Village of

ROYAL PALM BEACH

FLORIDA

Stormwater Master Plan Update

Technical Report

September 2015

CDM Smith

Table of Contents

CDM Smith

BM178

List of Tables

List of Figures

Appendices

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Section 1

Introduction

1.1 Background and Purpose

On December 5th, 2014 the Village of Royal Palm Beach (the Village) contracted with CDM Smith to provide engineering services for an update of the Village's Stormwater Master Plan (SWMP). The SWMP was originally developed by CDM Smith in the year 2000 to evaluate the hydrology and hydraulics of the existing Primary Stormwater Management System (PSMS) and to develop alternative improvements to reduce identified flooding problems within this system and to develop a stormwater utility development plan (2001 Study).

The hydrologic and hydraulic evaluation was conducted with the U.S. Environmental Protection Agency's (EPA's) Stormwater Management Model (SWMM). Since the 2001 Study, the following updates were provided by CDM Smith at the request of the Village:

- In June 2001, the Florida Department of Transportation (FDOT) inquired about the feasibility of the Village accepting additional stormwater runoff into their PSMS as a result of the widening of State Route (SR) 80. CDM Smith simulated this alternative in the model, with results indicating that no significant increase in flood stages within the Village's PSMS would occur as a result of the SR 80 widening project. These results were documented in a memorandum dated June 1, 2001.

- In September 2004, two hurricanes (Frances and Jeanne) impacted southeastern Florida causing significant wind damage and flooding. One result of the high rainfall volume in this month was significant street flooding within the Saratoga Subdivision, which is located in the northwest portion of the Village just south of the M-1 Canal. As a result of the September 2004 flooding, the Village requested that CDM Smith update the stormwater model to include refinements, the natural wetland system within the Saratoga Subdivision, as well as the interconnection between the natural wetland and the Palm Beach County Royal Pines Natural Area. In addition, CDM Smith updated the existing stormwater model from the EPA's SWMM Version 4.4 to Version 5, which is the current release of the model and operates in the Microsoft Windows environment. These results were documented in the 2005 Village of Royal Palm Beach Florida Stormwater Master Plan System Analysis (2005 Study) Since the completion of the 2005 Study, two additional studies have been completed by others that may affect the results of the 2005 Study. The first study was completed by the Indian Trails Improvement District (ITID, 2013), which recommends that their flood storage capacity be recovered more quickly, resulting in increased discharges from their stormwater system to Village's PSMS during non-flood event periods by 200 cfs. Second, the South Florida Water Management District (SFWMD) developed an updated study for the C-51 Canal that included flood modeling in 2013. The SFWMD model included on-peak flows of 200 cfs from ITID to the M1-Canal through ITID structures.

- On February 3, 2014, CDM Smith sent a letter report to the Village summarizing revisions to the model to address the concerns stemming from the ITID and SFWMD models, including:

- Adding 200 cfs of inflow to the Village's PSMS as requested by ITID;
- Updating the operational control rules for the Amil gate to the C-51 Canal and sluice gates on the M-1 Canal;
- Adding the S-151A Control Structure; and,
- Adding a boundary condition in the model to represent operational controls (gates) established by SFWMD for the C-51 Canal, upstream of its confluence with the M-1 Canal.

- On March 25, 2014, CDM Smith updated the previous letter report based on further published information on the SFWMD C-51 Canal model update made available by the Village. The conclusions from the comparison between the Village stormwater model and the SFWMD stormwater model was that the Village model results predicted peak stages in the M-1 Canal up to 0.5 ft higher than predicted by the SFWMD C-51 model for the same design storm event. CDM Smith concluded that the differences could be the result of differences in methodology and/or differences in topography, since the SFWMD used newer and more refined LiDAR topography that was not available in 2005.

Based upon the findings documented in the March 25, 2014 memorandum, CDM Smith recommended that the more detailed modeling of the Village's PSMS completed in 2005 be updated to include the more recent hydrologic and hydraulic information so that the model results are more comparable to those published by the SFWMD based upon their 2013 modeling effort. Data used by CDM Smith to update the SWMM developed for the Village included:

- 2007-08 Light Detection and Ranging (LiDAR) topographic data;
- The Village's Geographic Information System (GIS) stormwater structure inventory;
- Subdivision plans (post 2005);
- M-1 Canal survey data;
- Land use data; and
- Hydraulic structure information and model data available from the SFWMD.

The data and methodologies used in the modeling effort is presented in **Section 2** of this report. Additionally, CDM Smith estimated an approximate volume of muck based on the survey data provided by the Village that would need to be dredged to maintain the canals at their intended design. CDM Smith prepared a Draft Technical Memorandum discussing the results of this study and recommendations for dredging which was delivered to the Village on April 15, 2015. The memorandum is incorporated into this document as **Section 3**. **Section 4** of this memorandum presents model results and a comparisons of the Village's updated stormwater model to the SFWMD C-51 model results.

1.2 Physical Description

The Village of Royal Palm Beach was incorporated in 1959 and consists of approximately 11.5 square miles. The Village is generally bounded by State Route 7 to the east, Southern Boulevard (S.R. 80) to the South, Crestwood Boulevard to the west, and 40th Street to the north. A small annexed area (0.8 square miles) also exists to the south of Southern Boulevard. In the previous studies, only that portion of the Village north of Southern Boulevard was evaluated. For this update, the annexed area was added to the model, as was the Portosol Development in the northeast corner of the Village, north of Okeechobee Boulevard and immediately west of State Route 7. **Figure 1-1** shows the limits of the Village.

Land uses in the village are primarily residential based with supporting commercial services. There are approximately 800 acres of surface water bodies and 470 acres of wetlands within the Village limits. These areas are identified in **Figure 1-2**. Land surface elevations range from a high of approximately 35 feet (referenced to the North American Vertical Datum of 1988, ft-NAVD) in the Village Commons to approximately 15 ft-NAVD south of Southern Blvd.

The majority of the Village has topography between 15 and 20 ft-NAVD as shown in **Figure 1-3**.

1.3 Stormwater Management Systems Overview

The Village is located within the C-51 major basin (164 square miles), and more specifically the C-51 West subbasin (79.5 square miles). Various water control structures are located throughout the basin and serve several purposes including flood protection for the basin, discharge of flood flows from the adjacent L-8 basin to tidewater, water supply to the basins during periods of low flow, and maintaining an adequate groundwater table elevation west of structure S-55 in order to limit saltwater intrusion. When excess water is present in the C-51 West subbasin, it can be discharged to the Intracoastal Waterway via structures G-124 and S-155, or alternatively, to the Water Conservation Area (WCA 1) via structures S-5AE, S-5AW and S-5A. Stages in the western reach of the C-51 Canal are controlled by structures G-124 and S-5A. Since 2005, the S-155A divide structure has been built in the C-51 Canal, immediately west of State Road 7 to separate flows from the eastern C-51 watershed, which discharge to tide through the S-155 structure.

The SFWMD (*C-51 Basin Rule Draft*, February 2014) describes the S-155A structure as a remotely operated dual gate spillway. The structure has a design capacity of 1,460 cfs from the C-51 Western Basin to the east. The water level upstream of S-155A is maintained at 9.6 to 10.6 ft NAVD during the wet season to divert excess water into STA-1E though the S-319 Pump Station. Under flood conditions, the gates close if the tailwater exceeds 10.3 ft NAVD, the headwater rises above 11.6 ft NAVD, the headwater falls below 9.6 ft NAVD, or the flow through the S-155 structure exceeds 4,800 cfs.

The S-55 structure is a gated spillway located within the C-51 Canal at Dixie Highway. This structure controls stages in the canal and regulates discharge into the Intracoastal Waterway. G-124 consists of culverts located within the C-51 Canal. The structure acts as a divide between the east and west C-51 subbasins and is typically closed off by the use of gates and flashboards. Structures S-5AW (gates spillway), S-5AE (gates spillway), and S-5A (pump station) are all located at the west end of the C-51 Canal near its confluence with the L-10/L-12, and L-8 Canals. These structures are operated in a manner to control runoff into or from the C-51 basin as well as to supply water to the C-51 basin from WCA 1 and Lake Okeechobee.

Stormwater in the Village is generally collected in one of three primary canal systems that flow into the C-51 canal. The largest canal system is the M-1 canal that conveys stormwater runoff from ITID, and the Village to the C-51 canal. Stormwater runoff from the ITID (north side of the Village) is discharged into the Village's PSMS based upon a gate operation schedule permitted by the SFWMD.

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1 inch = 2,200 feet

Submitted on: 5/18/2015

CDM Smith

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Figure 1-1
Site Map
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL

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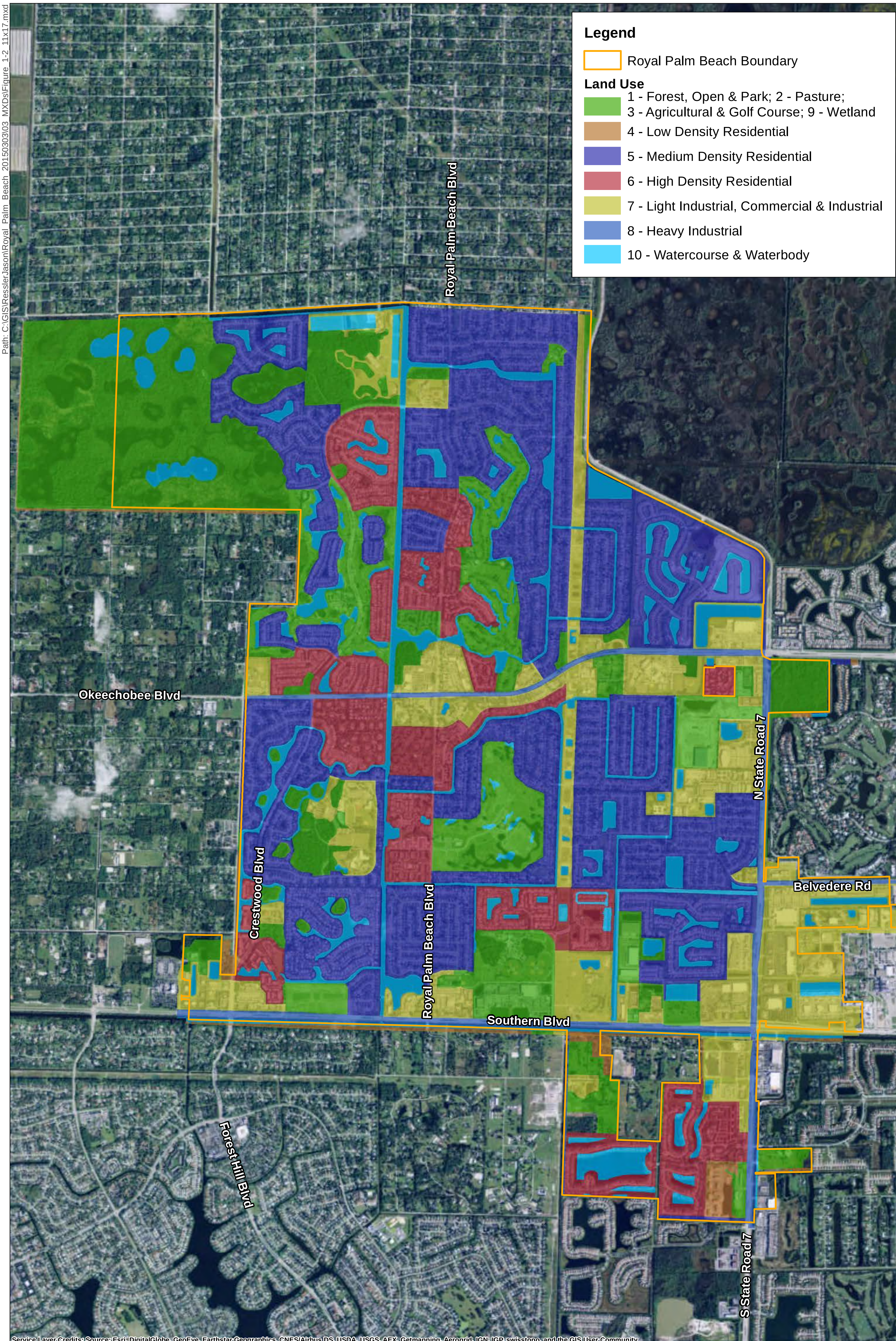

1 inch = 2,450 feet

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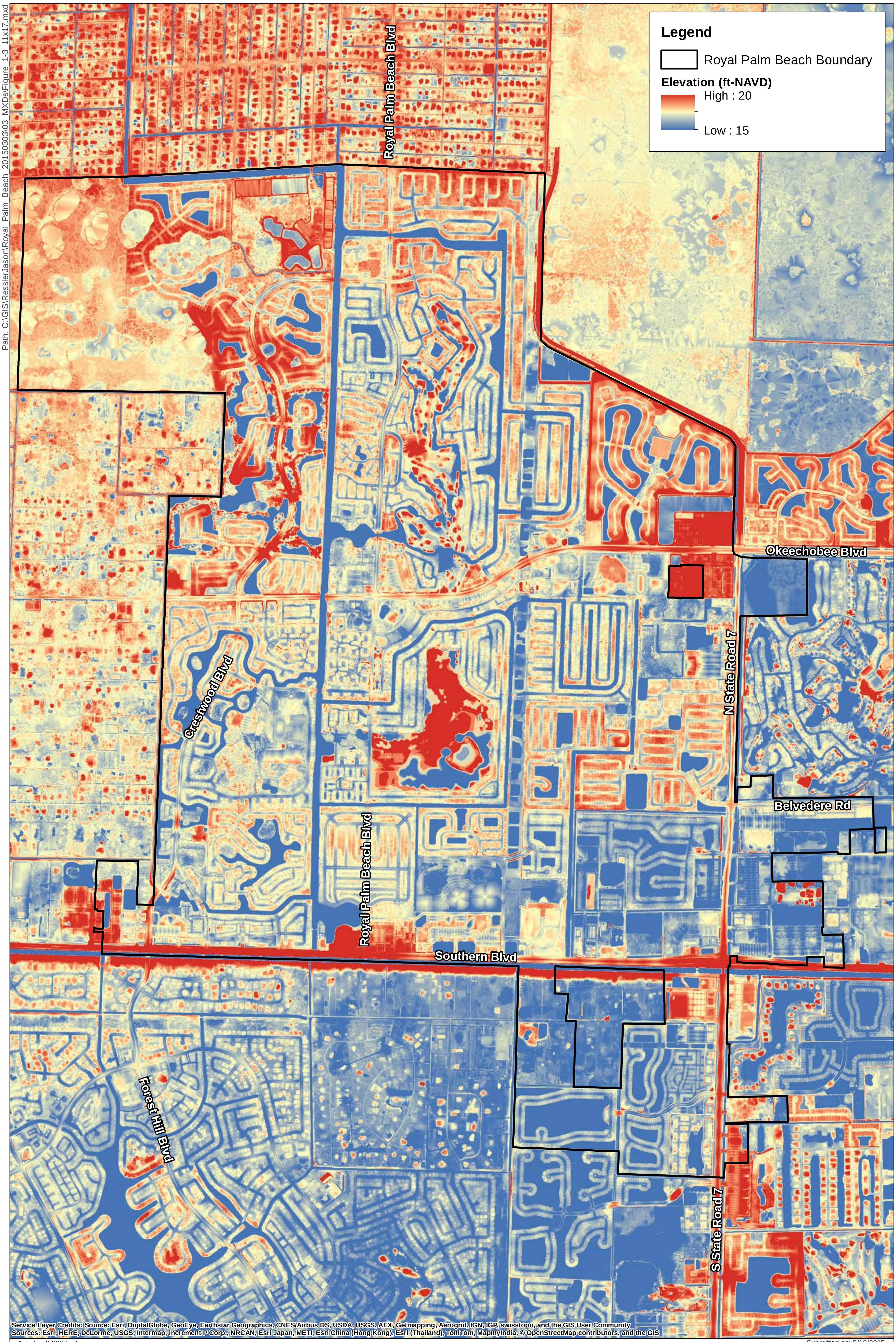
Submitted on: 5/18/2015

Figure 1-2
Land Use
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL



1 inch = 2,200 feet

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Figure 1-3
Topography
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL

Two gates (Roach and 40th Street structures) are located on the north side of the Village on the M-1 canal. A third gate (known as the Amil gate) is located along the M-1 canal just north of Southern Boulevard. Gate operation schedules will be further described in Section 2 of this report.

The second canal is the smaller Northern Palm Beach Water Control District Canal system. Water levels in this canal are controlled by a fixed weir structure on Southern Boulevard. The third system is the Lake Worth Drainage District E-1 Canal located in the southeast corner of the Village and is controlled by stages in the C-51 canal. It should be noted that this canal is also downstream of the Pond Cypress Natural Area.

1.4 Historical Flooding

The most recent storm in this part of Palm Beach County was Tropical Storm Isaac, which hit South Florida in August, 2012. Flooding in the Village was limited due to relatively low tailwater conditions in the C-51 Canal. The storm did cause flooding in ITID, which spurred the rule changes to allow an additional 200 cfs in the M-1 Canal.

Prior to Isaac, flooding occurred within the Village in the Saratoga Subdivision as a result of the rainfall associated with Hurricane Frances and Hurricane Jeanne that hit southeastern Florida in September 2004. Prior to that event, the most significant flooding had occurred in the fall of 1999 when approximately 20 homes flooded within the La Mancha Subdivision as a result of a breach in the berm separating the Village from the Pond Cypress Natural Area. On October 14 and 15, 1999 approximately 9.6 inches of rainfall fell over a 48 hour period filling the available storage within the Pond Cypress Natural Area and causing the breach. As a result of the breach, Palm Beach County worked with the SFWMD and the Village to develop a management plan for the Pond Cypress Natural Area that included restoration of the berm separating the Village from the Pond Cypress Natural Area and the design of a drawdown structure that would allow the County to do a controlled release of stormwater from the Pond Cypress Natural Area to the C-51 Canal during flood conditions.

Other historical flooding problems documented by the Village included street flooding within the Royal Palm Homes subdivision, flooding in a low lying area in the vicinity of Sevilla Ave., street flooding along Ponce De Leon St., and flooding of a low lying area on Meadowlark Dr.

Section 2

Data and Methodology Update

This section describes the methods used to update the SWMM data sets developed for the 2005 Study. As previously noted, SWMM Version 5 was used for the analysis of the Village's PSMS (See **Figure 2-1**). A detailed discussion on methods used to develop SWMM is presented in the 2005 Study. The hydrologic and hydraulic model elements were updated using the following data:

- 2007-08 Light Detection and Ranging (LiDAR) topographic data;
- The Village's Geographic Information System (GIS) stormwater structure inventory;
- Subdivision plans (post 2005);
- M-1 Canal survey data;
- Land use data; and
- Hydraulic structure information and model data available from the SFWMD.

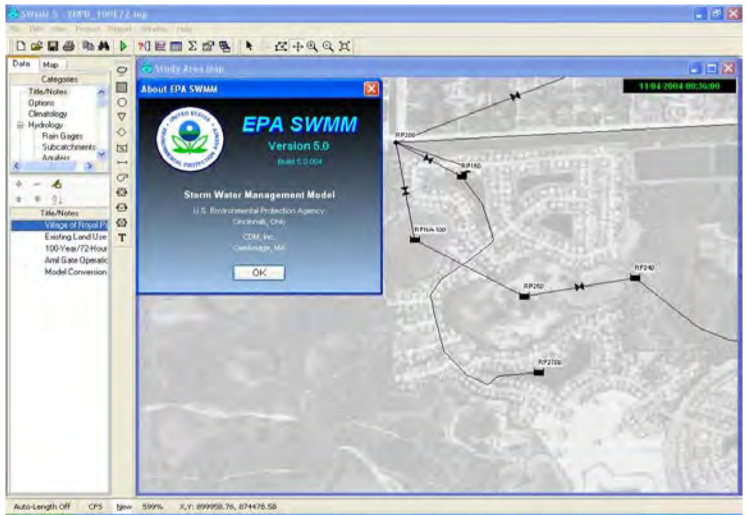


Figure 2-1
Village of Royal Palm Beach
Stormwater Master Plan
SWMM Version 5 Interface

The SWMM computer model was selected based on its ability to simulate the hydrologic and hydraulic behaviors of the Village PSMS. In addition, SWMM has been verified for stormwater design and master plan uses throughout Florida and is accepted by the Florida regulatory community.

2.1 Hydrologic Parameters

Hydrologic model parameters used for the model simulations are described in this section. **Appendix A** provides the resultant hydrologic parameters used in the hydrologic modeling including the Hydrologic Unit (HU) alphanumeric identification, width and area, percent impervious area, percent impervious routed to pervious, average overland slope, Manning's roughness values, initial abstractions, and infiltration rates, and soil storage values. The raw data used to calculate these updated parameters are described in the remainder of this section.

2.1.1 Light Detection and Ranging (LIDAR) Topographic Data Update

Updated topographic data was provided by the Village, which included a 4-ft by 4-ft Light Detection and Ranging (LIDAR) grid covering the Village limits and neighboring areas (see Figure 1-3). In the Village Commons area, a 2-ft by 2-ft grid was developed by the Village from survey for the post-construction topography. CDM Smith merged these two datasets into one comprehensive Digital Elevation Model (DEM). The DEM is used to guide HU delineation and estimate stage-storage area relationships and (hydraulic) overland flow profiles.

2.1.2 Hydrologic Unit Area Update

HUs are generally defined by natural physical features or constructed stormwater management systems that control and direct stormwater runoff to a common outfall. The following general criteria were used to determine hydrologic unit boundaries:

- Large-scale physical features such as major roads were used to establish hydrologic divides.
- HU boundaries were delineated where structures or topographic features could appreciably impound water for the 100-year event.
- In areas without hydrologic divides, HU boundaries were determined by the extent of the PSMS.
- Existing reports and construction drawings were used, along with field verification, to define ambiguous boundaries.

For modeling purposes, the Village was subdivided into 153 HUs ranging in size from 2.5 acres to 785 acres and averaging 51 acres. The largest HU represents the Royal Palm Beach Pines Natural Area; the next largest HU is 220 acres. Two additional HUs were added to account for stormwater inflows from the Upper Indian Trails Basin and the Lower Indian Trails Basin, which are outside the Village limits.

The LiDAR DEM indicated that there was generally a shallow berm at the edge of the canals in the Village; therefore, runoff from the HUs adjacent to the canals would not necessarily sheet flow into the canals. Because of this, the canals were provided separate HUs such that on the precipitation that falls inside the berms would runoff directly to the canal. A similar methodology was used for the larger ponds (if they also were bermed). All other HUs runoff directly to Village's PSMS and can thus flow to the canals through the pipe system, or though overland flows that are profiles of the berms (see below).

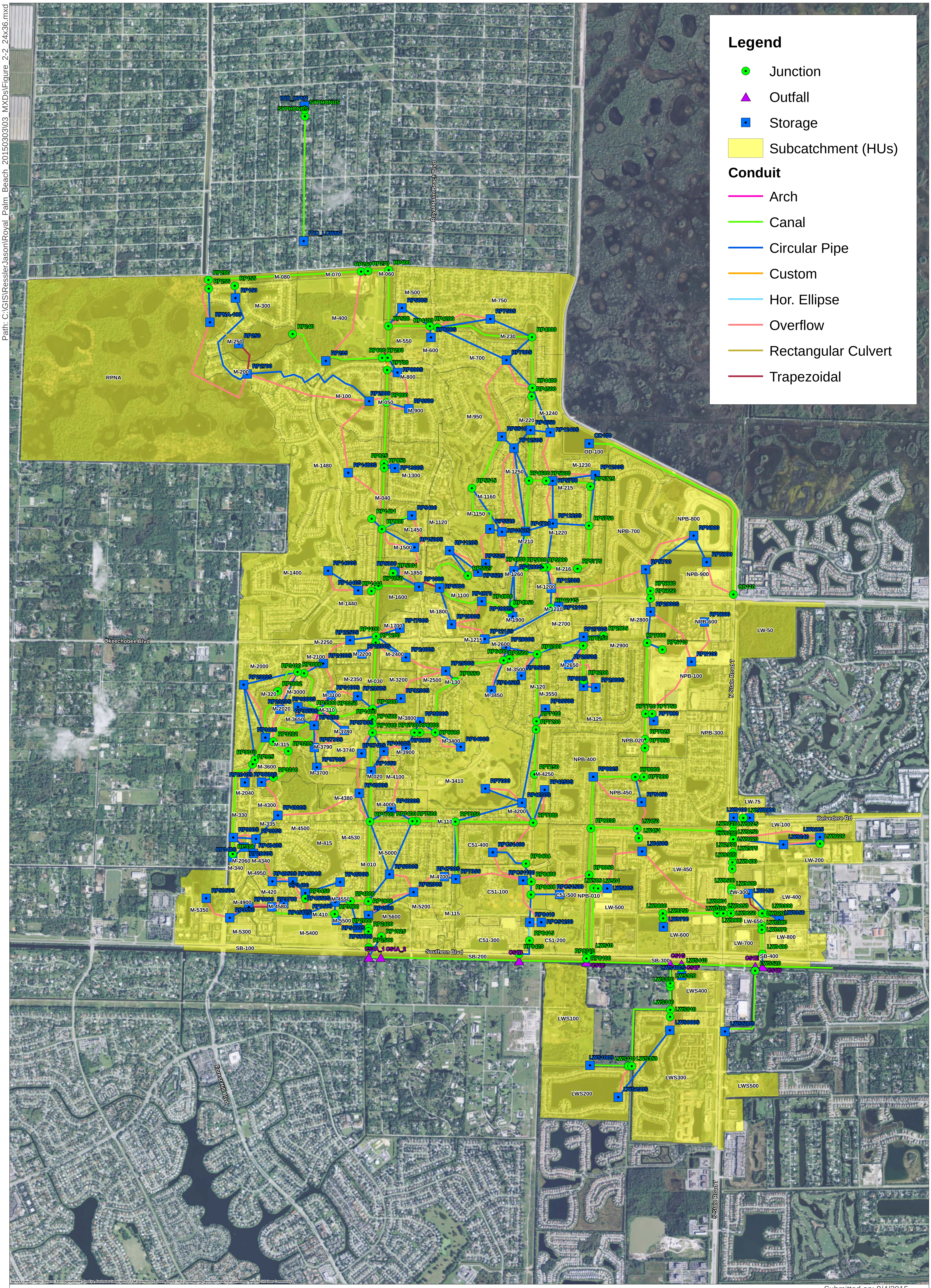
The HUs were then digitized as polygons using the Geographic Information System (GIS) software ArcGIS Version 10.2. These HUs are illustrated on the model schematic in **Figure 2-2**, and the areas are indicated in the Appendix A tables.

2.1.3 Rainfall Intensities and Quantities

Specified rainfall data was used to generate stormwater runoff hydrographs for each hydrologic unit in the hydrologic model. Observed rainfall data are generally characterized by an amount (depth, measured in inches), intensity (inches per hour), frequency or occurrence (return period, in years), event duration (hours), spatial distribution (local variance), and temporal distribution (time variance). Design storm events are typically named by the return period of the rainfall depth and by the event duration. For example, a 100-year, 72-hour design storm event describes a rainfall depth over a 72-hour period that has a one percent (1 in 100) chance of occurring at a particular location in any given year.

For this study, design storm event quantities and distributions were updated using the SFWMD in 15-minute intervals for the three design storm events simulated with the model. These data are consistent with those used in the 2013 SFWMD C-51 model. The three design storm events and corresponding rainfall volumes simulated are listed below:

- 10-year return period/24-hour event duration = 7.4 inches of rainfall.
- 25-year return period/ 72-hour event duration = 12.2 inches of rainfall.



1 inch = 1,150 feet

Submitted on: 9/4/2015

CDM Smith

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0 ¾ 1½ 3 Miles

Figure 2-2
Model Schematic
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL

- 100-year return period/72-hour event duration = 16.3 inches of rainfall.

Additionally, Tropical Storm Isaac was simulated with rainfall extracted from the SFWMD C-51 HMS model. This rainfall was provided in 15-minute intervals over a 5-day period for two gages: Gage 1, which covered the Village HUs, had a total volume of 13.44 inches over a 5-day period with a peak intensity of approximately 0.6 inches per hour. Gage 2, which covered the ITID HUs had a total volume of 12.94 inches over a 5-day period with a peak intensity of approximately 0.5 in/hr.

2.1.4 Soil Types and Model Infiltration Parameter Updates

Soil data were used to evaluate stormwater runoff, infiltration, and recharge potential for pervious areas. Information on soil types was obtained from data compiled by the U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) Soil Survey of Palm Beach County, Florida (NRCS, 1978) and in digital format from the SFWMD. Each soil type has been assigned a soil series and Hydrologic Soil Group designated by the NRCS. Hydrologic Soil Group A is comprised of soils having very high infiltration potential and low runoff potential. Hydrologic Soil Group D is characterized by soils with very low infiltration potential and a high runoff potential. Hydrologic Soil Groups B and C are designated between these two categories. For the purposes of this study, dual class soil groups were assigned to the more conservative value (wet season). **Table 2-1** presents the NRCS Hydrologic Soil Group assigned to each NRCS defined soils series within the study area. GIS and spreadsheets were used to generate the percentage of each Hydrologic Soil Group within the updated HUs. The results are presented in Appendix A.

Table 2-1
Village of Royal Palm Beach Stormwater Master Plan
Soils Series Data

Map Unit Symbol Number	Soils Series Name	NRCS Hydrologic Soils Group
4	ARENTS-URBAN LAND COMPLEX, 0 TO 5 % SLOPES	C
10	BOCA FINE SAND	B/D
12	CHOBEE FINE SANDY LOAM	B/D
15	FLORIDANA FINE SAND	A/D
16	HALLANDALE FINE SAND	A/D
24	OKEELANTA MUCK	A/D
29	PINEDA FINE SAND	B/D
30	PINELLAS FINE SAND	B/D
31	PITS, 0 TO 5 % SLOPES	A
36	RIVIERA FINE SAND	B/D
37	RIVIERA FINE SAND, DEPRESSIONAL	B/D
38	RIVIERA-URBAN LAND COMPLEX	B/D
39	SANIBEL MUCK	A/D
42	TEQUESTA MUCK	B/D
47	UDORTHENTS, 2 TO 35 % SLOPES	B
48	URBAN LAND	C
49	WABASSO FINE SAND	B/D

Note - Hydrologic soil groups A/D and B/D were assigned to D for modeling purposes.

The Horton infiltration equation option was used to calculate the rate and volume of water that infiltrates into the soil, which is the same methodology used in the 2005 Study.

The Horton infiltration equation is based upon conveyance through an unsaturated soil zone, and must be modified in order to represent saturated soil conditions. SWMM includes a soil storage shut-off option that restricts the infiltration of stormwater once the soil storage capacity is exceeded. Soil storage capacity is a measure of the amount of soil pore space (in inches) available for the storage of infiltrated water. **Table 2-2** shows the global infiltration parameters that were used for this study. The table lists maximum and minimum infiltration rates and soil storage capacities for average antecedent moisture conditions (AMC – Type II). Area-weighted infiltration parameters were computed for each hydrologic unit. **Figure 2-3** displays the soils map covering the Village.

Table 2-2
Village of Royal Palm Beach Stormwater Master Plan
Global Soils Parameters (Horton Equation)

Hydrologic Soil Group	Maximum Infiltration Rate (in/hr)	Minimum Infiltration Rate (in/hr)	Infiltration Decay Rate (1/hr)	Soil Storage Capacity (in)
				AMC II Average
A	12	1.00	2.0	6.5
B	9	0.50	2.0	5.0
C	6	0.25	2.0	3.8
D	4	0.15	2.0	1.4

2.1.5 Overland Flow Parameters

The hydrologic layer of SWMM uses overland flow data in the form of width, slope, and Manning's roughness to create a physically based overland flow runoff plane to route runoff to conduits and storage for further routing. The overland flow hydraulic length (L) is the weighted-average travel length to the point of interest. The need for a weighted average is apparent for areas with odd geometry where a long, thin portion of the area may be misrepresented with a biased L. For ponded areas, the point of interest chosen was the centroid of ponding. For areas where ponding does not occur, the point of interest is the outflow from the area. Overland flow length is used to better estimate hydrologic unit width for the hydrologic routing by use of the equation:

$$A = LW;$$

Where:

A = basin area (sq. ft.),

L = overland flow length (ft.), and

W = overland flow width (ft.)

Overland flow slope is the average slope over the hydraulic length and is calculated by dividing the difference in elevation by the hydraulic length. Length and slope information were estimated from the LiDAR DEM. The calculated overland flow values are presented in Appendix A.

Manning's roughness is used for the overland flow routing using Manning's equation. **Table 2-3** lists typical values for shallow overland flow Manning's n. Note that pervious land use coverages appear "rough" because the depth of overland flow (a few inches) is equal to or less than the roughness feature. Impervious are roughness values were set to 0.015 throughout the Village. For pervious areas, the roughness value was determined by land use and ranged from 0.2 for residential,

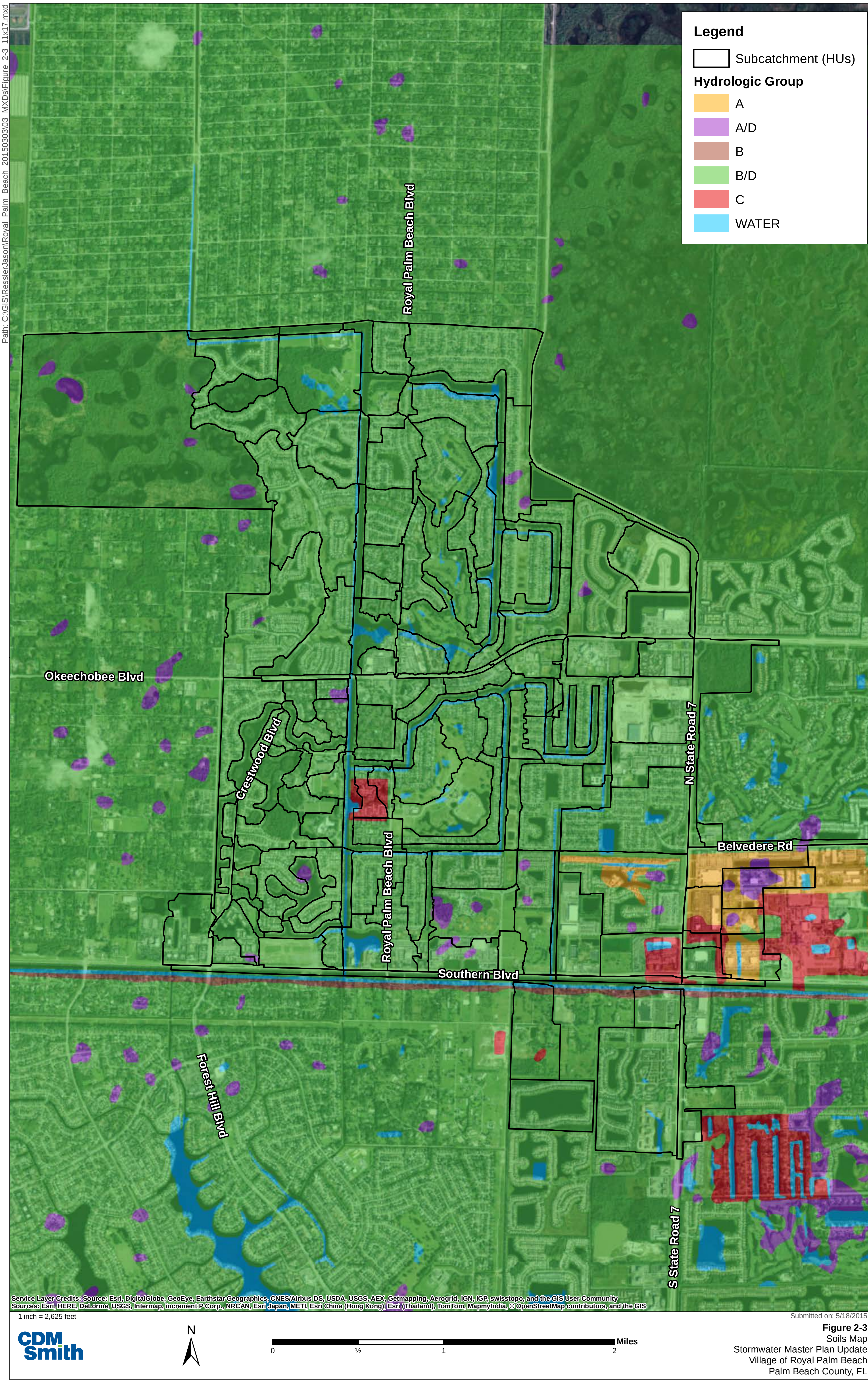

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Figure 2-3
Soils Map
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL

commercial and industrial to 0.4 for open and forested areas. A map of land use types was provided in Section 1 (Figure 1-2). Roughness values were provided to each land use and then area weighted over each HU to find the representative value.

Table 2-3
Village of Royal Palm Beach Stormwater Master Plan
Estimate of Manning's Roughness Coefficients for Overland Flow

Source	Ground Cover	Manning's n	Range
Crawford and Linsley (1966)[a]	Smooth asphalt	0.012	
	Asphalt of concrete paving	0.014	
	Packed clay	0.03	
	Light turf	0.20	
	Dense turf	0.35	
	Dense shrubbery and forest litter	0.4	
Engman (1986)[b]	Concrete or asphalt	0.011	0.01-0.013
	Bare sand	0.01	0.01-0.16
	Graveled Surface	0.02	0.012-0.03
	Bare clay-loam (eroded)	0.02	0.012-0.033
	Range (natural)	0.13	0.01-0.32
	Bluegrass sod	0.45	0.39-0.63
	Short grass prairie	0.15	0.10-0.20
	Bermuda grass	0.41	0.30-0.48

Notes: [a] Obtained by calibration of Stanford Watershed Model.
[b] Computed by Engman (1986) by kinetic wave and storage analysis of measured rainfall-runoff data.

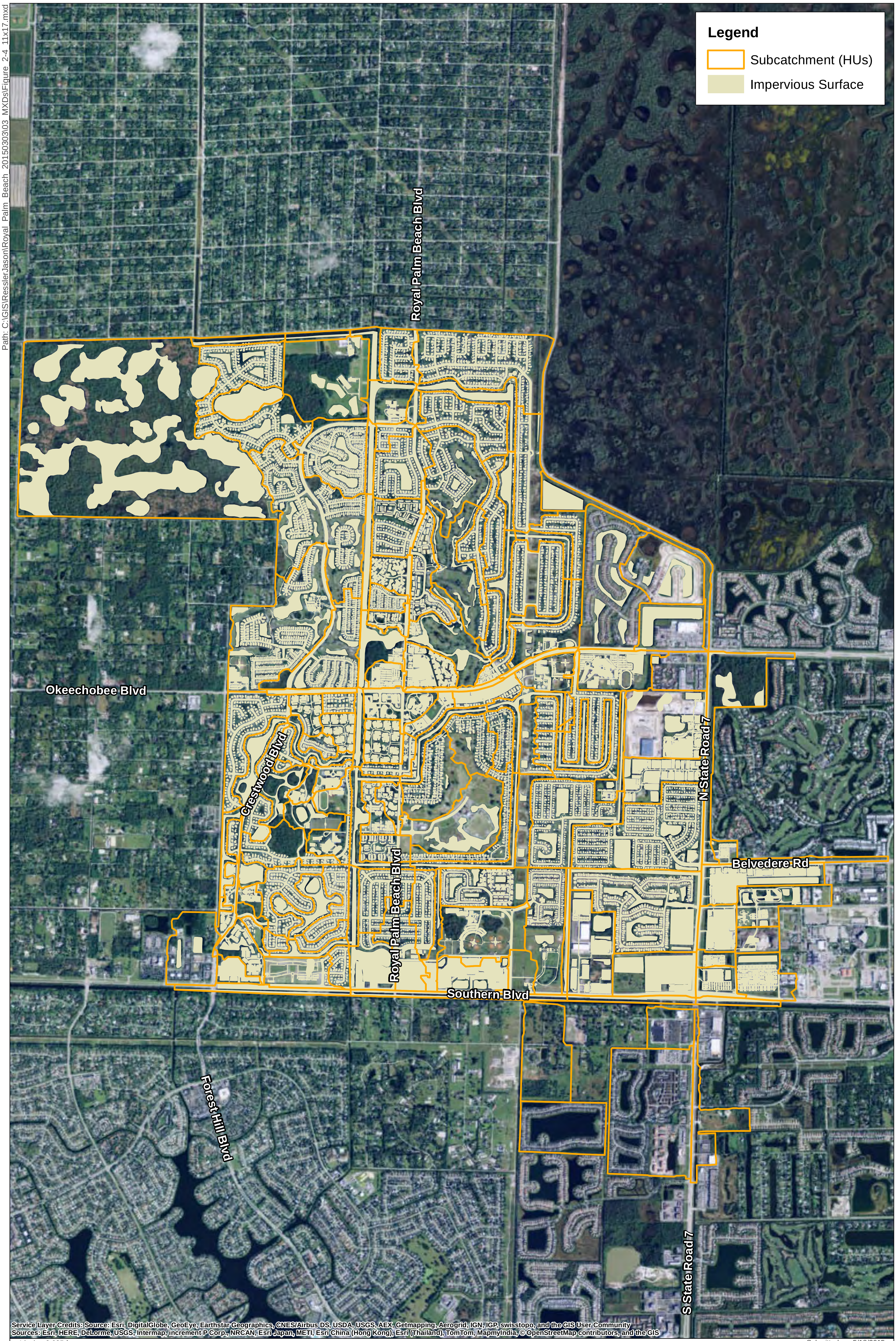
2.1.6 Impervious Area Updates

Updated aerial photography was used to estimate the impervious percentage for each hydrologic unit for most of the model. A national database of impervious cover from the United States Geologic Survey (USGS) was used to estimate the impervious coverage of the annex area south of the C-51 Canal. **Figure 2-4** presents the impervious coverage for the Village. Note that wetlands and water bodies count as impervious surfaces in the model, because in these areas there is no infiltration capacity under wet season conditions. The total impervious cover for the Village is 47.5 percent of the area, with a range from 2 to 91 percent over the HUs. Appendix A presents the impervious coverage per HU.

Figure 2-5 shows the USGS impervious coverage for the southern annex. As discussed above, the area covering the ponds were given 100 percent impervious cover, which has been corrected by hand prior to model input. Additionally, a comparison of this dataset with the coverage developed from aerial photography for the bulk of the watershed (north of Southern Blvd) shows the USGS dataset generally had lower values. Therefore, these values were adjusted 5 to 13 percent higher (depending on land use) prior to input into the model.

2.1.7 Land Use Update

Land use data was used to estimate the percentage of the imperviousness area routed to pervious, surface friction factors (discussed above), and initial abstractions for each HU. Existing land use information was obtained from two sources. The Village Zoning and Planning Department provided



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1 inch = 2,625 feet

CDM Smith

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Submitted on: 5/18/2015

Figure 2-4
Impervious Coverage Map
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL

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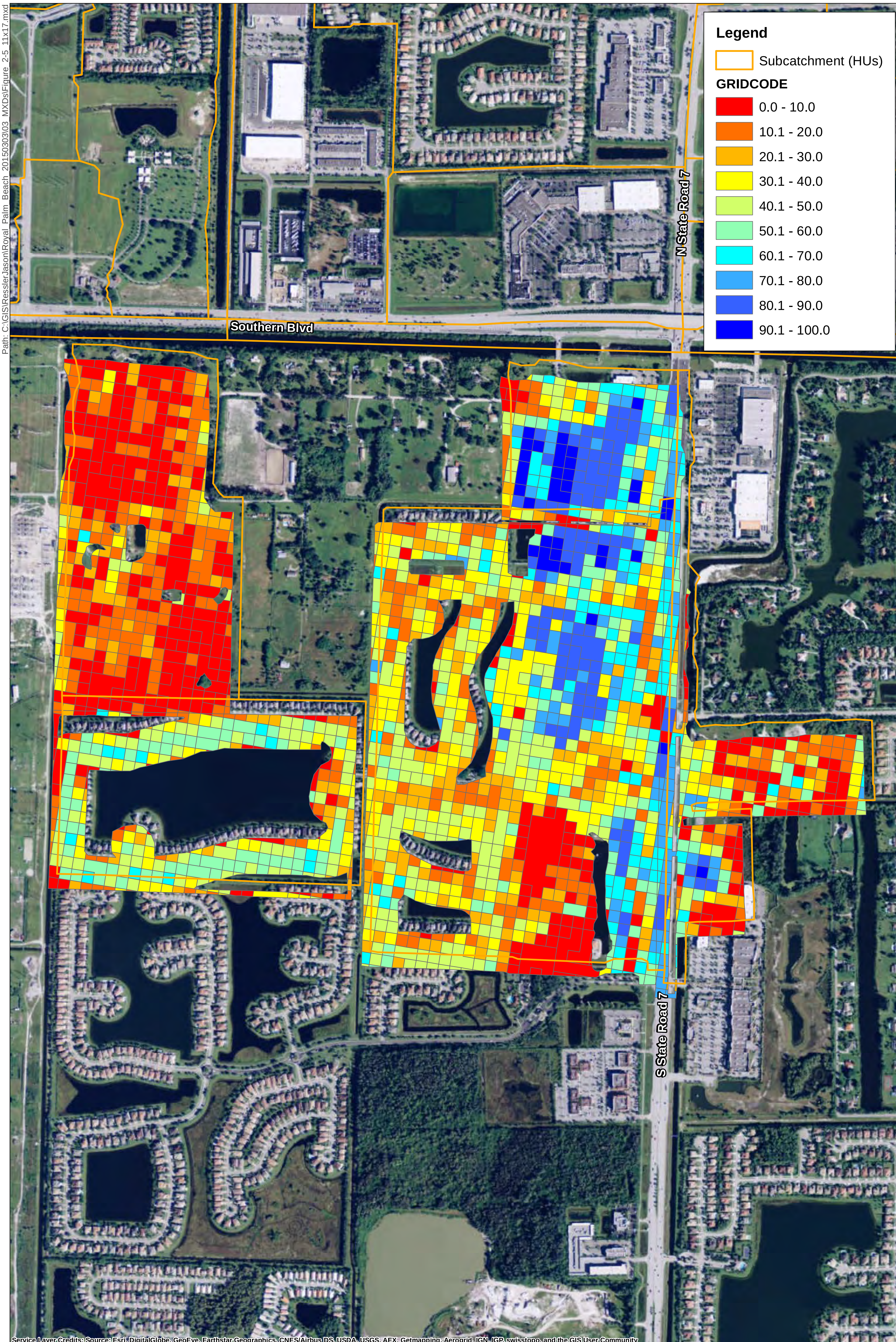

1 inch = 750 feet

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0 1/8 1/4 1/2 Miles

Submitted on: 5/18/2015

Figure 2-5
Impervious Coverage for Annex
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL

CDM Smith with a copy of its 1999 zoning plan. Existing land use data were also obtained from the SFWMD. Using these data sets, CDM Smith developed a matrix grouping the land use data into 10 categories for modeling purposes. A summary of the land use categories is presented in **Table 2-4**. GIS was then used to generate the percent of each land use category for each HU as shown in Appendix A. A map of land uses was presented in Section 1 (Figure 1-2).

Table 2-4 lists the percent of Impervious Area routed to pervious areas, also known as Non-Directly Connected Impervious Area (NDCIA), assigned to each land use category. The NDCIA represents the impervious surfaces that have a pervious buffer prior to discharge into the stormwater system. These areas are provided limited infiltration, and use the surface friction factors of the pervious layer.

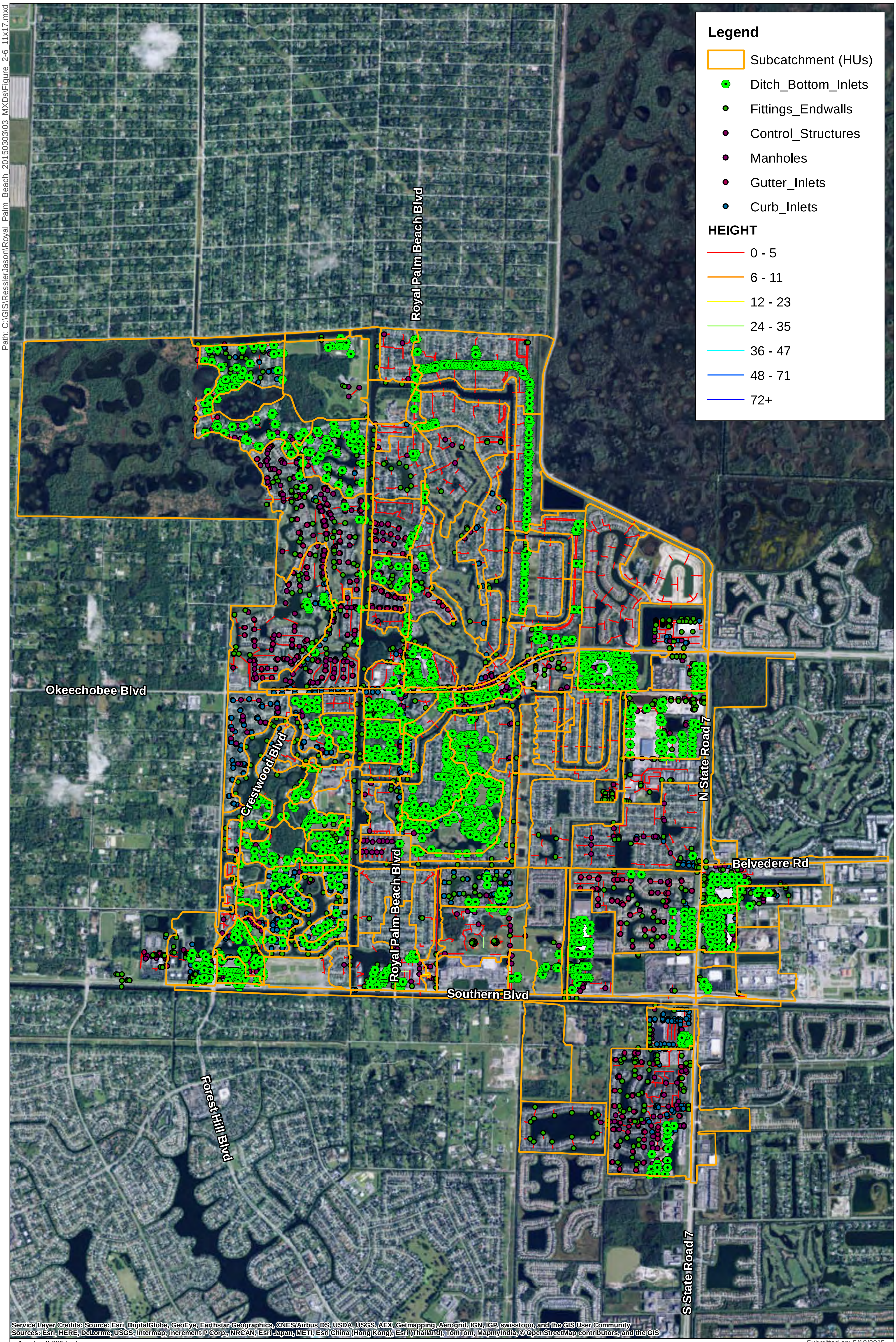
Table 2-4
Village of Royal Palm Beach Stormwater Master Plan
Parameters by Land Use Category

Land Use Category	Percent Routed to Impervious	Pervious[1] n	Pervious IA	Impervious IA
1. Forest, Open, & Park	80	0.4	0.25	0.1
2. Pasture	80	0.3	0.25	0.1
3. Agriculture & Golf Course	80	0.3	0.25	0.1
4. Low Density Residential	50	0.25	0.25	0.1
5. Medium Density Residential	14	0.2	0.25	0.1
6. High Density Residential	15	0.2	0.25	0.1
7. Commercial/ Light Industrial, Utilities	10	0.2	.25	0.1
8. Heavy Industrial/ Roads	10	0.2	0.25	0.1
9. Wetlands	0	-	0.5	0.5
10. Waterbodies	0	-	0.1	0.1

Note: (1) Impervious Area n = 0.015 for all land uses.

2.2 Hydraulic Parameter Updates

The PSMS for the Village consists of a combination of conveyance and storage elements. Conveyance elements primarily consist of pipes, open channels (canals), culvert crossings, and stage/flow control gates. Storage elements consist of stormwater ponds, and floodplain storage (where appropriate). Since the completion of the 2005 Study, the Village has developed a GIS inventory of their stormwater infrastructure as depicted in **Figure 2-6**. This dataset was augmented in the northeast using the Portosol and Village Commons construction drawings provided by Village. Additionally, the Village



1 inch = 2,625 feet

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CDM Smith

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0 ½ 1 2 Miles

Figure 2-6
Stormwater Inventory
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL

provided CDM Smith with open channel geometry data surveyed by Erdman Anthony and Associates in 2014 (see Section 3). Stormwater pond information was obtained from field survey (by F.R.S. & Associates, Inc.) and construction drawing review provided by the Village.

As can be seen from the model schematic Figure 2-2, there are eight outfalls from the model to the C-51 Canal. These represent four separate but related systems in the model. There are two outfalls from the M-1 Canal, representing the Amil Gate and the two parallel gated 72-inch culverts. The M-1 Canal drains about three quarters of the watershed. East of these structures, near the intersection of Lamstein Lane and Southern Blvd, is a 48-inch outfall that drains a relatively small area of the Village. Approximately 1600 ft east of Lamstein Lane is the outfall of the Northern Palm Beach Water Control District (NPBWCD) Canal, which drains most of the eastern portion of the Village. The remaining outfalls are for Lake Worth Drainage District (LWDD) Canals including the E-1 Canal east of State Road 7.

Flow and stages in the M-1 Canal are controlled by three variable gate structures (Roach, 40th St., and Amil Gate Structures). Flow and stages in the NPBWCD Canal are controlled by the fixed weir at its confluence of the C-51 Canal. Flows and stages in the LWDD E-1 Canal are controlled by stages in the C-51 Canal. Representation of these control structures are discussed under the Boundary Conditions Section (Section 2.2.7).

Storage areas (wetlands, natural depression areas, and man-made lakes) influence the hydraulics of the system in all of the basins. Therefore, storage accountability within the basin is essential in the development of the hydraulic model. The following paragraphs describe the information used to develop the hydraulic model.

2.2.1 Structures/Facilities Updates

A major component of this study was the inventory of the stormwater management structures along the PSMS. This information forms the foundation for the model representation of the hydraulic system. As previously discussed, hydraulic characteristics of the structures and facilities representing the PSMS were collected from the GIS database and construction drawings of stormwater facilities (i.e., culverts, bridges, detention ponds). Sources of this information included the following:

- Village of Royal Palm Beach GIS geodatabase
- Village of Royal Palm Beach Archived Construction Drawings
- SFWMD Permit Data
- Palm Beach County Construction Drawing Files
- ITID Comprehensive Drainage Plan (2013)
- Lake Worth Drainage District Maintained Canal Elevations Map

2.2.2 Stage-Area Relationship Updates

For this study, stage-area relationships were developed/updated from the LiDAR DEM. Stage-area relationships were needed for most of the HUs to account for the volume of potential street flooding above the PSMS. Some of the larger storage units were provided for existing golf courses and large stormwater ponds.

2.2.3 Equivalent Pipe Updates

As discussed previously, the LiDAR DEM indicated that there is a shallow berm between the canals and most Village neighborhoods. Therefore, the runoff from most of these neighborhoods drains to the underground stormwater (pipe) system and stages up in the streets, prior to running off into the canals. At the same time, the berms allow for higher stages in the canals before they can get out of bank and overflow into the neighborhoods.

To simulate this in SWMM, a storage node is provided for each HU and given the stage-area relationship calculated from the DEM as described above. Pipes are added to the model from the storage node to junctions at locations along the canals, and parallel (hydraulic) overflows are added to represent flow over the berm (see below) if stages in the streets or stages in the canal overtop the berm elevation.

Figure 2-6 shows that in many cases, there are multiple pipes connecting a neighborhood to the adjacent canal. Note that very short channel links may cause instabilities in SWMM, so the pipe outfalls are often co-located for convenience. If the outfall pipes are the same size, SWMM has an option to provide multiple barrels of a pipe in a single link; however, most of the outfalls from a given neighborhood vary in size. One option would be to add parallel links for every pipe, though this can make for a difficult model to edit and a difficult to read schematic. As an alternate, CDM Smith has combined multiple outfall pipes into equivalent pipes using standard pipe equations that account for size, roughness, length, and local losses. In general, an average size and length is given to the pipe, and the multiple barrel option is used to provide the number of pipes. For example, three outfalls: one 24-inch, one 30-inch, and one 36-inch becomes 3 barrels of 30-inch pipe with a length representative of the three outfall pipes. To match head losses for a given flow condition, the pipe roughness value is often adjusted. Equivalent pipes were used to represent 2 outfalls to as many as 15 outfalls. The link description box has been used to track the number of pipes and pipe sizes used in the equivalents.

Local losses in closed conduit systems can cause abrupt changes in the hydraulic grade line. CDM Smith used the methodology described in the 2005 Study to account for local losses.
In general, entrance losses were set to 0.3, as a representative local loss for multiple types of pipe inverts. Exit losses were set to 1.0 for outfalls into canals when the outfall was not parallel to the line of flow and for outfalls to lakes and ponds. Outfalls parallel to the line of flow, such as road culverts, were given exit losses of 0.5.

2.2.4 Canal Cross-section Updates

Canal cross-sections are input into the model as irregular shaped conduit links. The conduit is supplied a table of station and elevation data derived from the 2014 survey discussed in Section 3. In general, the cross-sections end at the top of berm, to not double count storage with the storage nodes. Between surveyed cross-sections, the closest survey was used to represent the canal, though in some cases the inverts were adjusted to account for regional bottom slope. Where the newer survey was not conducted, the cross-sections as survey in 2000 were used (i.e. retained from the previous model).

2.2.5 Hydraulic Overland Flow Link Updates

Hydraulic Overland flow links are added to the model to represent potential flow between storage nodes or between a storage node and a canal junction. This is not to be confused with overland flows in the runoff (hydrologic) calculations. In the hydraulic model, overland flows are relatively short flows over shallow berms or ridges (often a road crown) to equalize flood stages between two areas. As discussed previously, overland flows are used parallel to the outfall pipes to link street flooding to the canals. They are also used to equalize street flooding between two HUs which have been delineated based on underground stormwater system, where there are no major roads separating the neighborhoods. Another use is parallel to bridge links or culverts to represent potential overtopping.

Overland flow links, if relatively flat, may be represented by wide weirs or short, wide open trapezoidal channels. If the boundary is more irregular, the irregular conduit is used and the link is similar to a short, wide shallow channel. To maintain model stability, the links cannot be too short. Typically, a minimum of 50 ft is used.

2.2.6 Control Structure Updates

The operation schedules for the control structures at 40th Street and Roach, which regulate inflow from the Indian Trails Improvement District, and the Amil gate structure at the confluence of the M-1 Canal and the C-51 Canal were updated to reflect current protocols and those proposed under SFWMD Permit No. 50-00761-S (issued 2/10/2014), which will modify how ITID discharges to the M-1 Canal under certain circumstances.

Currently, there are two sets of gates that control discharge from ITID and the Upper M-1 Canal Basin into the Village and the Lower M-1 Canal. The Roach structure consists of twin 84-inch diameter culverts that control flow by slide gates. The inverts of the twin 84-inch diameter culverts are approximately at elevation 5.6 ft-NAVD. The 40th Street Structure consists of four 3.5-ft high slide gates. Two of the gates are 5-ft wide and the other two are 4-ft wide. The invert elevation of the gates is 10.6 ft-NAVD.

Under typical current operating conditions, peak discharge from ITID into the village is limited to no more than 565 cfs. Additionally, the 40th and Roach structures are closed and there are no discharges from ITID into the Village when the stage in M-1 Canal downstream of the structures exceeds 14.6-ft NAVD. The gates will remain closed until the M-1 Canal stage recedes below 13.5-ft NAVD.

Under the new operating schedule promulgated in SFWMD Permit No. 50-00761-S, when the M-1 Canal stage exceeds 14.6-ft NAVD, ITID will be permitted to continue discharging through the 40th and Roach structures at a peak rate of 200 cfs during the peak of the storm event, with full permitted discharge resuming once the M-1 Canal has recovered to 13.5-ft NAVD. This inflow will be offset by opening manual slide gates at the Amil Gate structure at the C-51 Canal confluence to allow additional outflow from the M-1 Canal into the C-51 Canal equal to the ITID inflow plus 50 cfs (i.e. a maximum of 250 cfs when IDID discharges 200 cfs).

CDM Smith developed models for both scenarios. For ease of modeling, the 40th and Roach structures were combined into a single outfall link with a control curve associating outflow with head differential across the structure. Control rules were built into the models that would simulate closure of the gates or throttling of inflow to 200 cfs for respective modeling scenarios. For the new control rule scenario, pump links were added to the model at the discharge of the M-1 Canal into the C-51 Canal to simulate outflow from the ITID manual slide gates equal to inflow plus 50 cfs. The Village Amil Gate representation was updated from a pump link to an outfall link with flow dependent on head across the structure, which was necessary to accurately model the discharge through the Amil Gate given the updated boundary conditions in the C-51 Canal (discussed below).

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Explicit modeling of the C-51 Canal has been removed in this update; other control structures that may influence the Village's stormwater management systems (S-155, S-155A, and S-319) were not included in the Village SWMM model.

2.2.7 Boundary Condition Updates

Significant changes have been made to the operation and control of the C-51 Canal, which serves as the outfall for all of the primary stormwater management systems in the Village. Since the 2005 SWMPU, SFWMD has brought online a pair of structures, the S-155A and the S-319, that have significantly altered normal water levels and design storm tailwaters in the C-51 Canal. These alterations have increased the sensitivity of the Village stormwater management systems to tailwater influences. The SWMM model representation of the C-51 Canal and boundary stages has been altered considerably from the previous master plan update in order to simulate these changes.

For ease of modeling and to ensure accurate representation of the complex new control schema for the C-51 Canal and its 178 mi^2 drainage basin, CDM Smith removed any explicit modeling of the C-51 Canal from the SWMM model. All of the Village primary stormwater management systems were configured with an outfall node with a dynamic boundary condition representing the C-51 Canal as modeled by SFWMD in their February 2014 HEC-RAS model developed for the C-51 Basin Rule Re-evaluation. The SFWMD C-51 Canal Basin model will be discussed in greater detail in Section 4.5.

Model time-series results on the headwater and tailwater sides of the S-155A structure were extracted from the 10-year, 72-hour and 100-year, 72-hour C-51 Basin HEC-RAS models and were adapted to dynamic time-series boundary stages for the SWMM model outfall nodes. For the 10-year, 24-hour SWMM design storm model, the first two days of the 10-year, 72-hour HEC-RAS model were ignored and the time-series began on the third (wet) day. An interpolation based on rainfall depth was used to estimate dynamic boundary conditions for the 25-year, 72-hour design storm (which was not simulated by SFWMD). For all three design storms, two time-series were developed: the headwater of the S-155A structure, and the tailwater of the S-155A structure. Those Village systems that discharge to the C-51 Canal upstream of the S-155A (M-1 and NPBWCD) were assigned the headwater boundary time-series, and those that discharge downstream of S-155A (LWDD) were assigned the tailwater boundary time-series.

For the Tropical Storm Isaac validation event (discussed in Section 4.1), boundary time-series were developed from recorded stage data at the S-155A structure obtained from SFWMD.

Section 3

Canal Cross-section Analysis

As part of the Stormwater Master Plan Update, CDM Smith was tasked by the Village to compare recently (2014) surveyed canal cross-sections to the canal cross-section data obtained by F.R.S. & Associates, Inc. in 2000. The cross-section data collected in 2000 were used to build the stormwater model representation of the Village's PSMS using SWMM. The SWMM model was used to develop the 2005 Plan. This section discusses the analysis of the canal cross-sections and recommendations for potential re-grading or dredging of the canal system throughout the Village.

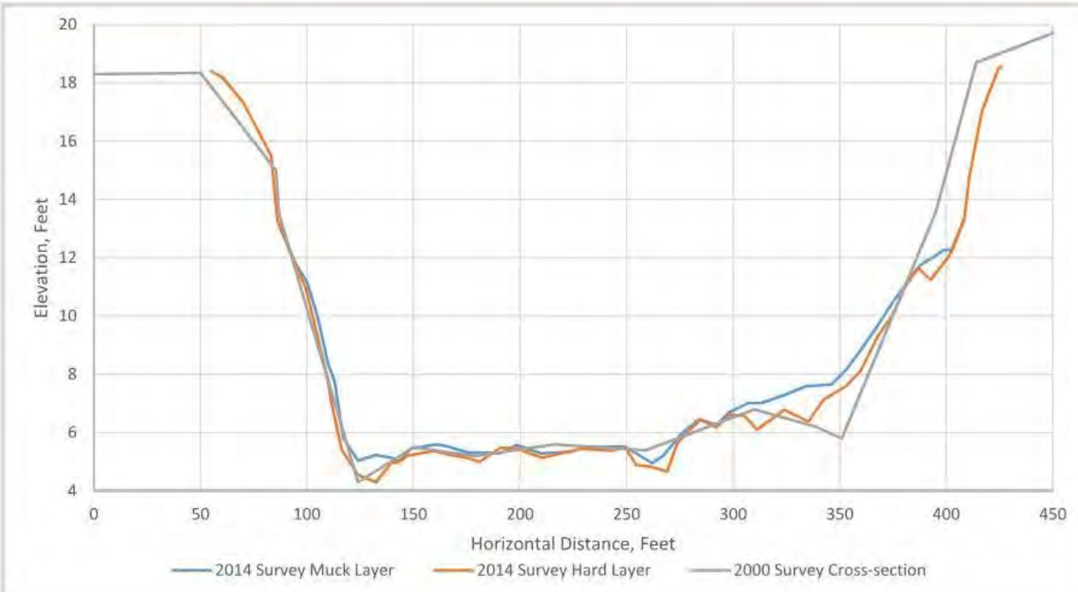
3.1 Survey Data

Cross-sections of primary and secondary canals were surveyed and prepared by Erdman Anthony Engineering Services and were provided to CDM Smith by the Village in a series of four AutoCAD files. The location of the cross-sections were distributed across the Village PSMS. The cross-sections were aligned on physical coordinates in the AutoCAD file to the locations based on the East Florida 1983 State Plane coordinate system, with profile sections located in the file adjacent to the plan survey of the canal. The profile of both the surveyed muck and surveyed hard bottom layers were shown in AutoCAD file as separate polylines. The profile of the cross-sections were presented with a distorted scale on the vertical axis by a factor of five.

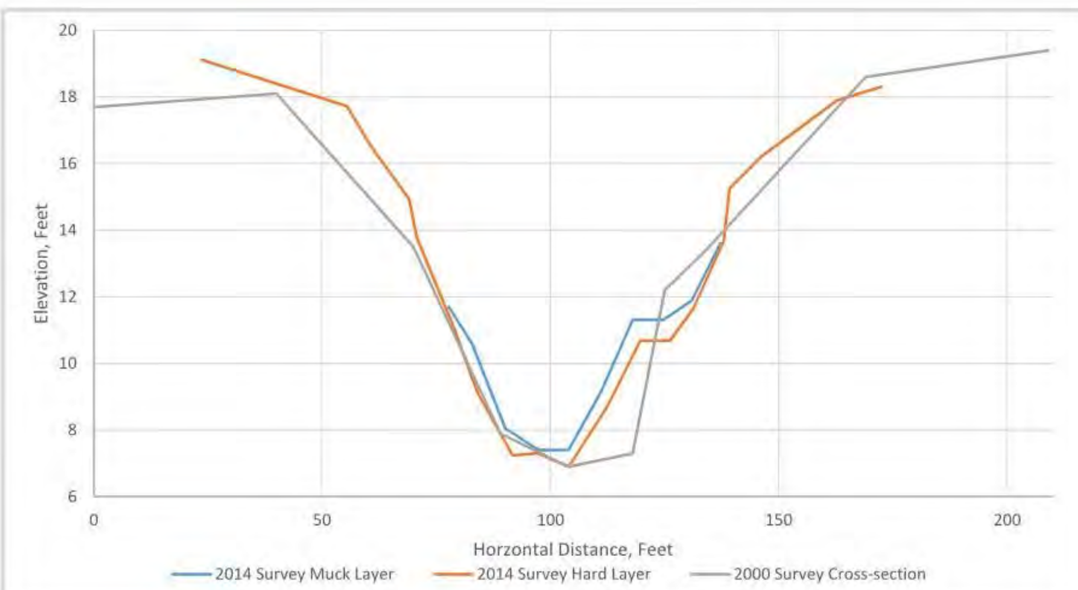
The area between the muck layer and hard layer was found for each cross-section using the hatch and properties tools in AutoCAD. These values were exported to Microsoft Excel and reduced by a factor of five to account for the distortion in the original drawings. The error caused by simple reduction was minimal when compared to scaled reduction in AutoCAD. Distances between cross-sections were found using ArcGIS. The location of the cross-sections were imported into ArcGIS from AutoCAD and were checked against aerials provided in the surveyor's files. Distances were calculated between the cross-sections based on the East Florida 1983 Plane coordinate system. Several sections were not included in the calculations: the M-1 canal, as it is owned by Indian Trails Improvement District, and the canal through the Village Golf Club, which is privately owned. The total distance of all village canals analyzed is 14.2 miles.

Figure 3-1 shows the cross-sections from the 2000 survey and the recent 2014 survey in four locations where both surveys were conducted. This figure also shows the cross-sectional area between the hard layer and the top of the sediment, from which the sediment area was estimated. Using the cross-sectional area, the volume of sediment was estimated by multiplying the cross sectional area by the distance between adjacent cross-sections. Dead end areas of the canal system were calculated using a single cross-section multiplied by the distance between the cross-section and the end of the canal.

FIGURE 1



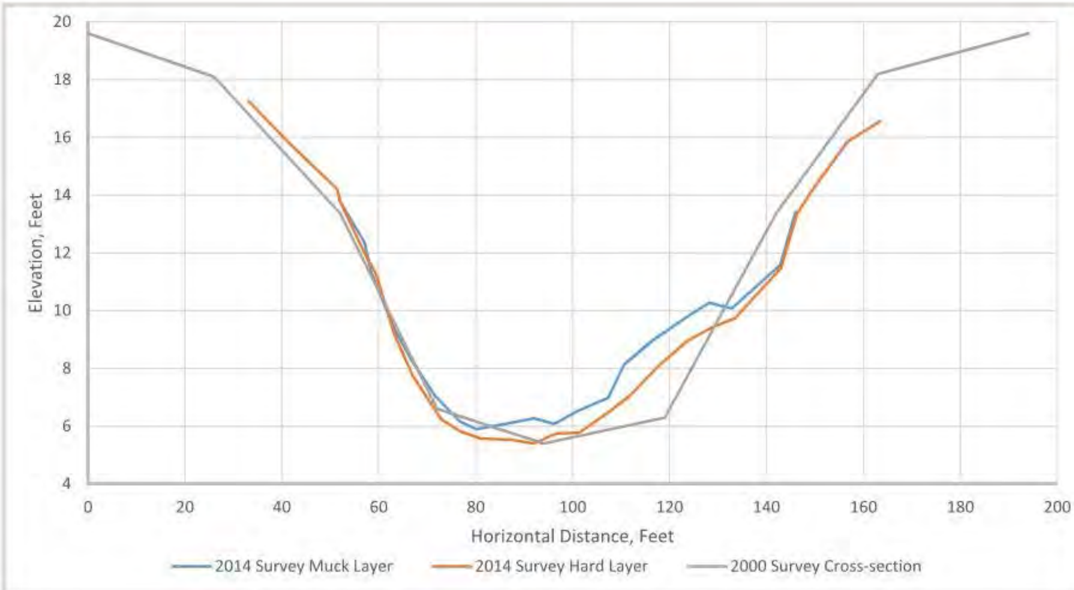
Comparison A



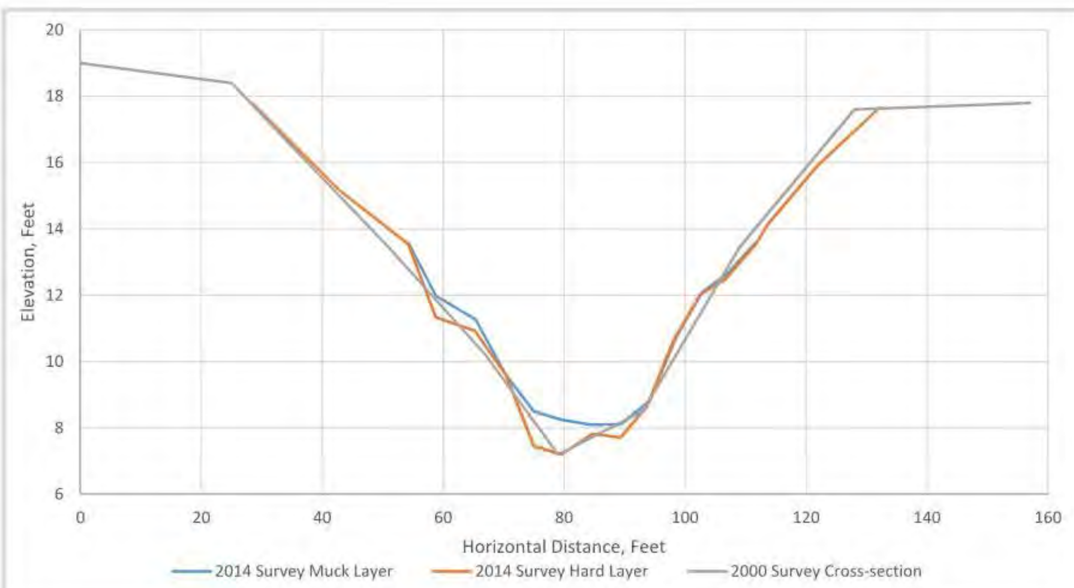
Comparison B

Page | 1

FIGURE 1



Comparison C



Comparison D

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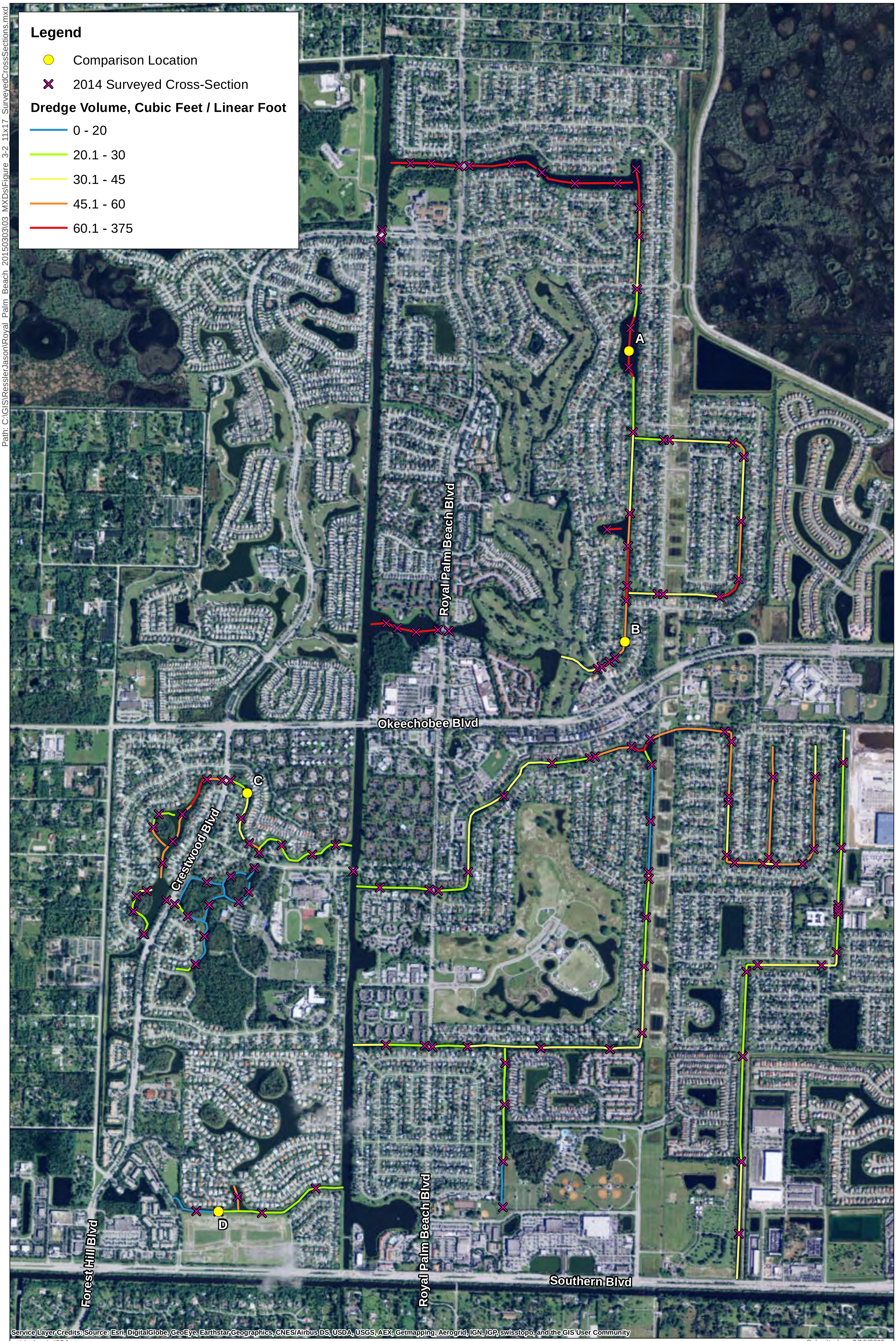
Figure 3-2 shows the locations of the survey sections and the estimated locations of the highest volumes of built-up sediment material (muck). The total volume of sediment was estimated to be 119,000 cubic yards.



1 inch = 1,425 feet

CDM Smith

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Submitted on: 5/18/2015

Figure 3-2
Canal Dredging Volumes
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL

Because several of the cross-sections were over 1000 feet apart as well as canal shape changes occurring between cross-sections, it is recommended to include a factor of safety in the sediment volume estimates of 1.2 (20 percent). Therefore, the estimated dredging volume in the system is 140,000 cubic yards.

In general, the 2014 survey data indicate that the canal hard layer of the cross-sections are generally 0 feet to 3 feet deeper that those obtained in 2000. The 2000 survey data did not have the detail at the bottom of the canal that the 2014 survey provides. Figure 1 indicates the change in in surveyed cross-sectional shape from the 2000 survey to the 2014 survey. Figure 3-2 shows the location of the four cross-section comparisons presented in Figure 3-1.

3.2 Sediment Removal

Prior to removal of the sediment, the Village should seek guidance from the South Florida Water Management District (SFWMD) to determine if a permit will be required to remove the sediment, or if the sediment can be removed as part of routine maintenance. Typically, a dredging contract would remove the sediment using track excavators on sectional barges. The dredged material would be loaded onto barge mounted hoppers that would pushed to pre-determined unloading points within the Village's PSWMS. The dredged material is typically stacked within a contained area for gravity drainage of the water content. Following a prescribed time to allow for gravity based water drainage, the dredged material can be loaded in to transport vehicles and disposed at an approved location (e.g., borrow pit facility). The selected Contractor will need to coordinate with the Village areas to stockpile the dredged material. Minimum considerations for the dredging process include:

- Permit requirements;
- Stormwater pollution prevention plan;
- Dredging methods;
- Canal access points;
- Sediment stockpile and drainage methods; and,
- Sediment transport and disposal methods and routes.

An example dredging specification has been included as **Appendix E**.

Model results with and without the muck layer are presented in Section 4.

Section 4

Water Quantity Results

The main objectives of this study are to update the existing SWMM model with more recent hydrologic and hydraulic data, and to compare the results from the updated model to the SFWMD C-51 Model developed by the SFWMD. This section of the report discusses the following:

- Model validation results for Tropical Storm Isaac;
- Design storm simulation results;
- Analysis of sedimentation accumulation ("muck") on flood stages; and,
- Comparison of updated model results to the SFWMD C-51 model results.

As previously discussed, a detailed discussion of model development and methodologies is included in the 2005 Plan, and not repeated in this technical memorandum.

4.1 Model Validation

Model validation is essentially a "reality check" to show that the modeled system adequately represents the actual system. If the model does not reasonably match observed stages (or flows, where applicable), the model should be calibrated to the given storm and validated or verified with a separate event. Model calibration refers to the adjustment of model parameters within reasonable limits so that the simulated response approximates what was measured in the field during a real rainfall event. For this project, Tropical Storm Isaac was used as a model validation event. This storm was chosen because the SFWMD has published stages in both the C-51 and M-1 Canals.

4.1.1 Rainfall and Stage Data

CDM Smith used the same rainfall time-series as SFWMD used for the calibration of the C-51 Basin model to Tropical Storm Isaac. Rainfall time-series were generated using NEXRAD rainfall averages over the lower M-1 Canal Basin area.

Stage data for the M-1 Canal was recorded at the Okeechobee Blvd Bridge and immediately upstream of the Amil Gate. CDM Smith obtained the stage data at these locations from SFWMD. CDM Smith used recorded headwater stage data at the S-155A structure to provide the C-51 boundary condition as discussed in Section 2.3.8.

4.1.2 Validation Results

Figure 4-1 displays a comparison of the observed stage in the M-1 Canal at the Amil Gate with the model result at this location. Due to the proximity of this location to the boundary condition in the C-51 Canal, the timing of the peak stage is greatly influenced by the boundary condition. Note the comparison between modeled and observed stage at this location is very good along the rising limb of the storm through August 27th, and then begins to diverge. On August 28th, there is a large difference in the timing of the peak that is caused by the timing in the C-51 boundary condition. However, the peak stage in the model is within 0.1 ft of the observed stage. No reasonable modifications of model input parameters will create a stage in the M-1 canal that would match the observed stage in timing, using this boundary condition.

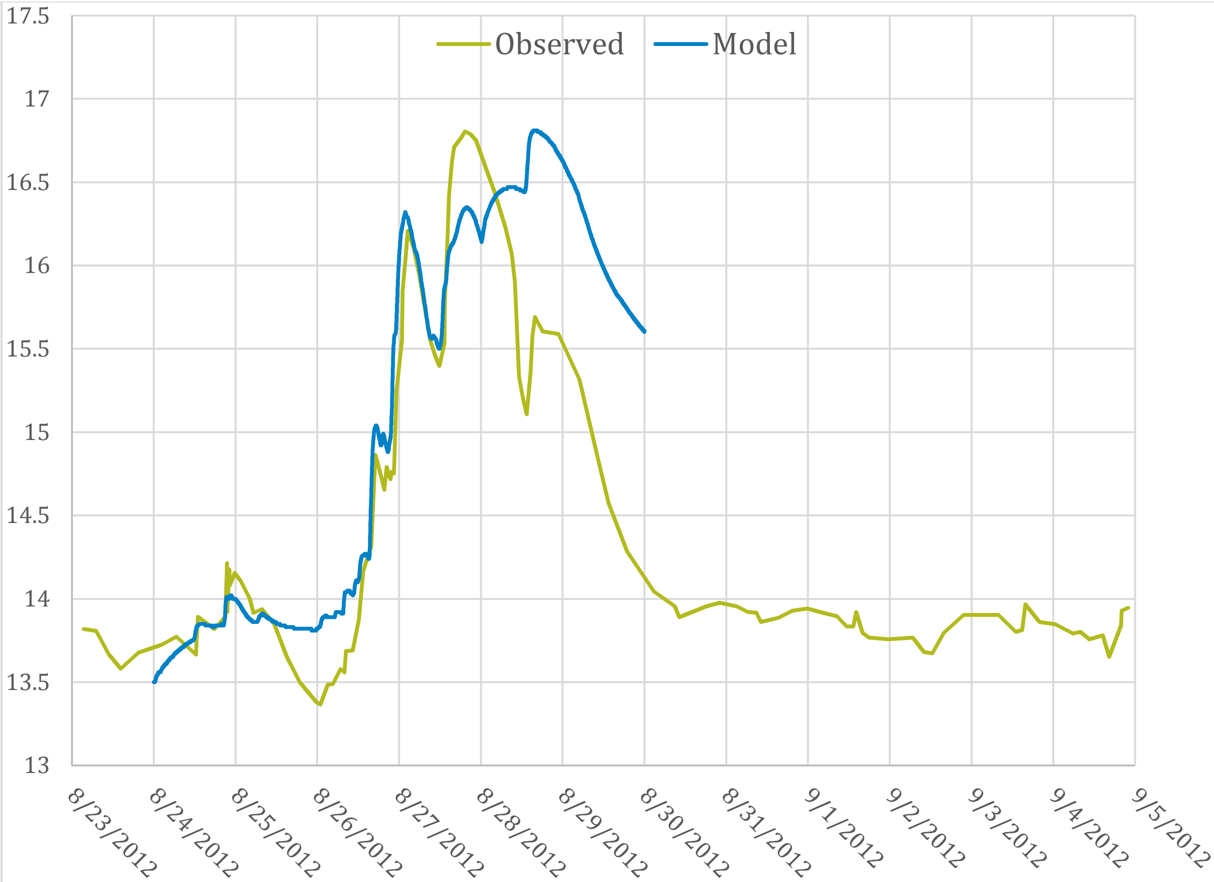

Figure 4-1. Isaac Validation Model

At Okeechobee Blvd, the modeled stage is over 1 ft higher than the observed stage published in the SFWMD C-51 report. The SFWMD report indicates that there is an error in the data and therefore the SFWMD did not use the data to calibrate the C-51 model. It is likely that there is an unresolved datum shift since the peak stage at this location is significantly lower than the peak stage at the Amil Gate (which would necessitate considerable backwards flow, were it correct).

Since the Okeechobee Blvd data was not useful and the Amil Gate data showed reasonable agreement on peak stage, the model was considered validated based on the data available.

4.2 Design Storm Results

The updated model was run for the 10-year, 24 hour; 25-year, 72-hour; and 100-year, 72-hour storm events under two simulation conditions: no on-peak inflows from ITID and 200 cfs inflow from ITID.

4.2.1 No On-Peak Inflows from ITID

The peak stage per model node for the three design storms under the no on-peak flow scenario are presented in **Appendix F** as **Table F-1**. **Table 4-1** provides the peak outfall flows for this scenario.

Table 4-1
Village of Royal Palm Beach Stormwater Master Plan
Peak Outfall Flows – No On-Peak Flows from ITID

Location	Model Outfall	Peak Flow (cfs)		
		10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
M-1: Amil Gate	C51A_1	1503	1492	1481
M-1: Dual 72-in	C51A_2	120	175	241
Lamstein Lane	C51B	192	226	290
NPBWCD Canal	C51C	270	326	510
LWDD E-1 (North)	C51D	266	378	499
LWDD E-1 (South)*	C51E	91	116	159
LWDD 18 in	C51F	13	15	16
LWDD S-4*	C51G	66	147	196

* South outfalls show Village flows only

The Amil gate flows are limited by the structure's rating curve and the downstream boundary condition.

4.2.2 Inflows from ITID at 200 cfs

The recent SFWMD Permit No. 50-00761-S allows increased discharges from ITID's stormwater system to the M-1 Canal. This scenario was tested with the updated SWMM. The peak stage per model node for the three design storms under the 200 cfs inflow from ITID scenario are also presented in **Appendix F** as **Table F-2**. **Table 4-2** provides the peak outfall flows for this scenario.

Table 4-2
Village of Royal Palm Beach Stormwater Master Plan
Peak Outfall Flows – 200 cfs On-Peak Flows from ITID

Location	Model Outfall	Peak Flow (cfs)		
		10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
M-1: Amil Gate	C51A_1	1505	1568	1592
M-1: Dual 72-in	C51A_2	115	173	239
Lamstein Lane	C51B	192	226	290
NPBWCD Canal	C51C	270	326	510
LWDD E-1 (North)	C51D	266	378	499
LWDD E-1 (South)*	C51E	91	116	159
LWDD 18 in	C51F	13	15	16
LWDD S-4*	C51G	66	147	196

* South outfalls show Village flows only

The peak stages in the Village do not significantly increase due to the additional flows, because there is also additional discharge at the Amil Gate and the M-1 Canal has sufficient capacity. However, this only would be true if the Amil Gate is permitted the higher flow rate as modeled. The additional flows from

ITID will increase stages due to increased total volume if the Amil Gate flows are limited to previous permitted conditions.

Figure 4-2, **Figure 4-3**, and **Figure 4-4** show the estimated flood depths for the 10-year, 24 hour; 25-year, 72-hour; and 100-year, 72-hour storm events, respectfully. These flood depths are estimated by assigning all areas within a given model HU the peak flood stage of the HU load junction, converting the polygons to a raster surface and subtracting the topography DEM from the calculated flood surface. All remaining negative areas are thus not flooded and all remaining positive areas represent the estimated depth of flooding. As expected, the streets become severely flooded during the 100-year storm.

The stormwater model results also indicate a potential for neighborhood house flooding, however, it is important to note that this map is based on LiDAR coverage and not finished floor elevations (FFEs). Therefore, a flood extent covering a given structure does not necessarily indicate that the structure is expected to flood and should be verified in the future using finished floor elevation data (as available).

4.3 Model Results With and Without the Muck Layer

The updated SWMM was prepared with the hard bottom layer found in the canals in the 2014 survey (see Section 3). To test the consequences of having a layer of muck reducing canal conveyance, the 100-year design storm was run for simulations that used both the hard bottom layer and the muck layer cross-sections. In addition to using the shallower of the cross-section, the version of the model with the muck layer used higher channel roughness values. Therefore, this model includes not just the volume of muck currently in the canals, but a pre-dredged representation of bottom vegetation.

The model results show no discernable difference in peak stage due to the muck layer. Most of the nodes had increases between 0 and 0.05 ft, which when rounded to a tenth of a foot becomes a zero increase. We round model results of peak stage to the nearest tenth of a foot to coincide with the confidence of the model input, i.e. the model is not necessarily accurate to a hundredth of a foot.

The 2014 survey showed no loss of storage above the water line. Therefore, all loss of storage is considered "dead storage", which is storage areas which are already filled prior to the model simulation start. Therefore, the minor increase that do occur are due to loss of conveyance from both the loss of cross-sectional area and the increased roughness. The canals in the Village are large enough to convey the 100-year design storm event as the flooding that does occur is due to local stormwater system capacities and the boundary condition at the C-51 Canal. Peak stages are primarily a result of stormwater volume as opposed to carrying capacity. Therefore, the loss of capacity due to sedimentation and increased roughness does not adversely affect the peak flood stage in the model. However, there may be water quality benefits and aesthetic benefit to the community in maintaining the canals to their design standard.

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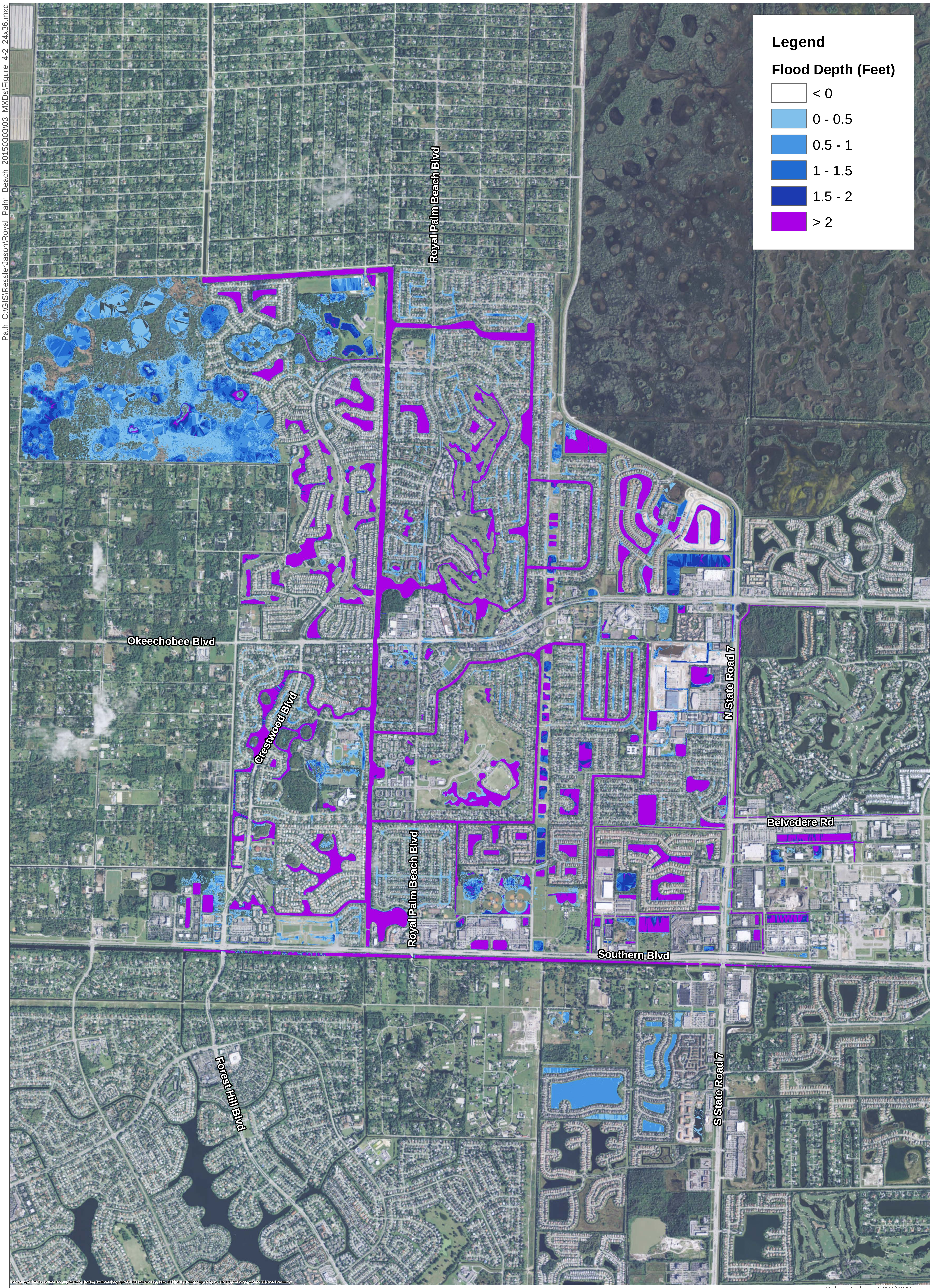

1 inch = 1,150 feet

Submitted on: 5/18/2015

CDM Smith

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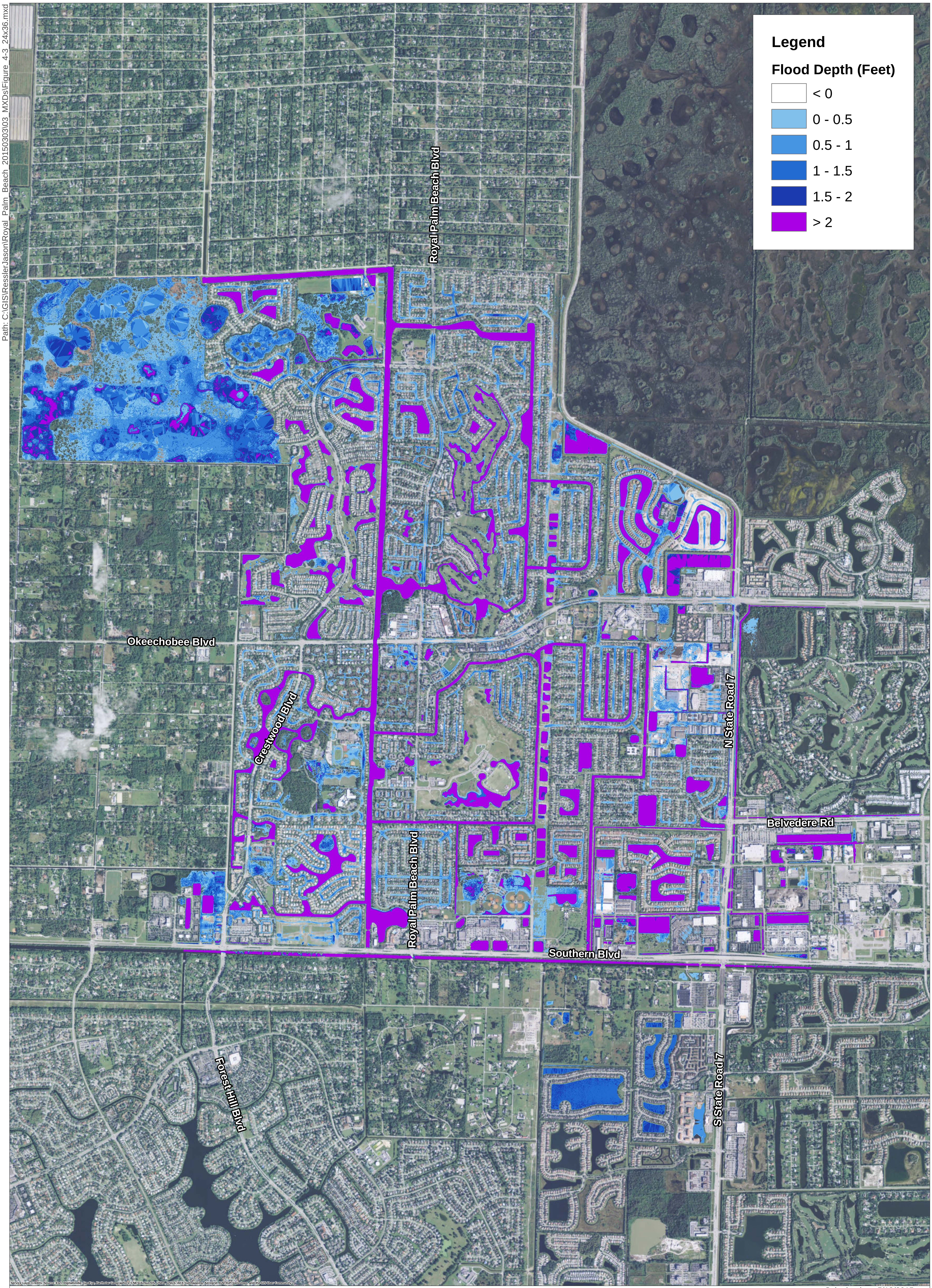
0 ¾ 1½ 3 Miles

Figure 4-2
10-Year, 24-Hour Flood Map
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL



1 inch = 1,150 feet

Submitted on: 5/18/2015

CDM Smith

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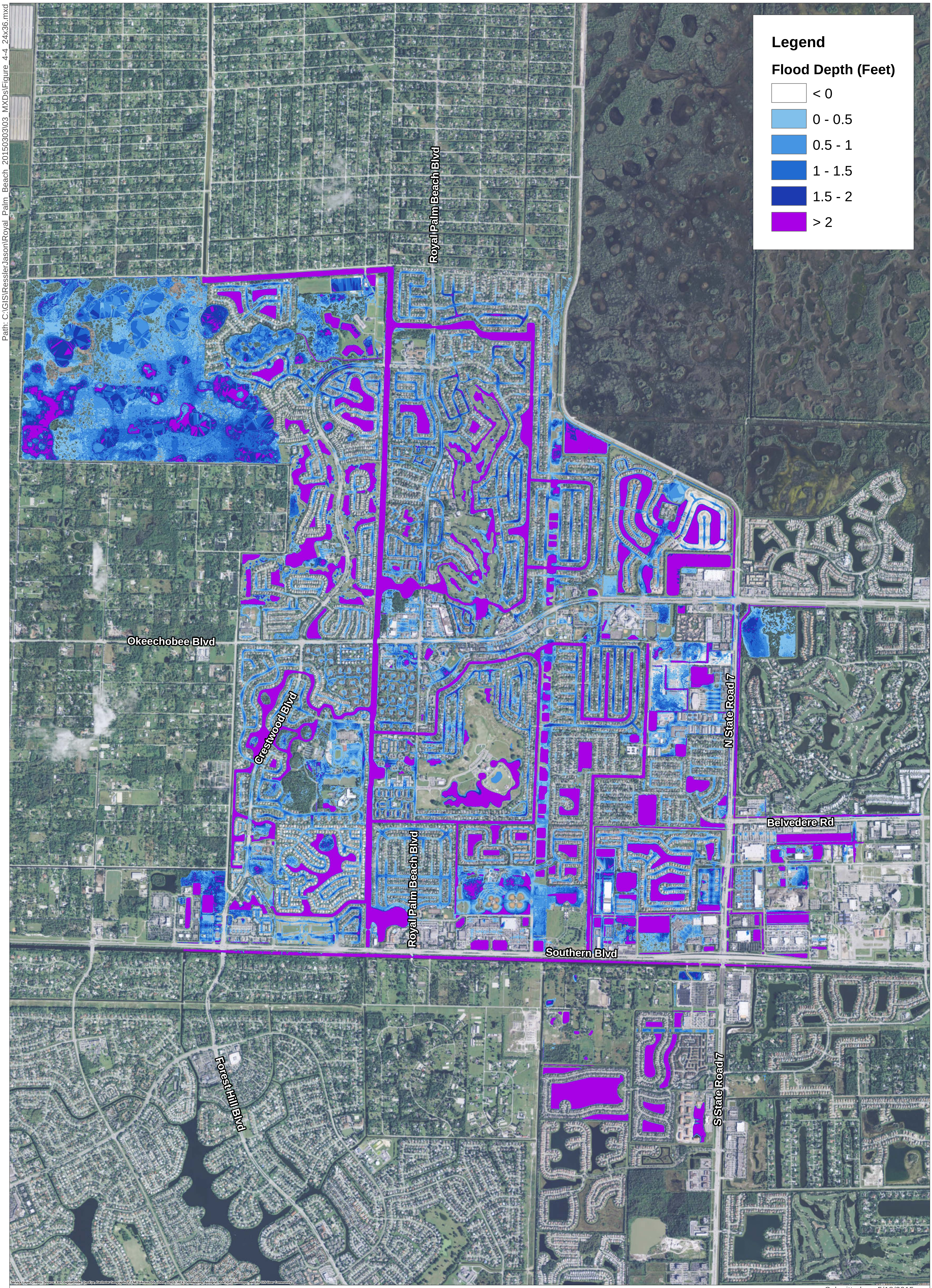
0 ¾ 1½ 3 Miles

Figure 4-3
25-Year, 72-Hour Flood Map
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL



1 inch = 1,150 feet

Submitted on: 5/18/2015

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0 ¾ 1½ 3 Miles

CDM Smith

Figure 4-4
100-Year, 72-Hour Flood Map
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL

4.4 Level of Service (LOS)

Level of Service (LOS) may be defined by a comparison of the peak flood stages provided by the model to surveyed elevations (such as finished floor elevations or FFEs) within a set area for a given storm. Where surveyed elevations are not available, LOS is often defined by depth above crown for roads and depth above ground for structures. For this study, the following LOS criteria were compared to the model:

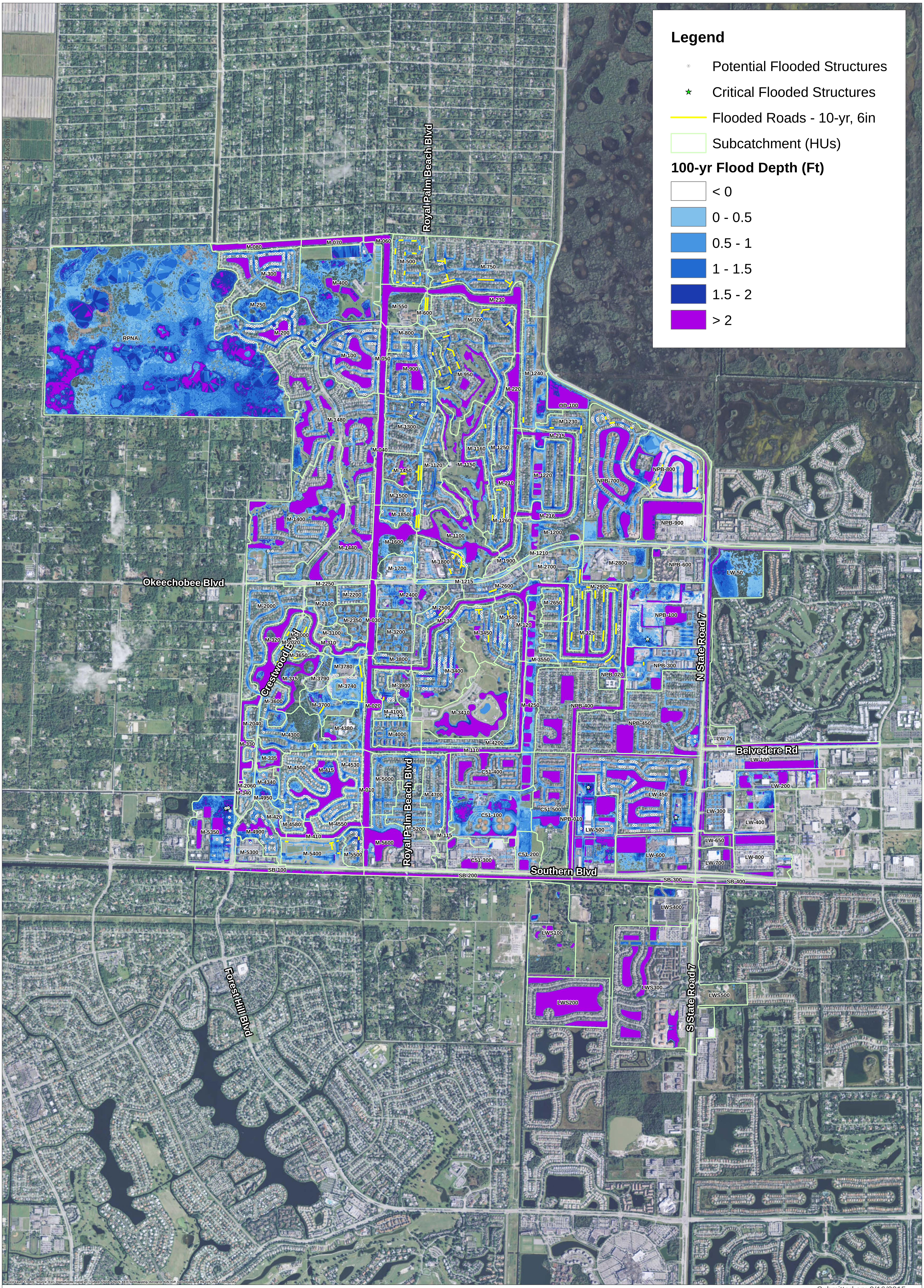
- A flood elevation of 6 inches above road crown for the 10-year, 24-hour design storm. The length of road is measured in GIS for locations where the road is predominately flooded to this depth or deeper.
- A flood elevation of 1 foot above ground (as determined by the LiDAR topography) for the 100-year, 72-hour design storm, in relation to structures. Where FFEs are not available, 1-ft above LiDAR is a common (and relatively conservative) LOS. For this study, structures that failed this criteria were considered "critical".
- As shown below, the Village of Royal Palm Beach did not display many Critical Flooded Structures; therefore, to help differentiate LOS from one area to another, a more conservative LOS criteria was added. A "Potential" Flooded Structure is noted at any location where the flood elevation is greater than ground elevation, for the 100-year, 72-hour design storm.

Figure 4-5 displays the locations of these LOS criteria overlaying the 100-year flood depth from Figure 4-4. Note that there are only five Critical Flooded Structures within the Village boundary. These all are located at larger structures, not single family residences. Because the LiDAR is unreliable under larger structures, none of these five is necessarily expected to flood for the 100-year storm. It is recommended that surveyed FFEs be compared to the model results to determine if these locations are expected to flood.

There are over 500 locations where structures may potentially flood if the FFEs were at or just above the adjacent ground elevation (as measured by LiDAR). Again, it is expected that most if not all of these structures were built with finished floors at least 1 ft above adjacent ground. The "potentially" flooded structures are more likely to show areas of significant driveway and yard flooding, than actual structure flooding, but they are useful in differentiating LOS between neighborhoods.

In order to find the problem areas based on the LOS criteria, the number of critical and potential flooded structures, as well as the length of flooded roads for the 10-year storm were noted for each model subbasin. A ranking of the subbasins versus these LOS criteria is provided as **Table 4-3**. The criteria were ranked with different weighting for the length of flooded roads versus the flooded structure count and with normalization by subbasin area and without. The average of these rankings is provided in Table 4-3, although it should be noted that different weighting may produce different results and all the higher ranked subbasins may be considered problem areas.

Table 4-3 also includes a column on whether it is recommended that a Capital Improvement Project (CIP) be investigated to improve the LOS for the given subbasin. For most of the subbasins, including many top ranked subbasins, the recommendation is not to implement a CIP because the cause of flooding is the peak stage in the M-1 Canal or one of the tributary canals. In these cases, the cost to improve LOS would be prohibitive versus the expected benefit. This is because the peak stage in the M-1 and tributary canals is caused by the Village-wide volume of floodwaters and the limited (permitted) outfall flows from the M-1 Canal system to the C-51 Canal.



1 inch = 1,240 feet

Submitted on: 9/16/2015

N

0 ¾ 1½ 3 Miles

CDM Smith

Figure 4-5
LOS Map
Stormwater Master Plan Update
Village of Royal Palm Beach
Palm Beach County, FL

Table 4-3
Village of Royal Palm Beach Stormwater Master Plan
Ranking of Potential Problem Areas

Subbasin	Neighborhood	Area	Flooded Structure count	Critical Flooded Structures	Flooded Roads (ft)	Rank - Ave	CIP (Y/N)
M-200	Saratoga Pines	75.6	55	0	0	1	N
M-3740	Crestwood Middle School	22.3	8	0	972	2	Y
M-5500	The Estates of Royal Palm	17.1	10	0	185	3	Y
M-4100	Greenway Village North	22.8	11	3	69	4	N
M-300	Saratoga Pines	75.8	41	0	0	5	N
LW-450	Bella Terra	177.3	85	1	0	6	N
M-2900	The Willows	93.0	5	0	3779	6	Y
M-3450	The Willows	48.9	18	0	682	8	N
M-1850	Hidden Harbor	16.8	4	0	745	9	N
M-100	Saratoga Lakes	88.6	43	0	0	10	N
M-2500	Royal Village Townhomes	19.3	7	0	276	11	N
M-1800	The Trails	40.2	9	0	1106	11	N
M-4900	Gables	32.0	15	0	0	11	N
M-3400	The Willows	75.4	34	0	0	14	N
M-600	Royal Palm Bch Blvd	9.1	0	0	926	15	Y
M-3500	The Willows	25.9	8	0	252	16	N
M-4500	The Estates of Royal Palm	51.8	17	0	60	17	N
M-900	Hunington Woods	66.1	21	0	67	18	N

In the 100-year storm, the total flow entering the M-1 Canal system is greater than the permitted outflows, and therefore, the canal system backfills. Larger conveyance in the canals would not improve this condition, nor would larger pipes from the neighborhoods to the canals, except where noted below. In cases where the peak flood stage in the neighborhood is equivalent to the peak flood stage in the canal system, larger pipes provide no benefit due to potential backflow from the canal. Backflow preventers may be utilized; however, backflow preventers require higher heads to open, which could potentially increase flood stages. Backflow preventers are also costly to maintain. The next potential (and costly) mitigation alternative would be to use pump stations and backflow preventers in concert.

Since structures in these neighborhoods are not likely to flood in the 100-year storm (the LOS count was based on the overly conservative estimate of FFE at ground elevation), the benefit of costly alternatives would be small. It is recommended that spot surveys of FFEs be taken in neighborhoods with multiple potentially flooded structures to determine if there is significant benefit to lowering the 100-year flood stage.

Locations of recommended CIPs occur where the peak stage in the streets exceed the peak stage in the Canal system for the given storm. These are:

- Subbasin M-3740 near Crestwood Middle School. Park Road is predicted to be inundated by a depth greater than 6 inches for nearly 1000 ft in the 10-year storm. This section of road is drained by two 18-inch diameter pipes. Increasing the pipe size should reduce flood depths enough to meet LOS.

- Subbasin M-5500, the Estates of Royal Palm Beach adjacent to Southern Blvd and the M-1 Canal. This relatively small area (17 acres) has 10 potentially flooded structures and nearly 200 ft of flooded roadway. In this case, the peak stage in the neighborhood is slightly higher than the peak stage in the M-1 Canal for the 100-year storm. The area is served by two 24-inch outfalls and one 15-inch outfall. Increasing pipe sizes may improve the potentially flooded structures, and will allow the roads to meet LOS.

- Subbasin M-2900, the Willows in the finger canal area (northwest portion). Over 3,700 ft of road is expected to be inundated in this area during the 10-year storm. This area is served by 15 outfalls of varying sizes from 15-inches to 24-inches. The LOS goal can be met by increasing the size of the smaller outfalls, or adding outfalls to the existing system.

- Subbasin M-600, Royal Palm Beach Boulevard, north of Crestwood and south of the tributary canal to the M-1 Canal. This portion of the main north-south road through the heart of the Village is expected to flood, in both the north and south lanes for about 450 ft (over 900 ft total). This area is served by a single 18-inch outfall. The outfall pipe could be replaced with larger pipe or a second outfall could be added to meet LOS.

4.5 Comparison to the SFWMD C-51 Model

In February 2014, SFWMD published the C-51 Basin Rule Re-evaluation report. As part of this study, SFWMD updated their HEC-RAS and HEC-HMS model of the full 178 mi^2 contributing area to the C-51 Canal. The results of the study have implications for future flood control management of the C-51 Basin and revisions of base flood elevations.

To aid in the assessment of the C-51 study and its implications for floodplain management in the Village, CDM Smith was tasked with performing a comparison of the Village SWMM model results to those of the SFWMD HEC-RAS model. This comparison was performed at the Village Amil Gate at the confluence of the M-1 Canal and the C-25 Canal; the M-1 Canal was the only primary outfall of the Village modeled with significant detail in the SFWMD HEC-RAS model, and as such served as the best basis for comparison.

As shown in **Figure 4-6** and **Figure 4-7** below, the updated Village SWMM model produces peak stages that are comparable to those of the SFWMD HEC-RAS model. For the 10-year event, the SWMM model produces a peak stage (14.5-ft NAVD) within one tenth of a foot of that predicted by the C-51 HEC-RAS model (14.4-ft NAVD). A similar comparison was noted for the 100-year event, with a SWMM model peak stage of 16.5-ft NAVD versus a peak stage of 16.6-ft NAVD in the C-51 Basin Model.

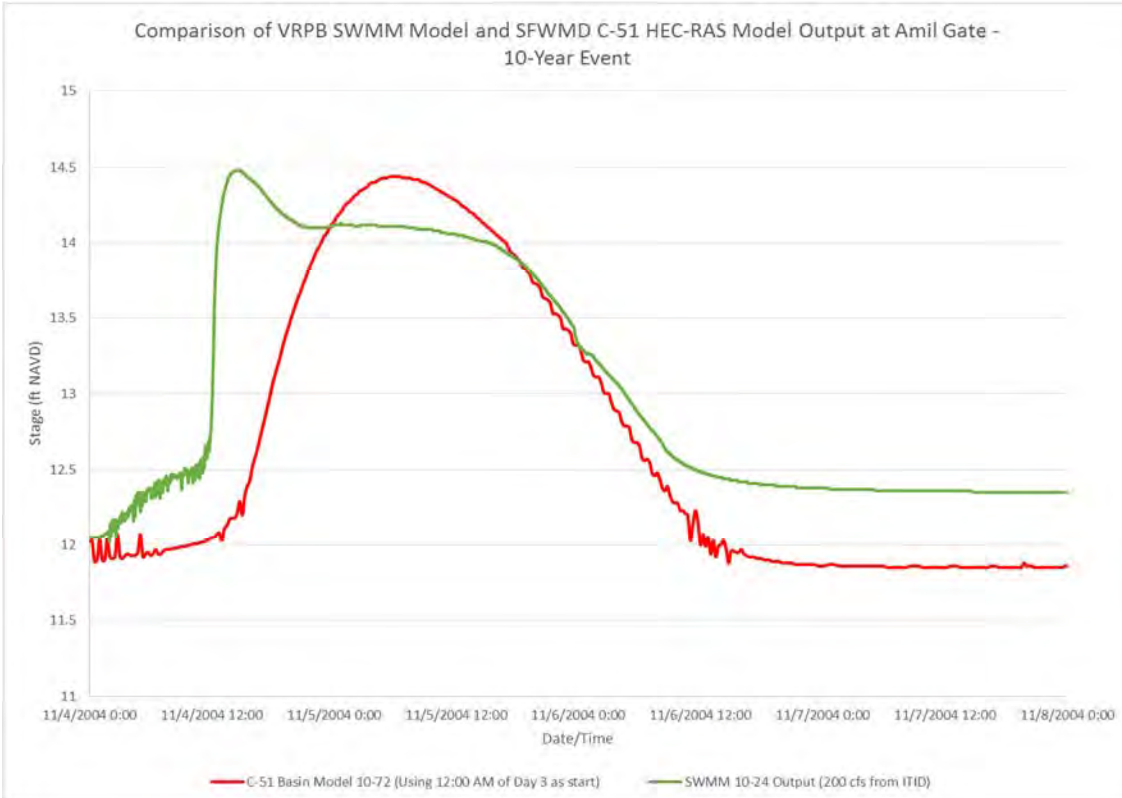


Figure 4-6. Comparison of Village SWMM Model with SFWMD C-51 Basin Model – 10-Year

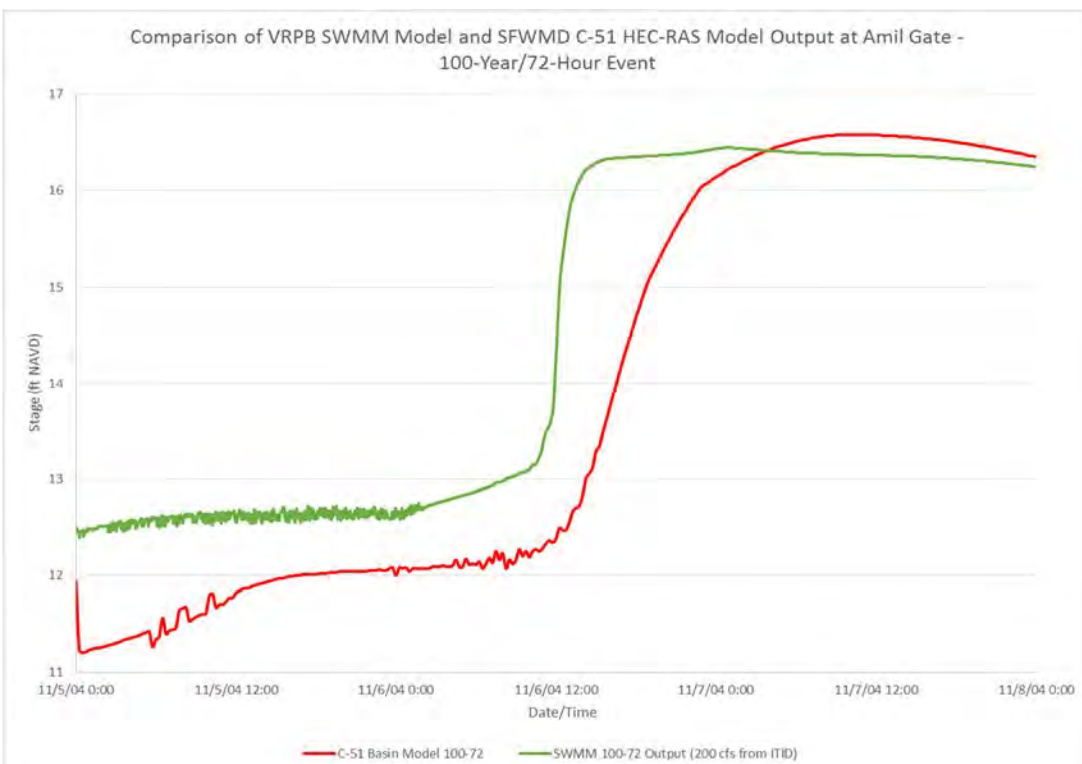


Figure 4-7. Comparison of Village SWMM Model with SFWMD C-51 Basin Model – 100-Year

As seen in the figures above, the timing of the peaks varies considerably, with the SWMM model peaking 20-24 hours earlier than the C-51 Basin model. This could be due to several factors, including general differences in level of detail in modeling of the M-1 Basin between two models, as well as the differences between the SWMM hydrologic method and the Technical Release 55/Unit Hydrograph method of developing runoff hydrographs employed in the SFWMD HEC-HMS model.

4.6 Summary of Results

The following summarizes the SWMP Update Results:

- The updated model was validated with Tropical Storm Isaac and showed a close match in peak stage at the Amil Gate. To the extent practicable given the available data, the storm validated the model update;
- Design storm simulation results show significant street flooding for the 100-year storm, and indicate likely structure flooding in some locations;
- The peak stages in the M1 Canal are within 0.1 ft of the stages estimated by the SFWMD C51 Model, for both the 10-year, 24-hour and 100-year, 72 hour storms. However, the timing of the peaks are not a close match. The more detailed SWMM should provide a better estimate of the flood timing, as well as a more accurate estimate of flood stages in portions of the Village further away from the M1-Canal.
- The analysis of sedimentation accumulation ("muck") on flood stages showed only minor increases due to the loss of cross-sectional area and increased roughness.
- The LOS analysis shows only five (5) structures in the Village are expected to flood for the 100-year, 72-hour design storm, This LOS is based on the premise that all structures have finished floor elevations (FFEs) at least one foot above ground elevation. All five of these structures are larger buildings where the LiDAR (ground elevation) may be suspect. It is recommended these locations be checked for actual FFEs.
- Because there were so few flooded structures, a secondary LOS analysis was conducted with a more conservative count of flooded structures when ground elevation is compared to flood stage directly. Over 500 structures may potentially be flooded if FFEs are at ground elevation. It is recommended that FFEs be spot checked in neighborhoods which have multiple locations of potentially flooded structures.
- A third LOS analysis was conducted by measuring lengths of roads inundated by more than 6 inches for the 10-year, 24-hour design storm. Approximately 4 miles of roads in the Village do not meet this LOS.
- These data were combined over the model subbasins, weighted and/or normalized by subbasin area, and ranked. A ranking of potential problem areas is provided in Table 4-3.
- Because many of these problem areas are due to the peak stage in the M-1 and tributary canals, it was determined that it would not be feasible to provide Capital Improvement Projects (CIPs) to mitigate these problems. This conclusion may need to be revisited if FFEs in these neighborhoods are found to be lower than expected, i.e. lower than one-foot above adjacent ground.

- Locations where feasible CIPs are recommended were provided in Section 4-4. These include Park Road near Crestwood Middle School, Royal Palm Beach Blvd, north of Crestwood, The Willows, in the finger canal area, and the Estates of Royal Palm Beach, near Southern Boulevard.

APPENDIX A

HYDROLOGIC PARAMETERS

HU	Area (Ac)	Impervious %	Width (ft)	Slope %	Impervious n -	Pervious n -	Impervious IA (in)	Pervious IA (in)	Non-DCIA % of Imp. Area	Max Inf Rate (in/hr)	Min Inf Rate (in/hr)	Soil Storage (in)
C51-100	92.3	29.5	2,526	0.10	0.024	0.40	0.33	0.25	12.2	4.0	0.10	1.40
C51-200	24.6	23.8	1,682	0.42	0.015	0.34	0.10	0.25	80.0	4.0	0.10	1.40
C51-300	48.3	85.7	3,178	0.31	0.017	0.39	0.17	0.25	5.0	4.0	0.10	1.40
C51-400	70.3	52.6	4,781	0.38	0.015	0.20	0.10	0.25	12.6	4.0	0.10	1.40
C51-500	92.2	34.5	1,568	0.11	0.015	0.20	0.10	0.25	10.9	4.0	0.10	1.40
LW-100	71.7	76.7	1,644	0.14	0.015	0.20	0.10	0.25	8.6	10.3	0.80	5.59
LW-200	59.4	34.3	1,872	0.05	0.015	0.20	0.10	0.25	9.5	8.8	0.64	4.64
LW-300	37.6	72.4	1,539	0.57	0.015	0.20	0.10	0.25	10.0	9.1	0.65	5.13
LW-400	23.6	15.3	1,861	2.88	0.015	0.20	0.10	0.25	9.5	8.7	0.62	4.63
LW-450	177.3	59.3	8,014	0.07	0.015	0.20	0.10	0.25	10.2	5.6	0.28	2.48
LW-50	98.0	24	743	0.07	0.019	0.38	0.21	0.25	11.2	4.0	0.10	1.40
LW-500	90.4	51.9	2,896	0.23	0.015	0.25	0.10	0.25	10.3	4.0	0.10	1.40
LW-600	77.1	70.3	2,900	0.46	0.015	0.35	0.10	0.25	9.4	4.7	0.16	2.29
LW-650	12.5	51.7	1,754	1.70	0.015	0.20	0.10	0.25	9.9	4.7	0.15	2.25
LW-700	26.7	71.6	1,513	0.78	0.015	0.20	0.10	0.25	9.5	4.4	0.13	1.83
LW-75	27.6	32.6	643	0.18	0.015	0.20	0.10	0.25	10.0	4.0	0.10	1.40
LW-800	50.5	55.8	2,098	0.33	0.015	0.20	0.10	0.25	8.1	8.9	0.63	4.80
M-010	17.5	51.6	10,165	2.70	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-020	38.0	49.2	15,351	3.24	0.015	0.20	0.10	0.25	0.0	4.1	0.11	1.57
M-030	16.0	60.8	7,811	2.00	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-040	19.8	69.6	17,212	5.82	0.015	0.29	0.10	0.25	0.0	4.0	0.10	1.40
M-050	13.3	68.5	11,559	5.49	0.015	0.21	0.10	0.25	0.0	4.0	0.10	1.40
M-060	16.1	45.5	7,365	3.77	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-070	11.8	20.9	5,329	4.16	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-080	16.3	30.4	7,724	4.36	0.015	0.23	0.10	0.25	0.0	4.0	0.10	1.40
M-100	88.6	63.2	3,048	0.25	0.015	0.20	0.11	0.25	12.4	4.0	0.10	1.40
M-110	28.4	46.2	12,064	2.06	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-1100	70.1	29.4	4,513	0.91	0.015	0.29	0.10	0.25	12.0	4.0	0.10	1.40
M-1120	51.5	53.3	2,095	0.45	0.015	0.24	0.10	0.25	15.2	4.0	0.10	1.40
M-115	21.2	54.2	579	0.94	0.015	0.27	0.10	0.25	11.7	4.0	0.10	1.40
M-1150	87.4	24	4,996	0.67	0.015	0.29	0.10	0.25	17.2	4.0	0.10	1.40
M-1160	26.3	54.8	1,968	0.46	0.015	0.20	0.10	0.25	13.2	4.0	0.10	1.40
M-120	30.2	46.8	13,496	1.68	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-1200	53.3	33	2,995	0.40	0.015	0.28	0.10	0.25	11.8	4.0	0.10	1.40
M-1210	8.1	89.6	313	0.17	0.015	0.35	0.10	0.25	11.2	4.0	0.10	1.40
M-1215	9.4	88.2	378	0.32	0.015	0.20	0.10	0.25	10.0	4.0	0.10	1.40
M-1220	76.6	46.9	5,112	0.46	0.015	0.20	0.10	0.25	12.3	4.0	0.10	1.40
M-1230	32.2	39.9	2,019	1.04	0.015	0.20	0.10	0.25	12.7	4.0	0.10	1.40
M-1240	66.7	35.9	3,315	0.51	0.015	0.20	0.11	0.25	11.6	4.0	0.10	1.40
M-125	32.2	48.3	17,247	3.32	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-1250	45.0	52.8	4,490	0.76	0.015	0.20	0.10	0.25	14.1	4.0	0.10	1.40
M-1260	20.9	46	1,698	0.65	0.015	0.22	0.10	0.25	14.2	4.0	0.10	1.40
M-130	25.1	44.5	8,250	0.93	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-1300	54.8	50.5	1,661	0.15	0.015	0.20	0.10	0.25	14.2	4.0	0.10	1.40
M-1400	189.0	50.2	9,529	0.49	0.016	0.25	0.14	0.25	11.2	4.0	0.10	1.40
M-1440	94.8	50.1	4,917	0.69	0.016	0.26	0.13	0.25	12.8	4.0	0.10	1.40
M-1450	29.2	64.8	2,127	0.50	0.015	0.20	0.10	0.25	13.6	4.0	0.10	1.40
M-1480	200.0	48.3	10,601	0.23	0.018	0.25	0.17	0.25	11.7	4.0	0.10	1.40
M-1500	17.0	64.4	924	0.35	0.015	0.25	0.10	0.25	15.5	4.0	0.10	1.40
M-1600	41.0	58.7	4,588	0.75	0.015	0.37	0.10	0.25	0.0	4.0	0.10	1.40
M-1700	19.1	75.4	1,118	0.33	0.015	0.30	0.10	0.25	10.2	4.0	0.10	1.40
M-1800	40.2	77.5	1,765	0.43	0.015	0.20	0.10	0.25	11.3	4.0	0.10	1.40
M-1850	16.8	59.7	1,505	0.61	0.015	0.30	0.10	0.25	20.7	4.0	0.10	1.40
M-1900	15.5	63.5	985	0.40	0.015	0.20	0.10	0.25	10.9	4.0	0.10	1.40
M-200	75.6	53.1	2,217	0.28	0.017	0.22	0.16	0.25	10.1	4.0	0.10	1.40
M-2000	75.0	53.3	2,762	0.32	0.015	0.20	0.10	0.25	13.8	4.0	0.10	1.40
M-2020	12.2	61.8	1,007	0.74	0.015	0.20	0.10	0.25	13.2	4.0	0.10	1.40
M-2040	10.4	59.3	1,358	0.74	0.015	0.20	0.10	0.25	12.3	4.0	0.10	1.40
M-2060	17.8	71.3	1,205	0.28	0.015	0.22	0.10	0.25	14.4	4.0	0.10	1.40
M-210	29.1	41.1	12,903	2.14	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-2100	22.9	58	1,185	0.36	0.015	0.20	0.10	0.25	15.0	4.0	0.10	1.40

HU	Area (Ac)	Impervious %	Width (ft)	Slope %	Impervious n -	Pervious n -	Impervious IA (in)	Pervious IA (in)	Non-DCIA % of Imp. Area	Max Inf Rate (in/hr)	Min Inf Rate (in/hr)	Soil Storage (in)
M-215	19.8	33.8	9,076	2.37	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-216	19.2	31.5	8,927	2.01	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-220	20.0	58.5	10,175	3.24	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-2200	13.6	57.9	827	0.47	0.015	0.20	0.10	0.25	15.2	4.0	0.10	1.40
M-2250	9.5	84.9	259	0.12	0.015	0.20	0.10	0.25	14.2	4.0	0.10	1.40
M-230	36.9	58.1	15,500	0.96	0.015	0.22	0.10	0.25	0.0	4.0	0.10	1.40
M-2350	22.1	71	1,203	0.26	0.015	0.20	0.10	0.25	15.1	4.0	0.10	1.40
M-2400	43.9	66	2,288	0.19	0.015	0.20	0.10	0.25	10.4	4.0	0.10	1.40
M-250	34.3	90.9	4,601	1.08	0.029	0.20	0.48	0.25	0.7	4.0	0.10	1.40
M-2500	19.3	62.4	1,357	0.52	0.015	0.20	0.10	0.25	13.4	4.0	0.10	1.40
M-2600	24.9	85.7	1,221	0.24	0.015	0.20	0.10	0.25	12.0	4.0	0.10	1.40
M-2650	22.4	51.4	1,571	0.49	0.015	0.20	0.10	0.25	13.9	4.0	0.10	1.40
M-2700	36.5	36.4	1,994	0.78	0.015	0.37	0.10	0.25	12.0	4.0	0.10	1.40
M-2800	63.9	54.9	2,559	0.30	0.017	0.22	0.14	0.25	9.0	4.0	0.10	1.40
M-2900	93.0	51.9	5,044	0.53	0.015	0.21	0.10	0.25	13.9	4.0	0.10	1.40
M-300	75.8	59.4	3,427	0.22	0.017	0.20	0.14	0.25	9.5	4.0	0.10	1.40
M-3000	11.8	64	914	0.51	0.015	0.20	0.10	0.25	14.3	4.0	0.10	1.40
M-310	19.5	42.8	9,918	2.45	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
M-3100	13.7	53.7	1,044	0.48	0.015	0.20	0.10	0.25	14.2	4.0	0.10	1.40
M-315	32.8	34.3	4,976	0.96	0.022	0.29	0.28	0.25	0.0	4.0	0.10	1.40
M-320	30.3	65.8	11,786	1.98	0.017	0.20	0.16	0.25	0.0	4.0	0.10	1.40
M-3200	34.7	67.5	1,507	0.30	0.015	0.20	0.10	0.25	15.1	4.0	0.10	1.40
M-330	15.8	64.7	12,670	5.02	0.015	0.24	0.10	0.25	0.0	4.0	0.10	1.40
M-335	13.3	73.5	1,766	1.02	0.021	0.20	0.27	0.25	0.0	4.0	0.10	1.40
M-340	2.5	64.7	1,938	1.08	0.015	0.23	0.10	0.25	0.0	4.0	0.10	1.40
M-3400	75.4	27.1	3,284	1.19	0.015	0.24	0.10	0.25	14.1	6.1	0.26	2.88
M-3410	102.1	27.3	8,891	1.00	0.015	0.30	0.10	0.25	21.7	9.0	0.50	5.00
M-3450	48.9	31.2	1,497	0.54	0.015	0.26	0.10	0.25	20.1	4.0	0.10	1.40
M-3500	25.9	47.5	1,503	0.41	0.015	0.20	0.10	0.25	14.3	4.0	0.10	1.40
M-3550	26.3	22.5	4,287	1.06	0.015	0.20	0.10	0.25	8.6	4.0	0.10	1.40
M-3600	22.9	61.5	1,661	0.33	0.019	0.20	0.22	0.25	10.0	4.0	0.10	1.40
M-3650	3.6	54.3	591	1.24	0.015	0.20	0.10	0.25	12.1	4.0	0.10	1.40
M-3700	27.3	31.1	2,474	0.73	0.019	0.39	0.20	0.25	11.0	4.0	0.10	1.40
M-3740	22.3	36.1	1,011	0.36	0.015	0.30	0.10	0.25	10.6	4.0	0.10	1.40
M-3780	17.2	58.3	1,301	0.38	0.017	0.20	0.15	0.25	8.8	4.0	0.10	1.40
M-3790	11.6	53.2	1,319	0.42	0.019	0.32	0.19	0.25	8.0	4.0	0.10	1.40
M-3800	20.2	58.1	1,352	0.71	0.015	0.20	0.10	0.25	12.9	4.0	0.10	1.40
M-3900	18.5	57.5	1,133	0.33	0.015	0.20	0.10	0.25	14.1	5.2	0.19	2.81
M-400	136.1	13.4	3,751	0.26	0.02	0.38	0.25	0.25	6.8	4.0	0.10	1.40
M-4000	28.7	46.7	1,239	0.20	0.015	0.23	0.10	0.25	13.8	4.0	0.10	1.40
M-410	13.9	61.2	9,920	2.75	0.016	0.33	0.13	0.25	0.0	4.0	0.10	1.40
M-4100	22.8	56.9	1,547	0.67	0.015	0.20	0.10	0.25	14.7	5.7	0.23	3.40
M-415	37.7	70	7,080	2.05	0.018	0.20	0.18	0.25	0.0	4.0	0.10	1.40
M-420	9.1	35.4	408	0.79	0.015	0.25	0.10	0.25	15.1	4.0	0.10	1.40
M-4200	41.7	44.1	2,486	0.48	0.015	0.22	0.10	0.25	13.8	4.0	0.10	1.40
M-4250	29.3	15.6	4,072	1.26	0.015	0.20	0.10	0.25	8.4	4.0	0.10	1.40
M-4300	52.5	36.7	1,126	0.17	0.015	0.29	0.11	0.25	17.2	4.0	0.10	1.40
M-4340	11.0	54.3	426	0.31	0.015	0.37	0.10	0.25	14.6	4.0	0.10	1.40
M-4380	27.3	44.2	1,245	0.20	0.015	0.26	0.10	0.25	10.4	4.0	0.10	1.40
M-4500	51.8	55.3	3,592	0.54	0.015	0.21	0.11	0.25	12.7	4.0	0.10	1.40
M-4530	33.6	59.1	2,164	0.41	0.015	0.20	0.10	0.25	13.1	4.0	0.10	1.40
M-4550	13.9	56.3	1,343	0.72	0.015	0.20	0.10	0.25	10.2	4.0	0.10	1.40
M-4580	8.5	61.5	640	0.67	0.015	0.20	0.10	0.25	11.1	4.0	0.10	1.40
M-4700	37.9	57.4	1,757	0.24	0.015	0.23	0.10	0.25	15.1	4.0	0.10	1.40
M-4900	32.0	58.1	1,579	0.40	0.015	0.21	0.10	0.25	11.6	4.0	0.10	1.40
M-4950	7.8	32.6	526	0.44	0.015	0.32	0.10	0.25	16.5	4.0	0.10	1.40
M-500	40.2	53.8	4,334	0.65	0.015	0.20	0.10	0.25	13.1	4.0	0.10	1.40
M-5000	54.2	56.4	2,394	0.24	0.015	0.20	0.10	0.25	14.2	4.0	0.10	1.40
M-5200	54.8	70.3	1,409	0.16	0.015	0.22	0.10	0.25	11.6	4.0	0.10	1.40
M-5300	18.2	77.3	629	0.16	0.015	0.20	0.10	0.25	10.0	4.0	0.10	1.40
M-5350	71.2	7.7	2,737	0.34	0.015	0.33	0.10	0.25	10.9	4.0	0.10	1.40

HU	Area (Ac)	Impervious %	Width (ft)	Slope %	Impervious n -	Pervious n -	Impervious IA (in)	Pervious IA (in)	Non-DCIA % of Imp. Area	Max Inf Rate (in/hr)	Min Inf Rate (in/hr)	Soil Storage (in)
M-5400	42.8	43.5	1,032	0.25	0.017	0.38	0.16	0.25	14.9	4.0	0.10	1.40
M-550	37.9	43.8	1,792	0.33	0.015	0.35	0.10	0.25	8.2	4.0	0.10	1.40
M-5500	17.1	54.7	1,158	0.63	0.015	0.20	0.10	0.25	13.1	4.0	0.10	1.40
M-5600	47.4	78.1	2,941	0.67	0.015	0.20	0.10	0.25	6.2	4.0	0.10	1.40
M-600	9.1	47.5	658	0.69	0.015	0.23	0.10	0.25	11.2	4.0	0.10	1.40
M-700	76.1	49.7	3,545	0.31	0.015	0.20	0.10	0.25	14.0	4.0	0.10	1.40
M-750	157.3	45.7	6,420	0.41	0.015	0.22	0.10	0.25	13.7	4.0	0.10	1.40
M-800	14.6	57.5	893	0.51	0.015	0.20	0.10	0.25	13.5	4.0	0.10	1.40
M-900	66.1	56.9	3,403	0.18	0.015	0.20	0.10	0.25	10.3	4.0	0.10	1.40
M-950	96.5	33.5	7,733	2.19	0.015	0.26	0.10	0.25	14.8	4.0	0.10	1.40
NPB-010	13.3	62.6	8,178	4.23	0.015	0.20	0.10	0.25	0.0	4.0	0.10	1.40
NPB-020	22.0	37.9	3,309	3.40	0.015	0.20	0.10	0.25	9.4	4.0	0.10	1.40
NPB-100	115.4	36.5	2,992	0.16	0.017	0.39	0.15	0.25	11.3	4.0	0.10	1.40
NPB-300	59.5	67.5	1,744	0.20	0.015	0.20	0.10	0.25	9.4	4.0	0.10	1.40
NPB-400	113.9	52.5	4,170	0.30	0.015	0.20	0.10	0.25	9.4	4.0	0.10	1.40
NPB-450	177.2	55.9	5,741	0.27	0.015	0.20	0.10	0.25	9.5	4.0	0.10	1.40
NPB-600	44.1	2.3	1,522	0.19	0.015	0.34	0.10	0.25	13.7	4.0	0.10	1.40
NPB-700	152.9	18.1	7,991	0.60	0.015	0.20	0.10	0.25	9.2	4.0	0.10	1.40
NPB-800	89.3	16.6	6,407	0.83	0.015	0.20	0.10	0.25	8.6	4.0	0.10	1.40
NPB-900	65.8	32.7	2,337	10.00	0.015	0.20	0.10	0.25	6.8	4.0	0.10	1.40
OD-100	50.2	32.2	38,081	23.95	0.015	0.20	0.10	0.25	6.1	4.0	0.10	1.40
RPNA	784.8	43	6,214	0.04	0.026	0.39	0.40	0.25	100.0	4.0	0.10	1.40
SB-100	26.2	71.5	3,199	2.00	0.015	0.25	0.10	0.25	6.9	4.0	0.10	1.40
SB-200	28.0	67.7	4,801	2.91	0.015	0.26	0.10	0.25	7.6	4.0	0.10	1.40
SB-300	18.1	63.4	1,462	2.40	0.015	0.24	0.10	0.25	5.9	4.2	0.11	1.60
SB-400	12.8	75.1	4,327	5.26	0.015	0.24	0.10	0.25	6.7	4.2	0.12	1.66
LWS100	94.8	19.4	2,065	0.40	0.015	0.30	0.10	0.25	22.2	4.3	0.12	1.60
LWS200	92.0	77.9	13,354	0.67	0.015	0.20	0.10	0.25	8.0	4.0	0.10	1.40
LWS300	220.6	59.2	16,018	0.60	0.015	0.25	0.11	0.25	13.2	4.0	0.10	1.40
LWS400	39.9	75.2	5,794	1.00	0.015	0.21	0.10	0.25	10.1	4.4	0.13	1.70
LWS500	57.3	53.7	8,314	1.00	0.021	0.29	0.26	0.25	7.3	4.0	0.10	1.41
UPM-1	4541.0	18.7	13,000	0.10	0.015	0.25	0.10	0.25	65.0	4.0	0.10	1.40
LOWM-1	3912.0	11.5	21,000	0.10	0.015	0.25	0.10	0.25	65.0	4.0	0.10	1.40

HU	Hydrologic Soil Group			
	A	B	C	D
C51-100	0	0	0	100
C51-200	0	0	0	100
C51-300	0	0	0	100
C51-400	0	0	0	100
C51-500	0	0	0	100
LW-100	78	0	0	22
LW-200	60	0	2	38
LW-300	56	0	31	13
LW-400	56	0	10	34
LW-450	20	0	0	80
LW-50	0	0	0	100
LW-500	0	0	0	100
LW-600	0	0	37	63
LW-650	0	0	35	64
LW-700	1	0	16	83
LW-75	0	0	0	100
LW-800	57	0	15	28
LWS100	0	4	2	94
LWS200	0	0	0	100
LWS300	0	0	0	100
LWS400	0	8	0	92
LWS500	0	0	0	100
M-010	0	0	0	100
M-020	0	0	7	93
M-030	0	0	0	100
M-040	0	0	0	100
M-050	0	0	0	100
M-060	0	0	0	100
M-070	0	0	0	100
M-080	0	0	0	100
M-100	0	0	0	100
M-110	0	0	0	100
M-1100	0	0	0	100
M-1120	0	0	0	100
M-115	0	0	0	100
M-1150	0	0	0	100
M-1160	0	0	0	100
M-120	0	0	0	100
M-1200	0	0	0	100
M-1210	0	0	0	100
M-1215	0	0	0	100
M-1220	0	0	0	100
M-1230	0	0	0	100
M-1240	0	0	0	100
M-125	0	0	0	100

HU	Hydrologic Soil Group			
	A	B	C	D
M-1250	0	0	0	100
M-1260	0	0	0	100
M-130	0	0	0	100
M-1300	0	0	0	100
M-1400	0	0	0	100
M-1440	0	0	0	100
M-1450	0	0	0	100
M-1480	0	0	0	100
M-1500	0	0	0	100
M-1600	0	0	0	100
M-1700	0	0	0	100
M-1800	0	0	0	100
M-1850	0	0	0	100
M-1900	0	0	0	100
M-200	0	0	0	100
M-2000	0	0	0	100
M-2020	0	0	0	100
M-2040	0	0	0	100
M-2060	0	0	0	100
M-210	0	0	0	100
M-2100	0	0	0	100
M-215	0	0	0	100
M-216	0	0	0	100
M-220	0	0	0	100
M-2200	0	0	0	100
M-2250	0	0	0	100
M-230	0	0	0	100
M-2350	0	0	0	100
M-2400	0	0	0	100
M-250	0	0	0	100
M-2500	0	0	0	100
M-2600	0	0	0	100
M-2650	0	0	0	100
M-2700	0	0	0	100
M-2800	0	0	0	100
M-2900	0	0	0	100
M-300	0	0	0	100
M-3000	0	0	0	100
M-310	0	0	0	100
M-3100	0	0	0	100
M-315	0	0	0	100
M-320	0	0	0	100
M-3200	0	0	0	100
M-330	0	0	0	100
M-335	0	0	0	100

HU	Hydrologic Soil Group			
	A	B	C	D
M-340	0	0	0	99
M-3400	0	41	0	59
M-3410	0	100	0	0
M-3450	0	0	0	100
M-3500	0	0	0	100
M-3550	0	0	0	100
M-3600	0	0	0	100
M-3650	0	0	0	100
M-3700	0	0	0	100
M-3740	0	0	0	100
M-3780	0	0	0	100
M-3790	0	0	0	100
M-3800	0	0	0	100
M-3900	0	0	59	41
M-400	0	0	0	100
M-4000	0	0	0	100
M-410	0	0	0	100
M-4100	0	0	83	17
M-415	0	0	0	100
M-420	0	0	0	100
M-4200	0	0	0	100
M-4250	0	0	0	100
M-4300	0	0	0	100
M-4340	0	0	0	100
M-4380	0	0	0	100
M-4500	0	0	0	100
M-4530	0	0	0	100
M-4550	0	0	0	100
M-4580	0	0	0	100
M-4700	0	0	0	100
M-4900	0	0	0	100
M-4950	0	0	0	100
M-500	0	0	0	100
M-5000	0	0	0	100
M-5200	0	0	0	100
M-5300	0	0	0	100
M-5350	0	0	0	100
M-5400	0	0	0	100
M-550	0	0	0	100
M-5500	0	0	0	100
M-5600	0	0	0	100
M-600	0	0	0	100
M-700	0	0	0	100
M-750	0	0	0	100
M-800	0	0	0	100

HU	Hydrologic Soil Group			
	A	B	C	D
M-900	0	0	0	100
M-950	0	0	0	100
NPB-010	0	0	0	100
NPB-020	0	0	0	100
NPB-100	0	0	0	100
NPB-300	0	0	0	100
NPB-400	0	0	0	100
NPB-450	0	0	0	100
NPB-600	0	0	0	100
NPB-700	0	0	0	100
NPB-800	0	0	0	100
NPB-900	0	0	0	100
OD-100	0	0	0	100
RPNA	0	0	0	100
SB-100	0	0	0	100
SB-200	0	0	0	100
SB-300	0	0	8	92
SB-400	0	0	11	89

APPENDIX B

HYDRAULIC PARAMETERS

Node	Type -	Invert (ft-NAVD)	Max Depth (ft)	Initial Depth (ft)	Initial Elevation (ft-NAVD)
ITID_LowM1	Storage	0.0	25.0	13.6	13.6
ITID_UpM1	Storage	0.0	25.0	14.6	14.6
LW0050	Junction	0.0	20.0	9.5	9.5
LW0100	Junction	0.0	20.0	7.1	7.1
LW0150	Storage	0.0	20.0	7.1	7.1
LW0200	Junction	0.0	20.0	7.1	7.1
LW0300	Junction	0.0	20.0	7.1	7.1
LW0350	Storage	0.0	20.0	7.1	7.1
LW0370	Junction	0.0	20.0	7.1	7.1
LW0380	Junction	0.0	20.0	7.1	7.1
LW0400	Junction	0.0	20.0	7.1	7.1
LW2970	Junction	0.0	20.0	7.1	7.1
LW2975	Junction	0.0	20.0	7.1	7.1
LW450	Junction	0.0	20.0	9.5	9.5
LW450S	Storage	0.0	20.0	10.6	10.6
LW451	Junction	0.0	20.0	9.5	9.5
LW500S	Storage	0.0	20.0	10.5	10.5
LW501	Junction	0.0	20.0	9.5	9.5
LW505	Junction	0.0	20.0	9.5	9.5
LW510	Junction	0.0	20.0	9.5	9.5
LW8900	Storage	0.0	20.0	9.5	9.5
LW9000	Junction	0.0	20.0	9.5	9.5
LW9100	Storage	0.0	20.0	9.5	9.5
LW9200	Junction	0.0	20.0	9.5	9.5
LW9210	Junction	0.0	20.0	9.5	9.5
LW9215	Junction	0.0	20.0	9.5	9.5
LW9220	Junction	0.0	20.0	7.1	7.1
LW9225	Storage	0.0	20.0	10.6	10.6
LW9226	Junction	0.0	20.0	7.1	7.1
LW9240	Storage	0.0	20.0	7.1	7.1
LW9250	Junction	0.0	20.0	7.1	7.1
LW9300	Junction	0.0	20.0	7.1	7.1
LW9400	Junction	0.0	20.0	7.1	7.1
LW9500	Junction	0.0	20.0	7.1	7.1
LW9600	Junction	0.0	20.0	7.1	7.1
LW9650	Junction	0.0	20.0	7.1	7.1
LW9700	Storage	0.0	20.0	10.9	10.9
LW9750	Junction	0.0	20.0	9.5	9.5
LW9800	Junction	0.0	20.0	9.5	9.5
LW9900	Junction	0.0	20.0	9.5	9.5
LW9901	Junction	0.0	20.0	9.5	9.5
LWS100S	Storage	0.0	20.0	11.6	11.6
LWS110	Junction	0.0	20.0	11.6	11.6
LWS200S	Storage	0.0	20.0	11.6	11.6

Node	Type -	Invert (ft-NAVD)	Max Depth (ft)	Initial Depth (ft)	Initial Elevation (ft-NAVD)
LWS300S	Storage	0.0	20.0	11.6	11.6
LWS310	Junction	0.0	20.0	11.6	11.6
LWS320	Junction	0.0	20.0	11.6	11.6
LWS330	Junction	0.0	20.0	11.6	11.6
LWS340	Junction	0.0	20.0	11.6	11.6
LWS350	Junction	0.0	20.0	11.6	11.6
LWS400S	Storage	0.0	20.0	11.1	11.1
LWS410	Junction	0.0	20.0	11.1	11.1
LWS500S	Storage	0.0	20.0	14.6	14.6
LWS520	Junction	0.0	20.0	14.6	14.6
OD100	Storage	0.0	20.0	15.1	15.1
OD110	Junction	0.0	20.0	15.1	15.1
RP1000	Storage	0.0	20.0	12.1	12.1
RP1050	Junction	-0.8	20.0	12.9	12.1
RP1100	Junction	-1.0	20.0	13.1	12.1
RP1120S	Storage	0.0	20.0	12.1	12.1
RP1160S	Storage	0.0	20.0	12.1	12.1
RP1200	Junction	-1.1	20.0	13.2	12.1
RP1200S	Storage	0.0	20.0	12.1	12.1
RP1210S	Storage	0.0	20.0	12.1	12.1
RP1211S	Junction	0.0	20.0	12.1	12.1
RP1215S	Storage	0.0	20.0	12.1	12.1
RP1220S	Storage	0.0	20.0	12.1	12.1
RP1230S	Storage	0.0	20.0	12.1	12.1
RP1240S	Storage	0.0	20.0	12.1	12.1
RP1250S	Storage	0.0	20.0	12.1	12.1
RP1260S	Storage	0.0	20.0	12.1	12.1
RP1300	Junction	-1.3	20.0	13.4	12.1
RP1300S	Storage	0.0	20.0	12.1	12.1
RP1400	Junction	-1.4	20.0	13.5	12.1
RP1400S	Storage	0.0	20.0	12.6	12.6
RP1440S	Storage	0.0	20.0	12.6	12.6
RP1441	Junction	0.0	20.0	12.1	12.1
RP1480S	Storage	0.0	20.0	12.6	12.6
RP1481	Junction	0.0	20.0	12.1	12.1
RP150	Storage	0.0	20.0	12.1	12.1
RP1500	Junction	-1.5	20.0	13.6	12.1
RP1500S	Storage	0.0	20.0	12.1	12.1
RP155	Junction	0.0	20.0	12.1	12.1
RP1600	Junction	-1.6	20.0	13.7	12.1
RP1650	Storage	-1.7	20.0	13.8	12.1
RP1700	Junction	-1.8	20.0	13.9	12.1
RP1700S	Storage	0.0	20.0	12.1	12.1
RP1800	Junction	0.0	20.0	12.1	12.1

Node	Type	Invert	Max Depth	Initial Depth	Initial Elevation
	-	(ft-NAVD)	(ft)	(ft)	(ft-NAVD)
RP1800S	Storage	0.0	20.0	12.1	12.1
RP1900	Storage	0.0	20.0	12.1	12.1
RP1900S	Storage	0.0	20.0	12.1	12.1
RP1925	Junction	0.0	20.0	12.1	12.1
RP200	Junction	0.0	20.0	12.1	12.1
RP2000	Junction	0.0	20.0	12.1	12.1
RP2000S	Storage	0.0	20.0	12.1	12.1
RP2020S	Storage	0.0	20.0	12.1	12.1
RP2040S	Storage	0.0	20.0	12.1	12.1
RP2060S	Storage	0.0	20.0	12.1	12.1
RP2100S	Storage	0.0	20.0	12.1	12.1
RP2200S	Storage	0.0	20.0	12.1	12.1
RP2250S	Storage	0.0	20.0	12.1	12.1
RP230	Junction	0.0	20.0	12.1	12.1
RP235	Storage	0.0	20.0	12.1	12.1
RP2350S	Storage	0.0	20.0	12.1	12.1
RP240	Junction	0.0	20.0	12.1	12.1
RP2400	Junction	-3.5	25.0	10.5	7.1
RP2400S	Storage	0.0	20.0	12.1	12.1
RP250	Storage	0.0	20.0	12.1	12.1
RP2500	Junction	-0.7	20.0	7.7	7.1
RP2500S	Storage	0.0	20.0	12.1	12.1
RP255	Junction	0.0	20.0	12.1	12.1
RP260	Junction	0.0	20.0	12.1	12.1
RP2600S	Storage	0.0	20.0	12.1	12.1
RP2650S	Storage	0.0	20.0	12.1	12.1
RP270	Junction	0.0	20.0	12.1	12.1
RP2700	Storage	0.0	20.0	12.1	12.1
RP2700S	Storage	0.0	20.0	12.1	12.1
RP2800S	Storage	0.0	20.0	11.9	11.9
RP2805	Junction	0.0	20.0	12.1	12.1
RP2900	Storage	0.0	20.0	12.1	12.1
RP2900S	Storage	0.0	20.0	12.1	12.1
RP3000	Junction	0.0	20.0	12.1	12.1
RP3000S	Storage	0.0	20.0	12.1	12.1
RP3002	Junction	0.0	20.0	12.1	12.1
RP3005	Storage	0.0	20.0	12.1	12.1
RP3010	Junction	0.0	20.0	12.1	12.1
RP3100	Junction	0.0	20.0	12.1	12.1
RP3100S	Storage	0.0	20.0	12.1	12.1
RP3200	Storage	0.0	20.0	12.1	12.1
RP3200S	Storage	0.0	20.0	12.1	12.1
RP3202	Junction	0.0	20.0	12.1	12.1
RP3205	Junction	0.0	20.0	12.1	12.1

Node	Type -	Invert (ft-NAVD)	Max Depth (ft)	Initial Depth (ft)	Initial Elevation (ft-NAVD)
RP3210	Junction	0.0	20.0	12.1	12.1
RP325	Junction	0.0	20.0	12.1	12.1
RP3300	Junction	0.0	20.0	12.1	12.1
RP330S	Storage	0.0	20.0	12.1	12.1
RP3350	Junction	0.0	20.0	12.1	12.1
RP335S	Storage	0.0	20.0	12.1	12.1
RP338	Junction	0.0	20.0	12.1	12.1
RP3400	Storage	0.0	20.0	12.1	12.1
RP3400S	Storage	0.0	20.0	12.1	12.1
RP340S	Storage	0.0	20.0	12.1	12.1
RP3450	Junction	0.0	20.0	12.1	12.1
RP3450S	Storage	0.0	20.0	12.1	12.1
RP3500	Storage	0.0	20.0	12.1	12.1
RP3500S	Storage	0.0	20.0	12.1	12.1
RP3550	Storage	0.0	20.0	12.1	12.1
RP3550S	Storage	0.0	20.0	12.1	12.1
RP3600	Storage	0.0	20.0	12.1	12.1
RP3600S	Storage	0.0	20.0	12.1	12.1
RP3650S	Storage	0.0	20.0	12.1	12.1
RP3700	Storage	0.0	20.0	12.1	12.1
RP3700S	Storage	0.0	20.0	12.1	12.1
RP3740S	Storage	0.0	20.0	12.1	12.1
RP3780S	Storage	0.0	20.0	12.1	12.1
RP3790S	Storage	0.0	20.0	12.1	12.1
RP3800S	Storage	0.0	20.0	12.1	12.1
RP3900	Junction	0.0	20.0	12.1	12.1
RP400	Junction	0.0	20.0	12.1	12.1
RP4000	Junction	0.0	20.0	12.1	12.1
RP4000S	Storage	0.0	20.0	12.1	12.1
RP4100	Junction	0.0	20.0	12.1	12.1
RP4100S	Storage	0.0	20.0	12.1	12.1
RP4200	Junction	0.0	20.0	12.1	12.1
RP4200S	Storage	0.0	20.0	12.1	12.1
RP4250S	Storage	0.0	20.0	12.1	12.1
RP4300	Junction	-2.4	20.0	14.5	12.1
RP4300S	Storage	0.0	20.0	12.1	12.1
RP4340S	Storage	0.0	20.0	12.1	12.1
RP4380S	Storage	0.0	20.0	12.1	12.1
RP4400	Junction	0.0	20.0	12.1	12.1
RP4500	Junction	0.0	20.0	12.1	12.1
RP4500S	Storage	0.0	20.0	12.1	12.1
RP4530S	Storage	0.0	20.0	12.1	12.1
RP4550	Storage	0.0	20.0	12.1	12.1
RP4550S	Storage	0.0	20.0	12.1	12.1

Node	Type -	Invert (ft-NAVD)	Max Depth (ft)	Initial Depth (ft)	Initial Elevation (ft-NAVD)
RP4580S	Storage	0.0	20.0	12.1	12.1
RP4600	Junction	0.0	20.0	12.1	12.1
RP4700	Storage	0.0	20.0	12.1	12.1
RP4700S	Storage	0.0	20.0	12.1	12.1
RP4800	Junction	0.0	20.0	12.1	12.1
RP4900	Junction	0.0	20.0	12.1	12.1
RP4950	Junction	0.0	20.0	12.1	12.1
RP4950S	Storage	0.0	20.0	12.1	12.1
RP4970	Storage	0.0	20.0	12.1	12.1
RP500	Junction	0.0	20.0	12.1	12.1
RP5000	Storage	0.0	20.0	12.1	12.1
RP5000S	Storage	0.0	20.0	12.1	12.1
RP500S	Storage	0.0	20.0	12.1	12.1
RP5200S	Storage	0.0	20.0	12.1	12.1
RP5300	Storage	0.0	20.0	9.8	9.8
RP5301	Junction	0.0	20.0	12.1	12.1
RP5350S	Storage	0.0	20.0	12.1	12.1
RP5400	Storage	0.0	20.0	12.1	12.1
RP5400S	Storage	0.0	20.0	12.1	12.1
RP5500	Storage	0.0	20.0	12.1	12.1
RP5500S	Storage	0.0	20.0	12.1	12.1
RP5510	Storage	0.0	20.0	12.1	12.1
RP5515	Junction	0.0	20.0	12.1	12.1
RP5520	Storage	0.0	20.0	12.1	12.1
RP5525	Storage	0.0	20.0	12.1	12.1
RP5526	Storage	0.0	20.0	12.1	12.1
RP5527	Junction	0.0	20.0	12.1	12.1
RP5600	Junction	0.0	20.0	12.1	12.1
RP5700	Storage	0.0	20.0	12.1	12.1
RP5725	Junction	0.0	20.0	12.1	12.1
RP5750	Junction	0.0	20.0	12.1	12.1
RP5775	Junction	0.0	20.0	12.1	12.1
RP5800	Junction	0.0	20.0	12.1	12.1
RP5900	Junction	0.0	20.0	12.1	12.1
RP600	Junction	0.0	20.0	12.1	12.1
RP6000	Storage	0.0	20.0	12.1	12.1
RP600S	Storage	0.0	20.0	12.1	12.1
RP6200	Junction	0.0	20.0	12.1	12.1
RP6250	Junction	0.0	20.0	12.1	12.1
RP6300	Junction	0.0	20.0	12.1	12.1
RP6400	Junction	0.0	20.0	12.1	12.1
RP6500	Junction	0.0	20.0	12.1	12.1
RP6550	Junction	0.0	20.0	12.1	12.1
RP6600	Junction	0.0	20.0	12.1	12.1

Node	Type -	Invert (ft-NAVD)	Max Depth (ft)	Initial Depth (ft)	Initial Elevation (ft-NAVD)
RP6700	Junction	0.0	20.0	12.1	12.1
RP6800	Junction	0.0	20.0	12.1	12.1
RP6900	Storage	0.0	20.0	12.1	12.1
RP700	Junction	0.0	20.0	12.1	12.1
RP7000	Storage	0.0	20.0	12.1	12.1
RP700S	Storage	0.0	20.0	12.1	12.1
RP7100	Junction	0.0	20.0	12.1	12.1
RP7200	Junction	0.0	20.0	12.1	12.1
RP7250	Junction	0.0	20.0	12.1	12.1
RP7300	Junction	0.0	20.0	12.1	12.1
RP7350	Junction	0.0	20.0	12.1	12.1
RP7355	Storage	0.0	20.0	12.1	12.1
RP7400	Junction	0.0	20.0	12.1	12.1
RP7500	Junction	0.0	20.0	12.1	12.1
RP750S	Storage	0.0	20.0	12.1	12.1
RP7600	Junction	0.0	20.0	11.9	11.9
RP7700	Junction	0.0	20.0	11.9	11.9
RP7750	Junction	0.0	20.0	11.9	11.9
RP7800	Storage	0.0	20.0	11.6	11.6
RP7825	Junction	0.0	20.0	11.9	11.9
RP7850	Junction	0.0	20.0	11.9	11.9
RP7900	Junction	0.0	20.0	11.9	11.9
RP800	Junction	0.0	20.0	12.1	12.1
RP8000	Junction	0.0	20.0	11.9	11.9
RP800S	Storage	0.0	20.0	12.1	12.1
RP8010	Junction	0.0	20.0	7.1	7.1
RP8025	Storage	0.0	20.0	11.9	11.9
RP8030	Junction	0.0	20.0	11.9	11.9
RP8050	Junction	-0.4	20.0	12.3	11.9
RP8100	Junction	-1.0	20.0	12.9	11.9
RP825	Junction	-0.1	20.0	12.2	12.1
RP8404	Junction	0.0	20.0	12.1	12.1
RP8406	Junction	0.0	20.0	12.1	12.1
RP8408	Junction	0.0	20.0	12.1	12.1
RP8410	Storage	0.0	20.0	12.1	12.1
RP8415	Junction	0.0	20.0	12.1	12.1
RP8420	Junction	0.0	20.0	12.1	12.1
RP850	Junction	-0.2	20.0	12.3	12.1
RP900	Junction	-0.5	20.0	12.6	12.1
RPC51100	Storage	0.0	20.0	12.1	12.1
RPC51200	Storage	0.0	20.0	12.1	12.1
RPC51400	Storage	0.0	20.0	12.1	12.1
RPC51500	Storage	0.0	20.0	12.1	12.1
RPN100	Storage	0.0	20.0	10.2	10.2

Node	Type	Invert	Max Depth	Initial Depth	Initial Elevation
	-	(ft-NAVD)	(ft)	(ft)	(ft-NAVD)
RPN110	Junction	0.0	20.0	11.9	11.9
RPN450	Storage	0.0	20.0	11.9	11.9
RPN600	Storage	0.0	20.0	12.1	12.1
RPN650	Junction	0.0	20.0	11.9	11.9
RPN660	Junction	0.0	20.0	15.1	15.1
RPN700	Storage	0.0	20.0	15.1	15.1
RPN800	Storage	0.0	20.0	15.1	15.1
RPN900	Storage	0.0	20.0	15.1	15.1
RPNA-100	Storage	0.0	20.0	12.1	12.1
SyphonDS	Junction	0.0	30.0	13.6	13.6
SyphonUS	Junction	0.0	30.0	13.6	13.6

Link	US Node	DS Node	Length	Roughness	US Invert	DS Invert	Type	Depth	Width	Left Slope	Right Slope	Barrels	Coefficient
	-	-	(ft)	-	(ft-NAVD)	(ft-NAVD)	-	(ft)	(ft)	-	-	(Count)	-
ITIDM1	SyphonDS	ITID_LowM1	11,000	0.040	7.00	5.00	IRREGULAR					1	
LW0050	LW0050	LW0100	254	0.013	7.08	5.58	CIRCULAR	5				1	
LW0100	LW0100	LW0200	910	0.000	5.50	2.55	IRREGULAR					1	
LW0150	LW0150	LW0300	146	0.013	7.05	2.05	CIRCULAR	6				1	
LW0150_OF	LW0150	LW0200	50	0.030	15.80	15.70	TRAPEZOIDAL	3	400	10	10	1	
LW0200	LW0200	LW0370	350	0.000	2.55	3.72	IRREGULAR					1	
LW0201	LW0200	LW0300	105	0.013	6.41	6.40	CIRCULAR	5				1	
LW0350_OF	LW0350	LW0300	400	0.040	14.00	13.90	TRAPEZOIDAL	5	200	10	10	1	
LW0370	LW0370	LW0380	97	0.013	3.72	3.77	CIRCULAR	5				2	
LW037R	LW0370	LW0380	97	0.030	16.10	16.00	TRAPEZOIDAL	4	150	10	10	1	
LW0380	LW0380	LW0400	505	0.000	3.77	3.38	IRREGULAR					1	
LW0400	LW0400	C51D	210	0.013	3.38	3.02	CIRCULAR	5				2	
LW2970	LW2970	LW2975	72	0.013	5.03	5.02	CIRCULAR	6				1	
LW2970_OF	LW2970	LW2975	50	0.030	14.80	14.70	IRREGULAR					1	
LW2975	LW2975	LW9300	232	0.010	5.35	5.34	IRREGULAR					1	
LW450	LW450	LW9210	2,515	0.030	5.00	5.10	IRREGULAR					1	
LW450S_OF	LW450S	LW9900	50	0.030	15.70	15.60	IRREGULAR					1	
LW451	LW451	LW450	71	0.013	8.24	8.11	CIRCULAR	4				1	
LW500S_OF	LW500S	LW450S	50	0.030	15.80	15.70	IRREGULAR					1	
LW500S_OF2	LW500S	LW505	50	0.030	15.00	14.90	IRREGULAR					1	
LW501	LW501	LW505	45	0.013	9.55	9.52	CIRCULAR	1.5				2	
LW505	LW505	LW450	2,986	0.030	5.10	5.00	IRREGULAR					1	
LW505_OF	LW505	RP8050	50	0.030	14.50	14.40	IRREGULAR					1	
LW510	LW510	LW505	1,920	0.030	5.00	5.10	IRREGULAR					1	
LW8900	LW8900	LW9000	48	0.023	6.52	6.11	CIRCULAR	5				1	
LW8900_OF	LW8900	LW9000	48	0.040	16.70	16.60	IRREGULAR					1	
LW9000	LW9000	LW9100	414	0.000	6.11	5.21	IRREGULAR					1	
LW9100	LW9100	LW9200	167	0.013	5.21	4.92	CIRCULAR	6				1	
LW9100_OF	LW9100	LW9200	164	0.040	17.00	16.90	IRREGULAR					1	
LW9200	LW9200	LW9215	286	0.010	4.92	5.36	IRREGULAR					1	
LW9210	LW9210	LW9215	246	0.013	10.54	9.55	CIRCULAR	5				1	
LW9220	LW9220	LW9250	72	0.013	5.05	5.04	CIRCULAR	6				1	
LW9220_OF	LW9220	LW9250	72	0.040	15.70	15.60	IRREGULAR					1	
LW9225	LW9226	LW9240	55	0.013	7.40	7.22	CIRCULAR	2				1	
LW9225_OF	LW9225	LW9250	50	0.030	15.20	15.10	IRREGULAR					1	
LW9240	LW9240	LW9250	1,345	0.013	8.55	4.85	CIRCULAR	4				1	
LW9240_OF	LW9240	LW9225	50	0.030	13.90	13.80	IRREGULAR					1	
LW9250	LW9250	LW2970	490	0.010	5.35	5.34	IRREGULAR					1	
LW9300	LW9300	LW9400	142	0.013	5.34	5.33	CIRCULAR	6				1	
LW9300_OF	LW9300	LW9400	141	0.040	16.64	16.44	IRREGULAR					1	
LW9400	LW9400	LW9500	578	0.000	4.55	3.95	IRREGULAR					1	
LW9500	LW9500	LW9600	89	0.013	4.00	4.58	CIRCULAR	6				1	
LW9500_OF	LW9500	LW9600	87	0.040	16.00	15.90	IRREGULAR					1	
LW9600	LW9600	LW9650	496	0.000	4.55	3.50	IRREGULAR					1	
LW9650	LW9650	LW0100	71	0.013	4.58	4.00	CIRCULAR	6				1	
LW9650_OF	LW9650	LW0100	50	0.030	15.40	15.30	IRREGULAR					1	
LW970_OF	LW9700	LW9800	79	0.040	15.70	15.60	IRREGULAR					1	
LW9750	LW9750	LW9800	79	0.023	7.59	7.64	CIRCULAR	2				1	
LW9800	LW9800	LW9900	1,650	0.000	7.64	7.08	IRREGULAR					1	
LW9901	LW9901	LW9900	48	0.013	9.00	8.66	CIRCULAR	2				1	
LWS100S	LWS100S	LWS110	1,090	0.010	8.40	8.50	IRREGULAR					1	
LWS110	LWS110	LWS350	40	0.015	8.50	8.40	CIRCULAR	6				1	
LWS200S	LWS200S	LWS300S	1,095	0.013	3.85	4.81	CIRCULAR	4				1	
LWS200S_OF	LWS200S	LWS350	50	0.010	16.50	16.40	IRREGULAR					1	
LWS300S_OF	LWS300S	LWS340	50	0.010	16.20	16.10	IRREGULAR					1	
LWS310	LWS310	LWS340	25	0.018	8.59	8.53	CIRCULAR	3.25				2	
LWS320	LWS320	C51G	360	0.010	8.00	7.90	IRREGULAR					1	
LWS330	LWS330	LWS320	94	0.013	8.10	8.00	CIRCULAR	6				1	
LWS330_OF	LWS330	LWS320	50	0.010	15.80	15.70	IRREGULAR					1	
LWS340	LWS340	LWS330	825	0.010	8.00	8.10	IRREGULAR					1	
LWS350	LWS350	LWS340	2,680	0.010	8.40	8.00	IRREGULAR					1	
LWS400S_OF	LWS400S	LWS320	50	0.010	16.70	16.60	IRREGULAR					1	
LWS410	LWS410	C51F	120	0.013	11.10	10.86	CIRCULAR	1.5				1	
LWS500S	LWS500S	LWS520	2,240	0.010	5.00	4.90	IRREGULAR					1	
OD110	OD110	OD100	6,600	0.030	14.80	18.00	IRREGULAR					1	
R1101_OF	RP1100	RP1200	98	0.040	17.70	17.60	IRREGULAR					1	
R1401R	RP1400	RP1500	60	0.040	18.50	18.40	TRAPEZOIDAL	5	200	10	10	1	
RP020R	LW0200	LW0300	105	0.040	15.85	15.75	TRAPEZOIDAL	4	150	10	10	1	
RP0350	LW0350	LW0300	123	0.013	2.03	2.05	CIRCULAR	6				1	
RP0372	LW0370	LW0380	81	0.013	3.90	3.77	CIRCULAR	5				1	
RP1000	RP1000	RP1050	1,000	0.030	4.00	3.00	IRREGULAR					1	
RP1050	RP1050	RP1100	1,600	0.000	-0.80	-1.00	IRREGULAR					1	
RP1100	RP1100	RP1200	100	0.010	-1.00	-1.10	IRREGULAR					1	
RP1120S_OF	RP1120S	RP5526	50	0.030	16.60	16.50	IRREGULAR					1	
RP1120S1	RP1120S	RP5526	230	0.013	11.01	10.50	CIRCULAR	2				2	
RP1120S2	RP1120S	RP5527	700	0.013	9.69	9.45	CIRCULAR	3				1	

Link	US Node	DS Node	Length	Roughness	US Invert	DS Invert	Type	Depth	Width	Left Slope	Right Slope	Barrels	Coefficient
	-	-	(ft)	-	(ft-NAVD)	(ft-NAVD)	-	(ft)	(ft)	-	-	(Count)	-
RP1160S_OF1	RP1160S	RP1250S	50	0.030	15.80	15.70	IRREGULAR					1	
RP1160S_OF2	RP1160S	RP1260S	50	0.030	15.40	15.30	IRREGULAR					1	
RP1160S1	RP1160S	RP5520	150	0.018	11.15	11.51	CIRCULAR	2				2	
RP1160S2	RP1160S	RP4700	192	0.013	11.15	10.78	CIRCULAR	2.5				1	
RP1160S3	RP1160S	RP5515	200	0.016	10.90	10.30	CIRCULAR	2				4	
RP1200	RP1200	RP1300	1,900	0.000	-1.00	-1.30	IRREGULAR					1	
RP1200S_OF	RP1200S	RP5800	50	0.030	15.80	15.70	IRREGULAR					1	
RP1200S1	RP1200S	RP5800	200	0.014	8.22	7.87	CIRCULAR	2.75				4	
RP1210S_OF	RP1210S	RP1200S	50	0.030	18.20	18.10	IRREGULAR					1	
RP1210S1	RP1210S	RP1211S	255	0.013	8.75	8.45	CIRCULAR	2.5				1	
RP1211S	RP1211S	RP1200S	112	0.013	7.45	7.25	CIRCULAR	3.5				1	
RP1215S	RP1215S	RP1210S	2,343	0.013	8.85	8.05	CIRCULAR	3.5				1	
RP1215S_OF	RP1215S	RP1800S	50	0.030	17.70	17.60	IRREGULAR					1	
RP1220S_OF	RP1220S	RP5700	50	0.030	15.60	15.50	IRREGULAR					1	
RP1220S1	RP1220S	RP5700	185	0.013	8.42	7.96	CIRCULAR	2				1	
RP1220S2	RP1220S	RP4700	190	0.013	7.66	7.10	CIRCULAR	2.5				2	
RP1220S3	RP1220S	RP5800	185	0.013	7.83	7.20	CIRCULAR	2				1	
RP1220S4	RP1220S	RP5750	185	0.013	10.47	9.55	CIRCULAR	3				1	
RP1230S_OF	RP1230S	RP5700	50	0.030	16.30	16.20	IRREGULAR					1	
RP1230S1	RP1230S	RP5700	250	0.014	9.70	9.08	CIRCULAR	2.75				2	
RP1230S2	RP1230S	RP5750	186	0.013	10.87	10.46	CIRCULAR	2				1	
RP1240S_OF	RP1240S	RP5700	50	0.030	16.30	16.20	IRREGULAR					1	
RP1240S1	RP1240S	RP4400	200	0.018	10.83	10.05	CIRCULAR	2.5				2	
RP1240S2	RP1240S	RP4550	200	0.014	9.57	9.21	CIRCULAR	2.75				2	
RP1250S_OF	RP1250S	RP4700	50	0.030	16.10	16.00	IRREGULAR					1	
RP1250S1	RP1250S	RP5510	190	0.013	6.68	5.92	CIRCULAR	3				1	
RP1250S2	RP1250S	RP4550	250	0.018	5.65	5.15	CIRCULAR	2.5				3	
RP1250S3	RP1250S	RP4600	200	0.018	8.01	7.62	CIRCULAR	2				2	
RP1250S4	RP1250S	RP4700	200	0.018	8.70	8.31	CIRCULAR	2.25				2	
RP1260S_OF	RP1260S	RP4800	50	0.030	16.70	16.60	IRREGULAR					1	
RP1260S1	RP1260S	RP4700	197	0.013	11.25	10.86	CIRCULAR	1.5				1	
RP1260S2	RP1260S	RP4800	197	0.013	11.19	10.80	CIRCULAR	2				1	
RP1260S3	RP1260S	RP4900	197	0.013	9.19	8.80	CIRCULAR	1.75				1	
RP1260S4	RP1260S	RP4950	170	0.013	12.05	11.71	CIRCULAR	1.5				1	
RP1300	RP1300	RP1400	380	0.000	-1.30	-1.40	IRREGULAR					1	
RP1300S_OF	RP1300S	RP825	50	0.030	17.00	16.90	IRREGULAR					1	
RP1300S1	RP1300S	RP825	250	0.013	6.40	5.99	CIRCULAR	3.5				1	
RP1300S2	RP1300S	RP850	250	0.014	5.02	4.89	CIRCULAR	2.5				4	
RP1400S_OF	RP1400S	RP1440S	50	0.030	17.60	17.50	IRREGULAR					1	
RP1400S1	RP1400S	RP1440S	440	0.013	5.95	6.05	CIRCULAR	4.5				1	
RP1401	RP1400	RP1500	65	0.010	-1.40	-1.50	IRREGULAR					1	
RP1440S_OF	RP1440S	RP1050	50	0.030	17.80	17.70	IRREGULAR					1	
RP1441	RP1441	RP1050	100	0.013	7.95	6.65	CIRCULAR	3.5				1	
RP1480_OF1	RP1480S	RP2900	50	0.030	17.60	17.50	IRREGULAR					1	
RP1480S_OF	RP1480S	RP900	50	0.030	17.80	17.70	IRREGULAR					1	
RP1481	RP1481	RP900	160	0.013	8.75	5.55	CIRCULAR	3.5				1	
RP150_OF	RP150	RP200	50	0.030	17.70	17.60	IRREGULAR					1	
RP1500	RP1500	RP1600	300	0.000	-1.50	-1.60	IRREGULAR					1	
RP1500S	RP1500S	RP900	200	0.018	6.70	6.53	CIRCULAR	2.5				2	
RP1500S_OF1	RP1500S	RP900	50	0.030	17.30	17.20	IRREGULAR					1	
RP1500S_OF2	RP1500S	RP5300	50	0.030	16.60	16.50	IRREGULAR					1	
RP155	RP155	RP200	286	0.013	7.17	6.55	CIRCULAR	2.5				1	
RP1600	RP1600	RP1650	1,225	0.000	-1.60	-1.70	IRREGULAR					1	
RP1650	RP1650	RP1700	1,225	0.000	-1.70	-1.80	IRREGULAR					1	
RP1700	RP1700	RP1800	2,360	0.000	1.55	0.55	IRREGULAR					1	
RP1700S	RP1700S	RP1100	400	0.016	10.17	8.05	CIRCULAR	3.5				2	
RP1700S_OF	RP1700S	RP1100	50	0.030	16.30	16.20	IRREGULAR					1	
RP1800	RP1800	RP1900	400	0.000	0.65	0.55	IRREGULAR					1	
RP1800S	RP1800S	RP5000	400	0.015	9.15	5.60	CIRCULAR	3				4	
RP1800S_OF	RP1800S	RP4970	50	0.030	16.50	16.40	IRREGULAR					1	
RP1900	RP1900	RP2000	400	0.000	0.55	1.25	IRREGULAR					1	
RP1900S_OF	RP1900S	RP4900	50	0.030	17.00	16.90	IRREGULAR					1	
RP1900S1	RP1900S	RP4950	425	0.013	12.74	7.78	CIRCULAR	3.5				1	
RP1900S2	RP1900S	RP4900	200	0.019	10.92	10.05	CIRCULAR	2.5				2	
RP1926	RP1925	C51A_2	98	0.013	10.40	10.30	CIRCULAR	6				2	
RP200	RP200	RP260	4,670	0.010	2.50	2.40	IRREGULAR					1	
RP2000S_OF	RP2000S	RP3005	50	0.030	17.00	16.90	IRREGULAR					1	
RP2000S1	RP2000S	RP3010	200	0.013	11.71	8.55	CIRCULAR	1.5				3	
RP2000S2	RP2000S	RP3005	175	0.012	6.66	6.25	CIRCULAR	2				3	
RP2000S3	RP2000S	RP3000	175	0.018	7.49	6.60	CIRCULAR	2.5				4	
RP2020S	RP2020S	RP3000	170	0.015	11.79	9.35	CIRCULAR	1.5				4	
RP2020S_OF1	RP2020S	RP3202	50	0.030	16.60	16.50	IRREGULAR					1	
RP2020S_OF2	RP2020S	RP3000	50	0.030	17.20	17.10	IRREGULAR					1	
RP2040S	RP2040S	RP325	200	0.017	10.25	6.55	CIRCULAR	1.75				5	
RP2040S_OF	RP2040S	RP325	50	0.030	16.90	16.80	IRREGULAR					1	
RP2060S_OF	RP2060S	RP330S	50	0.030	16.40	16.30	IRREGULAR					1	

Link	US Node	DS Node	Length	Roughness	US Invert	DS Invert	Type	Depth	Width	Left Slope	Right Slope	Barrels	Coefficient
	-	-	(ft)	-	(ft-NAVD)	(ft-NAVD)	-	(ft)	(ft)	-	-	(Count)	-
RP2060S1	RP2060S	RP340S	100	0.018	9.35	7.35	CIRCULAR	2.25				4	
RP2060S2	RP2060S	RP330S	130	0.018	9.85	7.95	CIRCULAR	1.75				3	
RP2100S	RP2100S	RP3100	210	0.013	7.89	6.44	CIRCULAR	3				2	
RP2100S_OF1	RP2100S	RP3100	50	0.030	17.50	17.40	IRREGULAR					1	
RP2100S_OF2	RP2100S	RP3100S	50	0.030	16.80	16.70	IRREGULAR					1	
RP2200S	RP2200S	RP1200	250	0.013	9.15	8.82	CIRCULAR	3.5				1	
RP2200S_OF	RP2200S	RP1200	50	0.030	17.10	17.00	IRREGULAR					1	
RP2250S	RP2250S	RP1100	615	0.013	7.95	7.00	CIRCULAR	3.5				1	
RP2250S_OF	RP2250S	RP2100S	50	0.030	17.00	16.90	IRREGULAR					1	
RP230	RP230	RP600	60	0.023	13.93	9.71	CIRCULAR	1.5				1	
RP230_OF	RP230	RP600	50	0.030	18.50	18.40	TRAPEZOIDAL	2	50	200	200	1	
RP235	RP235	RP230	1,650	0.050	12.00	11.50	IRREGULAR					1	
RP2350S	RP2350S	RP1300	175	0.017	7.24	6.70	CIRCULAR	2.25				4	
RP2350S_OF	RP2350S	RP3100S	50	0.030	6.40	6.30	IRREGULAR					1	
RP240	RP240	RP235	1,440	0.050	12.50	12.00	IRREGULAR					1	
RP2400	RP2400	RP2500	500	0.000	-3.45	0.63	IRREGULAR					1	
RP2400S_OF1	RP2400S	RP1200	50	0.030	17.50	17.40	IRREGULAR					1	
RP2400S_OF2	RP2400S	RP2500S	50	0.030	16.60	16.50	IRREGULAR					1	
RP2400S1	RP2400S	RP1100	500	0.013	9.34	9.00	CIRCULAR	3				1	
RP2400S2	RP2400S	RP1200	270	0.016	7.05	7.04	CIRCULAR	2.5				1	
RP250	RPNA-100	RP255	627	0.013	13.50	12.57	CIRCULAR	2				1	
RP2500	RP2500	C51A_1	119	0.013	-0.67	-0.56	RECT_CLOSED	16	15			1	
RP2500S	RP2500S	RP6550	240	0.015	8.90	8.40	CIRCULAR	2.5				3	
RP2500S_OF	RP2500S	RP6550	50	0.030	16.20	16.10	IRREGULAR					1	
RP260	RP260	RP270	62	0.023	3.80	3.55	CIRCULAR	8				2	
RP260_OF2	RP260	RP235	50	0.030	17.50	17.40	IRREGULAR					1	
RP2600S_OF	RP2600S	RP6500	50	0.030	16.60	16.50	IRREGULAR					1	
RP2600S1	RP2600S	RP6300	160	0.018	6.43	6.38	CIRCULAR	2.25				2	
RP2600S2	RP2600S	RP6400	175	0.013	12.45	11.75	CIRCULAR	1.25				1	
RP2600S3	RP2600S	RP6500	250	0.018	7.41	6.84	CIRCULAR	2.25				4	
RP2650S	RP2650S	RP6250	160	0.013	10.40	10.00	CIRCULAR	2				4	
RP2650S_OF	RP2650S	RP6250	50	0.030	17.00	16.90	IRREGULAR					1	
RP26R	RP260	RP270	62	0.040	19.00	18.90	TRAPEZOIDAL	4	150	10	10	1	
RP270	RP270	RP400	670	0.010	2.40	2.30	IRREGULAR					1	
RP2700	RP2700	RP150	3,223	0.013	2.33	10.94	CIRCULAR	3.5				1	
RP2700_OF1	RP2700	RP250	50	0.030	18.00	17.90	TRAPEZOIDAL	2	500	200	200	1	
RP2700_OF2	RP2700	RP2900	50	0.030	17.30	17.20	IRREGULAR					1	
RP2700-2	RP2700	RP2900	2,750	0.013	0.00	5.95	CIRCULAR	2.5				1	
RP2700S1	RP2700S	RP6250	105	0.013	5.43	5.32	CIRCULAR	6				1	
RP2700S2	RP2700S	RP6300	500	0.013	9.25	7.85	CIRCULAR	2				3	
RP2800S	RP2800S	RP7600	650	0.017	10.96	10.70	CIRCULAR	3.5				2	
RP2800S_OF	RP2800S	RPN100	50	0.030	15.40	15.30	IRREGULAR					1	
RP2805	RP2805	RP2700S	357	0.013	5.95	5.59	CIRCULAR	6				1	
RP2900_OF	RP2900	RP800	50	0.030	17.70	17.60	IRREGULAR					1	
RP2900S	RP2900S	RP6000	160	0.019	9.50	9.00	CIRCULAR	2				15	
RP2900S_OF1	RP2900S	RP6000	50	0.030	16.60	16.50	IRREGULAR					1	
RP2900S_OF2	RP2900S	RP2650S	50	0.030	15.90	15.80	IRREGULAR					1	
RP3000	RP3000	RP3100	50	0.035	7.10	6.20	RECT_CLOSED	10	18			2	
RP3000S	RP3000S	RP3300	180	0.016	10.60	9.55	CIRCULAR	2				2	
RP3000S_OF	RP3000S	RP3300	50	0.030	17.40	17.30	IRREGULAR					1	
RP3002	RP3002	RP3000	930	0.030	0.50	2.30	IRREGULAR					1	
RP3005	RP3005	RP3002	1,320	0.030	4.50	0.50	IRREGULAR					1	
RP3010	RP3010	RP3005	1,000	0.030	5.70	4.50	IRREGULAR					1	
RP3100	RP3100	RP3300	1,485	0.000	3.80	2.80	IRREGULAR					1	
RP3100S	RP3100S	RP3300	200	0.012	6.18	5.75	CIRCULAR	2.5				2	
RP3100S_OF	RP3100S	RP3300	50	0.030	17.10	17.00	IRREGULAR					1	
RP3200	RP3200	RP3300	128	0.023	8.32	8.22	ARCH	63				1	
RP3200_OF1	RP3200	RP3300	50	0.030	17.70	17.60	IRREGULAR					1	
RP3200S	RP3200S	RP1300	200	0.017	5.75	4.95	CIRCULAR	3				4	
RP3200S_OF1	RP3200S	RP1300	50	0.030	17.10	17.00	IRREGULAR					1	
RP3200S_OF2	RP3200S	RP2500S	50	0.030	17.10	17.00	IRREGULAR					1	
RP3202_1	RP3202	RP3200	1,500	0.030	5.50	4.90	IRREGULAR					1	
RP3202_2	RP3202	RP3005	200	0.030	11.30	11.20	IRREGULAR					1	
RP3205_1	RP3205	RP3202	520	0.030	7.30	7.00	IRREGULAR					1	
RP3205_2	RP3205	RP3200	1,250	0.030	7.30	6.30	IRREGULAR					1	
RP3210	RP3210	RP3205	1,080	0.030	4.60	4.80	IRREGULAR					1	
RP325	RP325	RP3010	143	0.013	6.05	5.45	RECT_CLOSED	11.83	7.58			1	
RP325_OF	RP325	RP3010	50	0.030	17.00	16.90	IRREGULAR					1	
RP3300	RP3300	RP3350	480	0.030	3.50	4.70	IRREGULAR					1	
RP330S	RP330S	RP325	2,540	0.030	8.10	8.00	IRREGULAR					1	
RP3350	RP3350	RP1300	1,370	0.000	4.70	2.90	IRREGULAR					1	
RP335S	RP335S	RP330S	76	0.013	9.60	7.53	CIRCULAR	4				1	
RP335S_OF	RP335S	RP330S	50	0.030	16.80	16.70	IRREGULAR					1	
RP338	RP338	RP330S	500	0.030	8.00	8.10	IRREGULAR					1	
RP3400	RP3400	RP3450	202	0.013	5.55	5.54	CIRCULAR	3.5				1	
RP3400_OF	RP3400	RP3450	202	0.040	16.80	16.70	IRREGULAR					1	

Link	US Node	DS Node	Length	Roughness	US Invert	DS Invert	Type	Depth	Width	Left Slope	Right Slope	Barrels	Coefficient
	-	-	(ft)	-	(ft-NAVD)	(ft-NAVD)	-	(ft)	(ft)	-	-	(Count)	-
RP3400S	RP3400S	RP6600	220	0.012	9.00	8.00	CIRCULAR	2.5				3	
RP3400S_OF	RP3400S	RP6600	168	0.040	16.20	16.10	IRREGULAR					1	
RP340S_OF	RP340S	RP338	50	0.030	14.40	14.30	IRREGULAR					1	
RP3450_OF	RP3450	RP3500	50	0.030	16.70	16.60	IRREGULAR					1	
RP3450S	RP3450S	RP6500	240	0.017	6.08	5.85	CIRCULAR	2.75				2	
RP3450S_OF	RP3450S	RP6500	50	0.030	17.10	17.00	IRREGULAR					1	
RP3500	RP3500	RP3900	478	0.000	5.00	3.50	IRREGULAR					1	
RP3500S	RP3500S	RP6300	200	0.013	8.60	8.23	CIRCULAR	2.5				3	
RP3500S_OF	RP3500S	RP6300	50	0.030	17.10	17.00	IRREGULAR					1	
RP3550	RP3550	RP3600	195	0.013	10.60	7.16	CIRCULAR	3.5				1	
RP3550_OF	RP3550	RP3600	50	0.030	16.70	16.60	IRREGULAR					1	
RP3550S	RP3550S	RP7100	95	0.013	13.05	9.80	CIRCULAR	2.5				6	
RP3550S_OF	RP3550S	RP7100	50	0.030	15.20	15.10	IRREGULAR					1	
RP3600	RP3600	RP3700	140	0.013	10.31	10.35	CIRCULAR	2				1	
RP3600_OF	RP3600	RP3700	50	0.030	16.30	16.20	IRREGULAR					1	
RP3600R	RP3600	RP3700	100	0.040	16.55	14.62	TRAPEZOIDAL	5	200	10	10	1	
RP3600S	RP3600S	RP3210	150	0.018	8.20	8.05	CIRCULAR	2.25				4	
RP3600S_OF1	RP3600S	RP3210	50	0.030	15.70	15.60	IRREGULAR					1	
RP3600S_OF2	RP3600S	RP4300S	50	0.030	16.10	16.00	IRREGULAR					1	
RP3650S	RP3650S	RP3200	200	0.013	11.83	9.55	CIRCULAR	1.25				1	
RP3650S_OF	RP3650S	RP3000S	50	0.030	17.20	17.10	IRREGULAR					1	
RP3700	RP3700	RP3500	1,219	0.000	5.40	5.60	IRREGULAR					1	
RP3700S	RP3700S	RP3790S	400	0.013	12.68	9.12	CIRCULAR	2				1	
RP3700S_OF	RP3700S	RP3740S	50	0.030	16.30	16.20	IRREGULAR					1	
RP3740S	RP3740S	RP1600	200	0.013	8.14	8.05	CIRCULAR	1.5				2	
RP3740S_OF1	RP3740S	RP4380S	50	0.030	16.50	16.40	IRREGULAR					1	
RP3740S_OF2	RP3740S	RP1600	50	0.030	16.30	16.20	IRREGULAR					1	
RP3780S	RP3780S	RP3300	200	0.018	7.67	7.47	CIRCULAR	2				5	
RP3780S_OF	RP3780S	RP3300	50	0.030	16.30	16.20	IRREGULAR					1	
RP3790S	RP3790S	RP3200	170	0.012	7.05	6.17	CIRCULAR	2.5				3	
RP3790S_OF	RP3790S	RP3200	50	0.030	16.50	16.40	IRREGULAR					1	
RP3790S_OF2	RP3790S	RP3780S	50	0.030	16.30	16.20	IRREGULAR					1	
RP3800S_OF	RP3800S	RP6600	50	0.030	16.70	16.60	IRREGULAR					1	
RP3800S1	RP3800S	RP6600	250	0.015	9.98	9.93	CIRCULAR	2				3	
RP3800S2	RP3800S	RP6800	250	0.017	8.55	7.98	CIRCULAR	2				3	
RP3900	RP3900	RP4000	518	0.000	3.50	2.70	IRREGULAR					1	
RP400	RP400	RP500	1,600	0.010	2.30	2.20	IRREGULAR					1	
RP4000	RP4000	RP1800	630	0.000	2.70	2.00	IRREGULAR					1	
RP4000S_OF1	RP4000S	RP7500	50	0.030	16.70	16.60	IRREGULAR					1	
RP4000S_OF2	RP4000S	RP4100S	50	0.030	16.00	15.90	IRREGULAR					1	
RP4000S1	RP4000S	RP1700	200	0.018	7.58	7.00	CIRCULAR	3				2	
RP4000S2	RP4000S	RP7500	170	0.013	8.99	8.50	CIRCULAR	1.75				3	
RP4100	RP4100	RP4200	200	0.010	7.90	6.30	IRREGULAR					1	
RP4100S_OF	RP4100S	RP1650	50	0.030	16.10	16.00	IRREGULAR					1	
RP4100S1	RP4100S	RP1600	250	0.019	8.52	7.82	CIRCULAR	2				2	
RP4100S2	RP4100S	RP1650	70	0.014	8.45	8.25	CIRCULAR	2.5				2	
RP4200	RP4200	RP500	1,100	0.000	0.60	1.50	IRREGULAR					1	
RP4200S_OF	RP4200S	RP7300	50	0.030	16.80	16.70	IRREGULAR					1	
RP4200S1	RP4200S	RP7350	170	0.013	8.15	7.75	CIRCULAR	2.5				2	
RP4200S2	RP4200S	RP7300	170	0.019	8.45	8.05	CIRCULAR	2.5				4	
RP4200S3	RP4200S	RP7200	180	0.013	8.21	7.85	CIRCULAR	2.5				1	
RP4250S	RP4250S	RP7300	110	0.013	13.05	9.80	CIRCULAR	2.5				5	
RP4250S_OF	RP4250S	RP7300	50	0.030	16.00	15.90	IRREGULAR					1	
RP4300	RP4300	RP4400	1,630	0.000	2.00	2.50	IRREGULAR					1	
RP4300S	RP4300S	RP335S	158	0.013	3.25	3.13	CIRCULAR	4.5				1	
RP4301	RP4300	RP4100	2,833	0.000	-2.40	0.00	IRREGULAR					1	
RP4340S	RP4340S	RP335S	180	0.013	9.55	8.05	CIRCULAR	2				1	
RP4340S_OF	RP4340S	RP4950S	50	0.030	16.50	16.40	IRREGULAR					1	
RP4380S	RP4380S	RP1700	155	0.019	9.85	9.45	CIRCULAR	2				2	
RP4380S_OF1	RP4380S	RP1700	50	0.030	16.70	16.60	IRREGULAR					1	
RP4380S_OF2	RP4380S	RP4300S	50	0.030	16.00	15.90	IRREGULAR					1	
RP440	RP4400	RP4500	60	0.010	4.20	4.30	IRREGULAR					1	
RP4401	RP4400	RP4500	45	0.040	19.00	18.90	TRAPEZOIDAL	4	150	10	10	1	
RP4500	RP4500	RP4550	1,225	0.000	1.20	1.50	IRREGULAR					1	
RP4500S	RP4500S	RP3400	200	0.013	7.38	6.55	CIRCULAR	2				16	
RP4500S_OF	RP4500S	RP3450	50	0.030	16.30	16.20	IRREGULAR					1	
RP4530S	RP4530S	RP3400	190	0.013	8.36	7.16	CIRCULAR	2.5				6	
RP4530S_OF1	RP4530S	RP4550S	50	0.030	16.80	16.70	IRREGULAR					1	
RP4550	RP4550	RP4600	1,225	0.000	4.00	6.70	IRREGULAR					1	
RP4550S_OF	RP4550S	RP3450	50	0.030	16.50	16.40	IRREGULAR					1	
RP4550S1	RP4550S	RP4000	170	0.013	9.15	7.37	CIRCULAR	2.5				1	
RP4550S2	RP4550S	RP3900	160	0.013	9.85	7.95	CIRCULAR	2				1	
RP4550S3	RP4550S	RP3500	170	0.013	8.72	7.85	CIRCULAR	2				2	
RP4580S	RP4580S	RP3700	180	0.017	6.15	5.98	CIRCULAR	2.5				2	
RP4580S_OF1	RP4580S	RP3700	50	0.030	16.80	16.70	IRREGULAR					1	
RP4580S_OF2	RP4580S	RP3450	50	0.030	16.30	16.20	IRREGULAR					1	

Link	US Node	DS Node	Length	Roughness	US Invert	DS Invert	Type	Depth	Width	Left Slope	Right Slope	Barrels	Coefficient
	-	-	(ft)	-	(ft-NAVD)	(ft-NAVD)	-	(ft)	(ft)	-	-	(Count)	-
RP4600	RP4600	RP4700	1,500	0.000	6.70	3.20	IRREGULAR					1	
RP4700	RP4700	RP4800	1,034	0.000	3.20	2.80	IRREGULAR					1	
RP4700S	RP4700S	RP7355	135	0.013	8.30	6.61	CIRCULAR	2.25				3	
RP4700S_OF1	RP4700S	RP7355	50	0.030	16.90	16.80	IRREGULAR					1	
RP4700S_OF2	RP4700S	RP5200S	50	0.030	16.10	16.00	IRREGULAR					1	
RP4800	RP4800	RP4900	1,395	0.000	2.80	5.20	IRREGULAR					1	
RP4900	RP4900	RP4950	40	0.035	8.05	8.35	RECT_CLOSED	14	18			2	
RP4950	RP4950	RP4970	750	0.030	6.10	6.20	IRREGULAR					1	
RP4950S	RP4950S	RP4500S	600	0.013	7.59	6.56	CIRCULAR	2.5				1	
RP4950S_OF	RP4950S	RP4500S	50	0.030	16.30	16.20	IRREGULAR					1	
RP4970	RP4970	RP5000	860	0.030	10.10	10.00	IRREGULAR					1	
RP500	RP500	RP600	1,150	0.010	2.20	2.10	IRREGULAR					1	
RP5000	RP5000	RP1000	50	0.035	5.90	7.00	RECT_CLOSED	14	18			2	
RP5000R	RP5000	RP1000	32	0.040	19.00	18.90	TRAPEZOIDAL	5	200	10	10	1	
RP5000S_OF	RP5000S	RP5200S	50	0.030	16.00	15.90	IRREGULAR					1	
RP5000S1	RP5000S	RP7500	165	0.013	7.66	7.00	CIRCULAR	4				1	
RP5000S2	RP5000S	RP1700	320	0.013	8.81	9.05	CIRCULAR	2				1	
RP5000S3	RP5000S	RP1800	148	0.013	11.93	8.90	CIRCULAR	2.5				1	
RP500S_OF	RP500S	RP500	50	0.030	17.20	17.10	IRREGULAR					1	
RP500S1	RP500S	RP4200	200	0.018	12.00	9.55	CIRCULAR	1.5				3	
RP500S2	RP500S	RP500	175	0.019	8.15	7.71	CIRCULAR	2.5				3	
RP5200S	RP5200S	RP1900	127	0.013	9.65	9.00	CIRCULAR	4.5				1	
RP5200S_OF	RP5200S	RP1900	50	0.030	16.10	16.00	IRREGULAR					1	
RP5300	RP5301	RP1000	321	0.023	9.85	9.75	CIRCULAR	1.5				1	
RP5300_OF	RP5300	RP1000	321	0.040	16.40	16.30	IRREGULAR					1	
RP5350S_OF	RP5350S	RP3550	50	0.030	17.80	17.70	IRREGULAR					1	
RP5400	RP5400	RP900	729	0.013	8.20	7.05	CIRCULAR	2				1	
RP5400_OF1	RP5400	RP900	729	0.040	17.90	17.80	IRREGULAR					1	
RP5400_OF2	RP5400	RP1500S	50	0.030	15.80	15.70	IRREGULAR					1	
RP5400S	RP5400S	RP3900	130	0.013	11.04	10.74	CIRCULAR	2.5				1	
RP5400S_OF1	RP5400S	RP3900	50	0.030	16.50	16.40	IRREGULAR					1	
RP5400S_OF2	RP5400S	RP5500S	50	0.030	15.90	15.80	IRREGULAR					1	
RP5500_OF	RP5500	RP800	50	0.030	16.90	16.80	IRREGULAR					1	
RP5500S	RP5500S	RP2000	180	0.013	10.01	9.67	CIRCULAR	2				2	
RP5500S_OF	RP5500S	RP2000	50	0.030	16.80	16.70	IRREGULAR					1	
RP5500S1	RP5500	RP800	300	0.018	8.57	5.49	CIRCULAR	2				3	
RP5500S2	RP5500S	RP4000	175	0.013	11.72	11.35	CIRCULAR	1.25				2	
RP5510	RP5510	RP5515	1,280	0.030	8.00	7.90	IRREGULAR					1	
RP5515	RP5515	RP5520	1,500	0.030	7.90	8.00	IRREGULAR					1	
RP5520_OF	RP5520	RP5525	50	0.010	12.90	12.80	IRREGULAR					1	
RP5525_OF	RP5525	RP5526	50	0.030	16.30	16.20	IRREGULAR					1	
RP5526_OF	RP5526	RP5527	50	0.030	11.20	11.10	IRREGULAR					1	
RP5527	RP5527	RP5000	1,450	0.030	6.20	6.30	IRREGULAR					1	
RP5600	RP5600	RP4600	500	0.000	5.40	6.70	IRREGULAR					1	
RP5601	RP5600	RP5700	80	0.010	5.40	5.70	IRREGULAR					1	
RP5602	RP5600	RP5700	45	0.040	19.00	18.90	TRAPEZOIDAL	4	150	10	10	1	
RP5700	RP5700	RP5725	1,200	0.000	5.70	2.30	IRREGULAR					1	
RP5725	RP5725	RP5750	1,215	0.000	2.30	4.90	IRREGULAR					1	
RP5750	RP5750	RP5775	1,540	0.000	4.90	1.90	IRREGULAR					1	
RP5775	RP5775	RP5800	840	0.000	1.90	5.00	IRREGULAR					1	
RP5800	RP5800	RP5900	70	0.010	5.00	4.90	IRREGULAR					1	
RP5801	RP5800	RP5900	45	0.040	19.00	18.90	TRAPEZOIDAL	4	150	10	10	1	
RP5900	RP5900	RP4800	515	0.000	4.90	4.00	IRREGULAR					1	
RP6000	RP6000	RP6200	40	0.035	3.10	1.70	IRREGULAR					1	
RP6000R	RP6000	RP6200	32	0.040	19.00	18.90	TRAPEZOIDAL	5	200	10	10	1	
RP600S	RP600S	RP4200	325	0.013	11.55	9.55	CIRCULAR	1.5				1	
RP600S_OF	RP600S	RP4200	50	0.030	17.10	17.00	IRREGULAR					1	
RP604	RP600	RP700	95	0.035	2.10	2.00	CUSTOM	13.68				1	
RP6200	RP6200	RP6250	1,115	0.000	1.70	1.40	IRREGULAR					1	
RP6250	RP6250	RP6300	1,578	0.000	2.20	3.00	IRREGULAR					1	
RP6300	RP6300	RP7100	2,060	0.000	4.40	3.70	IRREGULAR					1	
RP6301	RP6300	RP6400	817	0.000	4.90	6.60	IRREGULAR					1	
RP6400	RP6400	RP6500	50	0.010	6.60	5.10	IRREGULAR					1	
RP6400R	RP6400	RP6500	50	0.040	18.50	18.40	TRAPEZOIDAL	4	150	10	10	1	
RP6500	RP6500	RP6550	1,660	0.000	3.50	4.80	IRREGULAR					1	
RP6550	RP6550	RP6600	1,870	0.000	4.80	3.10	IRREGULAR					1	
RP6600	RP6600	RP6700	490	0.000	3.10	5.30	IRREGULAR					1	
RP6700	RP6700	RP6800	50	0.010	5.30	5.00	IRREGULAR					1	
RP6701	RP6700	RP6800	50	0.040	18.50	18.40	TRAPEZOIDAL	4	150	10	10	1	
RP6800	RP6800	RP1600	1,242	0.000	5.00	5.50	IRREGULAR					1	
RP6900	RP6900	RP6800	250	0.015	9.15	9.00	CIRCULAR	2.5				2	
RP6900_OF	RP6900	RP4100S	50	0.030	16.00	15.90	IRREGULAR					1	
RP700	RP700	RP800	1,100	0.010	0.30	0.10	IRREGULAR					1	
RP7000_OF	RP7000	RP4200S	50	0.010	17.00	16.90	IRREGULAR					1	
RP7003	RP7000	RP4200S	260	0.015	7.67	10.55	CIRCULAR	2				3	
RP700S_OF1	RP700S	RP4400	50	0.030	17.40	17.30	IRREGULAR					1	

Link	US Node	DS Node	Length	Roughness	US Invert	DS Invert	Type	Depth	Width	Left Slope	Right Slope	Barrels	Coefficient
	-	-	(ft)	-	(ft-NAVD)	(ft-NAVD)	-	(ft)	(ft)	-	-	(Count)	-
RP700S_OF2	RP700S	RP5510	50	0.030	16.10	16.00	IRREGULAR					1	
RP700S1	RP700S	RP4300	500	0.014	7.80	6.50	CIRCULAR	3				2	
RP700S2	RP700S	RP4100	300	0.016	9.40	8.60	CIRCULAR	3				3	
RP700S3	RP700S	RP4400	180	0.013	4.40	4.12	CIRCULAR	4				1	
RP710_OF	RP7100	RP7200	50	0.040	16.40	16.30	IRREGULAR					1	
RP7100	RP7100	RP7200	50	0.010	3.70	4.20	IRREGULAR					1	
RP7200	RP7200	RP7250	1,500	0.000	2.60	3.40	IRREGULAR					1	
RP7250	RP7250	RP7300	1,300	0.000	3.40	2.70	IRREGULAR					1	
RP7300	RP7300	RP7350	2,225	0.000	3.00	2.00	IRREGULAR					1	
RP7350	RP7350	RP7400	1,195	0.010	4.40	3.00	IRREGULAR					1	
RP7355_1	RP7355	RP7350	1,619	0.013	7.75	6.21	CIRCULAR	6				1	
RP7355_2	RP7355	RP7350	1,800	0.030	3.90	3.80	IRREGULAR					1	
RP7400	RP7400	RP7500	50	0.010	3.00	4.70	IRREGULAR					1	
RP7401	RP7400	RP7500	50	0.040	18.80	18.70	TRAPEZOIDAL	4	150	10	10	1	
RP7500	RP7500	RP1700	1,250	0.000	4.70	1.50	IRREGULAR					1	
RP750S_OF	RP750S	RP4100	50	0.030	17.40	17.30	IRREGULAR					1	
RP750S1	RP750S	RP4300	500	0.017	8.90	8.60	CIRCULAR	4.5				3	
RP750S2	RP750S	RP4100	250	0.015	4.50	3.90	CIRCULAR	4				2	
RP7600	RP7600	RP7700	1,947	0.000	3.20	4.60	IRREGULAR					1	
RP7700	RP7700	RP7825	963	0.000	4.60	2.50	IRREGULAR					1	
RP7750	RP7750	RP7700	43	0.023	9.30	8.05	CIRCULAR	2.5				1	
RP7750R	RP7750	RP7700	43	0.040	17.72	17.35	TRAPEZOIDAL	7	200	10	10	1	
RP7800_OF	RP7800	RP7700	50	0.030	17.00	16.90	IRREGULAR					1	
RP7825	RP7825	RP7850	50	0.035	5.40	5.20	IRREGULAR					1	
RP7826_OF	RP7825	RP7850	34	0.040	16.50	16.40	IRREGULAR					1	
RP7850	RP7850	RP7900	1,006	0.000	1.20	1.10	IRREGULAR					1	
RP7900	RP7900	RP8000	50	0.029	3.54	3.53	RECT_CLOSED	13	24			3	
RP7900_OF	RP7900	RP8000	50	0.040	18.00	17.60	TRAPEZOIDAL	5	200	10	10	1	
RP800	RP800	RP825	1,700	0.010	0.10	-0.10	IRREGULAR					1	
RP8000	RP8000	RP8025	1,313	0.000	2.80	4.20	IRREGULAR					1	
RP800S_OF	RP800S	RP700	50	0.030	16.90	16.80	IRREGULAR					1	
RP800S_OF2	RP800S	RP5500	50	0.030	16.00	15.90	IRREGULAR					1	
RP800S1	RP800S	RP700	175	0.015	8.60	8.30	CIRCULAR	1.5				3	
RP800S2	RP800S	RP600	700	0.013	9.20	7.60	CIRCULAR	2				2	
RP8010	RP8010	C51C	180	0.013	6.65	5.68	CIRCULAR	6				3	
RP8025	RP8025	RP8030	1,500	0.000	0.50	4.90	IRREGULAR					1	
RP8030	RP8030	RP8050	1,725	0.000	4.90	-0.40	IRREGULAR					1	
RP8050	RP8050	RP8100	2,267	0.000	-0.40	-1.00	IRREGULAR					1	
RP810_OF	RP8100	RP8010	194	0.040	18.80	18.70	IRREGULAR					1	
RP828	RP825	RP850	50	0.037	-0.10	-0.20	IRREGULAR					1	
RP8404	RP8404	RP8406	641	0.013	8.14	7.67	CIRCULAR	2				1	
RP8406	RP8406	RP8408	305	0.013	7.16	7.13	CIRCULAR	2.5				1	
RP8408	RP8408	RP8410	784	0.013	6.14	5.04	CIRCULAR	3				1	
RP8410	RP8410	RP8415	500	0.013	4.99	4.80	HORIZ_ELLIPSE	2.83	4.42			1	
RP8410_OF	RP8410	RPC51200	50	0.030	17.20	17.10	IRREGULAR					1	
RP8415	RP8415	RP8420	660	0.013	4.94	4.77	CIRCULAR	3.5				1	
RP8420	RP8420	C51B	125	0.013	4.88	4.23	CIRCULAR	4				1	
RP850	RP850	RP900	1,900	0.010	-0.20	-0.50	IRREGULAR					1	
RP900	RP900	RP1050	1,600	0.000	-0.50	-0.80	IRREGULAR					1	
RPC51100	RPC51100	RP8406	260	0.013	9.42	9.28	CIRCULAR	2				1	
RPC51100_OF1	RPC51100	RPC51500	50	0.030	15.60	15.50	IRREGULAR					1	
RPC51100_OF2	RPC51100	RP7355	50	0.030	15.30	15.20	IRREGULAR					1	
RPC51200	RPC51200	RP8410	108	0.013	9.33	9.03	HORIZ_ELLIPSE	1.88	3			1	
RPC51200_OF	RPC51200	RPC51100	50	0.030	15.30	15.20	IRREGULAR					1	
RPC51400	RPC51400	RP8404	912	0.013	8.55	8.50	CIRCULAR	3				1	
RPC51400_OF1	RPC51400	RP7300	50	0.030	16.50	16.40	IRREGULAR					1	
RPC51400_OF2	RPC51400	RPC51100	50	0.030	16.30	16.20	IRREGULAR					1	
RPC51500	RPC51500	RP8408	464	0.013	8.66	8.19	CIRCULAR	2.5				1	
RPC51500_OF	RPC51500	RP8050	50	0.030	16.60	16.50	IRREGULAR					1	
RPN100_OF	RPN100	RP7700	50	0.030	16.80	16.70	IRREGULAR					1	
RPN110	RPN110	RP7600	67	0.013	5.65	5.12	CIRCULAR	3.5				1	
RPN450	RPN450	RP8000	490	0.013	9.29	9.00	CIRCULAR	2				1	
RPN450_OF1	RPN450	RP8025	50	0.030	17.50	17.40	IRREGULAR					1	
RPN450_OF2	RPN450	LW450	50	0.030	15.90	15.80	IRREGULAR					1	
RPN600_OF	RPN600	RPN100	50	0.030	17.00	16.90	IRREGULAR					1	
RPN650	RPN650	RP2800S	300	0.013	7.50	7.00	CIRCULAR	6				1	
RPN700	RPN700	RPN660	253	0.013	7.75	7.70	CIRCULAR	6				1	
RPN700_OF	RPN700	RP1200S	50	0.030	17.30	17.20	IRREGULAR					1	
RPN800	RPN800	RPN700	390	0.013	8.85	8.75	CIRCULAR	3				1	
RPN800_OF	RPN800	RPN700	50	0.030	16.90	16.80	IRREGULAR					1	
RPN900	RPN900	RPN800	630	0.013	12.85	8.55	CIRCULAR	3				1	
RPN900_OF	RPN900	OD110	50	0.030	17.80	17.70	IRREGULAR					1	
RPNA-100	RPNA-100	RP250	400	0.013	6.16	5.32	RECT_CLOSED	2	3.2			1	
RPNA-100_OF1	RPNA-100	RP200	50	0.010	18.30	18.20	IRREGULAR					1	
RPNA-100_OF2	RPNA-100	RP2700	50	0.010	18.40	18.30	IRREGULAR					1	
Sypho2	SyphonUS	SyphonDS	180	0.013	0.00	0.00	RECT_CLOSED	6	10			1	

Link	US Node	DS Node	Length	Roughness	US Invert	DS Invert	Type	Depth	Width	Left Slope	Right Slope	Barrels	Coefficient
	-	-	(ft)	-	(ft-NAVD)	(ft-NAVD)	-	(ft)	(ft)	-	-	(Count)	-
ITID_GATES	RP2000	RP2400					PUMP						
ITID_200cfs	ITID_LowM1	RP400					PUMP						
ORIFICE1@RP7800-RP7750	RP7800	RP7750			11.55		ORIFICE	0.5					0.62
ORIFICE@RP2900-RP800	RP2900	RP800			12.05		ORIFICE	1					0.65
ORIFICE@RP150-RP200	RP150	RP155			12.05		ORIFICE	0.5					0.65
ORIFICE@RPN660-RPN650	RPN660	RPN650			15.05		ORIFICE	1.25	3.5				0.6
WEIR@LW9215-LW9220	LW9215	LW9220			9.45		WEIR	10	10				3.1
WEIR@LW99900-LW0050	LW9900	LW0050			9.45		WEIR	10	10				3.1
WEIR@LWS300S-LWS310_1	LWS300S	LWS310			11.55		WEIR V-Notch	0.67	0.67	1	1		3.1
WEIR@LWS300S-LWS310_2	LWS300S	LWS310			14.00		WEIR	10	10				3.1
WEIR@LWS400S-C51F1	LWS400S	LWS410			11.05		WEIR V-Notch	0.67	0.67	1	1		3.1
WEIR@LWS400S-C51F2	LWS400S	LWS410			13.50		WEIR	10	8				3.1
Weir@LWS520-C51E	LWS520	C51E			14.55		WEIR	10	25				3.1
WEIR@RP1440-RP1441	RP1440S	RP1441			12.55		WEIR	4.4	11.9				3.1
WEIR@RP1480-RP900	RP1480S	RP1481			12.55		WEIR	4.4	11.9				3.1
WEIR@RP150-RP200_1	RP150	RP155			17.35		WEIR	10	4.5				3.2
WEIR@RP150-RP200_2	RP150	RP155			16.55		WEIR	0.8	0.6				3.2
WEIR@RP1900-RP1925	RP1900	RP1925			12.18		WEIR	14.42	12				3.0
WEIR@RP250-RP240_1	RP250	RP240			17.75		WEIR	10	4				2.8
WEIR@RP250-RP240_2	RP250	RP240			12.07		WEIR V-Notch	0.67	0.67	1	1		3.1
WEIR@RP250-RP240_3	RP250	RP240			14.82		WEIR	2	1.5				2.8
Weir@RP2800S-RP2700	RP2800S	RP2805			15.00		WEIR	10	8				3.1
WEIR@RP2900-RP800	RP2900	RP800			16.30		WEIR	15	2.25				3.2
WEIR@RP300-RP400	ITID_LowM1	RP400			20.55		WEIR	20	500				2.8
WEIR@RP5300-RP5301_1	RP5300	RP5301			15.00		WEIR	10	4				3.1
WEIR@RP5300-RP5301_2	RP5300	RP5301			9.81		WEIR V-Notch	0.67	0.67	1	1		3.1
WEIR@RP7800-RP7750	RP7800	RP7750			16.50		WEIR	10	8				3.1
WEIR@RPN660-RPN650	RPN660	RPN650			17.55		WEIR	10	11				3.1
WEIR@RPNA-RP200	RP255	RP200			20.55		WEIR	10	50				2.8
WEIR1@LW450-LW451	LW450S	LW451			14.77		WEIR	10	7.5				3.1
WEIR1@LW450-LW9901	LW450S	LW9901			15.00		WEIR	10	8				3.1
WEIR1@LW500-LW505	LW500S	LW501			14.64		WEIR	10	3				3.1
WEIR1@LW9225-LW9240	LW9225	LW9226			14.55		WEIR	10	6				3.0
WEIR1@LW9700-LW9750	LW9700	LW9750			15.00		WEIR	10	8				3.1
WEIR1@RP3450-3500	RP3450	RP3500			15.50		WEIR	10	8				3.1
WEIR1@RP8100-C51B	RP8100	RP8010			11.88		WEIR	20	30				3.1
WEIR1@RPN100-RP7600	RPN100	RPN110			15.19		WEIR	10	8				3.1
WEIR2@LW450-LW451	LW450S	LW451			10.65		WEIR V-Notch	0.67	0.67	1	1		3.0
WEIR2@LW500-LW505	LW500S	LW501			10.52		WEIR V-Notch	0.5	0.5	1	1		3.0
WEIR2@LW9225-LW9240	LW9225	LW9226			10.55		WEIR V-Notch	0.67	0.67	1	1		3.1
WEIR2@LW9700-LW9750	LW9700	LW9750			10.91		WEIR V-Notch	0.67	0.67	1	1		3.0
WEIR2@RLW450-LW9901	LW450S	LW9901			10.60		WEIR V-Notch	0.67	0.67	1	1		3.0
WEIR2@RP3450-3500	RP3450	RP3500			12.05		WEIR V-Notch	0.67	0.67	1	1		3.1
WEIR2@RP8100-C51B	RP8100	RP8010			14.49		WEIR	20	66				3.1
Weir2@RPN100-RP7600	RPN100	RPN110			10.16		WEIR V-Notch	0.67	0.67	1	1		3.1
Weir2Syphon	ITID_UpM1	SyphonUS			14.55		WEIR	10	13.5				3.1
Amil_Gate	RP2000	RP2400			12.35		Rating Curve						
ORIFICE2@RP300-RP400	ITID_LowM1	RP400			0.00		Rating Curve						

APPENDIX C

OPERATION SCHEDULE PERMITS COMBINED- ITID

OPERATIONS SCHEDULE
INDIAN TRAIL IMPROVEMENT DISTRICT'S (ITID'S) M-1 BASIN TO THE SOUTH FLORIDA WATER MANAGEMENT DISTRICT'S C-51 CANAL

Operations of the ITID that discharge stormwater into the C-51 Canal via the M-1 Canal will occur in one of five modes: Water Conservation, Normal, Rainfall Conditional, Conditional, or Emergency as defined below:

Water Conservation Mode of Operations

The Water Conservation mode of operations is defined based on conditions in which it is critical to conserve water within the C-51 Basin and limit discharges of freshwater to tide.

Normal Mode of Operations

The Normal mode of operations is the default mode and shall be used when no in Water Conservation, Rainfall Conditional, Stage Conditional (Recovery) or Emergency modes operation. During the Normal mode of operations, ITID will have the flexibility and ability to manage its operations independently, and required communications and coordination efforts with the SFWMD will be minimal.

Stage Conditional (Recovery) Mode of Operations

The Stage Conditional (Recovery) mode of operations will occur when water levels immediately west of the S-155A divide structure reach a level within 0.5 feet below its design stage. During conditional operations, ITID will have reduced flexibility and ability to manage its operations independently, and required communications and coordination efforts with the SFWMD will be moderate.

Rainfall Conditional Mode of Operations

The Rainfall Conditional mode of operations will occur when measured rainfall or the total of measured and predicted rainfall (as determined by the National Weather Service [NWS] or the SFWMD Quantitative Precipitation Forecast [QPF]) for the Village of Royal Palm Beach [VRPB] in any 24-hour period exceeds 5.3 inches (three-year, one-day storm event).

Emergency Operations

The Emergency mode of operations will occur when one or more of the following exist:

1. The S-155A divide structure must be closed due to operational criteria set by the United States Army Corps of Engineers (USACE) in the Design Documentation Report C-51 Canal & Stormwater Treatment Area 1 East

2. The water level immediately west of the S-155A divide structure exceeds design conditions as specified in the USACE's Design Documentation Report C-51 Canal & Stormwater Treatment Area 1 East; or

3. An emergency has been declared in any portion of the C-51 Basin by the Governing Board of the SFWMD pursuant to Chapters 120.569(2)(d), 373.119, and 373.439,

Florida Statutes, and Rules 40E- 1.609(9) and 40E-4.451, Florida Administrative Code.

Refer to Table 1 for the operational requirements, maximum allowable discharges, and agencies' responsibilities regarding discharge from the M-1 Canal to the C-51 Canal. Refer to Table 2 seasonal operations schedule. Refer to Table 3 for the specific criteria defining each mode of operations.

OPERATIONS SCHEDULE
ITID'S M-1 BASIN TO THE SFWMD's C-51 CANAL

TABLE 1

<table>
<tr><th>Mode of Operations</th><th>Maximum Allowable Discharge from the M-1 Canal to the C-51 Canal</th><th>ITID Responsibilities</th><th>SFWMD Responsibilities</th></tr>
<tr><td>Water Conservation</td><td>720 cfs (all discharge to be made through the VRPB Amil gate)</td><td>Close all operable structures</td><td>Monitor overall C-51 conditions. Communicate and coordinate with ITID as necessary. Operate as necessary and in compliance with this operations schedule, the water control manual, and other requirements.</td></tr>
<tr><td>Normal</td><td>1,285 cfs</td><td>Operate Roach structure, 40th Street structure, and the operable structures at the Amil location so that total discharge from the VRPB auto Amil gate and the ITID operable gates does not exceed 1,285 cfs</td><td rowspan="3">Monitor overall C-51 conditions. Communicate and coordinate with ITID as necessary. Operate as necessary and in compliance with this operations schedule, the water control manual, and other requirements: 1) S-155 & S-155A to move discharges from west C-51 to east C-51 to to tide as needed; 2) S-319 to make discharges to STA-1E</td></tr>
<tr><td>Rainfall Conditional</td><td rowspan="2">720 cfs plus the conditional discharge. The conditional discharge is defined as the lesser of (a) the available hydraulic capacity of S-155A, or (b) 565 cfs, but not less than 200 cfs.</td><td rowspan="2">Operate Roach structure, 40th Street structure and operable structures at Amil location so as not to exceed the conditional discharge; coordinate with VRPB operations staff regarding stages in the M-1 Canal</td></tr>
<tr><td>Stage Conditional (Recovery)</td></tr>
<tr><td>Emergency</td><td>Maximum allowable discharge will vary and be set by SFWMD</td><td>Take part in coordination communications (e-mail/ teleconference) with SFWMD and VRPB operations staff; comply with emergency operational instructions issued by SFWMD</td><td>Issue operational instructions to ITID (and other in emergency area) via e-mail; teleconference specifying water levels and discharges required to coordinate emergency operations</td></tr>
</table>

OPERATIONS SCHEDULE
ITID'S M-1 BASIN TO THE SFWMD's C-51 CANAL

TABLE 2

Conditions						Discharge To		
Season	Months	Impoundment (ft NGVD)	Upper M-1 Basin (ft NGVD)		Lower M-1 Basin (ft NGVD)	L-8 Canal	C-51 Canal	M Canal via L-8 Plan/Pilot Pump Plan
Wet	Jun - Oct	≤16[1]	≤16	AND	≤15	NO	NO	When Authorized[2]
		>16[1]	≤16	AND	≤15	YES	NO	
		>16[1]	>16	AND/OR	>15	YES	YES[3]	
Dry	Nov - Apr	≤21	≤17	AND	≤17	NO	NO	
		>21	>17	AND/OR	>17	YES	YES[3]	
Transition	May	≤21	≤16	AND	≤15.5	NO	NO	
		>21	>16	AND/OR	>15.5	YES	YES[3]	

[1] 20-ft NGVD w/o the M-1 Impoundment Plans
[2] In accordance w/ the L-8 Plan or permanent agreement for the Pilot Pump Plan
[3] See Table 3

OPERATIONS SCHEDULE
ITID'S M-1 BASIN TO THE SFWMD's C-51 CANAL

TABLE 3

Mode of Operations	Surface Water Elevations: C-51 Canal		M-1 Canal w/in VRPB: @ 40th (TW)	M-1 Canal w/in VRPB: @ Okeechobee Blvd		M-1 Canal w/in VRPB: @ Amil		40th St. (HW) Lower M-1 Basin	Structure Operations/Conditions[3]: Auto Amil Gate (VRPB)	Structure Operations/Conditions[3]: Operable Gates @ Amil	Structure Operations/Conditions[3]: 40th St. & Roach Structures
	ft NGVD		ft NGVD	ft NGVD		ft NGVD		ft NGVD	ft NGVD	ft NGVD	ft NGVD
Water Conservation	S-155A HW<12.5; TW<11.2	AND	≤13.5	N/A	AND	≤13.8	AND	≤15.0 (Wet); ≤17.0 (Dry)	HW Open >13.8, Close ≤13.8	Close all operable structures: the order and rate of structure closures shall result in stages in VRPB such that 13.5 ≤ M-1	
Normal[1]		AND	≤14.9	N/A	AND	<14.5	AND	>15.0 (Wet); >17.0 (Dry)		Reasonably balance ITID discharge to M-1 Canal from Roach & 40th Street structures = discharge to C-51 from operable gates at Amil location	
		OR	>14.9	N/A	OR	>14.5	AND			Comply w/ criteria described in the Stage Conditional (Recovery) section below	
Rainfall Conditional[2]	N/A	N/A	N/A	>13.8	N/A	N/A	AND			Operate to achieve stages 13.5 ≤ M-1 Canal ≤ 13.8 at Okeechobee Blvd.	Reduce total discharges so stages are: 13.5 ≤ M-1 Canal ≤ 13.8 at Okeechobee Blvd.
Stage Conditional (Recovery)	S-155A 12.5≤HW≤13.0 or 11.2≤TW≤11.7							15.0<M-1 Basin<19.0 (Wet); 17.0<M-1 Basin<19.0 (Dry)		Operate Roach & 40th Street structures and operable structures at Amil location such that discharge from Roach & 40th Street structures does not exceed discharge from operable structure at Amil location and M-1 Canal stage does not exceed 14.9 immediately downstream of the 40th Street structure or 14.0 immediately upstream of the Amil location for more than 72 hours; after 72 hours reduce flow from Roach & 40th Street structures to 200 cfs (w/o SFWMD coordination) until M-1 Canal stage immediately south of the 40th Street structure <14.9.	
				15.5 < M-1 ≤ 16.0						Same as above for no more than 48 hours	
				16.0 < M-1 ≤ 16.5						Same as above for no more than 24 hours	
	S-155A HW≥12.5; TW≥11.2									See Emergency Mode of Operations	
Emergency	Declared Emergency per definition herein			N/A			OR	≥ 19.0		Up to **200 cfs** pass through flow from ITID to C-51 unless otherwise specified by SFWMD. Structures to be operated in compliance with instructions issued by SFWMD to ITID (and others in emergency area) specifying water levels and discharges. 16.5-ft NGVD is a stage of concern w/in the M-1 Canal and the SFWMD will make operations decisions to ensure this stage is protected.	

[1] Normal Conditions in VRPB are ≤14.9-ft NGVD in the M-1 Canal immediately downstream of the 40th St. structure and <14.5-ft NGVD in the M-1 Canal immediately upstream of the Amil location

[2] Pre-Event & During Event - Measured rainfall or the total of measured and predicted rainfall (as determined by the NWS or SFWMD) for VRPB in any 24-hr period exceeds 5.0 inches (three-year, one-day storm event). This mode of operation shall continue until the measured rainfall or total of measured and predicted rainfall is less than 5.0 inches in 24 hours. The resulting mode of operations shall be determined based on stages at the various locations specified herein.

[3] **The SFWMD, at its discretion, may allow greater or prescribe less discharge from the Roach & 40th Street Structures and/or the M-1 Canal into the C-51 Canal in any mode of operations based on conditions in the basin.**

APPENDIX D

AMIL GATE RATING CURVE

AMIL gates are manufactured in 21 standard sizes, designated AMIL D80, AMIL D90 . . . up to AMIL D800.

SELECTING YOUR AMIL GATE

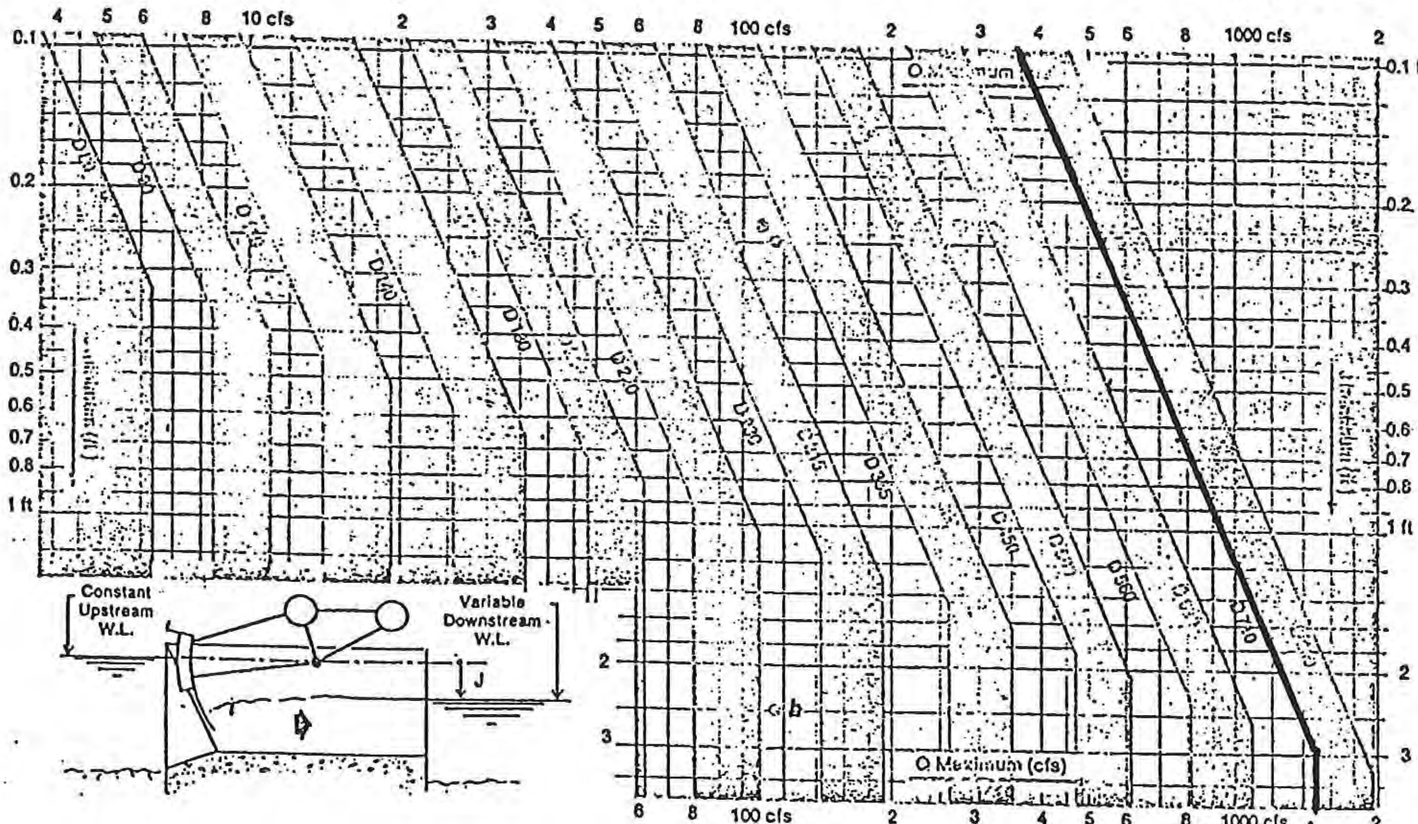
Plot on the chart below the point corresponding to:

1. *Maximum discharge* Q_M to be handled at the gate
2. *Minimum head differential* J_m available at maximum discharge for the equipped structure

Find the proper gate size on the first black line to the right of this point.

STAGE	ΔH	Q(CFS)
13.8'	0'	0
14.3'	0.5'	720
16.8'	3.0'	1500*

*ASSUMES NOT IN TAILWATER CONTROL



GATE SIZE SELECTION CHART
Hydraulic Data based on *TRANOR** *Standard Structure* (see next page)

Example 1:

The water level must be kept constant at elevation 54.00 ft in a canal, at a location where the maximum discharge is 115 cfs. Maximum tailwater elevation is 53.75 ft. Which gate is suitable?

The minimum head differential available for the equipped structure is J_m = 54.00 − 53.75 = 0.25 ft. Point a on the chart corresponds to Q_M = 115 cfs and J_m = 0.25 ft. The suitable gate size is the AMIL D355.

Note that for a head differential of 0.25 ft, the AMIL D355 capacity is 124 cfs.

Example 2:

The free surface elevation of a lake has to be maintained constant. The maximum discharge at the outlet is equal to 115 cfs and the drop is 2.50 ft. Which gate is suitable?

*Point **b** on the chart corresponds to the above data and the suitable gate size is now the AMIL D280.*

Note that the AMIL D280 has a maximum capacity of 142 cfs.

Source: Shalloway, Foy, Rayman, & Newell, Inc. 1997

FIGURE 26

APPENDIX E

DREDGING AND DEWATERING/DRYING OF DREDGED MATERIAL SPEC

SECTION 02482
DREDGING AND DEWATERING/DRYING OF DREDGED MATERIAL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals necessary and perform all dredging of Village of Royal Palm Beach and dewatering and drying of dredged material as shown on the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submit copies of all documentation required to establish compliance with the Contract Documents. Submittals shall include the following:

1. A work plan for the proposed work shall be submitted within 30 days of the Notice to Proceed. The work plan shall include descriptions of all methods, materials, equipment and incidentals being proposed to perform all the work as shown on the Drawings and as specified herein. Do not proceed any further until written approval of work plan has be received.

2. Technical product literature for all products to be used in the work.

3. Drawings showing the proposed drying/containment areas, identifying all access points, equipment and piping.

1.03 REFERENCE STANDARDS

A. ASTM International

1. ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3)(2,700kN-m/m^3).

2. ASTM D1777 - Standard Test Method for Thickness of Textile Materials.

3. ASTM D3776 - Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.

4. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

5. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.

6. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.

7. ASTM D4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

A. Be responsible for the timely installation and maintenance of all sedimentation and erosion control measures and all turbidity control curtains necessary to perform all dredging, dewatering and drying of dredged material and disposal of dried material as specified and as shown on the Drawings. Measures in addition to those shown on the Drawings shall be installed, maintained, removed and cleaned up at the expense of the Contractor.

B. All measures and methods shall conform to the requirements outlined in the Order of Conditions appended to this Section.

PART 2 PRODUCTS

2.01 TURBIDITY CONTROL CURTAIN

A. Turbidity control curtain shall consist of flexible polyester reinforced vinyl filter fabric dielectrically welded to provide an upper hem for enclosing flotation material and a lower hem for enclosing ballast material. Adequate flotation and ballast shall be provided for each installation. Each curtain shall be made up of one or more sections run from shoreline to shoreline, length as required per each installation. Multiple sections shall be connected using shackled and bolted load lines with reinforced PVC pipe for watertight fabric closure. Appropriate depth of fabric, flotation material and ballast shall be used for each installation.

B. Filter fabric for turbidity control curtains shall meet the following properties:

		Average Physical Property	ASTM Test Method
1.	Weight	6.2 oz/yd	D3776
2.	Thickness	15 mils	D1777
3.	Elongation at Break	28 percent (warp)	D4637 24 percent (fill)
4.	Puncture Strength	180 lbs	D4833
5.	A.O.S. Std. Sieve	70 to 100	D4751
6.	Flow Rate	23 gpm/sq ft	D4491

PART 3 EXECUTION

3.01 TURBIDITY CONTROL CURTAIN INSTALLATION

A. Turbidity control curtains shall be installed prior to commencing any dredging work. Turbidity curtains shall be used during the entire dredging operation to minimize increases in turbidity outside the area of dredging.

B. Permanent turbidity control curtains shall be installed as necessary and where shown on the Drawings. These shall remain in place during the entire period of dredging work and shall be removed only after final acceptance of the dredging work.

C. Temporary turbidity control curtains shall be installed both upstream and downstream of the dredging work and relocated as the work progresses. Temporary turbidity curtains shall also be installed adjacent to wetlands replacement areas to prevent siltation of newly planted areas.

D. All turbidity control curtains shall extend the full depth of the Canal and their depth adjusted as required to match new bottom contours as the dredging work progresses.

E. The turbidity control curtains shall be maintained in good operating condition during the entire period of dredging work.

3.02 DREDGING

A. The excavation work in Village of Royal Palm Beach shall proceed in accordance with the Order of Conditions appended to this Section and the Contractor's approved work plan. The excavation work shall consist of the removal of materials both above and below the water level.

B. Excavation work above the water level shall begin only after erosion control measures have been installed and the site has been prepared.

C. Excavation of material below the water surface shall be defined as dredging work and shall be by either hydraulic dredging or bucket dredging. Buckets shall be gasketed so as to minimize leakage. If bucket dredging is used, bucket shall be attached to a crane or derrick. Draglines, rigidly fixed to land, will not be allowed. Material removed by hydraulic dredging shall be piped directly to drying/containment areas. Material removed by bucket dredging shall also be removed to the drying/containment areas prior to its reuse or disposal as surplus material. Transport of bucket dredged material shall be by barge or truck or a combination of the two. All such transport shall be made on the site within the limits shown on the Drawings. Transport of dredged materials on public roadways will not be allowed.

D. Dredging of Village of Royal Palm Beach shall strictly conform to the new contours as shown on the Drawings. Care shall be exercised so as not to undercut or otherwise disturb the existing bank areas, except those areas specifically being removed.

E. Access to Village of Royal Palm Beach for dredging work shall be limited to those areas as shown on the Drawings. All bank and wetland areas disturbed by the dredging operations shall be restored to their original condition.

3.03 DEWATERING/DRYING OF DREDGED MATERIALS

A. Temporary drying/containment areas shall be constructed in locations as shown on the Drawings. They shall be made fully operational prior to any dredging work. A minimum of two drying/containment areas shall be available at all times so as to allow for the dredging work and dewatering/drying of dredged materials to occur simultaneously.

B. The drying/containment areas shall consist of earth embankments constructed of impervious material. The moisture content of the impervious material being compacted shall be maintained within the range of 2 percent below to 3 percent above the optimum moisture content as determined by ASTM D1557, Method D. Material, which is too wet shall be spread and permitted to dry, assisted by harrowing if necessary, until the moisture content is reduced to a workable level. If the moisture content of the material is too low, water shall be applied by sprinkler systems.

C. Adjustable decanting devices shall be installed in the drying/ containment areas to allow for the removal of supernatant from the dredged material being dewatered/dried. All supernatant shall be discharged to [___________] at the locations shown on the Drawings. Facilities for treatment of the supernatant shall be provided and maintained. Such facilities shall be adequate to assure that turbidity in the receiving water will not be increased by more than 25 nephelometric turbidity units (NTU), as measured by the Engineer. Turbidity measurements of the canal and discharges to the canal will be made by the Engineer on a daily basis.

D. The dredged material shall be dewatered/dried so that the moisture content is no greater than 20 percent as measured by ASTM D1557, Method D.

3.04 REUSE/DISPOSAL OF EXCAVATED MATERIALS

A. Excavated material shall be reused for embankment fill or backfill only after it has been dewatered/dried sufficiently for transport by truck.

B. Surplus excavated material and impervious material used for embankments shall become the property of the Contractor and shall be removed and disposed of by him/her off the site.

3.05 FINAL ACCEPTANCE OF DREDGING WORK

A. A bathometric survey of Village of Royal Palm Beach shall be conducted after completion of the dredging work. The survey shall be conducted by a registered land surveyor in the State of Florida whose work is procured and paid for by the Contractor. A final bathometric plan shall be prepared using a 50-ft grid system, showing 1-ft contours shall be prepared and submitted to the Engineer for review and approval.

B. The drying/containment areas and the permanent turbidity control curtains shall not be removed until Village of Royal Palm Beach has been surveyed and the final dredged contours accepted by the Engineer. The Engineer reserves the right to require additional dredging work if Engineer determines that the new contours have not been met.

END OF SECTION

APPENDIX F

MODEL RESULTS: TABLES OF PEAK STAGE

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
C51A_1	14.0	14.9	16.3
C51A_2	14.0	14.9	16.3
C51B	14.0	14.9	16.3
C51C	14.0	14.9	16.3
C51D	11.5	12.4	13.9
C51E	11.5	12.4	13.9
C51F	14.0	14.9	16.3
C51G	14.0	14.9	16.3
ITID_LowM1	18.5	19.0	19.4
ITID_UpM1	19.1	19.8	20.3
LW0050	11.7	12.9	14.3
LW0100	11.6	12.8	14.3
LW0150	11.6	13.8	14.7
LW0200	11.6	12.8	14.3
LW0300	11.6	12.8	14.3
LW0350	11.6	12.8	14.3
LW0370	11.6	12.8	14.3
LW0380	11.6	12.7	14.2
LW0400	11.6	12.7	14.2
LW2970	11.8	13.6	15.0
LW2975	11.8	13.6	15.0
LW450	12.5	14.8	16.2
LW450S	13.6	15.0	16.0
LW451	12.6	14.9	16.0
LW500S	13.7	14.9	16.2
LW501	13.3	14.8	16.3
LW505	12.6	14.8	16.2
LW510	12.6	14.8	16.2
LW8900	11.9	13.9	15.4
LW9000	11.9	13.9	15.4
LW9100	11.9	13.9	15.4
LW9200	11.9	13.8	15.4
LW9210	12.5	14.8	16.2
LW9215	11.9	13.8	15.4
LW9220	11.9	13.7	15.3
LW9225	12.8	14.1	15.1
LW9226	12.0	14.0	15.0
LW9240	11.9	13.8	15.1
LW9250	11.8	13.6	15.1
LW9300	11.8	13.5	15.0
LW9400	11.7	13.3	14.7
LW9500	11.7	13.3	14.7
LW9600	11.7	13.1	14.5
LW9650	11.7	13.1	14.5
LW9700	14.3	15.2	15.9

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
LW9750	13.9	15.1	15.9
LW9800	11.7	13.0	14.4
LW9900	11.7	13.0	14.4
LW9901	12.5	14.7	16.0
LWS100S	14.0	14.9	16.3
LWS110	14.0	14.9	16.3
LWS200S	13.9	14.9	16.1
LWS300S	14.1	15.2	16.1
LWS310	14.0	14.9	16.3
LWS320	14.0	14.9	16.3
LWS330	14.0	14.9	16.3
LWS340	14.0	14.9	16.3
LWS350	14.0	14.9	16.3
LWS400S	15.3	16.1	17.1
LWS410	15.3	16.2	17.3
LWS500S	15.7	15.9	16.2
LWS520	15.7	15.9	16.2
OD100	16.8	17.9	18.4
OD110	15.1	15.1	18.4
RP1000	14.8	15.6	16.5
RP1050	14.8	15.6	16.5
RP1100	14.7	15.6	16.5
RP1120S	14.8	15.6	16.5
RP1160S	15.5	16.1	16.6
RP1200	14.7	15.6	16.5
RP1200S	15.1	15.9	16.6
RP1210S	17.7	18.0	18.3
RP1211S	15.3	16.1	16.7
RP1215S	17.9	18.0	18.2
RP1220S	15.3	15.9	16.5
RP1230S	15.6	16.0	16.6
RP1240S	15.7	16.2	16.7
RP1250S	15.3	15.8	16.6
RP1260S	15.8	16.1	16.6
RP1300	14.7	15.5	16.5
RP1300S	15.1	15.8	16.6
RP1400	14.7	15.5	16.5
RP1400S	15.6	16.6	17.4
RP1440S	15.4	16.4	17.1
RP1441	15.3	16.3	17.5
RP1480S	15.6	16.4	17.5
RP1481	15.5	16.4	18.2
RP150	16.8	17.9	18.3
RP1500	14.7	15.5	16.5
RP1500S	15.9	16.2	16.9

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
RP155	14.8	15.7	17.2
RP1600	14.7	15.5	16.5
RP1650	14.7	15.5	16.5
RP1700	14.7	15.5	16.5
RP1700S	15.4	15.9	16.5
RP1800	14.6	15.4	16.5
RP1800S	15.7	16.2	16.8
RP1900	14.6	15.4	16.5
RP1900S	14.8	15.6	16.5
RP1925	14.0	14.9	16.3
RP200	14.8	15.6	16.5
RP2000	14.6	15.4	16.5
RP2000S	16.1	16.5	17.0
RP2020S	16.4	16.7	17.0
RP2040S	15.7	16.2	16.7
RP2060S	15.4	15.9	16.5
RP2100S	15.6	16.1	16.6
RP2200S	15.3	15.8	16.5
RP2250S	14.9	16.2	17.3
RP230	17.7	18.1	18.3
RP235	17.7	18.1	18.3
RP2350S	15.6	16.1	16.5
RP240	17.7	18.1	18.3
RP2400	14.0	14.9	16.3
RP2400S	15.7	16.2	16.7
RP250	17.7	18.1	18.2
RP2500	14.0	14.9	16.3
RP2500S	15.1	15.6	16.5
RP255	18.3	18.8	19.0
RP260	14.8	15.6	16.5
RP2600S	15.4	16.0	16.6
RP2650S	15.4	15.8	16.5
RP270	14.8	15.6	16.5
RP2700	16.8	17.8	18.2
RP2700S	14.7	15.5	16.5
RP2800S	15.7	16.1	16.5
RP2805	14.7	15.6	16.5
RP2900	16.2	17.8	18.1
RP2900S	15.5	15.8	16.5
RP3000	14.7	15.5	16.5
RP3000S	16.4	16.7	17.2
RP3002	14.7	15.5	16.5
RP3005	14.7	15.5	16.5
RP3010	14.7	15.5	16.5
RP3100	14.7	15.5	16.5

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
RP3100S	15.6	16.1	16.5
RP3200	14.7	15.5	16.5
RP3200S	15.3	15.8	16.5
RP3202	14.7	15.5	16.5
RP3205	14.7	15.5	16.5
RP3210	14.7	15.5	16.5
RP325	14.8	15.6	16.5
RP3300	14.7	15.5	16.5
RP330S	14.8	15.6	16.5
RP3350	14.7	15.5	16.5
RP335S	15.1	16.0	16.6
RP338	14.8	15.6	16.5
RP3400	15.8	16.9	17.2
RP3400S	15.3	16.3	16.8
RP340S	15.0	15.6	16.5
RP3450	15.5	16.3	16.8
RP3450S	15.6	16.4	17.0
RP3500	14.6	15.4	16.5
RP3500S	15.2	15.7	16.5
RP3550	15.5	16.1	16.6
RP3550S	14.7	15.5	16.5
RP3600	15.5	16.1	16.6
RP3600S	14.9	15.6	16.5
RP3650S	17.3	17.5	17.6
RP3700	14.6	15.4	16.5
RP3700S	16.3	16.6	16.8
RP3740S	16.3	16.5	16.8
RP3780S	15.4	15.7	16.5
RP3790S	14.8	15.6	16.5
RP3800S	15.2	15.7	16.5
RP3900	14.6	15.4	16.5
RP400	14.8	15.6	16.5
RP4000	14.6	15.4	16.5
RP4000S	14.7	15.5	16.5
RP4100	14.8	15.6	16.5
RP4100S	14.7	15.5	16.5
RP4200	14.8	15.6	16.5
RP4200S	14.7	15.5	16.5
RP4250S	14.7	15.5	16.5
RP4300	14.8	15.6	16.5
RP4300S	15.3	16.1	16.6
RP4340S	16.2	16.9	17.2
RP4380S	15.6	16.3	16.6
RP4400	14.8	15.6	16.5
RP4500	14.8	15.6	16.5

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
RP4500S	15.8	16.9	17.2
RP4530S	15.8	16.9	17.2
RP4550	14.8	15.6	16.5
RP4550S	14.8	16.0	16.6
RP4580S	14.8	15.8	16.7
RP4600	14.8	15.6	16.5
RP4700	14.8	15.6	16.5
RP4700S	16.1	16.5	16.8
RP4800	14.8	15.6	16.5
RP4900	14.8	15.6	16.5
RP4950	14.8	15.6	16.5
RP4950S	15.9	16.9	17.2
RP4970	14.8	15.6	16.5
RP500	14.8	15.6	16.5
RP5000	14.8	15.6	16.5
RP5000S	15.8	16.3	16.8
RP500S	16.8	17.0	17.4
RP5200S	16.2	16.5	16.8
RP5300	16.4	16.7	16.9
RP5301	16.5	16.7	17.0
RP5350S	16.9	17.8	18.2
RP5400	16.1	16.4	16.9
RP5400S	16.1	16.3	16.7
RP5500	15.2	15.9	16.6
RP5500S	15.3	15.9	16.7
RP5510	15.5	16.2	16.8
RP5515	15.5	16.2	16.8
RP5520	15.5	16.2	16.8
RP5525	15.5	16.2	16.8
RP5526	14.8	15.6	16.5
RP5527	14.8	15.6	16.5
RP5600	14.8	15.6	16.5
RP5700	14.8	15.6	16.5
RP5725	14.8	15.6	16.5
RP5750	14.8	15.6	16.5
RP5775	14.8	15.6	16.5
RP5800	14.8	15.6	16.5
RP5900	14.8	15.6	16.5
RP600	14.8	15.6	16.5
RP6000	14.7	15.5	16.5
RP600S	17.3	17.5	17.6
RP6200	14.7	15.5	16.5
RP6250	14.7	15.5	16.5
RP6300	14.7	15.5	16.5
RP6400	14.7	15.5	16.5

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
RP6500	14.7	15.5	16.5
RP6550	14.7	15.5	16.5
RP6600	14.7	15.5	16.5
RP6700	14.7	15.5	16.5
RP6800	14.7	15.5	16.5
RP6900	14.7	15.6	16.5
RP700	14.8	15.6	16.5
RP7000	14.3	15.5	16.7
RP700S	15.3	15.8	16.6
RP7100	14.7	15.5	16.5
RP7200	14.7	15.5	16.5
RP7250	14.7	15.5	16.5
RP7300	14.7	15.5	16.5
RP7350	14.7	15.5	16.5
RP7355	14.7	15.5	16.5
RP7400	14.7	15.5	16.5
RP7500	14.7	15.5	16.5
RP750S	15.9	16.4	17.1
RP7600	14.1	14.9	16.2
RP7700	14.1	14.9	16.2
RP7750	14.1	15.0	16.3
RP7800	16.8	17.3	17.6
RP7825	14.1	14.9	16.2
RP7850	14.1	14.9	16.2
RP7900	14.1	14.9	16.2
RP800	14.8	15.6	16.5
RP8000	14.1	14.9	16.2
RP800S	15.7	16.0	16.6
RP8010	14.1	15.0	16.5
RP8025	14.1	14.9	16.2
RP8030	14.1	14.9	16.2
RP8050	14.1	14.9	16.2
RP8100	14.1	14.9	16.2
RP825	14.8	15.6	16.5
RP8404	15.2	16.1	16.7
RP8406	15.1	15.9	16.6
RP8408	15.0	15.9	16.5
RP8410	14.4	15.6	16.4
RP8415	14.3	15.4	16.4
RP8420	14.1	15.0	16.3
RP850	14.8	15.6	16.5
RP900	14.8	15.6	16.5
RPC51100	15.5	15.8	16.5
RPC51200	14.4	15.8	16.5
RPC51400	15.1	16.1	16.7

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
RPC51500	15.3	16.0	16.5
RPN100	15.0	15.9	16.5
RPN110	14.3	15.5	16.4
RPN450	16.1	16.6	16.8
RPN600	17.7	17.9	18.1
RPN650	15.7	16.1	16.6
RPN660	17.0	17.8	18.2
RPN700	17.0	17.8	18.2
RPN800	17.1	17.8	18.2
RPN900	17.1	17.9	18.3
RPNA-100	18.3	18.8	19.0
SyphonDS	18.5	19.1	19.4
SyphonUS	18.8	19.4	19.9

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
C51A_1	14.0	14.9	16.3
C51A_2	14.0	14.9	16.3
C51B	14.0	14.9	16.3
C51C	14.0	14.9	16.3
C51D	11.5	12.4	13.9
C51E	11.5	12.4	13.9
C51F	14.0	14.9	16.3
C51G	14.0	14.9	16.3
ITID_LowM1	18.2	18.8	19.2
ITID_UpM1	19.0	19.8	20.3
LW0050	11.7	12.9	14.3
LW0100	11.6	12.8	14.3
LW0150	11.6	13.8	14.7
LW0200	11.6	12.8	14.3
LW0300	11.6	12.8	14.3
LW0350	11.6	12.8	14.3
LW0370	11.6	12.8	14.3
LW0380	11.6	12.7	14.2
LW0400	11.6	12.7	14.2
LW2970	11.8	13.6	15.0
LW2975	11.8	13.6	15.0
LW450	12.5	14.8	16.2
LW450S	13.6	15.0	16.0
LW451	12.6	14.9	16.0
LW500S	13.7	14.9	16.2
LW501	13.3	14.8	16.2
LW505	12.6	14.8	16.2
LW510	12.6	14.8	16.2
LW8900	11.9	13.9	15.4
LW9000	11.9	13.9	15.4
LW9100	11.9	13.9	15.4
LW9200	11.9	13.8	15.4
LW9210	12.5	14.8	16.2
LW9215	11.9	13.8	15.4
LW9220	11.9	13.7	15.3
LW9225	12.8	14.1	15.1
LW9226	12.0	14.0	15.0
LW9240	11.9	13.8	15.1
LW9250	11.8	13.6	15.0
LW9300	11.8	13.5	15.0
LW9400	11.7	13.3	14.7
LW9500	11.7	13.3	14.7
LW9600	11.7	13.1	14.5
LW9650	11.7	13.1	14.5
LW9700	14.3	15.2	15.9

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
LW9750	13.9	15.1	15.9
LW9800	11.7	13.0	14.4
LW9900	11.7	13.0	14.4
LW9901	12.5	14.7	16.0
LWS100S	14.0	14.9	16.3
LWS110	14.0	14.9	16.3
LWS200S	13.9	14.9	16.1
LWS300S	14.1	15.2	16.1
LWS310	14.0	14.9	16.3
LWS320	14.0	14.9	16.3
LWS330	14.0	14.9	16.3
LWS340	14.0	14.9	16.3
LWS350	14.0	14.9	16.3
LWS400S	15.3	16.1	17.1
LWS410	15.3	16.2	17.3
LWS500S	15.7	15.9	16.2
LWS520	15.7	15.9	16.2
OD100	16.8	17.9	18.4
OD110	15.1	15.1	18.4
RP1000	14.8	15.6	16.6
RP1050	14.8	15.6	16.6
RP1100	14.7	15.6	16.5
RP1120S	14.8	15.6	16.6
RP1160S	15.5	16.1	16.6
RP1200	14.7	15.6	16.5
RP1200S	15.2	16.0	16.6
RP1210S	17.7	18.0	18.3
RP1211S	15.4	16.1	16.7
RP1215S	17.9	18.0	18.2
RP1220S	15.3	15.9	16.6
RP1230S	15.6	16.0	16.6
RP1240S	15.7	16.2	16.7
RP1250S	15.3	15.8	16.6
RP1260S	15.8	16.1	16.6
RP1300	14.7	15.5	16.5
RP1300S	15.1	15.8	16.6
RP1400	14.7	15.5	16.5
RP1400S	15.6	16.6	17.4
RP1440S	15.4	16.4	17.1
RP1441	15.3	16.3	17.5
RP1480S	15.6	16.4	17.5
RP1481	15.5	16.4	18.2
RP150	16.8	17.9	18.3
RP1500	14.7	15.5	16.5
RP1500S	15.9	16.2	16.9

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
RP155	14.8	15.8	17.3
RP1600	14.7	15.5	16.5
RP1650	14.6	15.5	16.5
RP1700	14.6	15.5	16.5
RP1700S	15.4	15.9	16.5
RP1800	14.6	15.4	16.5
RP1800S	15.7	16.2	16.8
RP1900	14.5	15.4	16.5
RP1900S	14.8	15.6	16.6
RP1925	14.0	15.0	16.3
RP200	14.8	15.6	16.6
RP2000	14.5	15.4	16.5
RP2000S	16.1	16.5	17.0
RP2020S	16.4	16.7	17.0
RP2040S	15.7	16.2	16.7
RP2060S	15.4	15.9	16.5
RP2100S	15.6	16.1	16.6
RP2200S	15.3	15.8	16.5
RP2250S	14.9	16.3	17.3
RP230	17.7	18.1	18.3
RP235	17.7	18.1	18.3
RP2350S	15.6	16.1	16.5
RP240	17.7	18.1	18.3
RP2400	14.1	15.0	16.3
RP2400S	15.7	16.2	16.7
RP250	17.7	18.1	18.2
RP2500	14.1	15.0	16.3
RP2500S	15.1	15.6	16.5
RP255	18.3	18.8	19.0
RP260	14.8	15.6	16.6
RP2600S	15.4	16.0	16.6
RP2650S	15.4	15.8	16.5
RP270	14.8	15.6	16.6
RP2700	16.8	17.8	18.2
RP2700S	14.7	15.5	16.5
RP2800S	15.7	16.1	16.5
RP2805	14.7	15.5	16.5
RP2900	16.2	17.8	18.1
RP2900S	15.5	15.8	16.5
RP3000	14.7	15.6	16.5
RP3000S	16.4	16.7	17.2
RP3002	14.7	15.6	16.5
RP3005	14.7	15.6	16.5
RP3010	14.7	15.6	16.5
RP3100	14.7	15.5	16.5

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
RP3100S	15.6	16.1	16.5
RP3200	14.7	15.6	16.5
RP3200S	15.3	15.8	16.5
RP3202	14.7	15.6	16.5
RP3205	14.7	15.6	16.5
RP3210	14.7	15.6	16.5
RP325	14.7	15.6	16.5
RP3300	14.7	15.5	16.5
RP330S	14.7	15.6	16.5
RP3350	14.7	15.5	16.5
RP335S	15.1	16.0	16.6
RP338	14.7	15.6	16.5
RP3400	15.8	16.9	17.2
RP3400S	15.3	16.3	16.8
RP340S	15.0	15.6	16.5
RP3450	15.5	16.3	16.8
RP3450S	15.6	16.4	17.0
RP3500	14.6	15.4	16.5
RP3500S	15.2	15.7	16.5
RP3550	15.5	16.1	16.6
RP3550S	14.7	15.5	16.5
RP3600	15.5	16.1	16.6
RP3600S	14.9	15.6	16.5
RP3650S	17.3	17.5	17.6
RP3700	14.6	15.4	16.5
RP3700S	16.3	16.6	16.8
RP3740S	16.3	16.5	16.8
RP3780S	15.4	15.7	16.5
RP3790S	14.8	15.6	16.5
RP3800S	15.2	15.7	16.5
RP3900	14.6	15.4	16.5
RP400	14.8	15.6	16.6
RP4000	14.6	15.4	16.5
RP4000S	14.7	15.5	16.5
RP4100	14.8	15.6	16.6
RP4100S	14.7	15.5	16.5
RP4200	14.8	15.6	16.6
RP4200S	14.6	15.5	16.5
RP4250S	14.7	15.5	16.5
RP4300	14.8	15.6	16.6
RP4300S	15.2	16.1	16.6
RP4340S	16.2	16.9	17.2
RP4380S	15.5	16.2	16.6
RP4400	14.8	15.6	16.6
RP4500	14.8	15.6	16.6

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
RP4500S	15.8	16.9	17.2
RP4530S	15.8	16.9	17.2
RP4550	14.8	15.6	16.6
RP4550S	14.7	15.9	16.6
RP4580S	14.8	15.8	16.7
RP4600	14.8	15.6	16.6
RP4700	14.8	15.6	16.6
RP4700S	16.1	16.5	16.8
RP4800	14.8	15.6	16.6
RP4900	14.8	15.6	16.6
RP4950	14.8	15.6	16.6
RP4950S	15.9	16.9	17.2
RP4970	14.8	15.6	16.6
RP500	14.8	15.6	16.6
RP5000	14.8	15.6	16.6
RP5000S	15.8	16.3	16.8
RP500S	16.8	17.0	17.4
RP5200S	16.2	16.5	16.8
RP5300	16.4	16.7	16.9
RP5301	16.5	16.7	16.9
RP5350S	16.9	17.8	18.2
RP5400	16.1	16.4	16.9
RP5400S	16.1	16.3	16.7
RP5500	15.2	15.9	16.6
RP5500S	15.3	15.8	16.7
RP5510	15.5	16.2	16.8
RP5515	15.5	16.2	16.8
RP5520	15.5	16.2	16.8
RP5525	15.5	16.2	16.8
RP5526	14.8	15.6	16.6
RP5527	14.8	15.6	16.6
RP5600	14.8	15.6	16.6
RP5700	14.8	15.6	16.6
RP5725	14.8	15.6	16.6
RP5750	14.8	15.6	16.6
RP5775	14.8	15.6	16.6
RP5800	14.8	15.6	16.6
RP5900	14.8	15.6	16.6
RP600	14.8	15.6	16.6
RP6000	14.7	15.5	16.5
RP600S	17.3	17.5	17.6
RP6200	14.7	15.5	16.5
RP6250	14.7	15.5	16.5
RP6300	14.7	15.5	16.5
RP6400	14.7	15.5	16.5

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
RP6500	14.7	15.5	16.5
RP6550	14.7	15.5	16.5
RP6600	14.7	15.5	16.5
RP6700	14.7	15.5	16.5
RP6800	14.7	15.5	16.5
RP6900	14.7	15.6	16.5
RP700	14.8	15.6	16.6
RP7000	14.3	15.5	16.7
RP700S	15.3	15.9	16.6
RP7100	14.7	15.5	16.5
RP7200	14.7	15.5	16.5
RP7250	14.7	15.5	16.5
RP7300	14.6	15.5	16.5
RP7350	14.6	15.5	16.5
RP7355	14.6	15.5	16.5
RP7400	14.6	15.5	16.5
RP7500	14.6	15.5	16.5
RP750S	15.9	16.4	17.1
RP7600	14.1	14.9	16.2
RP7700	14.1	14.9	16.2
RP7750	14.1	15.0	16.3
RP7800	16.8	17.3	17.6
RP7825	14.1	14.9	16.2
RP7850	14.1	14.9	16.2
RP7900	14.1	14.9	16.2
RP800	14.8	15.6	16.6
RP8000	14.1	14.9	16.2
RP800S	15.7	16.0	16.6
RP8010	14.1	15.0	16.5
RP8025	14.1	14.9	16.2
RP8030	14.1	14.9	16.2
RP8050	14.1	14.9	16.2
RP8100	14.1	14.9	16.2
RP825	14.8	15.6	16.6
RP8404	15.2	16.1	16.7
RP8406	15.1	15.9	16.6
RP8408	15.0	15.9	16.5
RP8410	14.4	15.6	16.4
RP8415	14.4	15.4	16.4
RP8420	14.1	15.0	16.3
RP850	14.8	15.6	16.6
RP900	14.8	15.6	16.6
RPC51100	15.5	15.8	16.5
RPC51200	14.4	15.8	16.5
RPC51400	15.1	16.1	16.7

Node	Peak Stage (ft NAVD)		
	10-year, 24-hour	25-year, 72-hour	100-year, 72-hour
RPC51500	15.3	16.0	16.5
RPN100	15.0	15.9	16.5
RPN110	14.3	15.5	16.4
RPN450	16.1	16.6	16.8
RPN600	17.7	17.9	18.1
RPN650	15.7	16.1	16.6
RPN660	17.0	17.8	18.2
RPN700	17.0	17.8	18.2
RPN800	17.1	17.8	18.2
RPN900	17.1	17.9	18.3
RPNA-100	18.3	18.8	19.0
SyphonDS	18.3	18.8	19.3
SyphonUS	18.6	19.3	19.8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