Ardaman recommended surveying the AOI to better represent the existing condition. The survey data provided by Van Buskirk/Fish & Associates, Inc. is included in Appendix C.

Existing (2014) Condition Description:

Based on recent survey, stormwater runoff collected from the north and south swales of West Price Boulevard generally flows west from the North Port Utilities Building, whereas stormwater runoff from the remaining areas flows east from this location. Accumulated stormwater runoff going west from the North Port Utilities Building ultimately flows north via the Indian burial ground toward the R-32 canal.

Stormwater runoff going east toward Big Slough is routed through a series of surface water features (ditches, swales and inlets) which connects to a sub-surface system along the north side of West Price Boulevard.

Existing Condition Model Update and Results:

The May 2012 Governing Board approved model was updated using the 2014 survey provided by Van Buskirk/Fish & Associates, Inc. The revised 100-year storm event model results indicate that West Price Boulevard would not flood near the North Port High School as previously predicted. However, the stretch of West Price Boulevard north of Little Salt Spring would still flood by 0.4 feet at the crown during the 10-year storm event. Survey data indicates that road overtopping would occur at the lowest point (near the culvert crossing) at 17.3 feet NAVD88. The model predicted the 25-year and 100-year storm maximum stages at West Price Boulevard are 17.9 and 18.2 feet NAVD88 respectively. The revised existing condition floodplain delineations for the 100-year storm event and the revised LOS are presented in Figure 3-18.

BMP Alternative Analysis

The objective of this series of BMPs is to mitigate flooding along the stretch of West Price Boulevard near the Indian burial ground to meet the existing City of North Port LOS criteria.

Five different BMP alternatives were considered. Only the three alternatives that were determined to be effective in improving the LOS are described below:

3.3.4.1 *West Price Boulevard BMP 1*

Description

The first BMP alternative involves dredging the R-24 and R-32 canals. As shown in Figure 3-19, this alternative would require: dredging 2,300 feet of R-24 canal and 1,800 feet of R-32 canal to add approximately 2 to 3 feet of depth; and installing one extra parallel 36-inch pipe at the existing culvert crossing, between Indian burial ground and the R-32 canal. Figures showing comparison of existing and BMP cross-sections and bottom profiles of these canals are provided in Appendix D.

The City is not allowed to disturb the 50-foot wide drainage right-of-way through the Indian burial ground.

Results

Model results, comparison of floodplains, and the maximum stages at notable locations are presented in Figure 3-19. Model results with BMP_1 alternative suggest that West Price Boulevard would not overtop during the 25-year storm event. In addition, this alternative would reduce flooding on some local streets (Dundee Ave, Surf Ave, and San Salvador Road) located north of R-32 canal.

The model predicted that the 100-year maximum stage at West Price Boulevard with BMP_1 alternative will be reduced from 18.2 to 17.5 feet NAVD88. West Price Boulevard would still overtop by 0.2 feet over the crown of the road at the lowest section during the 100-year storm event. However, the road would be passable according to City of North Port LOS criteria. Figure 3-20 shows the comparison of the 100-year floodplain and maximum stages at notable locations with BMP 1 alternative. Model results also indicate that there will be no adverse impacts at downstream areas due to this improvement.

3.3.4.2 *West Price Boulevard BMP 2*

Description

The second BMP alternative consists of raising the road (West Price Boulevard) such that it would not flood during the 100-year design storm event. This alternative would involve raising approximately 1,900 feet of West Price Boulevard to an elevation of 18.5 feet NAVD88. Survey data suggests that the lowest segment of the road, which is located at the culvert crossing, needs to be raised by 1.2 feet to reach an elevation of 18.5 feet NAVD88. Figure 3-21 shows the comparison of the 100-year floodplain as well as the extent of West Price Boulevard that needs to be raised to reduce flooding potential during the event.

Results

Model results suggest that the 100-year peak stages upstream and downstream of the culvert across West Price Boulevard would be 18.2 feet NAVD88 with this alternative. The model predicted the 100-year maximum stage at West Price Boulevard is below the recommended raised road crown elevation of 18.5 feet NAVD88. The peak stage model results suggest that there will be no adverse impacts or increase in stages upstream or downstream of the improvement for any modeled storm event.

Additional right-of-way requirement to raise the road and its availability should be thoroughly assessed prior to selecting this BMP alternative.

3.3.4.3 *West Price Boulevard BMP 3*

Description

The third BMP alternative evaluated incorporates both BMP_1 and BMP_2 improvements, i.e. dredging the R-32 and R-24 canals, adding a new pipe crossing, and raising the road such that it would not flood during the 100-year storm event.

Results

Model results suggest that the 100-year peak stage upstream of the culvert across West Price Boulevard would be 17.6 feet NAVD88 with this alternative. Figure 3-22 shows the comparison of the 100-year floodplain as well as the elements of BMP_3 improvements. This alternative would require raising approximately 950 feet of West Price Boulevard to elevation 18.0 feet NAVD88. Compared to BMP_2 improvements, this alternative would reduce the required road improvement length by half at a lower elevation (6 inches lower than BMP_2). Similar to BMP_1 and BMP_2, the peak stage model results suggest that there will be no adverse impacts or increase in stages upstream or downstream of the road improvement for any model storm event.

3.3.4.4 *Other Evaluated BMPs*

In addition to the three previously described BMP alternatives, a few other BMPs were evaluated. However, modeling results suggest that theses BMPs would not mitigate the flooding conditions along the evaluated stretch of West Price Boulevard.

One of the other BMPs evaluated was to install a 24-inch pipe at the south side of West Price Boulevard near the culvert that would run approximately 1,400 feet to the east and connect to the existing sub-surface system inlet. This BMP did not show any improvements since the BMP pipe is too long and there was not sufficient hydraulic gradient available to convey the necessary flow rate through the pipe.

Another BMP evaluated was to provide a 20-foot wide cut/swale that would connect the flooded area south of West Price Boulevard to the south towards the Little Salt Spring basin. 25-year storm event model results suggest that this BMP alternative would lower peak stages at West Price Boulevard only by 0.2 feet. However, the road would still flood during this event. Also, this BMP may raise environmental concerns considering that it would require diverting stormwater runoff from the road towards Little Salt Spring basin.

3.3.4.5 *Summary and Recommendations*

Various BMP alternatives were evaluated to mitigate flooding at West Price Boulevard with the purpose of meeting City of North Port LOS criteria. BMP_1 alternative (dredging R-24 and R-32 canals) would eradicate the road flooding in a 25-year design storm event, and it would minimize flooding in a 100-year storm event to make it passable during the event. BMP_2 alternative would eliminate road flooding in a 100-year design storm event by raising West Price Blvd. BMP_3 alternative would also eliminate West Price Boulevard road flooding in a 100-year storm event while minimizing road improvements. A summary of 100-year peak stages for each BMP alternatives and recommended road crown and edge of pavement elevations are provided in Table 3-13. It is estimated that it would cost $0.8 million, $0.9 million, and $1.3 million for BMP_1, BMP_2, and BMP_3, respectively (see Appendix E for the detailed cost estimates). These cost estimates are approximate, and they are used for the comparison purpose only. Considering the project cost, BMP_2 alternative (raising the road) appears to be the most effective approach to eliminate road flooding conditions for the 100-year design storm event. In 2010, the city cleaned these canals with the purpose of removing mucks accumulated at the bottom. It is recommended current cross-sections and bottom profiles of these canals be surveyed to verify dredging requirements prior to selecting dredging alternatives. Also, canal dredging cost could be less, if City of North Port performs the dredging using in-house resources.

Table 3-13: Summary of West Price Boulevard BMPs

BMP Description	100-year Flood Elevation (ft, NAVD88)		EOP Elevation (ft, NAVD88)		Road Crown Elevation (ft, NAVD88)		Preliminary Cost Estimate for Construction in 2017
	Without BMP	With BMP	Existing	Proposed	Existing	Proposed	
No. 1- Dredge R-24 and 32, add 36" pipe	18.2	17.5	17	17	17.3	17.3	$832,000
No. 2- Raise 1900 LF of Price Blvd 1.2' higher	18.2	18.2	17	18.2	17.3	18.5	$859,000
No. 3- Dredge R-24 and 32, add 36" pipe, Raise 850 LF of Price Blvd 0.7' higher	18.2	17.6	17	17.7	17.3	18.0	$1,308,000

The 25-year and 100-year storm events revised existing condition and BMP 1, 2, and 3 alternatives model results (maximum stages and maximum flows) are provided in tabular form within the accompanying geodatabase along with updated model network (basins, nodes, and reaches). CHAN model data and simulation run files for these alternatives are also included in an external hard drive.

4.0 CONCEPTUAL PERMIT APPLICATION

Conceptual permit application was not included in this project.

5.0 CONCLUSIONS

It is recommended that the City of North Port purchas the small number of habitable structures in which flooding is predicted in the 100 year event. Purchasing the affected properties may be more cost effective than implementing any BMPs. Figure 5-1 shows the 74 parcels (one parcel contains two habitable structures) identified in the LOS analysis, in addition to 25 parcels reported as flooded in 1992 and 27 properties reported as damaged in 2003 (also see Table 5-1 below). Several parcels were identified as flooded in more than one event, which is noted in the table.

It is recommended that finished floor elevations of the 101 parcels are acquired by survey, and finished floor elevations are compared with modeled 100 year event maximum stages, to determine which properties flood in the 100 year event. Highlighted rows indicate parcels that were identified as flooded in the LOS analysis, and have documented flooding in the 1992 and/or 2003 event.

Table 5-1: Summary of Parcels to Survey

PID	Address	City, State, Zip	In 100 Year Level of Service Analysis	Reported as Flooded in 1992	Reported as Flooded in 2003
1122-16-0325	1297 NACKMAN RD	NORTH PORT, FL 34288	Yes		
1008-25-5316	1400 LONGBOW AVE	NORTH PORT, FL 34288	Yes		
0976-26-4128	2386 VESTRIDGE ST	NORTH PORT, FL 34287	Yes		
0964-08-1404	2912 OKLAHOMA ST	NORTH PORT, FL 34286	Yes		
0995-18-2835	2989 SARLETTO ST	NORTH PORT, FL 34287		Yes	
0995-18-2836	2999 SARLETTO ST	NORTH PORT, FL 34287		Yes	
0967-06-0117	3166 SNOWBIRD ST	NORTH PORT, FL 34291	Yes	Yes	Yes
0993-26-4012	3236 MONTCLAIR CIR	NORTH PORT, FL 34287	Yes		
0993-26-3801	3262 MONTCLAIR CIR	NORTH PORT, FL 34287	Yes		
0993-26-3730	3589 MONTCLAIR CIR	NORTH PORT, FL 34287	Yes		
0993-26-3815	3626 MONTCLAIR CIR	NORTH PORT, FL 34287	Yes		
0993-26-3816	3652 MONTCLAIR CIR	NORTH PORT, FL 34287	Yes		

PID	Address	City, State, Zip	In 100 Year Level of Service Analysis	Reported as Flooded in 1992	Reported as Flooded in 2003
0954-14-2522	4268 BACKENSTO ST	NORTH PORT, FL 34291	Yes		Yes
1144-07-4316	4268 LEESBURG AVE	NORTH PORT, FL 34288	Yes		
1002-18-4613	4353 MCKIBBEN DR	NORTH PORT, FL 34287	Yes		
1002-27-6618	4399 MONGITE RD	NORTH PORT, FL 34287	Yes		
1002-18-4810	4440 MONGITE RD	NORTH PORT, FL 34287	Yes		
0955-15-4601	4441 COBBLER LN	NORTH PORT, FL 34286	Yes		
1002-27-6621	4441 MONGITE RD	NORTH PORT, FL 34287	Yes		
0996-19-1923	4531 NELE ST	NORTH PORT, FL 34287		Yes	
1002-18-4806	4534 MONGITE RD	NORTH PORT, FL 34287	Yes		
1002-27-6627	4567 MONGITE RD	NORTH PORT, FL 34287	Yes		
0996-19-1922	4573 NELE ST	NORTH PORT, FL 34287		Yes	
1002-27-6628	4583 MONGITE RD	NORTH PORT, FL 34287	Yes		
1002-27-6629	4599 MONGITE RD	NORTH PORT, FL 34287	Yes		
1002-27-6630	4609 MONGITE RD	NORTH PORT, FL 34287	Yes		
1002-27-6631	4625 MONGITE RD	NORTH PORT, FL 34287	Yes		
1002-18-5011	4628 MONGITE RD	NORTH PORT, FL 34287	Yes		
1002-18-5010	4640 MONGITE RD	NORTH PORT, FL 34287	Yes		
1002-27-6632	4641 MONGITE RD	NORTH PORT, FL 34287	Yes		
1002-18-5008	4668 MONGITE RD	NORTH PORT, FL 34287	Yes		
0996-19-4324	4943 GROBE ST	NORTH PORT, FL 34287	Yes		
0996-19-2317	4964 GROBE ST	NORTH PORT, FL 34287		Yes	
1001-27-6105	4974 ESCALANTE DR	NORTH PORT, FL 34287	Yes		
1001-27-6106	4982 ESCALANTE DR	NORTH PORT, FL 34287	Yes		
1001-27-6316	4983 ESCALANTE DR	NORTH PORT, FL 34287	Yes		
0996-19-4325	4987 GROBE ST	NORTH PORT, FL 34287	Yes		
1001-27-6107	4990 ESCALANTE DR	NORTH PORT, FL 34287	Yes		
0996-19-2318	4991 BULLARD ST	NORTH PORT, FL 34287		Yes	

PID	Address	City, State, Zip	In 100 Year Level of Service Analysis	Reported as Flooded in 1992	Reported as Flooded in 2003
0953-15-2713	5005 LACEY ST	NORTH PORT, FL 34286	Yes		Yes
0996-09-4126	5009 BULLARD ST	NORTH PORT, FL 34287	Yes		
0955-15-3218	5060 IBSON LN	NORTH PORT, FL 34286	Yes		
0942-15-3308	5089 HABLOW LN	NORTH PORT, FL 34286	Yes		
0942-15-3307	5101 HABLOW LN	NORTH PORT, FL 34286	Yes		
1001-27-6115	5102 ESCALANTE DR	NORTH PORT, FL 34287	Yes		
0942-15-3205	5133 INKS LN	NORTH PORT, FL 34286	Yes		
1001-27-6117	5142 ESCALANTE DR	NORTH PORT, FL 34287	Yes		
0942-15-3204	5149 INKS LN	NORTH PORT, FL 34286	Yes		
0942-15-3301	5173 HABLOW LN	NORTH PORT, FL 34286	Yes		
0953-15-2415	5208 GRIGGS AVE	NORTH PORT, FL 34291	Yes		
0953-15-2214	5224 HACKLEY RD	NORTH PORT, FL 34291	Yes		
0953-15-2615	5272 GADBOYS AVE	NORTH PORT, FL 34291	Yes		
0953-15-2614	5278 GADBOYS AVE	NORTH PORT, FL 34291	Yes		
0953-15-2324	5290 HAAS AVE	NORTH PORT, FL 34291	Yes		
1001-27-6122	5292 TREKELL ST	NORTH PORT, FL 34287	Yes		
1001-27-6123	5302 TREKELL ST	NORTH PORT, FL 34287	Yes		
0996-19-4339	5323 GROBE ST	NORTH PORT, FL 34287		Yes	
0944-15-2728	5363 LACEY ST	NORTH PORT, FL 34286	Yes		Yes
0955-15-4505	5382 NOHAVA RD	NORTH PORT, FL 34286	Yes		
0954-14-2930	5437 MANDRAKE TER	NORTH PORT, FL 34291	Yes		
0954-14-2515	5497 LADY SLIPPER AVE	NORTH PORT, FL 34291			Yes
0953-14-1109	5516 REISTERSTOWN RD	NORTH PORT, FL 34291			Yes
0944-07-1204	5519 GARRISON AVE	NORTH PORT, FL 34291			Yes
0953-14-1108	5547 TANEYTOWN ST	NORTH PORT, FL 34291			Yes
0953-14-1208	5551 REISTERSTOWN RD	NORTH PORT, FL 34291	Yes	Yes	Yes

PID	Address	City, State, Zip	In 100 Year Level of Service Analysis	Reported as Flooded in 1992	Reported as Flooded in 2003
0953-14-1113	5555 HENNESSY ST	NORTH PORT, FL 34291	Yes	Yes	Yes
0953-14-1207	5585 REISTERSTOWN RD	NORTH PORT, FL 34291			Yes
0953-14-1111	5588 REISTERSTOWN RD	NORTH PORT, FL 34291	Yes		Yes
0944-07-1202	5621 GARRISON AVE	NORTH PORT, FL 34291	Yes		
0953-14-1206	5621 REISTERSTOWN RD	NORTH PORT, FL 34291	Yes	Yes	Yes
0953-14-1112	5624 REISTERSTOWN RD	NORTH PORT, FL 34291	Yes	Yes	Yes
0942-08-0004	5625 N SUMTER BLVD	NORTH PORT, FL 34286	Yes		
1002-18-4802	5650 POSTMA ST	NORTH PORT, FL 34287	Yes		
0954-14-2520	5654 LADY SLIPPER AVE	NORTH PORT, FL 34291			Yes
0944-07-1309	5664 GARRISON AVE	NORTH PORT, FL 34291	Yes		Yes
0944-07-1304	5779 REISTERSTOWN RD	NORTH PORT, FL 34291	Yes	Yes	Yes
0967-05-8905	5788 SYLVANIA AVE	NORTH PORT, FL 34291			Yes
0967-05-8904	5814 SYLVANIA AVE	NORTH PORT, FL 34291			Yes
0942-04-1904	5815 SUMTER BLVD	NORTH PORT, FL 34286	Yes		Yes
0968-05-7474	5834 BURWIN AVE	NORTH PORT, FL 34291	Yes		
0968-05-7448	5839 BATTERSEA AVE	NORTH PORT, FL 34291	Yes		Yes
0968-05-7450	5861 BATTERSEA AVE	NORTH PORT, FL 34291	Yes		Yes
0968-05-8024	5933 BURWIN AVE	NORTH PORT, FL 34291	Yes		
0968-05-7454	5971 BATTERSEA AVE	NORTH PORT, FL 34291	Yes		Yes
0941-04-1613	6527 REISTERSTOWN RD	NORTH PORT, FL 34291			Yes
0943-01-1009	6531 TANEYTOWN ST	NORTH PORT, FL 34291		Yes	
0941-04-1611	6669 REISTERSTOWN RD	NORTH PORT, FL 34291	Yes	Yes	Yes
0941-04-1609	6869 REISTERSTOWN RD	NORTH PORT, FL 34291		Yes	Yes

PID	Address	City, State, Zip	In 100 Year Level of Service Analysis	Reported as Flooded in 1992	Reported as Flooded in 2003
0941-04-1615	6969 REISTERSTOWN RD	NORTH PORT, FL 34291			Yes
0952-12-1121	7254 MUNCEY RD	NORTH PORT, FL 34291	Yes		
0996-09-3204	8515 FAY AVE	NORTH PORT, FL 34287		Yes	
0996-19-4520	8634 HERBISON AVE	NORTH PORT, FL 34287		Yes	
0996-19-4508	8645 CRISTOBAL AVE	NORTH PORT, FL 34287		Yes	
0996-19-4519	8664 HERBISON AVE	NORTH PORT, FL 34287		Yes	
0996-19-4517	8720 HERBISON AVE	NORTH PORT, FL 34287	Yes		
0996-19-4515	8772 HERBISON AVE	NORTH PORT, FL 34287		Yes	
0996-19-4513	8795 CRISTOBAL AVE	NORTH PORT, FL 34287		Yes	
0995-19-2413	8796 PORTO BELLO AVE	NORTH PORT, FL 34287	Yes		
0996-19-4514	8798 HERBISON AVE	NORTH PORT, FL 34287	Yes	Yes	
0995-18-2838	8855 CHESEBRO AVE	NORTH PORT, FL 34287		Yes	
0995-18-2837	8875 CHESEBRO AVE	NORTH PORT, FL 34287		Yes	

We trust that this report satisfies your expectations and appreciate the opportunity to work with you on this important project. If you have any questions, or if we can be of further service to you, please do not hesitate to call.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

10/10/2014

Shankar Gautam
N. A.

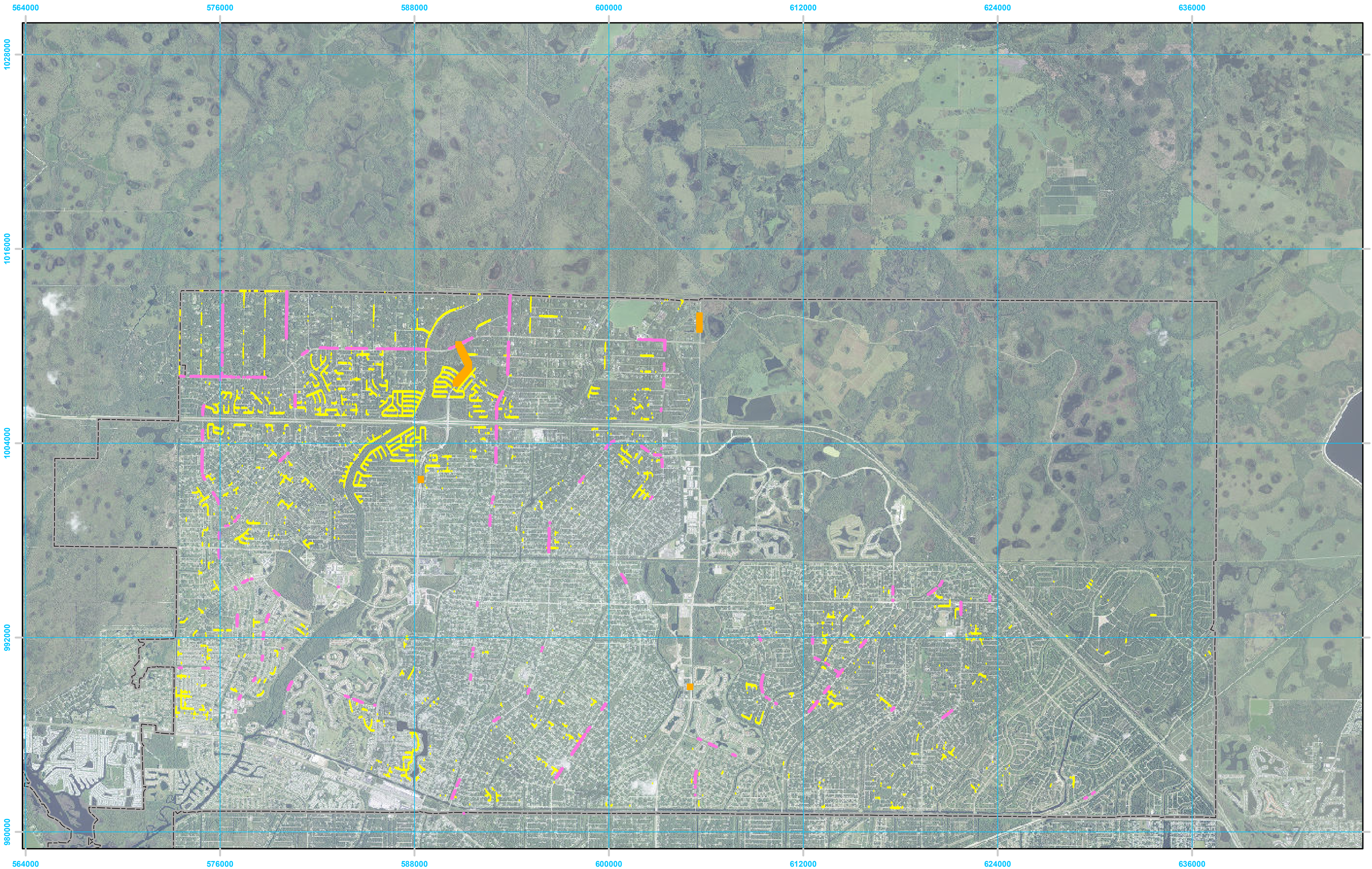
Nestor Aceituno, P.E.
Senior Project Engineer

Shankar Gautam, P.E.
Project Engineer

cc: Elizabeth Wong, City of North Port

FIGURES

FIGURE 2-1



N
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0 3,000 6,000
Feet

Scale: 1" = 6000'

Evacuation Route Floods
Collector Street Floods
Local Street Floods
Northport Boundary

City of North Port, Florida

Southwest Florida Water Management District

Project: 03-065	Projection: State Plane Florida West	
Prepared: 9/17/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: \\03-065\ArcGIS_ArcLayouts\20140909 - Final BMP Figures\LOS 10.mxd		

10 YEAR LEVEL OF SERVICE

CITY OF NORTH PORT, SARASOTA COUNTY, FL

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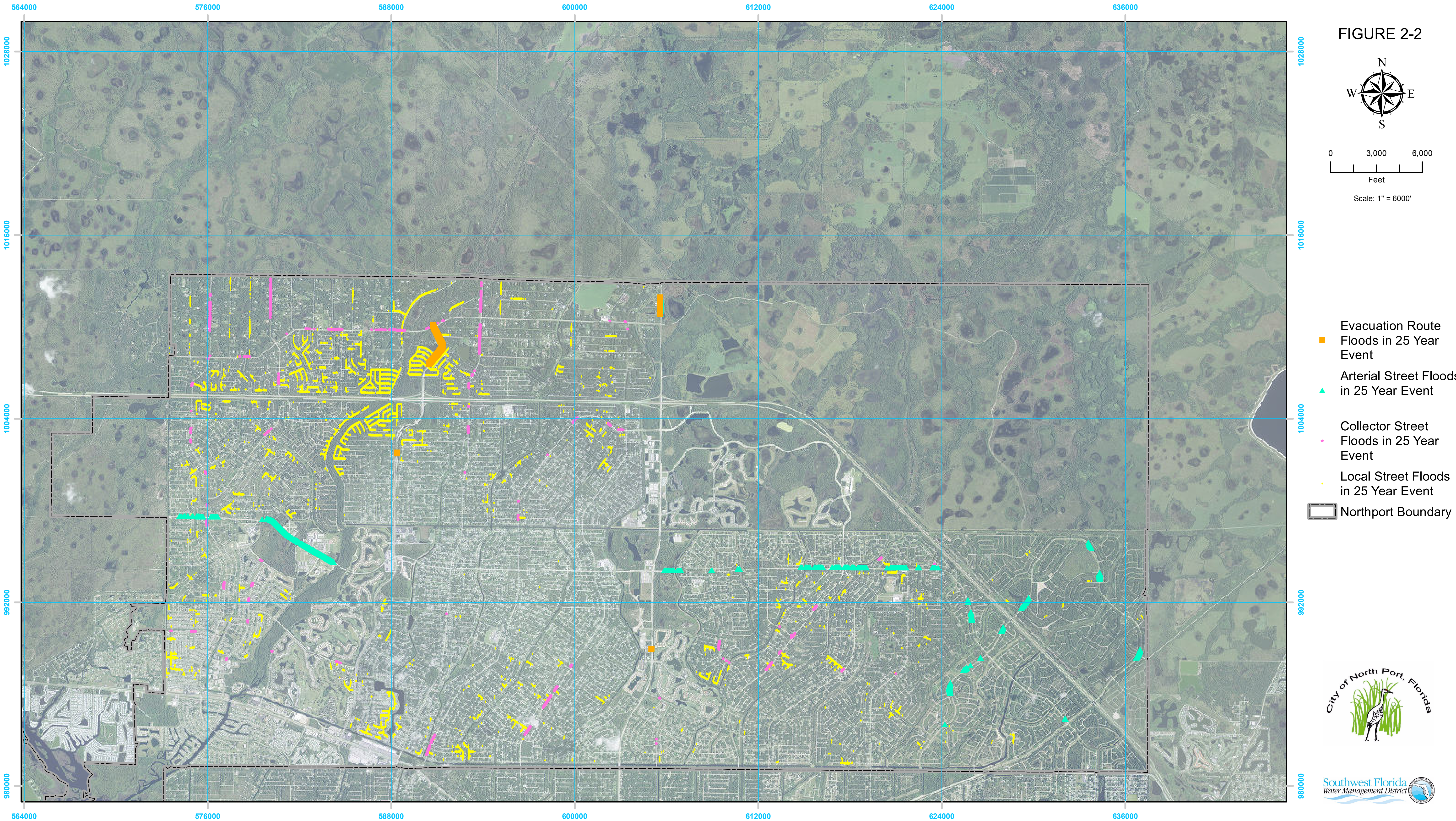
8008 South Orange Avenue
Orlando, Florida 32809



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Prepared by: CGG	Modified by:	Modified:
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25 YEAR LEVEL OF SERVICE

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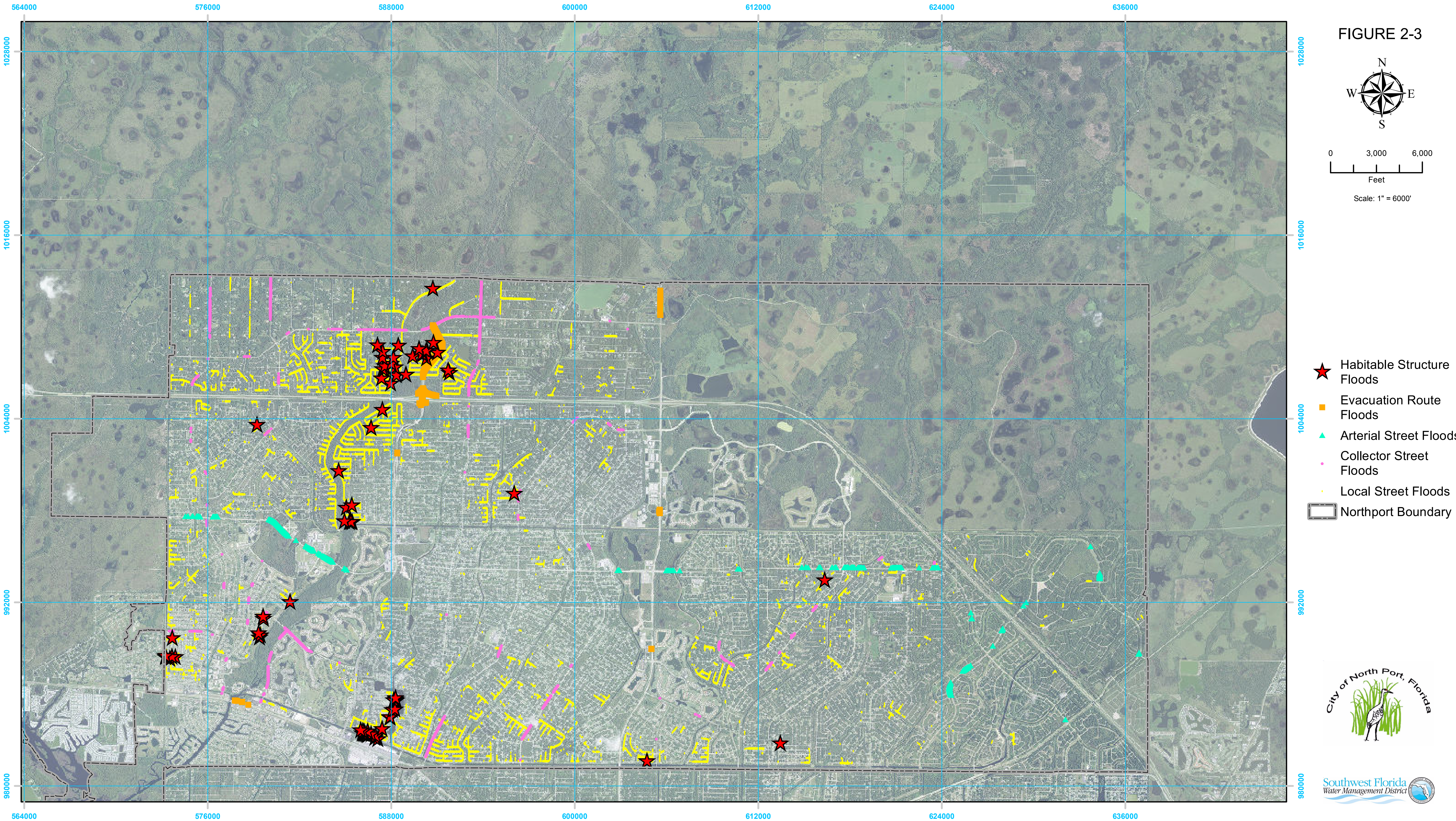

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Prepared by: CGG	Modified by:	Modified:
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100 YEAR LEVEL OF SERVICE

CITY OF NORTH PORT, SARASOTA COUNTY, FL

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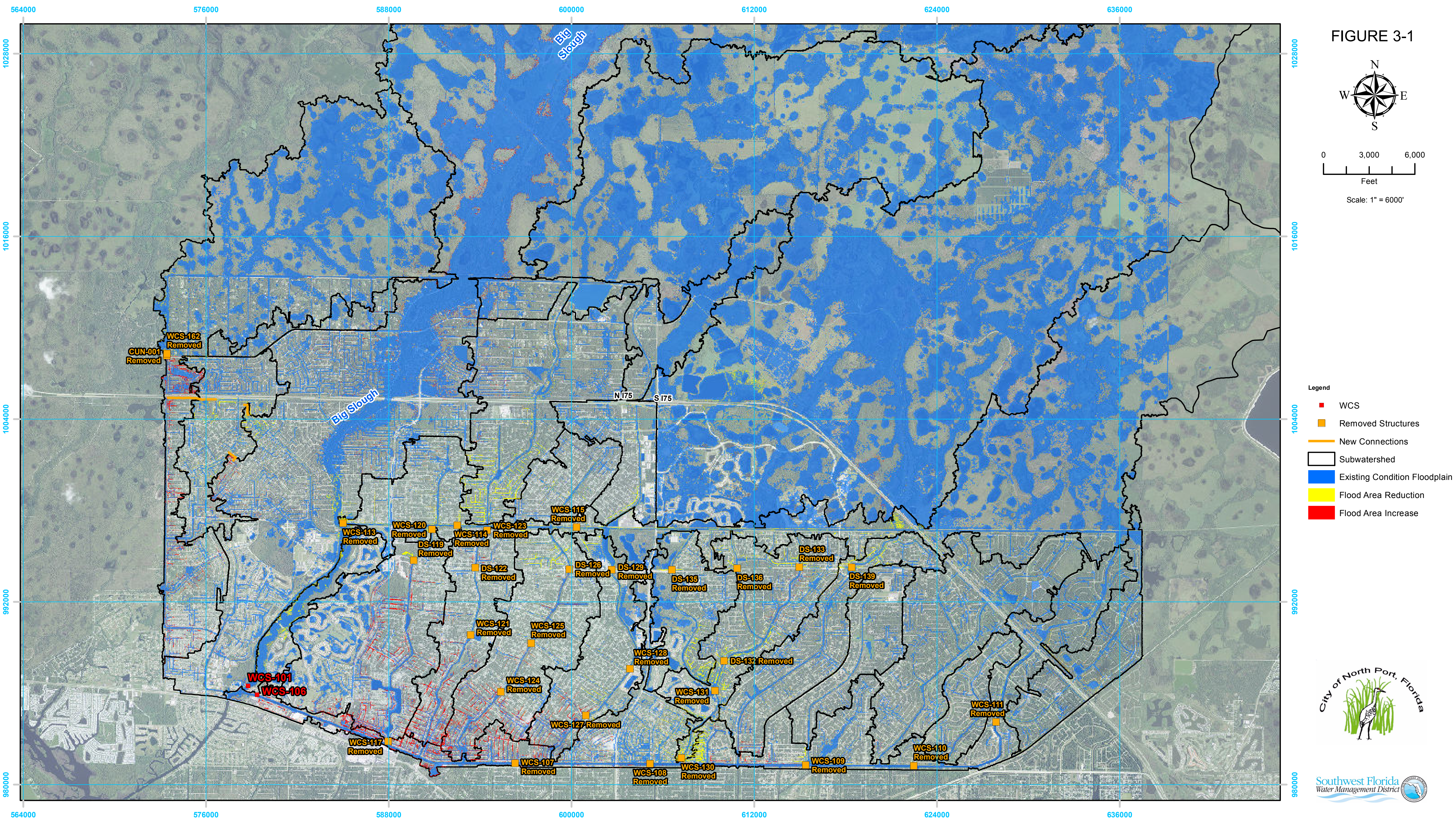
Orlando, Florida 32809

FIGURE 3-1



City of North Port, Florida

Southwest Florida Water Management District

NORTH PORT / BIG SLOUGH WMP

BMP ALTERNATIVE 1 - 1 DAY 100 YEAR EVALUATION

Project: 03-065	Projection: Florida East West	
Prepared: 10-11-07	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
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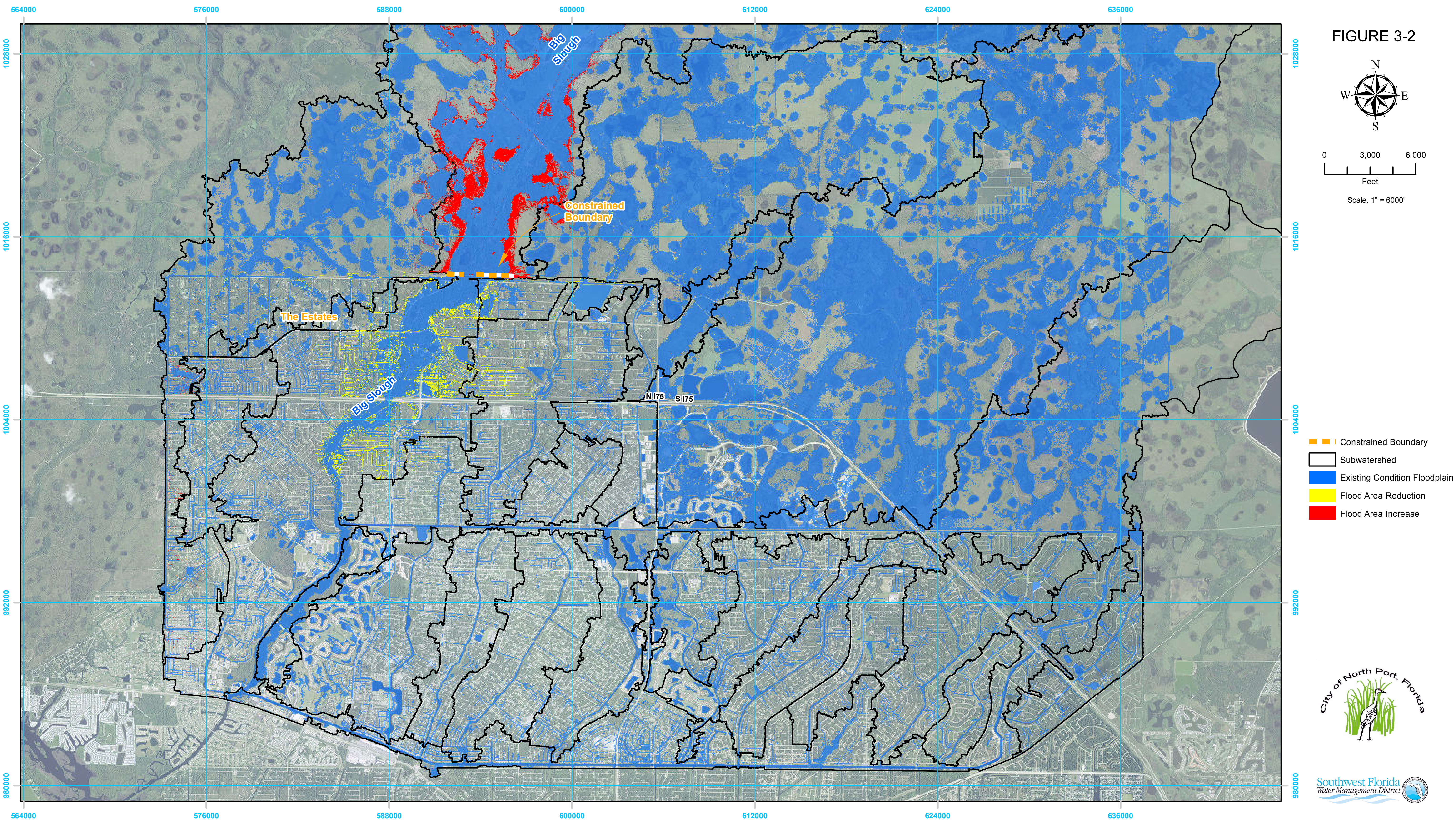
FIGURE 3-2



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Prepared: 9/9/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: \\03-065\ArcGIS_ArcLayouts\20140909 - Final BMP Figures\BMP2.mxd		

NORTH PORT / BIG SLOUGH WMP

BMP ALTERNATIVE 2 - 1 DAY 100 YEAR EVALUATION

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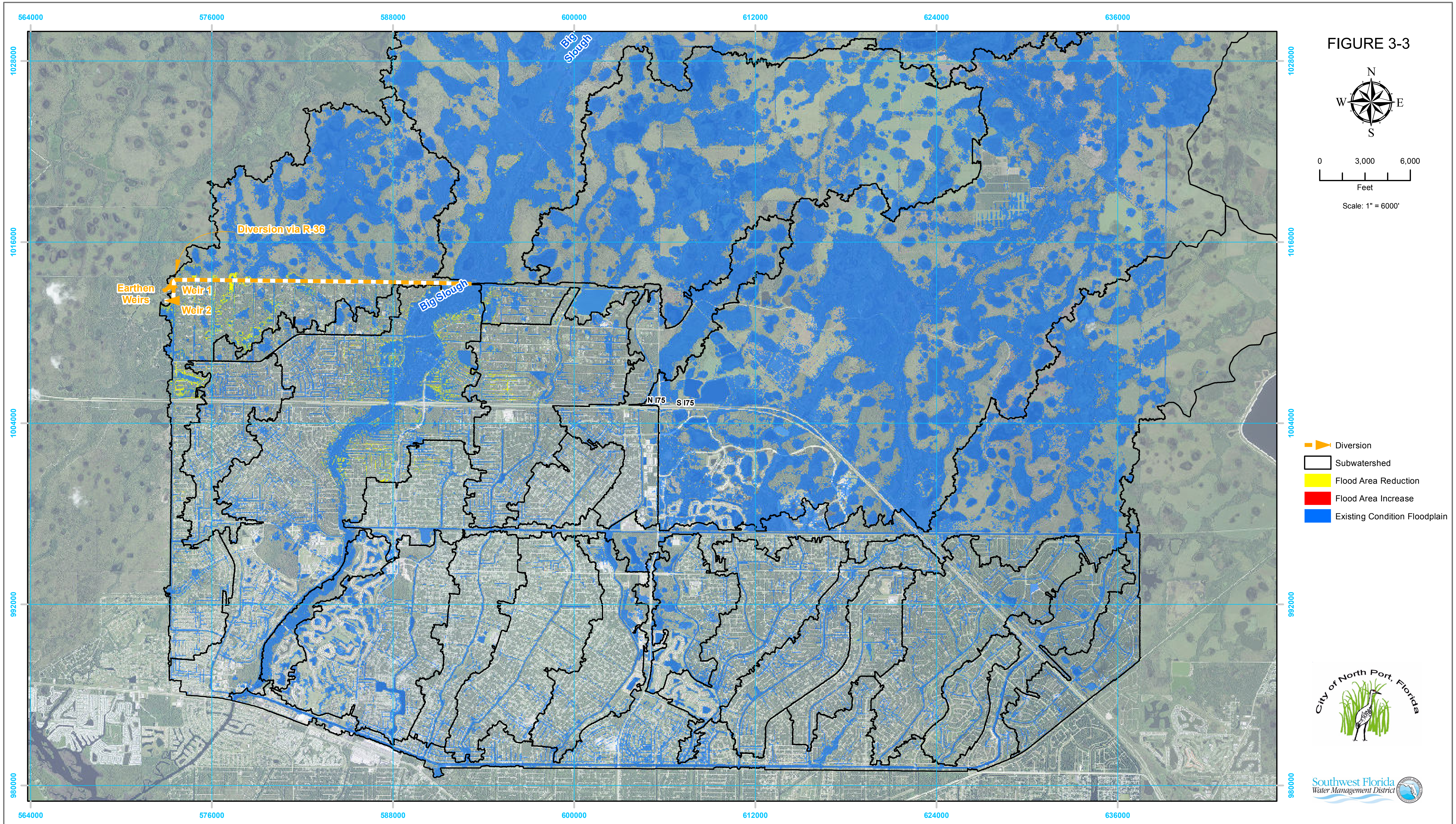
Orlando, Florida 32809

FIGURE 3-3



City of North Port, Florida

Southwest Florida Water Management District

Project: 03-065	Projection: State Plane Florida West	
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Prepared by: CGG	Modified by:	Modified:
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NORTH PORT / BIG SLOUGH WMP

BMP ALTERNATIVE 3 - 1 DAY 100 YEAR EVALUATION

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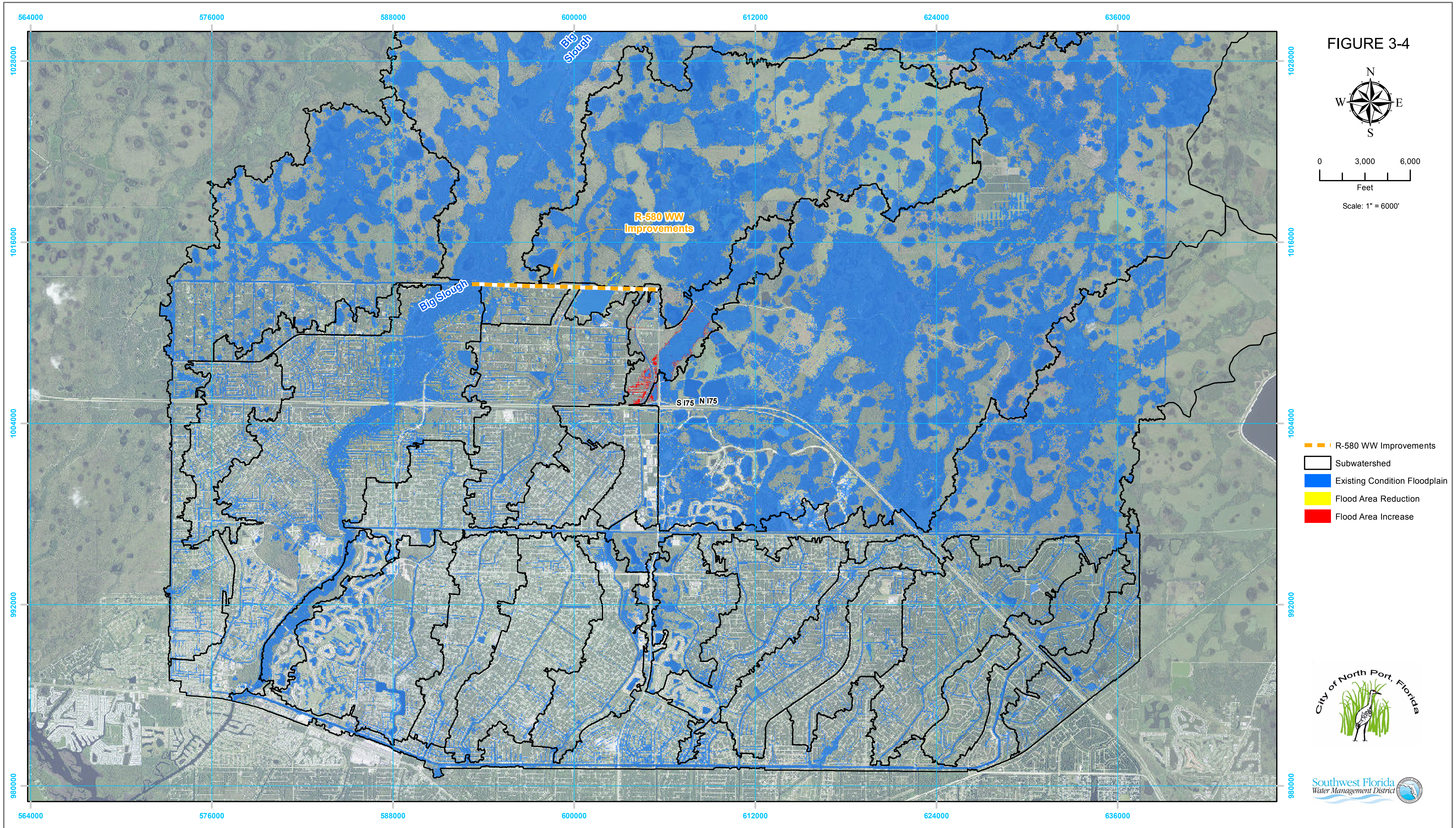
FIGURE 3-4



Project: 03-065	Projection: State Plane Florida West	
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Prepared by: CGG	Modified by:	Modified:
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NORTH PORT / BIG SLOUGH WMP

BMP ALTERNATIVE 4 - 1 DAY 100 YEAR EVALUATION

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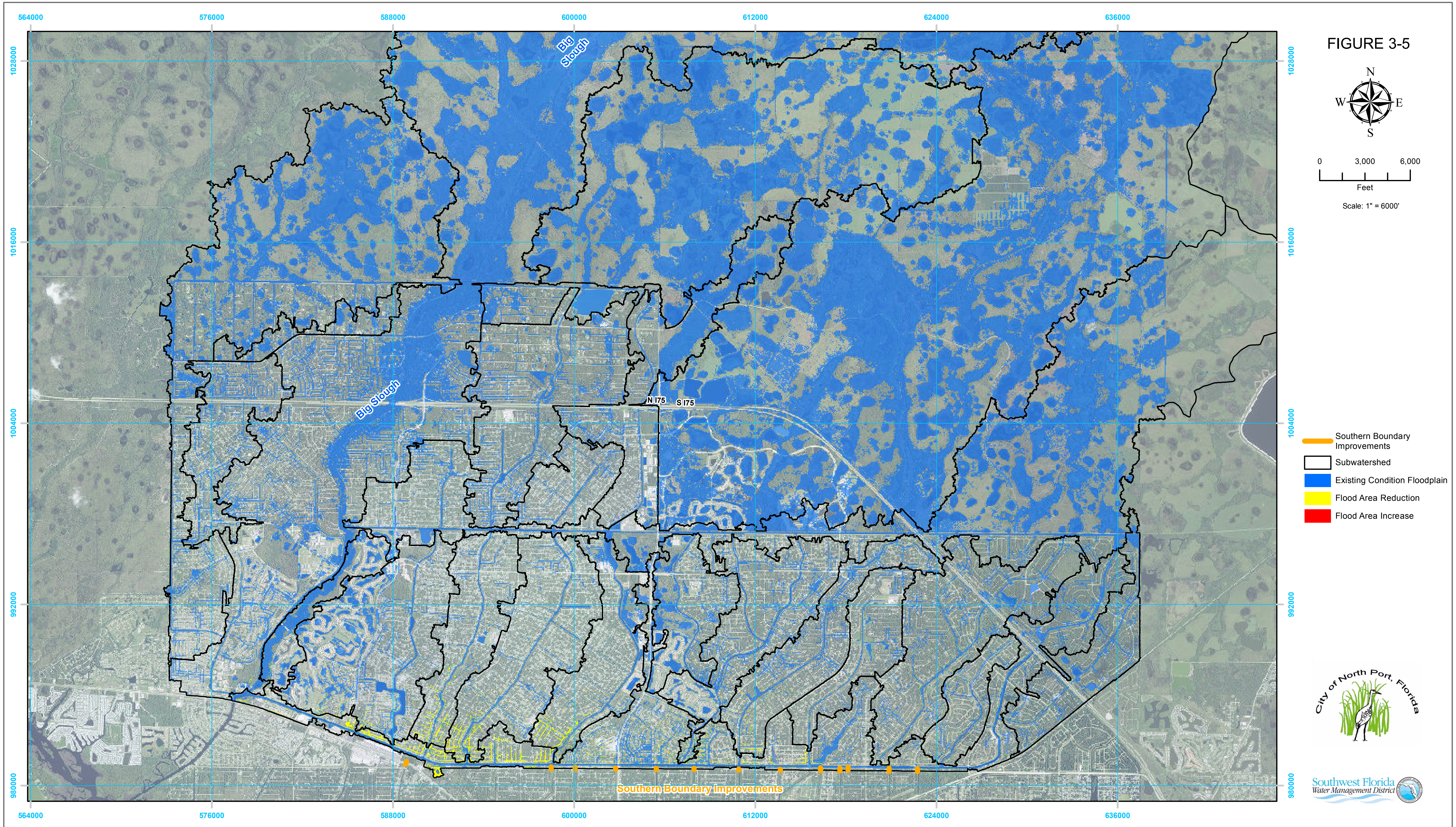
Orlando, Florida 32809



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Prepared: 9/9/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
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NORTH PORT / BIG SLOUGH WMP

BMP ALTERNATIVE 5 - 1 DAY 100 YEAR EVALUATION

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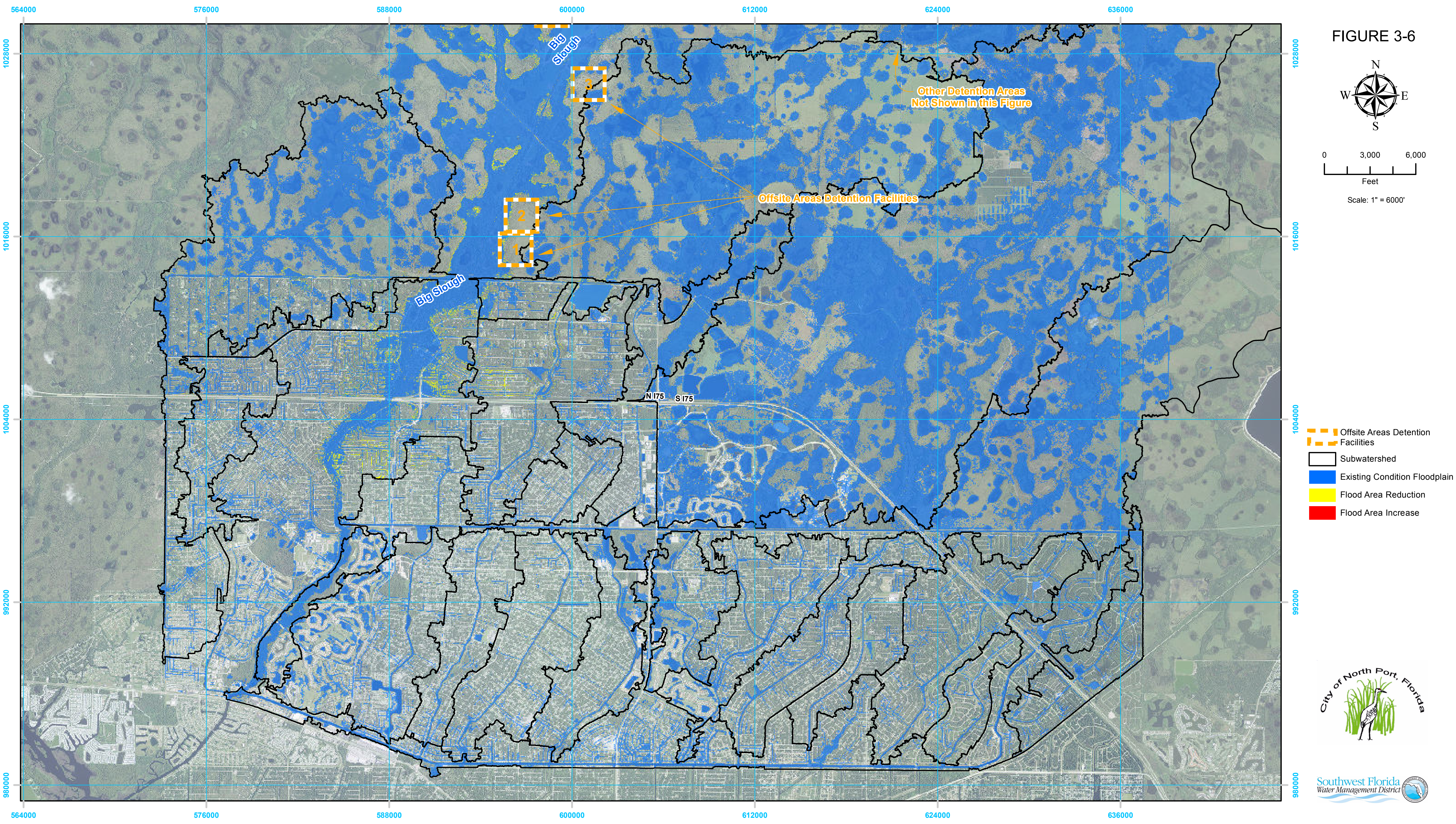
Orlando, Florida 32809

FIGURE 3-6



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Prepared: 9/9/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: \\03-065\ArcGIS_ArcLayouts\20140909 - Final BMP Figures\BMP6.mxd		

NORTH PORT / BIG SLOUGH WMP

BMP ALTERNATIVE 6 - 1 DAY 100 YEAR EVALUATION

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Orlando, Florida 32809

FIGURE 3-7

N
W
E
S

0 300 600
Feet
Scale: 1" = 600'

- Network Nodes
- Basins

Floodplain Change

- Decrease
- Increase
- No Change

City of North Port, Florida

Southwest Florida Water Management District

MODEL RESULTS WITH MEAN ANNUAL FLOODPLAIN COMPARISON AND DIFFERENCE IN MAX STAGES

R-36 CANAL AT I-75 BMP EVALUATION

Project: 03-065	Projection: State Plane Florida West	
Prepared: 9/10/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: \\20140909 - Final BMP Figures\BMP1 Crossing Mean Ann.mxd		

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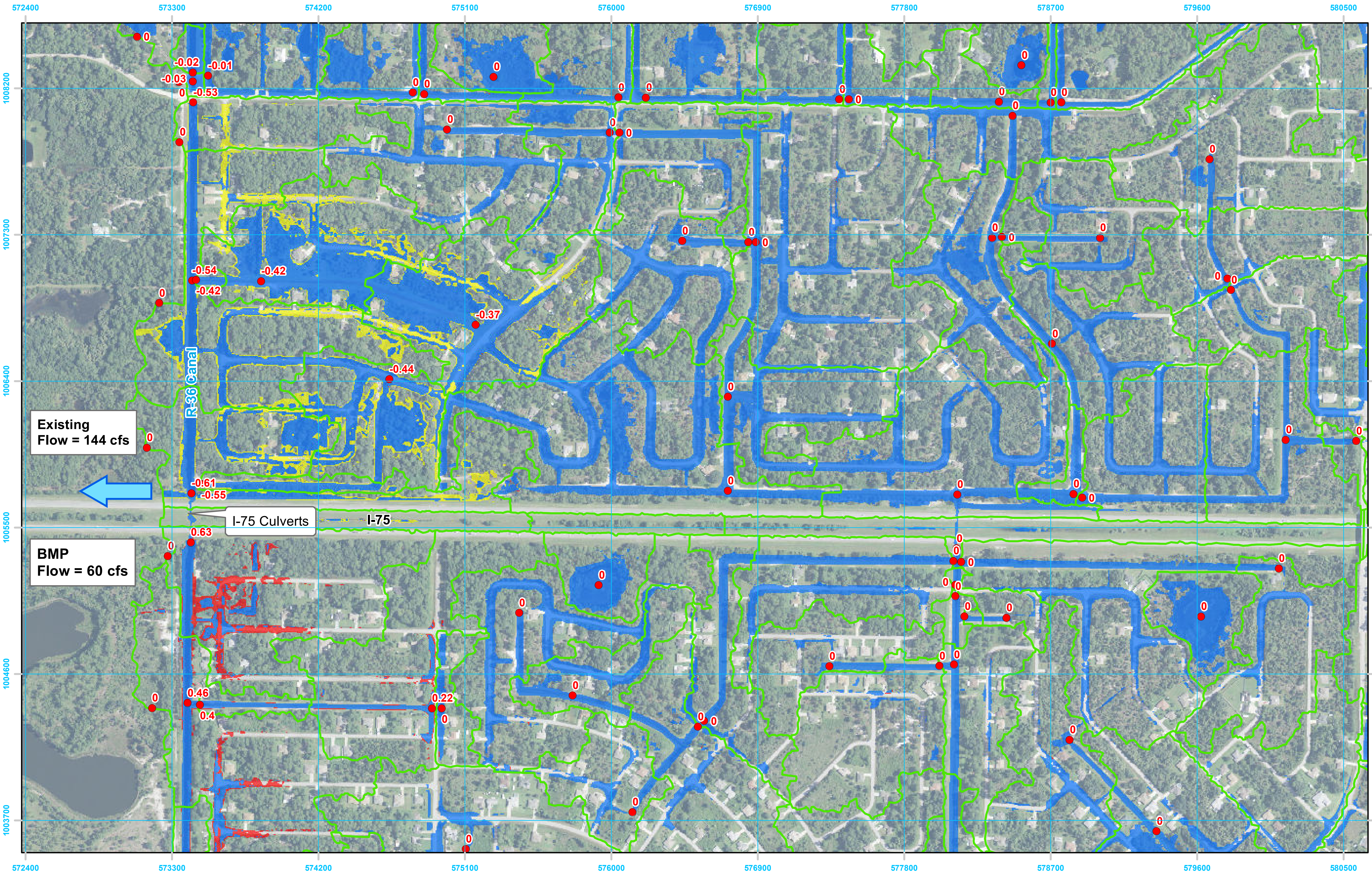
Orlando, Florida 32809

FIGURE 3-8



N
W E
S

0 300 600
Feet
Scale: 1" = 600'

- Network Nodes
- Basins

Floodplain Change

- Decrease
- Increase
- No Change

City of North Port, Florida

Southwest Florida Water Management District

MODEL RESULTS WITH 1-DAY 100-YEAR FLOODPLAIN COMPARISON AND DIFFERENCE IN MAX STAGES

R-36 CANAL AT I-75 BMP EVALUATION

Project: 03-065	Projection: State Plane Florida West	
Prepared: 9/10/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: \\20140909 - Final BMP Figures\BMP1 Crossing 1D100Yr.mxd		

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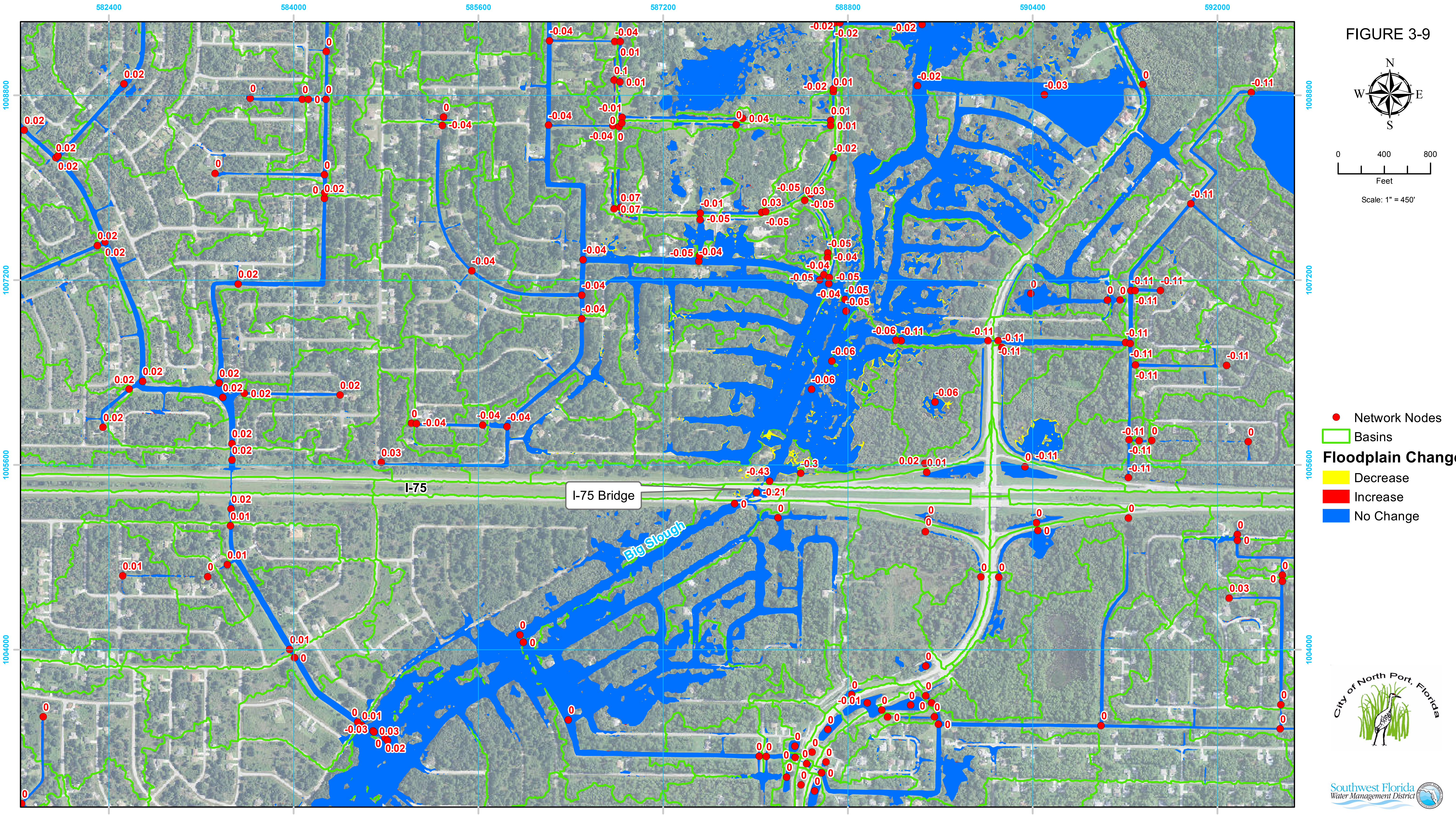
Orlando, Florida 32809

FIGURE 3-9



MODEL RESULTS WITH MEAN ANNUAL FLOODPLAIN COMPARISON AND DIFFERENCE IN MAX STAGES

MYAKKAHATCHEE CREEK AT 1-75 BMP EVALUATION

Project: 03-065	Projection: State Plane Florida West	
Prepared: 9/10/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: \\20140909 - Final BMP Figures\BMP2 Crossing Mean Ann.mxd		

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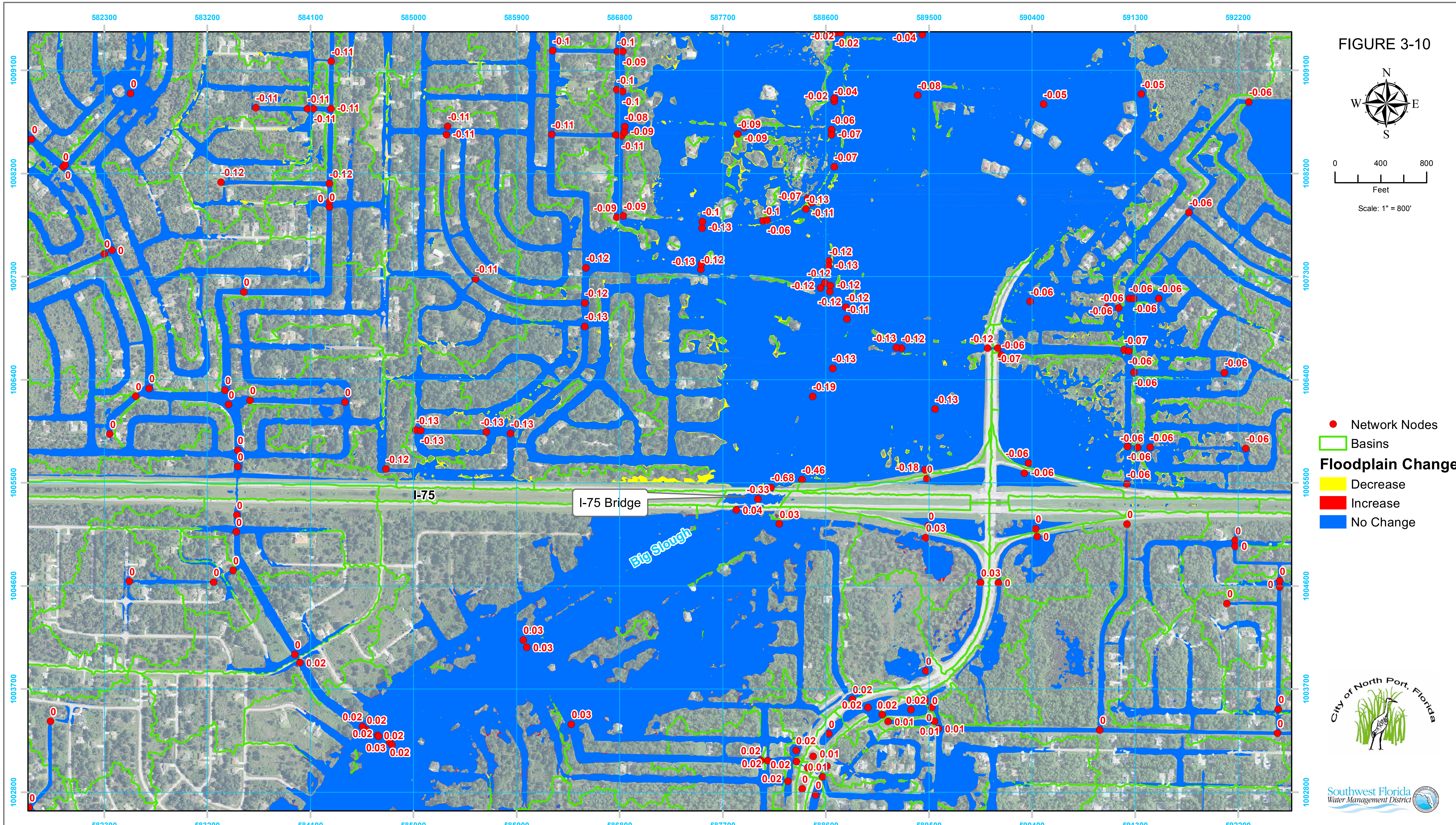
Orlando, Florida 32809



MODEL RESULTS WITH 1-DAY 100-YEAR FLOODPLAIN COMPARISON AND DIFFERENCE IN MAX STAGES

MYAKKAHATCHEE CREEK AT I-75 BMP EVALUATION

Project: 03-065	Projection: State Plane Florida West	
Prepared: 9/10/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: _ArcLayouts\20140909 - Final BMP Figures\BMP2 Crossing 1D100Yr.mxd		

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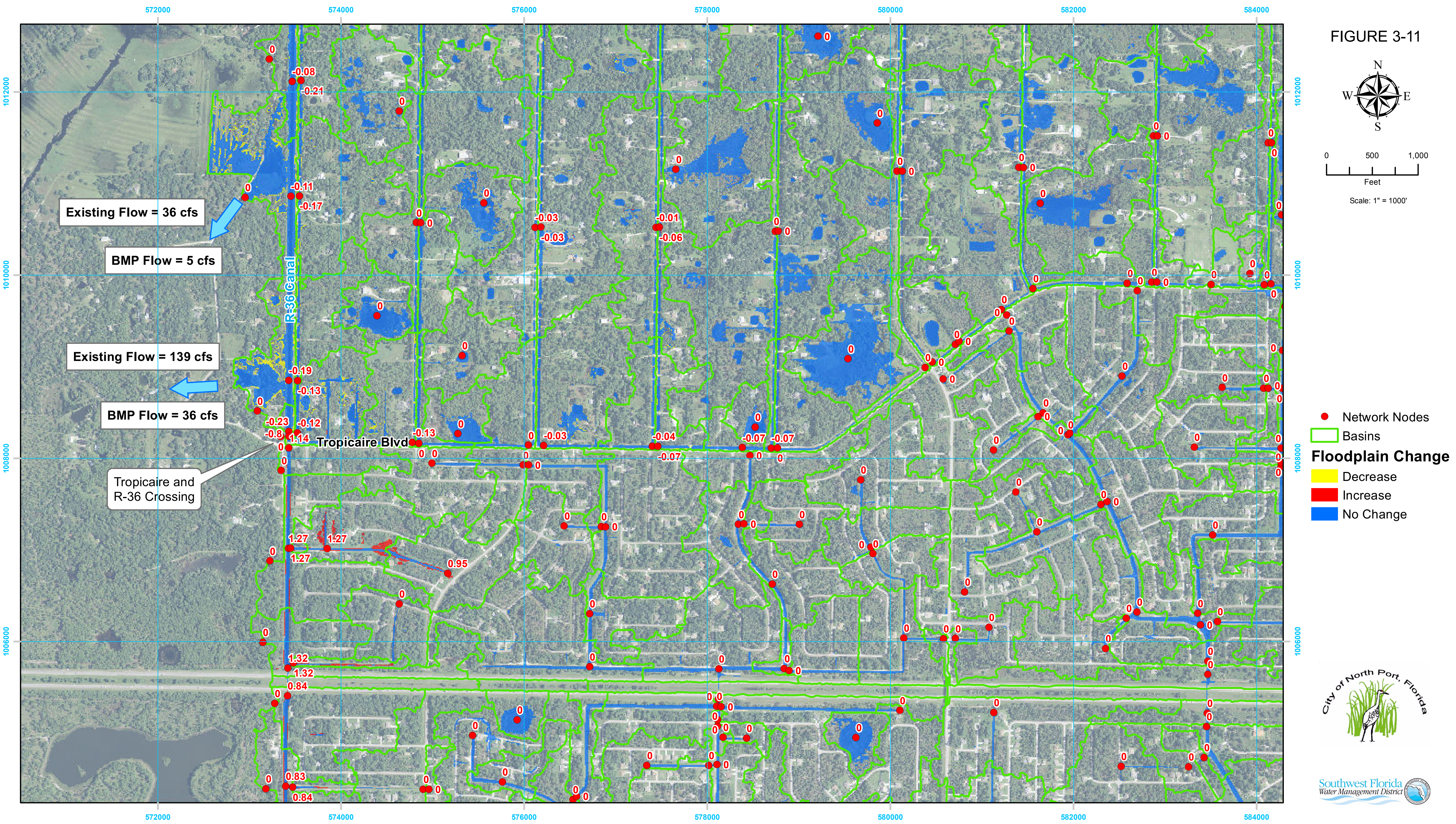
8008 South Orange Avenue
Orlando, Florida 32809



MODEL RESULTS WITH MEAN ANNUAL FLOODPLAIN COMPARISON AND DIFFERENCE IN MAX STAGES

R-36 CANAL AT TROPICAIRE BOULEVARD BMP EVALUATION

Project: 03-065	Projection: State Plane Florida West	
Prepared: 9/10/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: \\20140909 - Final BMP Figures\BMP3 Crossing Mean Ann.mxd		

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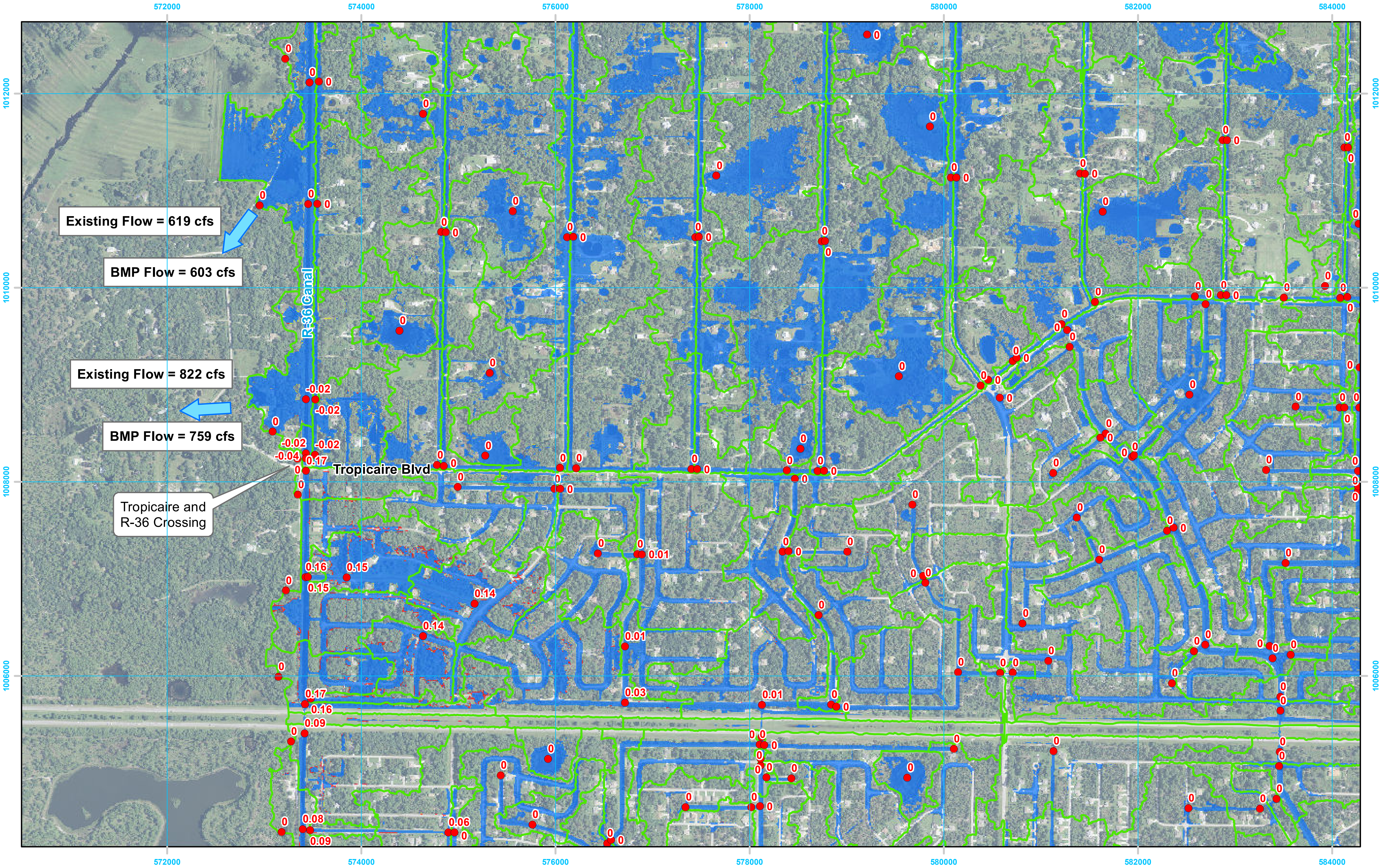
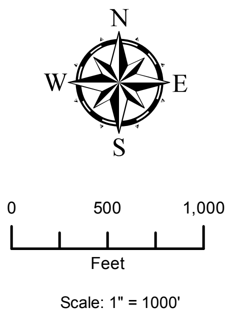
FIGURE 3-12





- Network Nodes
- Basins

Floodplain Change

- Decrease
- Increase
- No Change

MODEL RESULTS WITH 1-DAY 100-YEAR FLOODPLAIN COMPARISON AND DIFFERENCE IN MAX STAGES

R-36 CANAL AT TROPICAIRE BOULEVARD BMP EVALUATION

Project: 03-065	Projection: State Plane Florida West	
Prepared: 9/10/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: \\20140909 - Final BMP Figures\BMP3 Crossing 1D100Yr.mxd		

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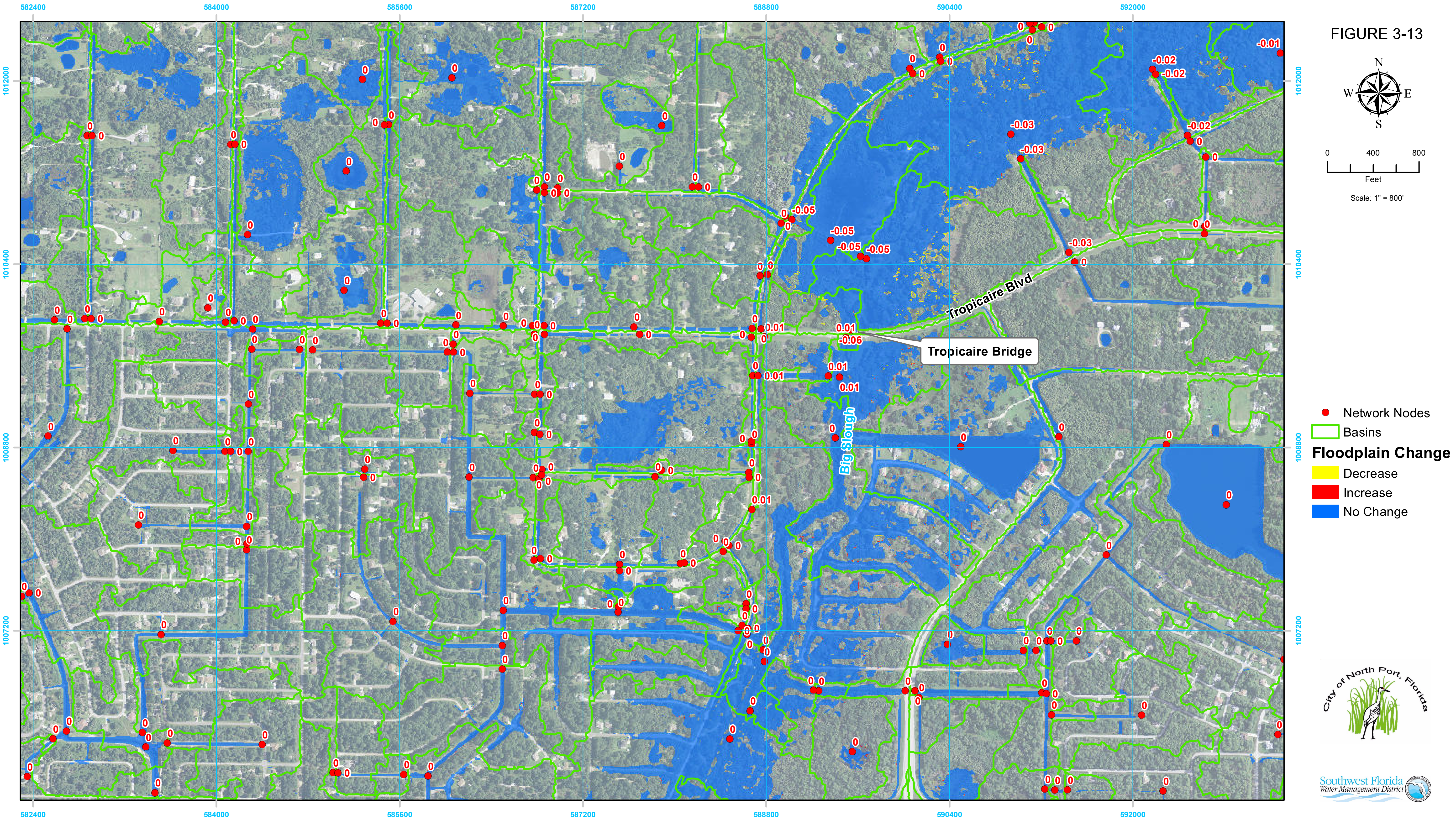

MODEL RESULTS WITH MEAN ANNUAL FLOODPLAIN COMPARISON AND DIFFERENCE IN MAX STAGES

MYAKKAHATCHEE CREEK AT TROPICAIRE BOULEVARD BMP EVALUATION

Project: 03-065	Projection: State Plane Florida West	
Prepared: 9/10/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: \\20140909 - Final BMP Figures\BMP4 Crossing Mean Ann.mxd		

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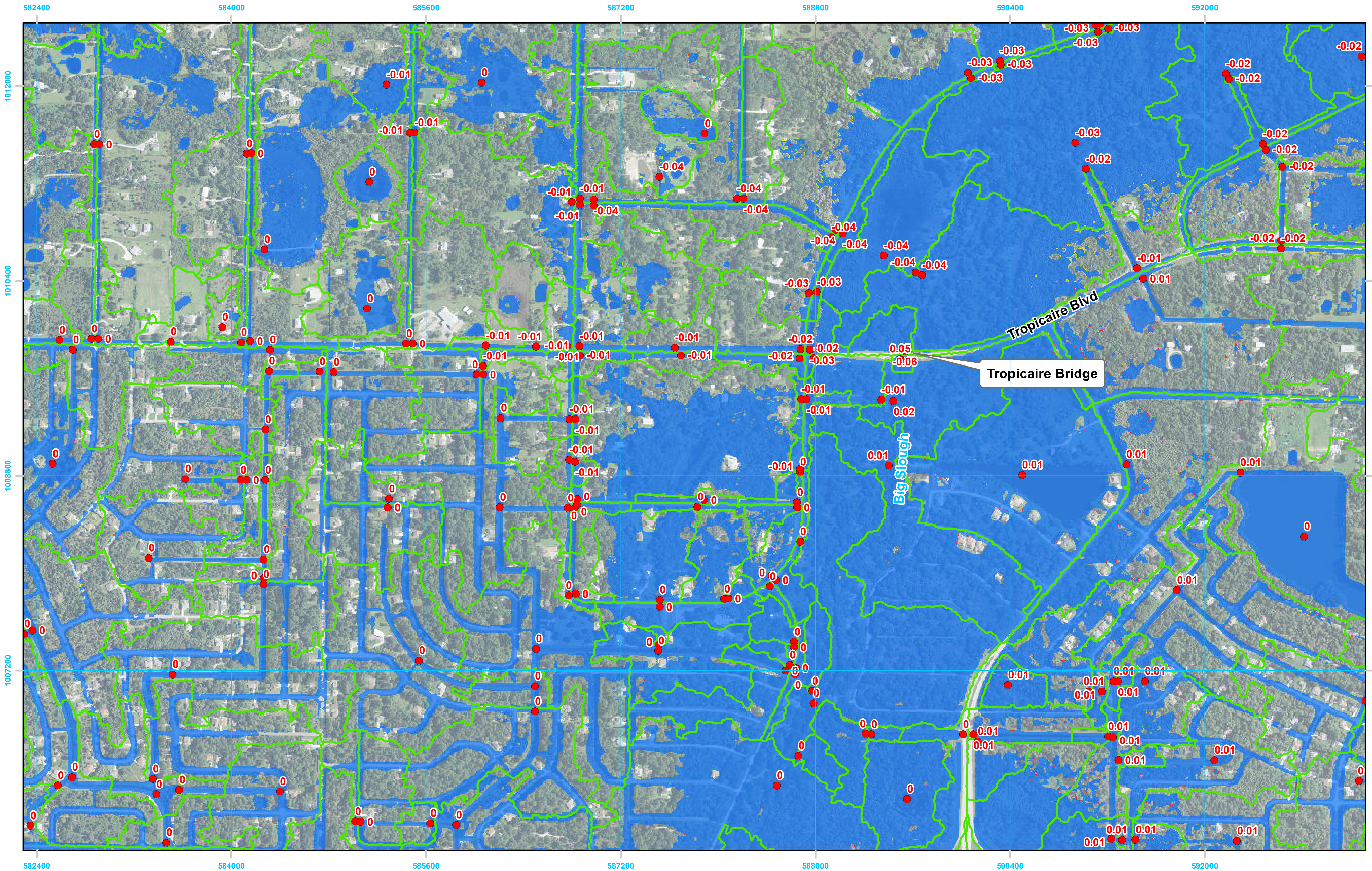
FIGURE 3-14



N
W E
S

0 400 800
Feet
Scale: 1" = 800'

- Network Nodes
- Basins

Floodplain Change

- Decrease
- Increase
- No Change

City of North Port, Florida

Southwest Florida Water Management District

MODEL RESULTS WITH 1-DAY 100-YEAR FLOODPLAIN COMPARISON AND DIFFERENCE IN MAX STAGES

MYAKKAHATCHEE CREEK AT TROPICAIRE BOULEVARD BMP EVALUATION

Project: 03-065	Projection: State Plane Florida West	
Prepared: 9/10/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: \\20140909 - Final BMP Figures\BMP4 Crossing 1D100Yr.mxd		

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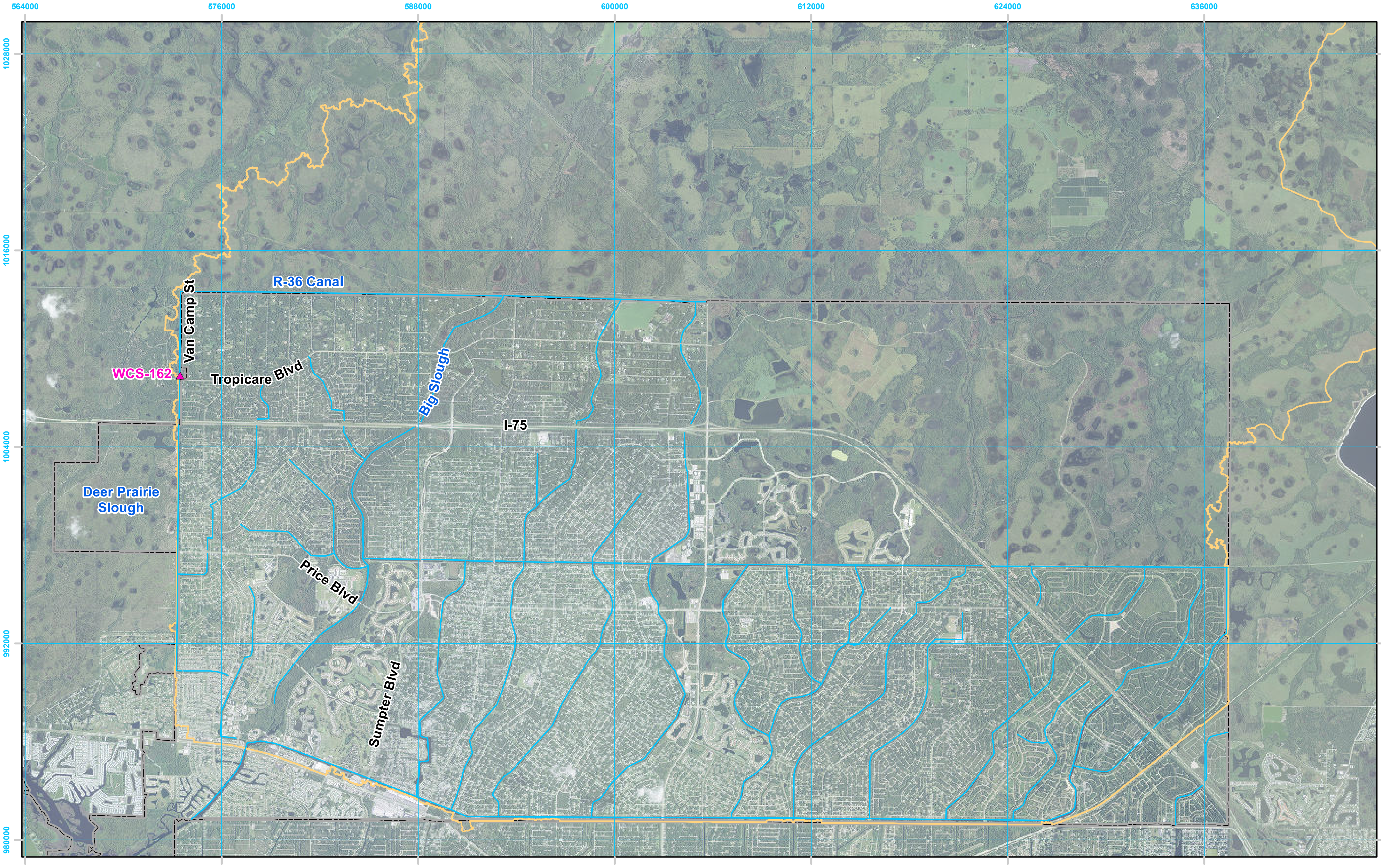
FIGURE 3-15



N
W
E
S

0 3,000 6,000
Feet
Scale: 1" = 6000'

Water Control Structures
Waterway Flow
Watershed Boundary
Northport Boundary

City of North Port, Florida

Southwest Florida Water Management District

Project: 03-065	Projection: State Plane Florida West	
Prepared: 9/9/2014	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: CGG	Modified by:	Modified:
File: \\03-065\ArcGIS_ArcLayouts\20140909 - Final BMP Figures\WCS-162.mxd		

LOCATION OF WCS-162
CITY OF NORTH PORT, SARASOTA COUNTY, FL

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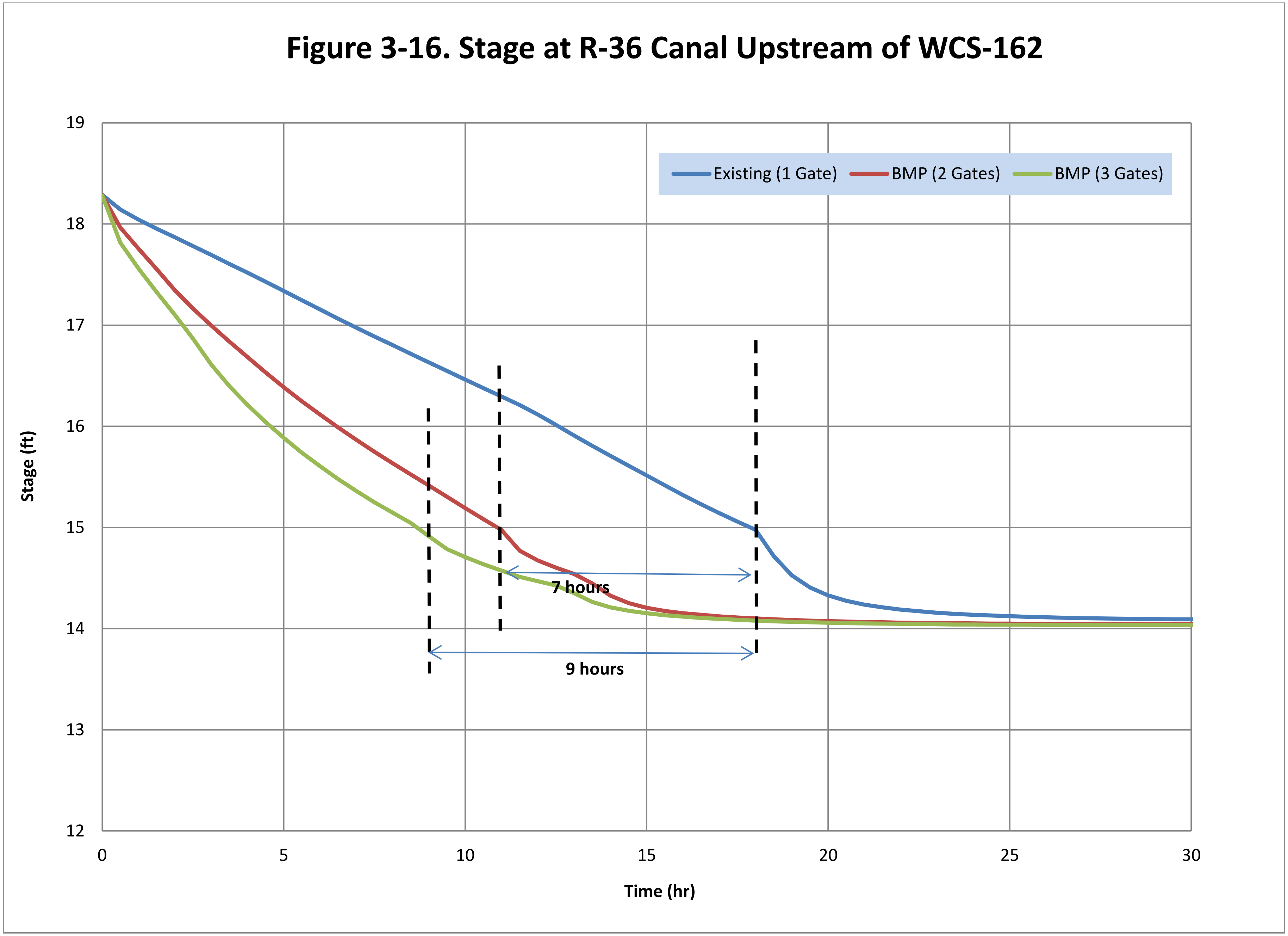
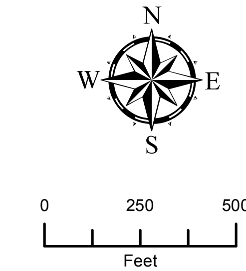


Figure 3-16. Stage at R-36 Canal Upstream of WCS-162
Existing (1 Gate)
BMP (2 Gates)
BMP (3 Gates)
Stage (ft)
19
18
17
16
15
14
13
12
7 hours
9 hours
0
5
10
15
20
25
30
Time (hr)

FIGURE 3-17



Scale: 1" = 500'

- Habitable Structure Floods in 100 Year Event
- Arterial Street Floods in 100 Year Event
- Evacuation Route Floods in 100 Year Event
- Collector Street Floods in 25 Year Event
- Local Street Flods in 25 Year Event

City of North Port, Florida

Southwest Florida Water Management District

EXISTING CONDITION LOS AND 100-YEAR FLOODPLAIN

NORTH PORT/BIG SLOUGH WMP

Project: 03-065	Projection: State Plane Florida West	
Prepared: 08-05-14	Horizontal Datum: HARN	Vertical Datum: N/A
Prepared by: TJC	Modified by:	Modified:
File: _ArcLayouts\20140909 - Final BMP Figures\LOS2012 City Criteria.mxd		

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FIGURE 3-18

N E S W

0 250 500
Feet
Scale: 1" = 500'

- Habitable Structure Floods in 100 Year Event
- Arterial Street Floods in 100 Year Event
- Evacuation Route Floods in 100 Year Event
- Collector Street Floods in 25 Year Event
- Local Street Flods in 25 Year Event

City of North Port, Florida

Southwest Florida Water Management District

UPDATED EXISTING CONDITION 100-YEAR FLOODPLAIN

NORTH PORT/BIG SLOUGH WMP

Project: 03-065	Projection: State Plane Florida West	
Prepared: 08-05-14	Horizontal Datum: HARN	Vertical Datum: N/A
Prepared by: TJC	Modified by:	Modified:
File: _ArcLayouts\20140909 - Final BMP Figures\Price Blvd Existing_1D100Y.mxd		

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FIGURE 3-19

N
W E
S

0 250 500
Feet

Node (Maxstage Change)
BMP_1
Decrease
Increase
No Change

City of North Port, Florida

Southwest Florida Water Management District

BMP_1 25-YEAR FLOODPLAIN COMPARISON
NORTH PORT/BIG SLOUGH WMP

Project: 03-065	Projection: State Plane Florida West	
Prepared: 08-05-14	Horizontal Datum: HARN	Vertical Datum: N/A
Prepared by: TJC	Modified by:	Modified:
File: _ArcLayouts\20140909 - Final BMP Figures\Price Blvd BMP1_1D25Y.mxd		

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Geotechnical, Environmental and Materials Consultants
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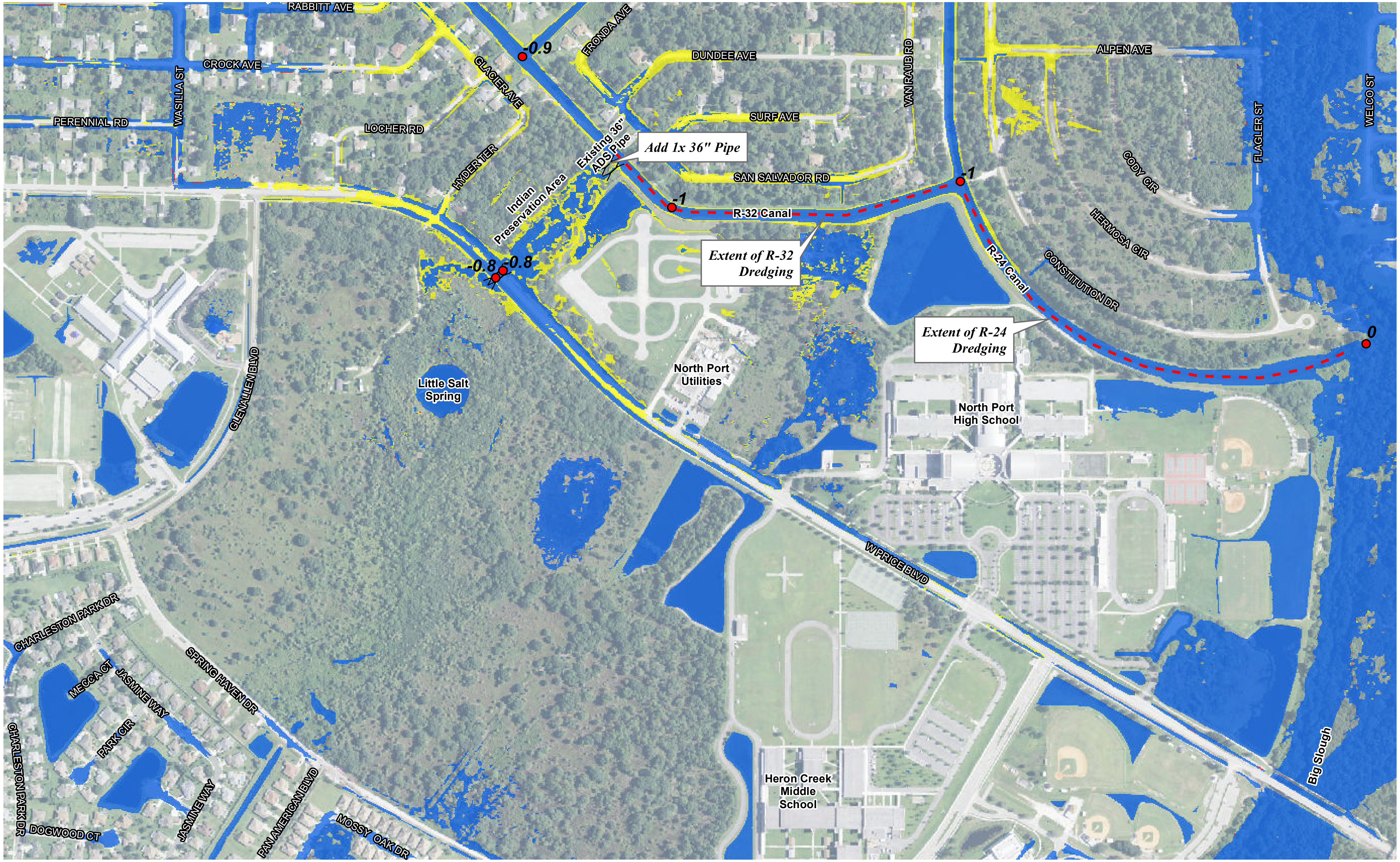
Orlando, Florida 32809

FIGURE 3-20



N
W E
S

0 250 500
Feet
Scale: 1" = 500'

Legend

- Node (Maxstage Change)
- BMP_1
- Decrease
- Increase
- No Change

City of North Port, Florida

Southwest Florida Water Management District

BMP_1 100-YEAR FLOODPLAIN COMPARISON

NORTH PORT/BIG SLOUGH WMP

Project: 03-065	Projection: State Plane Florida West	
Prepared: 08-05-14	Horizontal Datum: HARN	Vertical Datum: N/A
Prepared by: TJC	Modified by:	Modified:
File: _ArcLayouts\20140909 - Final BMP Figures\Price Blvd BMP1_1D100Y.mxd		

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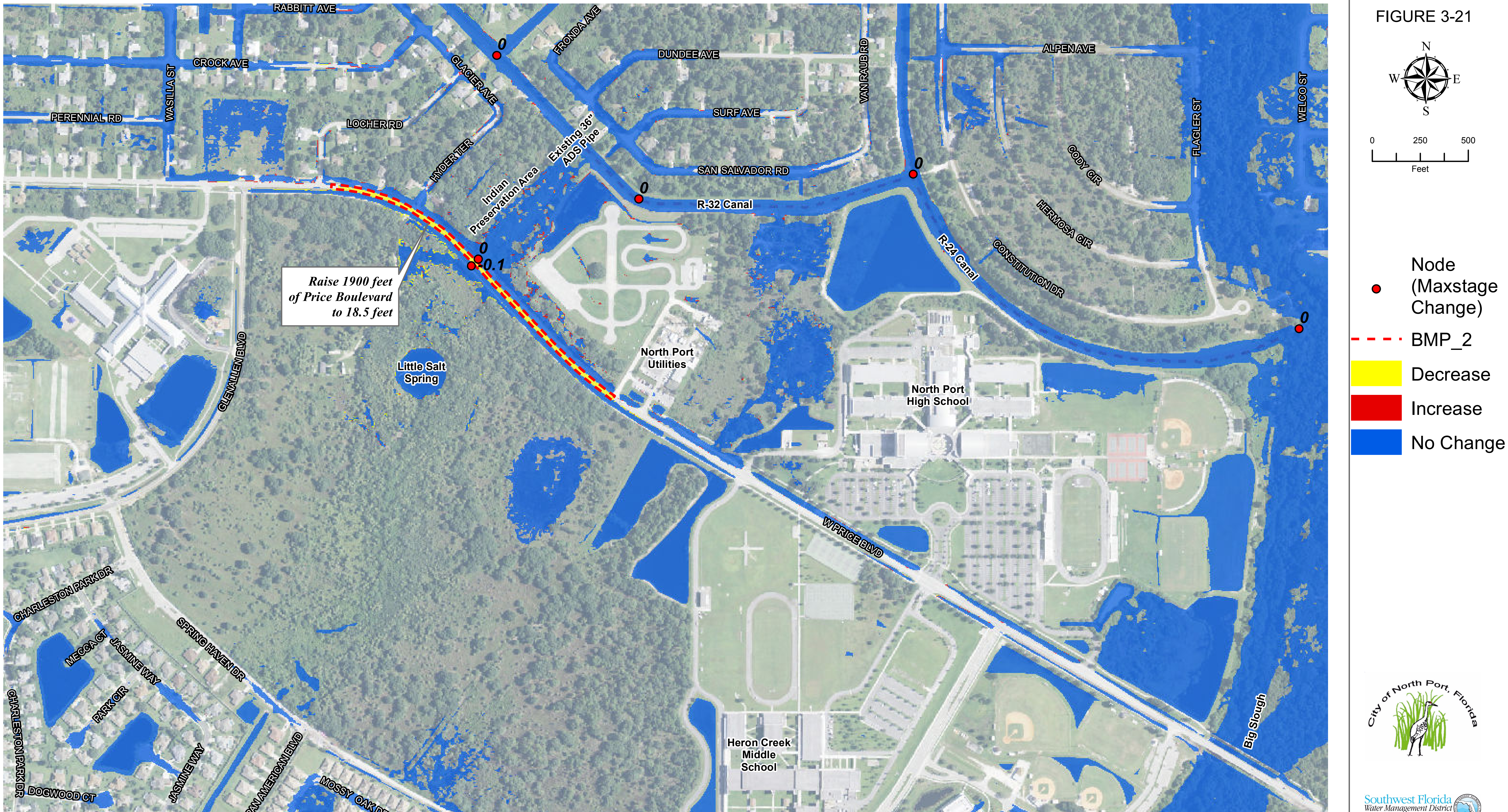
Orlando, Florida 32809

FIGURE 3-21



City of North Port, Florida

Southwest Florida Water Management District

BMP_2 100-YEAR FLOODPLAIN COMPARISON

NORTH PORT/BIG SLOUGH WMP

Project: 03-065	Projection: State Plane Florida West	
Prepared: 08-05-14	Horizontal Datum: HARN	Vertical Datum: N/A
Prepared by: TJC	Modified by:	Modified:
File: \\ArcGIS_ArcLayouts\20140909 - Final BMP Figures\Price Blvd BMP 2.mxd		

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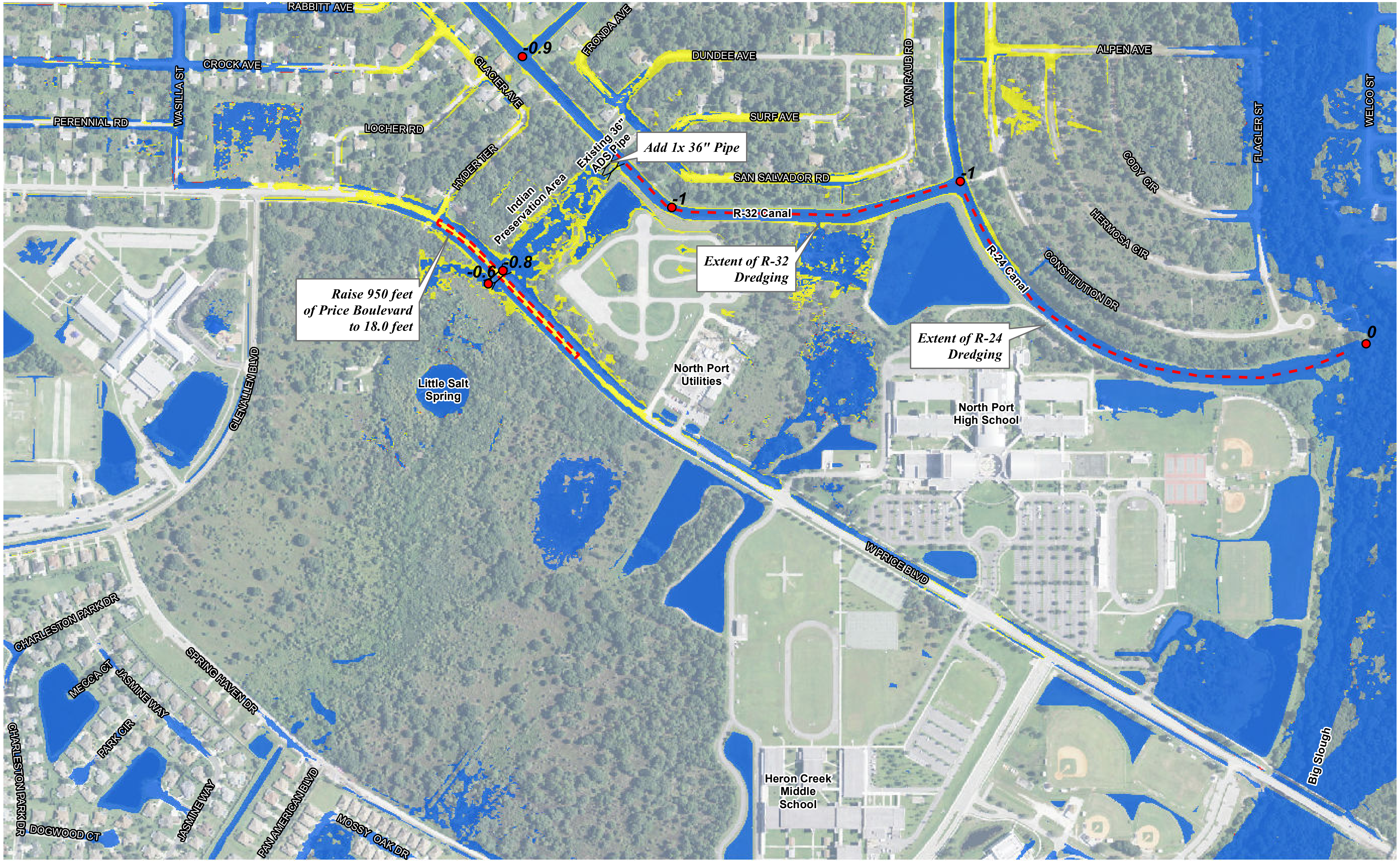
8008 South Orange Avenue
Orlando, Florida 32809

FIGURE 3-22



N
W E
S

0 250 500
Feet

- Node (Maxstage Change)
- BMP_3
- Decrease
- Increase
- No Change

City of North Port, Florida

Southwest Florida Water Management District

BMP_3 100-YEAR FLOODPLAIN COMPARISON

NORTH PORT/BIG SLOUGH WMP

Project: 03-065	Projection: State Plane Florida West	
Prepared: 08-05-14	Horizontal Datum: HARN	Vertical Datum: N/A
Prepared by: TJC	Modified by:	Modified:
File: \\ArcGIS_ArcLayouts\20140909 - Final BMP Figures\Price Blvd BMP 3.mxd		

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Geotechnical, Environmental and Materials Consultants
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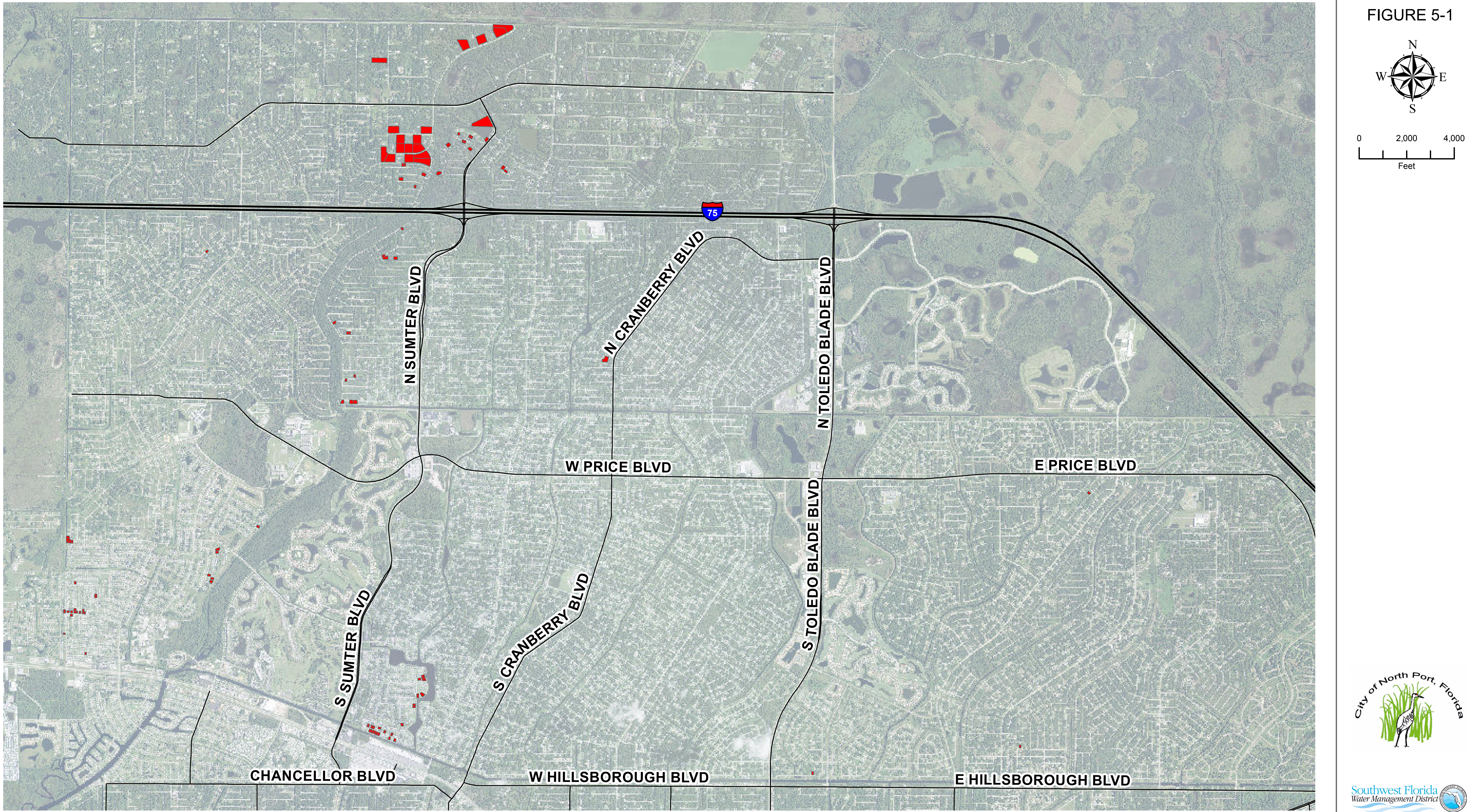
FIGURE 5-1



City of North Port, Florida

Southwest Florida Water Management District

FLOODED PARCELS TO SURVEY

NORTH PORT/BIG SLOUGH WMP

Project: 03-065	Projection: State Plane Florida West	
Prepared: 09-30-14	Horizontal Datum: HARN	Vertical Datum: N/A
Prepared by: TJC	Modified by:	Modified:
File: \\Model_Maintenance\ArcGIS_ArcLayouts\Flooded_Parcels_To_Survey.mxd		

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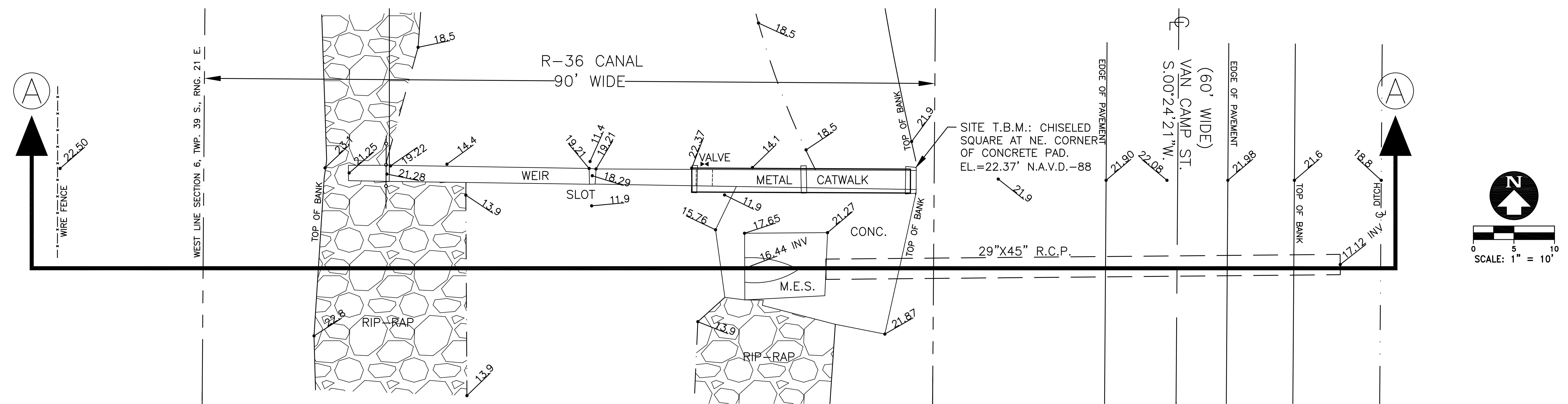
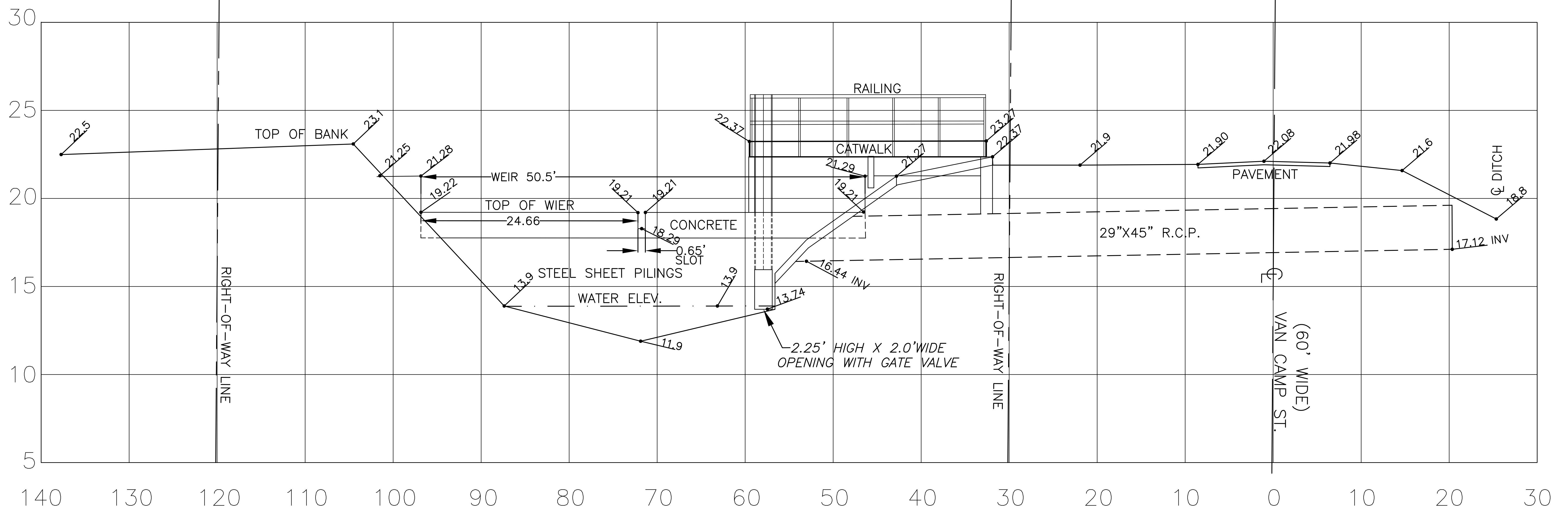
Orlando, Florida 32809

APPENDIX A

2014 Survey Data of WCS-162





SECTION "A"-"A"
WATER CONTROL STRUCTURE #162

LEGEND

T.B.M.	TEMPORARY BENCH MARK
E.O.P.	EDGE OF PAVEMENT
℄	CENTERLINE
7.7	TYPICAL SPOT ELEVATION
R.C.P.	REINFORCED CONCRETE PIPE
M.E.S.	MITERED END SECTION

FOR: CITY OF NORTH PORT
DEPARTMENT OF ENGINEERING

SURVEYOR'S NOTES/REPORT:

1) BEARINGS ARE BASED ON AN ASSUMED MERIDIAN. A BEARING OF S.00°24'21"W. WAS ASSIGNED TO THE CENTERLINE OF VAN CAMP STREET PER RECORD PLAT OF NORTH PORT CHARLOTTE ESTATES.
2) ELEVATIONS SHOWN ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988. F.D.E.P. BENCH MARK N-698-2007.
3) THE ACCURACY OF THIS MAP OF SURVEY IS BASED ON CONTROL MEASUREMENTS THAT MEET OR EXCEED THE MINIMUM ACCURACY REQUIREMENTS FOR THIS TYPE OF SURVEY AS SPECIFIED IN CHAPTER 5J-17, FAC. THIS MAP'S DIGITAL DATA IS INTENDED TO BE DISPLAYED AT A SCALE OF 1"=20' OR SMALLER.
4) SURVEY PERFORMED FOR THE "SPECIFIC PURPOSE" OF PROVIDING ELEVATION AND DIMENSION DETAILS OF THE WATER CONTROL STRUCTURE FOR USE BY THE CITY OF NORTH PORT DEPARTMENT OOF ENGINEERING.

CERTIFICATE

I, hereby certify that this Map/Report of Survey as shown and/or described herein represents the results of Field Surveys performed under my supervision, that it is true and correct to the best of my knowledge, information and belief and meets the requirements of Chapter 5J-17, F.A.C. pursuant to Section 472.027, F.S. Subject to all notations as shown herein.

Van Buskirk / Fish & Associates, Inc., LB#3739

By: [signature]
Alan K. Fish, P.S.M.
Registered Professional Surveyor & Mapper
Florida Certificate No. 3941

Date of Survey: JUNE 19TH, 2014

"Not valid without the signature and the original raised seal of a Florida licensed surveyor and mapper."

FIELD BOOK: 587 PAGE(S): 3

REVISIONS: | BY:

MAP OF "SPECIFIC PURPOSE SURVEY, OF WATER CONTROL STRUCTURE # 162 IN NORTH PORT CHARLOTTE ESTATES
CITY OF NORTH PORT, SARASOTA COUNTY, FLORIDA

Van Buskirk / Fish & Associates, Inc.
SURVEYORS - MAPPERS - DEVELOPMENT CONSULTANTS
12450 Unit C Tamiami Trail · North Port, FL 34287 · (941) 426-0681

DATE: 6-19-2014
SCALE: AS NOTED
DRAWN: GC
PROJECT NO. 14-1087
SHEET 1 OF 1 SHEETS

APPENDIX B

WCS-162 Pictures

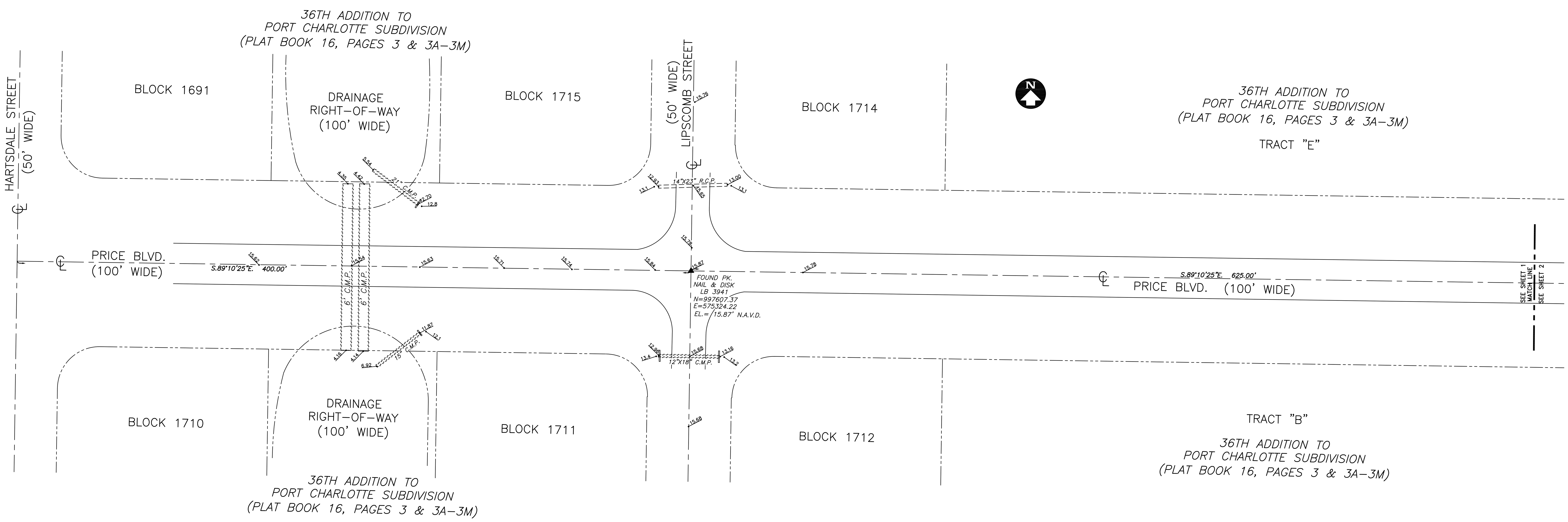
Looking North-West from the downstream of WCS-162

Looking South-West from the upstream of WCS-162

Looking South-West from the upstream of WCS-162

APPENDIX C

2014 Survey Data of West Price Boulevard



LEGEND

- FOUND 4" X 4" CONCRETE MONUMENT (DISK NUMBER NOTED, IF ANY)
- SET 4"X 4" CONCRETE MONUMENT WITH L.S. 3941 DISK.
- FOUND #4 OR #5 IRON ROD (CAP NUMBER NOTED, IF ANY)
- SET #4 IRON ROD WITH L.B. 3739 CAP.
- FOUND 1/2" TO 1" IRON PIPE (NUMBER NOTED, IF ANY)
- FOUND NAIL OR NAIL & DISC (NUMBER NOTED, IF ANY)
- SET NAIL & DISC, LS #3941
- ( ) PARENTHESES INDICATE RECORD BEARING OR DISTANCE IF DIFFERENT THAN MEASURED
- UTILITY POLE & GUY ANCHOR
- LIGHT POLE
- MAIL BOX
- STREET SIGN
- WATER VALVE
- BACK FLOW PREVENTION DEVICE
- SANITARY CLEAN OUT
- ELECTRICAL BOX
- GTE CANISTER
- PHONE RISER
- WATER METER
- HYDRANT
- SANITARY SEWER MANHOLE
- PHONE BOX
- TYPICAL SPOT ELEVATION
- SPOT ELEVATION (POST CONSTRUCTION)
- RE–ENFORCED CONCRETE PIPE (R.C.P.)
- CORRUGATED METAL PIPE (C.M.P.)
- CORRUGATED PLASTIC PIPE (C.P.P.)
- OHL — OVERHEAD UTILITY LINES
- U.G.T. — UNDER GROUND TELEPHONE LINES
- WM — WATER MAIN
- WS — WATER SERVICE
- GAS — UNDER GROUND GAS LINE
- CHAIN LINK FENCE
- WIRE FENCE
- WOOD FENCE

P.C.	POINT OF CURVATURE
P.T.	POINT OF TANGENCY
P.O.B.	POINT OF BEGINNING
P.O.C.	POINT OF COMMENCEMENT
P.R.M.	PERMANENT REFERENCE MONUMENT
P.C.P.	PERMANENT CONTROL POINT
T.B.M.	TEMPORARY BENCH MARK
E.O.P.	EDGE OF PAVEMENT
℄	CENTERLINE
BL	BASELINE
FND.	FOUND
I.P.	IRON PIPE
I.R.	IRON ROD
C.M.P.	CORRUGATED METAL PIPE
R.C.P.	REINFORCED CONCRETE PIPE
C.M.	CONCRETE MONUMENT
EL.	ELEVATION
F.F.	FINISH FLOOR
H.W.	HEAD WALL
B.O.C.	BACK OF CURB
P.R.C.	POINT OF REVERSE CURVATURE
B.F.P.	BACK FLOW PREVENTION DEVICE
M.A.F.L.	MEAN ANNUAL FLOOD LINE
F.S.P.C.S.	FLORIDA STATE PLANE COORDINATE SYSTEM

- PINE TREE (TYP)
- OAK TREE (TYP)
- PALM TREE 10" DIAMETER (TYP)

SURVEYOR'S NOTES/REPORT:

1) BEARINGS ARE BASED ON "GRID NORTH" FLORIDA STATE PLANE COORDINATE SYSTEM, "WEST ZONE". COORDINATES ARE NAD 1983/2007.
2) ELEVATIONS SHOWN ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988.
3) THIS SURVEY WAS PERFORMED FOR THE "SPECIFIC PURPOSE" OF PROVIDING TOPOGRAPHIC SPOT ELEVATIONS, CULVERT AND STORM DRAIN PIPE SIZES AND ELEVATIONS, CULVERT MATERIAL TYPES AND OTHER SELECTED ELEVATION DATA FOR USE IN A DRAINAGE STUDY OF THE PORTIONS OF PRICE BLVD. SHOWN ON THIS MAP OF SURVEY.
4) EASEMENTS SHOWN IF ANY, ARE INTERPRETED FROM RECORD PLAT DEDICATIONS OR TITLE INFORMATION SUPPLIED TO OR ACQUIRED BY, THE SURVEYOR AT TIME OF SURVEY. THE SURVEYED PROPERTY MAY BE SUBJECT TO OTHER RESERVATIONS, RESTRICTIONS, COVENANTS, EASEMENTS OR AGREEMENTS AFFECTING THE PROPERTIES NOT DEPICTED ON THIS SURVEY. UNDERGROUND UTILITIES HAVE NOT BEEN LOCATED. IF UTILITY LINES ARE SHOWN, THEY WERE LOCATED AS MARKED BY OTHERS AND THE SURVEYOR ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OR THE COMPLETENESS OF SAID UTILITY LOCATIONS.
5) THE ACCURACY OF THIS MAP OF SURVEY IS BASED ON CONTROL MEASUREMENTS THAT MEET OR EXCEED THE MINIMUM ACCURACY REQUIREMENTS FOR THIS TYPE OF SURVEY AS SPECIFIED IN CHAPTER 5J–17, FAC. THIS MAP'S DIGITAL DATA IS INTENDED TO BE DISPLAYED AT A SCALE OF 1"=20' OR SMALLER.

FOR: THE CITY OF NORTH PORT, FLORIDA

CERTIFICATE

I, hereby certify that this Map/Report of Survey Sheets 1 through 8, as shown herein represents the results of Field Surveys performed under my supervision, that it is true and accurate to the best of my knowledge, information and belief and meets the requirements of Chapter 5J–17, F.A.C. pursuant to Section 472.027, F.S. Subject to all notations as shown herein.

Van Buskirk / Fish & Associates, Inc., LB#3739

By: [signature]
Alan K. Fish, P.S.M.
Registered Professional Surveyor & Mapper
Florida Certificate No. 3941

Date of Survey: JUNE 17, 2014

"Not valid without the signature and the original raised seal of a Florida licensed surveyor and mapper."

ALAN K. FISH · LICENSE NUMBER No. 3941 · STATE OF FLORIDA · Professional Surveyor & Mapper

REVISIONS:	BY:

MAP OF "SPECIFIC PURPOSE SURVEY" SHOWING FIELD SURVEY DATA COLLECTED FOR A DRAINAGE STUDY ALONG A PORTION OF PRICE BLVD. IN THE CITY OF NORTH PORT, FLORIDA

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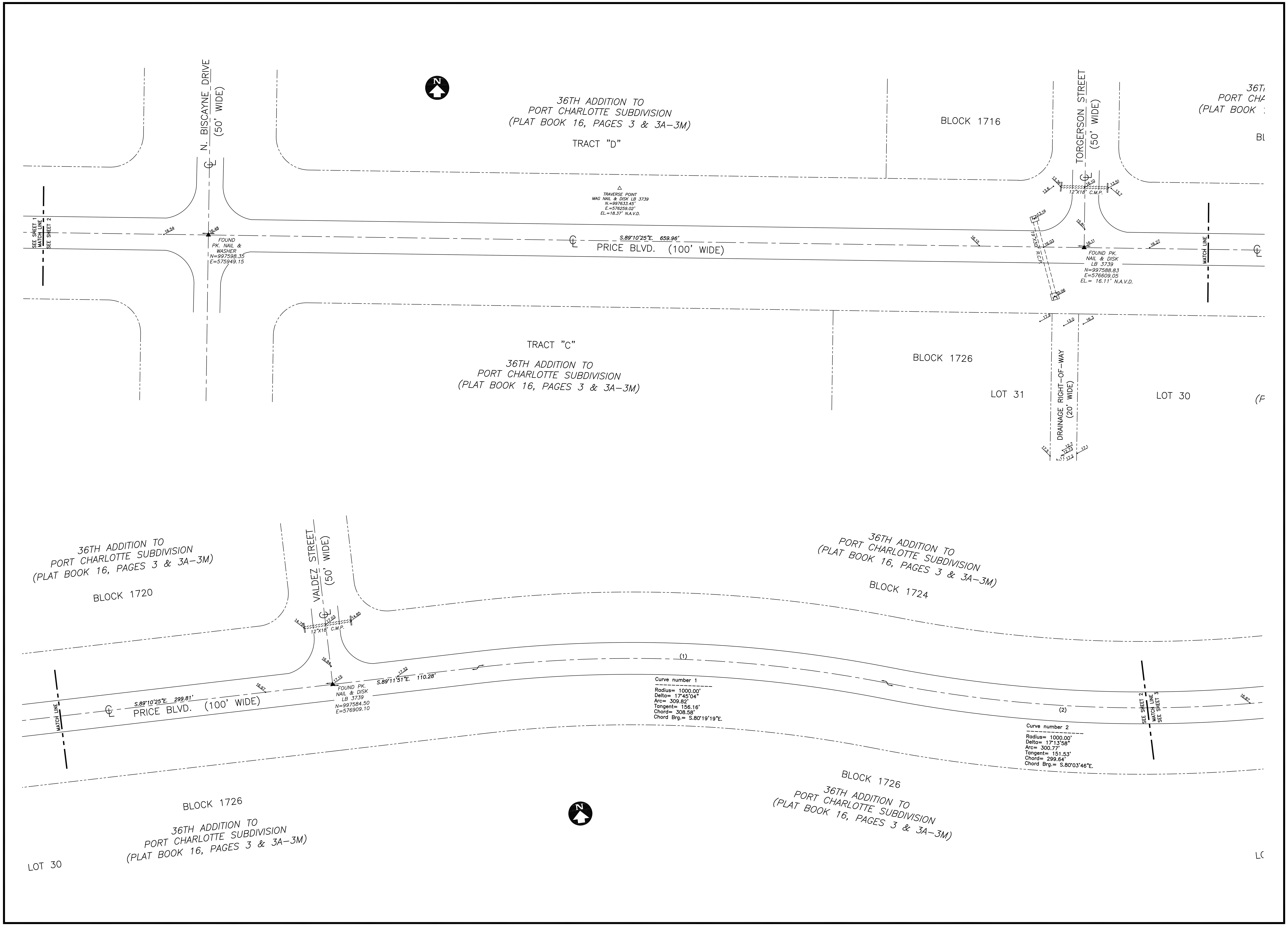
DATE: 6-17-2014
SCALE: 1" = 30'
DRAWN: GC
PROJECT NO. 14-1088
SHEET 1 OF 7 SHEETS



REVISIONS:	BY:

MAP OF "SPECIFIC PURPOSE SURVEY" SHOWING FIELD SURVEY DATA COLLECTED FOR A DRAINAGE STUDY ALONG A PORTION OF PRICE BLVD. IN THE CITY OF NORTH PORT, FLORIDA

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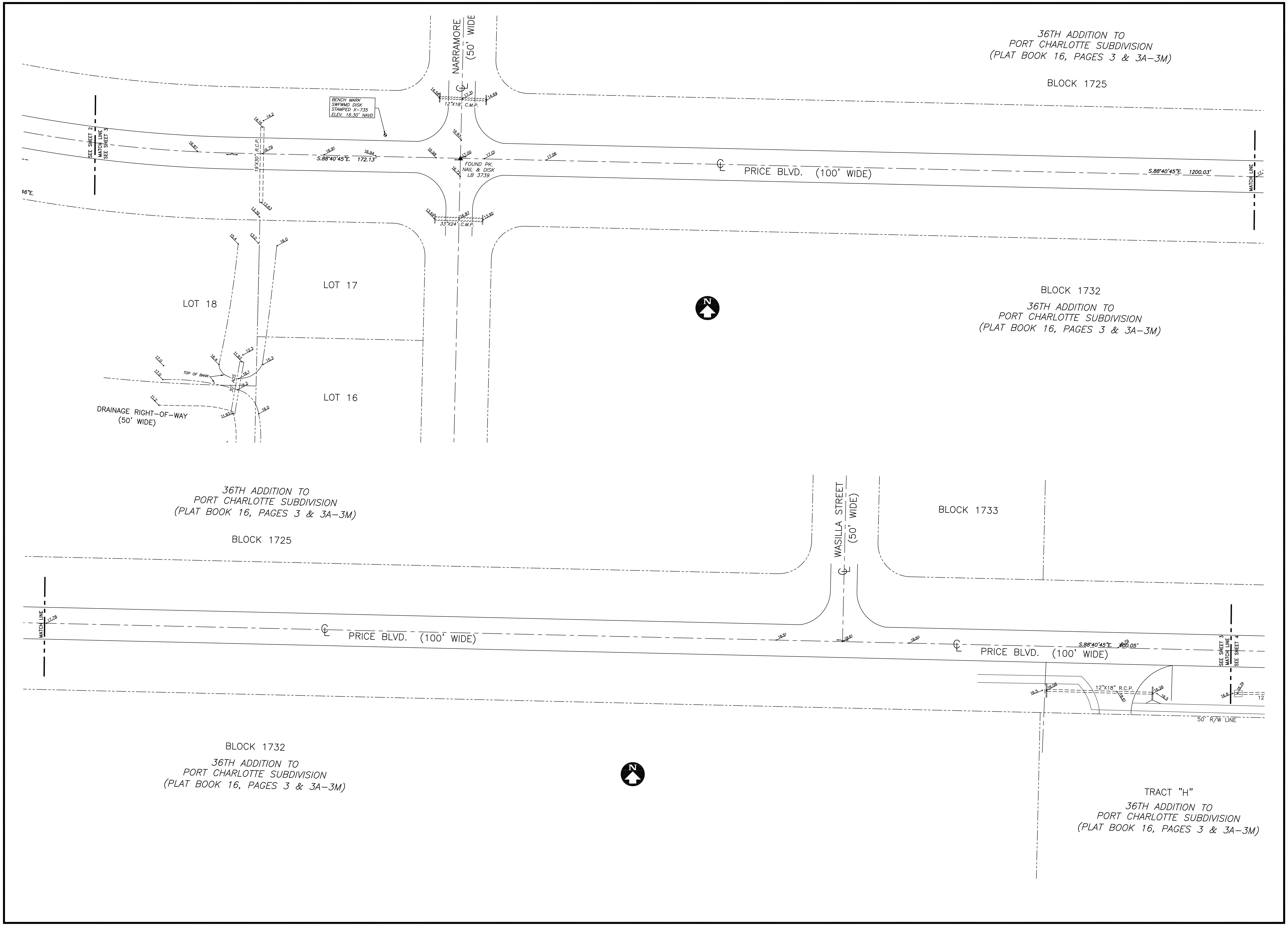
DATE: 6-17-2014
SCALE: 1" = 30'
DRAWN: GC
PROJECT NO. 14-1088
SHEET 2 OF 7 SHEETS



REVISIONS:	BY:

MAP OF "SPECIFIC PURPOSE SURVEY" SHOWING FIELD SURVEY DATA COLLECTED FOR A DRAINAGE STUDY ALONG A PORTION OF PRICE BLVD. IN THE CITY OF NORTH PORT, FLORIDA

Van Buskirk / Fish & Associates, Inc.
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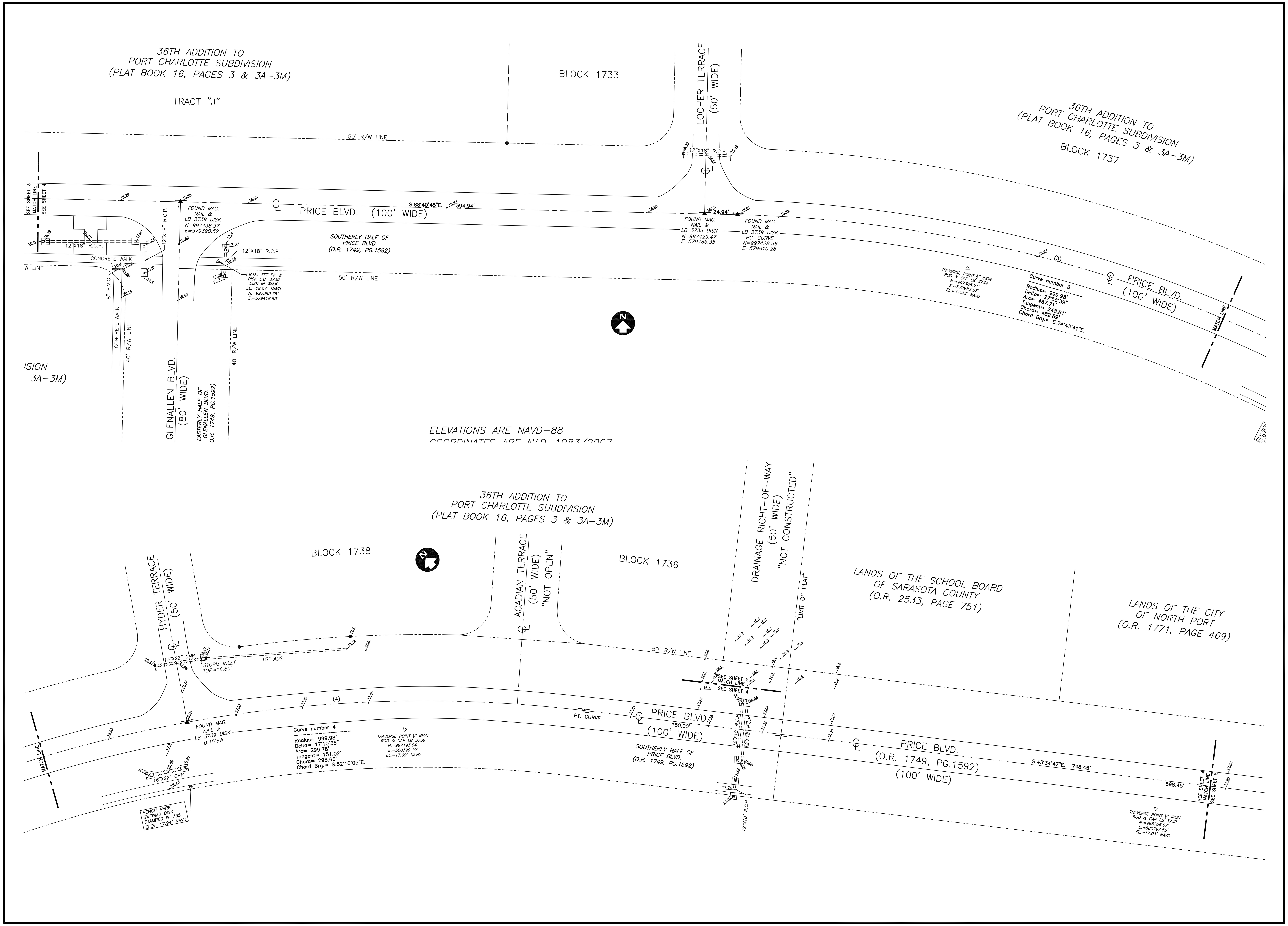
DATE: 6-17-2014
SCALE: 1" = 30'
DRAWN: AKF
PROJECT NO. 14-1088



REVISIONS:	BY:

MAP OF "SPECIFIC PURPOSE SURVEY" SHOWING FIELD SURVEY DATA COLLECTED FOR A DRAINAGE STUDY ALONG A PORTION OF PRICE BLVD. IN THE CITY OF NORTH PORT, FLORIDA

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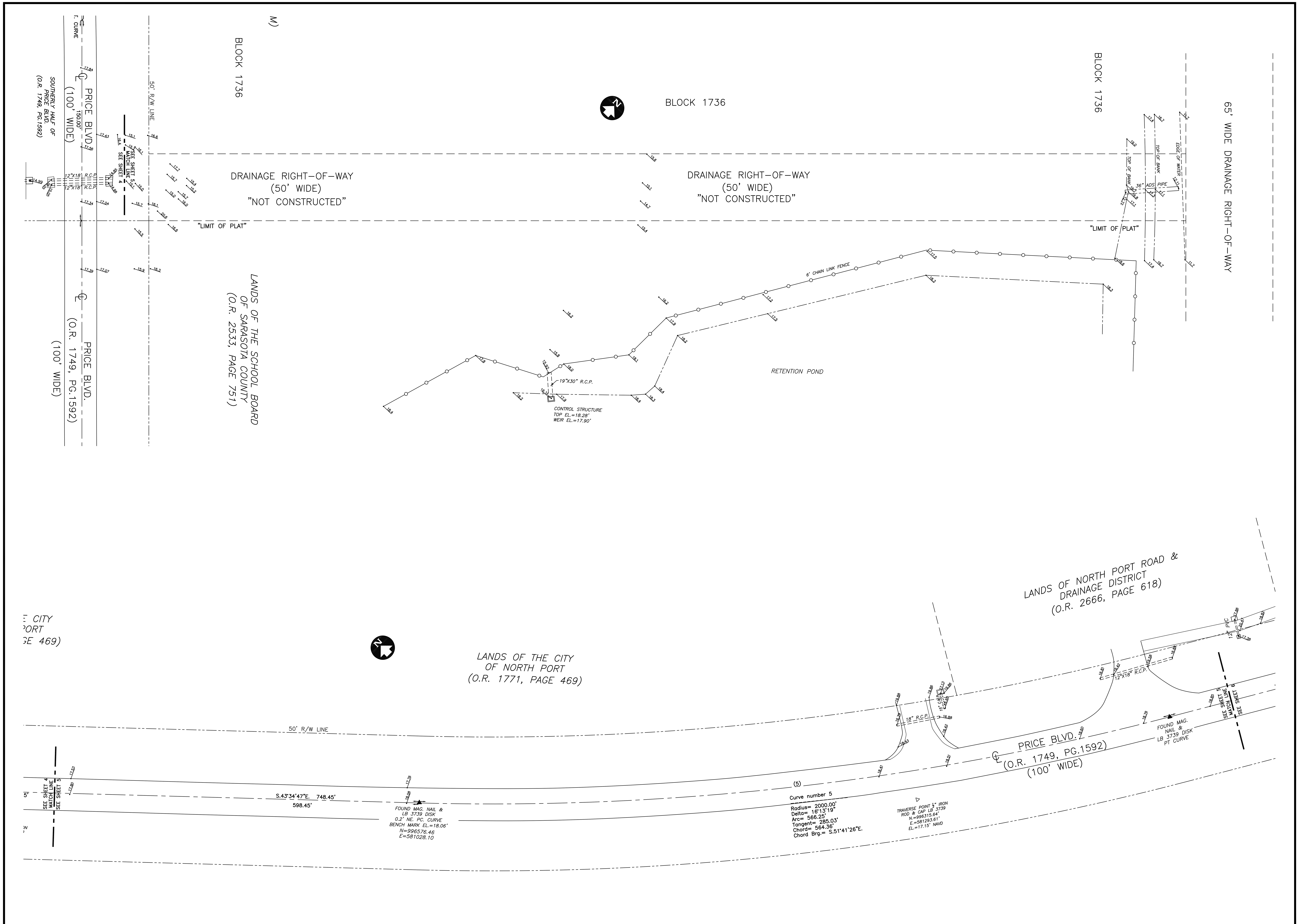
DATE: 6-17-2014
SCALE: 1" = 30'
DRAWN: AKF
PROJECT NO. 14-1088



REVISIONS:	BY:

MAP OF "SPECIFIC PURPOSE SURVEY" SHOWING FIELD SURVEY DATA COLLECTED FOR A DRAINAGE STUDY ALONG A PORTION OF PRICE BLVD. IN THE CITY OF NORTH PORT, FLORIDA

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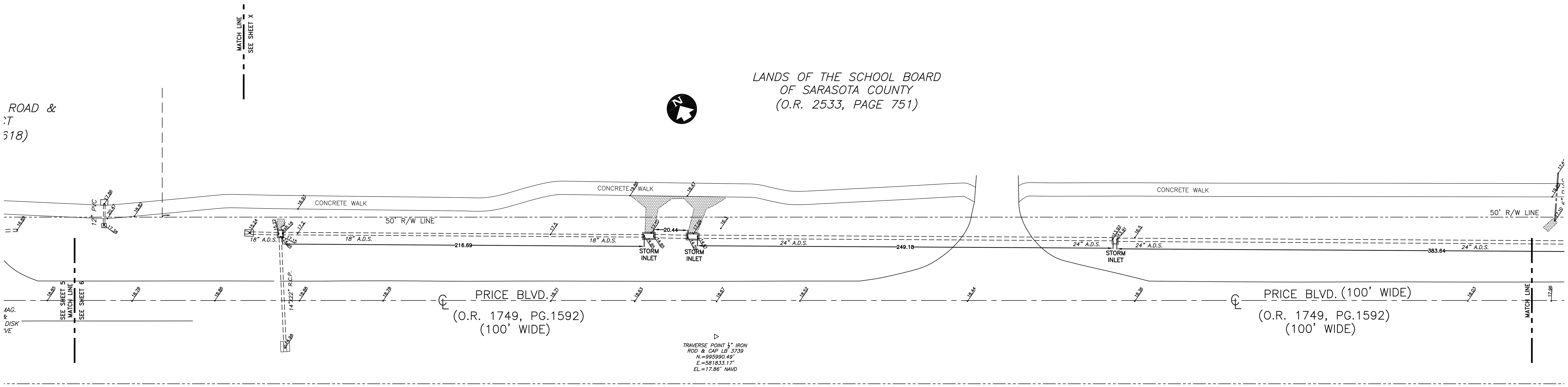
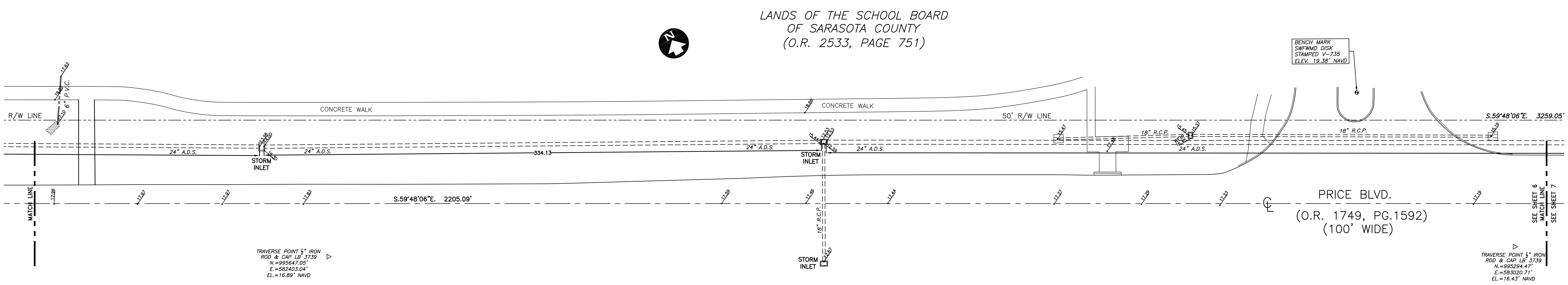
DATE: 6-17-2014
SCALE: 1" = 30'
DRAWN: AKF
PROJECT NO. 14-1088
SHEET 5 OF 7 SHEETS



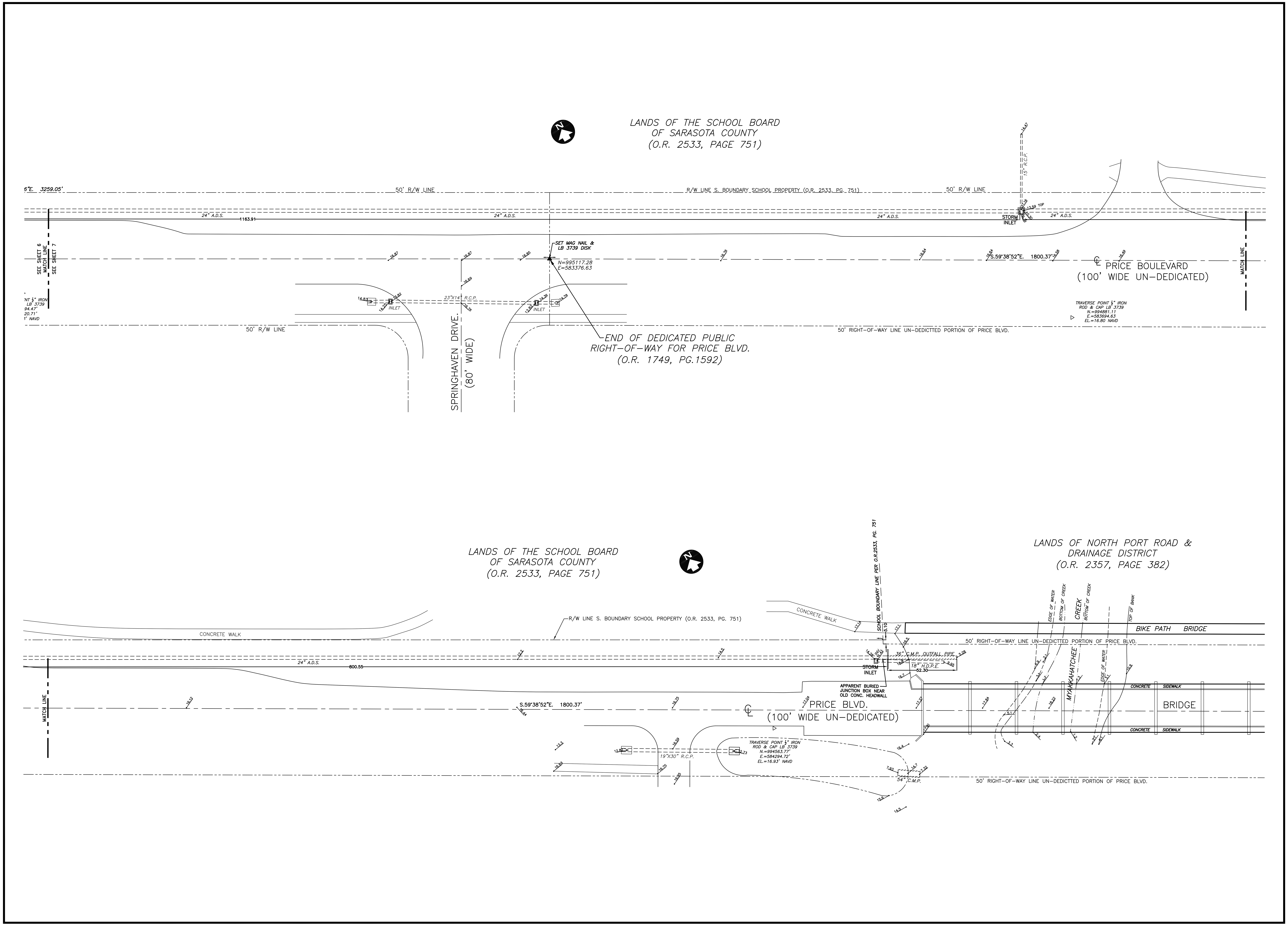


REVISIONS:	BY:

MAP OF "SPECIFIC PURPOSE SURVEY" SHOWING FIELD SURVEY DATA COLLECTED FOR A DRAINAGE STUDY ALONG A PORTION OF PRICE BLVD. IN THE CITY OF NORTH PORT, FLORIDA

Van Buskirk / Fish & Associates, Inc.
SURVEYORS - MAPPERS - DEVELOPMENT CONSULTANTS
12450 Unit C Tamiami Trail · North Port, FL 34287 · (941) 426-0681

DATE: 6-17-2014
SCALE: 1" = 30'
DRAWN: AKF
PROJECT NO. 14-1088



REVISIONS:	BY:

MAP OF "SPECIFIC PURPOSE SURVEY" SHOWING FIELD SURVEY DATA COLLECTED FOR A DRAINAGE STUDY ALONG A PORTION OF PRICE BLVD. IN THE CITY OF NORTH PORT, FLORIDA

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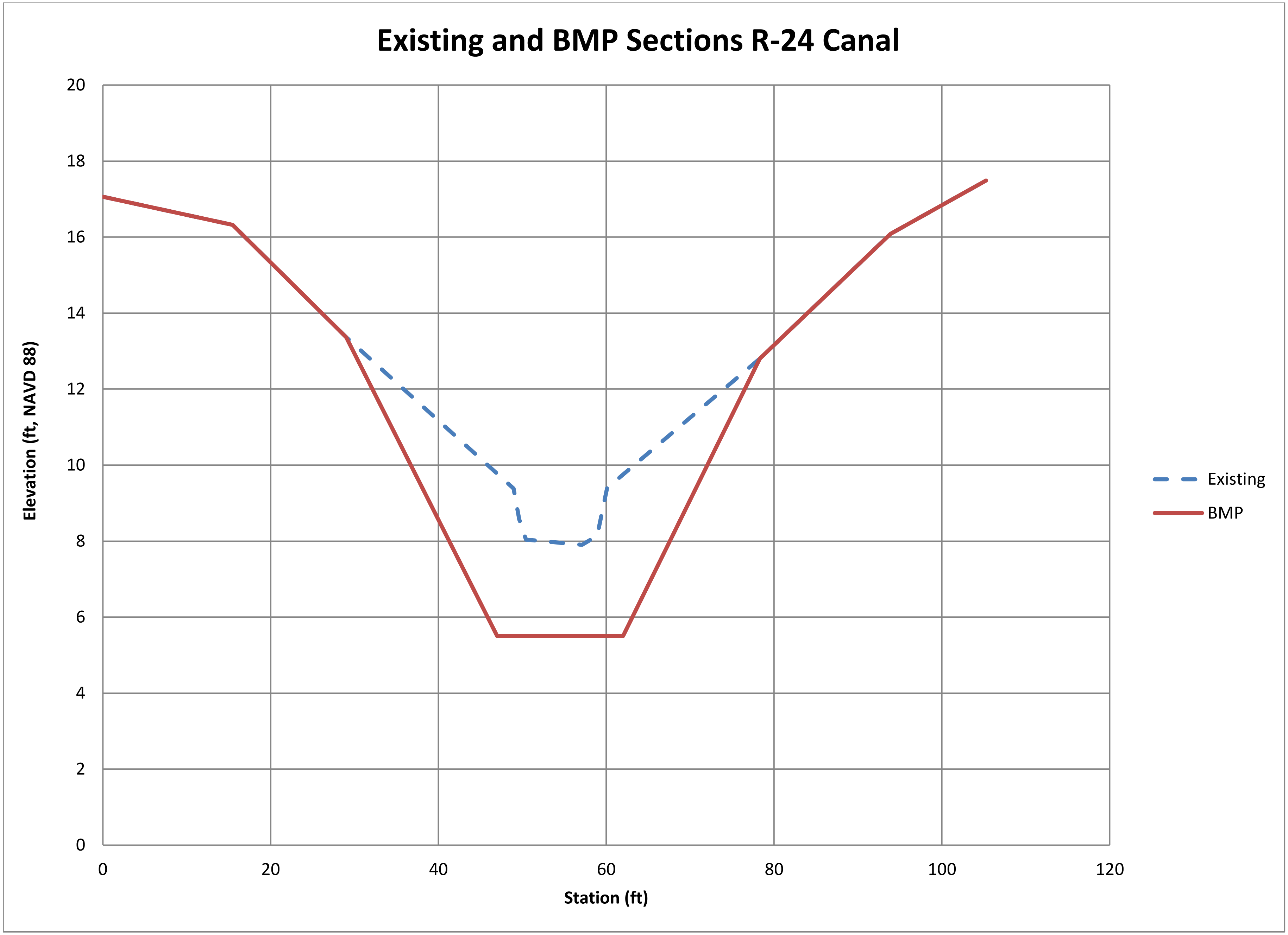
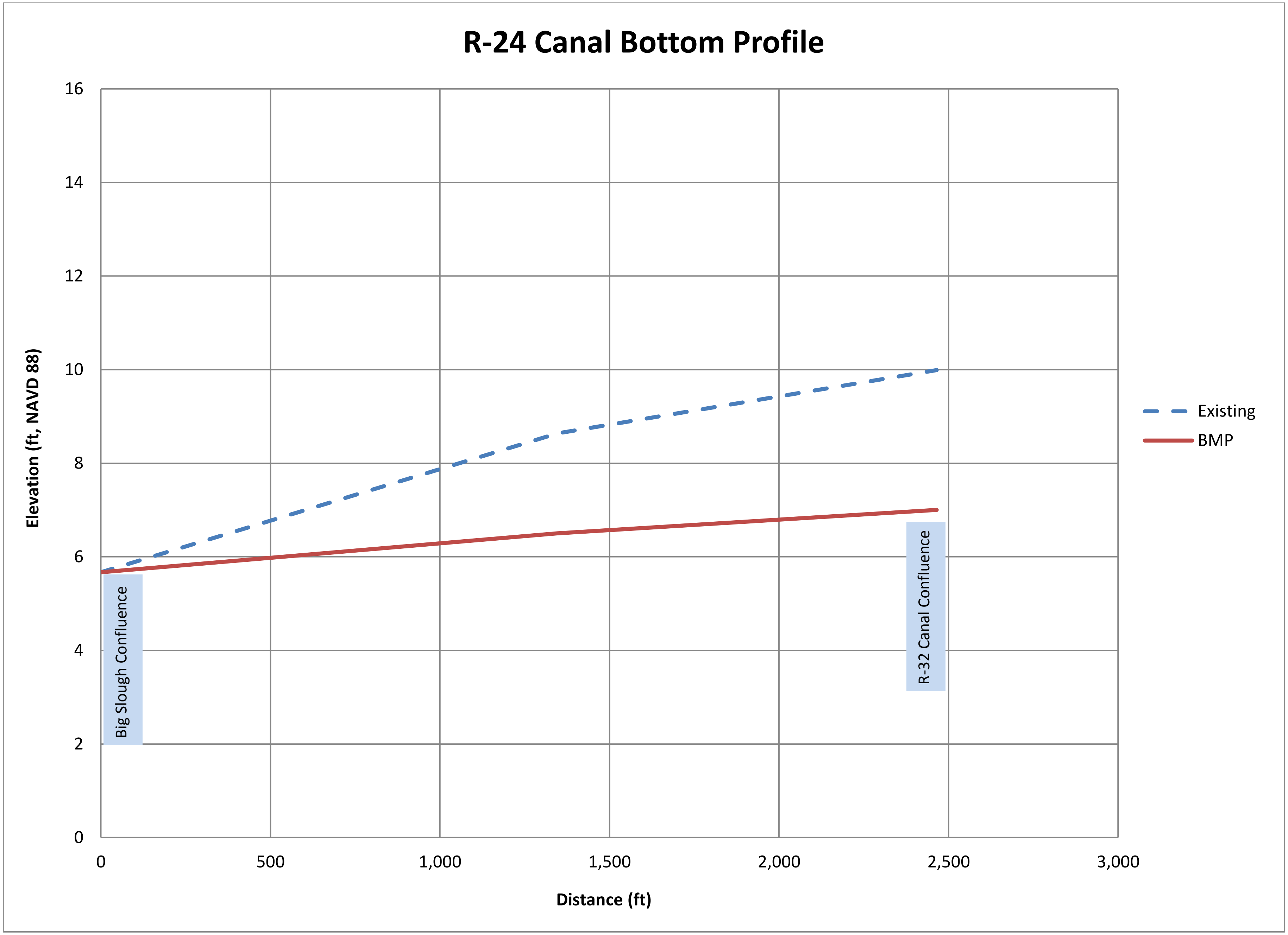
DRAWN: AKF
PROJECT NO. 14-1088
SHEET 7 OF 7 SHEETS

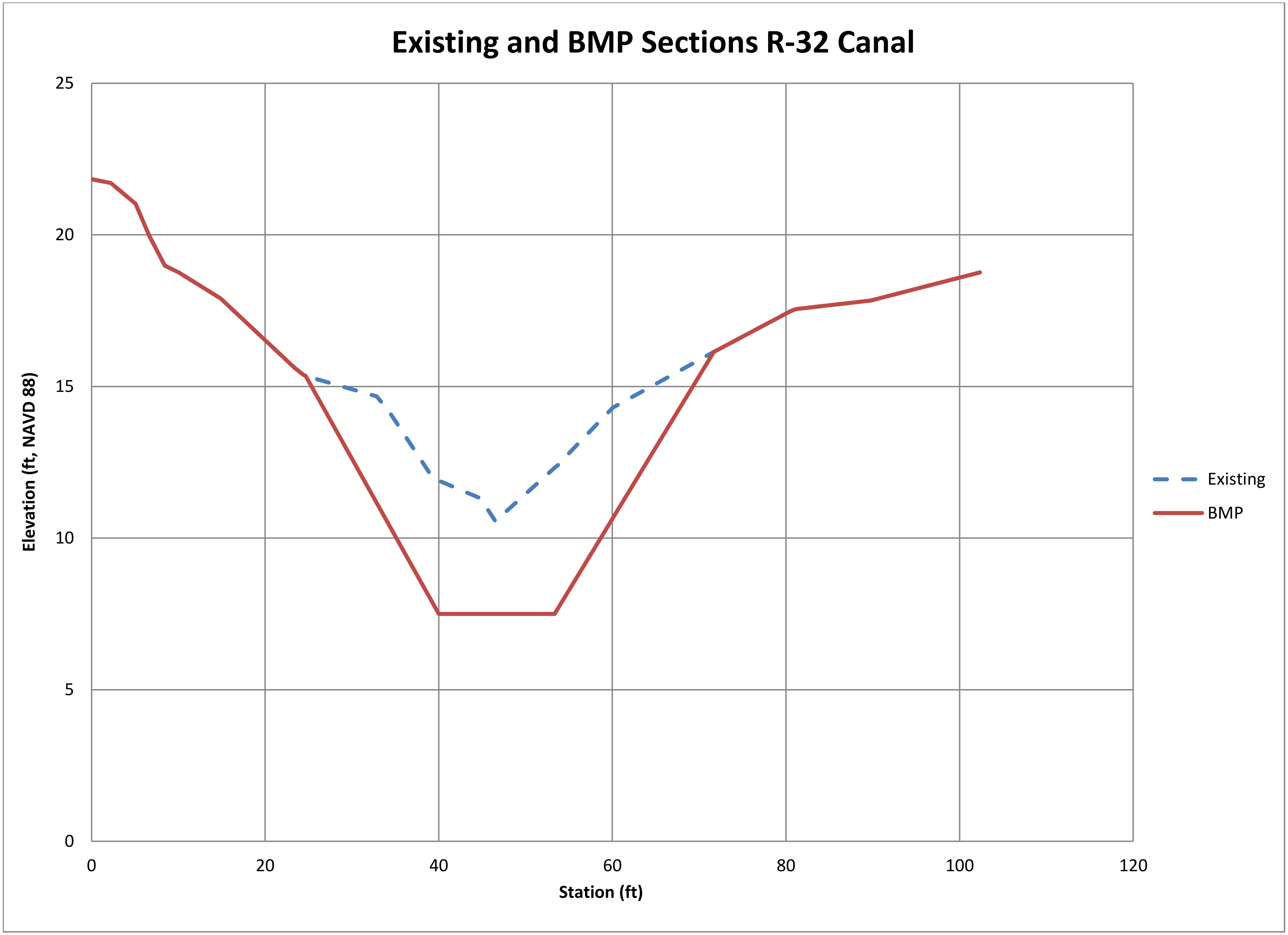
APPENDIX D

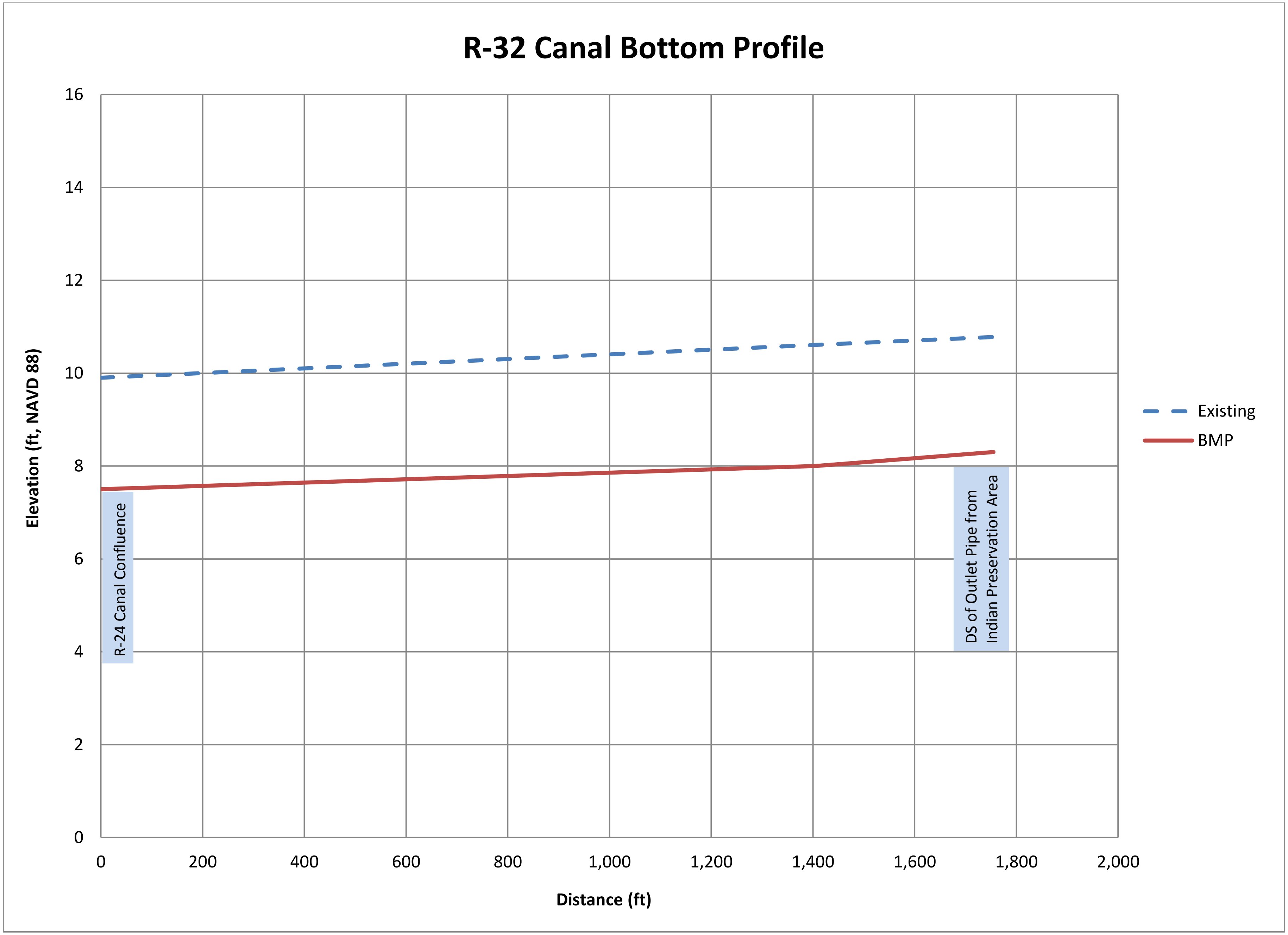
Canal Cross-sections and Profiles


Existing and BMP Sections R-24 Canal
Elevation (ft, NAVD 88)
20
18
16
14
12
10
8
6
4
2
0
0
20
40
60
80
100
120
Station (ft)
Existing
BMP



R-24 Canal Bottom Profile
Elevation (ft, NAVD 88)
16
14
12
10
8
6
4
2
0
0
500
1,000
1,500
2,000
2,500
3,000
Distance (ft)
Big Slough Confluence
R-32 Canal Confluence
Existing
BMP


Existing and BMP Sections R-32 Canal
25
20
15
10
5
0
0
20
40
60
80
100
120
Elevation (ft, NAVD 88)
Station (ft)
Existing
BMP


R-32 Canal Bottom Profile
Elevation (ft, NAVD 88)
16
14
12
10
8
6
4
2
0
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
Distance (ft)
Existing
BMP
R-24 Canal Confluence
DS of Outlet Pipe from Indian Preservation Area

APPENDIX E

Preliminary Cost Estimates

BMP No. 1 (Dredging R-24 and R-32 Canals) Preliminary Cost Estimates

Item	Length (ft)	Width (ft)	Cross Section area	Quantity	Unit	Unit Cost *	Estimated Cost	Comments
Dredging and removal of dredgings - 1,800 ft of R-32 Canal	1800		144.5	9633	CY	$ 25	$ 240,833	
Dredging and removal of dredgings - 2,300 ft of R-24 Canal	2300		118.3	10077	CY	$ 25	$ 251,935	
Bank Stabilization R-32 Canal Assume 1, 800ft long 20 feet wide on each side	1800	38		7600	SY	$ 2	$ 15,200	
Bank Stabilization R-24 Canal Assume 2,300 ft long 20 feet wide on each side	2300	38		9711	SY	$ 2	$ 19,422	
36-inch Pipe Crossing				40	LF	$ 50	$ 2,000	
Erosion and Sediment Control							$ -	
MOT				1	LS	$ 5,000	$ 5,000	
Mobilization and Demobilization				1	LS	$ 5,000	$ 5,000	
Other Project Costs				1	LS	$ 5,000	$ 5,000	
Subtotal							**$ 544,391**	
Design and Permitting Consultant Services (15%)							$ 81,659	
Construction and Inspection Consultant Services (5%)							$ 27,220	
Contingency (10%)							$ 65,327	
Total FY 2014 cost							$ 718,596	
Total FY 2017 Inflated Cost (5% per year)							**$ 831,864**	

* Estimated Costs from Thomas Marine Construction

BMP No. 2 (Raising 1,900 ft of Price Boulevard) Preliminary Cost Estimates

Item	Length (ft) *	Width (ft)	Depth (in)	Quantity	Unit	Unit Cost	Estimated Cost **	Comments
Detail Topographic Survey				1	ea	$ 5,000	$ 5,000	
Mill Existing Asphalt	2100	24		5600	SY	$ 15	$ 84,000	
Add road base to elevate road 1.2'	2100	26	15	6067	SY	$ 30	$ 182,000	$15 per SY per 8" thickness. Double cost for 15" thickness.
Type SP Structural Course 1.5"	2100	26	1.5	455	TON	$ 100	$ 45,500	100lb per SY per inch thickness / 2000lb per ton
Friction Course 1.5"	2100	26	1.5	455	TON	$ 120	$ 54,600	
Swale Regrading and sodding (assume 20 ft wide each side of Price Blvd)	2100	20		9333	SY	$ 5	$ 46,667	
Surveying (Construction staking, surveying, as-builts)				1	LS	$ 7,500	$ 7,500	
Erosion and Sediment Control				1	LS	$ 5,000	$ 5,000	
MOT				1	LS	$100,000	$ 100,000	Need bypass lanes
Mobilization and Demobilization (6%)				1	LS	$ 31,816	$ 31,816	
Subtotal							**$ 562,083**	
Design and Permitting Consultant Services (15%)							$ 84,312	
Construction and Inspection Consultant Services (5%)							$ 28,104	
Contingency (10%)							$ 67,450	
Total FY 2014 cost							$ 741,949	
Total FY 2017 Inflated Cost (5% per year)							**$ 858,899**	

* Add 100 feet on each for transition to existing road pavement elevation

** Cost inflated about 15% from 2014 Sumter/Price Intersection improvements cost from Ben Newman

BMP No. 3 (Raising 950 ft of Price Boulevard and Dredging R-24 and R-32 Canals) Preliminary Cost Estimates

Item	Length (ft) *	Width (ft)	Depth (in)	Quantity	Unit	Unit Cost	Estimated Cost **	Comments
Detail Topographic Survey				1	ea	$ 5,000	$ 5,000	
Mill Existing Asphalt	1150	24		3067	SY	$ 15	$ 46,000	
Add road base to elevate road 8"	1150	26	8	3322	SY	$ 15	$ 49,833	$15 per SY per 8" thickness.
Type SP Structural Course 1.5"	1150	26	1.5	249	TON	$ 100	$ 24,917	100lb per SY per inch thickness / 2000lb per ton
Friction Course 1.5"	1150	26	1.5	249	TON	$ 120	$ 29,900	
Swale Regrading and sodding (assume 20 ft wide each side of Price Blvd)	1150	20		5111	SY	$ 5	$ 25,556	
Surveying (Construction staking, surveying, as-builts)				1	LS	$ 7,500	$ 7,500	
Erosion and Sediment Control				1	LS	$ 5,000	$ 5,000	
MOT				1	LS	$100,000	$ 100,000	Need bypass lanes
Mobilization and Demobilization (6%)				1	LS	$ 17,622	$ 17,622.33	
Dredging R-24 and R-34 Canals (see BMP 1 cost estimate for detailed cost breakdown)							$ 544,391	
Subtotal							**$ 855,719**	
Design and Permitting Consultant Services (15%)							$ 128,358	
Construction and Inspection Consultant Services (5%)							$ 42,786	
Contingency (10%)							$ 102,686	
Total FY 2014 cost							$ 1,129,549	
Total FY 2017 Inflated Cost (5% per year)							**$ 1,307,594**	

* Add 100 feet on each for transition to existing road pavement elevation

** Cost inflated about 15% from 2014 Sumter/Price Intersection improvements cost from Ben Newman