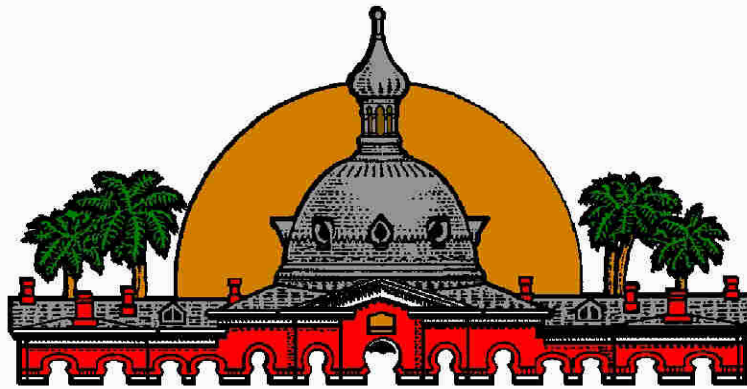


BROOKER CREEK AREA

STORMWATER MANAGEMENT MASTER PLAN (UPDATE NO. 2)



Hillsborough County
Florida

Updated By

PBS&J

Tampa, Florida

Original Dated: September 1998

Update: October 2001

Update: September 2006

BROOKER CREEK AREA

STORMWATER MANAGEMENT MASTER PLAN UPDATE

Prepared for the Hillsborough County Board of
County Commissioners

Update By

PBS&J
September 2006

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1.0 INTRODUCTION

1.1 Project Location and Description

The Brooker Creek Area (BCA) watershed lies in the northwest portion of Hillsborough County. It drains approximately 22 square miles and is composed primarily of rural / agricultural lands and single family residential land use. Development is concentrated around the lake chains. **Figures 1-1 and 1-2 show** the BCA location map and watershed boundary.

The watershed has two major conveyance systems. These two loosely connected systems drain separately the northern and southern portions of the watershed. The northern system is drained by Brooker Creek itself, which in its eastern half is comprised of several lake chains and wetland storage areas that form the creek's upper reaches. Brooker Creek runs in an east to west direction and eventually outfalls to Lake Tarpon in Pinellas County.

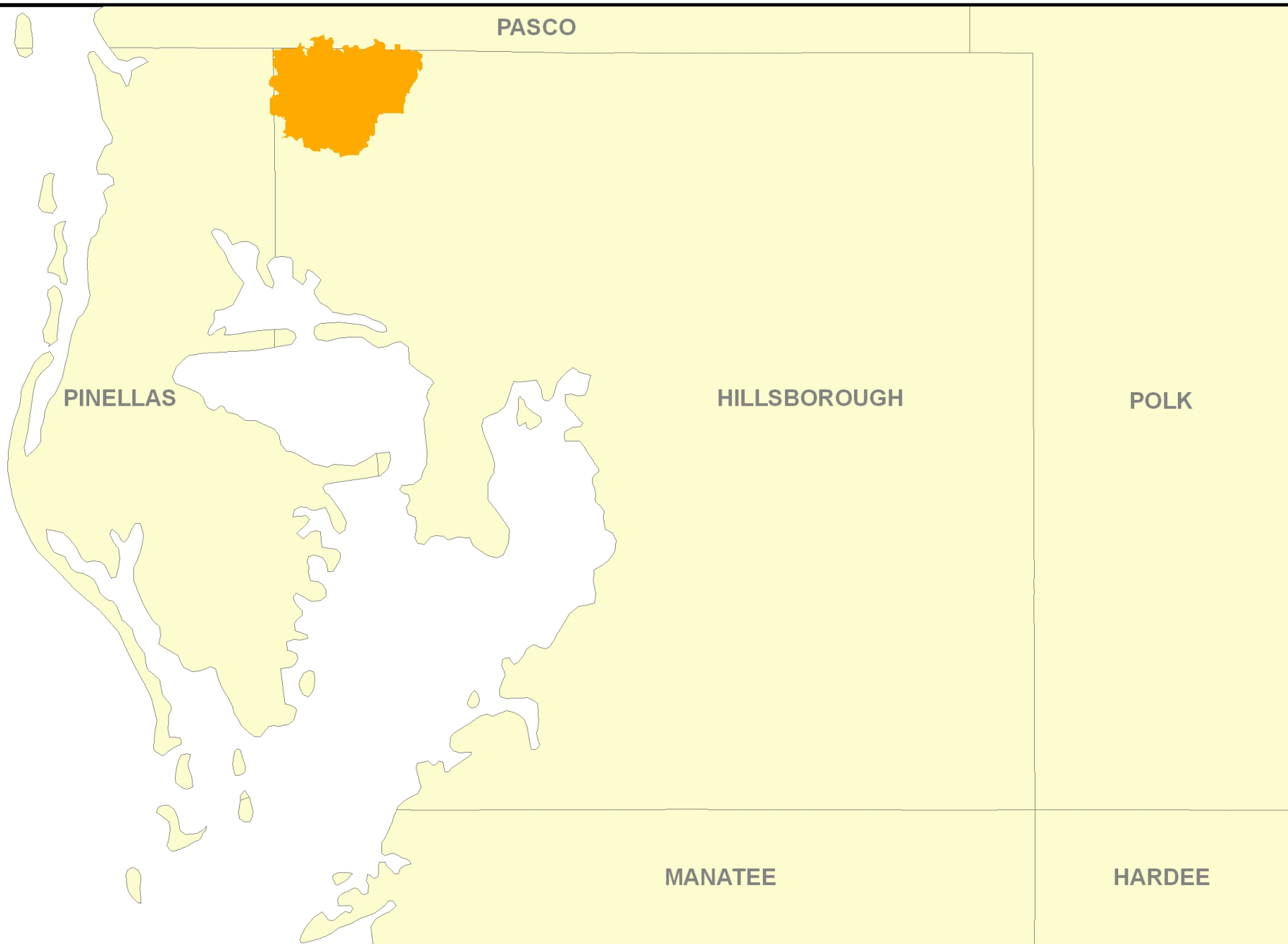
The southern system is comprised of a lake chain and wetland systems that drain under Patterson Road and ultimately discharge into the Pinellas County portion of the watershed. The northern and southern systems are partially interconnected by small diameter pipes in the area of Patterson Road.

1.2 Purpose and Scope

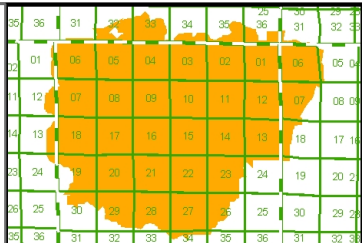
The purpose of this study was to update an existing conditions hydrologic and hydraulic (H&H) model for the BCA watershed and re-evaluate improvement projects recommended in the previous Watershed Management Plan (WMP). The WMP proposed improvements are based on an evaluation of the flood protection levels of service (FPLOS) and an identification of improvements necessary to correct any deficiencies.

The objectives of the H&H model update were to:

- Make model improvements necessary to meet the requirements of the Southwest Florida Water Management District (District) Watershed Management Program Guidelines and Specifications (G&S), per the comments provided in the District's model review as well as further analysis conducted as part of this project. In this manner, the model will be considered as "best available information" for County stormwater permitting as well as for the District's Environmental Resource Permit (ERP) process.
- Make use of the recent digital topographic data obtained by the County, including the datum conversion from the 1929 National Geodesic Vertical Datum (NGVD) to the 1983 North American Vertical Datum (NAVD).
- Be able to use the model for any potential modification of the FEMA regulatory floodplain.
- Reflect recent land use changes in the watershed.
- Make adjustments to account for changes in watershed boundaries to conform with those



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Legend

- Watershed Boundary
- State Counties

Notes:

This area is used for general map note information such as map accuracy/standards, source information, elevation information, etc.

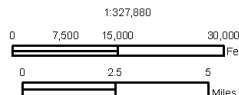


Figure 1-1: Location Map

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan Update

Filename:

Map 1.mxd

Map Date:

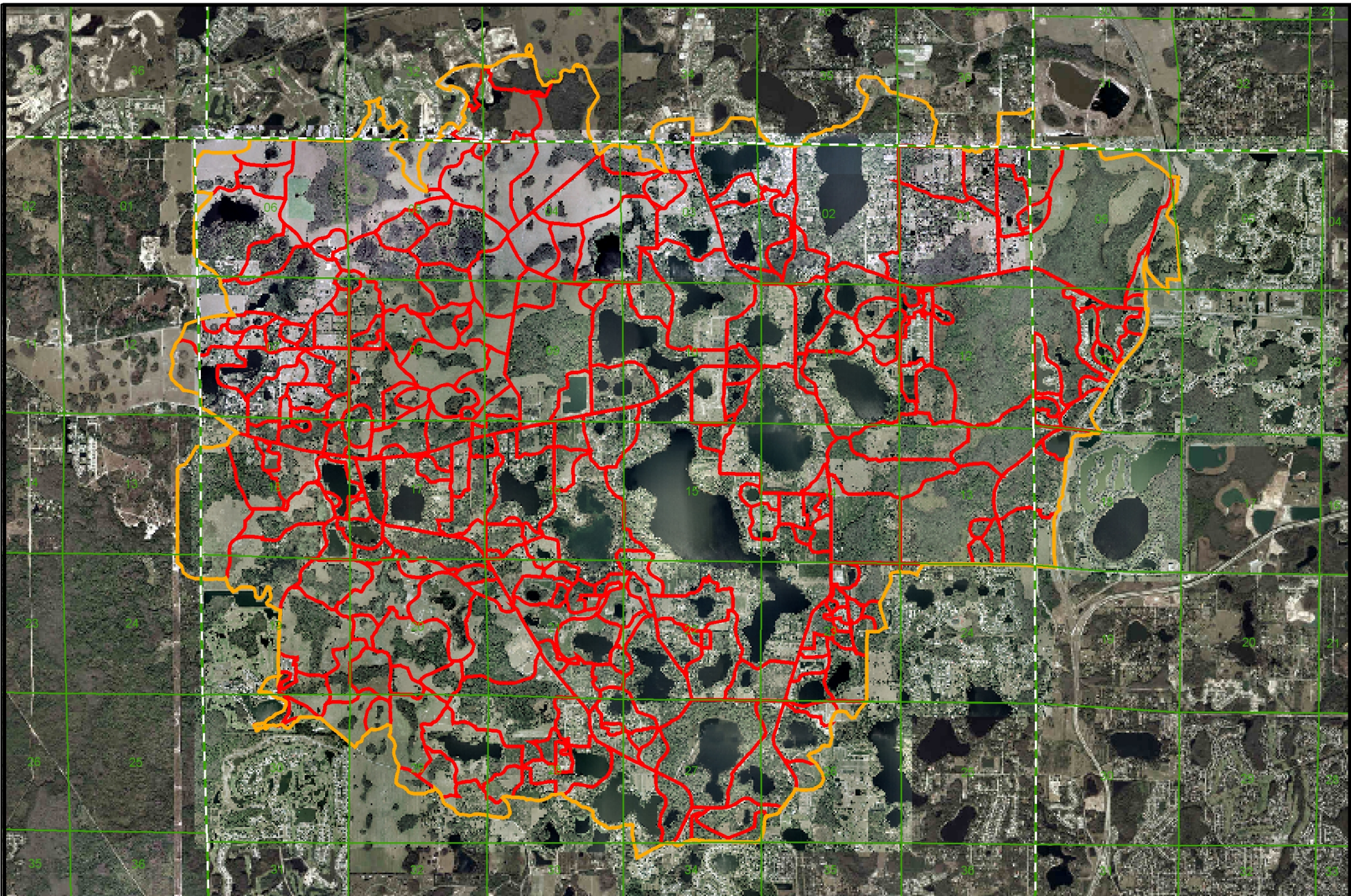
6-21-06

Map Prepared By:

PBS&J

Date of Photography:

2004



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Legend

- Roads
- Township/Range
- Section, Township, Range
- Watershed Boundary
- Subbasin Boundaries

Notes:

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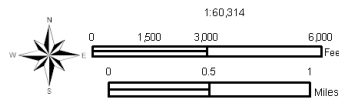


Figure 1-2: Watershed Boundary Map

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan Update

Filename: Map2.mxd

Map Date: 6-21-06

Map Prepared By: PBS&J

Date of Photography:

2004

of adjacent watersheds

The scope for this project included an evaluation of the watershed existing and proposed H&H conditions based on six design storm events of 24-hour duration and return periods of 2.33, 5, 10, 25, 50 and 100 years.

This project was jointly funded by Hillsborough County and the Southwest Florida Water Management District's (SWFWMD) Northwest Hillsborough Basin.

1.3 Background

In 1996 Hillsborough County developed an H&H model for the Brooker Creek watershed using the Hillsborough County Stormwater Management Modeling System (HILLSMMS), a predecessor of the current Hillsborough County Stormwater Management Model (HC-SWMM), which is the County's current standard modeling software. The model was developed using the available aerial contour maps (1989) and survey information from 1995. This model was stabilized, but required further calibration. The calibration process was undertaken in 1997. Work at that time also included generation of a Watershed Management Plan (WMP) report that was completed in 1998.

In August 2001, Hillsborough County completed an update of the WMP that included:

- Updating the HILLSMMS model to the new HC-SWMM version.
- Renumbering all of nodes and junctions to include the BCA descriptor number 49 for easy identification of the watershed.
- The addition of new land use features or significant physical changes that occurred in the watershed during the period from 1995 – 2000 (e.g. new roads, developments, stormwater projects, etc.).

The update also included additional verification of the previous model calibration using the September and December 1997 storm events. This made the process consistent with watershed management planning efforts conducted for other watersheds.

2.0 WATERSHED DESCRIPTION

2.1 INTRODUCTION

This chapter describes the climatic, physiography and hydrology, geology and hydrogeology, and soils and land use characteristics of the Brooker Creek Area (BCA) watershed.

2.2 CLIMATE

The Hillsborough County climate as a whole can be classified as humid subtropical. Annual average precipitation is around 52 inches and almost 60% of this total falls during the four-month rainy season that extends from June through September. This time frame coincides with the occurrence of most tropical storms and hurricanes and the conditions are ripe for regular, convective afternoon and evening thunderstorms. These summer events, which can be very localized, are highly variable in both intensity and volume. Larger summer storm events, particularly those associated with tropical systems, can cause flooding problems in areas where the capacity of the existing stormwater system is inadequate to convey stormwater flows.

Winter rainfall is, historically, relatively light and is generally associated with the weak cold fronts that descend from the northern part of the country and travel south through the region. However, some of the largest rain events have occurred in the winter months. Examples are the events that occurred in late 1997 and early 1998 during the El Nino weather phenomenon.

The mean annual temperature in Hillsborough County is approximately 72° F (Fahrenheit). The mean monthly temperature ranges from a low of approximately 60° F in January to a high of approximately 82° F in August. Typically, summer temperatures range from morning lows in the high 70's and low 80's to afternoon highs that routinely reach into the mid-90's, but rarely do they exceed 100° F. Summer humidity ranges into the mid to upper 90's. Conversely, typical winter low temperatures generally range above freezing into the 40's; only occasionally dropping into the low 20's and teens. High temperatures generally reach into the upper 60's or low 70's for most of the season, especially between passages of the cold fronts.

2.3 SOILS

Soil properties that influence hydrologic conditions, particularly infiltration rates are: a) depth to the water table, b) soil permeability, and c) depth to a layer or layers that slow or impede water movement. For hydrologic analysis purposes, soils are grouped into four categories A, B, C, and D depending on infiltration capacity. The major hydrologic soil groups are:

- Group A (low runoff potential) soils have high infiltration rates and a high rate of water transmission even when thoroughly wetted. They have typical infiltration rates of 10 in./hr when dry and 0.50 in./hr when saturated.

- Group B (moderately runoff potential) soils have moderate infiltration rates when thoroughly wetted and a moderate rate of water transmission. They have typical infiltration rates of 8 in./hr when dry and 0.40 in./hr when saturated.
- Group C (moderately high runoff potential) soils have low infiltration rates when thoroughly wetted and a low rate of water transmission. They have typical infiltration rates of 5 in./hr when dry and 0.25 in./hr when saturated.
- Group D (high runoff potential) soils have very slow infiltration rates when thoroughly wetted and a very low rate of water transmission. They have typical infiltration rates of 3 in./hr when dry and 0.10 in./hr when saturated.

Soils are also assigned dual hydrologic classifications (e.g. A/D or B/D) if they exhibit substantially different hydrologic characteristics during the wet and dry seasons. During the wet season, these soils become saturated throughout much of the soil column due to elevated water table conditions. Infiltration is thus impeded and the soils exhibit Group D infiltration characteristics. During the dry season when the water levels recede, infiltration rates increase to those corresponding to Group A or Group B levels.

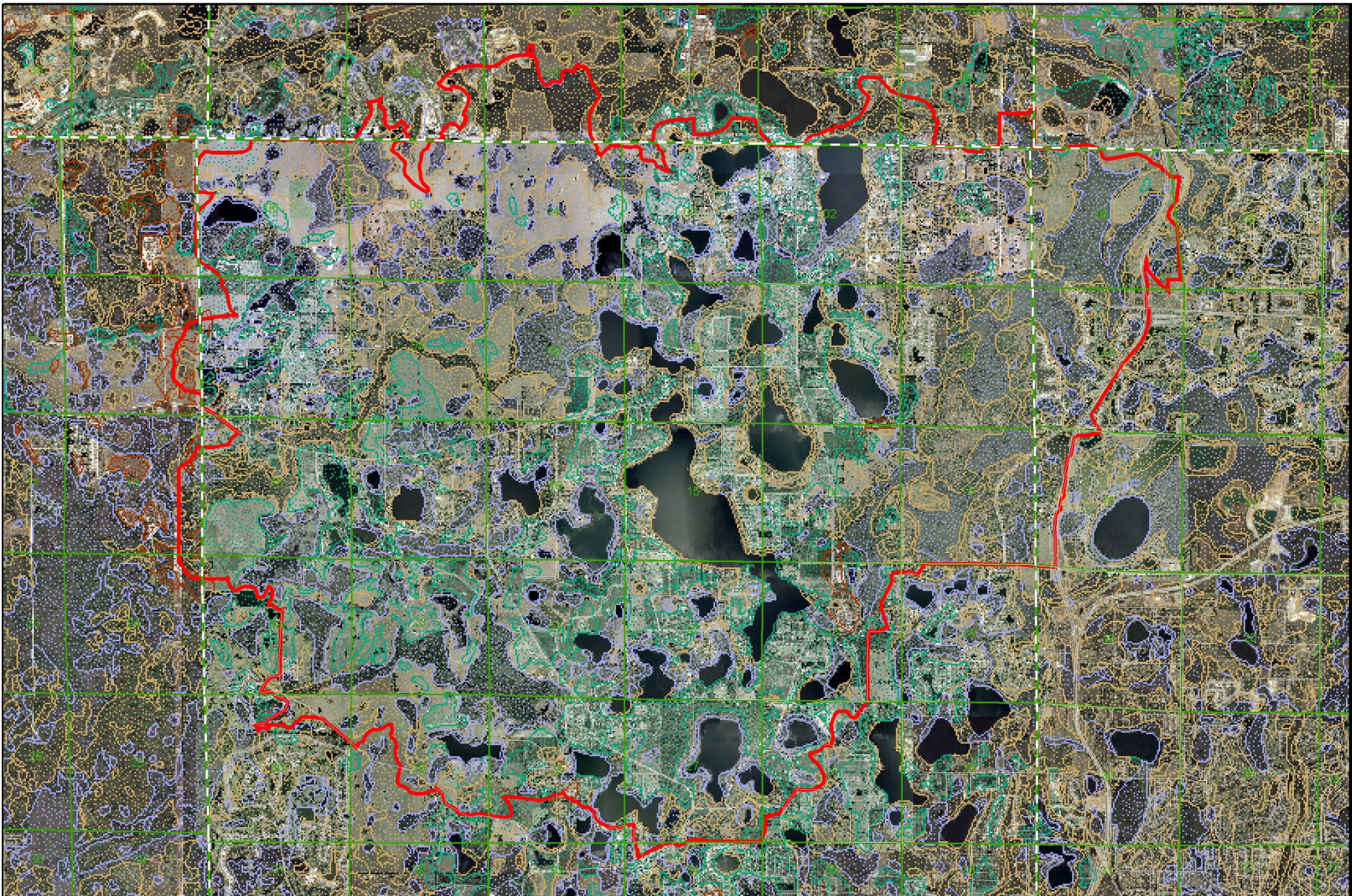
Table 2-1 and Figure 2-1 show the area soils distribution by hydrologic soil group. As shown, the predominant soil type is B/D. Soil types that fall within the B/D classification found within the BCA are Adamsville, Bassinger, Malabar, Pomello, St Johns and Smyrna fine sands. This information was obtained from the Geographical Information Systems (GIS) layers developed by the District. Additional soil information, such as drainage classification, percent slope, water table depth, permeability, natural vegetation and potential uses for development and agriculture, is available from the Natural Resources Conservation Service (NRCS) Soil Survey for Hillsborough County.

**Table 2-1
Soil Distribution by Hydrologic Soil Group**

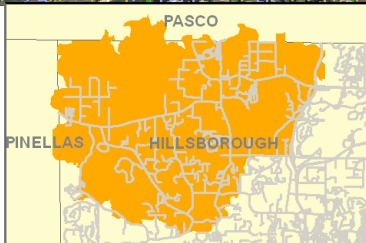
| Hydrologic Soil Group | Area (acres) | Percent of Project Area (%) |
|-----------------------|-----------------|-----------------------------|
| A | 118.8 | 0.66 |
| B/D | 8,554.9 | 47.40 |
| C | 3,863.7 | 21.41 |
| D | 3,664.3 | 20.30 |
| W | 1,844.9 | 10.22 |
| Total | 18,046.7 | 100.00 |

2.4 PHYSIOGRAPHY AND HYDROLOGY

The BCA lies within the Polk Upland physiographic unit. This unit is part of the Central or Mid-Peninsular physiographic zone, one of three in Florida. This zone is characterized by



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Legend

- Roads A/D
- Township/Range B
- Section, Township, Range B/D
- Roads C
- Watershed Boundary C/D
- A
- D

Notes:

This area is used for general map note information such as map accuracy/standards, source information, elevation information, etc.

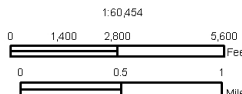


Figure 2-1: Soil Map

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan Update

Filename:

Map4.mxd

Map Date:

6-21-06

Map Prepared By:

PBS&J

Date of Photography:

2004

discontinuous highlands formed by sub-parallel ridges that are separated by broad valleys. Land elevations in the BCA vary between a high of approximately 60 feet NAVD in the northeast portion of the watershed to 22 feet NAVD at the watershed boundaries. The average basin slope is 5.7 feet/mile. **Figure 2-2** shows the basin topography.

The watershed contains many lakes, wetland areas and depressions. The numerous lakes and other depressional features were formed by sinkholes and other processes associated with the dissolution of the underlying limestone formations. Small lakes tend to be round, the most common expression of a sinkhole feature. Larger lakes usually are formed by the coalescence of several sinkholes and do not express a characteristic shape.

As indicated in Section 1, the watershed has two major conveyance systems. These two loosely connected systems drain separately the northern and southern portions of the watershed. The northern system is drained by Brooker Creek itself, which runs east to west and outfalls to Lake Tarpon in Pinellas County. The eastern half of the northern system is comprised of several lake chains and wetland storage areas that form the creek's upper reaches.

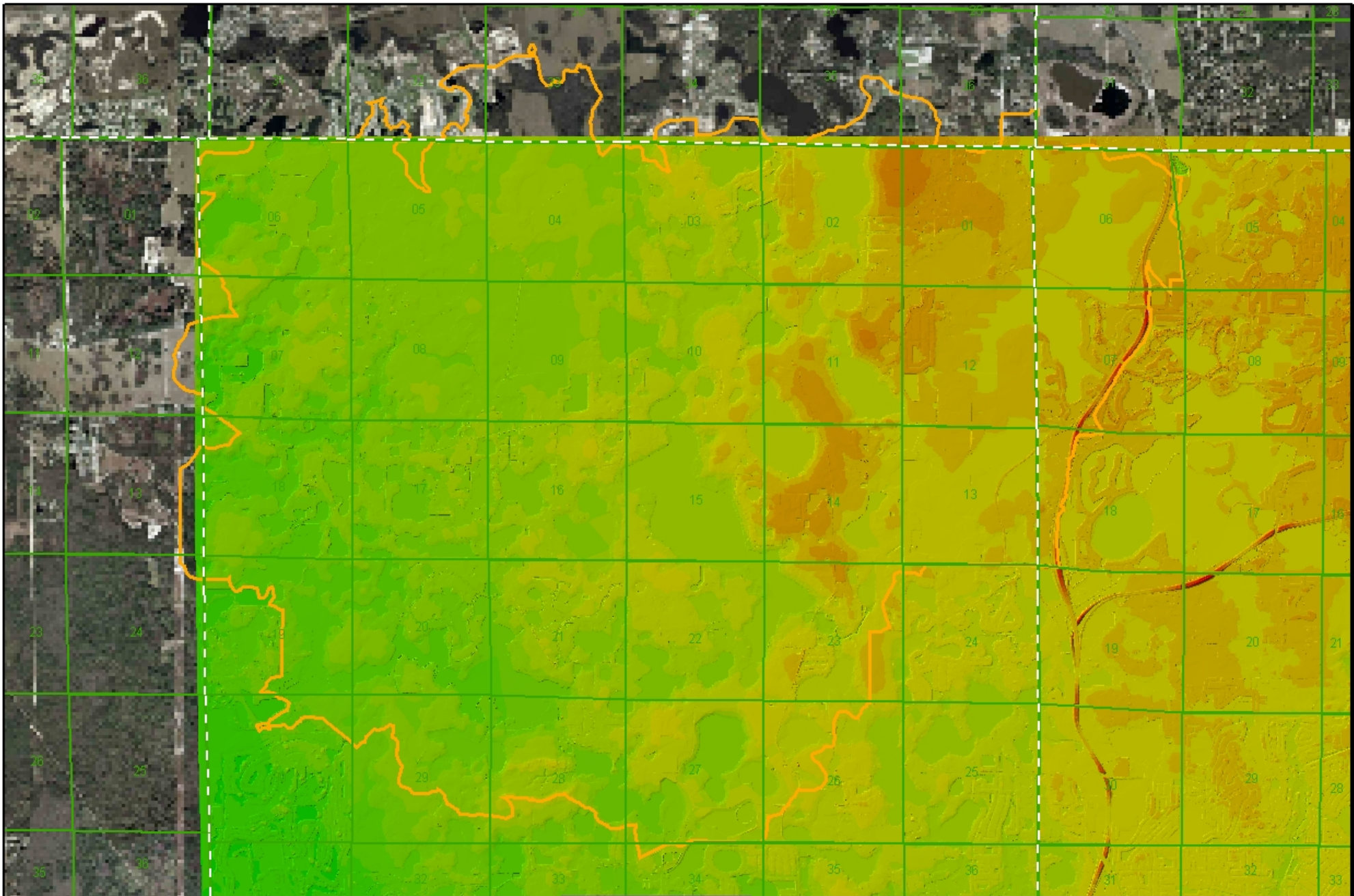
The southern system is comprised of a lake chain and wetland system that outfalls under Patterson Road into a drainage ditch and ultimately outfalls to Pinellas County. The southern system is connected to the northern system via small diameter pipes that were most likely installed for agricultural purposes.

2.5 GEOLOGY AND HYDROGEOLOGY

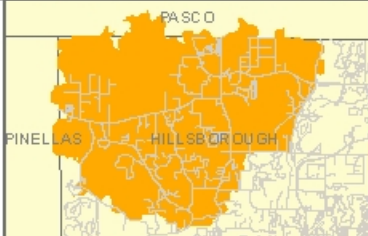
The area is underlain by a thick sequence of sedimentary strata divided into an upper zone of unconsolidated sediments and lower zone of consolidated carbonate rock.

At land surface, undifferentiated sediments including silt, sand, and clay form surficial deposits which vary in thickness from less than 10 feet in coastal areas to over 100 feet in paleokarst depression or in sand ridges. Typical thickness of the surficial deposits varies from 20-to 50 feet. In low-lying areas near lakes and streams, thin layers of organic material mix with the surficial deposits. Pleistocene-aged silts and clays form the base of the undifferentiated sediments.

Underlying the unconsolidated material is a series of Tertiary-aged limestones and dolomites that form the carbonate platform of peninsular Florida. The sequence of carbonate rocks includes, in descending order, the following formations: Tampa Member of the Hawthorn Group, Suwannee Limestone, Ocala Group, Avon Park, Oldsmar, and Cedar Key Formations. A lithographic change from limestone and dolomite to a sequence of gypsiferous dolomite begins in the lower portion of the Avon Park Formation and continues into the Oldsmar and Cedar Key Formations. The top of this lithologic change marks the middle confining unit of the Floridan aquifer system. The middle confining unit is generally considered the base of the freshwater production zone of the Upper Floridan aquifer.



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Legend

- Roads
- Township/Range
- Section, Township, Range
- Watershed Boundary

Notes:

This aerial is used for general map role information such as map accuracy, landmarks, source information, detail information, etc.



Figure 2-2: Topographic Map

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan Update

File name:

Map3.mxd

Map Date:

6-21-06

Map Prepared By:

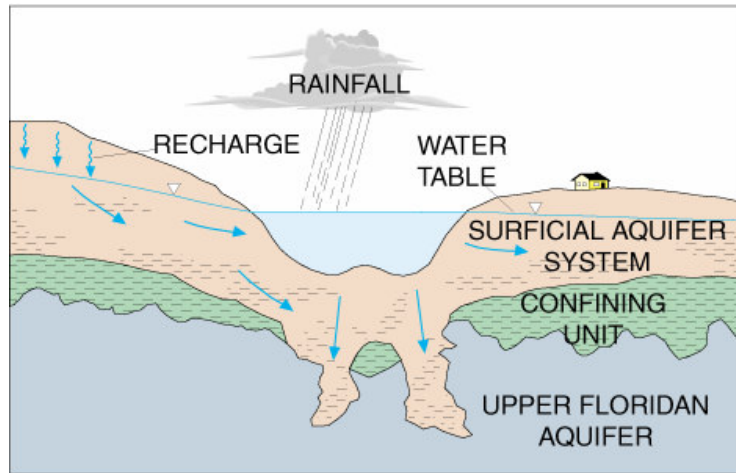
PBS&J

Date of Photography:

2004

The Tampa Member of the Hawthorn Group is a tan-colored carbonate and sand mixture, which can contain variable amounts of clay and minor amounts of phosphate. The Tampa Member can be fossiliferous and may also contain phosphate grains and chert. The Tampa Member ranges from 50 to 150 feet in thickness.

The Suwannee Limestone consists of two rock types; the upper portion is a tan-colored, crystalline limestone containing prominent gastropod and pelecypod molds, and the lower portion is a cream-colored limestone containing foraminifers and pellets of micrite in a finely crystalline limestone matrix. The Suwannee Limestone varies from 150 to 300 feet in thickness.



—> DIRECTION OF GROUND-WATER MOVEMENT

The Ocala Group contains a series of limestones that are generally soft, friable, porous and fossiliferous. This unit is late Eocene in age and ranges in thickness from 90 to 300 feet. The Avon Park Formation comprises brown, highly fossiliferous, soft to well-indurated, chalky limestone and a gray to brown, very fine microcrystalline dolomite. The Avon Park Formation ranges from 300 to 500 feet in thickness.

The hydrogeologic flow system of the Tampa Bay region contains two distinct groundwater reservoirs: the unconfined surficial aquifer and the semi-confined Upper Floridan aquifer. The Upper Floridan aquifer is under water table conditions in areas where the clay confining layer is discontinuous or absent.

Surficial Aquifer

The surficial aquifer is comprised primarily of unconsolidated deposits of fine-grained sand with an average thickness of 30 feet. Due to the karst geology of the region, thickness of the sand is highly variable. The depth of the water table ranges from near land surface to several tens of feet below land surface. Water table elevation is primarily influenced by rainfall; annual highs in most years occur during the end of the wet season (in Sept.- Oct.), and annual lows occur near the end of the dry season (in May-June). The direction of groundwater flow varies locally and is significantly influenced by the topography of the land surface. The hydraulic gradient (change of elevation per unit length) in the area typically ranges from a few feet per mile to about ten feet per mile. The permeability of the surficial aquifer is generally low and water withdrawn from this aquifer is used most often for lawn irrigation and watering livestock. Surficial aquifer wells typically yield less than 20 gallons per minute.

Semi-Confining Zone

Below the surficial aquifer is a semi-confining unit comprised of clay, silt and sandy clay that somewhat retards the movement of water between the overlying surficial aquifer and the underlying Floridan Aquifer. The confining materials are comprised of blue-green to gray, plastic, sandy clay and clay. The upper portion of the Arcadia Formation (Hawthorn Group) typically forms the semi-confining layer.

Leakage from the surficial aquifer into the Floridan aquifer occurs by infiltration across the semi-confining layer or through fractures or secondary openings in the semi-confining unit caused by chemical dissolution of the underlying limestone. Due to the highly karstic nature of the geologic system, the clay semi-confining layer can be absent in one area but tens of feet thick a short distance away. These localized karst features, in which the clay semi-confining layer is breached or missing, significantly increases hydraulic connection between the two aquifers (Hancock and Smith 1996).

Upper Floridan Aquifer

The Upper Floridan aquifer consists of a continuous series of carbonate units that include portions of the Tamar Member of the Hawthorn Group, Suwannee Limestone, Ocala Limestone and Avon Park Formation. Groundwater within the Upper Floridan aquifer is typically under artesian conditions within the project area.

Near the base of the Avon Park Formation lies the middle confining unit of the Floridan aquifer, an evaporate sequence of very low permeability that is composed of gypsiferous dolomite and dolomitic limestone. The middle confining unit generally delineates the boundary between the freshwater Upper Floridan aquifer and the brine-saturated Lower Floridan aquifer. The evaporites function as a lower confining unit and retard vertical flow across the boundary. In general, the permeability of the Upper Floridan aquifer is moderate in the Tampa Member and Suwannee Limestone, low in the Ocala Limestone and very high in portions of the Avon Park Formation. The limestone and dolomite beds produce significant quantities of water due largely to numerous solution openings along bedding planes and fractures. The Ocala Limestone yields limited amounts of water and may be considered a semi-confining layer within the Upper Floridan aquifer. Overall, the Ocala Limestone tends to act as a semi-confining zone between the overlying Tampa/Suwannee Formations and the underlying Avon Park Formation. Transmissivity of the Avon Park Formation is very high due to the fractured nature of the dolomite zones.

Ground water flow in the Floridan aquifer originates as rainfall that percolates downward from the surficial aquifer. In areas where the Upper Floridan aquifer outcrops, this recharge can be direct. Recharge rates are generally higher in the northern portion of the County. Recharge can be highly variable throughout the area, however, due to karst ecology and induced leakage caused by ground-water withdrawals. The regional hydraulic gradient and direction of flow in the Upper Floridan aquifer is generally toward the south and west.

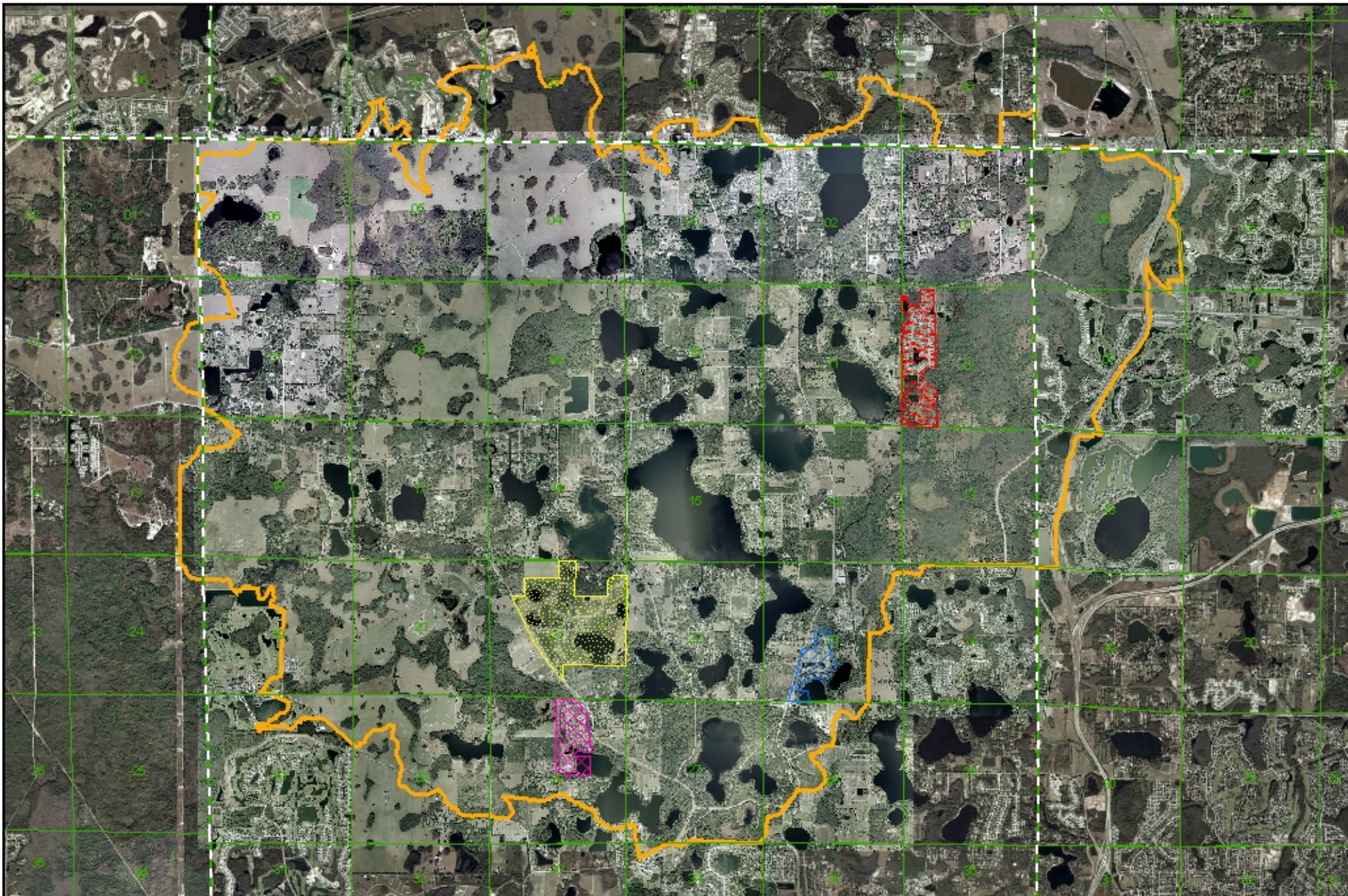
2.6 LAND USES

Preliminary land use distribution data for the Brooker Creek Watershed was obtained from the District's GIS land use layer. The layer is based on the Florida Land Use and Cover Classification System (FLUCCS) and represents conditions as observed in 1999. To update the land use distribution information, the 1999 FLUCCS map was compared with the 1999 and 2004 aerial imageries to assess changes that have occurred since the FLUCCS data was captured. **Figure 2-3** shows the areas where land use changes have occurred since 1999. The areas identified in the figure are listed below. Due to the large lake and wetland areas, not many changes in land use have occurred in the watershed in recent years.

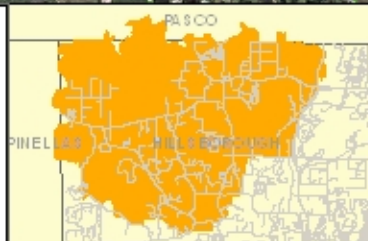
- Area 1: Echo Lake Subdivision – Construction of a residential development west of Boy Scout Road changed “tree crops” to “low density residential.”
- Area 2: Fern Ridge Subdivision – Construction of a residential development along Lutz Lake Fern Road changed “tree crops” and “open land” to “medium density residential.”
- Area 3: Keystone Shore Estates – Construction of residential development east of Gunn Highway changed “cropland and pastureland” and “open land” to “low density residential.”
- Area 4: Lakes of Steeplechase – Preliminary construction of a road within planned residential development changed “tree crops” to “transportation.”

Figure 2-4 and Table 2-2 show the BCA land use distribution. As shown, the watershed is comprised of 22 percent cropland and pastureland, 21 percent residential development, and 11 percent lakes and reservoirs.

The BCA contains several areas of Significant or Essential Upland Wildlife Habitat that are associated with the Brooker Creek floodplain and other large lake and wetland areas. Residential areas are concentrated mainly around the lakes with other subdivisions scattered throughout portions of the watershed. The majority of these residential areas tend to be older subdivisions with little or no stormwater treatment being provided.



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Legend

- Section, Township, Range
- Watershed Boundary
- NAME**
- Echo Lake Subdivision
- Fern Ridge
- Keybase Shore Estates
- Lakes of Steepchase

Notes:

This was only used for general map info information such as map accuracy/standards, source information, elevation information, etc.



Figure 2-3: Land Use Updates Map

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan Update

Filename:

Map5.mxd

Map Date:

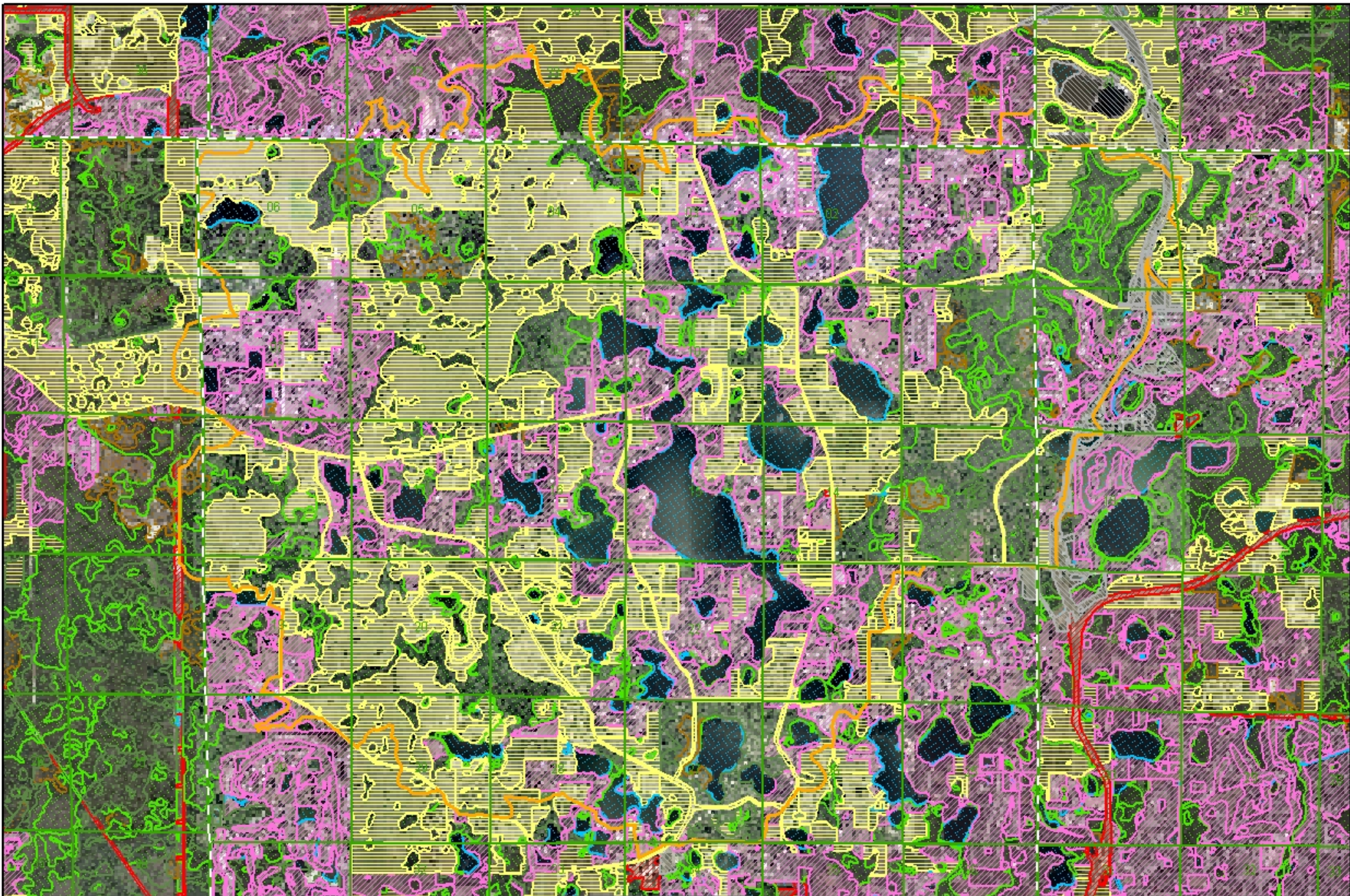
7-21-06

Map Prepared By:

PBSJ

Date of Photography:

2004



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- Legend
- Township/Range
 - Section, Township, Range
 - Watershed Boundary
 - Urban and Built-Up
 - Agriculture
 - Rangeland
 - Wetland Forests
 - Water
 - Wetlands
 - Barren Land
 - Transportation
 - Special Classifications

Notes:
This is used for general map information such as map accuracy, habitats, source information, elevation information, etc.



Figure 2-4: Land Use Map
Project: 100716.03
Watershed: Brooker Creek
Watershed Masterplan Update

| | | |
|------------------------------|----------------------|---------------------------|
| File Name: Map5.mxd | Map Date: 6-21-06 | Map Prepared By: PBS&J |
| Date of Photography: 2004 | | |

**Table 2-2
Land Use Distribution**

| FLUCCS Code | Description | Area (acres) | Percent of Project Area (%) |
|--------------------|--|---------------------|------------------------------------|
| 1100 | RESIDENTIAL LOW DENSITY < 2 DWELLING UNITS | 1,855 | 10.28 |
| 1200 | RESIDENTIAL MED DENSITY 2->5 DWELLING UNIT | 1,985 | 11.00 |
| 1300 | RESIDENTIAL HIGH DENSITY | 5 | 0.03 |
| 1400 | COMMERCIAL AND SERVICES | 51 | 0.28 |
| 1600 | EXTRACTIVE | 43 | 0.24 |
| 1700 | INSTITUTIONAL | 49 | 0.27 |
| 1800 | RECREATIONAL | 142 | 0.79 |
| 1900 | OPEN LAND | 54 | 0.30 |
| 2100 | CROPLAND AND PASTURELAND | 3,903 | 21.63 |
| 2200 | TREE CROPS | 1,211 | 6.71 |
| 2400 | NURSERIES AND VINEYARDS | 151 | 0.84 |
| 2500 | SPECIALTY FARMS | 138 | 0.77 |
| 2550 | TROPICAL FISH FARMS | 4 | 0.02 |
| 2600 | OTHER OPEN LANDS <RURAL> | 403 | 2.23 |
| 3200 | SHRUB AND BRUSHLAND | 409 | 2.27 |
| 3300 | MIXED RANGELAND | 38 | 0.21 |
| 4100 | UPLAND CONIFEROUS FOREST | 151 | 0.84 |
| 4110 | PINE FLATWOODS | 380 | 2.11 |
| 4120 | LONGLEAF PINE - XERIC OAK | 242 | 1.34 |
| 4200 | UPLAND HARDWOOD FORESTS - PART 1 | 9 | 0.05 |
| 4340 | HARDWOOD CONIFER MIXED | 654 | 3.63 |
| 4400 | TREE PLANTATIONS | 24 | 0.13 |
| 5200 | LAKES | 1,788 | 9.91 |
| 5300 | RESERVOIRS | 274 | 1.52 |
| 6110 | BAY SWAMPS | 289 | 1.60 |
| 6150 | STREAM AND LAKE SWAMPS (BOTTOMLAND) | 1,108 | 6.14 |
| 6200 | WETLAND CONIFEROUS FORESTS | 154 | 0.85 |
| 6210 | CYPRESS | 1,499 | 8.30 |
| 6300 | WETLAND FORESTED MIXED | 129 | 0.71 |
| 6410 | FRESHWATER MARSHES | 403 | 2.24 |
| 6430 | WET PRAIRIES | 100 | 0.56 |
| 6440 | EMERGENT AQUATIC VEGETATION | 18 | 0.10 |
| 7400 | DISTURBED LAND | 11 | 0.06 |
| 8100 | TRANSPORTATION | 365 | 2.02 |
| 8300 | UTILITIES | 5 | 0.03 |
| Total: | | 18,047 | 100.00 |

3.0 MAJOR CONVEYANCE SYSTEMS

3.1 Introduction

This chapter contains a general description of the two major conveyance systems, Northern and Southern, in the BCA watershed. Each system includes a number of subsystems as described below and shown in **Figure 3-1**.

3.2 Northern System

The northern system of the watershed is comprised of several wetlands and lake chains that form the upper reaches of Brooker Creek, as well as the channelized portion of the creek downstream of Island Ford Lake. The main conveyance subsystems of the northern system include:

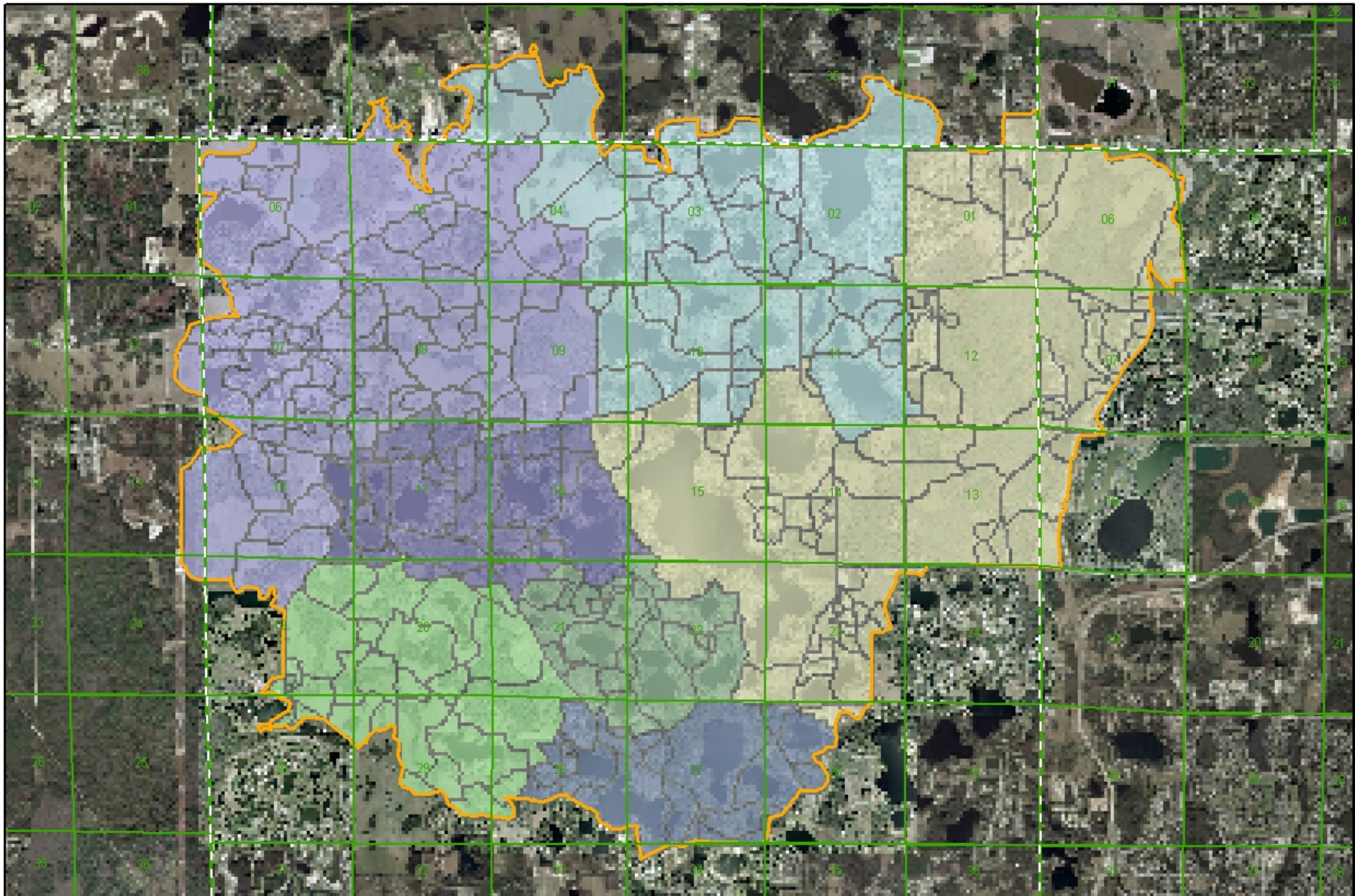

- Keystone Lake
- Island Ford Lake and Lateral Lake Chain
- Lake Alice Chain
- Brooker Creek Channel

3.2.1 Keystone Lake

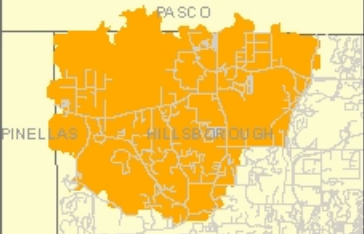
This system starts at the wetland located north of Cheval and drains south under Lutz Lake Fern Road into several other wetland systems. These wetlands are the headwaters of Brooker Creek, which flows south under Van Dyke Road before turning westward towards Gunn Highway. The creek runs under Gunn Highway into a short canal leading to Keystone Lake. Keystone is the largest lake in the watershed with an approximate surface area of 400 acres. Discharge from Keystone Lake is controlled by two adjustable gates located at its northern end. The gates discharge into the box culverts under Tarpon Springs Road that connect Keystone Lake to the southern end of Island Ford Lake.

3.2.2 Island Ford Lake and Lateral Lake Chain

Island Ford Lake is also the outfall of a lateral lake chain that drains the northeast portion of the watershed. While some of the lateral lake chain basins are connected by well-defined flow paths, others are only connected by overland flow. The chain's most upstream features are Mound Lake and Lake Elizabeth that connect to Lake Wood. A canal connects the western boundary of Lake Wood to Lake Fern. A wetland located on the northern part of the Lake Fern basin connects this part of the chain to Crescent Lake. Crescent Lake connects to Island Ford Lake via a wetland branch extending to the south. Lakes Artillery and Wastena discharge into Crescent Lake from the north to complete the lateral lake chain. There are three adjustable gates and a concrete spillway at the western end of Island Ford Lake. This structure controls the collective discharge of the subsystem.

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Legend

- Township/Range
- Section, Township, Range
- Watershed Boundary

Subbasin Boundaries

SUBWATERSH

- Brooker Creek Channel
- Horse Lake Chain
- Island Ford Lake and Lateral Lake Chain
- Keystone Lake
- Lake Alice Chain
- Lake Juanita Chain
- Orange Grove Wetlands and Outfall Ditch



Hillsborough County
Florida

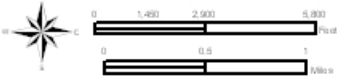


Figure 3-1: Major Tributary Map

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan Update

| | | |
|------------------------------|----------------------|---------------------------|
| File Name: Map7.mxd | Map Date: 6-21-06 | Map Prepared By: PBG&J |
| Date of Photography: 2004 | | |

Overflow from this subsystem flows north and enters into the Duck Slough watershed. Water flows through several large wetlands which are controlled by a series of weirs. Discharge from this area continues into Pasco County. The model's northern hydraulic boundary was established within the Heritage Springs development, just north of the county line.

3.2.3 Lake Alice Chain

Lake Alice is the upstream end of a lake chain that contributes flow to Brooker Creek. This lake chain is located to the south of Tarpon Springs Rd and west of Keystone Lake. Lake Alice is connected to Lake Taylor by overland discharge. Sunset Lake to the west is also connected to Taylor Lake via irrigation ditches in a plant nursery. Sunset Lake is connected on its western border to Jackson Lake. Flow from the Jackson lake chain passes under Boy Scout Road and discharges into the Brooker Creek channel described below.

3.2.4 Brooker Creek Channel

The Brooker Creek channel starts at the downstream end of a large wetland that receives flows from the Island Ford control structure as well as the overflows from Lake Frances. At this point, Brooker Creek is a manmade incised channel. The Creek flows in a southwestern direction and receives the discharge of the Lake Alice chain before crossing under Tarpon Springs Road. The creek continues to flow in a southwesterly direction until crossing the Hillsborough/Pinellas county line. A second hydraulic boundary for the BCA watershed model was established at this location. Brooker Creek eventually outfalls into Lake Tarpon in Pinellas County.

3.3 Southern System

The second major conveyance system in the BCA watershed drains the southern half of the watershed. This system is comprised of two lake chains and several large wetlands that flow from east to west. The main conveyance subsystems of the southern system include:

- Horse Lake Chain
- Lake Juanita Chain
- Orange Grove Wetlands and Outfall Ditch

3.3.1 Horse Lake Chain

Horse Lake is the most upstream feature of a lake chain that drains the southeastern most part of the watershed. The lake is connected to Lake Raleigh via a crossdrain under Gunn Highway. Lake Raleigh is connected to Lake Rogers on its northern border. This lake is connected to Church Lake under Boy Scout Road. Lake Echo and Church Lake are hydraulically connected by a narrow wetland.

3.3.2 Lake Juanita Chain

This second lateral lake chain starts at Lake Juanita and connects to Rainbow Lake on the western side of Crawley Road. A wetland in the northern part of Rainbow Lake connects to Velburton Lake. The overflow from Velburton Lake is connected to a large wetland system via a ditch and a culvert under Boy Scout Road. The third hydraulic boundary of the H&H model was set on the downstream side of the wetland along the Hillsborough/Pinellas county line.

3.3.3 Orange Grove Wetlands and Outfall Ditch

The two southern lake chains discharge into the upstream end of a system of several wetlands. Flow in these wetlands is to the west through several large orange groves. Discharge from the wetlands flows under Patterson Road at the Sand Dollar Golf and Shooting Club. After crossing Patterson Road, water enters into a well-defined ditch that flows along the northern boundary of the Nine Eagles subdivision to the wetland system where the third hydraulic boundary of the computer model along the Hillsborough/Pinellas county line was established

4.0 METHODOLOGY

This chapter provides a general description of the computer software and engineering analysis techniques that were used to develop the existing conditions hydrologic and hydraulic model for the BCA watershed. Engineering approaches, and assumptions used are also explained. As indicated in Section 1, the update of the hydrologic and hydraulic (H&H) model was based on the results of the computer model review conducted by the District, as well as further analysis performed as part of this project.

4.1 GENERAL METHODOLOGY AND DATABASE DEVELOPMENT

The Hillsborough County modified version of the EPA Storm Water Management Model (HC-SWMM) was used for analysis of the H&H conditions of the BCA watershed.

The hydrologic model contained in the HC-SWMM makes use of the U.S. Soil Conservation Service (SCS) Runoff Curve Number (CN) method. Stormwater runoff hydrographs are developed on the basis of soil and land cover characteristics. Subbasin inflow hydrographs are input at subbasin nodes within the hydraulic model. Discharges are routed through the system using a modified version of the SWMM EXTRAN block to compute water surface elevations at nodes and discharges at links throughout the hydraulic network.

Natural channels are represented in EXTRAN as conduits with irregular cross section data. The cross section data is input as ground shots (elevations and stations across the channel), in a format similar to that of HEC-2 (US Army Corps of Engineers) cross section data. EXTRAN uses the cross section data only to obtain channel geometry. The program uses invert elevations input on the conduit records to determine elevations. A natural channel is, thus, treated as a prismatic conduit with an irregular shape.

4.2 HYDROLOGY

As indicated previously, the SCS method, as included in the HC-SWMM was used for this application. The Hillsborough County Storm Water Management Technical Manual indicates that a value of 256 with a corresponding dimensionless unit hydrograph is appropriate for the County. An initial abstraction coefficient of 0.2 was used throughout this study. Initial abstraction is computed as the initial abstraction coefficient multiplied by the soil storage depth. The soil storage depth(s) is computed from the runoff curve number (CN) on the basis of the SCS methodology.

Rainfall depths associated with the design storm events used in this study to evaluate H&H conditions were determined from the isohyetal maps included in the Southwest Florida Water Management District's Environmental Resource Permitting Information Manual. The rainfall depths by storm event used in the model simulations are as follows:

| Design Storm Event | Rainfall Depth (inches) |
|--------------------|-------------------------|
| Mean Annual | 4.50 |
| 5-year | 5.50 |
| 10-year | 7.00 |
| 25-year | 8.00 |
| 50-year | 10.5 |
| 100-year | 11.5 |

The design storms’ rainfall distribution used is the SCS 24-Hour Type II Florida Modified as required by SWFWMD and Hillsborough County.

4.2.1 Subbasin Delineation

The BCA subbasin delineations were updated using the 2004 aerial imagery and the 2004 one-foot contours. Subbasin boundaries were delineated consistent with the District’s G&S by tracing ridgelines around depressions measuring one acre or greater in size and having an associated depth of two-feet or more. For areas where recent construction has taken place, the subbasin delineations were updated using data from Environmental Resource Permits (ERPs). The ERPs used in the model update are listed in **Table 4-1**. In addition, to account for areas that had not been included previously as part of this watershed, the portion of Hillsborough County between Pasco County and the northern Brooker Creek watershed boundary was added to the hydrologic/hydraulic model.

**Table 4-1
Environmental Resource Permits (ERPs)**

| ERP Number | ERP Name | ERP Issue Date |
|------------|-------------------------|----------------|
| 5162 | Canterbury Subdivision | 5-20-1993 |
| 21677 | Echo Lake Subdivision | 3-13-2001 |
| 5662 | Fern Ridge Subdivision | 11-21-2000 |
| 20036 | Keystone Shore Estates | 5-8-2001 |
| 6302 | Lakes of Steeplechase | 1-29-2002 |
| 1774 | Silver Dollar Ranch | 10-15-2003 |
| 11590 | Silver Dollar Trap Club | 8-25-1995 |

The original subbasin layer for the BCA watershed was obtained from Hillsborough County. This layer included 115 subbasins ranging in size from 2.75 acres to 1081 acres. As part of the update, the watershed was divided into 279 subbasins, ranging in size from 2.25 acres to 980 acres.

Figure 1 in Exhibit A contains the Subbasin Delineation Map. This map shows the original as well as the updated subbasin delineations.

4.2.2 Soil Data

As described in Section 2, an updated version of the SWFWMD GIS soil layer was used to obtain soil information for the BCA watershed. Each soil polygon in the GIS layer was associated with an attribute that designates its soil identification number. A database table was used to associate soil identification numbers with their corresponding hydrologic soil group (HSG). **Figure 2-1** shows the soil distribution by hydrologic soil group in the watershed.

4.2.3 Land Use

As previously described, the SWFWMD GIS Land Use layer (1999) was used to represent existing conditions land use. This layer was then updated with collected ERPs since the completion of the Brooker Creek Watershed Management Masterplan in 1999 to reflect recent land use changes. Each land use polygon in the GIS layer is associated with an attribute that designates a classification from the Florida Land Use Classification System (FLUCCS). **Figure 2-4** shows the Land Use/Land Cover data used in the analysis.

4.2.4 Runoff Curve Numbers

The curve number (CN) is an index that represents the combined hydrologic effect of soil, land use, hydrologic condition, and antecedent soil moisture. The CN method requires land use and soil information (specifically HSG) for each subbasin. A runoff CN is assigned to each land use and soils combination. A single CN is computed for each subbasin by taking an area-weighted average of CNs for all such land use and soil combinations comprising the subbasin.

SCS runoff curve number calculations were based on the GIS intersection of the SWFWMD soil layer, the updated land use/land cover layer and subbasin layer for the watershed. The resulting polygons have attributes of HSG, FLUCCS code and subbasin number. A runoff curve number lookup table provided by Hillsborough County containing land use (FLUCCS code) and soils information (HSG) was used to assign a runoff curve number to each polygon. **Table 4-2** shows the database lookup table that was used to associate each FLUCCS code with an SCS land use category and HSG for computing runoff curve numbers assuming average antecedent moisture conditions. The area weighted average CN was then computed for each subbasin.

4.2.5 Time-of-Concentration

The extensive subbasin delineation updates required a recalculation of all time-of-

**Table 4-2
Curve Number Look-Up Table**

| FLUCCS Code | Land Use Description | Hydrologic Soil Group (HSG) | | | | | |
|-------------|--|-----------------------------|-----|-----|-----|------|-----|
| | | A | B | C | D | B/D | W |
| 1100 | RESIDENTIAL LOW DENSITY <2 DWELLING UNITS | 50 | 68 | 79 | 84 | 81.5 | 100 |
| 1200 | RESIDENTIAL MED DENSITY 2->5 DWELLING UNIT | 57 | 72 | 81 | 86 | 83.5 | 100 |
| 1300 | RESIDENTIAL HIGH DENSITY | 77 | 85 | 90 | 92 | 91 | 100 |
| 1400 | COMMERCIAL AND SERVICES | 89 | 92 | 94 | 95 | 94.5 | 100 |
| 1700 | INSTITUTIONAL | 69 | 81 | 87 | 90 | 88.5 | 100 |
| 1800 | RECREATIONAL | 49 | 69 | 79 | 84 | 81.5 | 100 |
| 1900 | OPEN LAND | 39 | 61 | 74 | 80 | 77 | 100 |
| 2100 | CROPLAND AND PASTURELAND | 49 | 69 | 79 | 84 | 81.5 | 100 |
| 2140 | ROW CROPS | 49 | 69 | 79 | 84 | 81.5 | 100 |
| 2200 | TREE CROPS | 44 | 65 | 77 | 82 | 79.5 | 100 |
| 2400 | NURSERIES AND VINEYARDS | 57 | 73 | 82 | 86 | 84 | 100 |
| 2500 | SPECIALTY FARMS | 59 | 74 | 82 | 86 | 84 | 100 |
| 2550 | TROPICAL FISH FARMS | 59 | 74 | 82 | 86 | 84 | 100 |
| 2600 | OTHER OPEN LANDS (RURAL) | 30 | 58 | 71 | 78 | 74.5 | 100 |
| 3100 | HERBACEOUS | 63 | 71 | 81 | 89 | 85 | 100 |
| 3200 | SHRUB AND BRUSHLAND | 35 | 56 | 70 | 77 | 73.5 | 100 |
| 3300 | MIXED RANGELAND | 49 | 69 | 79 | 84 | 81.5 | 100 |
| 4100 | UPLAND CONIFEROUS FOREST | 45 | 66 | 77 | 83 | 80 | 100 |
| 4110 | PINE FLATWOODS | 57 | 73 | 82 | 86 | 84 | 100 |
| 4120 | LONGLEAF PINE - XERIC OAK | 43 | 65 | 76 | 82 | 79 | 100 |
| 4340 | HARDWOOD CONIFER MIXED | 36 | 60 | 73 | 79 | 76 | 100 |
| 4400 | TREE PLANTATIONS | 36 | 60 | 73 | 79 | 76 | 100 |
| 5200 | LAKES | 100 | 100 | 100 | 100 | 100 | 100 |
| 5300 | RESERVOIRS | 100 | 100 | 100 | 100 | 100 | 100 |
| 5400 | BAYS AND ESTUARIES | 100 | 100 | 100 | 100 | 100 | 100 |
| 6110 | BAY SWAMPS | 98 | 98 | 98 | 98 | 98 | 98 |
| 6120 | MANGROVE SWAMPS | 98 | 98 | 98 | 98 | 98 | 98 |
| 6150 | STREAM AND LAKE SWAMPS (BOTTOMLAND) | 98 | 98 | 98 | 98 | 98 | 98 |
| 6200 | WETLAND CONIFEROUS FORESTS | 98 | 98 | 98 | 98 | 98 | 98 |
| 6210 | CYPRESS | 98 | 98 | 98 | 98 | 98 | 98 |
| 6300 | WETLAND FORESTS MIXED | 98 | 98 | 98 | 98 | 98 | 98 |
| 6400 | VEGETATED NON-FORESTED WETLANDS | 98 | 98 | 98 | 98 | 98 | 98 |
| 6410 | FRESHWATER MARSHES | 98 | 98 | 98 | 98 | 98 | 98 |
| 6420 | SALTWATER MARSHES | 98 | 98 | 98 | 98 | 98 | 98 |
| 6430 | WET PRAIRIES | 98 | 98 | 98 | 98 | 98 | 98 |
| 6440 | EMERGENT AQUATIC VEGETATION | 98 | 98 | 98 | 98 | 98 | 98 |
| 6500 | NON - VEGETATED | 98 | 98 | 98 | 98 | 98 | 98 |
| 6510 | TIDAL FLATS / SUBMERGED SHALLOW PLATFORM | 98 | 98 | 98 | 98 | 98 | 98 |
| 6520 | SHORELINES | 98 | 98 | 98 | 98 | 98 | 98 |
| 6530 | INTERMITTENT PONDS | 98 | 98 | 98 | 98 | 98 | 98 |
| 7100 | BEACHES OTHER THAN SWIMMING BEACHES | 77 | 86 | 91 | 94 | 92.5 | 100 |
| 7400 | DISTURBED LAND | 77 | 86 | 91 | 94 | 92.5 | 100 |
| 8100 | TRANSPORTATION | 81 | 88 | 91 | 93 | 92 | 100 |
| 8200 | COMMUNICATIONS | 81 | 88 | 91 | 93 | 92 | 100 |
| 8300 | UTILITIES | 81 | 88 | 91 | 93 | 92 | 100 |

concentration estimates. The method used for calculating travel times is based on that described in the Hillsborough County Stormwater Technical Manual, and are summarized below. Calculations were made by adding the travel time for segments of appropriate flow paths.

| | |
|-----------------------------------|--|
| Overland Flow..... | Kinematic Wave Equation |
| Shallow Concentrated Paved..... | SCS equations relating velocity to watercourse slope |
| Shallow Concentrated UnPaved..... | SCS equations relating velocity to watercourse slope |
| Channel Flow..... | Assumed velocity 2 ft/sec |
| Pipe Flow..... | Assumed velocity 3 ft/sec |

4.3 HYDRAULICS

The HC-SWMM EXTRAN block was used to simulate the hydraulic conditions within the watershed. Many of the model input data were updated as part of this project. These updates, as described in more detail below, include connectivity updates, datum conversion, storage representation, boundary conditions, overflow weirs, roughness coefficients, and model numerical instabilities.

4.3.1 Connectivity Updates

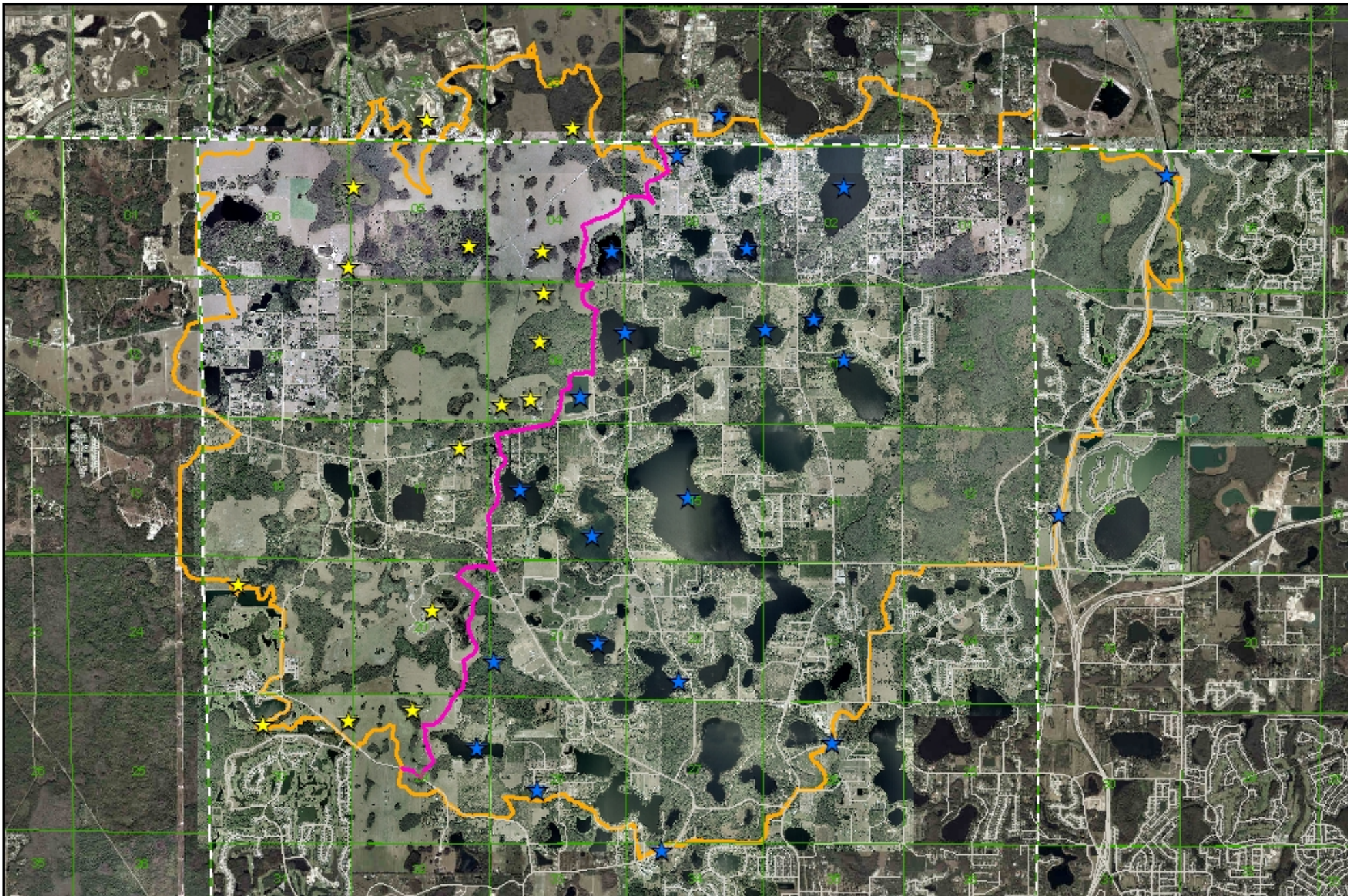
The original model connectivity was obtained and then updated with information available from previous studies, ERPs, construction drawings, the digital topography, and the District’s lake structure surveys. In addition, field reconnaissance was conducted to better assess the hydraulic connectivity and accuracy of the existing model input data. The ERPs used in the model update are listed above in **Table 4-1**. The updated existing conditions link-node diagram is included as **Figure 2** in **Exhibit A**.

4.3.2 Datum Conversion

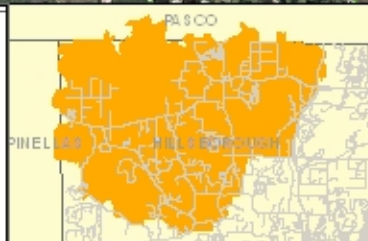
As part of the BCA watershed update, the model hydraulics were converted from NGVD29 to NAVD88 in order to meet new Hillsborough County criteria. The conversion factors were determined using the Army Corps of Engineer’s Corpscon program. As seen in **Figure 4-1**, a conversion factor of -0.84 feet was used for the western portion of the watershed while a conversion factor of -0.83 feet was utilized for the eastern portion of the watershed.

4.3.3 Storage Representation

Lake, pond and wetland storage is represented in the hydraulic model by stage/area relationships assigned to model junctions. This relationship was developed utilizing



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Legend

Orange line: Watershed Boundary
 Pink line: datum_line

Conversion

Yellow star: -0.84

Blue star: -0.83

Notes:

This was used for general map info information such as map accuracy/standards, source information, elevation information, etc.



Figure 4-1: Datum Conversion Map

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan Update

Filename:

Map5.mxd

Map Date:

6-21-06

Map Prepared By:

PBSJ

Date of Photography:

2004

one of two methods. When available, the stage/area relationships were obtained from ERPs and/or construction plans. Otherwise, the relationship was developed using GIS methods based on the TIN created from the data provided by Hillsborough County.

A GIS tool developed for this application uses a triangulated irregular network (TIN) that is generated for each subbasin. The TIN is then used to compute area-volume ratios at one-foot intervals for each node and subbasin in the model.

4.3.4 Boundary Conditions

The Brooker Creek watershed contains four hydraulic boundaries. The first location is the outfall connection at the north side of the watershed to Duck Slough in Pasco County. The second location is at the outfall at the west side of Lake Dan to Pinellas County. The remaining two locations are along the western edge of the watershed and represent the hydraulic connections to the Pinellas County portion of Brooker Creek.

All four boundary conditions were modeled as outfalls with tide gates. In addition, these boundaries were modeled as free fall conditions with elevated discharge. **Figure 4-2** shows the location of watershed model boundaries.

4.3.5 Overflow Weirs

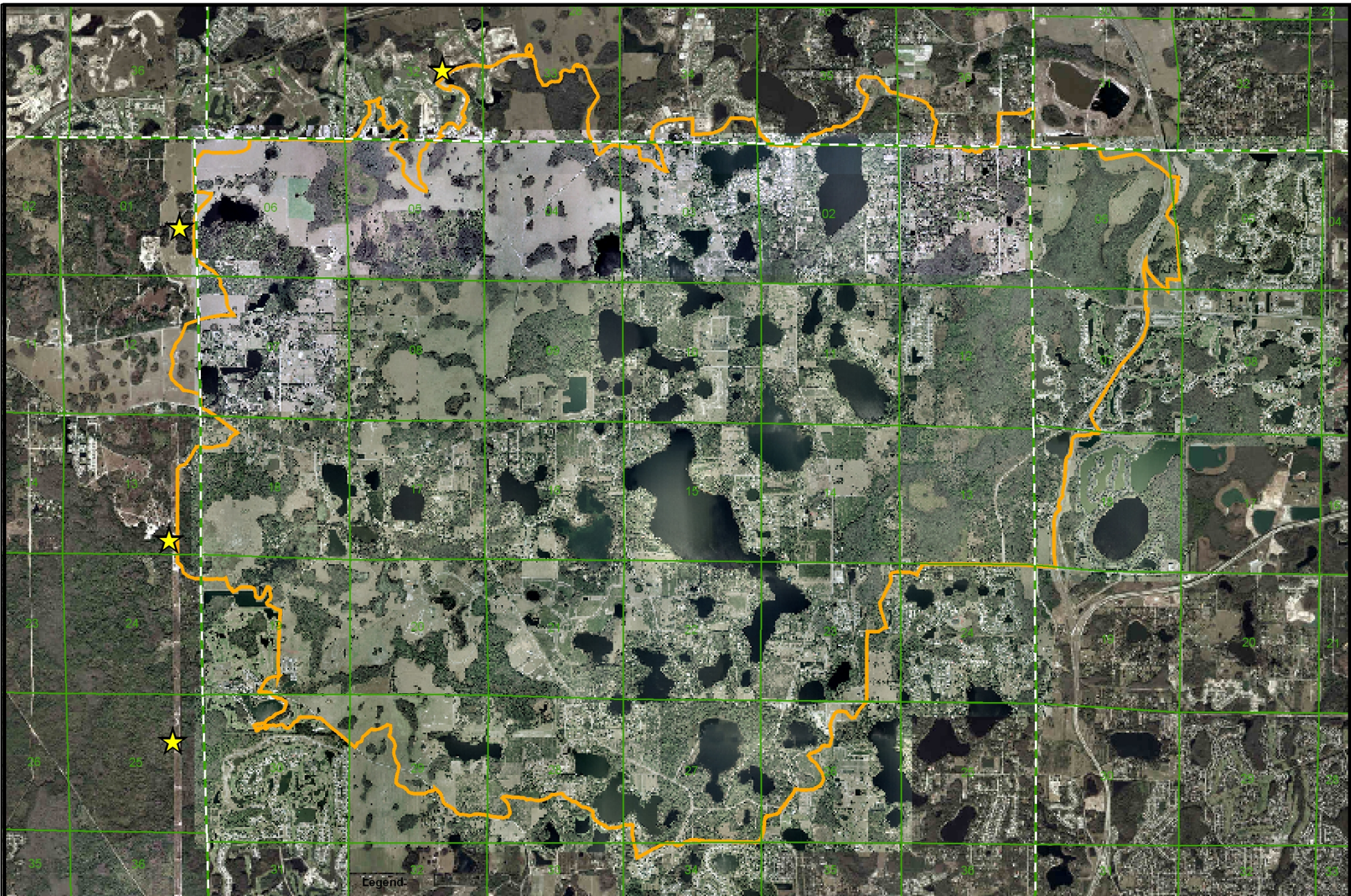
Broad crested weirs were used to simulate road overtopping and overland flow connections. Weir elevations and geometry were obtained from ERPs, construction plans, and digital topographic data. **Table 4-3** lists the weir flow coefficients used in the computer model, as provided by Hillsborough County.

**Table 4-3
Weir Flow Coefficients**






| Weir Type | Weir Flow Coefficient |
|-----------------------|-----------------------|
| Overland Flow Weir | 1.0 |
| Road Overtopping Weir | 2.0 |
| Structural Weir | 2.6 – 3.2 |

4.3.6 Roughness Coefficients

The roughness coefficients for the right, left, and center portion of channel sections were evaluated separately. In many cases, overbank areas were considered to be storage elements and not considered to have conveyance capability. Manning coefficients for channel sections were established by Hillsborough County staff engineers on the basis of photographs, site visits, and general knowledge of the area. The roughness coefficients may be adjusted in the future as more reliable field



Legend

-  Roads
-  Township/Range
-  Section, Township, Range
-  Watershed Boundary
-  Boundary Node

Notes:
This area is used for general map note information such as map accuracy/standards, source information, elevation information, etc.



Figure 4-2: Boundary Node Location Map

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan Update

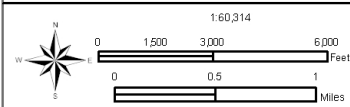
Filename: Map2.mxd

Map Date: 6-21-06

Map Prepared By: PBS&J

Date of Photography: 2004

PBS&J
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Ste. 200
Tampa, FL 33607



information becomes available. Higher roughness values sometimes result in smaller computed discharge values in downstream locations and larger computed water surface elevations in upstream locations.

This phenomena has been demonstrated in this basin near Patterson Rd. Prior to the removal of excessive overgrowth in the downstream channel, this area was prone to flooding. The roughness values in this area would need to be adjusted as part of any calibration efforts for storm events occurring before the improvements.

4.3.7 Numerical Instability

The EXTRAN model is based on an explicit solution algorithm used to solve the St. Venant equations that describe unsteady flow in channels. Explicit solution algorithms are subject to numerical instability caused by accumulated round-off error.

It is difficult to predict the conditions that cause numerical instability; however, short conduit lengths (less than 100 feet), steep bottom slopes for conduits, and low storage at nodes are frequently associated with numerical instability. Achieving numerical stability requires numerous adjustments to the model input data. Such adjustments include the use of the stretch factor to calculate equivalent pipes with longer lengths and lower roughness than the actual pipe dimensions, and the addition of storage at the junctions.

5.0 CALIBRATION

This chapter contains the calibration procedure and data used for the BCA existing conditions model. The goal of the calibration effort was to develop a hydraulic model that reflects observed conditions in the watershed and that can be used to predict system performance under design storm events and future watershed scenarios. Once calibrated, the model can be used to determine the benefits and impacts of proposed improvements.

5.1 Boundary Conditions

As previously described in Chapter 4 (Methodology) of this report, the Brooker Creek watershed was modeled with three boundary locations. The first boundary represents the northern system outfall to Duck Slough in Pasco County. The remaining two boundary locations represent the western outfalls to the Pinellas County portion of the Brooker Creek watershed, one of them for the northern and one for the southern conveyance system. All three boundaries were modeled as outfalls with free fall conditions. However, it should be noted that sufficient length was added to the channels connected to these boundary nodes to ensure no impact on stages within the project area.

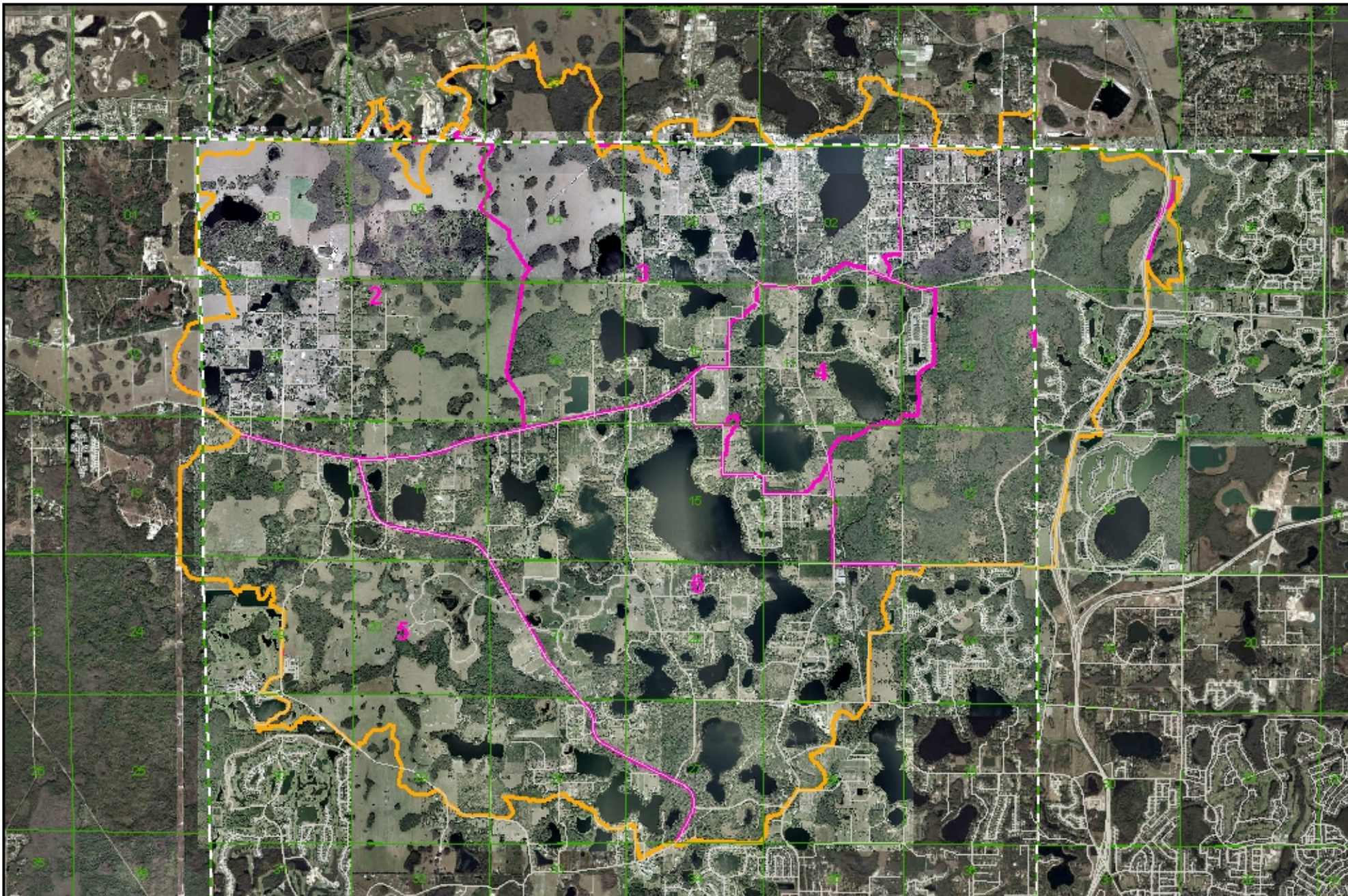

5.2 Existing Conditions Hydraulic Model Calibration Process

After the hydrologic and hydraulic model input checks were completed, a calibration process was conducted to compare results computed by the model to known hydrologic observations and/or measurements within the watershed. The storm event used for calibration was Hurricane Frances. This event was the second of a series of three hurricane events that hit the Tampa Bay area in August and September 2004. Hurricane Frances reached Hillsborough County on September 3rd and lasted for approximately 48-hours.


5.2.1 Rainfall Data

Rainfall data was obtained from the District's OneRain data. The OneRain dataset contains 15-minute Doppler rainfall measured between 1995 and 2005. From this data, rainfall volumes as well as distributions can be determined for various rainfall events, including the 2004 hurricane season events.

The Brooker Creek watershed was subdivided into six rainfall areas, as shown on **Figure 5-1**. These rainfall areas were delineated based on OneRain rainfall data cells that had similar rainfall volumes and distributions during the calibration event. The cells within each rainfall area were averaged to determine the volume and distribution to be used during the calibration process. The rainfall volumes used for each rainfall area is shown in **Table 5-1** below. As shown, the difference in total rainfall between the areas receiving the largest and smallest rainfall volumes is approximately 1.20-inches.

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Map Scale: 1:25,000

Legend


- Township/Range
- Section, Township, Range
- Roads
- Watershed Boundary
- Rainfall Area

Notes:

This was used for general map information such as map accuracy standards, source information, approval information, etc.

Hillsborough County
Florida

**Figure 5-1:
Rainfall Area Map**

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan
Update

| | | |
|------------------------------|----------------------|--------------------------|
| Filename: Map5.mxd | Map Date: 6-21-06 | Map Prepared By: PBSJ |
| Date of Photography: 2004 | | |

**Table 5-1
Hurricane Frances Rainfall Volumes**

| Rainfall Area | Rainfall Volume (inches)* |
|---------------|---------------------------|
| 1 | 10.21 |
| 2 | 9.07 |
| 3 | 9.17 |
| 4 | 9.28 |
| 5 | 9.42 |
| 6 | 10.28 |

*Rainfall volumes based on OneRain data between September 4-13, 2004

5.2.2 Adjustment of Model Input Parameters

The objective of this task was to simulate the recorded event and to compare computed water surface elevations to the measured values. The hydrologic and hydraulic model was then adjusted so that computed and measured values would more closely match. Calibration parameters included roughness coefficients and overland flow roughness values. The values of these parameters were adjusted based on interpretation of photographs, field observations, and a general knowledge of the area. Documentation was included in the project’s geodatabase.

One of the model assumptions in the original BCA H&H model was that the three control structures throughout the project area remained in the closed position. These structures are located on Keystone, Island Ford, and Crescent lakes and are operated by the District. **Figure 5-2** shows the location of these control structures.

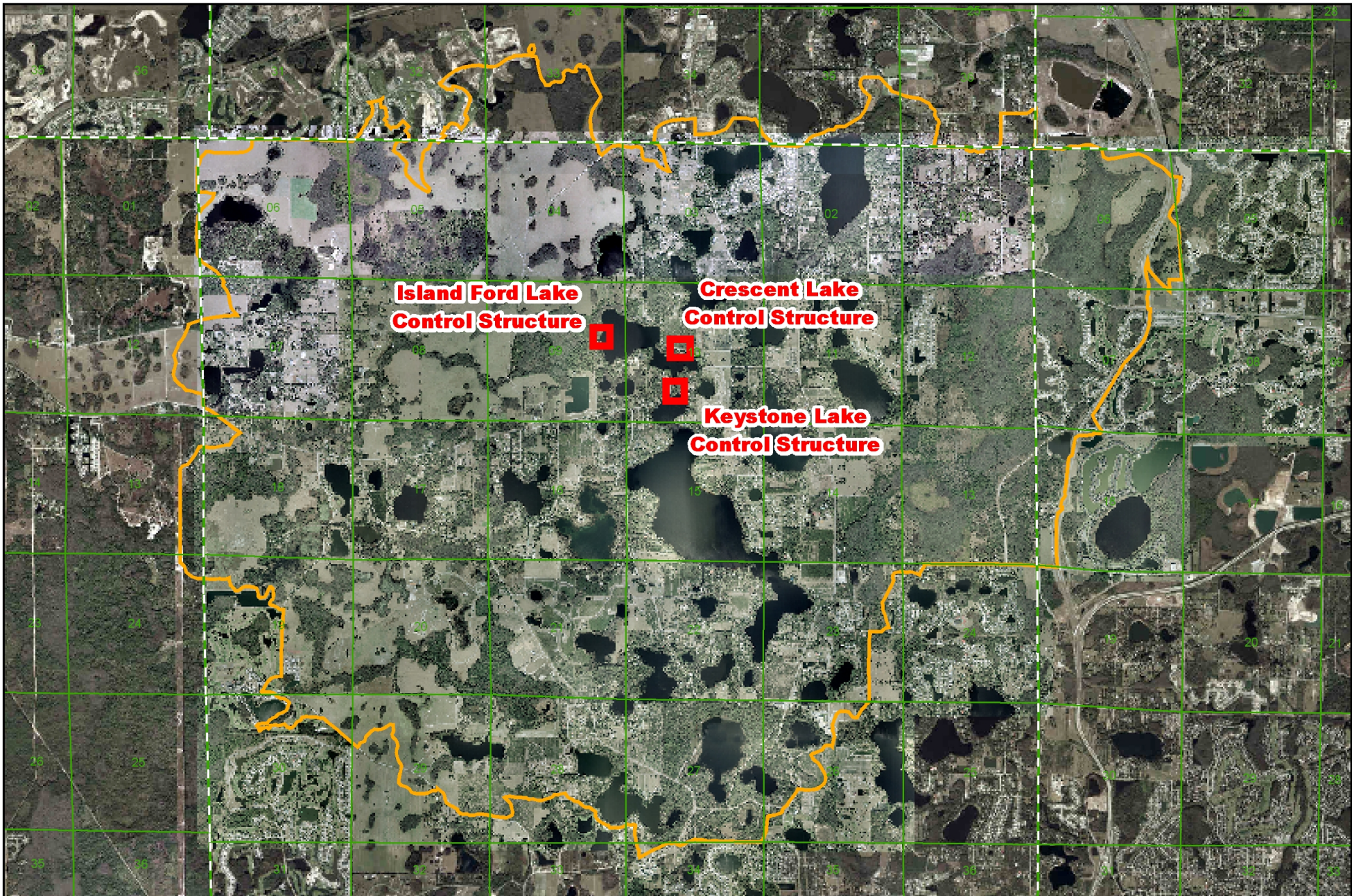
The Keystone Lake structure controls the discharge of water out of this lake into Island Ford Lake. The two 12-ft wide adjustable weir gates are located at the head of the box culverts under Tarpon Springs Rd.

Crescent Lake also outfalls to Island Ford Lake through a control structure. This adjustable gate is at the end of an arch pipe that runs under Crescent Rd.

The Island Ford Lake control structure consists of three 6-ft wide adjustable weir gates and a 50-ft wide spillway.

During Hurricane Frances, Keystone Lake, Crescent Lake and Island Ford Lake all had approximately the same peak stages which indicated that the control structures were open during the storm event. Therefore, as part of the calibration process, these weirs were modeled as open.

The initial water surface elevation for the H&H model junctions is another parameter which was determined prior to model simulations. Minimal measured data is available throughout the project area. However, a factor that was considered during the model verification process was that storage capacity in the watershed prior to Hurricane Frances was limited because of the antecedent wet conditions within the study area. Lake stage gage data before Hurricane Frances



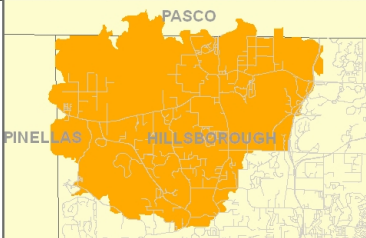
**Island Ford Lake
Control Structure**

**Crescent Lake
Control Structure**

**Keystone Lake
Control Structure**



5300 W. Cypress St.
Ste. 200
Tampa, FL 33607



- Legend**
- Township/Range
 - Section, Township, Range
 - Watershed Boundary
 - Lake Control Structure

Notes:

This area is used for general map note information such as map accuracy/standards, source information, elevation information, etc.

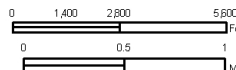


Figure 5-2: Lake Control Structures

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan Update

Filename: Map6.mxd

Map Date: 6-21-06

Map Prepared By: PBS&J

Date of Photography:

2004

showed lakes at nearly full capacity. Starting water elevations in the model were determined using four methods, as described below:

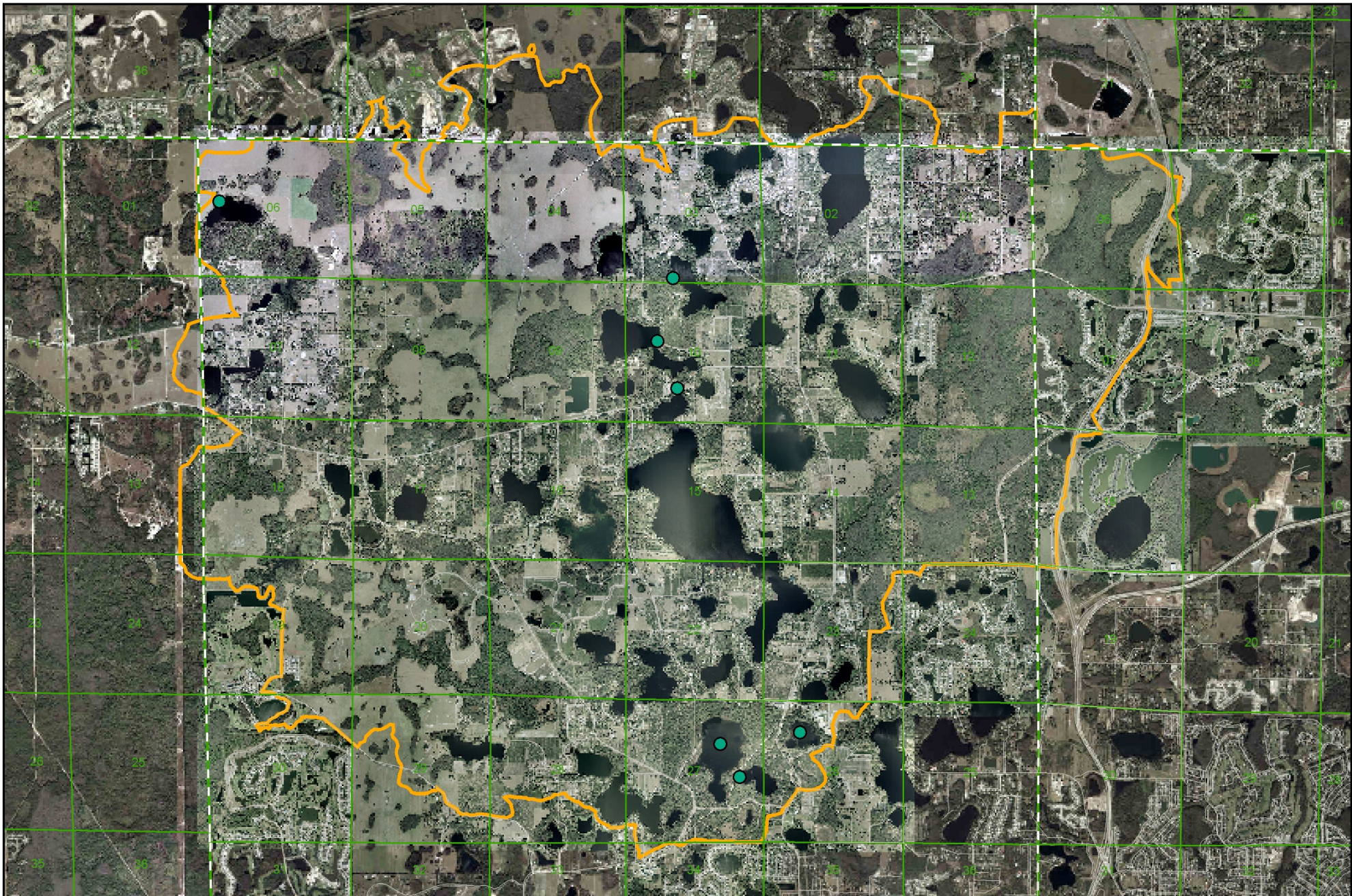
- For lakes where measured gage data was available, the water surface elevation prior to Hurricane Frances was selected as the initial water surface elevation. The stage data available for these lakes was manually read from staff gages by staff typically once a month.
- If the subbasin is hydraulically linked to the rest of the system, the control elevation (pipe invert, orifice elevation, weir elevation, etc.) was used as the initial starting water elevation.
- For storage areas with an undefined hydraulic control structure, the seasonal high water elevation as estimated from the 2004 aerials and one-foot contour data, was used as the starting water elevation.
- For lakes in which the District has set a High Guidance Level (HGL), this HGL value was used for the lake's initial water surface elevation.

The SCS has assigned dual hydrologic soil classifications to many soils within the basin. One value represents drained conditions and the other value represents un-drained conditions for the same soil. The runoff characteristics for these and other soils are known only within a range of values depending on antecedent moisture conditions and the extent of surface development. The available data indicated that conditions preceding Hurricane Frances varied throughout the watershed. This was done by evaluating rainfall as well as lake stages prior to Hurricane Frances. The curve numbers were thus adjusted from an AMC II to an AMC III as necessary. This was done utilizing the AMC conversion tool provided by Hillsborough County.

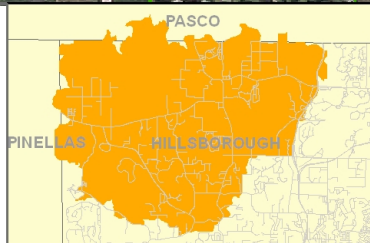
5.2.3 Gage Data

As previously described, the objective of this task was to simulate a recorded event and to compare computed water surface elevations to the measured values.

Stage data for selected lakes located within the watershed was obtained from District. As previously described, the stage data available for these lakes is manually read from staff gages typically once a month. While data for 32 lakes was obtained, only 7 of these lakes had both pre and post Hurricane Frances measured lake stages. The locations of these lakes are shown on **Figure 5-3**. The data used for the Hurricane Frances calibration event is listed in **Table 5-2** below.



5300 W. Cypress St.
Ste. 200
Tampa, FL 33607



- Legend**
- Gaging Station
 - Township/Range
 - Section, Township, Range
 - Roads
 - Watershed Boundary

Notes:

This area is used for general map note information such as map accuracy/standards, source information, elevation information, etc.

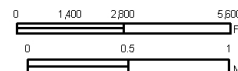


Figure 5-3: Data Collection Map

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan Update

Filename: Map6.mxd

Map Date: 6-21-06

Map Prepared By: PBS&J

Date of Photography:

2004

**Table 5-2
Hurricane Frances Gage Data**

| Lake Gage | Pre-France Elevation (ft NAVD88) | Post-Frances Elevation (ft NAVD88) |
|------------------|-------------------------------------|---------------------------------------|
| Crescent Lake | 40.9 | 41.1 |
| Horse Lake | 45.6 | 46.8 |
| Island Ford Lake | 39.6 | 40.8 |
| Keystone Lake | 40.2 | 40.8 |
| Lake Dan | 32.3 | 33.6 |
| Lake Raleigh | 39.7 | 40.9 |
| Lake Rogers | 36.6 | 37.4 |

*Lake stage elevations have been converted from the NAVD29 datum obtained from SWFWMD to NAVD88.

5.2.4 Calibration Results

Results of the calibration process are summarized in **Table 5-3** below. As can be seen, the predicted model peak stages provide a good match to the recorded gage stages. Furthermore, the close match of the peak stages for the three interconnected Northern System lakes (Keystone Lake, Island Ford Lake and Crescent Lake) is another indication of an accurate calibration. As previously described, continuous daily stage data over the calibration period was not available for the lakes during the Hurricane Frances storm event. Therefore, while predicted peak stages were compared during the calibration event, the time versus stage results were not able to be compared.

**Table 5-3
Hurricane Frances Calibration Results**

| Lake Gage | Post Frances SWFWMD Gage Data (ft NAVD88)* | Model Peak Stage (ft NAVD88) | Difference (feet) |
|------------------|---|---------------------------------|-------------------|
| Crescent Lake | 41.1 | 41.3 | 0.2 |
| Horse Lake | 46.8 | 46.6 | -0.2 |
| Island Ford Lake | 40.8 | 40.7 | -0.1 |
| Keystone Lake | 40.8 | 40.9 | 0.1 |
| Lake Dan | 33.6 | 33.6 | 0.0 |
| Lake Raleigh | 40.9 | 41.1 | 0.2 |
| Lake Rogers | 37.4 | 37.5 | 0.1 |

*Lake stage gage data has been converted from the NAVD29 datum obtained from SWFWMD to NAVD88.

5.3 Recommendations for Further Study

To further enhance the BCA watershed model, the following future tasks are recommended as additional resources and information becomes available.

- ◆ The watershed calibration process would benefit from more detailed lake stage gage data for the various lakes throughout the watershed. Continuous recorded values would allow for a model calibration based not only on peak stages but on

the time distribution as well.

- ◆ The model would also benefit from additional channel cross-sections. Only a portion of Brooker Creek, upstream of Tarpon Springs Road, was modeled as a natural channel in the original BCA masterplan. The rest of the channel was modeled as large storage areas. As part of this update, the channel downstream of Tarpon Springs Road was modeled as natural channels using cross-sections derived from the topographic data. Field reviews conducted as part of the current modeling effort revealed Brooker creek is well defined for this entire section.

6.0 EXISTING CONDITIONS LEVEL OF SERVICE ANALYSIS

6.1 Introduction

The existing conditions model was used to predict water surface elevations under the design storm event conditions listed below. While the level-of-service criteria are defined for the 25-year/24-hour storm event, other permitting requirements require the 100-year/24-hour and 2.33-year/24-hour storm event results as well. The remaining storm events were run to meet Hillsborough County criteria as well as the District's G&S.

100-year/5-day storm event
 100-year/24-hour storm event
 50-year/24-hour storm event
 25-year/24-hour storm event
 10-year/24-hour storm event
 5-year/24-hour storm event
 2.33-year/24-hour storm event

Minor model stability adjustments were conducted once the preliminary simulation results were conducted. Peak simulated water surface elevations for existing conditions throughout the watershed are shown in **Exhibit B**. In addition, model results are included in the Personal Geo Data Base attribute tables.

Model results were compared against the District's gaging records for various lakes throughout the watershed. Results of these comparisons are shown in the table below.

| Lake Name | SWFWMD Gaging Period | Highest Recorded Stage (ft NAVD) | Number of Times Highest Recorded Stage Reported | 100-Yr/24-Hr Design Storm Peak Stage (ft NAVD) |
|----------------|----------------------|----------------------------------|---|--|
| Dan | 1980-2005 | 33.6 | 2 | 33.9 |
| Garden | 1977-2005 | 32.9 | 1 | 32.9 |
| Jackson | 1973-2005 | 34.3 | 1 | 36.2 |
| Mound | 1973-2005 | 50.8 | 3 | 50.6 |
| Sunset | 1973-2005 | 35.0 | 1 | 36.3 |
| Taylor | 1971-2005 | 40.2 | 5 | 39.1 |
| Horse | 1931-2005 | 49.2 | 18 | 47.8 |
| Raleigh/Rogers | 1931-2005 | 45.3 | 13 | 44.3 |
| Church | 1935-2005 | 37.3 | 1 | 37.3 |

Lakes where modeled peak stages are significantly lower than the historic recorded peak stages were examined in more detail. That is the case of Lake Taylor, Lake Horse, and Lake Raleigh/Rogers.

For Lake Taylor, the highest recorded stage occurred during the El Nino period in 1998. That was an approximately 6-month period of continued rainfall. In addition, the historical peak stage occurred only once over the past 25-years. It should be noted that the second highest recorded

Existing Conditions Level of Service Analysis

peak stage during this time period is identical to the results from the modeled simulation. It is believed that the high recorded elevation in 1998 was caused by conveyance restrictions coupled with the long period of extremely wet conditions which created runoff volumes that largely exceed those of design storm events. Conveyance in this area between Lake Taylor and Lake Sunset is historically known to be impeded by overgrown vegetation in the natural areas located downstream from the lake. Maintenance activities have improved substantially in recent years. Those activities should be maintained in order to allow the drainage features to function properly.

After reviewing the historical records for the remaining two locations, Lake Horse and Lake Raleigh/Rogers, data indicates that a change in conditions, as reflected by the recorded stages, took place in the early 1980s that lowered the lake elevations. These changes may have been a result of road construction along Gunn Highway and/or Race Track Road. Historical peaks over the past 25-years are 46.9 ft NAVD and 41.91 ft NAVD, respectively, which are lower than the model simulated peak results.

6.2 Level of Service

The Hillsborough County Comprehensive Plan Stormwater Management Element contains definitions for flood protection levels of service (FPLOS) designations. According to the Comprehensive Plan, a storm return period and duration and letter designation are needed to define the level of flood protection (i.e. 25-year/24-hour level B). The flood level designations contained in the Comprehensive Plan are A, B, C and D, A being the highest level and D being the lowest. The level of service ratings A through D were assigned to the basins based on criteria more specifically defined as part of this model update. Those criteria are listed in **Table 6-1**.

Table 6-1
Level of Service Criteria

| Level of Service Category | Level of Service Definition* |
|---------------------------|--|
| A | No significant street flooding. All lanes are drivable. |
| B | Minor street flooding. At least one lane is drivable. |
| C | Street flooding. Flooding depth above the crown of the road is less than one foot. |
| D | No limitation on flooding. |

* The term drivable was defined as less than or equal to three (3) inches of water above the crown of the road.

As shown, FPLOS are defined in terms of road access conditions. Using the existing conditions predicted model results for the 25-year/24-hour storm event, FPLOS were developed throughout the Brooker Creek Watershed by comparing predicted peak model stages to road overtopping elevations. These level of service results are found in **Exhibit B**. Those locations for which road access is not relevant, such as wetland areas, were not assigned a FPLOS.

6.3 Model Predicted Problem Areas

A review of flooding records for the Brooker Creek basin revealed very few problem areas. This

is likely a result of the significant storage capacity available in the large number of lakes and wetland systems. Most identified problems were localized features in the secondary drainage system, which are not included in the computer model (e.g. undersized driveway culverts, depressional areas, etc.). The investigation of the level of service within the BCA watershed revealed only two locations where violation of the FPLOS might occur. These are described below. Proposed conditions peak model stages and revised level of service designations are presented in **Exhibit C**.

6.3.1 Unnamed Access Road at Upstream End of Brooker Creek

This problem area (Junction 490420) is located at the upstream end of Brooker Creek. The basin is comprised of cropland and pastureland and discharges to Brooker Creek downstream from the Island Ford Lake control structure. The unnamed access road is predicted to flood during a 25-yr storm. The model predicted peak flood elevation is 40.80 ft NAVD, versus a roadway elevation of 40.26 ft NAVD. This approximately 0.5-foot road overtopping corresponds to a LOS C.

Three corrugated metal pipes (CMP) are currently located at this location, two 36-inch and a 48-inch diameter pipes. Corrugated metal pipes have a tendency to deteriorate within a few years of being constructed, thus limiting the conveyance capacity of the pipe over time. Computer model simulations revealed that replacing the existing pipes with reinforced concrete pipes of the same inverts and diameters would reestablish the conveyance of the road culverts and would reduce the predicted 25-year/24-hour peak stage to elevation 40.75 ft NAVD, thus improving the road crossing to a FPLOS of B.

6.3.2 Burrell Road

Burrell Road is located south of Tarpon Springs Road between Lake Sunset and Lake Jackson. The input data for the road culvert under Burrell Road was modified during this model update utilizing data from the District's lake survey to show a 24-inch corrugated metal pipe. The peak water surface elevation was predicted to overtop the roadway by approximately 0.4-feet during the 25-year/24-hour event, which corresponds to a LOS C. The peak water surface elevation for this event was predicted to be 35.7 ft NAVD, versus a roadway elevation at 35.3 ft NAVD. As described above, corrugated metal pipes deteriorate within a few years of installation, therefore reducing the conveyance capacity of the culvert. In this case, computer model results also indicated that replacing the existing Burrell Road culvert with a reinforced concrete pipe of same inverts and diameter would reduce the 25-year/24-hour peak stage to 35.5 ft NAVD, thus improving the road crossing to a FPLOS of B.

6.4 Other Historical Problem Areas

The following historical problem areas were not predicted by the current SWMM model but warrant being addressed as part of this report.

6.4.1 Patterson Rd at the Sand Dollar Resort

The southern part of the watershed drains to the west and crosses under Patterson Rd in the vicinity of the Sand Dollar Resort. During a field review on June 26, 1997, a discussion with the manager of this resort revealed that the road has flooded in the past. The manager indicated the flooding problems occurred when the drainage ditches downstream of the culverts are not maintained and are overgrown with vegetation. Follow up discussions with the Hillsborough County Northwest Maintenance Unit (HCNWMU) revealed that major maintenance improvements were made to the ditches downstream of this area after the floods of 1989 and no additional flooding complaints have been received. The culverts under Patterson Rd appear to be adequate to handle the contributing runoff during storm events. As long as the ditches downstream are maintained, there should be no further flooding problems at this crossing.

6.4.2 Lake Breckenridge

This potential problem area is located immediately south of Tarpon Springs Rd between Boy Scout Rd and Patterson Rd. The homes surrounding Lake Breckenridge are individually platted and not part of a formal subdivision. This lake is a former borrow pit that receives a significant amount of runoff from the surrounding homes. The runoff is impounded by the lake as there is no natural outfall or formally designed control structure, only an 8 in. PVC pipe acting as a bleeder pipe. This pipe runs under the driveway of one of the homes to a small wetland located to the east. The record of complaints for this area indicated the water surface in the basin has flooded yards and submerged docks (Refer to Photo 1). Prior to 1997, the docks were reported to have been 5 to 6 feet above the water surface.



Photo 1: Submerged dock at Lake Breckenridge (August 1998)

The dramatic increase in water surface elevation, which caused the yard flooding and submerged docks described above, appears to be a direct result of runoff from the heavy rains that fell during 1997 and 1998. The owners report that since 1997, the lake level has remained elevated and fluctuates by approximately 2.5 ft during dry and rainy periods. If the lake surface remains elevated, future heavy rainy seasons may cause the lake to flood some of the surrounding homes. To prevent this flooding scenario, the possibility of adding a control structure to the lake to limit the water surface elevation could be investigated. A control structure located on the western side of the lake could discharge under Patterson Rd to the wetlands surrounding Brooker Creek. This scenario was not investigated as part of the current study because the problem is not caused by a single rainfall event, even for the 100-year/24-hour event conditions, but by long periods of continuous rainfall such as those associated with the El Nino phenomenon.

It is recommended that the County investigate this issue in more detail. Modifications to the lake's outfall may be possible to allow small lake discharges when downstream conditions permit and through negotiations with the permitting agencies. One possible solution may be to increase the size of the existing 8-inch bleed down pipe.

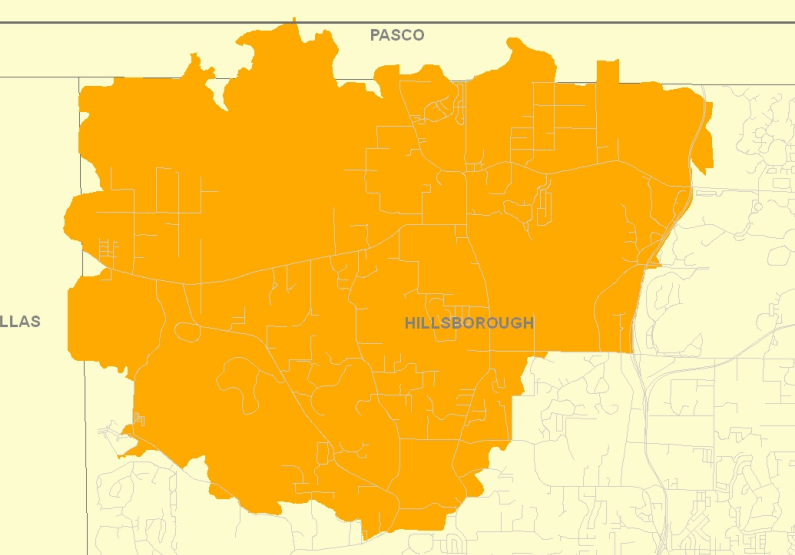
6.5 Floodplain

The floodplain for the Brooker Creek Watershed was updated using the modeled peak stages from the 100-year/24-hour design storm event. **Figure 3 in Exhibit A** contains the Floodplain Delineation Map. This map shows the original as well as the updated floodplain delineations. The 100-year/5-day storm event was also run for comparison against the 100-year/24-hour modeled peak stages. No significant differences were found.

Exhibit A



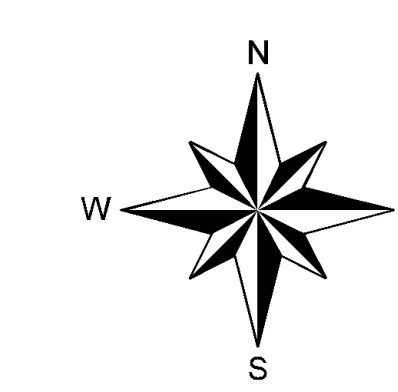
5300 W. Cypress St.
Ste. 200
Tampa, FL 33607



Legend

- Watershed Boundary
- Township/Range
- Section, Township, Range
- Subbasin Boundaries
- Original Subbasin Boundaries

Notes:
This area is used for general map note information such as map accuracy/standards, source information, elevation information, etc.



1:13,736

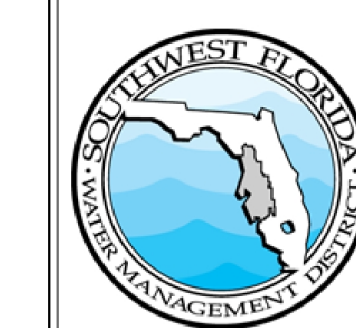
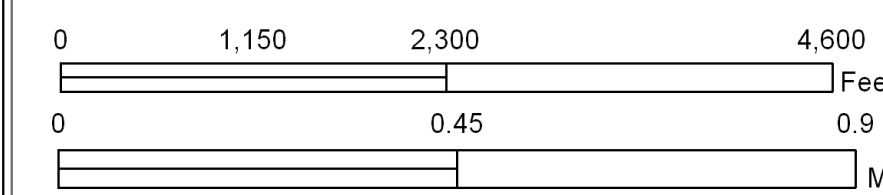


Figure 1: Watershed Subbasin Delineation Map

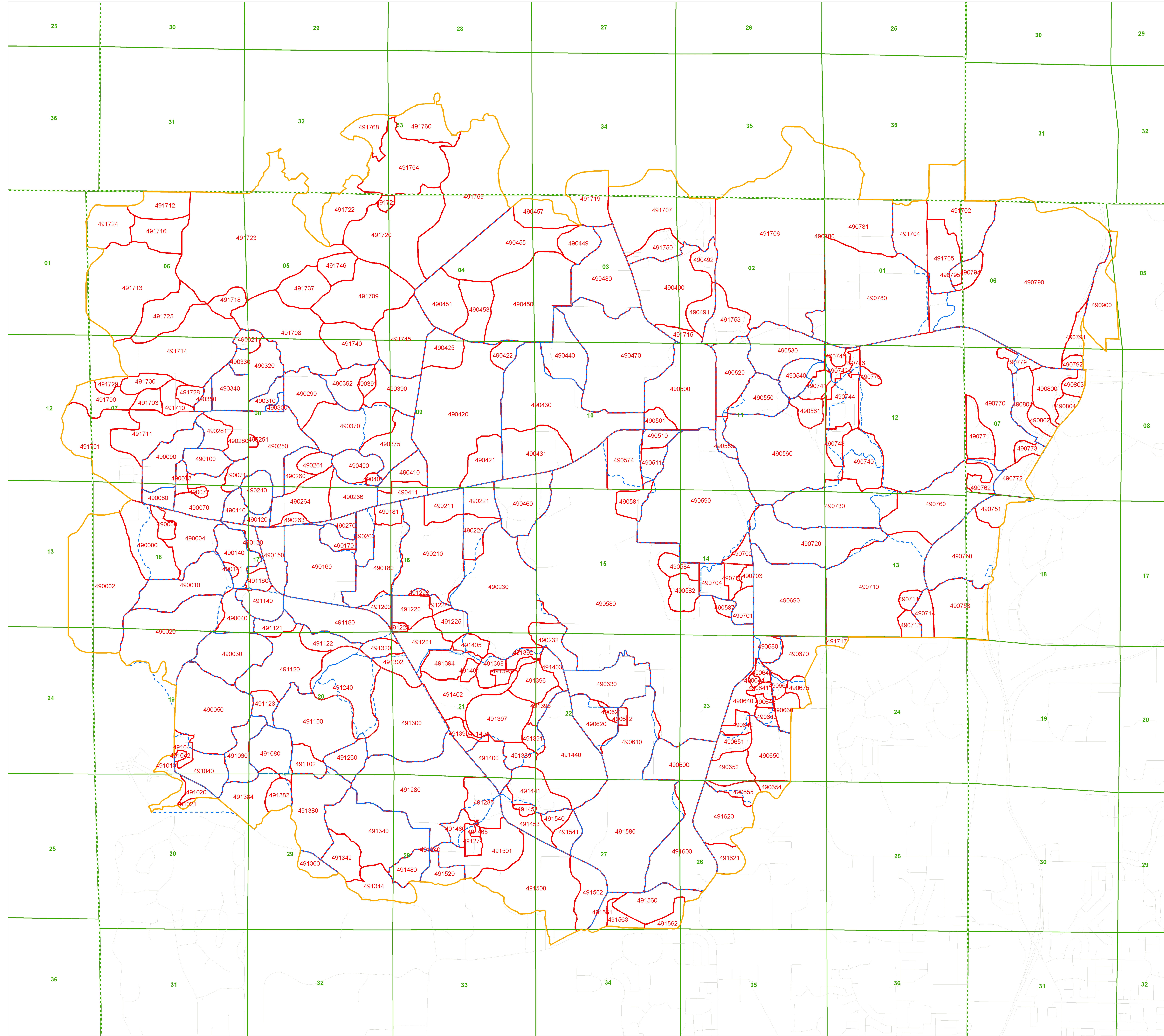
Project: 100716.03

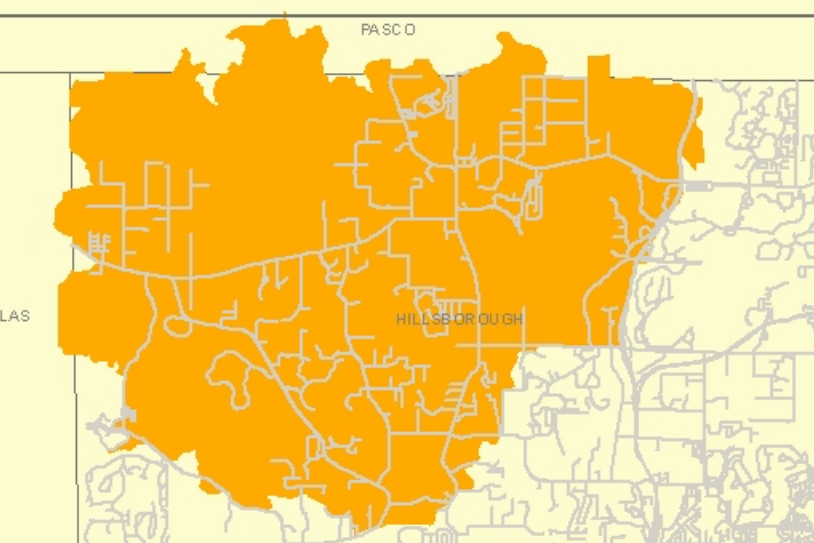
Watershed: Brooker Creek

Watershed Masterplan Update

| | | |
|------------------------|----------------------|---------------------------|
| Filename: Map11.mxd | Map Date: 6-21-06 | Map Prepared By: PBS&J |
|------------------------|----------------------|---------------------------|

Date of Photography:
2004



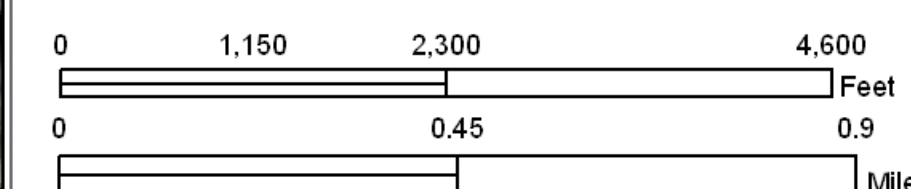
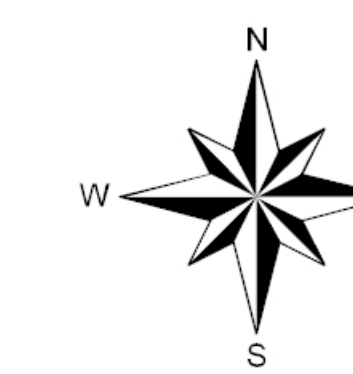


Legend

- Junctions
- Reach
- Watershed Boundary
- Township/Range
- Section, Township, Range
- Subbasin Boundaries

Notes

This area is used for general map note information such as map accuracy/standards, source information, elevation information, etc.



**Figure 2: Junction/
Reach Map**

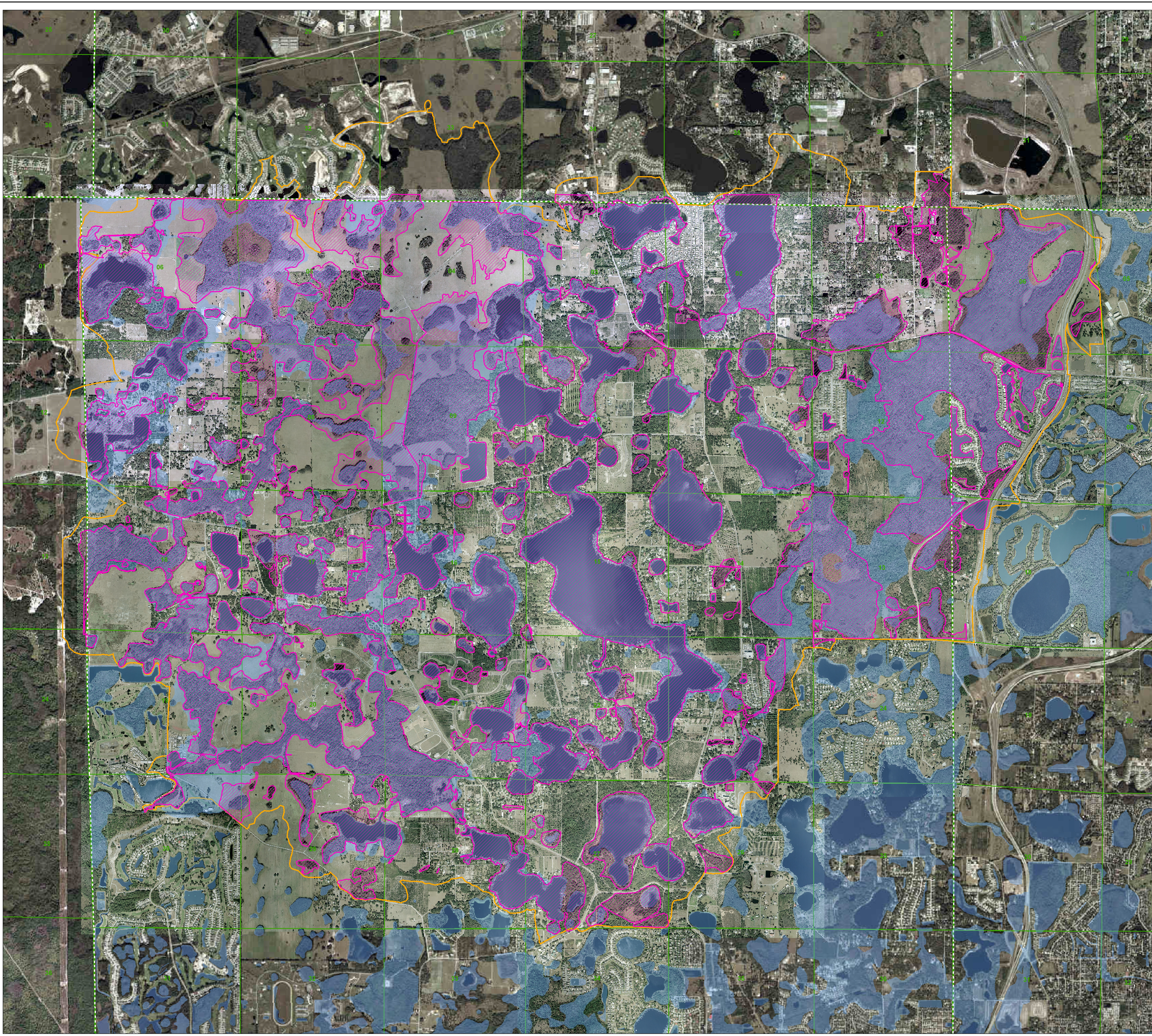
Project: 100716.03

Watershed: Brooker Creek

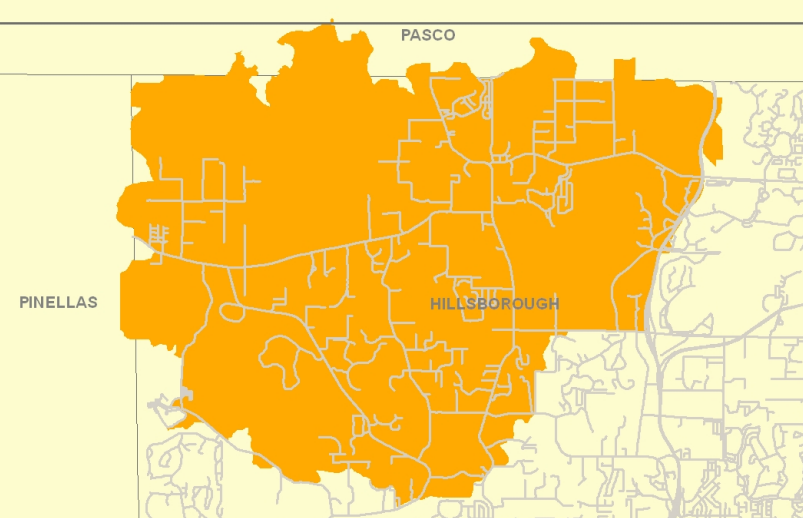
Watershed Masterplan Update

| | | |
|------------------------|----------------------|---------------------------|
| Filename: Map13.mxd | Map Date: 6-21-06 | Map Prepared By: PBS&J |
|------------------------|----------------------|---------------------------|

Date of Photography:
2004



5300 W. Cypress St., Ste. 200
Tampa, FL 33607



Legend

- Watershed Boundary
- Township/Range
- Section, Township, Range
- Original Floodplain
- Modified Floodplain

Notes:

This area is used for general map note information such as map accuracy/standards, source information, elevation information, etc.

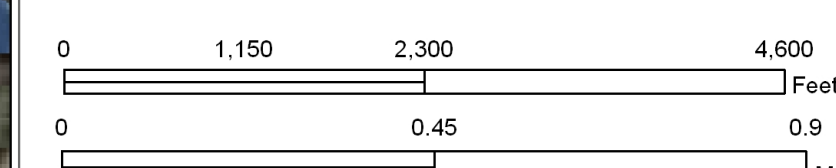
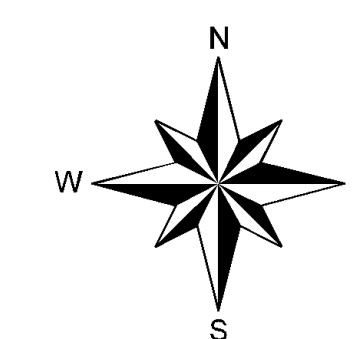


Figure 3: Floodplain Delineation Map

Project: 100716.03

Watershed: Brooker Creek

Watershed Masterplan Update

| | | |
|------------------------|----------------------|--------------------------|
| Filename: Map16.mxd | Map Date: 6-21-08 | Map Prepared By: PBSJ |
|------------------------|----------------------|--------------------------|

Date of Photography:
2004

Exhibit B

Table 1
Existing Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 490000 | 27.42 | 26.98 | 26.73 | 26.47 | 26.46 | 26.46 |
| 490004 | 29.50 | 28.98 | 28.68 | 28.36 | 28.03 | 27.89 |
| 490002 | 27.02 | 26.64 | 26.46 | 26.46 | 26.46 | 26.46 |
| 490008 | 29.57 | 29.05 | 28.75 | 28.45 | 28.09 | 27.91 |
| 490010 | 29.39 | 29.10 | 28.87 | 28.58 | 28.25 | 28.09 |
| 490020 | 29.39 | 28.90 | 28.67 | 28.46 | 28.22 | 28.09 |
| 490030 | 29.66 | 28.88 | 28.67 | 28.44 | 28.13 | 27.95 |
| 490040 | 31.11 | 30.68 | 30.43 | 30.19 | 29.90 | 29.75 |
| 490050 | 29.11 | 28.91 | 28.78 | 28.62 | 28.39 | 28.26 |
| 490070 | 30.87 | 30.32 | 30.02 | 29.69 | 29.34 | 29.18 |
| 490071 | 30.87 | 30.32 | 30.10 | 30.02 | 29.91 | 29.86 |
| 490072 | 29.36 | 28.88 | 28.61 | 28.34 | 28.02 | 27.86 |
| 490073 | 32.44 | 32.40 | 32.38 | 32.35 | 32.31 | 32.29 |
| 490080 | 31.49 | 30.89 | 30.09 | 29.63 | 29.35 | 29.18 |
| 490090 | 31.52 | 31.24 | 31.09 | 30.90 | 30.71 | 30.29 |
| 490100 | 30.87 | 30.32 | 30.02 | 29.77 | 29.69 | 29.65 |
| 490110 | 31.55 | 30.94 | 30.60 | 30.26 | 29.92 | 29.76 |
| 490120 | 34.07 | 33.68 | 33.59 | 33.50 | 33.38 | 33.31 |
| 490130 | 34.43 | 33.79 | 33.68 | 33.56 | 33.41 | 33.33 |
| 490140 | 33.75 | 33.50 | 33.34 | 33.20 | 33.06 | 33.00 |
| 490141 | 33.99 | 33.93 | 33.89 | 33.84 | 33.82 | 33.74 |
| 490150 | 36.21 | 35.66 | 34.98 | 34.52 | 33.95 | 33.67 |
| 490160 | 36.25 | 35.72 | 35.57 | 35.48 | 35.40 | 35.33 |
| 490170 | 39.11 | 38.92 | 38.80 | 38.72 | 38.55 | 38.30 |
| 490180 | 39.38 | 38.94 | 38.51 | 37.89 | 37.14 | 36.79 |
| 490181 | 39.38 | 38.94 | 38.51 | 37.89 | 37.14 | 36.79 |
| 490200 | 39.35 | 39.04 | 38.90 | 38.73 | 38.55 | 38.30 |
| 490210 | 39.07 | 38.73 | 38.53 | 38.33 | 38.07 | 37.93 |
| 490211 | 40.77 | 40.71 | 40.68 | 40.65 | 40.60 | 40.56 |
| 490220 | 43.14 | 42.99 | 42.87 | 42.54 | 42.02 | 41.72 |
| 490221 | 45.37 | 45.29 | 45.25 | 45.04 | 44.50 | 44.16 |
| 490230 | 42.13 | 41.74 | 41.51 | 41.29 | 41.03 | 40.90 |
| 490240 | 32.29 | 31.62 | 31.23 | 30.83 | 30.45 | 30.28 |
| 490250 | 33.85 | 33.42 | 33.18 | 32.94 | 32.53 | 32.32 |
| 490251 | 36.24 | 36.00 | 35.73 | 35.32 | 34.78 | 34.04 |
| 490260 | 35.05 | 34.84 | 34.72 | 34.48 | 33.28 | 33.00 |
| 490261 | 36.42 | 36.31 | 36.25 | 36.18 | 36.08 | 36.03 |
| 490263 | 36.83 | 36.31 | 35.98 | 35.65 | 35.25 | 35.04 |
| 490264 | 35.73 | 35.43 | 35.25 | 35.06 | 34.83 | 34.71 |
| 490266 | 36.44 | 36.24 | 36.12 | 35.99 | 35.80 | 35.68 |
| 490270 | 39.71 | 39.32 | 38.99 | 38.46 | 37.74 | 37.45 |
| 490280 | 36.25 | 36.00 | 35.73 | 35.32 | 34.78 | 34.54 |
| 490281 | 36.26 | 36.01 | 35.73 | 35.32 | 34.78 | 34.54 |
| 490290 | 35.57 | 35.19 | 35.03 | 34.84 | 34.55 | 34.37 |
| 490300 | 35.19 | 34.99 | 34.85 | 34.53 | 33.16 | 33.01 |

Table 1
Existing Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 490310 | 37.57 | 37.31 | 37.13 | 36.83 | 36.26 | 35.98 |
| 490320 | 38.25 | 38.09 | 37.98 | 37.87 | 37.76 | 37.72 |
| 490321 | 38.91 | 38.71 | 38.60 | 38.47 | 38.24 | 38.10 |
| 490330 | 38.81 | 38.77 | 38.74 | 38.70 | 38.66 | 38.43 |
| 490340 | 38.09 | 38.00 | 37.94 | 37.88 | 37.83 | 37.81 |
| 490350 | 38.86 | 38.81 | 38.77 | 38.72 | 38.67 | 38.47 |
| 490370 | 37.34 | 37.05 | 36.91 | 36.73 | 36.32 | 36.04 |
| 490375 | 39.60 | 39.24 | 39.05 | 38.83 | 38.50 | 38.27 |
| 490390 | 39.16 | 38.90 | 38.71 | 38.49 | 37.97 | 37.39 |
| 490391 | 38.41 | 38.17 | 38.00 | 37.79 | 37.26 | 37.20 |
| 490392 | 37.34 | 37.17 | 37.07 | 36.97 | 36.82 | 36.76 |
| 490400 | 39.58 | 39.23 | 39.05 | 38.95 | 38.89 | 38.78 |
| 490401 | 40.02 | 39.84 | 39.71 | 39.57 | 39.37 | 39.25 |
| 490410 | 39.60 | 39.24 | 39.05 | 38.83 | 38.50 | 38.27 |
| 490411 | 39.60 | 39.24 | 39.05 | 38.83 | 38.50 | 38.27 |
| 490420 | 41.01 | 40.88 | 40.82 | 40.75 | 40.65 | 40.57 |
| 490421 | 40.68 | 40.35 | 40.16 | 39.97 | 39.74 | 39.62 |
| 490422 | 41.34 | 41.24 | 41.18 | 41.11 | 41.05 | 40.96 |
| 490425 | 41.01 | 40.88 | 40.82 | 40.75 | 40.65 | 40.57 |
| 490430 | 42.83 | 42.20 | 41.87 | 41.57 | 41.25 | 41.10 |
| 490440 | 44.20 | 43.76 | 43.49 | 43.20 | 42.84 | 42.64 |
| 490450 | 41.19 | 40.98 | 40.87 | 40.74 | 40.61 | 40.58 |
| 490451 | 41.01 | 40.87 | 40.70 | 40.39 | 40.14 | 40.02 |
| 490453 | 41.01 | 40.87 | 40.70 | 40.39 | 40.14 | 40.02 |
| 490455 | 41.10 | 40.86 | 40.77 | 40.70 | 40.60 | 40.56 |
| 490460 | 48.13 | 47.89 | 47.69 | 47.47 | 47.17 | 47.00 |
| 490470 | 43.73 | 43.43 | 43.24 | 42.97 | 42.46 | 42.25 |
| 490480 | 43.73 | 43.43 | 43.24 | 42.97 | 42.46 | 42.25 |
| 490490 | 44.47 | 43.89 | 43.67 | 43.48 | 43.25 | 43.17 |
| 490500 | 45.49 | 45.25 | 45.18 | 45.11 | 45.00 | 44.94 |
| 490510 | 51.73 | 51.39 | 51.19 | 50.98 | 50.73 | 50.60 |
| 490520 | 50.52 | 50.08 | 49.83 | 49.56 | 48.66 | 47.99 |
| 490530 | 55.36 | 54.84 | 54.52 | 54.18 | 53.74 | 53.51 |
| 490535 | 58.99 | 58.68 | 58.48 | 58.25 | 57.94 | 57.75 |
| 490540 | 59.33 | 58.98 | 58.76 | 58.51 | 58.17 | 57.98 |
| 490550 | 50.56 | 50.13 | 49.95 | 49.74 | 49.45 | 49.28 |
| 490555 | 52.04 | 51.53 | 51.19 | 50.80 | 50.24 | 49.93 |
| 490560 | 50.58 | 50.24 | 50.10 | 49.97 | 49.82 | 49.74 |
| 490580 | 43.06 | 42.39 | 42.05 | 41.74 | 41.40 | 41.24 |
| 490590 | 50.64 | 50.23 | 50.01 | 49.77 | 49.49 | 49.35 |
| 490600 | 44.89 | 44.81 | 44.74 | 44.65 | 44.41 | 44.12 |
| 490610 | 43.81 | 43.11 | 42.77 | 42.41 | 41.99 | 41.79 |
| 490612 | 44.39 | 44.31 | 44.27 | 44.23 | 44.20 | 43.96 |
| 490620 | 43.81 | 43.11 | 42.77 | 42.41 | 41.99 | 41.79 |
| 490621 | 45.53 | 45.47 | 45.43 | 45.42 | 45.18 | 45.04 |

Table 1
Existing Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 490630 | 45.58 | 45.38 | 45.13 | 44.87 | 44.53 | 44.36 |
| 490637 | 44.37 | 43.43 | 43.06 | 42.75 | 42.43 | 42.26 |
| 490638 | 45.26 | 44.66 | 44.62 | 44.58 | 44.50 | 44.39 |
| 490639 | 51.04 | 50.09 | 49.71 | 49.39 | 49.21 | 49.11 |
| 490640 | 43.17 | 42.46 | 42.11 | 41.79 | 41.44 | 41.27 |
| 490641 | 49.24 | 48.80 | 48.12 | 47.43 | 46.73 | 46.48 |
| 490642 | 49.37 | 48.80 | 48.41 | 47.90 | 47.24 | 46.90 |
| 490643 | 46.24 | 45.80 | 45.52 | 45.21 | 44.81 | 44.54 |
| 490644 | 50.97 | 50.02 | 49.63 | 49.39 | 49.21 | 49.12 |
| 490645 | 52.40 | 51.99 | 51.72 | 51.44 | 51.27 | 50.83 |
| 490646 | 48.12 | 47.95 | 47.77 | 47.58 | 47.31 | 47.17 |
| 490650 | 46.55 | 46.17 | 45.83 | 45.46 | 45.00 | 44.69 |
| 490651 | 51.83 | 51.29 | 50.96 | 50.61 | 50.18 | 49.98 |
| 490652 | 46.57 | 46.39 | 46.34 | 46.29 | 46.22 | 46.20 |
| 490654 | 48.54 | 48.47 | 48.44 | 48.42 | 48.13 | 47.94 |
| 490655 | 48.97 | 48.93 | 48.90 | 48.87 | 48.83 | 48.80 |
| 490659 | 50.67 | 49.56 | 49.11 | 48.67 | 48.10 | 47.79 |
| 490660 | 48.95 | 48.13 | 47.54 | 46.70 | 46.02 | 45.61 |
| 490661 | 51.10 | 50.75 | 50.45 | 50.13 | 49.72 | 49.54 |
| 490670 | 50.96 | 49.69 | 49.21 | 48.82 | 48.29 | 47.98 |
| 490675 | 50.67 | 49.47 | 49.02 | 48.63 | 48.10 | 47.79 |
| 490680 | 51.14 | 50.58 | 50.23 | 49.92 | 49.55 | 49.36 |
| 490690 | 51.17 | 49.85 | 49.29 | 48.89 | 48.39 | 48.09 |
| 490700 | 60.55 | 60.05 | 59.68 | 59.29 | 58.86 | 58.65 |
| 490710 | 53.46 | 52.95 | 52.69 | 52.44 | 52.05 | 51.78 |
| 490711 | 54.65 | 54.59 | 54.53 | 54.49 | 54.43 | 54.40 |
| 490720 | 53.31 | 52.85 | 52.65 | 52.43 | 52.08 | 51.88 |
| 490730 | 54.34 | 54.02 | 53.35 | 52.77 | 52.25 | 51.97 |
| 490740 | 54.93 | 54.28 | 53.71 | 53.47 | 53.12 | 52.90 |
| 490742 | 60.25 | 59.91 | 59.70 | 59.47 | 59.32 | 59.25 |
| 490743 | 54.96 | 54.28 | 53.58 | 52.87 | 52.07 | 51.71 |
| 490744 | 54.97 | 54.28 | 53.58 | 52.87 | 52.14 | 51.96 |
| 490745 | 60.25 | 59.91 | 59.70 | 59.47 | 59.15 | 58.90 |
| 490746 | 60.68 | 60.51 | 60.23 | 59.82 | 59.23 | 58.89 |
| 490750 | 54.86 | 54.43 | 54.18 | 53.90 | 53.51 | 53.29 |
| 490751 | 57.03 | 56.75 | 56.59 | 56.42 | 56.23 | 56.13 |
| 490760 | 54.82 | 54.58 | 54.43 | 54.17 | 53.93 | 53.82 |
| 490770 | 55.83 | 55.66 | 55.55 | 55.42 | 55.20 | 55.06 |
| 490771 | 57.10 | 56.93 | 56.66 | 56.39 | 56.06 | 55.90 |
| 490772 | 58.66 | 58.19 | 57.91 | 57.62 | 57.26 | 57.08 |
| 490773 | 59.60 | 59.27 | 59.07 | 58.85 | 58.54 | 58.34 |
| 490776 | 57.70 | 57.64 | 57.62 | 57.42 | 57.12 | 56.94 |
| 490779 | 57.71 | 57.49 | 57.37 | 57.23 | 57.10 | 56.92 |
| 490780 | 58.38 | 57.93 | 57.67 | 57.40 | 57.06 | 56.89 |
| 490790 | 56.12 | 55.76 | 55.58 | 55.41 | 55.16 | 55.02 |

Table 1
Existing Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 490791 | 59.15 | 58.93 | 58.61 | 58.25 | 57.79 | 57.55 |
| 490792 | 59.07 | 58.63 | 58.35 | 58.04 | 57.63 | 57.41 |
| 490794 | 58.05 | 57.83 | 57.67 | 57.50 | 57.24 | 57.08 |
| 490795 | 58.04 | 57.76 | 57.44 | 57.24 | 56.98 | 56.84 |
| 490800 | 56.77 | 56.22 | 55.96 | 55.81 | 55.62 | 55.51 |
| 490801 | 57.91 | 57.60 | 57.44 | 57.26 | 57.11 | 56.93 |
| 490802 | 58.16 | 58.07 | 58.00 | 57.72 | 57.35 | 57.15 |
| 490803 | 59.24 | 58.78 | 58.52 | 58.24 | 57.89 | 57.71 |
| 490804 | 59.24 | 58.78 | 58.52 | 58.24 | 57.89 | 57.71 |
| 490900 | 56.12 | 55.76 | 55.58 | 55.41 | 55.16 | 55.02 |
| 491000 | 20.35 | 20.23 | 20.15 | 20.07 | 19.98 | 19.94 |
| 491010 | 25.97 | 25.69 | 25.50 | 25.28 | 24.94 | 24.75 |
| 491019 | 29.01 | 28.12 | 27.85 | 27.62 | 27.43 | 27.30 |
| 491020 | 29.45 | 29.24 | 29.05 | 28.83 | 28.53 | 28.37 |
| 491021 | 29.44 | 29.23 | 29.05 | 28.83 | 28.54 | 28.38 |
| 491022 | 29.43 | 29.22 | 29.04 | 28.83 | 28.53 | 28.38 |
| 491040 | 26.54 | 25.96 | 25.70 | 25.43 | 25.04 | 24.83 |
| 491041 | 29.91 | 29.63 | 29.46 | 29.27 | 29.01 | 28.86 |
| 491042 | 29.23 | 28.99 | 28.87 | 28.75 | 28.61 | 28.55 |
| 491043 | 29.14 | 28.90 | 28.78 | 28.63 | 28.39 | 28.25 |
| 491044 | 29.85 | 29.54 | 29.37 | 29.19 | 28.94 | 28.81 |
| 491060 | 30.05 | 29.92 | 29.85 | 29.75 | 29.29 | 28.87 |
| 491080 | 30.92 | 30.34 | 30.11 | 29.89 | 29.34 | 28.89 |
| 491100 | 32.22 | 31.53 | 31.21 | 30.86 | 30.48 | 30.27 |
| 491102 | 32.22 | 31.60 | 31.46 | 31.30 | 31.08 | 30.96 |
| 491120 | 32.69 | 32.53 | 32.11 | 31.46 | 30.63 | 30.23 |
| 491121 | 32.72 | 32.55 | 32.37 | 32.33 | 32.25 | 32.21 |
| 491122 | 33.47 | 33.42 | 33.38 | 33.35 | 33.30 | 33.28 |
| 491123 | 34.06 | 33.89 | 33.78 | 33.67 | 33.51 | 33.43 |
| 491140 | 32.93 | 32.66 | 32.57 | 32.48 | 32.34 | 32.26 |
| 491160 | 34.32 | 33.73 | 33.39 | 33.03 | 32.57 | 32.33 |
| 491180 | 36.48 | 35.87 | 35.41 | 34.93 | 34.30 | 33.98 |
| 491200 | 38.28 | 37.71 | 37.35 | 36.98 | 36.55 | 36.34 |
| 491220 | 38.91 | 38.58 | 38.42 | 38.25 | 38.05 | 37.95 |
| 491221 | 36.94 | 36.71 | 36.58 | 36.43 | 36.26 | 36.19 |
| 491222 | 39.85 | 39.24 | 38.96 | 38.68 | 38.35 | 38.20 |
| 491223 | 36.95 | 36.72 | 36.58 | 36.44 | 36.28 | 36.20 |
| 491240 | 33.84 | 33.50 | 33.19 | 32.86 | 32.45 | 32.24 |
| 491260 | 32.99 | 32.29 | 31.97 | 31.64 | 31.35 | 31.22 |
| 491280 | 33.10 | 32.38 | 32.05 | 31.75 | 31.51 | 31.39 |
| 491285 | 39.29 | 39.15 | 39.04 | 38.83 | 38.29 | 37.65 |
| 491300 | 33.00 | 32.30 | 31.98 | 31.74 | 31.53 | 31.41 |
| 491302 | 36.93 | 36.69 | 36.56 | 36.42 | 36.22 | 36.15 |
| 491320 | 36.89 | 36.67 | 36.54 | 36.41 | 36.23 | 36.16 |
| 491340 | 34.59 | 34.20 | 33.81 | 33.34 | 32.74 | 32.43 |

Table 1
Existing Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 491344 | 39.09 | 38.71 | 38.48 | 38.23 | 37.90 | 37.72 |
| 491342 | 34.62 | 34.24 | 34.15 | 34.09 | 34.00 | 33.96 |
| 491360 | 37.17 | 37.01 | 36.88 | 36.74 | 36.54 | 36.42 |
| 491380 | 35.94 | 35.77 | 35.65 | 35.49 | 35.21 | 35.05 |
| 491382 | 33.78 | 33.66 | 33.59 | 33.52 | 33.42 | 33.37 |
| 491384 | 32.67 | 32.47 | 32.34 | 32.23 | 32.09 | 31.95 |
| 491387 | 40.65 | 40.31 | 40.09 | 39.86 | 39.72 | 39.62 |
| 491388 | 41.67 | 41.41 | 41.26 | 41.10 | 40.79 | 40.55 |
| 491390 | 40.91 | 40.36 | 40.11 | 39.85 | 39.72 | 39.62 |
| 491391 | 40.74 | 40.36 | 40.13 | 39.89 | 39.74 | 39.63 |
| 491393 | 45.71 | 45.56 | 45.45 | 45.19 | 44.71 | 44.41 |
| 491394 | 42.03 | 41.33 | 40.94 | 40.53 | 40.02 | 39.77 |
| 491395 | 40.74 | 40.36 | 40.13 | 39.89 | 39.74 | 39.63 |
| 491396 | 41.60 | 41.36 | 41.23 | 40.96 | 40.30 | 40.06 |
| 491397 | 40.57 | 40.26 | 40.07 | 39.85 | 39.72 | 39.62 |
| 491398 | 44.39 | 44.21 | 44.13 | 44.10 | 44.02 | 43.75 |
| 491399 | 41.75 | 41.44 | 41.28 | 41.12 | 40.79 | 40.55 |
| 491400 | 38.68 | 38.18 | 36.75 | 36.25 | 35.14 | 34.84 |
| 491401 | 42.93 | 42.52 | 42.43 | 42.33 | 42.20 | 42.12 |
| 491402 | 40.74 | 40.33 | 40.10 | 39.85 | 39.72 | 39.62 |
| 491404 | 41.75 | 41.45 | 41.29 | 41.12 | 40.79 | 40.55 |
| 491406 | 42.27 | 41.36 | 40.95 | 40.54 | 40.02 | 39.77 |
| 491407 | 40.69 | 40.30 | 40.08 | 39.85 | 39.72 | 39.62 |
| 491392 | 47.62 | 47.56 | 47.53 | 47.51 | 47.25 | 47.07 |
| 491403 | 48.37 | 48.26 | 48.19 | 48.11 | 48.01 | 47.83 |
| 491440 | 40.77 | 40.38 | 40.15 | 39.92 | 39.78 | 39.68 |
| 491441 | 40.77 | 40.38 | 40.15 | 39.92 | 39.78 | 39.68 |
| 491460 | 37.39 | 36.98 | 36.68 | 36.24 | 35.81 | 35.61 |
| 491465 | 37.10 | 36.72 | 36.50 | 36.25 | 35.83 | 35.63 |
| 491480 | 37.16 | 36.98 | 36.84 | 36.69 | 36.48 | 36.00 |
| 491500 | 37.32 | 36.81 | 36.55 | 36.26 | 35.86 | 35.65 |
| 491501 | 37.29 | 36.80 | 36.54 | 36.25 | 35.85 | 35.65 |
| 491502 | 38.18 | 38.08 | 38.05 | 37.97 | 37.76 | 37.66 |
| 491520 | 41.81 | 41.70 | 41.52 | 41.07 | 40.01 | 39.68 |
| 491540 | 44.55 | 44.36 | 44.22 | 44.12 | 43.84 | 43.49 |
| 491541 | 47.47 | 46.94 | 46.58 | 46.15 | 45.46 | 44.98 |
| 491452 | 44.10 | 44.04 | 44.02 | 43.92 | 43.55 | 43.35 |
| 491453 | 40.99 | 40.48 | 40.18 | 39.85 | 39.41 | 39.17 |
| 491560 | 44.21 | 43.72 | 43.49 | 43.19 | 42.56 | 42.08 |
| 491561 | 42.49 | 42.39 | 42.12 | 41.81 | 41.35 | 41.02 |
| 491562 | 45.83 | 45.50 | 45.31 | 45.11 | 44.85 | 44.71 |
| 491563 | 42.49 | 42.39 | 42.12 | 41.81 | 41.35 | 41.22 |
| 491580 | 44.28 | 43.87 | 43.63 | 43.39 | 43.11 | 42.96 |
| 491600 | 44.29 | 43.87 | 43.64 | 43.40 | 43.11 | 42.96 |
| 491620 | 47.83 | 47.53 | 47.35 | 47.17 | 46.93 | 46.81 |

Table 1
Existing Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 491621 | 51.05 | 50.80 | 50.63 | 50.45 | 50.20 | 50.06 |
| 424000 | 24.13 | 24.08 | 24.07 | 24.07 | 24.07 | 24.07 |
| 490232 | 46.55 | 46.48 | 46.44 | 46.39 | 46.32 | 46.26 |
| 490431 | 44.90 | 44.75 | 44.60 | 44.37 | 44.07 | 43.90 |
| 490449 | 44.15 | 43.89 | 43.73 | 43.55 | 43.29 | 43.13 |
| 490457 | 41.12 | 40.89 | 40.79 | 40.71 | 40.61 | 40.56 |
| 490491 | 50.95 | 50.61 | 50.28 | 49.11 | 48.42 | 48.17 |
| 490492 | 51.40 | 51.19 | 51.03 | 50.91 | 50.25 | 49.72 |
| 490501 | 49.23 | 49.09 | 49.01 | 48.93 | 48.82 | 48.76 |
| 490511 | 51.64 | 51.00 | 50.60 | 50.18 | 49.65 | 49.38 |
| 490561 | 59.59 | 59.10 | 58.80 | 58.48 | 58.11 | 57.92 |
| 490581 | 46.30 | 46.18 | 46.11 | 46.04 | 45.94 | 45.88 |
| 490582 | 52.53 | 52.30 | 52.16 | 51.98 | 51.82 | 51.77 |
| 490584 | 52.46 | 52.37 | 52.32 | 51.97 | 51.51 | 51.27 |
| 490587 | 57.82 | 57.48 | 57.25 | 56.97 | 56.61 | 56.52 |
| 490701 | 58.83 | 58.76 | 58.71 | 58.64 | 58.55 | 58.51 |
| 490702 | 60.65 | 60.58 | 60.53 | 60.47 | 60.42 | 60.20 |
| 490703 | 55.90 | 55.57 | 55.40 | 55.22 | 55.00 | 54.89 |
| 490704 | 60.92 | 60.78 | 60.69 | 60.57 | 60.39 | 60.29 |
| 490713 | 54.64 | 54.49 | 54.37 | 54.19 | 53.82 | 53.61 |
| 490741 | 59.94 | 59.38 | 59.18 | 58.98 | 58.74 | 58.62 |
| 490762 | 59.34 | 59.15 | 59.03 | 58.72 | 58.18 | 57.85 |
| 490781 | 62.43 | 62.22 | 62.09 | 61.96 | 61.75 | 61.64 |
| 491274 | 39.32 | 39.17 | 39.06 | 38.92 | 38.40 | 37.75 |
| 491284 | 37.64 | 37.27 | 36.96 | 36.46 | 36.06 | 35.79 |
| 491389 | 40.79 | 40.66 | 40.60 | 40.56 | 40.35 | 40.20 |
| 491700 | 28.69 | 28.08 | 27.53 | 26.90 | 26.12 | 25.71 |
| 491701 | 28.50 | 27.41 | 26.70 | 25.82 | 24.39 | 23.51 |
| 491702 | 58.01 | 57.75 | 57.51 | 57.19 | 56.74 | 56.50 |
| 491703 | 28.50 | 27.61 | 27.50 | 27.42 | 27.31 | 27.27 |
| 491704 | 58.91 | 58.83 | 58.78 | 58.73 | 58.66 | 58.61 |
| 491705 | 58.04 | 57.76 | 57.51 | 57.19 | 56.74 | 56.50 |
| 491706 | 52.43 | 51.93 | 51.62 | 51.30 | 50.91 | 50.71 |
| 491707 | 47.88 | 47.46 | 47.22 | 46.98 | 46.67 | 46.52 |
| 491708 | 38.89 | 38.70 | 38.59 | 38.47 | 38.27 | 38.14 |
| 491709 | 39.42 | 39.31 | 39.24 | 39.17 | 39.09 | 39.04 |
| 491710 | 29.28 | 29.06 | 28.89 | 28.79 | 28.65 | 28.58 |
| 491711 | 28.50 | 27.41 | 26.70 | 26.03 | 25.42 | 25.12 |
| 491712 | 35.50 | 34.89 | 34.47 | 33.99 | 33.33 | 32.99 |
| 491713 | 33.93 | 33.53 | 33.33 | 33.04 | 32.67 | 32.50 |
| 491714 | 32.75 | 32.52 | 32.38 | 32.22 | 32.02 | 31.94 |
| 491715 | 43.73 | 43.43 | 43.24 | 42.97 | 42.46 | 42.25 |
| 491716 | 35.32 | 35.04 | 34.88 | 34.70 | 34.36 | 34.15 |
| 491717 | 55.33 | 55.28 | 55.24 | 55.22 | 55.10 | 55.00 |
| 491718 | 36.79 | 36.64 | 36.55 | 36.44 | 36.29 | 36.20 |

Table 1
Existing Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 491719 | 47.61 | 47.03 | 46.66 | 46.26 | 45.70 | 45.39 |
| 491720 | 40.87 | 40.71 | 40.61 | 40.49 | 40.31 | 40.20 |
| 491721 | 41.02 | 40.72 | 40.53 | 40.31 | 39.98 | 39.79 |
| 491722 | 40.44 | 40.11 | 39.92 | 39.74 | 39.57 | 39.48 |
| 491723 | 38.54 | 38.12 | 37.81 | 37.50 | 37.08 | 36.88 |
| 491724 | 35.30 | 35.03 | 34.88 | 34.70 | 34.36 | 34.15 |
| 491725 | 34.87 | 34.57 | 34.40 | 34.20 | 33.95 | 33.82 |
| 491728 | 35.37 | 35.29 | 35.21 | 35.15 | 34.61 | 34.03 |
| 491729 | 31.52 | 31.38 | 31.35 | 30.93 | 30.19 | 29.76 |
| 491730 | 30.63 | 30.16 | 29.87 | 29.56 | 29.17 | 29.00 |
| 491737 | 38.88 | 38.69 | 38.64 | 38.59 | 38.53 | 38.50 |
| 491740 | 38.74 | 38.66 | 38.62 | 38.56 | 38.49 | 38.46 |
| 491745 | 39.38 | 39.23 | 39.14 | 39.04 | 38.92 | 38.86 |
| 491746 | 39.29 | 39.17 | 39.08 | 38.94 | 38.72 | 38.60 |
| 491750 | 47.43 | 46.72 | 46.32 | 45.92 | 45.43 | 45.20 |
| 491753 | 51.77 | 51.56 | 51.45 | 51.33 | 50.77 | 50.48 |
| 490574 | 46.90 | 46.34 | 46.00 | 45.65 | 45.22 | 45.01 |
| 491405 | 44.75 | 44.66 | 44.60 | 44.55 | 44.34 | 44.13 |
| 490714 | 54.66 | 54.60 | 54.56 | 54.43 | 54.09 | 53.91 |
| 490753 | 54.87 | 54.62 | 54.46 | 54.19 | 53.78 | 53.56 |
| 491224 | 43.54 | 43.34 | 42.78 | 42.18 | 41.41 | 41.01 |
| 491225 | 44.44 | 44.16 | 43.96 | 43.72 | 43.41 | 43.23 |
| 491759 | 41.07 | 40.83 | 40.68 | 40.51 | 40.31 | 40.22 |
| 491760 | 40.98 | 40.75 | 40.61 | 40.45 | 40.27 | 40.19 |
| 491764 | 40.77 | 40.55 | 40.38 | 40.19 | 40.00 | 39.93 |
| 491768 | 40.70 | 40.46 | 40.29 | 40.09 | 39.63 | 39.26 |
| 499999 | 40.64 | 40.41 | 40.24 | 40.05 | 39.59 | 39.22 |
| 499998 | 40.61 | 40.39 | 40.22 | 40.03 | 39.58 | 39.22 |
| 499997 | 36.15 | 36.06 | 36.00 | 35.93 | 35.80 | 35.67 |

Table 2
Existing Conditions Levels of Service (LOS)

| Node | Road Elevation (NAVD) | 25-Year/24-Hour Storm Event | | 100-Year/24-Hour Storm Event | |
|--------|-----------------------|-----------------------------|-----|------------------------------|-----|
| | | Peak Stage (ft NAVD) | LOS | Peak Stage (ft NAVD) | LOS |
| 490004 | 33.16 | 28.68 | A | 29.50 | A |
| 490010 | 28.96 | 28.87 | A | 29.39 | C |
| 490020 | 31.00 | 28.67 | A | 29.39 | A |
| 490030 | 29.96 | 28.67 | A | 29.66 | A |
| 490050 | 31.00 | 28.78 | A | 29.11 | A |
| 490070 | 31.26 | 30.02 | A | 30.87 | A |
| 490080 | 31.26 | 30.09 | A | 31.49 | B |
| 490120 | 35.36 | 33.59 | A | 34.07 | A |
| 490130 | 34.50 | 33.68 | A | 34.43 | A |
| 490140 | 34.50 | 33.34 | A | 33.75 | A |
| 490150 | 35.26 | 34.98 | A | 36.21 | C |
| 490160 | 35.30 | 35.57 | C | 36.25 | C |
| 490170 | 42.30 | 38.80 | A | 39.11 | A |
| 490180 | 38.66 | 38.51 | A | 39.38 | C |
| 490181 | 41.00 | 38.51 | A | 39.38 | A |
| 490200 | 39.50 | 38.90 | A | 39.35 | A |
| 490210 | 42.77 | 38.53 | A | 39.07 | A |
| 490220 | 42.77 | 42.87 | B | 43.14 | C |
| 490232 | 46.20 | 46.44 | B | 46.55 | C |
| 490240 | 35.00 | 31.23 | A | 32.29 | A |
| 490250 | 35.00 | 33.18 | A | 33.85 | A |
| 490260 | 34.50 | 34.72 | B | 35.05 | C |
| 490263 | 39.50 | 35.98 | A | 36.83 | A |
| 490266 | 39.76 | 36.12 | A | 36.44 | A |
| 490270 | 39.76 | 38.99 | A | 39.71 | A |
| 490290 | 37.06 | 35.03 | A | 35.57 | A |
| 490300 | 35.00 | 34.85 | A | 35.19 | B |
| 490310 | 37.06 | 37.13 | B | 37.57 | C |
| 490320 | 39.36 | 37.98 | A | 38.25 | A |
| 490340 | 39.36 | 37.94 | A | 38.09 | A |
| 490375 | 39.06 | 39.05 | A | 39.6 | C |
| 490390 | 39.00 | 38.71 | A | 39.16 | B |
| 490410 | 39.06 | 39.05 | A | 39.6 | C |
| 490420 | 40.53 | 40.82 | C | 41.01 | C |
| 490430 | 44.67 | 41.87 | A | 42.83 | A |
| 490431 | 45.50 | 44.60 | A | 44.9 | A |
| 490440 | 44.67 | 43.49 | A | 44.2 | A |
| 490450 | 44.50 | 40.87 | A | 41.19 | A |
| 490460 | 47.67 | 47.69 | B | 48.13 | C |
| 490470 | 46.67 | 43.24 | A | 43.73 | A |
| 490480 | 44.50 | 43.24 | A | 43.73 | A |
| 490490 | 46.67 | 43.67 | A | 44.47 | A |
| 490500 | 53.50 | 45.18 | A | 45.49 | A |
| 490501 | 52.57 | 49.01 | A | 49.23 | A |
| 490510 | 52.57 | 51.19 | A | 51.73 | A |

Table 2
Existing Conditions Levels of Service (LOS)

| Node | Road Elevation (NAVD) | 25-Year/24-Hour Storm Event | | 100-Year/24-Hour Storm Event | |
|--------|-----------------------|-----------------------------|-----|------------------------------|-----|
| | | Peak Stage (ft NAVD) | LOS | Peak Stage (ft NAVD) | LOS |
| 490520 | 53.50 | 49.83 | A | 50.52 | A |
| 490530 | 59.61 | 54.52 | A | 55.36 | A |
| 490535 | 59.37 | 58.48 | A | 58.99 | A |
| 490540 | 59.37 | 58.76 | A | 59.33 | A |
| 490555 | 61.37 | 51.19 | A | 52.04 | A |
| 490574 | 47.50 | 46.00 | A | 46.9 | A |
| 490580 | 44.56 | 42.05 | A | 43.06 | A |
| 490590 | 50.37 | 50.01 | A | 50.64 | C |
| 490600 | 44.56 | 44.74 | B | 44.89 | C |
| 490610 | 44.07 | 42.77 | A | 43.81 | A |
| 490630 | 45.37 | 45.13 | A | 45.58 | B |
| 490637 | 48.86 | 43.06 | A | 44.37 | A |
| 490638 | 50.50 | 44.62 | A | 45.26 | A |
| 490639 | 53.50 | 49.71 | A | 51.04 | A |
| 490640 | 47.67 | 42.11 | A | 43.17 | A |
| 490641 | 50.50 | 48.12 | A | 49.24 | A |
| 490643 | 48.07 | 45.52 | A | 46.24 | A |
| 490644 | 52.50 | 49.63 | A | 50.97 | A |
| 490645 | 53.50 | 51.72 | A | 52.4 | A |
| 490646 | 48.86 | 47.77 | A | 48.12 | A |
| 490650 | 49.17 | 45.83 | A | 46.55 | A |
| 490659 | 51.50 | 49.11 | A | 50.67 | A |
| 490660 | 48.07 | 47.54 | A | 48.95 | C |
| 490661 | 51.50 | 50.45 | A | 51.1 | A |
| 490670 | 50.87 | 49.21 | A | 50.96 | B |
| 490675 | 51.50 | 49.02 | A | 50.67 | A |
| 490680 | 50.87 | 50.23 | A | 51.14 | C |
| 490690 | 53.31 | 49.29 | A | 51.17 | A |
| 490700 | 60.00 | 59.68 | A | 60.55 | C |
| 490703 | 57.87 | 55.40 | A | 55.9 | A |
| 490710 | 53.31 | 52.69 | A | 53.46 | B |
| 490714 | 57.00 | 54.56 | A | 54.66 | A |
| 490720 | 52.87 | 52.65 | A | 53.31 | C |
| 490740 | 58.17 | 53.71 | A | 54.93 | A |
| 490743 | 58.17 | 53.58 | A | 54.96 | A |
| 490744 | 58.17 | 53.58 | A | 54.97 | A |
| 490750 | 56.37 | 54.18 | A | 54.86 | A |
| 490753 | 57.00 | 54.46 | A | 54.87 | A |
| 490760 | 54.27 | 54.43 | B | 54.82 | C |
| 490770 | 57.00 | 55.55 | A | 55.83 | A |
| 490780 | 58.00 | 57.67 | A | 58.38 | C |
| 490790 | 56.97 | 55.58 | A | 56.12 | A |
| 490800 | 58.37 | 55.96 | A | 56.77 | A |
| 490900 | 65.30 | 55.58 | A | 56.12 | A |
| 491010 | 27.00 | 25.50 | A | 25.97 | A |

Table 2
Existing Conditions Levels of Service (LOS)

| Node | Road Elevation (NAVD) | 25-Year/24-Hour Storm Event | | 100-Year/24-Hour Storm Event | |
|--------|-----------------------|-----------------------------|-----|------------------------------|-----|
| | | Peak Stage (ft NAVD) | LOS | Peak Stage (ft NAVD) | LOS |
| 491020 | 29.16 | 29.05 | A | 29.45 | C |
| 491021 | 29.50 | 29.05 | A | 29.44 | A |
| 491040 | 27.50 | 25.70 | A | 26.54 | A |
| 491041 | 30.00 | 29.46 | A | 29.91 | A |
| 491042 | 30.00 | 28.87 | A | 29.23 | A |
| 491060 | 29.66 | 29.85 | B | 30.05 | C |
| 491080 | 31.26 | 30.11 | A | 30.92 | A |
| 491100 | 32.66 | 31.21 | A | 32.22 | A |
| 491121 | 34.06 | 32.37 | A | 32.72 | A |
| 491140 | 33.16 | 32.57 | A | 32.93 | A |
| 491160 | 34.76 | 33.39 | A | 34.32 | A |
| 491180 | 35.50 | 35.41 | A | 36.48 | C |
| 491200 | 39.00 | 37.35 | A | 38.28 | A |
| 491220 | 39.27 | 38.42 | A | 38.91 | A |
| 491221 | 39.00 | 36.58 | A | 36.94 | A |
| 491222 | 40.00 | 38.96 | A | 39.85 | A |
| 491260 | 33.66 | 31.97 | A | 32.99 | A |
| 491274 | 38.89 | 39.06 | B | 39.32 | C |
| 491280 | 34.17 | 32.05 | A | 33.1 | A |
| 491284 | 38.84 | 36.96 | A | 37.64 | A |
| 491285 | 38.84 | 39.04 | B | 39.29 | C |
| 491320 | 39.00 | 36.54 | A | 36.89 | A |
| 491340 | 34.17 | 33.81 | A | 34.59 | C |
| 491342 | 35.46 | 34.15 | A | 34.62 | A |
| 491360 | 37.07 | 36.88 | A | 37.17 | B |
| 491380 | 35.46 | 35.65 | B | 35.94 | C |
| 491388 | 42.47 | 41.26 | A | 41.67 | A |
| 491391 | 41.17 | 40.13 | A | 40.74 | A |
| 491394 | 42.77 | 40.94 | A | 42.03 | A |
| 491395 | 41.50 | 40.13 | A | 40.74 | A |
| 491397 | 41.00 | 40.07 | A | 40.57 | A |
| 491400 | 38.00 | 36.75 | A | 38.68 | C |
| 491401 | 45.50 | 42.43 | A | 42.93 | A |
| 491402 | 43.07 | 40.10 | A | 40.74 | A |
| 491440 | 43.00 | 40.15 | A | 40.77 | A |
| 491453 | 42.67 | 40.18 | A | 40.99 | A |
| 491460 | 39.00 | 36.68 | A | 37.39 | A |
| 491465 | 36.37 | 36.50 | B | 37.1 | C |
| 491500 | 42.67 | 36.55 | A | 37.32 | A |
| 491501 | 37.47 | 36.54 | A | 37.29 | A |
| 491520 | 41.63 | 41.52 | A | 41.81 | B |
| 491600 | 50.47 | 43.64 | A | 44.29 | A |
| 491620 | 50.47 | 47.35 | A | 47.83 | A |
| 491715 | 46.67 | 43.24 | A | 43.73 | A |
| 499998 | 41.50 | 40.22 | A | 40.61 | A |

Table 2
Existing Conditions Levels of Service (LOS)

| Node | Road Elevation (NAVD) | 25-Year/24-Hour Storm Event | | 100-Year/24-Hour Storm Event | |
|--------|-----------------------|-----------------------------|-----|------------------------------|-----|
| | | Peak Stage (ft NAVD) | LOS | Peak Stage (ft NAVD) | LOS |
| 499999 | 41.50 | 40.24 | A | 40.64 | A |

Exhibit C

Table 1
Proposed Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 490000 | 27.46 | 27.03 | 26.77 | 26.52 | 26.46 | 26.46 |
| 490004 | 29.53 | 29.05 | 28.73 | 28.43 | 28.10 | 27.96 |
| 490002 | 27.05 | 26.68 | 26.47 | 26.46 | 26.46 | 26.46 |
| 490008 | 29.57 | 29.05 | 28.75 | 28.45 | 28.09 | 27.91 |
| 490010 | 29.39 | 29.10 | 28.87 | 28.58 | 28.25 | 28.09 |
| 490020 | 29.39 | 28.90 | 28.67 | 28.46 | 28.22 | 28.09 |
| 490030 | 29.66 | 28.88 | 28.67 | 28.44 | 28.13 | 27.95 |
| 490040 | 31.11 | 30.68 | 30.43 | 30.19 | 29.90 | 29.75 |
| 490050 | 29.11 | 28.91 | 28.78 | 28.62 | 28.39 | 28.26 |
| 490070 | 30.92 | 30.38 | 30.07 | 29.77 | 29.43 | 29.28 |
| 490071 | 30.92 | 30.39 | 30.10 | 30.02 | 29.91 | 29.86 |
| 490072 | 29.36 | 28.88 | 28.61 | 28.34 | 28.02 | 27.86 |
| 490073 | 32.44 | 32.40 | 32.38 | 32.35 | 32.31 | 32.29 |
| 490080 | 31.49 | 30.91 | 30.27 | 29.60 | 29.43 | 29.28 |
| 490090 | 31.53 | 31.24 | 31.09 | 30.90 | 30.71 | 30.29 |
| 490100 | 30.92 | 30.39 | 30.07 | 29.77 | 29.69 | 29.65 |
| 490110 | 31.60 | 31.02 | 30.67 | 30.34 | 30.00 | 29.85 |
| 490120 | 34.06 | 33.71 | 33.62 | 33.53 | 33.41 | 33.34 |
| 490130 | 34.41 | 33.82 | 33.71 | 33.59 | 33.44 | 33.37 |
| 490140 | 33.75 | 33.50 | 33.35 | 33.21 | 33.07 | 33.01 |
| 490141 | 33.99 | 33.93 | 33.89 | 33.84 | 33.82 | 33.74 |
| 490150 | 36.20 | 35.64 | 34.95 | 34.49 | 33.92 | 33.76 |
| 490160 | 36.25 | 35.70 | 35.55 | 35.45 | 35.36 | 35.21 |
| 490170 | 39.11 | 38.92 | 38.80 | 38.72 | 38.55 | 38.30 |
| 490180 | 39.38 | 38.94 | 38.50 | 37.88 | 37.12 | 36.77 |
| 490181 | 39.38 | 38.94 | 38.50 | 37.88 | 37.12 | 36.77 |
| 490200 | 39.35 | 39.04 | 38.90 | 38.73 | 38.55 | 38.30 |
| 490210 | 39.07 | 38.73 | 38.53 | 38.33 | 38.07 | 37.93 |
| 490211 | 40.77 | 40.71 | 40.68 | 40.65 | 40.60 | 40.56 |
| 490220 | 43.14 | 42.99 | 42.87 | 42.54 | 42.02 | 41.72 |
| 490221 | 45.37 | 45.29 | 45.25 | 45.04 | 44.50 | 44.16 |
| 490230 | 42.13 | 41.74 | 41.51 | 41.29 | 41.03 | 40.90 |
| 490240 | 32.36 | 31.71 | 31.31 | 30.93 | 30.55 | 30.38 |
| 490250 | 33.90 | 33.47 | 33.22 | 32.99 | 32.64 | 32.44 |
| 490251 | 36.24 | 36.00 | 35.73 | 35.32 | 34.78 | 34.04 |
| 490260 | 35.05 | 34.84 | 34.72 | 34.48 | 33.28 | 33.00 |
| 490261 | 36.42 | 36.31 | 36.25 | 36.18 | 36.08 | 36.03 |
| 490263 | 36.83 | 36.31 | 35.98 | 35.65 | 35.25 | 35.04 |
| 490264 | 35.73 | 35.43 | 35.25 | 35.06 | 34.83 | 34.71 |
| 490266 | 36.44 | 36.24 | 36.12 | 35.99 | 35.80 | 35.68 |
| 490270 | 39.71 | 39.32 | 38.99 | 38.46 | 37.74 | 37.45 |
| 490280 | 36.25 | 36.00 | 35.73 | 35.32 | 34.78 | 34.54 |
| 490281 | 36.26 | 36.01 | 35.73 | 35.32 | 34.78 | 34.54 |
| 490290 | 35.62 | 35.23 | 35.08 | 34.90 | 34.63 | 34.45 |
| 490300 | 35.19 | 34.99 | 34.85 | 34.53 | 33.16 | 33.01 |

Table 1
Proposed Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 490310 | 37.57 | 37.31 | 37.13 | 36.83 | 36.26 | 35.98 |
| 490320 | 38.25 | 38.09 | 37.98 | 37.87 | 37.76 | 37.72 |
| 490321 | 38.91 | 38.71 | 38.60 | 38.47 | 38.24 | 38.10 |
| 490330 | 38.81 | 38.77 | 38.74 | 38.70 | 38.66 | 38.43 |
| 490340 | 38.09 | 38.00 | 37.94 | 37.88 | 37.83 | 37.81 |
| 490350 | 38.86 | 38.81 | 38.77 | 38.72 | 38.67 | 38.47 |
| 490370 | 37.34 | 37.05 | 36.90 | 36.71 | 36.29 | 36.17 |
| 490375 | 39.60 | 39.24 | 39.05 | 38.82 | 38.48 | 38.35 |
| 490390 | 39.16 | 38.90 | 38.71 | 38.49 | 37.97 | 37.39 |
| 490391 | 38.42 | 38.17 | 38.00 | 37.79 | 37.26 | 37.20 |
| 490392 | 37.34 | 37.17 | 37.07 | 36.97 | 36.82 | 36.76 |
| 490400 | 39.58 | 39.23 | 39.05 | 38.95 | 38.89 | 38.78 |
| 490401 | 40.02 | 39.84 | 39.71 | 39.57 | 39.37 | 39.25 |
| 490410 | 39.60 | 39.24 | 39.05 | 38.82 | 38.48 | 38.35 |
| 490411 | 39.60 | 39.24 | 39.05 | 38.82 | 38.48 | 38.35 |
| 490420 | 40.98 | 40.85 | 40.78 | 40.69 | 40.56 | 40.41 |
| 490421 | 40.68 | 40.35 | 40.16 | 39.97 | 39.74 | 39.62 |
| 490422 | 41.34 | 41.24 | 41.18 | 41.11 | 41.05 | 40.96 |
| 490425 | 40.98 | 40.85 | 40.78 | 40.69 | 40.56 | 40.41 |
| 490430 | 42.82 | 42.20 | 41.87 | 41.57 | 41.25 | 41.10 |
| 490440 | 44.20 | 43.76 | 43.49 | 43.20 | 42.84 | 42.64 |
| 490450 | 41.19 | 40.98 | 40.87 | 40.74 | 40.61 | 40.57 |
| 490451 | 40.98 | 40.83 | 40.60 | 40.37 | 40.14 | 40.02 |
| 490453 | 40.98 | 40.83 | 40.60 | 40.37 | 40.14 | 40.02 |
| 490455 | 41.10 | 40.86 | 40.77 | 40.70 | 40.60 | 40.56 |
| 490460 | 48.13 | 47.89 | 47.69 | 47.47 | 47.17 | 47.00 |
| 490470 | 43.73 | 43.43 | 43.24 | 42.97 | 42.46 | 42.25 |
| 490480 | 43.73 | 43.43 | 43.24 | 42.97 | 42.46 | 42.25 |
| 490490 | 44.47 | 43.89 | 43.67 | 43.48 | 43.25 | 43.17 |
| 490500 | 45.49 | 45.25 | 45.18 | 45.11 | 45.00 | 44.94 |
| 490510 | 51.73 | 51.39 | 51.19 | 50.98 | 50.73 | 50.60 |
| 490520 | 50.52 | 50.08 | 49.83 | 49.56 | 48.66 | 47.99 |
| 490530 | 55.36 | 54.84 | 54.52 | 54.18 | 53.74 | 53.51 |
| 490535 | 58.99 | 58.68 | 58.48 | 58.25 | 57.94 | 57.75 |
| 490540 | 59.33 | 58.98 | 58.76 | 58.51 | 58.17 | 57.98 |
| 490550 | 50.56 | 50.13 | 49.95 | 49.74 | 49.45 | 49.28 |
| 490555 | 52.04 | 51.53 | 51.19 | 50.80 | 50.24 | 49.93 |
| 490560 | 50.58 | 50.24 | 50.10 | 49.97 | 49.82 | 49.74 |
| 490580 | 43.06 | 42.38 | 42.04 | 41.74 | 41.40 | 41.24 |
| 490590 | 50.64 | 50.23 | 50.01 | 49.77 | 49.49 | 49.35 |
| 490600 | 44.89 | 44.81 | 44.74 | 44.65 | 44.41 | 44.12 |
| 490610 | 43.81 | 43.11 | 42.77 | 42.41 | 41.99 | 41.79 |
| 490612 | 44.39 | 44.31 | 44.27 | 44.23 | 44.20 | 43.96 |
| 490620 | 43.81 | 43.11 | 42.77 | 42.41 | 41.99 | 41.79 |
| 490621 | 45.53 | 45.47 | 45.43 | 45.42 | 45.18 | 45.04 |

Table 1
Proposed Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 490630 | 45.58 | 45.38 | 45.13 | 44.87 | 44.53 | 44.36 |
| 490637 | 44.37 | 43.43 | 43.06 | 42.75 | 42.43 | 42.26 |
| 490638 | 45.26 | 44.66 | 44.62 | 44.58 | 44.50 | 44.39 |
| 490639 | 51.04 | 50.09 | 49.71 | 49.39 | 49.21 | 49.11 |
| 490640 | 43.16 | 42.45 | 42.10 | 41.79 | 41.44 | 41.27 |
| 490641 | 49.24 | 48.80 | 48.12 | 47.43 | 46.73 | 46.48 |
| 490642 | 49.37 | 48.80 | 48.41 | 47.90 | 47.24 | 46.90 |
| 490643 | 46.24 | 45.80 | 45.52 | 45.21 | 44.81 | 44.54 |
| 490644 | 50.97 | 50.02 | 49.63 | 49.39 | 49.21 | 49.12 |
| 490645 | 52.40 | 51.99 | 51.72 | 51.44 | 51.27 | 50.83 |
| 490646 | 48.12 | 47.95 | 47.77 | 47.58 | 47.31 | 47.17 |
| 490650 | 46.55 | 46.17 | 45.83 | 45.46 | 45.00 | 44.69 |
| 490651 | 51.83 | 51.29 | 50.96 | 50.61 | 50.18 | 49.98 |
| 490652 | 46.57 | 46.39 | 46.34 | 46.29 | 46.22 | 46.20 |
| 490654 | 48.54 | 48.47 | 48.44 | 48.42 | 48.13 | 47.94 |
| 490655 | 48.97 | 48.93 | 48.90 | 48.87 | 48.83 | 48.80 |
| 490659 | 50.67 | 49.56 | 49.11 | 48.67 | 48.10 | 47.79 |
| 490660 | 48.95 | 48.13 | 47.54 | 46.70 | 46.02 | 45.61 |
| 490661 | 51.10 | 50.75 | 50.45 | 50.13 | 49.72 | 49.54 |
| 490670 | 50.96 | 49.69 | 49.21 | 48.82 | 48.29 | 47.98 |
| 490675 | 50.67 | 49.47 | 49.02 | 48.63 | 48.10 | 47.79 |
| 490680 | 51.14 | 50.58 | 50.23 | 49.92 | 49.55 | 49.36 |
| 490690 | 51.17 | 49.85 | 49.29 | 48.89 | 48.39 | 48.09 |
| 490700 | 60.55 | 60.05 | 59.68 | 59.29 | 58.86 | 58.65 |
| 490710 | 53.46 | 52.95 | 52.69 | 52.44 | 52.05 | 51.78 |
| 490711 | 54.65 | 54.59 | 54.53 | 54.49 | 54.43 | 54.40 |
| 490720 | 53.31 | 52.85 | 52.65 | 52.43 | 52.08 | 51.88 |
| 490730 | 54.34 | 54.02 | 53.35 | 52.77 | 52.25 | 51.97 |
| 490740 | 54.93 | 54.28 | 53.71 | 53.47 | 53.12 | 52.90 |
| 490742 | 60.25 | 59.91 | 59.70 | 59.47 | 59.32 | 59.25 |
| 490743 | 54.96 | 54.28 | 53.58 | 52.87 | 52.07 | 51.71 |
| 490744 | 54.97 | 54.28 | 53.58 | 52.87 | 52.14 | 51.96 |
| 490745 | 60.25 | 59.91 | 59.70 | 59.47 | 59.15 | 58.90 |
| 490746 | 60.68 | 60.51 | 60.23 | 59.82 | 59.23 | 58.89 |
| 490750 | 54.86 | 54.43 | 54.18 | 53.90 | 53.51 | 53.29 |
| 490751 | 57.03 | 56.75 | 56.59 | 56.42 | 56.23 | 56.13 |
| 490760 | 54.82 | 54.58 | 54.43 | 54.17 | 53.93 | 53.82 |
| 490770 | 55.83 | 55.66 | 55.55 | 55.42 | 55.20 | 55.06 |
| 490771 | 57.10 | 56.93 | 56.66 | 56.39 | 56.06 | 55.90 |
| 490772 | 58.66 | 58.19 | 57.91 | 57.62 | 57.26 | 57.08 |
| 490773 | 59.60 | 59.27 | 59.07 | 58.85 | 58.54 | 58.34 |
| 490776 | 57.70 | 57.64 | 57.62 | 57.42 | 57.12 | 56.94 |
| 490779 | 57.71 | 57.49 | 57.37 | 57.23 | 57.10 | 56.92 |
| 490780 | 58.38 | 57.93 | 57.67 | 57.40 | 57.06 | 56.89 |
| 490790 | 56.12 | 55.76 | 55.58 | 55.41 | 55.16 | 55.02 |

Table 1
Proposed Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 490791 | 59.15 | 58.93 | 58.61 | 58.25 | 57.79 | 57.55 |
| 490792 | 59.07 | 58.63 | 58.35 | 58.04 | 57.63 | 57.41 |
| 490794 | 58.05 | 57.83 | 57.67 | 57.50 | 57.24 | 57.08 |
| 490795 | 58.04 | 57.76 | 57.44 | 57.24 | 56.98 | 56.84 |
| 490800 | 56.77 | 56.22 | 55.96 | 55.81 | 55.62 | 55.51 |
| 490801 | 57.91 | 57.60 | 57.44 | 57.26 | 57.11 | 56.93 |
| 490802 | 58.16 | 58.07 | 58.00 | 57.72 | 57.35 | 57.15 |
| 490803 | 59.24 | 58.78 | 58.52 | 58.24 | 57.89 | 57.71 |
| 490804 | 59.24 | 58.78 | 58.52 | 58.24 | 57.89 | 57.71 |
| 490900 | 56.12 | 55.76 | 55.58 | 55.41 | 55.16 | 55.02 |
| 491000 | 20.35 | 20.23 | 20.15 | 20.07 | 19.98 | 19.94 |
| 491010 | 25.97 | 25.69 | 25.50 | 25.28 | 24.94 | 24.75 |
| 491019 | 29.01 | 28.12 | 27.85 | 27.62 | 27.43 | 27.30 |
| 491020 | 29.45 | 29.24 | 29.05 | 28.83 | 28.53 | 28.37 |
| 491021 | 29.44 | 29.23 | 29.05 | 28.83 | 28.54 | 28.38 |
| 491022 | 29.43 | 29.22 | 29.04 | 28.83 | 28.53 | 28.38 |
| 491040 | 26.54 | 25.96 | 25.70 | 25.43 | 25.04 | 24.83 |
| 491041 | 29.91 | 29.63 | 29.46 | 29.27 | 29.01 | 28.86 |
| 491042 | 29.23 | 28.99 | 28.87 | 28.75 | 28.61 | 28.55 |
| 491043 | 29.14 | 28.90 | 28.78 | 28.63 | 28.39 | 28.25 |
| 491044 | 29.85 | 29.54 | 29.37 | 29.19 | 28.94 | 28.81 |
| 491060 | 30.05 | 29.92 | 29.85 | 29.75 | 29.29 | 28.87 |
| 491080 | 30.92 | 30.34 | 30.11 | 29.89 | 29.34 | 28.89 |
| 491100 | 32.22 | 31.53 | 31.21 | 30.86 | 30.48 | 30.27 |
| 491102 | 32.22 | 31.60 | 31.46 | 31.30 | 31.08 | 30.96 |
| 491120 | 32.69 | 32.53 | 32.11 | 31.46 | 30.63 | 30.23 |
| 491121 | 32.72 | 32.55 | 32.37 | 32.33 | 32.25 | 32.21 |
| 491122 | 33.47 | 33.42 | 33.38 | 33.35 | 33.30 | 33.28 |
| 491123 | 34.06 | 33.89 | 33.78 | 33.67 | 33.51 | 33.43 |
| 491140 | 32.93 | 32.66 | 32.57 | 32.48 | 32.34 | 32.26 |
| 491160 | 34.32 | 33.73 | 33.39 | 33.03 | 32.57 | 32.33 |
| 491180 | 36.48 | 35.87 | 35.41 | 34.93 | 34.30 | 33.98 |
| 491200 | 38.28 | 37.71 | 37.35 | 36.98 | 36.55 | 36.34 |
| 491220 | 38.91 | 38.58 | 38.42 | 38.25 | 38.05 | 37.95 |
| 491221 | 36.94 | 36.71 | 36.58 | 36.43 | 36.26 | 36.19 |
| 491222 | 39.85 | 39.24 | 38.96 | 38.68 | 38.35 | 38.20 |
| 491223 | 36.95 | 36.72 | 36.58 | 36.44 | 36.28 | 36.20 |
| 491240 | 33.84 | 33.50 | 33.19 | 32.86 | 32.45 | 32.24 |
| 491260 | 32.99 | 32.29 | 31.97 | 31.64 | 31.35 | 31.22 |
| 491280 | 33.10 | 32.38 | 32.05 | 31.75 | 31.51 | 31.39 |
| 491285 | 39.29 | 39.15 | 39.04 | 38.83 | 38.29 | 37.65 |
| 491300 | 33.00 | 32.30 | 31.98 | 31.74 | 31.53 | 31.41 |
| 491302 | 36.93 | 36.69 | 36.56 | 36.42 | 36.22 | 36.15 |
| 491320 | 36.89 | 36.67 | 36.54 | 36.41 | 36.23 | 36.16 |
| 491340 | 34.59 | 34.20 | 33.81 | 33.34 | 32.74 | 32.43 |

Table 1
Proposed Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 491344 | 39.09 | 38.71 | 38.48 | 38.23 | 37.90 | 37.72 |
| 491342 | 34.62 | 34.24 | 34.15 | 34.09 | 34.00 | 33.96 |
| 491360 | 37.17 | 37.01 | 36.88 | 36.74 | 36.54 | 36.42 |
| 491380 | 35.94 | 35.77 | 35.65 | 35.49 | 35.21 | 35.05 |
| 491382 | 33.78 | 33.66 | 33.59 | 33.52 | 33.42 | 33.37 |
| 491384 | 32.67 | 32.47 | 32.34 | 32.23 | 32.09 | 31.95 |
| 491387 | 40.65 | 40.31 | 40.09 | 39.86 | 39.72 | 39.62 |
| 491388 | 41.67 | 41.41 | 41.26 | 41.10 | 40.79 | 40.55 |
| 491390 | 40.91 | 40.36 | 40.11 | 39.85 | 39.72 | 39.62 |
| 491391 | 40.74 | 40.36 | 40.13 | 39.89 | 39.74 | 39.63 |
| 491393 | 45.71 | 45.56 | 45.45 | 45.19 | 44.71 | 44.41 |
| 491394 | 42.03 | 41.33 | 40.94 | 40.53 | 40.02 | 39.77 |
| 491395 | 40.74 | 40.36 | 40.13 | 39.89 | 39.74 | 39.63 |
| 491396 | 41.60 | 41.36 | 41.23 | 40.96 | 40.30 | 40.06 |
| 491397 | 40.57 | 40.26 | 40.07 | 39.85 | 39.72 | 39.62 |
| 491398 | 44.39 | 44.21 | 44.13 | 44.10 | 44.02 | 43.75 |
| 491399 | 41.75 | 41.44 | 41.28 | 41.12 | 40.79 | 40.55 |
| 491400 | 38.68 | 38.18 | 36.75 | 36.25 | 35.14 | 34.84 |
| 491401 | 42.93 | 42.52 | 42.43 | 42.33 | 42.20 | 42.12 |
| 491402 | 40.74 | 40.33 | 40.10 | 39.85 | 39.72 | 39.62 |
| 491404 | 41.75 | 41.45 | 41.29 | 41.12 | 40.79 | 40.55 |
| 491406 | 42.27 | 41.36 | 40.95 | 40.54 | 40.02 | 39.77 |
| 491407 | 40.69 | 40.30 | 40.08 | 39.85 | 39.72 | 39.62 |
| 491392 | 47.62 | 47.56 | 47.53 | 47.51 | 47.25 | 47.07 |
| 491403 | 48.37 | 48.26 | 48.19 | 48.11 | 48.01 | 47.83 |
| 491440 | 40.77 | 40.38 | 40.15 | 39.92 | 39.78 | 39.68 |
| 491441 | 40.77 | 40.38 | 40.15 | 39.92 | 39.78 | 39.68 |
| 491460 | 37.39 | 36.98 | 36.68 | 36.24 | 35.81 | 35.61 |
| 491465 | 37.10 | 36.72 | 36.50 | 36.25 | 35.83 | 35.63 |
| 491480 | 37.16 | 36.98 | 36.84 | 36.69 | 36.48 | 36.00 |
| 491500 | 37.32 | 36.81 | 36.55 | 36.26 | 35.86 | 35.65 |
| 491501 | 37.29 | 36.80 | 36.54 | 36.25 | 35.85 | 35.65 |
| 491502 | 38.18 | 38.08 | 38.05 | 37.97 | 37.76 | 37.66 |
| 491520 | 41.81 | 41.70 | 41.52 | 41.07 | 40.01 | 39.68 |
| 491540 | 44.55 | 44.36 | 44.22 | 44.12 | 43.84 | 43.49 |
| 491541 | 47.47 | 46.94 | 46.58 | 46.15 | 45.46 | 44.98 |
| 491452 | 44.10 | 44.04 | 44.02 | 43.92 | 43.55 | 43.35 |
| 491453 | 40.99 | 40.48 | 40.18 | 39.85 | 39.41 | 39.17 |
| 491560 | 44.21 | 43.72 | 43.49 | 43.19 | 42.56 | 42.08 |
| 491561 | 42.49 | 42.39 | 42.12 | 41.81 | 41.35 | 41.02 |
| 491562 | 45.83 | 45.50 | 45.31 | 45.11 | 44.85 | 44.71 |
| 491563 | 42.49 | 42.39 | 42.12 | 41.81 | 41.35 | 41.22 |
| 491580 | 44.28 | 43.87 | 43.63 | 43.39 | 43.11 | 42.96 |
| 491600 | 44.29 | 43.87 | 43.64 | 43.40 | 43.11 | 42.96 |
| 491620 | 47.83 | 47.53 | 47.35 | 47.17 | 46.93 | 46.81 |

Table 1
Proposed Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 491621 | 51.05 | 50.80 | 50.63 | 50.45 | 50.20 | 50.06 |
| 424000 | 24.13 | 24.09 | 24.07 | 24.07 | 24.07 | 24.07 |
| 490232 | 46.55 | 46.48 | 46.44 | 46.39 | 46.32 | 46.26 |
| 490431 | 44.90 | 44.75 | 44.60 | 44.37 | 44.07 | 43.90 |
| 490449 | 44.15 | 43.89 | 43.73 | 43.55 | 43.29 | 43.13 |
| 490457 | 41.12 | 40.89 | 40.79 | 40.71 | 40.61 | 40.56 |
| 490491 | 50.95 | 50.61 | 50.28 | 49.11 | 48.42 | 48.17 |
| 490492 | 51.40 | 51.19 | 51.03 | 50.91 | 50.25 | 49.72 |
| 490501 | 49.23 | 49.09 | 49.01 | 48.93 | 48.82 | 48.76 |
| 490511 | 51.64 | 51.00 | 50.60 | 50.18 | 49.65 | 49.38 |
| 490561 | 59.59 | 59.10 | 58.80 | 58.48 | 58.11 | 57.92 |
| 490581 | 46.30 | 46.18 | 46.11 | 46.04 | 45.94 | 45.88 |
| 490582 | 52.53 | 52.30 | 52.16 | 51.98 | 51.82 | 51.77 |
| 490584 | 52.46 | 52.37 | 52.32 | 51.97 | 51.51 | 51.27 |
| 490587 | 57.82 | 57.48 | 57.25 | 56.97 | 56.61 | 56.52 |
| 490701 | 58.83 | 58.76 | 58.71 | 58.64 | 58.55 | 58.51 |
| 490702 | 60.65 | 60.58 | 60.53 | 60.47 | 60.42 | 60.20 |
| 490703 | 55.90 | 55.57 | 55.40 | 55.22 | 55.00 | 54.89 |
| 490704 | 60.92 | 60.78 | 60.69 | 60.57 | 60.39 | 60.29 |
| 490713 | 54.64 | 54.49 | 54.37 | 54.19 | 53.82 | 53.61 |
| 490741 | 59.94 | 59.38 | 59.18 | 58.98 | 58.74 | 58.62 |
| 490762 | 59.34 | 59.15 | 59.03 | 58.72 | 58.18 | 57.85 |
| 490781 | 62.43 | 62.22 | 62.09 | 61.96 | 61.75 | 61.64 |
| 491274 | 39.32 | 39.17 | 39.06 | 38.92 | 38.40 | 37.75 |
| 491284 | 37.64 | 37.27 | 36.96 | 36.46 | 36.06 | 35.79 |
| 491389 | 40.79 | 40.66 | 40.60 | 40.56 | 40.35 | 40.20 |
| 491700 | 28.69 | 28.08 | 27.53 | 26.90 | 26.12 | 25.71 |
| 491701 | 28.50 | 27.41 | 26.70 | 25.82 | 24.39 | 23.51 |
| 491702 | 58.01 | 57.75 | 57.51 | 57.19 | 56.74 | 56.50 |
| 491703 | 28.50 | 27.61 | 27.50 | 27.42 | 27.31 | 27.27 |
| 491704 | 58.91 | 58.83 | 58.78 | 58.73 | 58.66 | 58.61 |
| 491705 | 58.04 | 57.76 | 57.51 | 57.19 | 56.74 | 56.50 |
| 491706 | 52.43 | 51.93 | 51.62 | 51.30 | 50.91 | 50.71 |
| 491707 | 47.88 | 47.46 | 47.22 | 46.98 | 46.67 | 46.52 |
| 491708 | 38.89 | 38.70 | 38.59 | 38.47 | 38.27 | 38.14 |
| 491709 | 39.42 | 39.31 | 39.24 | 39.17 | 39.09 | 39.04 |
| 491710 | 29.28 | 29.06 | 28.89 | 28.79 | 28.65 | 28.58 |
| 491711 | 28.50 | 27.41 | 26.70 | 26.03 | 25.42 | 25.12 |
| 491712 | 35.50 | 34.89 | 34.47 | 33.99 | 33.33 | 32.99 |
| 491713 | 34.89 | 33.53 | 33.33 | 33.04 | 32.67 | 32.50 |
| 491714 | 32.75 | 32.52 | 32.38 | 32.22 | 32.02 | 31.94 |
| 491715 | 43.73 | 43.43 | 43.24 | 42.97 | 42.46 | 42.25 |
| 491716 | 35.32 | 35.04 | 34.88 | 34.70 | 34.36 | 34.15 |
| 491717 | 55.33 | 55.28 | 55.24 | 55.22 | 55.10 | 55.00 |
| 491718 | 36.79 | 36.64 | 36.55 | 36.44 | 36.29 | 36.20 |

Table 1
Proposed Conditions Peak Stage (ft NAVD)

| Node Name | Peak Stage (ft NAVD) | | | | | |
|-----------|----------------------|---------------------|---------------------|---------------------|--------------------|----------------|
| | 100-Year/ 24-Hour | 50-Year/ 24-Hour | 25-Year/ 24-Hour | 10-Year/ 24-Hour | 5-Year/ 24-Hour | Mean Annual |
| 491719 | 47.61 | 47.03 | 46.66 | 46.26 | 45.70 | 45.39 |
| 491720 | 40.87 | 40.71 | 40.61 | 40.49 | 40.31 | 40.20 |
| 491721 | 41.02 | 40.72 | 40.53 | 40.31 | 39.98 | 39.79 |
| 491722 | 40.44 | 40.11 | 39.92 | 39.74 | 39.57 | 39.48 |
| 491723 | 38.54 | 38.12 | 37.81 | 37.50 | 37.08 | 36.88 |
| 491724 | 35.30 | 35.03 | 34.88 | 34.70 | 34.36 | 34.15 |
| 491725 | 34.89 | 34.57 | 34.40 | 34.20 | 33.95 | 33.82 |
| 491728 | 35.37 | 35.29 | 35.21 | 35.15 | 34.61 | 34.03 |
| 491729 | 31.52 | 31.38 | 31.35 | 30.93 | 30.19 | 29.76 |
| 491730 | 30.63 | 30.16 | 29.87 | 29.56 | 29.17 | 29.00 |
| 491737 | 38.88 | 38.69 | 38.64 | 38.59 | 38.53 | 38.50 |
| 491740 | 38.74 | 38.66 | 38.62 | 38.56 | 38.49 | 38.46 |
| 491745 | 39.38 | 39.23 | 39.14 | 39.04 | 38.92 | 38.86 |
| 491746 | 39.29 | 39.17 | 39.08 | 38.94 | 38.72 | 38.60 |
| 491750 | 47.43 | 46.72 | 46.32 | 45.92 | 45.43 | 45.20 |
| 491753 | 51.77 | 51.56 | 51.45 | 51.33 | 50.77 | 50.48 |
| 490574 | 46.90 | 46.34 | 46.00 | 45.65 | 45.22 | 45.01 |
| 491405 | 44.75 | 44.66 | 44.60 | 44.55 | 44.34 | 44.13 |
| 490714 | 54.66 | 54.60 | 54.56 | 54.43 | 54.09 | 53.91 |
| 490753 | 54.87 | 54.62 | 54.46 | 54.19 | 53.78 | 53.56 |
| 491224 | 43.54 | 43.34 | 42.78 | 42.18 | 41.41 | 41.01 |
| 491225 | 44.44 | 44.16 | 43.96 | 43.72 | 43.41 | 43.23 |
| 491759 | 41.07 | 40.83 | 40.68 | 40.51 | 40.31 | 40.22 |
| 491760 | 40.98 | 40.75 | 40.61 | 40.45 | 40.27 | 40.19 |
| 491764 | 40.77 | 40.55 | 40.38 | 40.19 | 40.00 | 39.93 |
| 491768 | 40.70 | 40.46 | 40.29 | 40.09 | 39.63 | 39.26 |
| 499999 | 40.64 | 40.41 | 40.24 | 40.05 | 39.59 | 39.22 |
| 499998 | 40.61 | 40.39 | 40.22 | 40.03 | 39.58 | 39.22 |
| 499997 | 36.15 | 36.06 | 36.00 | 35.93 | 35.80 | 35.67 |

Table 2
Proposed Conditions Levels of Service (LOS)

| Node | Road Elevation (NAVD) | 25-Year/24-Hour Storm Event | | 100-Year/24-Hour Storm Event | |
|--------|-----------------------|-----------------------------|-----|------------------------------|-----|
| | | Peak Stage (ft NAVD) | LOS | Peak Stage (ft NAVD) | LOS |
| 490004 | 33.16 | 28.73 | A | 29.53 | A |
| 490010 | 28.96 | 28.87 | A | 29.39 | C |
| 490020 | 31.00 | 28.67 | A | 29.39 | A |
| 490030 | 29.96 | 28.67 | A | 29.66 | A |
| 490050 | 31.00 | 28.78 | A | 29.11 | A |
| 490070 | 31.26 | 30.07 | A | 30.92 | A |
| 490080 | 31.26 | 30.27 | A | 31.49 | B |
| 490120 | 35.36 | 33.62 | A | 34.06 | A |
| 490130 | 34.50 | 33.71 | A | 34.41 | A |
| 490140 | 34.50 | 33.35 | A | 33.75 | A |
| 490150 | 35.26 | 34.95 | A | 36.2 | C |
| 490160 | 35.30 | 35.55 | B | 36.25 | C |
| 490170 | 42.30 | 38.80 | A | 39.11 | A |
| 490180 | 38.66 | 38.50 | A | 39.38 | C |
| 490181 | 41.00 | 38.50 | A | 39.38 | A |
| 490200 | 39.50 | 38.90 | A | 39.35 | A |
| 490210 | 42.77 | 38.53 | A | 39.07 | A |
| 490220 | 42.77 | 42.87 | B | 43.14 | C |
| 490232 | 46.20 | 46.44 | B | 46.55 | C |
| 490240 | 35.00 | 31.31 | A | 32.36 | A |
| 490250 | 35.00 | 33.22 | A | 33.9 | A |
| 490260 | 34.50 | 34.72 | B | 35.05 | C |
| 490263 | 39.50 | 35.98 | A | 36.83 | A |
| 490266 | 39.76 | 36.12 | A | 36.44 | A |
| 490270 | 39.76 | 38.99 | A | 39.71 | A |
| 490290 | 37.06 | 35.08 | A | 35.62 | A |
| 490300 | 35.00 | 34.85 | A | 35.19 | B |
| 490310 | 37.06 | 37.13 | B | 37.57 | C |
| 490320 | 39.36 | 37.98 | A | 38.25 | A |
| 490340 | 39.36 | 37.94 | A | 38.09 | A |
| 490375 | 39.06 | 39.05 | A | 39.6 | C |
| 490390 | 39.00 | 38.71 | A | 39.16 | B |
| 490410 | 39.06 | 39.05 | A | 39.6 | C |
| 490420 | 40.53 | 40.78 | B | 40.98 | C |
| 490430 | 44.67 | 41.87 | A | 42.82 | A |
| 490431 | 45.50 | 44.60 | A | 44.9 | A |
| 490440 | 44.67 | 43.49 | A | 44.2 | A |
| 490450 | 44.50 | 40.87 | A | 41.19 | A |
| 490460 | 47.67 | 47.69 | B | 48.13 | C |
| 490470 | 46.67 | 43.24 | A | 43.73 | A |
| 490480 | 44.50 | 43.24 | A | 43.73 | A |
| 490490 | 46.67 | 43.67 | A | 44.47 | A |
| 490500 | 53.50 | 45.18 | A | 45.49 | A |
| 490501 | 52.57 | 49.01 | A | 49.23 | A |
| 490510 | 52.57 | 51.19 | A | 51.73 | A |

Table 2
Proposed Conditions Levels of Service (LOS)

| Node | Road Elevation (NAVD) | 25-Year/24-Hour Storm Event | | 100-Year/24-Hour Storm Event | |
|--------|-----------------------|-----------------------------|-----|------------------------------|-----|
| | | Peak Stage (ft NAVD) | LOS | Peak Stage (ft NAVD) | LOS |
| 490520 | 53.50 | 49.83 | A | 50.52 | A |
| 490530 | 59.61 | 54.52 | A | 55.36 | A |
| 490535 | 59.37 | 58.48 | A | 58.99 | A |
| 490540 | 59.37 | 58.76 | A | 59.33 | A |
| 490555 | 61.37 | 51.19 | A | 52.04 | A |
| 490574 | 47.50 | 46.00 | A | 46.9 | A |
| 490580 | 44.56 | 42.04 | A | 43.06 | A |
| 490590 | 50.37 | 50.01 | A | 50.64 | C |
| 490600 | 44.56 | 44.74 | B | 44.89 | C |
| 490610 | 44.07 | 42.77 | A | 43.81 | A |
| 490630 | 45.37 | 45.13 | A | 45.58 | B |
| 490637 | 48.86 | 43.06 | A | 44.37 | A |
| 490638 | 50.50 | 44.62 | A | 45.26 | A |
| 490639 | 53.50 | 49.71 | A | 51.04 | A |
| 490640 | 47.67 | 42.10 | A | 43.16 | A |
| 490641 | 50.50 | 48.12 | A | 49.24 | A |
| 490643 | 48.07 | 45.52 | A | 46.24 | A |
| 490644 | 52.50 | 49.63 | A | 50.97 | A |
| 490645 | 53.50 | 51.72 | A | 52.4 | A |
| 490646 | 48.86 | 47.77 | A | 48.12 | A |
| 490650 | 49.17 | 45.83 | A | 46.55 | A |
| 490659 | 51.50 | 49.11 | A | 50.67 | A |
| 490660 | 48.07 | 47.54 | A | 48.95 | C |
| 490661 | 51.50 | 50.45 | A | 51.1 | A |
| 490670 | 50.87 | 49.21 | A | 50.96 | B |
| 490675 | 51.50 | 49.02 | A | 50.67 | A |
| 490680 | 50.87 | 50.23 | A | 51.14 | C |
| 490690 | 53.31 | 49.29 | A | 51.17 | A |
| 490700 | 60.00 | 59.68 | A | 60.55 | C |
| 490703 | 57.87 | 55.40 | A | 55.9 | A |
| 490710 | 53.31 | 52.69 | A | 53.46 | B |
| 490714 | 57.00 | 54.56 | A | 54.66 | A |
| 490720 | 52.87 | 52.65 | A | 53.31 | C |
| 490740 | 58.17 | 53.71 | A | 54.93 | A |
| 490743 | 58.17 | 53.58 | A | 54.96 | A |
| 490744 | 58.17 | 53.58 | A | 54.97 | A |
| 490750 | 56.37 | 54.18 | A | 54.86 | A |
| 490753 | 57.00 | 54.46 | A | 54.87 | A |
| 490760 | 54.27 | 54.43 | B | 54.82 | C |
| 490770 | 57.00 | 55.55 | A | 55.83 | A |
| 490780 | 58.00 | 57.67 | A | 58.38 | C |
| 490790 | 56.97 | 55.58 | A | 56.12 | A |
| 490800 | 58.37 | 55.96 | A | 56.77 | A |
| 490900 | 65.30 | 55.58 | A | 56.12 | A |
| 491010 | 27.00 | 25.50 | A | 25.97 | A |

Table 2
Proposed Conditions Levels of Service (LOS)

| Node | Road Elevation (NAVD) | 25-Year/24-Hour Storm Event | | 100-Year/24-Hour Storm Event | |
|--------|-----------------------|-----------------------------|-----|------------------------------|-----|
| | | Peak Stage (ft NAVD) | LOS | Peak Stage (ft NAVD) | LOS |
| 491020 | 29.16 | 29.05 | A | 29.45 | C |
| 491021 | 29.50 | 29.05 | A | 29.44 | A |
| 491040 | 27.50 | 25.70 | A | 26.54 | A |
| 491041 | 30.00 | 29.46 | A | 29.91 | A |
| 491042 | 30.00 | 28.87 | A | 29.23 | A |
| 491060 | 29.66 | 29.85 | B | 30.05 | C |
| 491080 | 31.26 | 30.11 | A | 30.92 | A |
| 491100 | 32.66 | 31.21 | A | 32.22 | A |
| 491121 | 34.06 | 32.37 | A | 32.72 | A |
| 491140 | 33.16 | 32.57 | A | 32.93 | A |
| 491160 | 34.76 | 33.39 | A | 34.32 | A |
| 491180 | 35.50 | 35.41 | A | 36.48 | C |
| 491200 | 39.00 | 37.35 | A | 38.28 | A |
| 491220 | 39.27 | 38.42 | A | 38.91 | A |
| 491221 | 39.00 | 36.58 | A | 36.94 | A |
| 491222 | 40.00 | 38.96 | A | 39.85 | A |
| 491260 | 33.66 | 31.97 | A | 32.99 | A |
| 491274 | 38.89 | 39.06 | B | 39.32 | C |
| 491280 | 34.17 | 32.05 | A | 33.1 | A |
| 491284 | 38.84 | 36.96 | A | 37.64 | A |
| 491285 | 38.84 | 39.04 | B | 39.29 | C |
| 491320 | 39.00 | 36.54 | A | 36.89 | A |
| 491340 | 34.17 | 33.81 | A | 34.59 | C |
| 491342 | 35.46 | 34.15 | A | 34.62 | A |
| 491360 | 37.07 | 36.88 | A | 37.17 | B |
| 491380 | 35.46 | 35.65 | B | 35.94 | C |
| 491388 | 42.47 | 41.26 | A | 41.67 | A |
| 491391 | 41.17 | 40.13 | A | 40.74 | A |
| 491394 | 42.77 | 40.94 | A | 42.03 | A |
| 491395 | 41.50 | 40.13 | A | 40.74 | A |
| 491397 | 41.00 | 40.07 | A | 40.57 | A |
| 491400 | 38.00 | 36.75 | A | 38.68 | C |
| 491401 | 45.50 | 42.43 | A | 42.93 | A |
| 491402 | 43.07 | 40.10 | A | 40.74 | A |
| 491440 | 43.00 | 40.15 | A | 40.77 | A |
| 491453 | 42.67 | 40.18 | A | 40.99 | A |
| 491460 | 39.00 | 36.68 | A | 37.39 | A |
| 491465 | 36.37 | 36.50 | B | 37.1 | C |
| 491500 | 42.67 | 36.55 | A | 37.32 | A |
| 491501 | 37.47 | 36.54 | A | 37.29 | A |
| 491520 | 41.63 | 41.52 | A | 41.81 | B |
| 491600 | 50.47 | 43.64 | A | 44.29 | A |
| 491620 | 50.47 | 47.35 | A | 47.83 | A |
| 491715 | 46.67 | 43.24 | A | 43.73 | A |
| 499998 | 41.50 | 40.22 | A | 40.61 | A |

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Proposed Conditions Levels of Service (LOS)

| Node | Road Elevation (NAVD) | 25-Year/24-Hour Storm Event | | 100-Year/24-Hour Storm Event | |
|--------|-----------------------|-----------------------------|-----|------------------------------|-----|
| | | Peak Stage (ft NAVD) | LOS | Peak Stage (ft NAVD) | LOS |
| 499999 | 41.50 | 40.24 | A | 40.64 | A |