DUCK POND

WATERSHED MANAGEMENT PLAN UPDATE

(Known Conditions through October 2005)

Prepared for:

Stormwater Management Section
Public Works Department, Hillsborough County
601 E. Kennedy Blvd
Tampa, FL 33602

AYRES
ASSOCIATES

Engineers/Planners/Scientists
8875 Hidden River Parkway, Suite 200
Tampa, FL 33637
(813) 978-8688, FAX (813) 978-9369

January 2007

Table of Contents

Table of Contents

Table of Contents

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Ayres Associates Project No. 61-0100.04
g:\county - hillsborough\61-0100.04_curiousity_duckpd_eastlk\reports\final reports\duck pond\duck pond wmp update.doc

CHAPTER 1 INTRODUCTION

1.1 OVERVIEW

Hillsborough County has undertaken a program to develop or update watershed management plans for all of unincorporated Hillsborough County areas. These areas are divided between seventeen watersheds. Flood protection issues have been addressed for each of the seventeen watersheds in separate watershed management master plans (WMPs) completed between 2000 and 2002. Since then, changes have occurred within each of the watersheds and affected the hydrologic and hydraulic features. Furthermore, change in standards and reference elevation datum has been considered. The combined changes warrant updating of the existing models used for the WMP development and associated GIS mapping.

Ayres Associates was selected by Hillsborough County to update the Duck Pond Watershed Management Plan as a part of the County's overall watershed management program. The project is being cooperatively funded between Hillsborough County and the Southwest Florida Water Management District's Hillsborough River Basin. The study area is situated in the northern portion of Hillsborough County in the vicinity of the University of South Florida (USF). The location is shown in **Figure 1-1.** Although the study area is identified as the Duck Pond Watershed, it includes portions of the Cypress Creek and Hillsborough River Basins, as defined by the Southwest Florida Water Management District (SWFWMD).

The Duck Pond Watershed Management Plan (WMP) Update is limited to Chapters 1 through 6, pertaining to watershed hydrology and hydraulics, the existing conditions stormwater management model, and the existing conditions Level of Service (LOS). The area of evaluation is concentrated on the watershed area within the Hillsborough County limits, although the model includes hydrologic and hydraulic elements within the City of Tampa and City of Terrace which impact the County's service area (see **Figure 1-2**).

The objectives of this WMP update are to identify/verify flooding problems under the existing condition and to perform an updated Level of Service (LOS) evaluation. Existing conditions are based on: the existing infrastructure and the analysis of computed water surface elevations and flows, latest aerial photographs, and latest topography and land use within the basin.

Where available, Environmental Resource Permit (ERP) data and "as-built" drawings were used to identify significant or new stormwater features. Unless specified otherwise, all elevations have been referenced to NAVD (North American Vertical Datum) 1988. Available land use, soils and topographic maps were employed to derive runoff parameters. Input data for the hydraulic model has been refined based on the physical characteristics of the watershed. Updated model input includes developments reflected in collected ERPs and "As Built" drawings through October 2005.

The results from the updated existing conditions model are used to re-evaluate the location and degree of expected flooding within the study area under the existing conditions for the 2.33-year, 5-year, 10-year, 25-year, 50-year and 100-year design storms. Hillsborough County has a targeted LOS for the primary conveyance features that will protect homes as well as limit street and yard flooding during the 25-year, 24-hour duration storm event. The existing condition 25-year, 24-hour model was used to evaluate LOS.

Where possible, the output from the model was compared with historical high water marks and flooding complaints registered with Hillsborough County. Historical, documented flooding problems were given priority.

1.2 PROJECT SETTING

The total study area encompasses approximately 5,104 acres within the Cypress Creek and Hillsborough River Watersheds. Approximately 1,350 and 3,754 acres are within the Cypress Creek and Hillsborough River Watersheds, respectively. Flooding, water quality and natural systems were evaluated in 2001 for approximately 4,262 acres (6.66 square miles). This 4,262 acres will be identified as the Duck Pond Watershed (DPW) for the remainder of this report. An additional 842 acres south of Fowler Avenue within the City of Tampa was also modeled using the County SWMM stormwater model. Two areas within the DPW study area are modeled hydrologically but not routed hydraulically include Subbasin 629720 (approximately 37 acres) and Subbasin 625000 (approximately 97 acres). Subbasin 629720 is located on the USF golf course and was not modeled in the USF North drainage system because it consists of a marsh wetland isolated from the USF north drainage system. Subbasin 625000 is located on the USF campus adjacent the intersection of Fowler Avenue and Bruce B. Downs Boulevard. Subbasin 625000 was not modeled because it is not hydraulically connected to the Duck Pond Watershed. Subbasin 625000 discharges south through a circular culvert under Fowler Avenue into City of Tampa stormwater systems. A break down of the areas within the study area is shown on **Table 1.1**

As shown in **Figure 1-2** the County watershed is generally bounded by the Hillsborough River on the east, I-275 on the west, Skipper Road / Bearss Avenue on the north, and Fowler Avenue on the south. The watershed area includes the USF campus. The watershed area was sub-divided into the following major drainage systems, each with their own outfall:

- Duck Pond
- USF North
- Raintree
- Bruce B. Downs
- USF East
- USF Campus East

The Bruce B. Downs, USF North, USF East and USF Campus East drainage systems are within the Cypress Creek Watershed and the Duck Pond and Raintree drainage systems are within the Hillsborough River Watershed. The Duck Pond System was further sub-divided into the following sub-drainage systems:

- Nebraska Avenue
- Robbins Lumber
- 131st Avenue
- Mall East and West
- USF Campus West

The Raintree System was further sub-divided into the following sub-drainage systems:

- Raintree North
- Raintree South

Land uses within the DPW boundaries are residential, commercial, industrial and institutional. The residential land uses are primarily multi-family apartment complexes, condominiums and duplexes due to their proximity to the USF campus. There are also some single-family residential sub-divisions east of the USF campus. The majority of the commercial land uses consist of strip shopping centers and office space along the major roadways within the DPW. The University Square Mall is the largest commercial land use within the DPW. The major roads are Fowler Avenue, Fletcher Avenue, 30th Street (Bruce B. Downs Boulevard), Skipper Road / Bearss Avenue, Nebraska Avenue and 56th Street. The University of South Florida, Veterans Administration Hospital and the University Community Hospital are the major institutional land uses within the DPW. Robbins Lumber is the largest industrial land use within the DPW. Little natural systems remain within the DPW due to dense development. However some isolated pockets of wetlands and upland forested areas are scattered throughout the DPW.

TABLE 1.1
Drainage Area Breakdown for Major Drainage Systems

Watershed	Major Conveyance		Area in DPW (acres)	Area in City of Tampa South of Fowler (acres)	Total Area (acres)
Hillsborough River	Duck Pond	Nebraska Ave.	317	0	317
		Robbins Lumber	151	0	151
		131st	691	0	691
		Mall East/West	569	0	569
		USF Campus West	575	0	575
	City of Tampa		0	610	610
	Raintree North		261	0	261
	Raintree South		348	232	580
Cypress Creek	B.B. Downs		442	0	442
	USF North		262	0	262
	USF East		215	0	215
	USF Campus East		431	0	431
Total			**4262**	**842**	**5104**

Few significant land use changes have occurred due to the built out condition of the DPW. However, commercial and institutional development continues on open spaces on the USF campus and Hillsborough County Planners are working towards improving property values with infrastructure improvements on public right-of-ways throughout the DPW.

The primary sources used to develop the 2001 Watershed Management Plan include the following:

- USF Area – Phase I Project Development Plan.
- Peer Review of the Duck Pond Outfall Design (May, 1987).
- Preliminary Design of the Duck Pond Outfall System (April, 1988).
- University of South Florida Master Stormwater Management Plan Study (May 1998).
- Raintree Terrace/Raintree North Subdivision Drainage Improvements Preliminary Study, October, 1999.
- "As-built" construction plans for various roadway, commercial and residential developments.
- Environmental Resource Permits for various developments.
- Aerial Photography with 1-foot contours (1" = 200') Southwest Florida Water Management District, July 1977.
- Year 2000 Aerial Photography (1" = 400') Hillsborough County.
- Hillsborough County Geographical Information Systems (GIS) data base
- Southwest Florida Water Management District data base.

1.3 DATA COLLECTION FOR WMP UPDATE

To properly describe the current condition of the watershed, available information was compiled from a variety of sources. These data included previous studies, existing aerial photographs and topography, latest land use coverage, recent ERP and construction plans, rainfall data, historical lake stage record, stream gage data, flooding complaints information, and a limited field investigation. The following agencies were involved during the data collection:

- Hillsborough County
- Southwest Florida Water Management District (SWFWMD)
- City of Tampa (COT)
- Florida Department of Transportation (FDOT)
- Federal Emergency Management Agency (FEMA)
- United States Geological Survey (USGS)
- Field Review

The following is a discussion of the sources and a listing of the literature review:

Soil Survey of Hillsborough County
The soil data classifies soil types for engineering and planning purposes. This data was in the Geographical Information System (GIS) format and delivered by Hillsborough County.

Land Use
Existing land use coverage was in GIS format and provided by Hillsborough County as obtained from the Southwest Florida Water Management District. This coverage is based on the Florida Land Use Cover Classification System (FLUCCS) 1999.

Roadway Plans, ERPs and CIP Plans
Several public roadway drainage systems were reviewed within the study area, as well as As-Built plans for County capital improvement projects (CIPs) and significant ERP sites. Record drawings were collected to obtain information to update subbasin delineations as well as identify new conveyance features. **Figure 1-2** illustrates the locations of ERPs reviewed for this update. **Table 1.2** lists the reviewed documents.

TABLE 1.2

Environmental Resource Permits Reviewed

ERP	Permit Type	Activity	Project Name	Issue Date
022851000	ERP Standard General	Commercial	Cracker Barrel-Bruce B Downs & Bearss	1/31/2002
018429001	ERP Standard General	Residential	Reflections	9/3/1999
012996002	ERP Standard General	Government	Hills Co-USF University Center	12/16/1999
000660004	MSSW General Permit	Residential	JPI Student Housing Project-Tampa	5/5/1999
023649001	ERP Standard General	Commercial	University Comm Hosp Parking Additions	2/19/2003
020468001	ERP Standard General	Residential	Avalon Heights Apartment Suites	12/21/2000
017978003	ERP Standard General	Government	DOT-I-275 Fletcher/N US 41 #10320-3476	3/22/2002
018952010	ERP Standard General	Commercial	Busch Grdns-Elephant Protective Contact	1/13/2003
000775003	ERP Standard General	Government	Hills Co-Fletcher-Magnolia Intersec Imp	8/27/2004
021443000	ERP Standard General	Commercial	Fletcher Mini Storage (1821 E Fletcher)	1/22/2001
000775001	ERP Standard General	Road Projects	Hills Co-Fletcher Ave-42nd St/N Palm Dr	9/26/2003
006413060	ERP Standard General	Government	USF-Maple Ii-Impervious Correction	6/3/2004
018952000	ERP Conceptual	Commercial	Busch Ent Corp-Master Drainage Plan	8/24/1999
022490001	ERP Standard General	Commercial	University Grove Office Park Phase II	10/9/2003
010932003	ERP Standard General	Government	Hills Co-Museum Of Science And Industry	7/12/2004
024189001	ERP Standard General	Government	Hills Co-Curiosity Creek Ph III	11/20/2003
018651001	ERP Standard General	Commercial	Walmart Tampa University West 2627-00	7/13/1999
002374003	ERP Standard General	Government	James A Haley Veterans Admin Hosp Pkg	8/29/2001
020240000	ERP Standard General	Road Projects	Hills Co-Intersec-131 Ave @ 22st N Recon	3/29/2000
006413047	ERP Standard General	Government	USF-Special Purpose Housing	5/16/2003
006413051	ERP Standard General	Government	USF-Lot 35 Expansion	7/10/2003
026617000	ERP Standard General	Residential	Bella Vista	6/30/2004
021382002	ERP Standard General	Road Projects	Hills Co-Gibson Ave Ph II Drainage Imp	1/5/2005
001850003	MSSW General Permit	Residential	University Village Walkway & Parking Imp	5/21/2001

TABLE 1.2
Environmental Resource Permits Reviewed

ERP	Permit Type	Activity	Project Name	Issue Date
002374004	ERP Standard General	Government	J Haley Veterans Hospital Pearl Prkg Lot	10/21/2004
006413050	ERP Standard General	Government	USF-Willow Drive Extension	5/28/2003
000121008	ERP Standard General	Government	Hills Co-15th St And 127th Ave Drg Impr	11/7/2002
006413027	ERP Standard General	Government	USF-Maple Dr Crosswalks/Sundome/Elm Dr	5/4/2001
021382000	ERP Standard General	Government	Hills Co-58th St & 122nd Ave Drain Impr	2/8/2001
006413056	ERP Standard General	Government	USF Quinn Hall Coll Of Bus Admin Expan	11/20/2003
019439000	ERP Standard General	Commercial	University Self Storage	7/19/1999
018952001	ERP Standard General	Commercial	Busch Gardens East Parking Lot	2/29/2000
006405006	ERP Standard General	Government	USF Idrb And Mtob	1/9/2004
000121007	MSSW Individual Permit	Government	Hills Co- USF Ph 4 Drainage Improvement	1/15/2002
008624002	ERP Standard General	Road Projects	Hills Co-Fowler Ave Pedestrian Overpass	8/28/2003
002090002	ERP Standard General	Semi-Public	All Childrens Hospital-Spec Care/Tampa	6/1/2000
018712002	ERP Standard General	Residential	Abbey @ Tampa (Fna Skipper Pointe Apts)	2/23/2000
006413022	ERP Standard General	Semi-Public	USF-Golf Cart Path Expansion	8/16/2000
023772000	ERP Notice General	Government	Hills Co-Sw USF Water Main Extension	6/27/2002
000121006	MSSW Individual Permit	Government	Hills Co-16th St Drainage Imp CIP#47003	10/22/2001
021586000	ERP Standard General	Government	Hills Co-19th St Drainage Impr-Ph I & II	2/23/2001
024763000	ERP Standard General	Residential	College Court Apartments	4/9/2003
010932002	MSSW General Permit	Government	Hills Co-Museum Of Science & Industry	8/7/2001
022490002	ERP Standard General	Residential	Student Housing At Fletcher Ave-56th St	9/9/2004
001962003	ERP Standard General	Commercial	Lot 5 University Collections	7/20/2000
001153003	ERP Standard General	Road Projects	Hills Co-Fletcher Ave 46th St Intersect	4/21/2005
006413061	ERP Standard General	Government	USF-Childrens Medical Services Elem 4	6/16/2004
002533002	ERP Standard General	Semi-Public	Shriners Expansion At USF	1/17/2001
003153005	ERP Standard General	Government	Hills Co-Raintree Oaks Drg Impr Ph 3	11/2/2000

TABLE 1.2
Environmental Resource Permits Reviewed

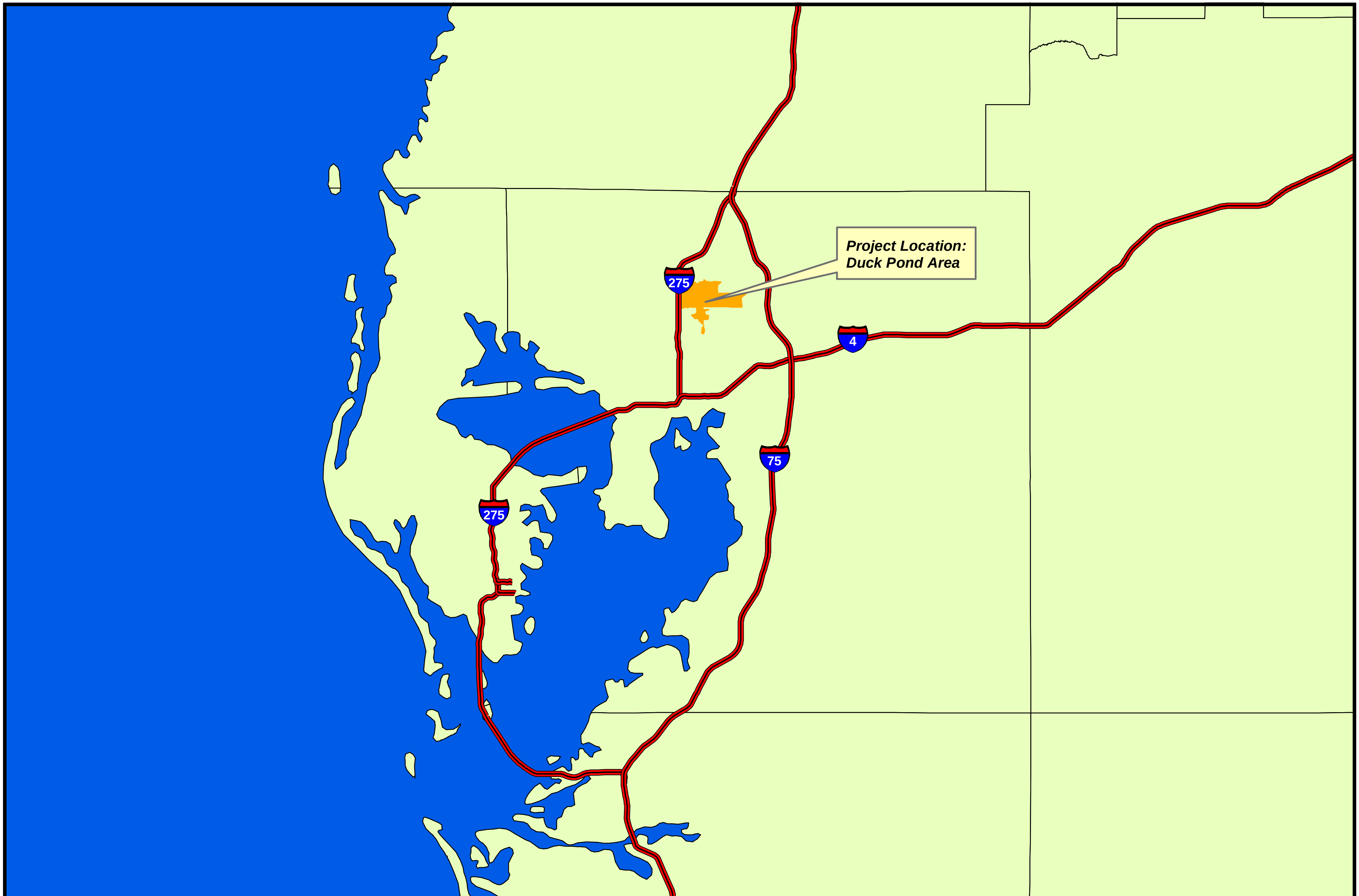
ERP	Permit Type	Activity	Project Name	Issue Date
002873008	ERP Standard General	Government	University Charter School	4/4/2003
021074001	ERP Standard General	Government	Hills Co-131st Ave-27th St Drng Imp	10/11/2004
006413043	ERP Standard General	Government	USF-Natural & Environmental Services Bld	11/22/2002
006413052	ERP Standard General	Government	USF Parking Garage	8/22/2003
023045000	ERP Standard General	Government	Hills Co-143rd Ave Drainage Imp	5/14/2002
027193000	ERP Standard General	Government	Hills Co-120th Ave Fm Nebraska To Co Pnd	6/25/2004
000121004	MSSW Individual Permit	Government	Hills Co-Bearss Ave/Duck Pond-Ph II	4/1/1999
022290001	ERP Standard General	Road Projects	40th St (Mckinley)-Busch To Fowler Seg E	9/21/2001

Aerial Photography and Contour Maps
Ayres Associates obtained latest aerial photographs (2004) and 1-foot digital contours (2002) from Hillsborough County.

Existing Studies
Ayres Associates performed a literature search for documents that may contain usable information pertaining to the study area. The literature search yielded the following:

- Duck Pond Watershed Management Plan Final Report, Hillsborough County, 2001
- Duck Pond Drainage Area Evaluation, City of Tampa, 2001
- Duck Pond Area Drainage Improvement Summary of Computer Modeling, Hillsborough County, 2005
- Flood in Southwest-Central Florida from Hurricane Frances, USGS, September 2004

Problem Area Documentation
Documentation for the reported flood prone areas was obtained through County records. These records were in GIS format and related to the complaints and locations associated with Hurricane Frances, during the month of September of 2004. In addition, Ayres staff performed a limited document search through SWFWMD and USGS regarding this event.



AYRES
ASSOCIATES
8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637

Legend

- Interstate Roads
- Duck Pond Area

Notes:

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

0 2 4 8 Miles

Figure 1-1: Duck Pond Area Watershed Location Map

Project: 61-0100.04

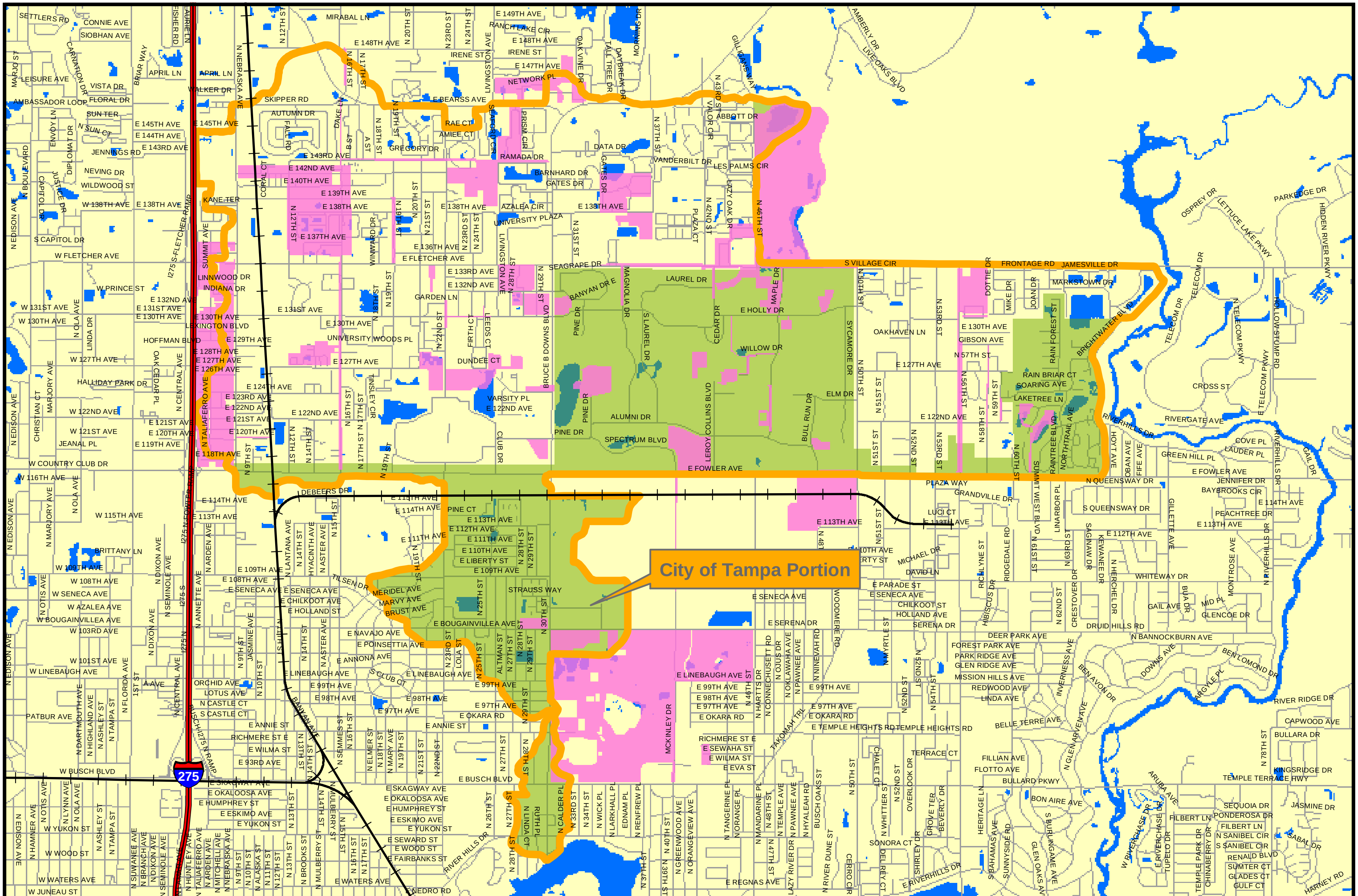
Watershed: Duck Pond Area

Hillsborough County:
WMP Update Program

Filename:	Map Date:	Map Prepared By:
Figure1-1.mxd	Mar. 31, 2006	Ayres Associates

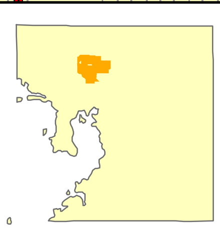
Date of Photography:

N/A



AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

- ERPs Reviewed
- Incorporated Areas
- Duck Pond Area
- Water Features

Notes:

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

0 0.15 0.3 0.6 Miles

Figure 1-2: Locations of ERPs Reviewed for the WMP Update

Project: 61-0100.04

Watershed: Duck Pond Area

Hillsborough County: WMP Update Program

Filename:	Map Date:	Map Prepared By:
Figure 1-2.mxd	Mar. 31, 2006	Ayres Associates

Date of Photography:

N/A

CHAPTER 2 WATERSHED DESCRIPTION

The general watershed characteristics have not changed since completion of the 2001 Watershed Management Plan. For this reason, much of the watershed description below is excerpted from the 2001 Watershed Management Plan, with expansion and clarification of text, as required. Update of this chapter includes revisions to general physiography and hydrology, including referenced subbasin sizes and number, as well as land use and topography. Figures have been regenerated using more recent land use and topographic data and refined watershed and subbasin delineations.

2.1 OVERVIEW

The Duck Pond Watershed (DPW) covers approximately 6.66 square miles or 4,262 acres in northern Hillsborough County in the vicinity of the USF Campus. The project area is primarily urban, and drains into either Cypress Creek or the Hillsborough River. Several major roads, including Nebraska Avenue, Bruce B. Downs Blvd., 56th Street, Fletcher Avenue, and Fowler Avenue travel through the project area. The basin, shown in **Figure 2-1**, is composed of 192 smaller units or subbasins ranging in size from approximately 0.61 to 251.3 acres. Land elevations in the DPW vary between a high of approximately 88 feet NAVD in the southeast portion of the project area to a low of around 24 feet NAVD. These elevations are shown on **Figure 2-2**.

2.2 CLIMATE

The climate of the DPW and for Hillsborough County 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. In addition, 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. The larger, normal summer storm events and those associated with tropical systems can cause flooding problems in areas where there are deficiencies in the existing stormwater, or other, drainage systems.

Winter rainfalls are, for the most part, relatively light and generally associated with the cold fronts that descend from the north through the south. However, some of the largest rain events have occurred in the winter months, and this is especially true in El Niño years (1997-98).

The annual mean temperature in Hillsborough County is about 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 that ranges into the mid to upper 90's can further exacerbate the situation. 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.

According to the National Weather Service in Ruskin, humidity does not vary as seasonally as temperature and rainfall. The Service keeps daily records for 1 and 7 o'clock A.M. and 1 and 7 o'clock P.M. The 7 A.M. time period generally records the highest humidity with the annual average at 88% with the 1 P.M. time period recording the lowest at an average of 58%.

Evapotranspiration rates vary, and limited data are available for analysis. Estimates of 39 inches per year have been reported. Viessman, et al. (1977) reports the figure to be closer to 48 inches per year. Lake evaporation data often quoted for use in Hillsborough County are those reported from Lake Alfred in Polk County, supplemented by scattered data available from the Lake Padgett weather station. Studies conducted by Tampa Bay Water estimate the lake evaporation rate to average approximately 56 inches per year.

2.3 SOILS

Soil distribution by type is shown in **Figure 2-3**. This information was developed based on Geographical Information Systems (GIS) coverages developed by the Southwest Florida Water Management District (SWFWMD). Much useful information, such as drainage classification, percent slope, water table depth, permeability, natural vegetation and potential uses for development and agriculture, can be obtained by consulting the NRCS Manual for Hillsborough County for each particular soil type.

These soil types can be arranged into four groups based on their runoff-potential; these types are shown in **Figure 2-4.** The hydrologic groups are commonly used in project area planning to estimate infiltration rates and moisture capacity. Soil properties that influence the minimum rate of infiltration obtained for a bare soil after prolonged wetting are: (a) depth to seasonally high water table; (b) intake rate and permeability; and (c) depth to a layer or layers that slow or impede water movement. The major soil hydrologic 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 inches per hour (in/hr) when dry and 0.50 in/hr when saturated. Soil types found in the DPW that fall into this group include the Candler fine sands, Orsino fine sand, and the Tavares-Millhopper fine sands.

- Group B (moderately low 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. Soil types found in the DPW which fall into this group include Seffner fine sand, and Zolfo fine sand.

- 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. Soil types found in the DPW that fall within this group include Basinger, Holopaw and Samsula, and Chobee muck.

- Dual classifications (e.g., A/D or B/D) can be assigned to soils that 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 and runoff rates. During the dry season when the water levels recede, infiltration rates increase and runoff rates decline to Group A or Group B levels.

2.4 PHYSIOGRAPHY AND HYDROLOGY

The DPW 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 discontinuous highlands formed by sub-parallel ridges that are separated by broad valleys. The project area has six major drainage systems each with their own outfall. These include; Duck Pond, Bruce. B. Downs, USF North, USF East, USF Campus East and Raintree Systems. The Bruce B. Downs, USF North, USF East and USF Campus East outfall to Cypress Creek. The Raintree System discharges directly to the Hillsborough River. The Duck Pond System outfalls to a City of Tampa storm sewer system south of Fowler Avenue at the University Square Mall. These systems in conjunction handle the majority of the stormwater conveyance within the project area.

There are some lakes, wetland areas and depressions located within the project area. The lakes and other depressional features in the area have been formed by sinkhole formation and other processes associated with the dissolution of the underlying limestone formations.

Hydrologically, surface flows originate for the most part through stormwater runoff with some influence from groundwater flows from lake seepage.

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 depressions or in sand ridges. Typical thickness of the surficial deposits varies from 20 feet 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.

The Tampa Member of the Hawthorn Group is a tan-colored carbonate and sand mixture, which can contain variable amounts of clay. 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.

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 northern 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. A general hydrogeologic cross-section of the Tampa Bay region is shown in **Figure 2-5**.

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 the quality of water within this aquifer is not suitable for human consumption. Water withdrawn from this aquifer is used most often for lawn irrigation. Surficial aquifer wells typically yield less than 20 gallons per minute.

Semi-Confining Zone

Below the surficial aquifer typically 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 Tampa 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 evaporite 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 features 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 EXISTING AND FUTURE LAND USE

Existing Land Uses
As stated previously, the DPW encompasses a wide variety of land uses. The existing Land Use Map, obtained from the Hillsborough County Property Appraiser's Office, is shown in **Figure 2-6**. **Table 2.1** provides a breakdown of land use by acreage and percent of land use for the watershed. **Figure 2-7** displays the SWFWMD 1999 Florida Land Use coverage for the watershed.

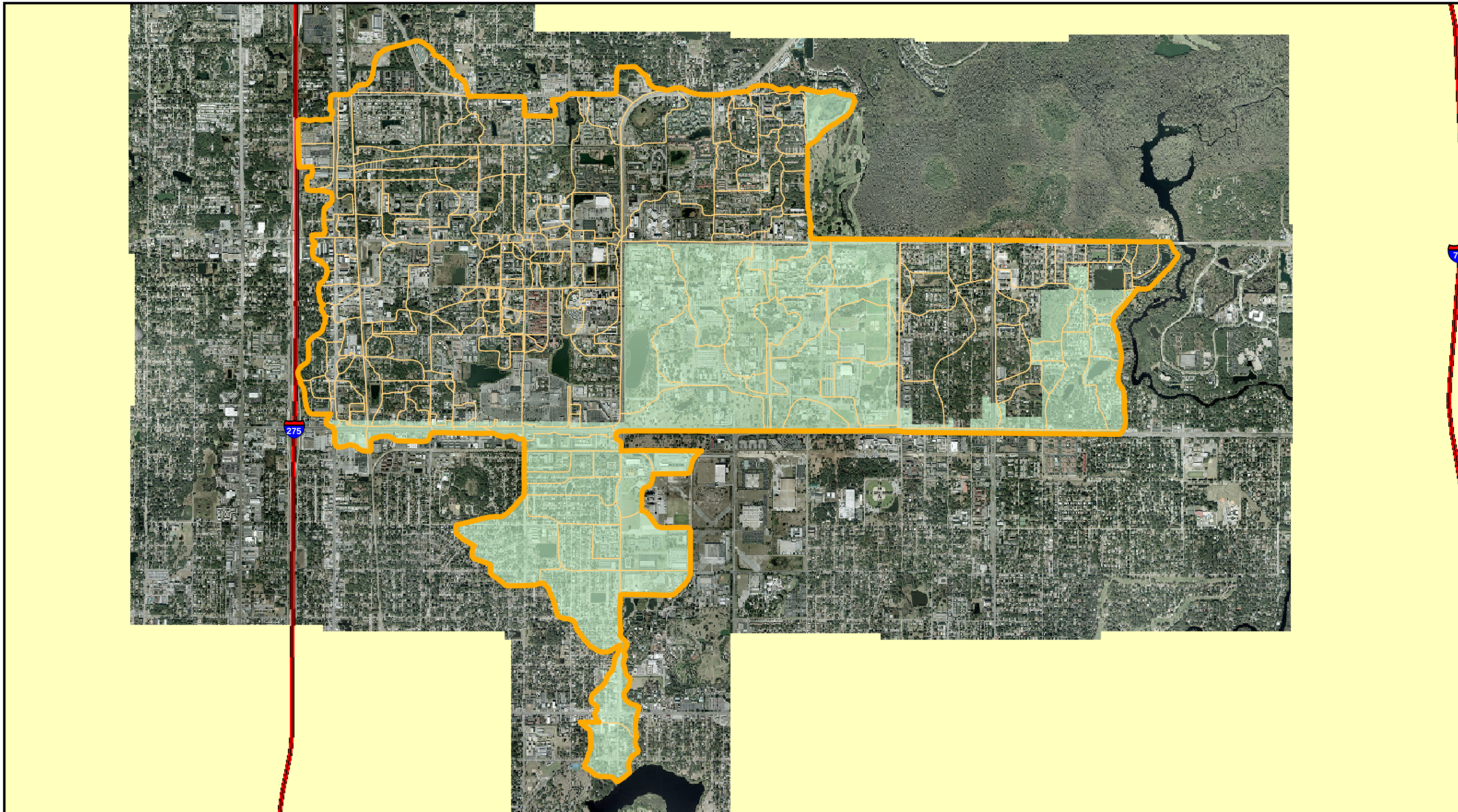
Future Land Uses
Due to the existing dense residential, commercial and institutional development and essentially built out conditions within the DPW, not many changes in land use are predicted by the Hillsborough County Comprehensive Plan. The expected future land uses for this area are shown in **Figure 2-8.** Definitions of the future land use types are shown on **Table 2.2**. Major Projects, DRIs, & Vested Projects within the watershed can be seen in **Figure 2-9.**

TABLE 2.1
Existing Land Uses (1995) – Duck Pond Watershed

LAND USE CATEGORY	TOTAL ACREAGE	PERCENT OF TOTAL
Commercial Heavy	109.82	2.53%
Commercial Light	379.30	8.73%
Industry Heavy	1.06	0.02%
Industry Light	44.78	1.03%
Multi-Family	704.26	16.22%
Mobile Home Park	149.56	3.44%
Public/Quasi-Public Inst.	365.85	8.42%
Public Communications/Utilities	33.67	0.78%
School University	933.91	21.50%
Single Family/Mobile Home	389.05	8.96%
Two Family	134.16	3.09%
Agriculture	5.49	0.13%
Roadways	886.93	20.42%
Unknown	205.08	4.72%
TOTAL	**4,343**	**100%**

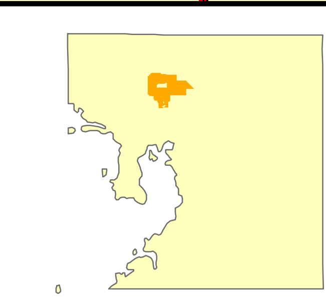
TABLE 2.2
Future Land Use Code Descriptions Shown on Figure 2-8
Duck Pond Watershed

CODE	DESCRIPTION
C	COMMERCIAL
CMU-35	COMMUNITY MIXED USE - 35
ESA	ESA
HC-24	HEAVY COMMERCIAL - 24
LD	LOW DENSITY RESIDENTIAL
LI	LIGHT INDUSTRIAL
LMD	LOW MEDIUM DENSITY RESIDENTIAL
MD	MEDIUM DENSITY RESIDENTIAL
OC	OFFICE COMMERCIAL
P/QP	PUBLIC / QUASI-PUBLIC
R/W	R/W
R-12	RESIDENTIAL - 12
R-20	RESIDENTIAL - 20
R-6	RESIDENTIAL - 6
R/OS	MAJOR RECREATIONAL / OPEN SPACE
ROW	RIGHT OF WAY
SMU-6	SUBURBAN MIXED USE - 6
UMU-20	URBAN MIXED USE - 20
WATER	WATER



AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

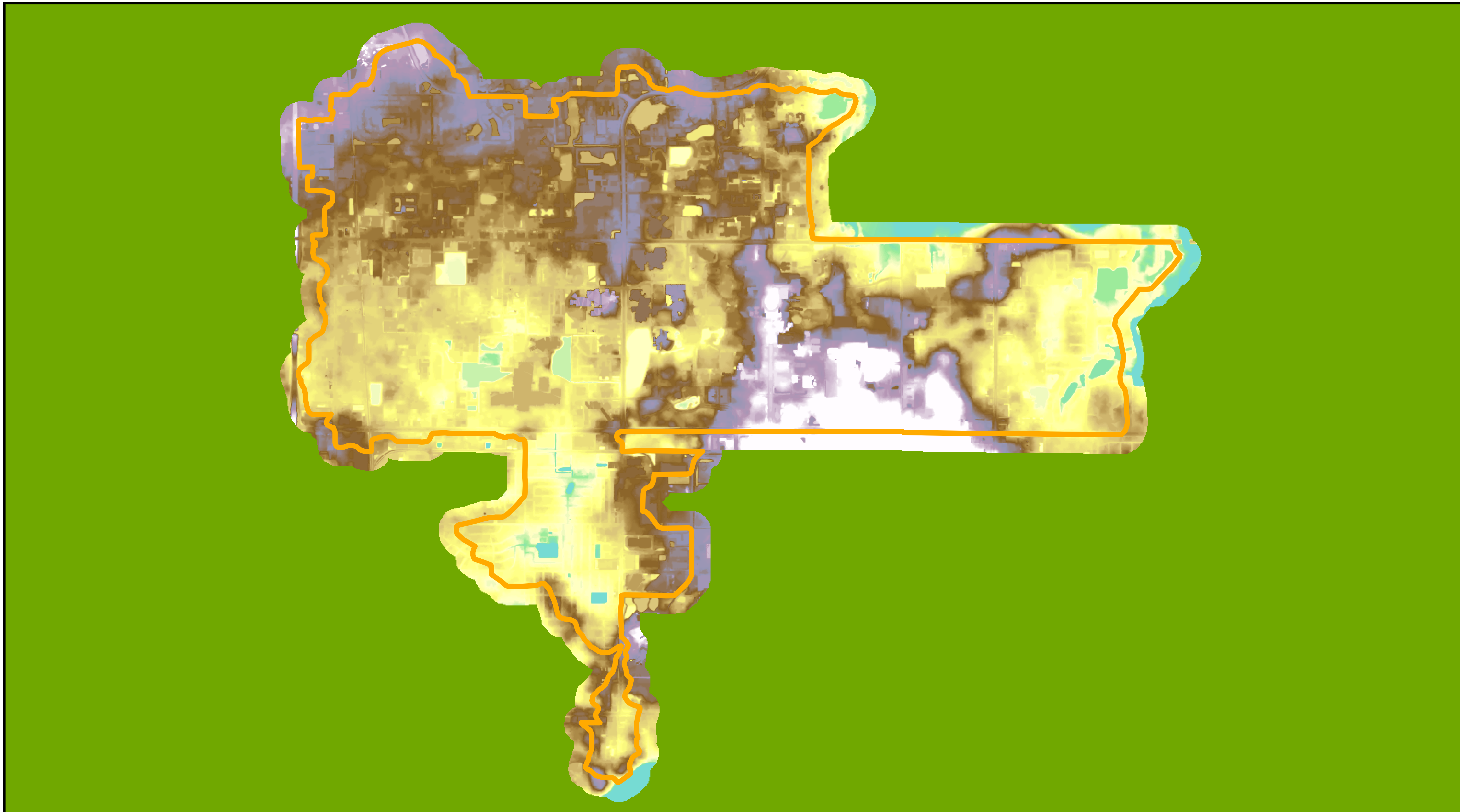
- Duck Pond Area
- Subbasin Delineations
- Incoporated Areas

Notes:

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

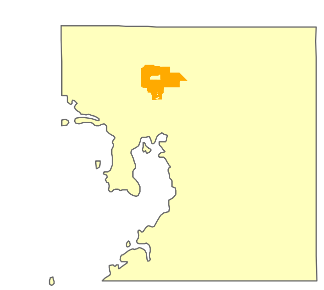
0 0.25 0.5 1 Miles

Figure 2-1: Subbasin Delineations	Filename: Figure 2-1.mxd	Map Date: Mar. 31, 2006	Map Prepared By: Ayres Associates
Project: 61-0100.04			
Watershed: Duck Pond Area	Date of Photography: 2004		
Hillsborough County: WMP Update Program			



AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

Elevations (NAVD)

88.00

54.00

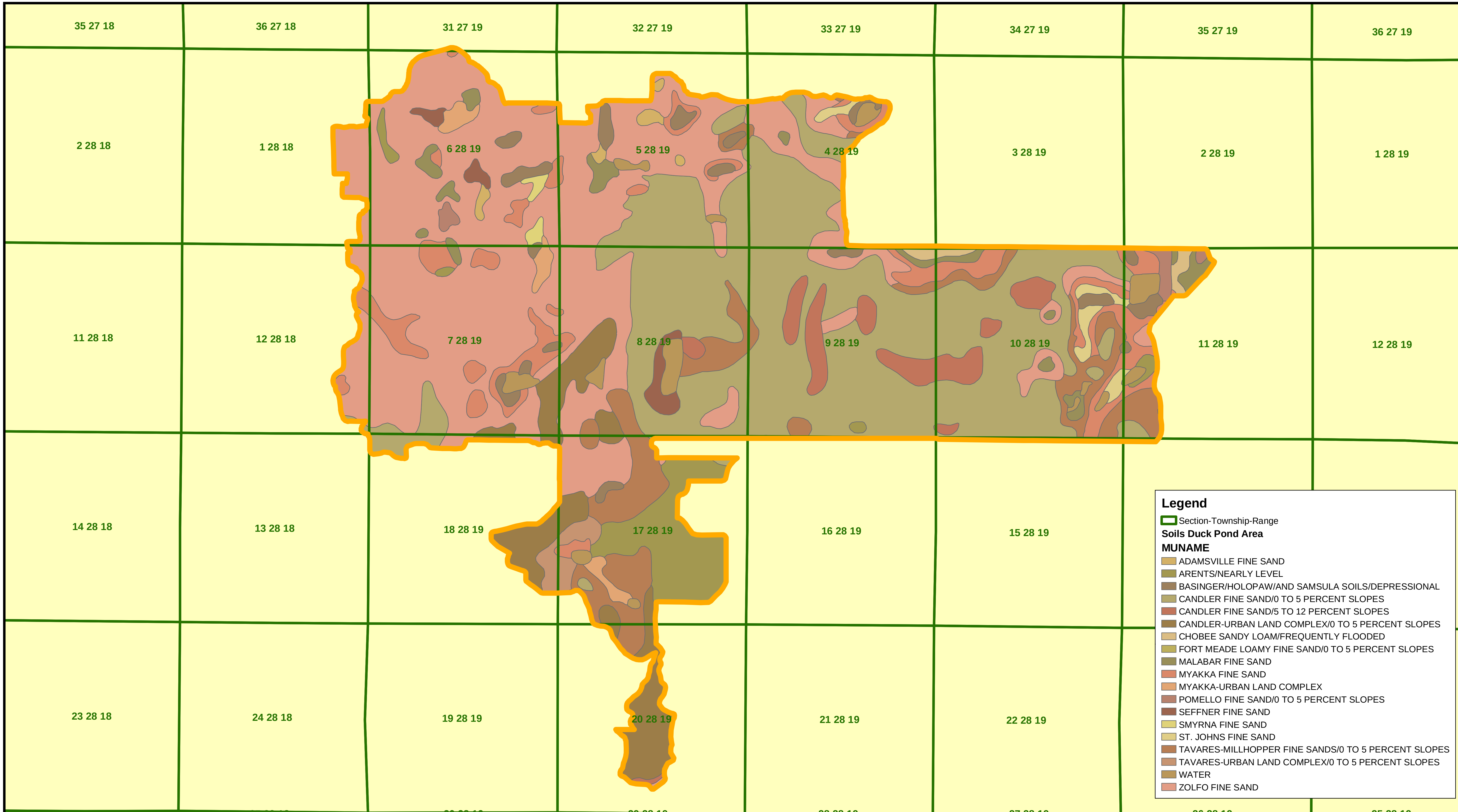
19.00

Notes:

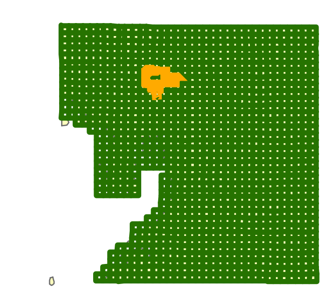
This area is used for general map note information such as map accuracy/standards, source information, elevation information, etc.

0 0.25 0.5 1 Miles

Figure 2-2: Topology Map	Filename: Figure 2-2.mxd	Map Date: Mar. 31, 2006	Map Prepared By: Ayres Associates
Project: 61-0100.04			
Watershed: Duck Pond Area	Date of Photography: N/A		
Hillsborough County: WMP Update Program			



AYRES ASSOCIATES
8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

See above

Notes:

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

0 0.25 0.5 1 Miles

Figure 2-3: Soil Classification Map

Project: 61-0100.04

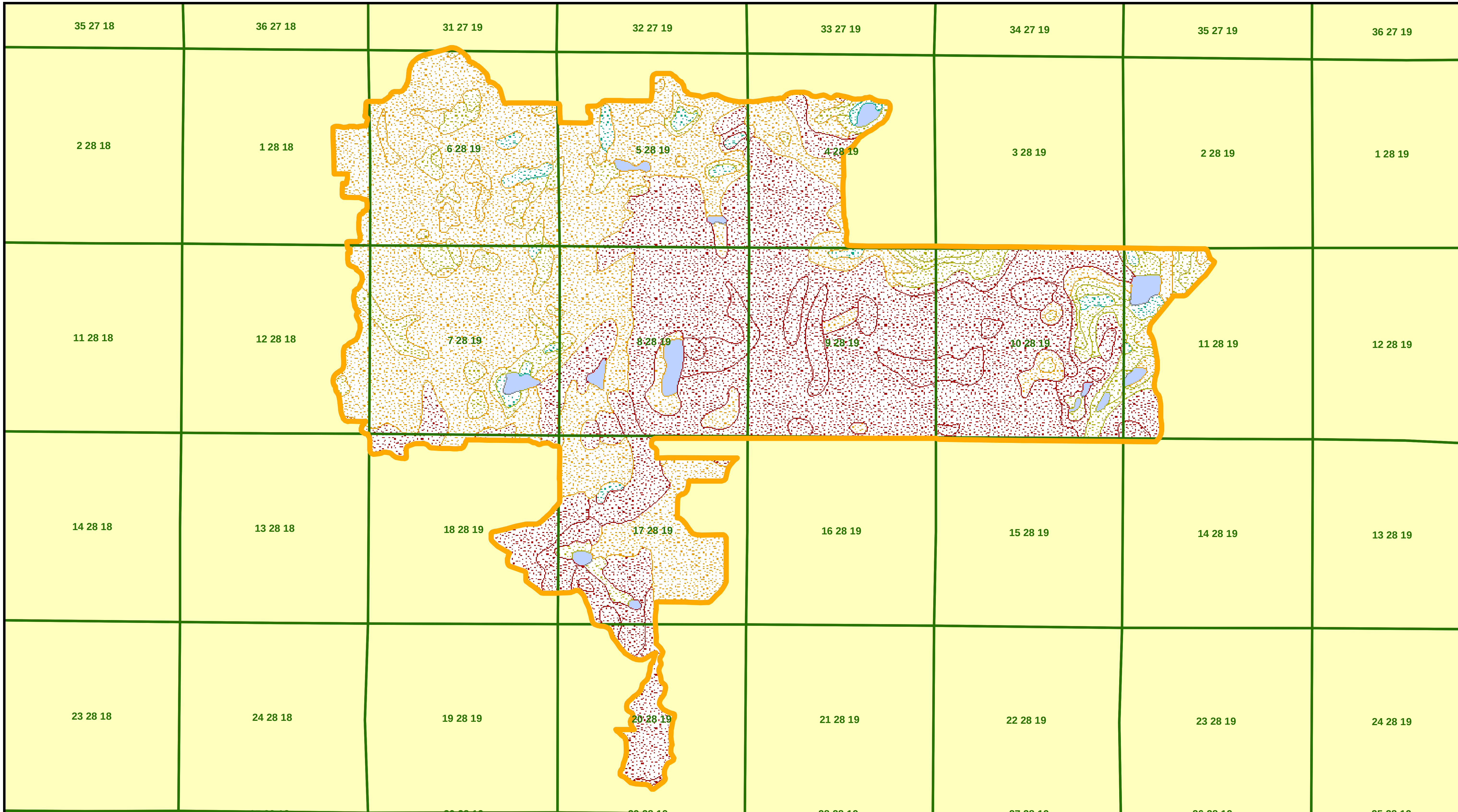
Watershed: Duck Pond Area

Hillsborough County:
WMP Update Program

Filename:	Map Date:	Map Prepared By:
Figure 2-3.mxd	Mar. 31, 2006	Ayres Associates

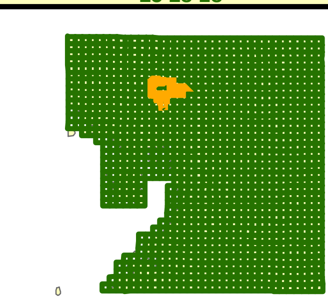
Date of Photography:

N/A



AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

Section-Township-Range

Hydrologic Soil Group

- A
- B/D
- C
- D
- W

Notes:

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

0 0.25 0.5 1 Miles

Figure 2-4: Hydrologic Soil Groups

Project: 61-0100.04

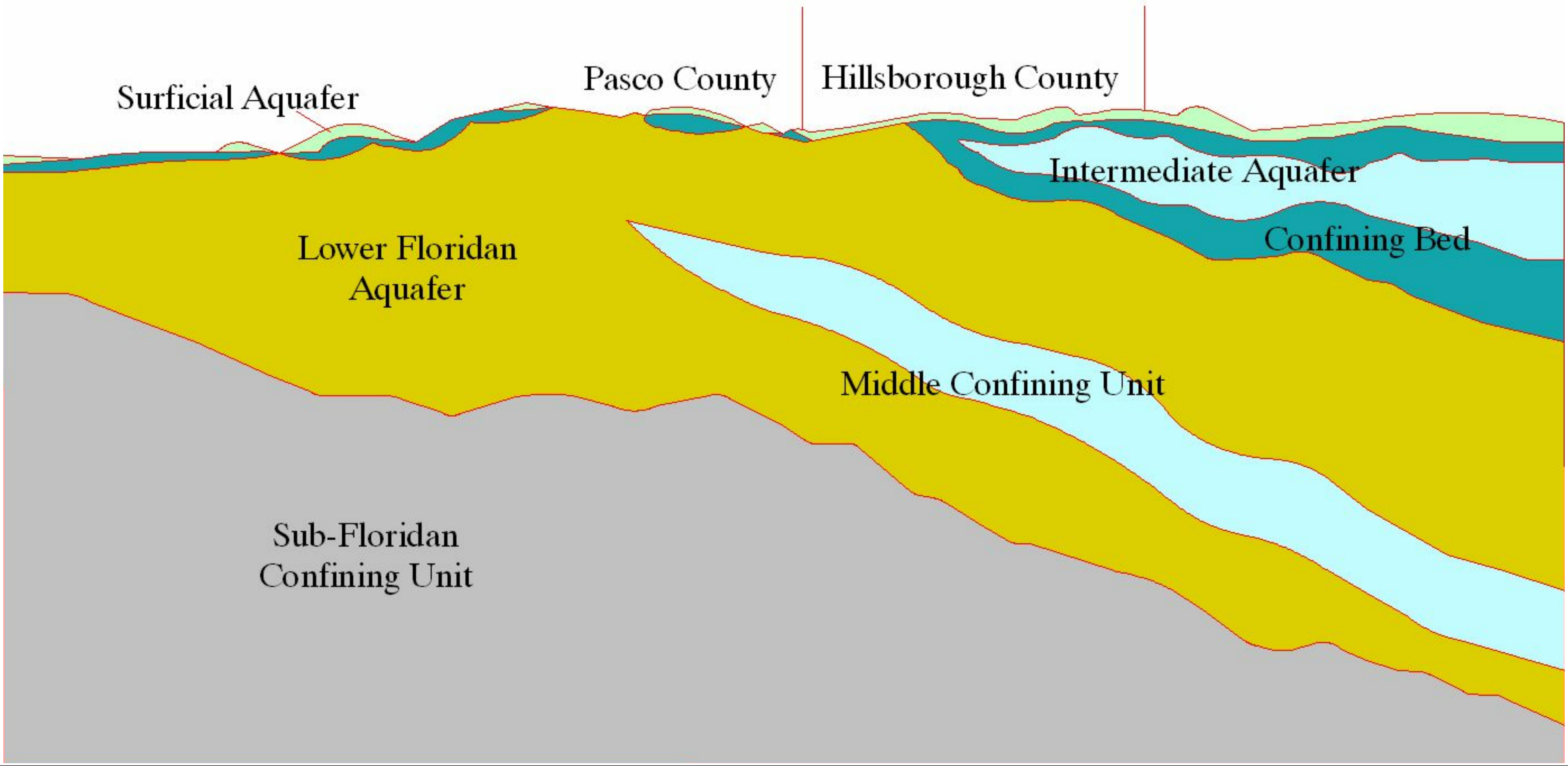
Watershed: Duck Pond Area

Hillsborough County:
WMP Update Program

Filename:	Map Date:	Map Prepared By:
Figure 2-4.mxd	Mar. 31, 2006	Ayres Associates

Date of Photography:

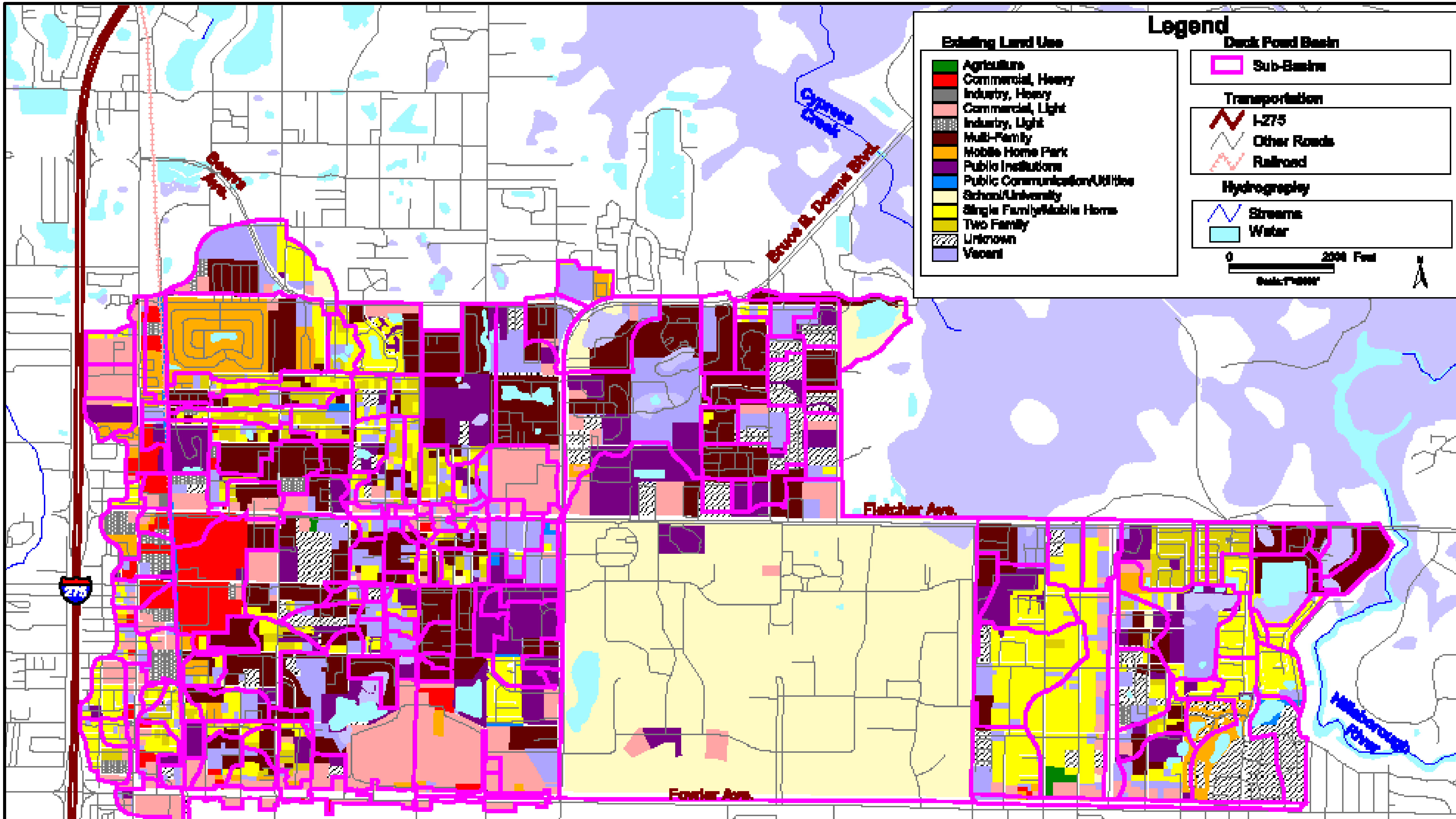
N/A



Duck Pond Area Watershed Management Plan Update
SWFWMD Hydrogeologic Cross-Section

Figure 2-5

AYRES ASSOCIATES



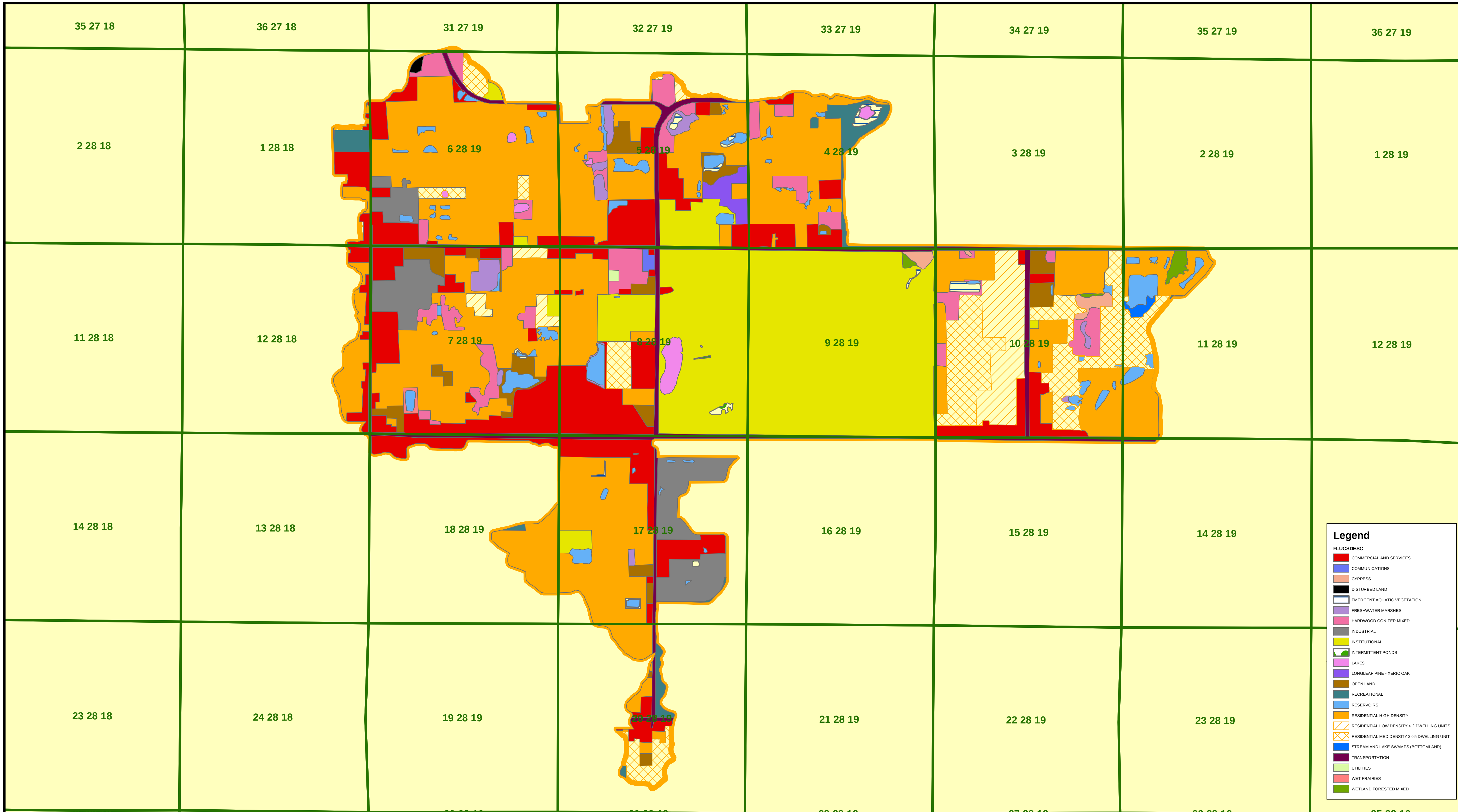
Duck Pond Area Watershed Management Plan Update

Existing Land Use

(Source: Duck Pond Watershed Management Plan, URS Corporation Southern, January 2001)

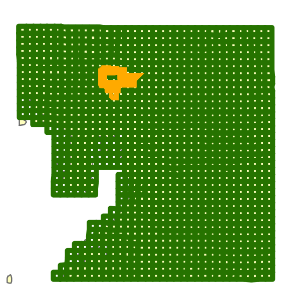
Figure 2-6

AYRES ASSOCIATES



AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

See above

Notes:

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

0 0.25 0.5 1 Miles

Figure 2-7: SWFWMD 1999 Land Use/Land Cover

Project: 61-0100.04

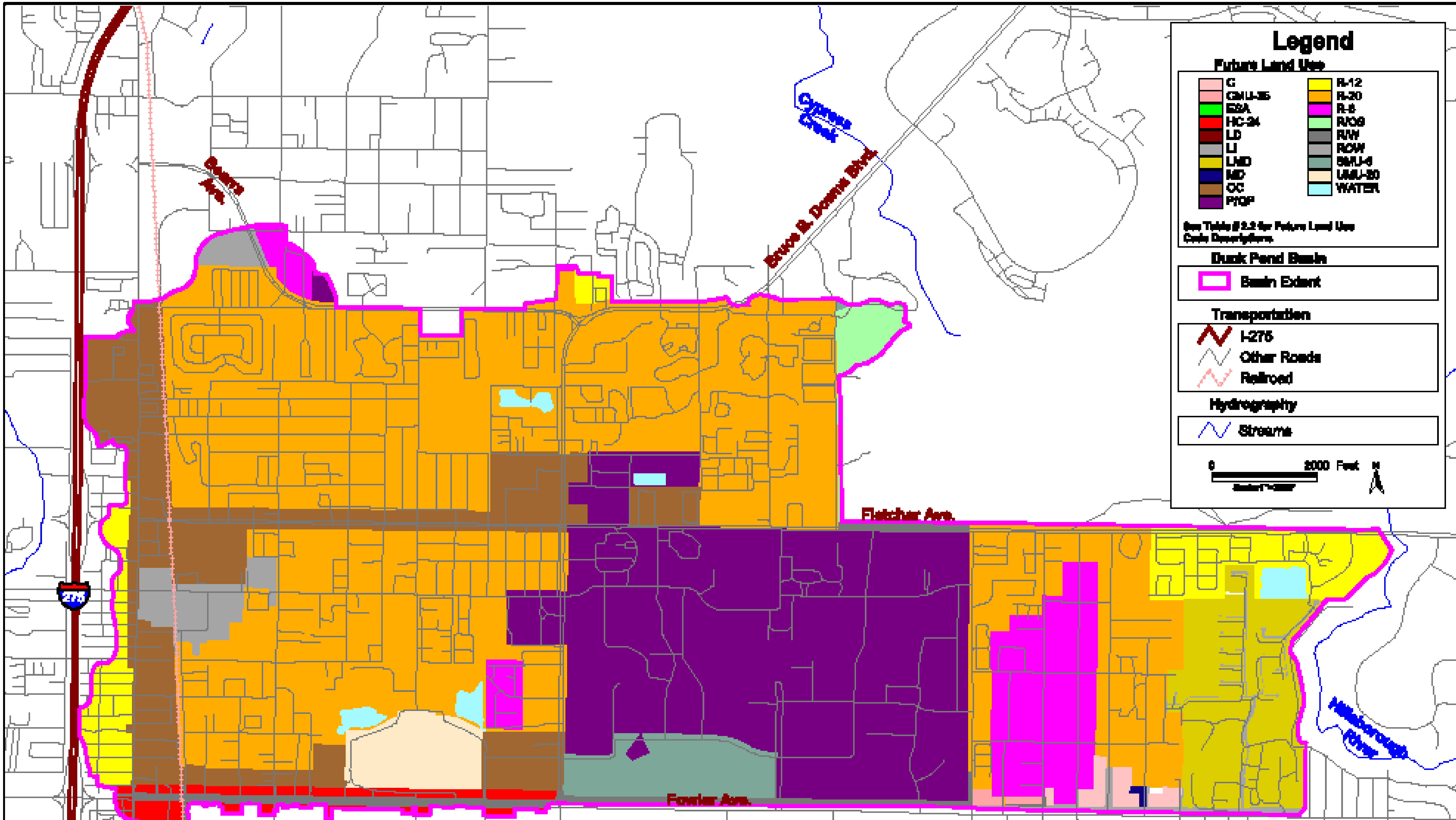
Watershed: Duck Pond Area

Hillsborough County: WMP Update Program

Filename:	Map Date:	Map Prepared By:
Figure 2-7.mxd	Mar. 31, 2006	Ayres Associates

Date of Photography:

N/A



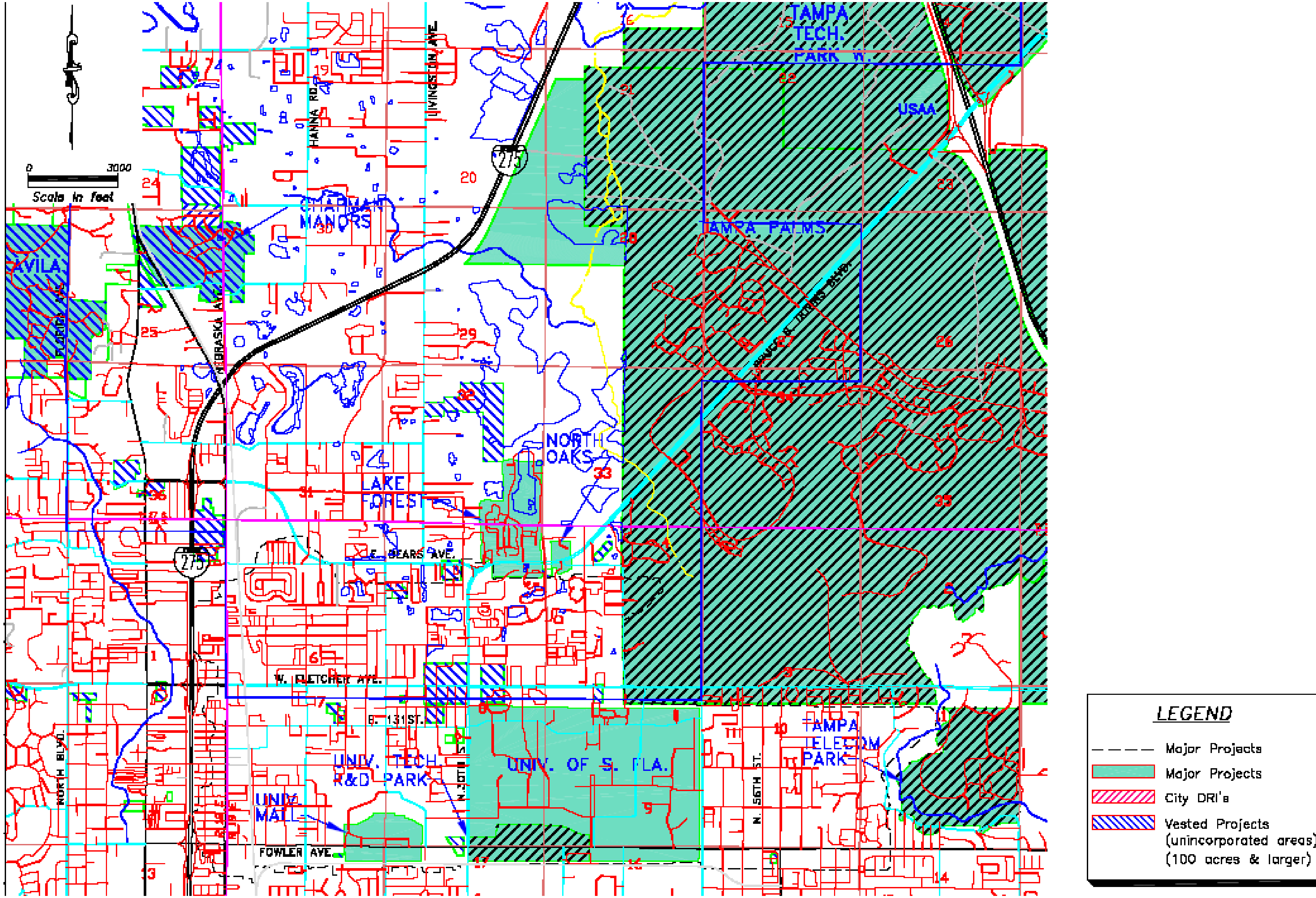
Duck Pond Area Watershed Management Plan Update

Future Land Use

(Source: Duck Pond Watershed Management Plan, URS Corporation Southern, January 2001)

Figure 2-8

AYRES ASSOCIATES



Duck Pond Area Watershed Management Plan Update

Major Projects, DRI's and Vested Projects

(Source: Duck Pond Watershed Management Plan, URS Corporation Southern, January 2001)

Figure 2-9

AYRES ASSOCIATES

CHAPTER 3 MAJOR CONVEYANCE SYSTEMS

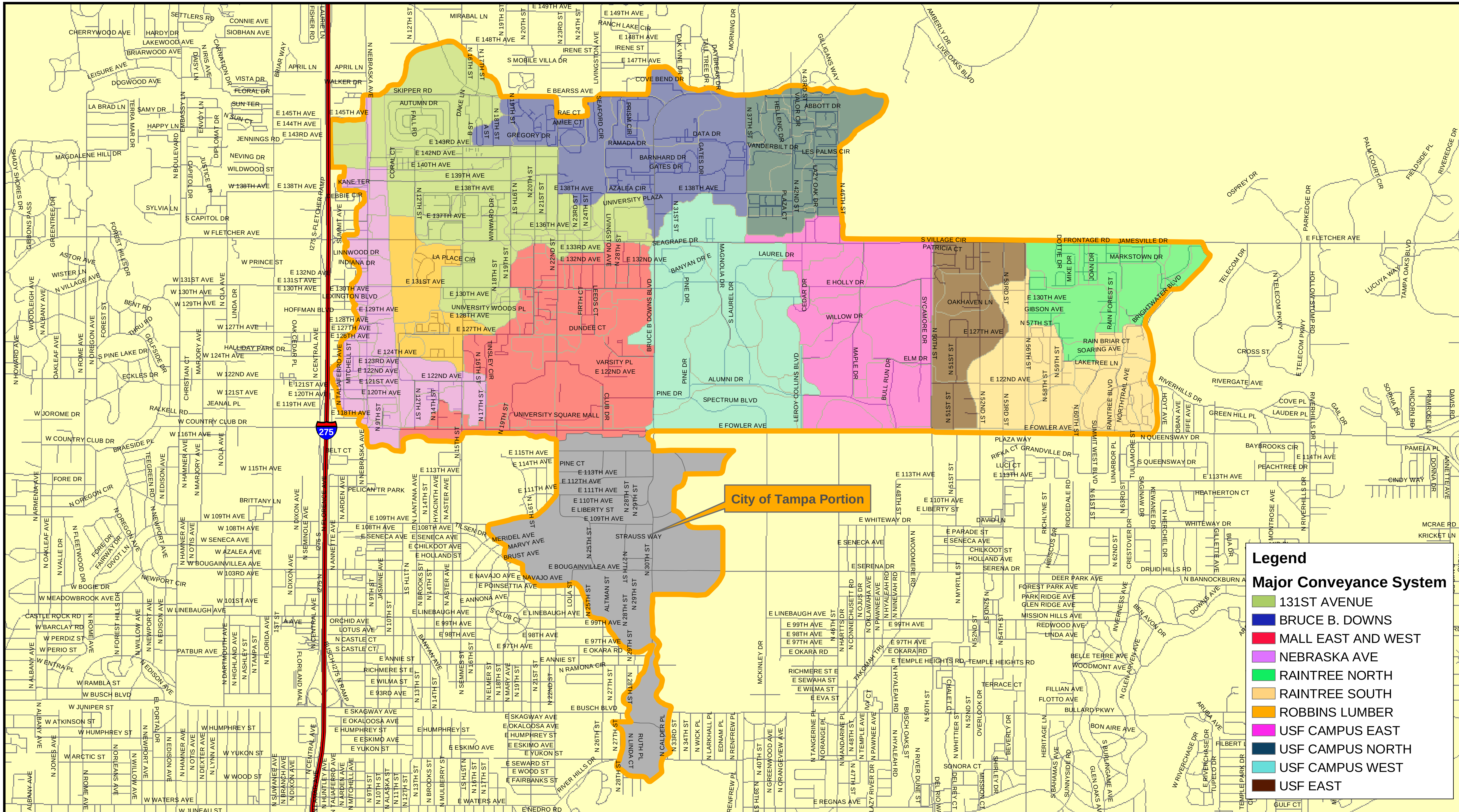
3.1 INTRODUCTION

This chapter contains a general description of the major conveyance systems in the Duck Pond Watershed (DPW). References to subbasin and junction IDs have been updated to reflect watershed-wide renumbering performed as part of this Watershed Management Plan Update. The existing condition system performance for the major conveyance systems is contained in Chapter 4.

The description of major conveyance systems in the DPW has been segmented into six major drainage areas as follows:

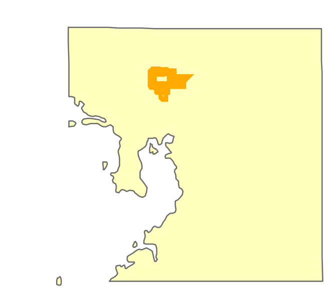
- Duck Pond
  - Nebraska Avenue
  - Robbins Lumber
  - 131st Avenue
  - Mall West/East
  - University of South Florida Campus West
- Bruce B. Downs
- USF North
- USF East
- University of South Florida Campus East
- Raintree
  - North
  - South

The dashed sub-systems are divisions or legs of the major drainage systems. **Figure 3-1** identifies locations of the six major drainage systems and sub-systems within the Duck Pond and Raintree systems, as well as other existing condition features within the DPW. **Figures 3-2a** through **3-2c**, located at the end of this Chapter, present the model connectivity for the Duck Pond conveyance systems.



AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

See above

Notes:

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

0 0.25 0.5 1 Miles

Figure 3-1: Major Conveyance System Map

Project: 61-0100.04

Watershed: Duck Pond Area

Hillsborough County:
WMP Update Program

Filename:	Map Date:	Map Prepared By:
Figure 3-1.mxd	Mar. 31, 2006	Ayres Associates

Date of Photography:
N/A

3.2 DUCK POND SYSTEM

The Duck Pond major drainage area encompasses approximately 2,303 acres and includes the contributing subbasin areas of the Nebraska Avenue, Robbins Lumber, 131st Avenue, Mall West/East and University of South Florida Campus West Systems. The ultimate outfall for these systems is known as Duck Pond.

Originally Duck Pond was a large pond that was in the area of the existing University Square Mall, a regional mall located west of the USF campus. During the mall construction Duck Pond took on the more defined shape it has presently and is located northwest of the mall. Another pond was constructed for the surrounding development and is located northeast of the mall. For the purpose of this report, the pond northwest of the mall will be referred to as Duck Pond West, and the pond northeast of the mall will be referred to as Duck Pond East. Duck Pond West and East are interconnected by a 72-inch reinforced concrete pipe (RCP), which travels through the northern portion of the mall development. Duck Pond East outfalls southward through double 48-inch RCPs which drain to a 4-foot by 4-foot box culvert under Fowler Avenue. This culvert has a 54-inch RCP segment at the down stream end. The 4-foot by 4-foot box culvert and the 54-inch RCP are part of an FDOT drainage system. The 54-inch culvert discharges to a ditch on the south side of Fowler Avenue. Fowler Avenue is the boundary between Hillsborough County and the City of Tampa, with the City stormwater system beginning on the south (downstream) side of the Fowler Avenue cross drain.

3.2.1 Nebraska Avenue System

The major conveyance system that borders the west side of the DPW is called the Nebraska Avenue system. This system encompasses approximately 317 acres and drains all of Nebraska Avenue (U.S. 41) from Skipper Road to Fowler Avenue with adjacent drainage areas that lie between Interstate 275 and the CSX Railroad line. The storm sewer along Nebraska Avenue begins approximately 250 feet south of Skipper Road. The storm sewer drains, via 24" up to 36" RCP, to a pond located adjacent to the CSX Railroad and approximately 700 feet north of Fletcher Avenue. The pond is behind a business and the inlet and outlet of the pond runs through the same easement from Nebraska Avenue to the pond.

The storm sewer continues south, via 30" up to 66" RCP to 120th Avenue and turns east and discharges to a Hillsborough County maintained pond located at the southwest quadrant of 12th Street and 122nd Avenue. A portion of the Fowler Avenue drainage system also discharges to the same County pond after being treated in an FDOT maintained pond. The outlet from the Hillsborough County pond discharges east along 122nd Avenue within a storm sewer to Duck Pond West. The 122nd Avenue storm sewer also accepts runoff from areas adjacent to 122nd Avenue. Drainage from areas between 122nd Avenue and Fowler Avenue, and east of the CSX Railroad, travels overland to the 122nd Avenue storm sewer. The overland conveyance is inhibited due to low-lying areas between Fowler Avenue and 122nd Avenue.

3.2.2 Robbins Lumber System

The Robbins Lumber drainage basin encompasses approximately 151 acres. This basin contains the Robbins Lumber plant and storage facilities and is located between the CSX Railroad and Duck Pond West, south of Fletcher Avenue and north of 127th Avenue. Robbins Lumber has a National Pollutant Discharge Elimination System (NPDES) industrial permit for stormwater discharge. The Robbins Lumber site discharges to a swale along 127th Avenue, which flows eastward. The storm sewer travels through a parking lot of a private apartment complex located at the southwest quadrant of 15th Street and 127th Avenue. The storm sewer discharges to an open channel on the east side of 15th Street between 122nd and 127th Avenues. The open channel then meanders southeasterly through residential areas and is connected to Duck Pond West.

3.2.3 131st Avenue System

The 131st Avenue System encompasses approximately 691 acres and is the conveyance system that discharges a large drainage area north of Fletcher Avenue to a large regional County stormwater pond located at 131st Avenue and 15th Street. The pond is commonly referred to as the 131st Avenue pond. The regional pond discharges to Duck Pond West via an existing Concrete Box Culvert (CBC) storm drain outfall.

The existing 131st Avenue system begins north of the apex of Skipper Road and Bearss Avenue. Some drainage area north of the apex along 16th and 17th Streets discharge into two small stormwater ponds at said apex. The west pond at the apex appears to have been constructed for a commercial development just west of the pond. The other pond appears to have been constructed for the Bearss Avenue extension roadway project. These ponds, with other drainage area northeast of the apex, drain to a ditch that discharges southward to the intersection of 143rd Avenue and 15th Street. The ditch is approximately 1,400 feet long. A large mobile home park discharges directly to the south end of the ditch. The Mobile Home Park, formerly known as the Four Seasons Mobile Home Park, is privately maintained and has a stormwater management and conveyance system within it.

The ditch enters a closed storm drain conveyance system at the 143rd Avenue and 15th Street intersection. A new CBC storm drain system has been constructed beginning at the south end ditch along 15th Street to Fletcher Avenue, and on to the aforementioned 131st Avenue pond. The CBC storm drain system was included in the existing conditions model.

Most of the drainage area between the CSX Railroad and 15th Street, south of 143rd Avenue discharges via a swale and side drain conveyance system to 15th Street. Areas along the east side of 15th Street between 143rd Avenue and Fletcher Avenue also drain toward 15th Street. A majority of the properties in this area are residential homes or apartments. A proposed system of lateral storm sewers has been designed to replace and or augment the existing conveyance systems along 142nd, 140th, 139th and 137th Avenues and discharge to the CBC storm sewer along 15th Street. There is some existing storm sewer along 140th Avenue, which will be used within the proposed lateral. These proposed laterals will extend from 15th Street to 12th Street along 140th, 139th, and 138th Avenues. The lateral at 142nd extends to the west side of the CSX Railroad. The lateral on 137th

Avenue will extend to its intersection with Cecelia Street where an existing County pond is located northwest of the intersection.

There are two commercial developments located west of Nebraska Avenue that discharge to a storm drain west of the CSX Railroad on 142nd Avenue. The storm drain runs along the north side of a mobile home park. The two commercial developments contain a Suncoast Roofing Supply store and the Malibu Grand Prix mini car race track and amusement center. The stormwater runoff from the Malibu Grand Prix appears to discharge to the stormwater management system that serves the adjacent commercial development. The stormwater management system for the commercial development has an underground vault and pump station that discharges east across Nebraska Avenue to the storm drain system north of the mobile home park. This storm drain system north of the mobile home park reportedly floods often.

The Hillsborough County Parks and Recreation Maintenance facility has a stormwater pond that serves the facility. Stormwater management systems of other commercial areas south of the Maintenance facility drain to a swale south of the Maintenance facility pond. A swale along the east side of the CSX Railroad connects to the swale south of the Maintenance facility. The swale south of the Maintenance facility eventually discharges across 12th Street via a cross drain to a vacant lot that lies north of Fletcher Avenue. The vacant lot does not appear to have a readily available outfall.

In the area of the Hillsborough County Parks and Recreation Maintenance facility the swale along the east side of the CSX Railroad is also connected to a cross drain at Fletcher Avenue. The cross drain connects to a swale and blind drainage area in the southwest quadrant of Fletcher Avenue and the CSX Railroad intersection. The blind drainage area contains a construction supply facility and some of the Robbins Lumber storage area. Within this blind basin there is a pond approximately 500 feet south of the intersection of Fletcher Avenue and the CSX Railroad which does not appear to have an outfall.

The drainage area along 19th Street originates south of 143rd Avenue and flows south to Fletcher Avenue via a storm drain system. The 19th Avenue storm drain consists of swales, side drains, and some storm sewer that lies mostly along the west side of 19th Street. There are various sizes of side drains along 19th Street.

The 19th Street storm drain system accepts drainage from a large swale approximately 600 feet south of 143rd Avenue. The large swale connects to a low area according to Doug Beam, of the Hillsborough County West Service Unit, is referred to as Lake Navajo and is owned by Hillsborough County. Near the same location where the swale discharges to the 19th Street storm drain system is where a cross drain discharges runoff from drainage areas east of 19th Street. A large private pond is located approximately half way between 143rd Avenue and Fletcher Avenue on the east side of 19th Street. The pond discharges to the 19th Street storm drain system.

The drainage areas along 20th, 22nd, 23rd Streets and Livingston Avenue drain to those roadways but the existing conveyance systems are swale and side drain systems which do not function well. The drainage eventually discharges to a closed storm drain system located along Fletcher Avenue. The Fletcher Avenue storm drain system travels from Bruce B. Downs Boulevard to east of 15th Street and discharges to the 131st Avenue pond. The 131st Avenue pond is approximately 16 acres in size.

The 131st Avenue pond accepts runoff from drainage areas adjacent to it via storm drain systems along with accepting flows from the 15th Avenue and Fletcher Avenue storm drainage systems. The 131st Avenue pond has a control structure with a broad crested weir and discharges into an existing CBC storm drain system. The existing CBC storm drain system accepts runoff from drainage areas along 19th Street and discharges south to Duck Pond West.

3.2.4 Mall West/East System

The Mall West/East System encompasses approximately 569 acres and is located at the south central portion of the DPW. The ultimate collection points in this system are Duck Pond West and Duck Pond East. A 72-inch equalizer pipe connects Duck Pond West with Duck Pond East. The portion of the system draining to Duck Pond West includes Fowler Avenue from Nebraska Avenue to the west entrance at the University Square Mall, approximately 60-percent of the University Square Mall, and residential and commercial areas north of the University Square Mall from 127th Avenue to Fletcher Avenue between 19th Street and Livingston Avenue. Fowler Avenue drains to a wet detention pond owned and maintained by the Florida Department of Transportation (FDOT). This pond is located adjacent to the Sports Authority parking lot and discharges to a ditch connected to Duck Pond West. The west side of the University Square Mall drains directly to Duck Pond through a closed storm sewer system. The residential and commercial properties north of the University Square Mall drain to a series of open and closed drainage systems along 20th and 22nd Streets. These drainage systems drain to double 48-inch pipes parallel to 127th Avenue. The double 48-inch pipes flow west to an open channel which drains south to Duck Pond. Additionally, Duck Pond West is the ultimate outfall for the Nebraska Avenue, 131st Avenue Pond, and Robbins Lumber Drainage Systems.

The portion of the system draining to Duck Pond East includes approximately 40-percent of the University Square Mall, the west side of the University of South Florida, and residential and commercial areas from Fowler Avenue to Fletcher Avenue between Bruce B. Downs Boulevard and Livingston Avenue. The east side of the University Square Mall drains directly to Duck Pond (East) through a closed storm sewer system. Storm water from the west side of the University of South Florida campus drains to Lake Behnke prior to discharging to an open channel which flows west to Duck Pond (East). This ditch also collects storm water from commercial and residential areas between Fowler Avenue and 127th Avenue. Detention ponds at the Veterans Administration Hospital outfall to a concrete lined ditch along 127th Avenue which also discharges to Duck Pond (East).

Duck Pond East is the last storage area in the Duck Pond System before it ultimately outfalls south to the City of Tampa. This final outfall begins on the south side of Duck Pond East where it is routed through various size pipes which discharge to the south side of Fowler Avenue into a City of Tampa closed channel system. It is then routed through a piped culvert under the CSX Railroad.

The flow is finally routed through various closed channels and ponds to the City of Tampa's pump station, which discharges, into the Hillsborough River via a 72-inch pipe.

3.2.5 University of South Florida Campus West

The University of South Florida (USF) Campus West system encompasses approximately 580 acres. Approximately 478 acres is within the DPW and drains west to Duck Pond East. The remaining 97 acres is outside of the DPW and drains south and leaves the USF Campus through a circular culvert under Fowler Avenue. The USF West system is generally bordered by Bruce B. Downs Boulevard to the west, North Palm Drive and Leroy Collins Boulevard to the east, Alumni Drive to the south, and Fletcher Avenue to the north; with the exception of two off-campus subbasins. One of the off-campus subbasins is north of Fletcher Avenue and the second off-campus subbasin is west of Bruce B. Downs Boulevard across Lake Behnke.

Elevations vary from approximately 65-feet at the center of the campus along the ridge line to 30-feet at Lake Behnke with a mild to moderate slope. Land uses include large impervious areas such as campus parking lots and buildings, large open green spaces, undeveloped wooded areas and Lake Behnke.

The majority of the USF Campus west system drains to two interconnected wet detention ponds recently permitted by the Southwest Florida Water Management District (SWFWMD). The first pond is 4 acres in area at the top of bank and is located east of Magnolia Drive. This pond discharges through a drop structure with two 42-inch RCP culverts to a 4-foot by 8-foot CBC under Magnolia Drive, which then discharges to the second interconnected pond. The second pond is 2.0 acres at the top of bank and is located west of Magnolia Drive. The second pond discharges directly to Lake Behnke through a drop structure with a 5-foot by 9-foot CBC. Drainage to Lake Behnke is through a series of stormwater conveyance piping systems and overland flow. The only portions of the USF Campus west system draining directly to Lake Behnke are located at the north west section of campus, the USF botanical gardens and the off-site area west of Bruce B.Downs Boulevard. Lake Behnke discharges to Duck Pond East through a drop structure with three 23-inch by 24-inch elliptical RCP culverts under Bruce B. Downs Boulevard.

3.3 BRUCE B. DOWNS SYSTEM

The Bruce B. Downs system encompasses approximately 442 acres and is located at the northern portion of the DPW. The system originates at a lake in the Pine Lake subdivision located south of Bearss Avenue and east of 19th Street. The lake drains east to a channel and low area at 142nd Street and 22nd Street. This channel flows east to Bruce B. Downs Boulevard. Runoff from several apartment complexes and commercial areas also drain to the channel. The channel crosses under Bruce B. Downs Boulevard and drains to a wetland area on the east side of Bruce B. Downs and Bearss Avenue intersection. Several residential and commercial complexes located north of University Hospital and east of Bruce B. Downs Boulevard also drain to the wetland area via gravity and pump station systems. This area then flows north under Bruce B. Downs Boulevard to a channel in the Lake Forest subdivision. This channel flows north to a lake in Lake Forest and combines with the 149th Street outfall system. The system ultimately discharges to Cypress Creek.

3.4 USF NORTH SYSTEM

The USF North system encompasses approximately 262 acres and is located directly north of the USF campus. Approximately 225 acres is located between 37th Street and 46th Street north of Fletcher Avenue. The remaining 37 acres is on the USF Golf Course east of 46th Street. The USF North drainage area is bounded by commercial properties along Fletcher Avenue on its south side, 46th Street on the east, 37th Street on the west, and an extension of Skipper Road on its north side. The entire drainage area is almost entirely built out with residential complexes. There is a private residential complex in the northwest corner of this drainage area that is closed. There are two outfall locations for the USF North system.

The majority of the USF North area drains north within the 42nd Street right-of-way. The 42nd Street right-of-way contains a storm sewer and three force mains which run north, almost to Skipper Road, to a large main line system. The main line storm sewer turns east and travels through the Breckenridge residential area along Abbot Drive and discharges to an outfall ditch that borders a lake located on the north end of the USF Golf Course. The eventual outfall for the USF Golf Course is Cypress Creek.

A residential area located west of the USF Golf Course entrance road drains eastward to a low area on the west side of 46th Street. When the low area becomes full during the wet season it causes a traffic hazard. With enough runoff this low area will overtop 46th Street and drain easterly onto the USF Golf Course.

3.5 USF EAST SYSTEM

The USF East System encompasses approximately 215 acres and is located east of and adjacent to 50th Street. 50th Street runs along the east side of the USF campus, hence the USF East name. The other boundaries of USF East are Fowler Avenue on the south, Fletcher Avenue on the north, and generally 52nd Street on it's east side. Some drainage area between 52nd Street and 53rd Street drains west to the USF East system. The south end of the USF East System consists of a closed subbasin bounded by 50th Street, 52nd Street, 122nd Avenue and Fowler Avenue to the west, east, north and south, respectively. Commercial properties within this closed subbasin along Fowler Avenue drain to a retention pond with no outfall between 50th and 51st Streets. The remaining portion of this subbasin drains to a low area at the south end of 51st Street with no outfall.

Stormwater in the central and north end of the USF East System is collected in two closed storm sewer systems along 127th Avenue and 52nd Street, and roadside ditches along the east side of 50th Street and the south side of Fletcher Avenue. The storm sewer along 127th Avenue collects storm water from residential areas to the north and south of 127th Avenue. This storm sewer is equipped with a pump station capable of discharging up to approximately 5.0 ft^3/s through a 10-inch force main to a FDOT borrow pit pond located at the north end of 52nd Street. The storm sewer along 52nd Street collects storm water from residential areas to the east and west of 52nd Street. This storm sewer drains by gravity to the FDOT borrow pit pond. The FDOT borrow pit pond has no outfall. Overflow from this pond discharges to a ditch draining to a wetland adjacent to Fletcher Avenue. The roadside ditches along 50th Street and Fletcher Avenue also drain to this wetland. This wetland drains north to Cypress Creek through a 48-inch culvert under Fletcher Avenue.

3.6 RAINTREE SYSTEM

The Raintree System borders the east side of the USF East drainage area, and is predominantly, though not completely, situated within the limits of the City of Temple Terrace. The Raintree system is bordered on the north by Fletcher Avenue, on the south by Fowler Avenue, on the east by the Hillsborough River, and on the west by 56th Street. Some drainage area on the west side of 56th Street and some south of Fowler Avenue are also included. For the purpose of this study, the Raintree drainage system has been divided into a North and South system as described below.

3.6.1 North System

Raintree North encompasses approximately 261 acres and is bordered on the north by Fletcher Avenue, on the south by Raintree Terrace Subdivision, on the east by the Hillsborough River, and on the west by 56th Street. The western area of Raintree North collects stormwater runoff in a wetland located west of Rain Forest Street by means of overland flow and culverts. The flow is routed east under Rain Forest Street to a pond located south of Carlton Arms Apartments. This pond south of Carlton Arms collects the remaining stormwater runoff from the eastern area of Raintree North where it is then routed to the Hillsborough River. The information on this system was taken from the report "Raintree Terrace / Raintree North Subdivision Drainage Improvements Preliminary Study", dated October 1999, and prepared by the Engineering Division at Hillsborough County.

3.6.2 South System

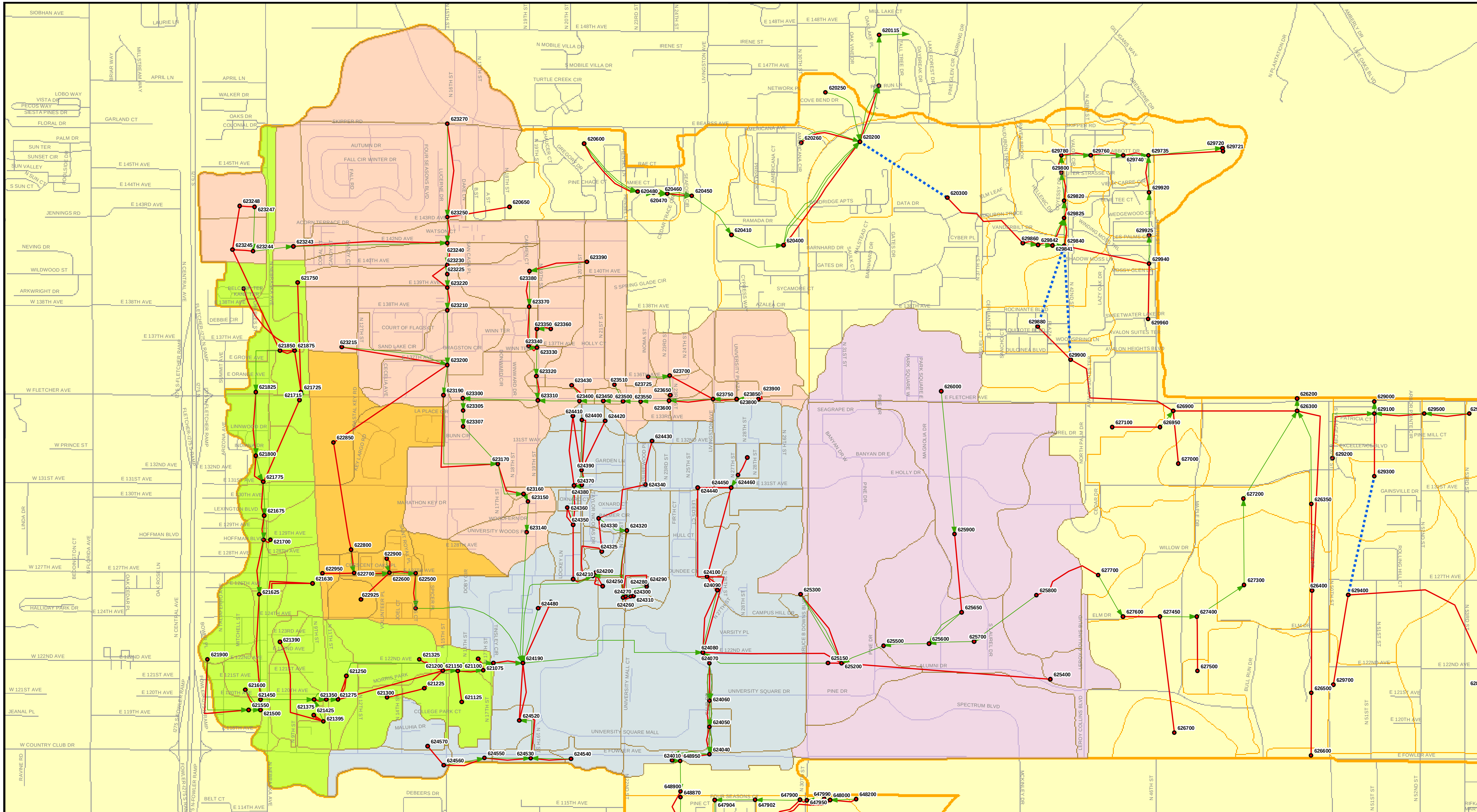
The Raintree south system encompasses approximately 580 acres. Approximately 348 acres is within the study area boundaries as depicted on **Figure 2-1**. An additional 232 acres south of Fowler Avenue is within the system. The area south of Fowler Avenue was considered an off-site area. The area was, however, considered when computing land use and natural systems within the study area and was included in the hydrologic and hydraulic modeling. Raintree South is bordered on the north by Raintree North, on the south by Fowler Avenue, on the east by the Hillsborough River, and on the west by 56th Street. Additional drainage area drains into the Raintree South system from west of 56th Street and south of Fowler Avenue via cross drains. Stormwater runoff is collected upstream on the west side of 56th Street and 122nd Street. It then crosses 56th Street from west to east on the south side of 122nd Street where it is channelled east through several lakes to Lake 3 east of Skylake Place. At this location additional stormwater runoff is combined in Lake 3 from runoff which originates south of Fowler Avenue. The combined stormwater runoff in Lake 3 then crosses Raintree Boulevard to Lake 2. Stormwater runoff from the north is combined with Lake 2 where it crosses under Brightwater Boulevard into the Hillsborough River. This information on this system was taken from the report "Raintree Drainage Area for USF Model", dated August 1999, and prepared by the Engineering Division at Hillsborough County.

3.7 UNIVERSITY OF SOUTH FLORIDA CAMPUS EAST

The University of South Florida (USF) Campus East system encompasses approximately 431 acres. This system is bordered by North Palm Drive and Leroy Collins Boulevard to the west, 50th Street to the east, Fowler Avenue to the south, and Fletcher Avenue to the north. An off-campus subbasin north of Fletcher Avenue also drains to this system.

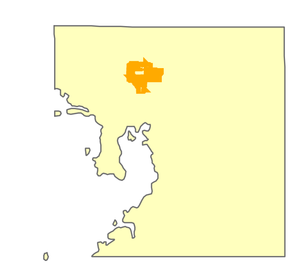
Elevations vary from approximately 70-feet in the southeast corner of the basin, to 30-feet in the Buck Hammock wetland in the northeast corner of the USF campus. The slopes within the basin are considered mild to moderate. Land use includes large impervious areas such as campus parking lots and buildings, large open spaces and undeveloped woodland.

Runoff collection within this system is accomplished mainly through closed storm sewer systems and overland flow. The southeastern area of the system drains to a natural depression between Bull Run Drive and 50th Street. The larger central subbasin drains several adjacent subbasins, by overland flow and stormwater piping systems, to the outfall at the northeastern wetland which ultimately outfalls through a 42-inch RCP culvert under Fletcher Avenue to Buck Hammock and Cypress Creek.



AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

- Stormwater_Junctions
- Stormwater_Conduits
- Stormwater_Weirs
- Stormwater_Pumps
- Basin_Delineations
- 131st Avenue Subbasins
- Mall East and West Subbasins
- Nebraska Aveunue Subbasins
- Robins Lumber Subbasins
- USF Campus West Subbasins

Notes:

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

0 0.125 0.25 0.5 Miles

Figure 3-2a: Connectivity Map of Duck Pond System (Hillsborough County Portion)

Project: 61-0100.04

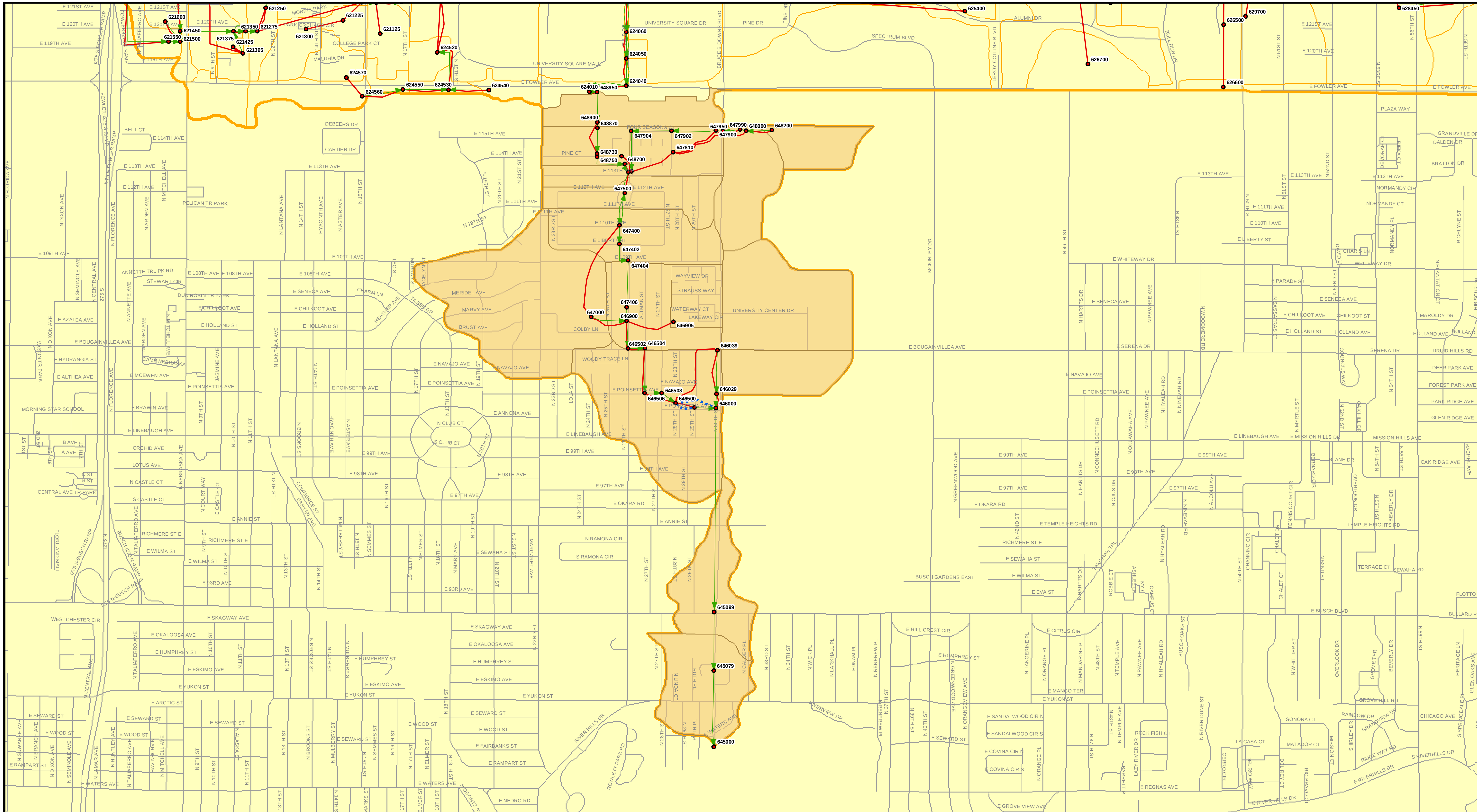
Watershed: Duck Pond Area

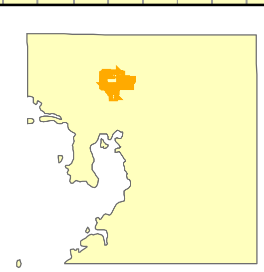
Hillsborough County: WMP Update Program

Filename:	Map Date:	Map Prepared By:
Figure 3-2a.mxd	Mar. 31, 2006	Ayres Associates

Date of Photography:

N/A





AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637

Legend

- Stormwater_Junctions
- Stormwater_Conduits
- Stormwater_Weirs
- Stormwater_Pumps
- Basin_Delineations
- Duck Pond System (COT Portion)

Notes:

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

0 0.125 0.25 0.5 Miles

Figure 3-2b: Connectivity Map of Duck Pond System (City of Tampa Portion)

Project: 61-0100.04

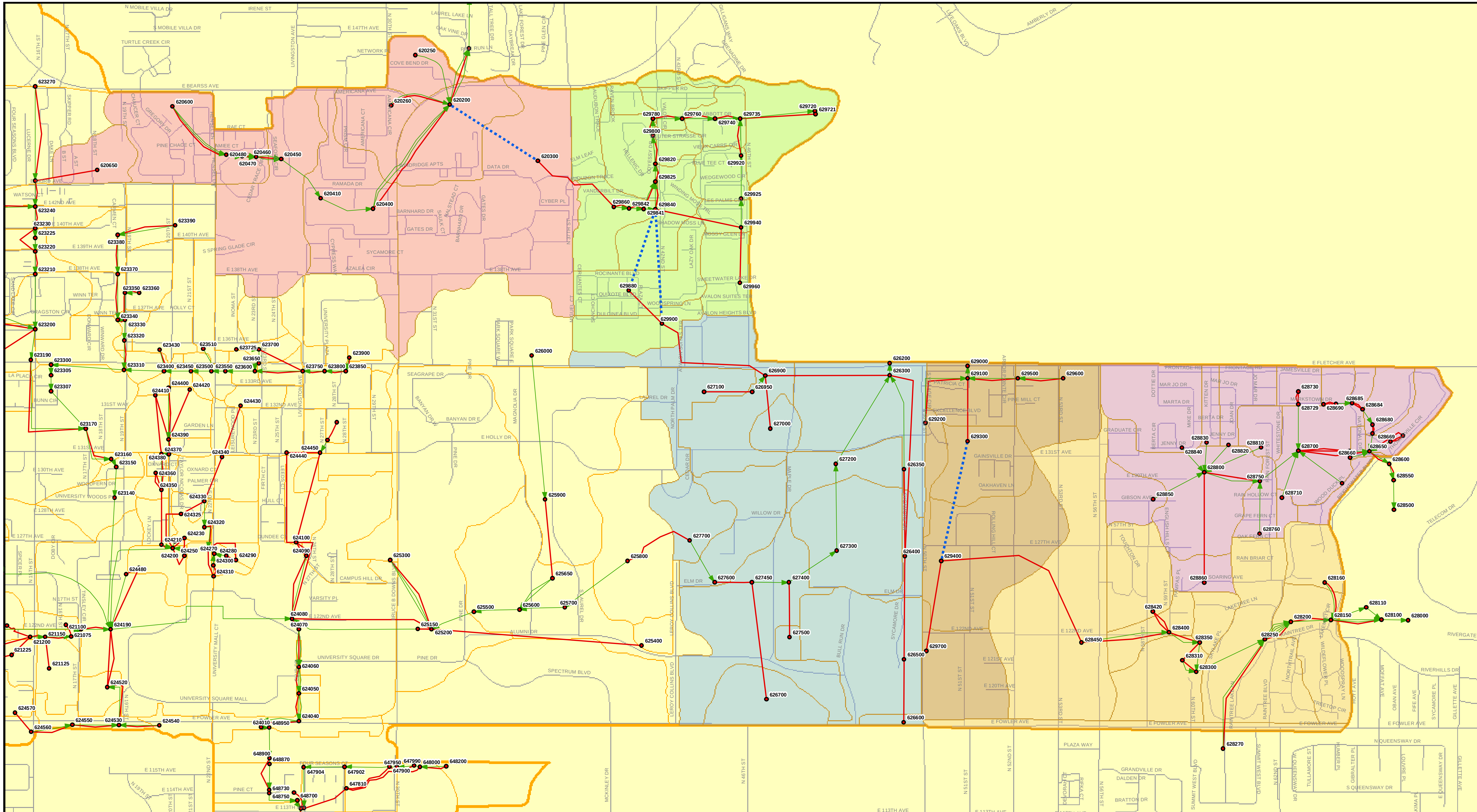
Watershed: Duck Pond Area

Hillsborough County: WMP Update Program

Filename:	Map Date:	Map Prepared By:
Figure 3-2b.mxd	Mar. 31, 2006	Ayres Associates

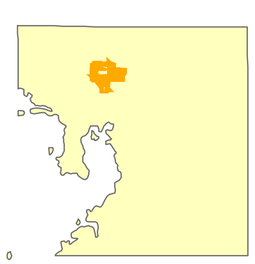
Date of Photography:

N/A



AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

- Stormwater_Junctions
- Stormwater_Conduits
- Stormwater_Weirs
- Stormwater_Pumps
- Basin_Delineations
- Bruce B. Downs
- Raintree North
- Raintree South
- USF Campus East
- USF Campus North
- USF East

Notes:

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

0 0.125 0.25 0.5 Miles

Figure 3-2c: Connectivity Map of Incorporated Systems (Raintree North and South, USF Campus East and North, USF East, Bruce B. Downs)

Filename:	Map Date:	Map Prepared By:
Figure 3-2c.mxd	Mar. 31, 2006	Ayres Associates

Project: 61-0100.04

Watershed: Duck Pond Area

Date of Photography:

N/A

Hillsborough County: WMP Update Program

CHAPTER 4 MODEL METHODOLOGY

Several analysis techniques were used to develop the DPW existing condition models. The Duck Pond WMP Update has employed techniques consistent with the previous study and with current Hillsborough County Stormwater Management Technical Guidelines. This chapter provides a general description of those methods and approaches.

4.1 GENERAL METHODOLOGY AND DATABASE DEVELOPMENT

The U.S.D.A. Natural Resources Conservation Service (NRCS) Runoff Curve Number (CN) method was used to generate runoff hydrographs from rainfall data and watershed parameters. This method estimates expected storm water runoff on the basis of soil and land cover characteristics. Runoff hydrographs were developed using the NRCS Dimensionless Unit Hydrograph method. A modification of the HEC-1 computer program (U.S. Army Corps of Engineers) was used to generate runoff hydrographs. This module is a part of the Hillsborough County modified SWMM software, HCSWMM, and replaces the EPA SWMM RUNOFF Block for simulation of runoff hydrographs.

Inflow hydrographs were generated at subbasin loading nodes. Discharges were routed through the system using Hillsborough County's HCSWMM program, which incorporates the EXTRAN Block of the EPA Storm Water Management Model v. 4.31 (SWMM) for hydrodynamic channel routing model. Specific County modifications are described in Section 4.3.

No changes were made to tailwater conditions for this model update, beyond the vertical datum adjustments from NGVD 1929 to NAVD 1988. The source of tailwater information for the portion of the DPW that discharges to Cypress Creek was taken from the *Cypress Creek Stormwater Management Master Plan (December 2000).* Tailwater conditions for the Duck Pond system's outfall at Fowler Avenue was simulated by appending the previous County model with the City of Tampa Duck Pond HCSWMM model. The City of Tampa Duck Pond Area model encompasses approximately 610 acres (roughly 1 square mile) of the City directly south of the DPW and extends to the ultimate outfall at the Hillsborough River Dam.

4.2 HYDROLOGY

The U.S. Army Corps of Engineers hydrologic computer model HEC-1 was modified to account for the relatively flat terrain of Hillsborough County. The modifications included altering the "shape factor" and the corresponding dimensionless unit hydrograph ordinates. 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. Therefore the program was modified to use the "256" shape factor and the recommended dimensionless unit hydrograph.

An initial abstraction coefficient of 0.2 was used throughout the study area. Initial abstraction is computed by HEC-1 as the initial abstraction coefficient multiplied by the soil storage depth. The soil storage depth(s) is computed from the runoff curve number (CN) by HEC-1 on the basis of the NRCS methodology.

Rainfall depths were estimated from isohyetal maps shown in the Southwest Florida Water Management District's (SWFWMD) Environmental Resource Permitting (ERP) Information Manual. The rainfall depths for the 1-Day (24 hours) storm events used in the model simulation are as follows:

STORM EVENT	24-HOUR DEPTH (in.)
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 storm rainfall distribution used was the NRCS 24-Hour Type II Florida Modified as required by SWFWMD and Hillsborough County.

4.2.1 Soil Data

SWFWMD GIS soil coverage was used to obtain soil information for the USF area watershed. The SWFWMD coverage was developed from data in the SCS *Soil Survey of Hillsborough County, Florida*, 1989. Each soil polygon in the GIS coverage is associated with attributes that designate it's soil identification numbers and hydrologic soil group (HSG). Hydrologic soil groups in the DPW consist of four designations - A, C, D, B/D, and Water. The HSG A soils have a high infiltration rate and low runoff potential. HSG C soils have slow infiltration rates and may contain a layer of fine texture soil which impedes the downward movement of water. HSG D soils include poorly-drained, very silty/clayey/organic soils or soils with high groundwater tables. The dual hydrologic classification (B/D) includes soils which have a seasonal high water table but can be drained; the first hydrologic soil group designates the drained condition and the second hydrologic soil group designates the undrained condition of the soil. **Figure 2-3** shows the hydrologic soil groups used in the analysis. It is based on the SWFWMD GIS soil coverage.

4.2.2 Land Use

The previous study utilized 1995 GIS Land Use coverages to derive subbasin runoff characteristics. The 1999 SWFWMD GIS Land Use coverage was used as a base for this model update (refer to **Figure 2-7**). Each land use polygon in the GIS coverage is associated with an attribute that designates a classification from the Florida Land Use Classification System (FLUCCS). In addition, the 2004 aerials and ERP data were evaluated and land use codes manually edited where justified, to better define the existing conditions. **Figure 4-1** denotes polygons in the DPW where 1999 FLUCCS codes were modified to improve the hydrologic characterization for this study.

As impervious area increases, runoff usually increases. However, SWFWMD has been regulating quantity of storm water runoff since 1985. The objective of regulation has been to prevent peak runoff rates under developed conditions from exceeding peak runoff rates associated with predevelopment conditions.

4.2.3 Runoff Curve Numbers

The NRCS Runoff Curve Number method was used to compute rainfall excess values. Runoff Curve number calculations were based on a GIS intersection of the SWFWMD land use coverage with the SWFWMD hydrologic soil coverage and with the DPW subbasin map. The resulting GIS polygons are associated with attributes of a hydrologic soil group and a FLUCCS code as represented in the SWFWMD GIS coverages. The polygons were then assigned a CN value based on these attributes using a database lookup table. **Table 4.1** shows the database lookup table that was used to associate each combination of FLUCCS code with a HSG for the purpose of computing runoff numbers (CN). An area weighted CN value was then computed for each subbasin using the polygons within the subbasin boundary.

4.2.4 Time-of-Concentration

Updated time-of-concentration estimates were developed for modified subbasins by adding the travel time for each appropriate flow path segment. Modifications to subbasin delineations are presented in **Figure 4-2**. The methods used for calculating travel times are based on that shown in the Hillsborough County Stormwater Technical Manual, and are summarized as follows:

Overland Flow:	Kinematic Wave Equation
Shallow Concentrated Paved:	NRCS equations relating velocity to watercourse slope
Shallow Concentrated UnPaved:	NRCS equations relating velocity to watercourse slope
Channel Flow:	Assumed velocity 2 ft/sec
Pipe Flow:	Assumed velocity 3 ft/sec

4.3 HYDRAULICS

The HCSWMM model, a modification of the U.S. EPA SWMM 4.31 model, was used to compute water surface elevations and discharges at conduits and junctions shown on the reach/junction connectivity diagram (see **Figures 3-2a, 3-2b and 3-2c**). The SWMM EXTRAN block is the basis for hydraulic routing. The most significant modifications of the HCSWMM software include directly integrating the NRCS unit hydrograph method to generate runoff hydrographs, and adding entrance and exit headloss coefficient fields, and a conduit stretch factor.

Other minor changes included the increase of dimensions of a number of key parameters, enhancements to the inputs and the outputs and error trapping. Input enhancements included a provision for specifying reach numbers for orifices and weirs and another for using elevations rather than depths above invert for starting water surface, stage-storage areas, and weir data. Several output enhancements have been provided including a provision for printing a summary file showing computed peak discharge values and computed peak water surface elevations.

Elliptical and arch pipes are included in the County's current version of HCSWMM. Natural channels are represented 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 (U.S. Army Corps of Engineers) cross section data. EXTRAN uses the cross section data only to obtain the shape geometry. It uses invert elevations input on the conduit records to determine the channel slope. Therefore, a natural channel is treated as a prismatic conduit with an irregular shape.

TABLE 4.1 Runoff Curve Number (CN) Lookup Table

FLUCSID	A	B	C	D	B/D	W	Description
1100	50	68	79	84	81.5	100	Residential, low density
1200	57	72	81	86	83.5	100	Residential, medium density
1300	77	85	90	92	91	100	Residential, high density
1400	89	92	94	95	94.5	100	Commercial and services
1500	81	88	91	93	92	100	Industrial
1600	77	86	91	94	92.5	100	Extractive
1700	69	81	87	90	88.5	100	Institutional
1800	49	69	79	84	81.5	100	Recreational
1900	39	61	74	80	77	100	Open land (Urban)
2100	49	69	79	84	81.5	100	Cropland and pastureland
2140	49	69	79	84	81.5	100	Cropland and pastureland
2200	44	65	77	82	79.5	100	Tree crops
2300	73	83	89	92	90.5	100	Feeding operations
2400	57	73	82	86	84	100	Nurseries and vineyards
2500	59	74	82	86	84	100	Specialty farms
2550	59	74	82	86	84	100	Aquaculture
2600	30	58	71	78	74.5	100	Other open land (Rural)
3100	63	71	81	89	85	100	Rangeland
3200	35	56	70	77	73.5	100	Shrub and brushland
3300	49	69	79	84	81.5	100	Mixed rangeland
4100	45	66	77	83	80	100	Upland coniferous forests
4110	57	73	82	86	84	100	Upland coniferous forests
4120	43	65	76	82	79	100	Upland coniferous forests
4200	36	60	73	79	76	100	Upland hardwood forests
4340	36	60	73	79	76	100	Mixed coniferous/hardwood
4400	36	60	73	79	76	100	Tree plantations
5100	100	100	100	100	100	100	Streams and waterways
5200	100	100	100	100	100	100	Lakes
5300	100	100	100	100	100	100	Reservoirs
5400	100	100	100	100	100	100	Bays and estuaries
6100	98	98	98	98	98	98	Wetland hardwood forests
6110	98	98	98	98	98	98	Bay swamps
6120	98	98	98	98	98	98	Mangrove swamps
6150	98	98	98	98	98	98	Stream and lake swamps
6200	98	98	98	98	98	98	Wetland coniferous forests
6210	98	98	98	98	98	98	Cypress
6300	98	98	98	98	98	98	Wetland forestedmixed
6400	98	98	98	98	98	98	Vegetated non-forested wetlands
6410	98	98	98	98	98	98	Freshwater marshes
6420	98	98	98	98	98	98	Saltwater marshes
6430	98	98	98	98	98	98	Saltwater marshes
6440	98	98	98	98	98	98	Emergent aquatic vegetation
6500	98	98	98	98	98	98	Non-vegetated
6510	98	98	98	98	98	98	Tidal flats
6520	98	98	98	98	98	98	Tidal flats
6530	98	98	98	98	98	98	Intermittent ponds
7100	77	86	91	94	92.5	100	Beaches
7400	77	86	91	94	92.5	100	Disturbed land
8100	81	88	91	93	92	100	Transportation
8200	81	88	91	93	92	100	Communications
8300	81	88	91	93	92	100	Utilities

4.4 BOUNDARY CONDITIONS

Tailwater information for the portion of the DPW that discharges to Cypress Creek was taken from the *Cypress Creek Stormwater Management Master Plan (December 2000)*, which was used for the previous modeling effort. Tailwater information for the Duck Pond system's outfall at Fowler Avenue was obtained by appending the City of Tampa SWMM model to the County model and routing the system to its ultimate discharge at the Hillsborough River Dam. The City of Tampa portion encompasses approximately 610 acres (0.95 square miles) of the City directly south of the DPW.

4.5 INITIAL CONDITIONS

Initial conditions defined in the 2001 models were generally left unaltered, with the exception of adjusting for the revised vertical datum. Where new structures were being added to the model, or where the defined initial conditions were noted to be incompatible with starting elevations at adjacent nodes or boundary conditions, adjustments have been made. The following general methods appear to be consistently applied for initial junction elevations for both the 2001 and 2006 design event models.

Natural Lakes, Wetlands and Stormwater Management Storage Areas – Initial stages generally correspond to defined seasonal high water table elevations (or estimates thereof) using ERP data, NRCS Soil Survey documents or vegetative indicators. Where control structures (weirs) are present, the starting elevation begins at the weir crest elevation. Water quality orifices or notched weirs are ignored, as the water quality volume is assumed to be filled at design event onset.

Piped Systems – Initial stages mimic dry pipe conditions and are set using the lowest connecting pipe elevation. Noted exceptions are (1) pipe systems directly connected to boundary conditions with initial stages above the pipe invert, and (2) pipe systems directly connected to surface waters whose initial stages are above the pipe invert. In these cases, the controlling water surface elevation is defined as the initial junction stage for all upstream junctions, up to the first junction whose low pipe invert is above the controlling water surface.

4.6 OVERFLOW WEIRS

At most roadway crossings, weirs were used to simulate the overtopping of the road. Broad crested weirs were also used to simulate overland flow connections. In some cases, overland flow weirs were used to convey overbank flow. Modeling of the overbank flow was performed as a flow re-entering the channel at a downstream junction point. Overtopping elevations have been evaluated and adjusted where necessary using the latest available topographic data as part of the watershed model update. Weir coefficients for roadway overtopping have generally been assigned a value of

2.0, and overland/inter-subbasin exchange weirs have generally been assigned a value of 1.0. Structural weirs (stormwater management control structures) have been assigned weir coefficients consistent with their specific design configuration.

4.7 ROUGHNESS COEFFICIENTS

Manning coefficients for channel sections were taken from several sources in the previous model and were not modified during the update. Higher roughness values sometimes result in smaller computed discharge values in downstream locations and larger computed water surface elevations in upstream locations. Pipe lengths and roughness values were adjusted to achieve numerical stability. This procedure is explained in the SWMM User's Manual Version 4; Extran Addendum, February 1989.

An additional enhancement of the County modified SWMM model is the inclusion of a stretch factor. This factor provides a method of determining equivalent pipes using the following formula:

$$n_e = n_p\, L_p^{1/2} \;/\; L_e^{1/2}$$

where;

n_e	=	Manning roughness of equivalent pipe
L_e	=	Computed equivalent length
n_p	=	Actual Manning roughness of the pipe
L_p	=	Actual length of the pipe

Additional storage was added at some junctions. This was done to achieve numerical stability at these junctions.

4.8 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 equivalent pipes with longer lengths and lower roughness than the actual pipe dimensions, and the addition of storage at the junctions.

4.9 DATA SOURCES

4.9.1 2001 Model

Request for field surveys were thoroughly reviewed by the County Project Manager and locations were finalized for the USF Area Phase I Study. Hillsborough County supplied the field survey information.

Many old design plans, miscellaneous drawings and permit information were obtained from Hillsborough County and SWFWMD.

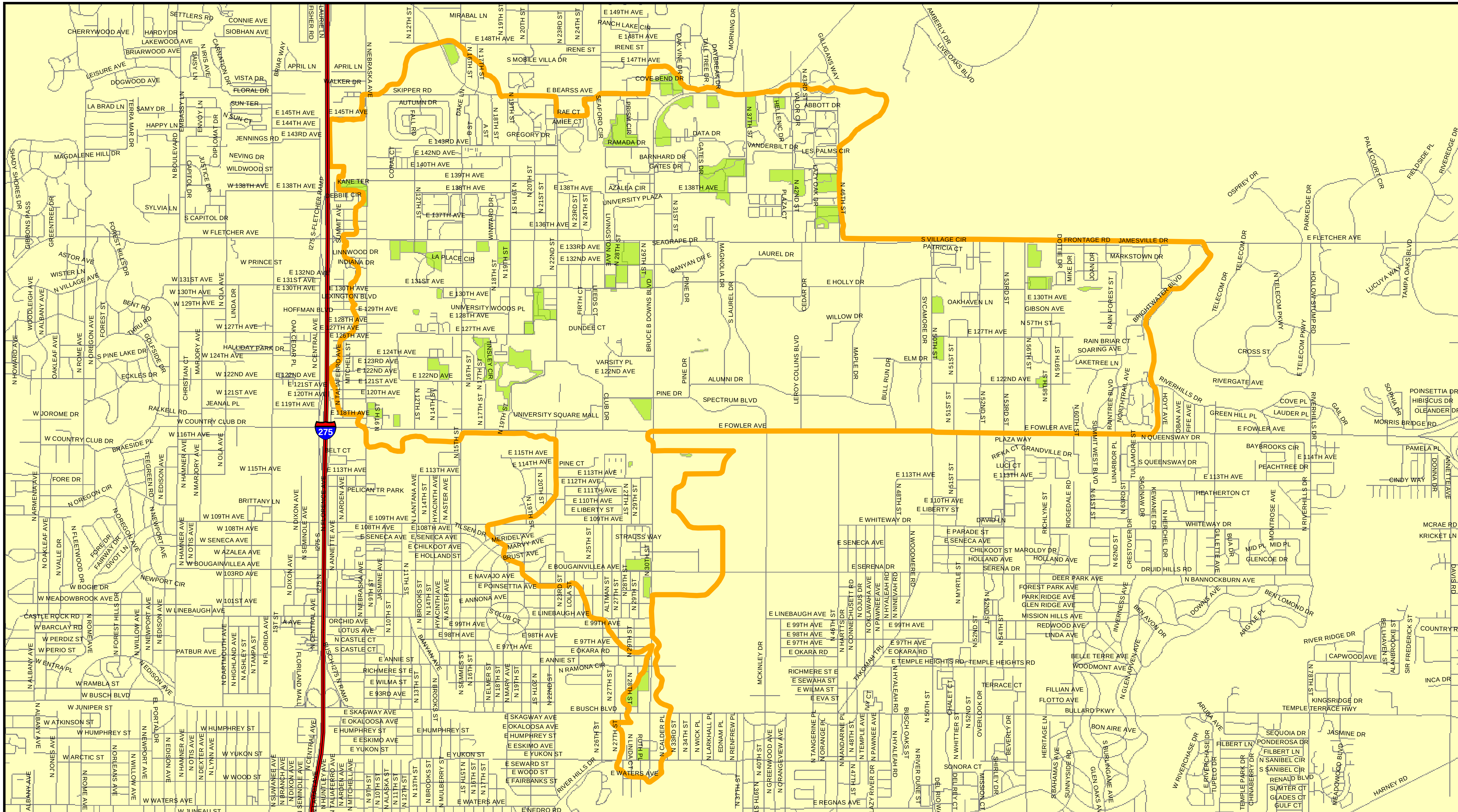
Many elevations were taken from SWFWMD aerial topographic maps. The SWFWMD aerials are of 1"=200' scale and show one foot interval contours. Elevations taken from the maps include, but are not limited to, the top of roads, stage/area data for ponds or lakes, wetlands and other storage areas, inverts of channels, control elevations for overland flow evaluation and site and road elevations for level-of-service determinations.

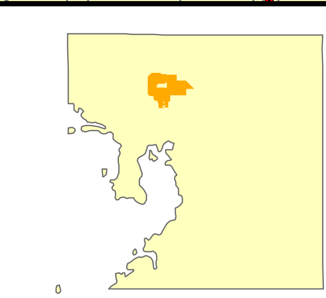
4.9.2 2006 Model Update

All model input files underwent vertical datum conversion from NGVD 1929 to NAVD 1988; and the formerly independent Duck Pond, City of Tampa Duck Pond, USF North, USF East, Raintree North and Raintree South model sets were combined into a single watershed model using the final model input files from the 2001 studies. Watershed-wide renumbering of subbasins, nodes and reaches was performed to prevent duplication of IDs and to conform to current Hillsborough County watershed numbering systems.

Hillsborough County supplied 2002 topographic data (1-foot digital contours) throughout the study area and digital aerial images from 2004. Land use data in the form of SWFWMD FLUCCS (1999) were also obtained. The FLUCCS codes were revised using aerial interpretation where justified, to better define the associated CN. These sources were used to verify and refine subbasin delineations, curve numbers and times-of-concentration in hydrologic input files, concentrating on the outer subbasins where the primary basin boundaries have been reconciled with adjacent watersheds. Additionally, significant storage areas were updated using the latest contour data and roadway or subbasin overtopping elevations were adjusted, as needed.

Design plans, County survey data, miscellaneous drawings and permit information were obtained from Hillsborough County and SWFWMD through October 2005. Most were local in nature and did not signify model revisions. Although ERPs, topography and aerials affected changes to subbasin hydrology, no hydraulic system revisions were necessitated.





AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637

Legend

- Duck Pond Area
- Land Use Updated Areas

Notes:

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

0 0.25 0.5 1 Miles

Figure 4-1: Amended Land Use for 2006 Update

Project: 61-0100.04

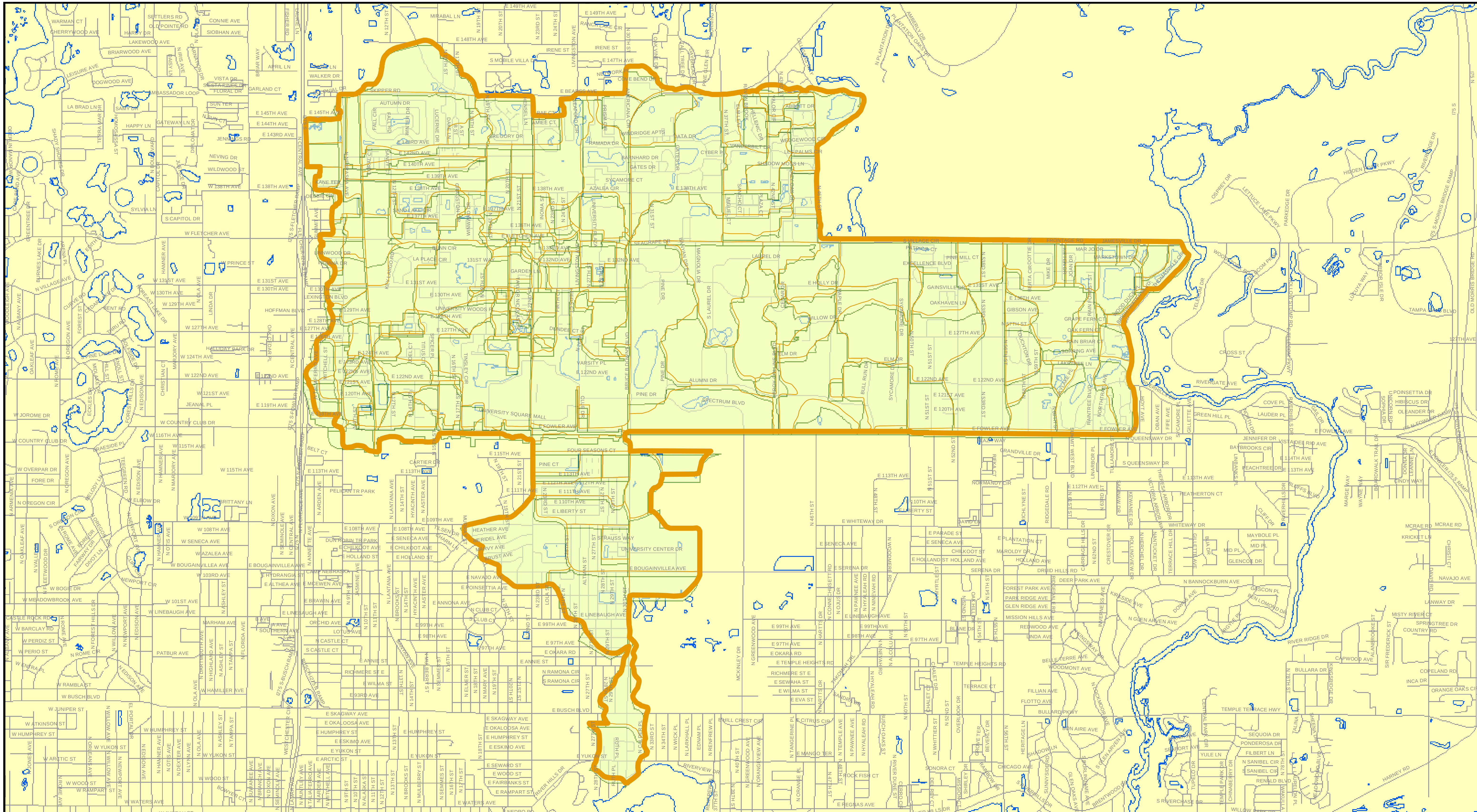
Watershed: Duck Pond Area

Hillsborough County:
WMP Update Program

Filename:	Map Date:	Map Prepared By:
Figure 4-1.mxd	Mar. 31, 2006	Ayres Associates

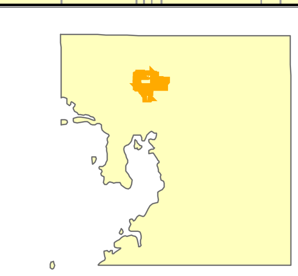
Date of Photography:

N/A



AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

- Subbasin Delineations Old
- Subbasin Delineations New

Notes:

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

0 0.25 0.5 1 Miles

Figure 4-2: Comparison of Subbasin Delineations

Project: 61-0100.04

Watershed: Duck Pond Area

Hillsborough County: WMP Update Program

Filename:	Map Date:	Map Prepared By:
Figure 4-2.mxd	Mar. 31, 2006	Ayres Associates

Date of Photography:

N/A

CHAPTER 5 CALIBRATION AND VERIFICATION

This watershed model update did not include formal re-calibration or verification of the model although flood complaints for the Hurricane Frances event of 2004 were compared to simulated flood problem areas for the 25-year, 24-hour design event. Correlation between reported flooding during Hurricane Frances and simulated flooding for the 25-year, 24-hour design storm event was very good. Reported flooding along 15th Street North, between 122nd Avenue and Fowler Avenue; and flooding at Fowler Avenue at the University Square Mall entrance was also simulated for the 25-year, 24-hour event. Reported flooding on 15th Street North near 127th Avenue was shown to be minor for the 25-year, 24-hour design event. Additionally, reported flooding on 22nd Avenue north of the University Square Mall was confirmed in the 25-year, 24-hour design event. Reported site flooding in subbasin 629960 is simulated for the 25-year, 24-hour design event. Reported flooding on 56th Street North could not be confirmed by the design simulation, as complaint locations were located north of the modeled conveyances and may have been due to exceedance of roadside swale capacity. The remaining flood complaint locations are either interior stormwater systems not included in the model or in areas without formal drainage.

The last calibration and verification results performed for the watershed are presented in the following sections. The calibration process includes simulating a measured event by first adjusting the hydrologic input parameters according to the measured rainfall depth and distribution and then comparing computed water surface elevations and flows to the measured values. The hydrodynamic model is then adjusted so that computed and measured values more closely match.

The model is considered well calibrated when the results of stage, flow, and volume are in reasonable agreement with the recorded data at the established gauge stations. The model is then adjusted with specific parameters and verified with another storm event's data.

5.1 BOUNDARY CONDITIONS

As described in Chapter 3, the Duck Pond Watershed project area is comprised of five major conveyance systems, each with their own outfalls. The Duck Pond system flows southwards through the City of Tampa to Lake Poinsettia before being pumped to a trunk line that discharges to the Hillsborough River just upstream of the Tampa Dam. As this system was modeled in combination with an existing SWMM model from the City of Tampa, that model’s free-fall outfall boundary condition was used. The boundary conditions used for the Bruce B. Downs system were obtained from the results of the Cypress Creek Stormwater Management Plan previously prepared for Hillsborough County. The USF North, USF East, Raintree North, and Raintree South models’ boundary conditions were taken from preliminary reports for each of these areas, respectively.

5.2 DATA COLLECTION

There is no historical rainfall, stage, or flow data available within the overall Duck Pond Watershed. At the onset of this project, a stage recorder was placed in Duck Pond East in an attempt to capture this system's response to a significant rainfall event. While the Bruce B. Downs system is considered calibrated based on the Cypress Creek Stormwater Master Plan, the other conveyance systems mentioned above have no calibration data.

Only one storm event of a magnitude acceptable for use in calibrating the Duck Pond system has occurred since the stage recorder's deployment. This relatively small rainfall event occurred over September 16-17, 2000 during a tropical storm. Rainfall records were collected from three gauges in or near the Duck Pond Watershed for this event. Two of the gauges are owned and operated by SWFWMD, which maintains an extensive network throughout the region. The third gauge was a garden type rainfall gauge that simply catches rainfall but does not permanently record depths. The SWFWMD White Trout Lake gauge was used to establish the distribution of the rainfall during this event. The calibration event rainfall depth of 3.5 in. was determined from the gauge within the watershed and the SWFWMD gauge at Busch Gardens. A graphical representation of the cumulative rainfall distribution for the September 16-17, 2000 event is shown in **Figure 5-1**.

5.3 EXISTING CONDITIONS MODEL CALIBRATION

In the HCSWMM model, most of the required input data simply describes the geometry and size of the hydraulic and hydrologic units of the subdivided study area. This data, such as the subbasin areas, channel widths, lengths and cross drain dimensions, are known quantities and are subject to very little interpretation. A few of the input requirements, however, are not derived from measurable qualities of the subattachments. These data are referred to as calibration parameters and include:

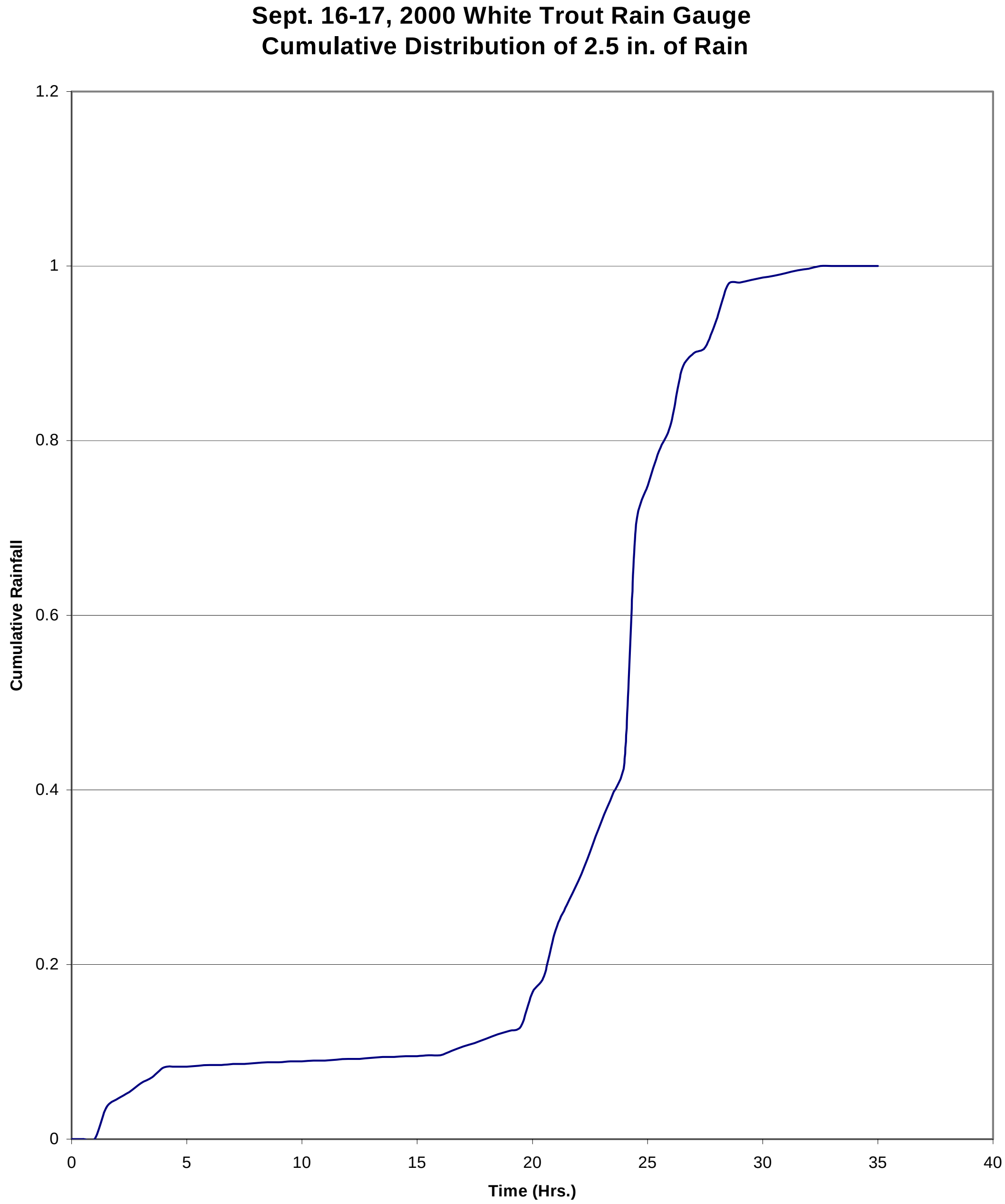
- The maximum and minimum infiltration rates for pervious areas
- The pervious and impervious depression storage volumes
- The channel and overland flow roughness coefficients

These parameters are first approximated with values derived from local data (e.g., aerial topographic photographs and soil surveys), but their final values are ultimately determined through model calibration.

After a fundamental hydrologic and hydraulic check, a calibration process is conducted to evaluate the general reliability of the model for producing reasonable results.

Initial water surface elevations in the Duck Pond system were obtained from gauge data for the model calibration. The initial model junction elevations in the other conveyance systems were determined based on junction inverts, the relatively dry conditions preceding the storm event and normal pool elevations where available.

Figure 5-1



The objectives of the calibration are to better match stage and discharge, of the calculated hydrographs with the recorded data. Based on a given set of calibration parameters, the model is adequately calibrated when the observed and calculated stage history of Duck Pond East agree within tolerances for the calibration storm.

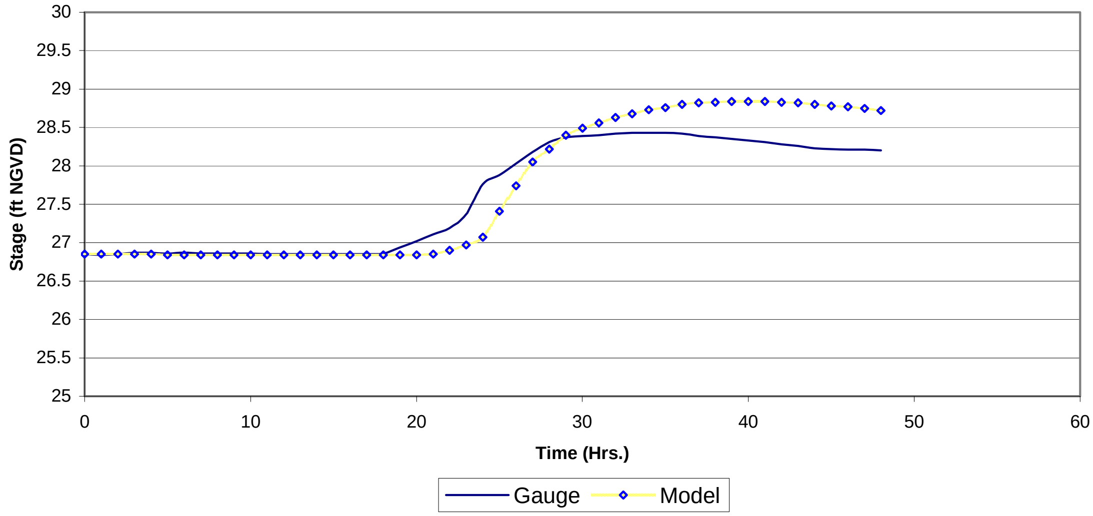
The maximum computed water surface elevation at Duck Pond East (28.84 ft., NGVD) from the calibration model was found to be slightly higher than the maximum surface elevation obtained from measured gauge data (28.43 ft., NGVD) for the September 16-17, 2000 events. **Figure 5-2** contains a graphical representation of this comparison.

5.4 Existing Conditions Model Verification

Modeling methodology requires further verification of the model using different storm events. Model verification is an important step, which ensures that adjustments made to the model during calibration are appropriate and that the model will produce reliable results. Due to the lack of historical data and rainfall events during this project, the verification process for the Duck Pond watershed is not possible at this time. The only additional means of establishing the reliability of a model is checking design output elevations for reasonableness and agreement with historical flooding. Design storm elevations in ponds, for which plans are available, can also be used as indicators of model accuracy. However the extent of development, which occurred after the plan set, that may contribute additional flow to these ponds must be considered.

Rainfalls in antecedent periods of 5 to 30 or more days prior to a storm are commonly used as indices of watershed wetness. This period of record prior to the calibration event was somewhat dry. However, adjustment of the model's curve numbers to AMC I conditions under predicted the stage in Duck Pond East. The use of AMC II condition curve numbers in the existing model provided the best calibration results and are considered reasonable.

Figure 5-2
Sept. 16-17 2000 Storm Event gauge data vs. 2001 HCSWMM Model Calibration Output in Duck Pond East



5.5 CONCLUSIONS

Comparison of computed stages at Duck Pond East, indicate the existing model slightly over predicts stage at this location. This is reasonable given that the hydraulic model is constructed from survey and design plans, which represent the conduit data as new and in good condition. This approach, while conservative in design storm evaluations, does not take into account the age of the system and possible restrictions due to blockage or other factors. The affects of these factors can not be adequately predicted using only one calibration point within the watershed.

The computed peak stage in Duck Pond East during the calibration event was higher by 0.41 feet than the actual peak stage, but within an acceptable tolerance. The model has also been observed to produce reliable results with respect to historical flooding locations. In general, this model is considered calibrated and capable of simulating design storm events in the Duck Pond Watershed.

Future rainfall events of significant depth could be used to further verify the Duck Pond system when used in conjunction with the stage gauge at Duck Pond East. The County should also consider deploying additional gauges in the watershed to more accurately predict the overall watershed's response to rainfall events.

CHAPTER 6 EXISTING CONDITIONS - LEVEL OF SERVICE

6.1 EXISTING CONDITIONS AND STANDARD DESIGN STORM EVENTS

Based on the Hillsborough County Stormwater Drainage Manual and Southwest Florida Water Management District (SWFWMD) Environmental Resource Permitting (ERP) Manual, a standard design storm is defined by duration, rainfall depth, and distribution for a specific return period.

There were six standard design storms used to analyze the flooding impacts in the Duck Pond Watershed. The standard design storms used in this study were the 100-year, 50-year, 25-year, 10-year, 5-year and 2.33-year (mean annual). The duration and distribution used in this study were set by SWFWMD criteria and are the 24-hour duration, and the SCS-type II Florida Modified distribution. Antecedent moisture condition II was also set by the same SWFWMD criteria.

The total amount of rainfall for a particular frequency was determined based on SWFWMD rainfall maps. The total rainfall used for each design storm event was provided in Chapter 4, Section 4.2.

6.2 LEVEL OF SERVICE METHODOLOGY

The Hillsborough County Comprehensive Plan, Stormwater Element contains definitions for the level of service flood protection designations. These definitions specify that a storm return period, storm duration and a letter designation are required to define a level of flood protection. The flood level of service designations contained in the Comprehensive Plan are A, B, C, and D. A is the highest service level and D is the lowest. However, these criteria are somewhat subjective in what is termed as "significant" flooding. Therefore, for the purposes of this study, an interpretation of this definition is assigned to the LOS categories. The following contains the interpretation of the Comprehensive Plan definitions used in the LOS analysis.

Hillsborough County has recently updated the LOS definitions to be used throughout the project area as interpreted in **Table 6.1** below. These definitions are for the 25-year, 24-hour storm event. The desired LOS for Hillsborough County is Level B.

TABLE 6 .1

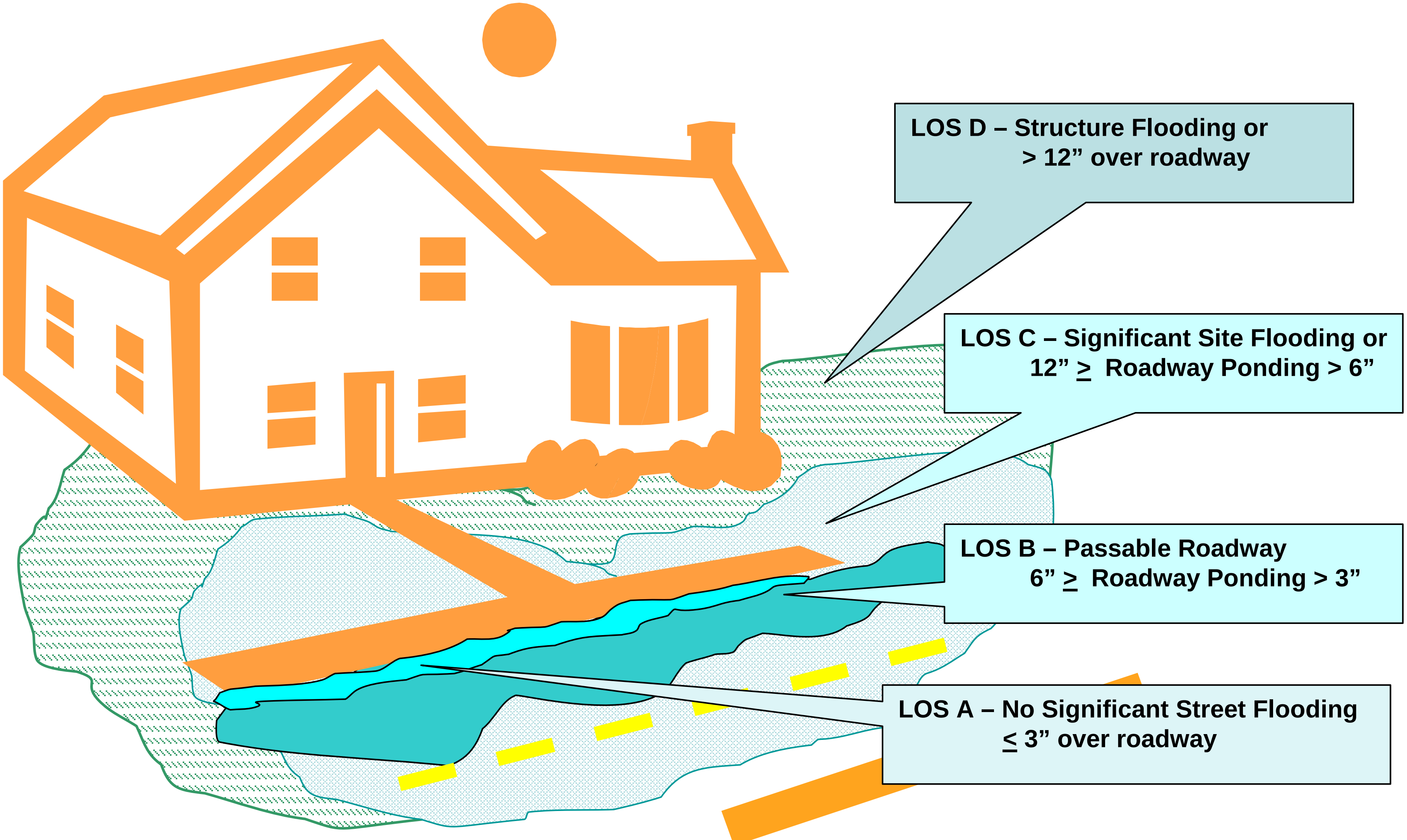
LEVEL OF SERVICE DEFINITION INTERPRETATIONS

Level	Hillsborough County Comprehensive Plan Definition	Master Plan Definition
A	No significant street flooding. All lanes are drivable.	No flooding.
B	Minor street flooding. At least one lane drivable.	Street Flooding is more than 3" and 6" or less above crown of road.
C	Street flooding. Flooding depth above the crown of the road is less than one foot.	Street Flooding is more than 6" and 12" or less above crown of road. Site flooding.
D	No limitation on flooding.	Street Flooding is more than 12" above crown of road. Structure flooding.

It was decided that drivable refers to less than or equal to three (3) inches of water above the crown of the road. It was also decided that one (1) lane passable means one (1) lane in each direction for a four (4) lane road or larger, or one (1) lane along the center of the road for a two (2) lane road.

The LOS designations in the Comprehensive Plan assumed that the sites (ground level surrounding adjacent property) are higher than the roads and that the houses are higher than the roads and the sites. This is not always the case. A Level of Service diagram map is shown in **Figure 6-1**.

The Comprehensive Plan contains estimated Adopted (existing conditions) and Ultimate (proposed) LOS designations for several watersheds in Hillsborough County. The current Hillsborough County target LOS for this area is Level B for the 25-year, 24-hour design storm event.



Level of Service Diagram Map

Figure 6-1

6.2.1 Establishment of Landmark Elevations

In order to evaluate the LOS for a study area, landmark elevations must first be determined. These elevations refer to landmarks contained in the LOS definitions, including roads, sites and structures. Landmark elevations are established for every subbasin in the study area. These landmarks then serve as a tool for determining the level of service for the subbasin, and on a broader scale, the system and the study area. The landmark elevations established for LOS analysis are the critical or lowest landmark elevations in a subbasin. The critical landmark elevations are reflective of the worst case flooding that could occur in a subbasin. These are obtained from survey data and from topographic analysis. Every subbasin in the study area is examined for the critical structure, site and road elevation. **Table 6.2** contains landmark elevations determined for each DPW subbasin. These landmark elevations reflect the flood depth tolerances contained in **Table 6.1**.

6.2.2 Comparison of Computed Results and Landmark Elevations

Using flood protection LOS designation criteria contained in **Table 6.1**, the landmark elevations for each subbasin are compared to the computed results of the updated hydraulic model. In general, the computed result for the most downstream junction was used for comparison with landmark elevations. **Table 6.2** contains the difference between established landmark elevations and computed water surface elevations for the 2.33-, 5-, 10-, 25-, 50- and 100-year, 24-hour storm events.

6.3 EXISTING CONDITIONS MODEL SIMULATION RESULTS AND LEVEL OF SERVICE DESIGNATIONS

The DPW stormwater management model results for the 2.33-, 5-, 10-, 25-, 50-, and 100-year design storm events are listed in **Table 6.2**. This table presents peak flood elevations in each drainage system network in the watershed.

Each subbasin hydrograph is generated by the hydrologic model and routes (for Connectivity Map see Appendix B) through the hydrodynamic model, to calculate stages and discharges. The results of the 25-yr LOS evaluation from **Table 6.2** can be seen graphically as **Figure 6-3**. The following sections discuss the individual flooding problem areas predicted by the HCSWMM model. All referenced subbasin and junction IDs refer to the updated numbering system.

The DPW is divided into six main drainage systems, which are listed below:

- Duck Pond
  - Nebraska Avenue
  - Robbins Lumber
  - 131st Avenue
  - Mall West/East
  - USF Campus West
- Bruce B. Downs
- USF North
- USF East
- Raintree
  - North
  - South
- USF Campus East

LOS designations were determined for all systems except for the USF Campus West and East systems because they are within unincorporated Hillsborough County.

The objective of this section is to present both the areas and major structures where the computer model indicated that insufficient drainage capacity exists and flooding occurs in the DPW. Locations of past flooding complaints to Hillsborough County can be seen in **Figure 6-2.**

LOS designations are assigned in three levels of detail: subbasin, system and study area.

The subbasins were aggregated into nine areas according to general drainage patterns. For each return period storm event, the LOS designation is first determined for the subbasin. The LOS is then determined for the individual drainage systems. Finally, the LOS designation is determined for the overall study area. The LOS of the Duck Pond Watershed study area is reflective of the worst case system and the LOS of the system is reflective of the worst case subbasin.

It is important to be aware of the limits of the methodology used in the LOS analysis. Most landmark elevation information was taken from SWFWMD topographic maps, some of which are approximately 20 years old, although roadway elevations were checked against 2002 County contour data. In addition, the LOS analysis does not identify flood protection deficiencies for secondary systems contained in a subbasin since only the major systems are contained in the hydraulic model. Conversely, since only the critical landmark elevations were identified in each subbasin, areas within a subbasin may contain a higher LOS than that assigned.

Table 6.3 presents a comparison of peak flood stages for the 25-yr, 24-hr and 100-yr, 24-hr storm events for the 2001 model and the 2006 update. Most variances are minor and reflect the fresh calculation of curve numbers and times-of-concentration that were performed as part of this update. Any significant variances are discussed in the table's comment field.

Generally, most of the notable changes are due to one of the following:

- Recent land cover changes or hydrology updates from new development
- Delineation adjustments based upon updated topology
- New or corrected roadway/subbasin overtopping connections

TABLE 6.2 Existing Conditions Level of Service

Duck Pond Watershed (Existing Conditions) Level of Service Analysis										Flood Level Designations						
Basin	Landmark Elev's			Peak Water Surface Elev's (Ft. NAVD)												25-year storm
Junction ID	Site	Struct	Road	2.33yr	5yr	10yr	25yr	50yr	100yr	2.33yr	5yr	10yr	25yr	50yr	100yr	Predicted Flood Locations (road / site / structure)
DUCK POND - BRUCE B. DOWNS																LOS 25-yr/ 24 Hr - D
620200	42.86	46.16	46.59	37.88	38.34	38.95	39.28	39.96	40.22	A	A	A	A	A	A	
620250	45.00	46.00	45.00	38.09	38.38	39.07	39.36	40.34	40.67	A	A	A	A	A	A	
620260	44.26	45.26	43.86	41.11	41.58	42.15	42.50	43.23	43.49	A	A	A	A	A	A	
620300	37.16	38.16	40.96	35.04	35.86	36.86	37.43	38.66	39.10	A	A	A	A	A	A	Site flooding for 25-yr/24 Hr
620400	43.46	44.46	46.59	38.38	39.25	40.58	40.99	41.55	41.81	A	A	A	A	A	A	
620450	42.26	43.26	40.16	40.33	40.85	41.39	41.65	42.21	42.42	A	C	D	D	D	D	143rd Ave. and 22nd St.
620460	43.96	44.96	43.46	40.33	40.85	41.39	41.66	42.21	42.43	A	A	A	A	A	A	
620600	44.16	45.16	47.00	41.37	41.72	42.17	42.59	43.84	44.43	A	A	A	A	A	A	
620650	44.16	45.16	46.00	40.38	41.21	42.32	42.99	44.47	44.91	A	A	A	A	A	A	
DUCK POND - 131ST AVENUE																LOS 25-yr/ 24 Hr - D
623140	33.16	34.16	32.66	31.43	32.30	33.16	33.65	34.74	35.07	A	A	B	C	D	D	19th St. & site flooding
623150	35.66	36.66	35.16	31.45	32.42	33.46	34.02	35.08	35.32	A	A	A	A	A	A	
623160	35.76	36.76	34.56	31.49	32.56	33.72	34.39	35.49	35.66	A	A	A	A	C	D	131st Ave.
623170	37.16	38.16	41.36	31.56	32.77	34.29	35.12	36.57	36.88	A	A	A	A	A	A	
623190	40.76	41.66	41.36	34.78	35.26	35.86	36.17	37.32	38.04	A	A	A	A	A	A	
623200	43.06	44.16	39.06	36.27	36.82	37.55	37.98	38.80	39.11	A	A	A	A	A	A	
623210	42.56	43.66	41.86	37.09	37.66	38.40	38.89	39.74	40.06	A	A	A	A	A	A	
623215	40.66	41.66	39.46	37.75	38.19	38.57	38.75	39.33	39.51	A	A	A	A	A	A	
623220	43.06	44.16	41.86	38.10	38.44	38.86	39.04	40.39	41.00	A	A	A	A	A	A	
623230	41.96	43.16	41.66	39.25	39.72	40.38	40.73	41.89	42.23	A	A	A	A	A	C	
623240	41.96	43.16	41.86	39.73	40.36	41.15	41.58	42.67	42.86	A	A	A	A	C	C	
623243	43.76	45.76	45.66	42.79	43.46	44.03	44.31	44.85	45.04	A	A	A	A	A	A	CSX RR -Site flooding at 10-yr/24 Hr
623245	49.16	51.16	48.66	44.11	45.18	45.41	45.47	45.58	45.65	A	A	A	A	A	A	
623248	48.16	50.16	50.16	45.54	46.08	46.97	47.47	48.15	48.25	A	A	A	A	A	A	
623250	43.66	45.66	44.16	39.94	40.63	41.46	41.96	43.09	43.42	A	A	A	A	A	A	143rd Ave.
623270	44.86	46.16	45.36	40.04	40.76	41.66	42.19	43.39	43.81	A	A	A	A	A	A	
623300	40.16	42.16	41.36	34.45	34.93	35.48	35.84	37.10	37.55	A	A	A	A	A	A	
623310	39.66	40.66	39.86	36.05	36.67	37.30	37.65	38.36	38.60	A	A	A	A	A	A	

TABLE 6.2 Existing Conditions Level of Service

Duck Pond Watershed (Existing Conditions) Level of Service Analysis										Flood Level Designations						
Basin	Landmark Elev's			Peak Water Surface Elev's (Ft. NAVD)												25-year storm
Junction ID	Site	Struct	Road	2.33yr	5yr	10yr	25yr	50yr	100yr	2.33yr	5yr	10yr	25yr	50yr	100yr	Predicted Flood Locations (road / site / structure)
DUCK POND - 131ST AVENUE CONTINUED																LOS 25-yr/ 24 Hr - D
623320	40.00	41.50	41.00	36.41	37.06	37.76	38.18	39.12	39.25	A	A	A	A	A	A	19th St.
623330	39.96	40.96	39.46	39.71	40.19	40.53	40.58	41.37	41.75	A	C	D	D	D	D	19th St. & site flooding
623340	40.16	41.16	39.86	39.74	40.20	40.54	40.59	41.37	41.76	A	B	C	C	D	D	19th St. & site flooding
623360	40.66	41.66	40.16	38.52	38.93	39.48	40.01	41.37	41.76	A	A	A	A	D	D	
623370	42.66	43.66	42.46	40.82	41.23	41.74	41.98	42.31	42.41	A	A	A	A	A	A	
623380	41.66	42.66	41.66	40.82	41.23	41.74	41.98	42.32	42.42	A	A	A	B	C	C	19th St. & site flooding
623390	42.16	43.16	42.36	40.83	41.25	41.76	42.00	42.35	42.44	A	A	A	A	A	A	
623400	40.46	41.66	41.36	36.72	37.36	38.01	38.33	38.95	39.16	A	A	A	A	A	A	
623430	39.16	40.16	38.66	36.95	37.63	38.29	38.60	39.17	39.36	A	A	A	A	C	C	
623450	38.66	40.66	41.36	37.14	37.76	38.43	38.77	39.39	39.60	A	A	A	A	A	A	Site flooding for 25-yr/24 Hr
623500	40.46	42.66	41.56	37.76	38.40	39.08	39.42	40.05	40.25	A	A	A	A	A	A	
623510	41.16	42.16	40.16	38.39	38.89	39.49	39.79	40.36	40.57	A	A	A	A	A	B	
623550	42.16	43.16	40.16	38.09	38.73	39.42	39.78	40.44	40.65	A	A	A	A	B	B	
623600	42.16	43.16	41.36	38.74	39.28	39.90	40.25	40.90	41.11	A	A	A	A	A	A	
623650	42.16	43.16	41.36	38.76	39.27	39.87	40.21	40.81	41.01	A	A	A	A	A	A	
623700	41.16	42.16	40.76	38.77	39.21	39.61	39.82	40.31	40.53	A	A	A	A	A	A	
623725	40.16	41.16	39.66	38.71	39.06	39.49	39.75	40.33	40.55	A	A	A	A	C	C	22nd St.
623750	43.16	44.16	42.16	39.25	39.77	40.37	40.72	41.43	41.64	A	A	A	A	A	A	
623800	44.66	45.66	43.16	40.03	40.19	40.47	40.92	41.77	41.99	A	A	A	A	A	A	
623850	45.16	46.16	45.16	40.83	40.97	41.19	41.38	42.31	42.56	A	A	A	A	A	A	
623900	45.16	46.16	45.16	42.13	42.41	42.95	43.47	44.99	45.63	A	A	A	A	A	B	
DUCK POND - ROBBINS LUMBER																LOS 25-yr/ 24 Hr - C
622400	34.86	35.86	33.66	32.99	33.19	33.45	33.62	34.29	34.59	A	A	A	A	C	C	
622500	35.16	36.16	36.45	34.80	34.93	35.05	35.13	35.30	35.35	A	A	A	A	A	A	
622600	35.96	36.96	36.96	35.15	35.35	35.58	35.77	36.14	36.25	A	A	A	A	A	A	
622700	36.76	37.76	37.16	35.43	35.69	35.99	36.25	36.77	36.89	A	A	A	A	A	A	
622800	37.66	38.66	37.86	36.11	36.44	36.77	36.93	37.27	37.38	A	A	A	A	A	A	
622850	39.66	40.66	40.00	39.22	39.32	39.46	39.52	39.65	39.69	A	A	A	A	A	A	

TABLE 6.2 Existing Conditions Level of Service

Duck Pond Watershed (Existing Conditions) Level of Service Analysis										Flood Level Designations						25-year storm Predicted Flood Locations (road / site / structure)
Basin	Landmark Elev's			Peak Water Surface Elev's (Ft. NAVD)												
Junction ID	Site	Struct	Road	2.33yr	5yr	10yr	25yr	50yr	100yr	2.33yr	5yr	10yr	25yr	50yr	100yr	
DUCK POND - ROBBINS LUMBER CONTINUED																LOS 25-yr/ 24 Hr - C
622900	37.16	38.16	36.96	35.57	36.09	36.53	36.69	36.89	36.95	A	A	A	A	A	A	
622925	36.56	37.56	36.26	36.38	36.55	36.74	36.85	37.00	37.01	A	B	B	C	C	C	127th Ave. & site flooding
622950	37.46	38.46	36.56	36.42	36.54	36.58	36.60	36.77	36.89	A	A	A	A	A	B	127th Ave.
DUCK POND - MALL EAST/WEST																LOS 25-yr/ 24 Hr - D
624010	30.16	32.66	30.66	30.02	30.67	31.04	31.20	31.58	31.78	A	A	B	C	C	D	Fowler Ave. Eastbound & site
624030	34.16	35.66	31.66	30.32	31.02	31.49	31.74	32.28	32.46	A	A	A	A	C	C	Fowler Ave. Westbound
624040	36.16	37.16	32.21	30.52	31.24	31.78	32.04	32.55	32.71	A	A	A	A	B	B	
624050	39.16	40.16	34.16	30.72	31.46	32.07	32.36	32.85	33.00	A	A	A	A	A	A	
624080	34.16	35.16	33.66	31.23	32.00	32.74	33.16	33.93	34.18	A	A	A	A	B	C	
624090	34.16	35.16	36.66	31.23	32.00	32.74	33.16	33.93	34.18	A	A	A	A	A	A	
624100	37.66	38.16	35.96	35.07	35.46	36.12	36.45	37.01	37.22	A	A	A	B	D	D	
624190	32.66	36.16	32.16	31.39	32.14	32.93	33.38	34.29	34.59	A	A	C	D	D	D	127th Ave. and 15th St. & site
624200	33.16	34.16	32.76	31.39	32.13	32.93	33.38	34.29	34.59	A	A	A	C	D	D	20th St. & site flooding
624210	34.16	35.66	32.76	32.12	32.58	32.96	33.38	34.29	34.59	A	A	A	C	D	D	20th St.
624230	38.16	39.16	33.66	26.62	31.76	32.93	33.38	34.29	34.59	A	A	A	A	C	C	
624250	38.16	39.16	35.96	34.35	34.50	34.74	34.89	35.28	35.43	A	A	A	A	A	A	
624260	33.16	34.16	30.66	31.40	32.13	32.93	33.38	34.29	34.59	C	D	D	D	D	D	22nd St. & site flooding
624290	39.16	40.16	38.16	35.08	35.16	35.25	35.30	35.40	35.44	A	A	A	A	A	A	
624310	39.16	40.16	38.16	33.97	34.03	34.11	34.16	34.29	34.59	A	A	A	A	A	A	
624320	35.16	37.16	30.66	31.40	32.13	32.93	33.38	34.29	34.59	C	D	D	D	D	D	22nd St.
624325	32.66	33.66	30.66	26.15	32.12	32.93	33.38	34.29	34.59	A	D	D	D	D	D	22nd St. & site flooding
624330	32.66	33.66	31.66	31.82	32.12	32.93	33.38	34.29	34.59	A	B	D	D	D	D	22nd St. & site flooding
624340	36.16	38.16	37.76	36.56	36.91	37.20	37.23	37.38	37.45	A	A	A	A	A	A	131st Ave. & site flooding
624350	33.66	36.66	33.66	33.41	33.51	33.67	33.77	34.29	34.59	A	A	A	A	C	C	20th St. & site flooding
624360	35.66	36.66	35.66	34.33	34.72	34.81	34.92	35.27	35.38	A	A	A	A	A	A	
624370	36.16	37.16	35.66	36.10	36.20	36.34	36.43	36.63	36.70	B	C	C	C	C	D	131st Ave. and 20th St. & site
624380	36.16	37.16	35.66	36.14	36.24	36.40	36.49	36.71	36.78	B	C	C	C	D	D	131st Ave. and 20th St. & site
624390	36.16	37.16	35.16	36.15	36.26	36.43	36.53	36.76	36.83	C	D	D	D	D	D	20th St. & site flooding

TABLE 6.2 Existing Conditions Level of Service

Duck Pond Watershed (Existing Conditions) Level of Service Analysis										Flood Level Designations						
Basin	Landmark Elev's			Peak Water Surface Elev's (Ft. NAVD)												25-year storm
Junction ID	Site	Struct	Road	2.33yr	5yr	10yr	25yr	50yr	100yr	2.33yr	5yr	10yr	25yr	50yr	100yr	Predicted Flood Locations (road / site / structure)
DUCK POND - MALL EAST/WEST CONTINUED																LOS 25-yr/ 24 Hr - D
624400	38.16	39.16	37.36	36.29	36.51	36.80	36.97	37.14	37.19	A	A	A	A	A	A	
624410	39.16	40.16	37.36	37.37	37.38	37.44	37.47	37.56	37.59	A	A	A	A	A	A	20th St.
624420	37.66	38.66	41.66	37.68	37.71	37.76	37.80	37.87	37.90	A	A	A	A	A	A	Site flooding for 25-yr/ 24 Hr
624430	39.16	40.16	37.06	37.31	37.35	37.42	37.45	37.54	37.57	A	B	B	B	B	C	132nd Ave.
624440	37.16	39.16	37.36	37.15	37.19	37.25	37.29	37.39	37.42	A	A	A	A	A	A	Site flooding for 25-yr/ 24 Hr
624450	37.16	38.16	35.96	36.03	36.20	36.44	36.56	37.09	37.31	A	A	B	C	D	D	131st Ave.
624470	41.16	42.16	40.16	36.60	37.50	38.76	39.14	39.39	39.58	A	A	A	A	A	A	
624490	31.86	32.86	32.16	29.08	31.04	32.93	33.38	34.29	34.59	A	A	C	D	D	D	19th St. & site/struct. flood
624520	34.16	35.16	32.16	31.39	32.14	32.93	33.38	34.29	34.59	A	A	C	D	D	D	Sports Authority
624530	32.16	33.16	31.57	31.39	32.14	32.93	33.38	34.29	34.59							Fowler Ave., site/struct. flood
624540	34.16	35.16	31.56	31.40	32.14	32.93	33.38	34.29	34.59							Fowler Ave.
624550	34.16	35.16	34.26	31.39	32.14	32.93	33.38	34.29	34.59							
624560	34.16	35.16	35.06	31.40	32.14	32.93	33.38	34.29	34.59							
624570	33.16	34.16	32.16	33.66	33.71	33.78	33.82	34.29	34.59	D	D	D	D	D	D	15th St. & site flooding
DUCK POND - NEBRASKA AVENUE																LOS 25-yr/ 24 Hr - D
621075	33.06	34.06	32.16	31.39	32.09	32.92	33.38	34.31	34.62	A	A	C	D	D	D	17th St. & site flooding
621100	32.96	33.96	32.36	32.01	32.08	32.92	33.38	34.31	34.62	A	A	C	D	D	D	122nd Ave. & site flooding
621125	29.16	30.16	31.66	29.39	32.02	32.92	33.37	34.31	34.62	A	B	D	D	D	D	15th St. and 17th St. & site/struct. flood
621200	32.16	34.16	32.00	31.90	32.07	32.92	33.38	34.31	34.62	A	A	C	D	D	D	122nd Ave. & site flooding
621225	33.16	34.16	31.66	32.01	32.07	32.92	33.38	34.31	34.62	B	B	D	D	D	D	15th St. & site flooding
621275	36.16	37.16	38.16	31.40	32.35	34.14	34.72	35.69	36.07	A	A	A	A	A	A	
621300	34.16	35.16	35.46	34.40	34.67	35.01	35.20	35.49	35.53	A	A	A	A	A	A	Site flooding for 25-yr/ 24 Hr
621325	33.56	34.66	33.56	34.24	34.38	34.55	34.65	34.85	34.92	C	C	C	D	D	D	122nd Ave. & site flooding
621350	34.16	35.16	37.66	31.68	32.43	34.19	34.78	35.77	36.15	A	A	A	A	A	A	Site flooding nr CSX RR
621375	34.06	35.16	33.76	31.50	32.54	34.24	34.81	35.78	36.17	A	A	B	D	D	D	120th Ave. & site flooding
621390	36.36	37.16	38.16	36.38	36.42	36.47	36.50	36.55	36.57	A	A	A	A	A	A	Site flooding for 25-yr/ 24 Hr
621395	33.82	36.16	41.96	31.40	32.49	34.25	34.82	35.84	36.22	A	A	A	A	A	A	Site flooding nr CSX RR

TABLE 6.2 Existing Conditions Level of Service

Duck Pond Watershed (Existing Conditions) Level of Service Analysis										Flood Level Designations						
Basin	Landmark Elev's			Peak Water Surface Elev's (Ft. NAVD)												25-year storm
Junction ID	Site	Struct	Road	2.33yr	5yr	10yr	25yr	50yr	100yr	2.33yr	5yr	10yr	25yr	50yr	100yr	Predicted Flood Locations (road / site / structure)
DUCK POND - NEBRASKA AVENUE CONTINUED																LOS 25-yr/ 24 Hr - D
621425	35.16	36.16	41.96	32.25	32.69	34.26	34.83	35.86	36.24	A	A	A	A	A	A	
621450	35.96	39.16	37.96	31.40	32.58	34.34	34.91	35.95	36.32	A	A	A	A	A	A	
621500	35.41	38.16	37.96	31.55	32.68	34.35	34.92	35.88	36.19	A	A	A	A	A	A	
621550	34.16	35.16	34.66	31.81	32.89	34.37	34.93	35.89	36.19	A	A	A	B	D	D	120th Ave. & site flooding
621600	33.96	35.16	37.96	32.47	34.10	34.53	34.92	35.88	36.20	A	A	A	A	A	A	Site flooding for 25-yr/ 24 Hr
621625	35.79	37.16	38.56	31.92	33.24	35.06	35.91	36.58	36.75	A	A	A	A	A	A	Site flooding for 25-yr/ 24 Hr
621630	36.66	37.66	37.16	35.22	35.29	35.49	35.98	36.64	36.79	A	A	A	A	A	A	
621650	37.16	38.16	37.16	32.58	34.02	36.18	36.57	37.00	37.14	A	A	A	A	A	A	
621675	36.86	37.66	37.36	33.19	34.81	37.04	37.32	37.73	37.87	A	A	A	A	B	C	Site flooding for 25-yr/ 24 Hr
621700	36.66	37.66	37.06	35.28	35.69	36.26	36.53	37.01	37.15	A	A	A	A	A	A	
621715	38.66	39.66	40.96	38.85	38.91	39.02	39.09	39.26	39.32	A	A	A	A	A	A	Site flooding for 25-yr/ 24 Hr
621725	41.16	42.16	40.96	39.15	39.47	39.91	40.25	40.93	41.25	A	A	A	A	A	B	
621750	44.56	45.16	44.56	44.27	44.57	44.59	44.63	44.74	44.76	A	A	A	A	A	A	Site flooding for 25-yr/ 24 Hr
621775	37.16	38.16	39.16	34.16	35.73	38.18	38.47	38.91	39.04	A	A	A	A	A	A	Site/struct. flood for 25-yr/ 24 Hr
621800	40.16	41.16	40.66	34.38	36.02	38.20	38.50	38.96	39.09	A	A	A	A	A	A	
621825	40.16	41.16	42.16	34.51	36.10	38.20	38.51	38.97	39.10	A	A	A	A	A	A	
621875	42.66	43.66	44.16	38.64	39.00	40.59	41.97	44.78	44.93	A	A	A	A	C	C	
621900	35.16	36.16	34.66	33.63	34.06	34.59	34.93	35.89	36.20	A	A	A	B	D	D	Talifero Ave.
621950	45.16	46.16	45.16	44.07	44.34	44.64	44.73	44.83	44.95	A	A	A	A	A	A	
RAINTREE - NORTH																LOS 25-yr/ 24 Hr - A
628650	28.16	30.16	29.16	26.28	26.43	26.67	26.84	27.24	27.95	A	A	A	A	A	A	
628670	28.16	30.16	29.16	27.34	27.51	27.77	27.96	28.52	29.10	A	A	A	A	A	A	Thomasville Circle
628680	28.16	30.16	29.16	26.34	26.48	26.71	26.91	27.47	27.95	A	A	A	A	A	A	
628685	30.16	31.16	34.16	28.24	28.56	28.85	29.01	29.54	29.75	A	A	A	A	A	A	
628690	33.16	34.16	34.16	31.02	31.25	31.55	31.71	32.38	32.71	A	A	A	A	A	A	
628700	31.66	32.66	33.16	27.88	28.21	28.72	29.10	30.16	30.62	A	A	A	A	A	A	
628710	31.16	32.16	32.16	29.29	29.44	29.56	29.61	30.17	30.63							
628720	31.16	32.16	30.16	29.55	29.64	29.74	29.80	30.18	30.63							

TABLE 6.2 Existing Conditions Level of Service

Duck Pond Watershed (Existing Conditions) Level of Service Analysis										Flood Level Designations						
Basin	Landmark Elev's			Peak Water Surface Elev's (Ft. NAVD)												25-year storm
Junction ID	Site	Struct	Road	2.33yr	5yr	10yr	25yr	50yr	100yr	2.33yr	5yr	10yr	25yr	50yr	100yr	Predicted Flood Locations (road / site / structure)
RAINTREE - NORTH CONTINUED																LOS 25-yr/ 24 Hr - A
628730	34.16	35.16	35.16	31.43	31.64	31.96	32.17	32.64	32.83	A	A	A	A	A	A	
628760	33.16	34.16	33.16	28.85	29.17	29.99	31.74	34.21	34.94							
628800	33.16	34.16	34.16	29.02	29.49	30.65	31.76	34.21	34.86							
628810	33.16	34.16	34.16	28.92	29.39	30.31	30.81	32.31	32.98							
628820	35.16	36.16	33.16	30.07	30.58	31.21	31.83	33.44	33.87	A	A	A	A	B	C	
628830	32.16	33.16	33.16	30.01	30.51	31.15	31.79	33.70	34.15	A	A	A	A	C	C	
628840	36.16	37.16	40.16	29.60	30.92	32.78	33.59	34.48	34.96	A	A	A	A	A	A	
628850	34.16	35.16	32.96	30.42	30.72	31.16	31.78	34.26	34.92	A	A	A	A	D	D	
628860	30.16	31.16	33.66	27.06	29.49	30.65	31.76	34.21	34.86							Soaring Ave. site/struct.
RAINTREE - SOUTH																LOS 25-yr/ 24 Hr - B
628160	30.16	31.16	29.66	25.25	25.48	25.77	26.27	27.01	27.61							
628200	34.16	35.16	29.16	25.26	25.67	26.29	26.77	27.74	28.04							
628250	33.16	34.16	32.66	25.26	25.67	26.29	26.77	27.78	28.12							
628270	32.16	33.16	32.96	27.59	29.12	31.12	32.27	33.88	34.14							Fowler Ave. adjacent site flood for 25-yr/24 Hr
628310	35.16	36.16	31.50	26.95	27.29	28.50	28.85	29.57	29.88	A	A	A	A	A	A	
628350	30.16	31.16	29.16	27.04	28.12	28.98	29.47	30.58	30.71							Sky Lake
628400	36.16	37.16	32.16	27.04	28.12	29.01	29.86	30.95	31.12	A	A	A	A	A	A	
628420	33.16	34.16	32.16	32.20	32.24	32.38	32.50	32.72	32.79	A	A	A	B	C	C	58th St.
628450	34.16	35.16	35.16	30.39	31.03	31.99	32.59	34.21	34.60	A	A	A	A	A	A	
USF NORTH																LOS 25-yr/ 24 Hr - C
629721	36.16	37.16	33.26	28.06	28.46	28.96	29.76	29.96	30.16							
629740	34.50	37.00	34.00	28.42	28.89	29.58	30.43	32.38	33.23	A	A	A	A	A	A	
629760	38.86	41.16	40.16	28.82	29.40	30.35	31.39	34.96	35.76	A	A	A	A	A	A	
629780	42.56	42.16	41.16	29.70	29.91	30.62	31.66	37.13	38.22	A	A	A	A	A	A	
629800	38.36	42.16	38.26	36.31	36.90	37.52	37.68	38.06	38.35	A	A	A	A	A	A	
629820	38.16	42.16	38.26	36.33	36.92	37.54	37.70	38.08	38.37	A	A	A	A	A	A	

TABLE 6.2 Existing Conditions Level of Service

Duck Pond Watershed (Existing Conditions) Level of Service Analysis										Flood Level Designations						
Basin	Landmark Elev's			Peak Water Surface Elev's (Ft. NAVD)												25-year storm
Junction ID	Site	Struct	Road	2.33yr	5yr	10yr	25yr	50yr	100yr	2.33yr	5yr	10yr	25yr	50yr	100yr	Predicted Flood Locations (road / site / structure)
USF NORTH CONTINUED																LOS 25-yr/ 24 Hr - C
629840	41.96	43.16	40.16	38.29	38.41	38.48	38.53	38.75	38.88	A	A	A	A	A	A	
629860	41.46	42.66	40.16	38.86	39.32	40.02	40.47	41.51	41.73	A	A	A	B	D	D	42nd St.
629880	40.16	40.16	38.66	37.30	37.89	38.40	38.65	39.13	39.29	A	A	A	A	B	C	
629900	41.66	40.16	39.16	36.91	37.86	38.40	38.54	38.80	38.89	A	A	A	A	A	A	
629920	37.76	35.66	40.16	29.17	30.47	32.93	33.76	35.81	36.56	A	A	A	A	A	A	
629940	38.86	40.16	39.16	32.92	33.48	37.73	38.14	38.75	38.88	A	A	A	A	A	A	
629960	39.16	40.16	38.66	38.88	39.05	39.27	39.33	39.43	39.48	A	B	C	C	C	C	46th St. & site flooding
USF EAST																LOS 25-yr/ 24 Hr - D
629100	29.16	34.66	34.16	27.72	28.75	29.55	30.36	31.34	31.61	A	A	A	A	A	A	Site flooding for 25-yr/ 24 Hr
629200	34.16	45.16	35.16	31.02	31.37	31.94	32.32	33.11	33.41	A	A	A	A	A	A	
629300	35.16	40.16	38.66	29.85	30.69	30.82	30.82	30.94	31.28	A	A	A	A	A	A	
629400	35.66	36.66	33.86	33.87	34.72	35.85	36.42	37.55	37.98	A	C	D	D	D	D	127th Ave. & site flooding
629500	33.16	36.16	34.16	28.91	29.85	30.42	30.85	31.70	32.01	A	A	A	A	A	A	
629600	36.16	40.16	36.16	33.16	33.46	34.00	35.21	36.01	36.23	A	A	A	A	A	A	
629700	56.16	57.16	54.86	49.76	53.01	53.81	53.92	54.27	54.39	A	A	A	A	A	A	

NOTE : A - NEGLIGIBLE RD FLOODING (0 TO 3 INCH)
B - MODERATE RD FLOODING - PASSABLE (3+ TO 6 INCH)
C - SUBSTANTIAL RD FLOODING (6+ TO 12 INCH)
D - SEVERE RD FLOODING (> 12 INCH)
- NOT IN COUNTY JURISDICTION

TABLE 6.3 Comparison of Updated Duck Pond Watershed Model Results to Previous Model

Basin Junction ID	Peak Water Surface Elev's (Ft. NAVD) 2001 25-yr	2006 25-yr	% change	2001 100-yr	2006 100-yr	% change	Comments
DUCK POND - BRUCE B. DOWNS							
620200	38.38	39.28	2.3%	39.20	40.22	2.6%	Tc updated from 60 min to 23 min
620250	38.48	39.36	2.3%	39.28	40.67	3.5%	Land Use/Hydrology Update per ERP
620260	41.58	42.50	2.2%	42.54	43.49	2.2%	Tc updated from 30 min to 9 min
620300	36.58	37.43	2.3%	38.31	39.10	2.1%	ERP Update for New Development
620400	40.92	40.99	0.2%	42.01	41.81	-0.5%	
620450	41.43	41.65	0.5%	42.25	42.42	0.4%	
620460	41.43	41.66	0.6%	42.26	42.43	0.4%	
620600	41.89	42.59	1.7%	42.90	44.43	3.6%	Tc updated from108 min to 34 min
620650	39.64	42.99	8.5%	41.05	44.91	9.4%	Significant basin delineation change; area added
DUCK POND - 131ST AVENUE							
623140	33.71	33.65	-0.2%	35.18	35.07	-0.3%	
623150	34.01	34.02	0.0%	35.62	35.32	-0.8%	
623160	34.31	34.39	0.2%	36.09	35.66	-1.2%	
623170	34.87	35.12	0.7%	36.95	36.88	-0.2%	
623190	35.78	36.17	1.1%	37.75	38.04	0.8%	
623200	37.62	37.98	1.0%	38.53	39.11	1.5%	
623210	38.50	38.89	1.0%	39.55	40.06	1.3%	
623215	38.62	38.75	0.3%	39.35	39.51	0.4%	
623220	38.93	39.04	0.3%	40.29	41.00	1.8%	
623230	40.53	40.73	0.5%	41.92	42.23	0.7%	
623240	41.34	41.58	0.6%	42.72	42.86	0.3%	
623243	44.14	44.31	0.4%	44.91	45.04	0.3%	
623245	45.27	45.47	0.4%	45.56	45.65	0.2%	
623248	46.82	47.47	1.4%	48.00	48.25	0.5%	
623250	41.90	41.96	0.1%	43.45	43.42	-0.1%	
623270	42.19	42.19	0.0%	43.88	43.81	-0.2%	
623300	35.39	35.84	1.3%	37.43	37.55	0.3%	
623310	37.00	37.65	1.8%	38.03	38.60	1.5%	
623330	40.55	40.58	0.1%	41.54	41.75	0.5%	
623340	40.56	40.59	0.1%	41.54	41.76	0.5%	
623360	39.79	40.01	0.6%	41.54	41.76	0.5%	

TABLE 6.3 Comparison of Updated Duck Pond Watershed Model Results to Previous Model

Basin Junction ID	Peak Water Surface Elev's (Ft. NAVD) 2001 25-yr	2006 25-yr	% change	2001 100-yr	2006 100-yr	% change	Comments
DUCK POND - 131ST AVENUE CONTINUED							
623370	41.87	41.98	0.3%	42.33	42.41	0.2%	
623380	41.87	41.98	0.3%	42.35	42.42	0.2%	
623390	41.85	42.00	0.4%	42.32	42.44	0.3%	
623400	37.66	38.33	1.8%	38.60	39.16	1.5%	
623430	37.91	38.60	1.8%	38.88	39.36	1.2%	
623450	38.12	38.77	1.7%	39.08	39.60	1.3%	
623500	38.76	39.42	1.7%	39.72	40.25	1.3%	
623510	39.46	39.79	0.8%	40.43	40.57	0.3%	
623550	39.09	39.78	1.8%	40.12	40.65	1.3%	
623600	39.53	40.25	1.8%	40.53	41.11	1.4%	
623650	39.48	40.21	1.8%	40.41	41.01	1.5%	
623700	39.54	39.82	0.7%	40.50	40.53	0.1%	
623725	39.75	39.75	0.0%	40.61	40.55	-0.1%	
623750	40.11	40.72	1.5%	41.27	41.64	0.9%	
623800	40.46	40.92	1.1%	41.56	41.99	1.0%	
623850	41.33	41.38	0.1%	42.24	42.56	0.8%	
623900	43.30	43.47	0.4%	45.25	45.63	0.8%	
DUCK POND - ROBBINS LUMBER							
622400	33.51	33.62	0.3%	34.83	34.59	-0.7%	
622500	35.14	35.13	0.0%	35.35	35.35	0.0%	
622600	35.83	35.77	-0.2%	36.31	36.25	-0.2%	
622700	36.36	36.25	-0.3%	37.10	36.89	-0.6%	
622800	36.99	36.93	-0.2%	37.54	37.38	-0.4%	
622850	39.07	39.52	1.2%	39.31	39.69	1.0%	
622900	36.63	36.69	0.2%	36.95	36.95	0.0%	
622925	36.82	36.85	0.1%	37.01	37.01	0.0%	
622950	36.57	36.60	0.1%	37.10	36.89	-0.6%	

TABLE 6.3 Comparison of Updated Duck Pond Watershed Model Results to Previous Model

Basin Junction ID	Peak Water Surface Elev's (Ft. NAVD) 2001 25-yr	2006 25-yr	% change	2001 100-yr	2006 100-yr	% change	Comments
DUCK POND - MALL EAST/WEST							
624010	31.17	31.20	0.1%	32.16	31.78	-1.2%	
624030	31.34	31.74	1.3%	32.27	32.46	0.6%	
624040	32.08	32.04	-0.1%	32.81	32.71	-0.3%	
624050	32.41	32.36	-0.2%	33.31	33.00	-0.9%	
624080	33.10	33.16	0.2%	34.36	34.18	-0.5%	
624090	33.10	33.16	0.2%	34.36	34.18	-0.5%	
624100	36.02	36.45	1.2%	36.82	37.22	1.1%	
624190	33.46	33.38	-0.2%	34.83	34.59	-0.7%	
624200	33.46	33.38	-0.2%	34.83	34.59	-0.7%	
624210	33.46	33.38	-0.2%	34.83	34.59	-0.7%	
624230	33.46	33.38	-0.2%	34.83	34.59	-0.7%	
624250	34.69	34.89	0.6%	35.10	35.43	0.9%	
624260	33.46	33.38	-0.2%	34.83	34.59	-0.7%	
624290	34.94	35.30	1.0%	35.20	35.44	0.7%	
624310	33.98	34.16	0.5%	34.83	34.59	-0.7%	
624320	33.46	33.38	-0.2%	34.83	34.59	-0.7%	
624325	33.46	33.38	-0.2%	34.83	34.59	-0.7%	
624330	33.46	33.38	-0.2%	34.83	34.59	-0.7%	
624340	36.52	37.23	1.9%	37.22	37.45	0.6%	
624350	33.80	33.77	-0.1%	34.83	34.59	-0.7%	
624360	32.54	34.92	7.3%	33.78	35.38	4.7%	Tc updated from 20 min to 9 min; LOS A for all storms
624370	36.46	36.43	-0.1%	36.73	36.70	-0.1%	
624380	36.53	36.49	-0.1%	36.83	36.78	-0.1%	
624390	36.56	36.53	-0.1%	36.88	36.83	-0.1%	
624400	36.91	36.97	0.2%	37.14	37.19	0.1%	
624410	37.41	37.47	0.2%	37.56	37.59	0.1%	
624420	37.69	37.80	0.3%	37.78	37.90	0.3%	
624430	37.39	37.45	0.2%	37.52	37.57	0.1%	
624440	37.30	37.29	0.0%	37.42	37.42	0.0%	
624450	36.42	36.56	0.4%	36.85	37.31	1.2%	

TABLE 6.3 Comparison of Updated Duck Pond Watershed Model Results to Previous Model

Basin Junction ID	Peak Water Surface Elev's (Ft. NAVD) 2001 25-yr	2006 25-yr	% change	2001 100-yr	2006 100-yr	% change	Comments
DUCK POND - MALL EAST/WEST CONTINUED							
624470	35.00	39.14	11.8%	36.65	39.58	8.0%	Hydrology updated from Walmart ERP
624490	33.46	33.38	-0.2%	34.83	34.59	-0.7%	
624520	33.46	33.38	-0.2%	34.83	34.59	-0.7%	
624570	33.86	33.82	-0.1%	34.82	34.59	-0.7%	
DUCK POND - NEBRASKA AVENUE							
621075	33.46	33.38	-0.2%	34.83	34.62	-0.6%	
621100	33.46	33.38	-0.2%	34.83	34.62	-0.6%	
621125	33.46	33.37	-0.3%	34.83	34.62	-0.6%	
621200	33.46	33.38	-0.2%	34.83	34.62	-0.6%	
621225	33.46	33.38	-0.2%	34.83	34.62	-0.6%	
621275	34.33	34.72	1.1%	35.95	36.07	0.3%	
621300	35.08	35.20	0.3%	35.40	35.53	0.4%	
621325	33.73	34.65	2.7%	34.83	34.92	0.3%	Roadway overtopping weir length shortened by County
621350	34.37	34.78	1.2%	36.00	36.15	0.4%	
621375	34.41	34.81	1.2%	36.01	36.17	0.4%	
621390	36.37	36.50	0.4%	36.40	36.57	0.5%	
621395	34.42	34.82	1.2%	36.02	36.22	0.6%	
621425	34.43	34.83	1.2%	36.03	36.24	0.6%	
621450	34.49	34.91	1.2%	36.10	36.32	0.6%	
621500	34.54	34.92	1.1%	36.10	36.19	0.2%	
621550	34.66	34.93	0.8%	36.11	36.19	0.2%	
621600	34.54	34.92	1.1%	36.10	36.20	0.3%	
621625	34.85	35.91	3.0%	36.36	36.75	1.1%	Subbasin overtopping weir lengths shortened by County
621630	35.53	35.98	1.3%	36.44	36.79	1.0%	
621650	35.85	36.57	2.0%	36.76	37.14	1.0%	Tc updated from 22 min to 8 min; subb. weir L reduced
621675	36.85	37.32	1.3%	37.32	37.87	1.5%	
621700	36.23	36.53	0.8%	36.78	37.15	1.0%	
621715	38.96	39.09	0.3%	39.14	39.32	0.5%	
621725	40.06	40.25	0.5%	41.03	41.25	0.5%	
621750	44.57	44.63	0.1%	44.63	44.76	0.3%	

TABLE 6.3 Comparison of Updated Duck Pond Watershed Model Results to Previous Model

Basin Junction ID	Peak Water Surface Elev's (Ft. NAVD) 2001 25-yr	2006 25-yr	% change	2001 100-yr	2006 100-yr	% change	Comments
DUCK POND - NEBRASKA AVENUE CONTINUED							
621775	38.08	38.47	1.0%	38.41	39.04	1.6%	
621800	38.10	38.50	1.0%	38.43	39.09	1.7%	
621825	38.10	38.51	1.1%	38.44	39.10	1.7%	
621875	40.33	41.97	4.1%	44.78	44.93	0.3%	No apparent cause for 25-yr change. 25-yr LOS still "A"
621900	34.66	34.93	0.8%	36.11	36.20	0.2%	
621950	44.82	44.73	-0.2%	45.09	44.95	-0.3%	
RAINTREE - NORTH							
628650	26.84	26.84	0.0%	27.95	27.95	0.0%	
628670	28.17	27.96	-0.7%	29.36	29.10	-0.9%	
628680	27.05	26.91	-0.5%	28.12	27.95	-0.6%	
628685	29.11	29.01	-0.3%	29.90	29.75	-0.5%	
628690	31.62	31.71	0.3%	32.63	32.71	0.2%	
628700	28.93	29.10	0.6%	30.41	30.62	0.7%	
628730	32.02	32.17	0.5%	32.60	32.83	0.7%	
628820	31.49	31.83	1.1%	33.56	33.87	0.9%	
628830	31.31	31.79	1.5%	33.72	34.15	1.3%	
628840	31.10	33.59	8.0%	34.22	34.96	2.2%	New Development in subbasin and reduced Tc; LOS "A"
628850	31.79	31.78	0.0%	33.85	34.92	3.2%	No apparent cause for 100-yr change
RAINTREE - SOUTH							
628310	28.83	28.85	0.1%	29.84	29.88	0.1%	
628400	29.87	29.86	0.0%	31.11	31.12	0.0%	
628420	32.44	32.50	0.2%	32.73	32.79	0.2%	
628450	33.02	32.59	-1.3%	34.65	34.60	-0.1%	
USF NORTH							
629760	31.07	31.39	1.0%	35.77	35.76	0.0%	
629780	31.54	31.66	0.4%	38.33	38.22	-0.3%	
629800	37.67	37.68	0.0%	38.44	38.35	-0.2%	
629820	37.69	37.70	0.0%	38.47	38.37	-0.3%	
629840	38.50	38.53	0.1%	38.89	38.88	0.0%	
629860	41.00	40.47	-1.3%	42.02	41.73	-0.7%	

TABLE 6.3 Comparison of Updated Duck Pond Watershed Model Results to Previous Model

Basin Junction ID	Peak Water Surface Elev's (Ft. NAVD) 2001 25-yr	2006 25-yr	% change	2001 100-yr	2006 100-yr	% change	Comments
USF NORTH CONTINUED							
629880	38.53	38.65	0.3%	39.18	39.29	0.3%	
629900	38.57	38.54	-0.1%	38.91	38.89	-0.1%	
629920	33.52	33.76	0.7%	36.26	36.56	0.8%	
629940	37.83	38.14	0.8%	38.89	38.88	0.0%	
629960	39.34	39.33	0.0%	39.51	39.48	-0.1%	
USF EAST							
629100	29.85	30.36	1.7%	31.31	31.61	1.0%	Updated drainage area and CN somewhat higher
629200	32.33	32.32	0.0%	33.53	33.41	-0.4%	
629300	30.86	30.82	-0.1%	31.33	31.28	-0.2%	
629400	36.23	36.42	0.5%	37.72	37.98	0.7%	
629500	30.49	30.85	1.2%	31.69	32.01	1.0%	
629600	33.92	35.21	3.8%	35.76	36.23	1.3%	Tc updated from 44 min to 16 min; LOS "A" all events
629700	53.88	53.92	0.1%	54.25	54.39	0.3%	

6.3.1 Duck Pond System

The Duck Pond System (referring to the Duck Pond primary conveyance area) includes the Nebraska Avenue, Robbins Lumber, 131st Avenue, Mall West/East and the USF Campus West systems. LOS designations were not determined for the USF Campus West system because it is within unincorporated Hillsborough County.

6.3.1.1 Nebraska System

The following is a list of existing flooding areas in the Nebraska System:

- The area east of the CSX Rail Road Tracks along Fowler Avenue and 122nd Avenue up to Duck Pond West begins to experience flooding along 15th Street and 122nd Avenue, during the 2.33-year storm event. Flooding along 14th Street does not occur until the 50-year storm event. Flooding along 17th Street first occurs during the 10-year storm event. Flooding along these roadways and adjacent properties is a result of no or inadequate storm sewer systems along these roadways. The only storm sewer in this area draining to Duck Pond West is along 122nd Avenue. The main trunk line of this storm sewer consists of a 54-inch diameter pipe with no inlets on the north side of 122nd Avenue extending from the Hillsborough County Pond adjacent to the CSX Rail Road to Duck Pond West. This storm sewer consists of one lateral 15-inch diameter C.M.P with four ditch bottom inlets from 15th Street to 17th Street. The area drains to a low blind area on private properties between these roadways. Water stages up and floods these properties as well as the adjacent roadways. The lack of conveyance systems along 12th, 14th, 15th, and 17th streets and lack of inlets on the 54-inch diameter main trunk line contributes to the flooding.

- The area west of the CSX Rail Road Tracks along 120th Avenue up to and including Taliaferro Avenue begins to experience flooding during the 2.33 year storm event. The pond at Taliaferro and 122nd Avenue and storm sewers along Taliaferro and 120th Avenue are undersized. The lateral pipes draining to the 6' x 7' box culvert along 120th Avenue from Nebraska Avenue to the Hillsborough County Pond do not adequately drain 120th Avenue and adjacent properties. The portion of Fowler Avenue draining to the F.D.O.T. wet detention pond adjacent to the CSX Rail Road does not flood until the 100-year storm event.

- Flooding along the south end of Nebraska Avenue from Fowler Avenue to Fletcher Avenue begins at the 25-year storm event. No flooding occurs along Nebraska Avenue up to the 100-year event from Fletcher Avenue to Skipper Road.

- Flooding also occurs within some private properties adjacent to the CSX rail road because no storm sewers exist to convey water to the Nebraska Avenue storm sewer. Additionally, a cross drain under the CSX rail road conveying storm water from Subbasin 621700 to the Robbins Lumber system was removed some time ago.

The LOS designations for the subbasins in the Nebraska Avenue System are displayed in **Table 6.2**.

The existing conditions level of service for the 25-year, 24-hour storm event for the Nebraska Avenue System is LOS D.

6.3.1.2 Robbins Lumber System

The following is a list of existing flooding areas in the Robbins Lumber System:

- The drainage ditch system east of the CSX Rail Road Tracks along 127th Avenue experiences roadway flooding during the 5-year storm event.

- The storm sewer travels through a parking lot of a private apartment complex located at the southwest quadrant of 15th Street and 127th Avenue. Then the storm sewer discharges to an open channel on the east side of 15th Street between 122nd and 127th Avenues. This storm sewer system experiences site and roadway flooding during the 10-year storm event.

- The next downstream system consists of a ditch that continues east until it reaches Duck Pond West. It experiences site flooding during the 2.33-year storm event and is a result of tailwater flooding conditions in Duck Pond West.

The LOS designations for the subbasins in the Robbins Lumber System are displayed in **Table 6.2**. The existing conditions level of service for the 25-year, 24-hour storm event for the Robbins Lumber System is LOS C.

6.3.1.3 131st Avenue System

The following is a list of existing flooding areas in the 131st Avenue System:

- The area along 19th Street from Duck Pond West to the 131st Avenue Pond begins to experience site and roadway flooding during the 10-year storm event. The worst flooding is at the south end of this segment of 19th Street near Duck Pond West. This appears to be a result of tail water conditions from Duck Pond West.

- The area along 15th Street from 143rd Avenue to 140th Avenue in Subbasins 623230 and 623240 experiences site and roadway flooding during the 50-year storm event. Upgraded lateral along 15th Street can not adequately function during the 50-year storm.

- Flooding occurs during the 25-year storm along 143rd Avenue south of the Four Seasons Sub-division in Subbasin 623250. This appears to be a result of an inadequate storm sewer lateral draining to the upgraded storm sewer along 15th Street.

- Flooding occurs along 19th Street from 138th Avenue to 143rd Avenue starting at the 2.33-year storm event. The worst flooding is at the south end in Subbasin 623330 and progressively improves northward up to Subbasin 623380. This appears to be a result of an inadequate storm sewer along 19th Street discharging to the primary trunk line serving Fletcher Avenue.

- Flooding occurs during the 50-year storm along 20th Street from Fletcher Avenue to 143rd Avenue in Subbasins 623380 and 623430.

- Flooding occurs along 22nd Street from Fletcher Avenue to 143rd Avenue in Subbasins 623510 to 623725 starting at the 5-year storm.

- Flooding occurs on 136th Avenue east of 22nd Street in Subbasins 623750 and 623725 starting at the 5-year storm. Hillsborough County has installed new storm sewer along 136th Avenue in 1999 (see Hillsborough County Project Number 40960). This new storm sewer system was included in the existing condition model.

The LOS designations for the subbasins in the 131st System are displayed in **Table 6.2**. The existing conditions level of service for the 25-year, 24-hour storm event for the 131st Avenue System is LOS D.

6.3.1.4 Mall West/East System

The following is a list of existing flooding areas in the Mall West/East System:

- Fowler Avenue at the east side of the University Mall entrance in Subbasin 624010 begins to flood at the 10-year storm event. The storm sewer in these subbasins collects discharge from Duck Pond East through two 48-inch concrete pipes which connect to a 4-foot by 4-foot CBC culvert with a short 48-inch diameter concrete pipe segment at the down stream end under Fowler Avenue. This storm sewer discharges to an open channel in the City of Tampa System south of Fowler Avenue. Flooding is a result of the tailwater condition in this open channel. Additionally, the 4-foot by 4-foot CBC under Fowler has less capacity than the two 48-inch pipes connected to it upstream. The tailwater condition and inadequate storm sewer create site flooding in the parking area at the south end of the Mall along Fowler Avenue during the 25-year storm.

- Duck Pond East overtops its bank at elevation 34-feet during the 50-year storm and floods residential roads and yards in the south west portion of a residential sub-division east of Duck Pond East in subbasin 624080.

- Duck Pond West in Subbasin 624190 floods 19th Street and 127th Avenue during the 10-year storm event. The tailwater effect from Duck Pond West creates roadway and site flooding in the subbasins immediately upstream of Duck Pond West during the 2.33-year storm. The roadways include 20th and 22nd Streets. Site flooding occurs in Subbasins 624200, 624210, 624230, 624250, 624260, 624320, 624325 and 624330 during the 5-year storm. Some structural flooding occurs in the Forest Place Apartment Complex immediately east of Duck

Pond West in subbasin 624490.

- Flooding occurs along 131st Avenue and on 20th and 22nd Street up to Fletcher Avenue during the 2.33 year storm. Site flooding occurs in subbasins 624370,624380 and 624390 during the 25-year storm event.

- Flooding occurs on 132nd Avenue and Leisure Wood Place just north of 131st Avenue during the 2.33-year storm. There are no existing storm sewer systems along these roadways to collect runoff. Stormwater collects in low spots and is trapped along 131st Avenue and 132nd Avenue. The existing condition model stored runoff in these low spots and conveyed it to the VA Hospital Pond with subbasin overtopping weirs. The LOS can be improved with new storm sewer systems along these roadways.

- Flooding occurs on Fowler Avenue at the west side of the University Mall in front of the Sports Authority during the 5-year storm. Areas east of this on Fowler Avenue do not flood until the 50-year storm.

- Flooding occurs on 15th Street in Subbasin 624570 during the 2.33-year storm because no storm sewer system collects runoff in this subbasin.

The LOS designations for the subbasins in the Mall West/East System are displayed in **Table 6.2**. The existing conditions level of service for the 25-year, 24-hour storm event for the Mall West/East System is LOS D.

The existing flood control level of service for the Duck Pond Watershed is LOS D because the worse case scenario is LOS D for more than one of the Duck Pond systems as described above.

Hillsborough County and the City of Tampa are working together to solve the flooding problems in this area.

6.3.2 Bruce B. Downs System

The following is a list of existing flooding areas in the Bruce B. Downs System:

- Site flooding occurred during the 50-year storm east of Bruce B. Downs Boulevard and west of 30th Street.
- Roadway flooding occurred along 143rd Avenue and 22nd Street during the 2.33-year storm. Flood depths are severe at the 10-year storm and beyond.

The LOS designations for the subbasins in the Bruce B. Downs System are displayed in **Table 6.2**. The existing conditions level of service for the 25-year, 24-hour storm event for the Bruce B. Downs System is LOS D.

6.3.3 USF North System

The following is a list of existing flooding areas in the USF North System:

- For the 25-year event, flooding occurs along 42nd Street beginning at a low point approximately 600 feet north of Fletcher Avenue and continues up to where a gravity storm sewer begins. The gravity storm sewer on 42nd Street begins approximately 1,600 feet south of Skipper Road.
- For the 50-year event flooding occurs 350 feet north of where the gravity storm sewer begins on 42nd Street and at the intersection of Abbot Drive and 46th Street. Abbot Drive is located approximately 400 feet south of the intersection of Skipper Road and 46th Street.

The LOS designations for the subbasins in the USF North System are displayed in **Table 6.2**. The existing conditions level of service for the 25-year, 24-hour storm event for the USF North System is LOS C.

6.3.4 USF East System

The following is a list of existing flooding areas in the USF East System:

- Flooding occurs along 127th Avenue between 50th and 52nd Streets beginning at the 5-year storm event. Flooding was limited to minor roadway and site flooding up to the 10-year storm event and increased to some finish floor elevations beginning at the 25-year storm event. The existing pump station capacity appears to be inadequate for storms greater than the 5-year storm event.
- 52nd Street near Fowler Avenue floods during the 25-year storm and site flooding occurs to adjacent properties in subbasin 629100 during the 50-year storm.
- Flooding occurs along 51st Street and adjacent properties in the closed Subbasin identified as 629700 at the south end of the USF - East Subbasin. The only storm water management system in this subbasin is a closed retention pond collecting storm water from a shopping center on the corner of 50th and Fowler Avenue. This retention pond does not overtop up to and including the 100-year event. The rest of Subbasin 629700 drains to 51st Street where there are no conveyance systems draining to this retention pond or to outfalls outside the subbasin.

The LOS designations for the subbasins in the USF East System are displayed in **Table 6.2**. The existing conditions level of service for the 25-year, 24-hour storm event for the USF East System is LOS D.

6.3.5 Raintree System

The Raintree area includes the Raintree North and Raintree South Systems. Subbasin LOS evaluation in incorporated areas (City of Temple Terrace) are not discussed.

6.3.5.1 Raintree North System

The following is a list of existing flooding areas in the Raintree South System:

- Site flooding in the vicinity of Thomasville Circle during the 50-year storm in subbasin 628670.
- Roadway and site flooding on Jenny Drive during the 50-year storm in Subbasins 628830.
- Site flooding along Joan Drive during the 100-year storm in subbasin 628820.
- Roadway flooding during the 50-year storm on Gibson Avenue in Subbasin 628850.

The LOS designations for the subbasins in the Raintree North System are displayed in **Table 6.2**. The existing conditions level of service for the 25-year, 24-hour storm event for the Raintree North System is LOS A.

6.3.5.2 Raintree South System

The following is a list of existing flooding areas in the Raintree South System:

- Roadway flooding on 58th Street during the 5-year storm.

The LOS designations for the subbasins in the Raintree South System are displayed in **Table 6.2**. The existing conditions level of service for the 25-year, 24-hour storm event for the Raintree South System is LOS B.

6.4 100-YEAR FLOODPLAIN

The 100-yr flood stages are generally used to regulate development with respect to placement of and compensation for fill within the floodplain; protection of buildings through sufficient elevation of the first floor; and federal flood insurance. Two 100-year flood events have been modeled for assessment of flood stages:

- The SCS Type II Florida Modified 24-hour Distribution (total precipitation of 11.0 inches)
- The SWFWMD 5-Day Rainfall Distribution (total precipitation 17.8 inches)

The rainfall distributions vary substantially with regard to both timing and intensity of rainfall, as well as the total volume of precipitation. The 24-hour design event is generally the more severe for rate-sensitive watersheds, while the 5-day design event will simulate higher flood stages for volume-sensitive watersheds. It must be noted, however, that the use of the 5-day event, coupled with typical stormwater modeling tools, may be overly conservative for watersheds with a high proportion of closed subbasins or with severely limited discharge (as is the case for Duck Pond) that results in substantial surface flooding. Most stormwater models, including ICPR and various SWMM-based models, will not simulate infiltration over pervious surfaces beyond that which occurs during computation of runoff excess. Additionally, large lakes and wetlands will typically percolate significant volumes of water on a daily basis, with higher driving heads increasing the percolation rate even further. For these reasons, the 100-year, 24-hour design event is considered the more realistic gage of 100-year flooding for regulatory purposes. The simulation accuracy of the 5-day design event would be improved by coupling with a 2-D groundwater-surface water model.

Table 6.4 compares the peak simulated flood stage and timing between the 100-year, 24-hour and the 100-year, 5-day design storm events. The average peak stage difference between the two storm events is approximately 0.43 feet and ranges between -2.15 feet and 2.07 feet. It is noted that larger peak stage differences (Z120-Z24>1.0 foot) occur in volume-sensitive subbasins such as small ponds, lakes, and closed or outflow-limited basins. As expected, peak stages occur much later in the simulation for the 100-year, 5-day event.

The County's proposed 100-yr floodplain map for the entire watershed is shown on **Figure 6-4.** Model updates do not result in significant changes to previously modeled flood stages (based upon the 24-hour design event) except for the following subbasins:

- Subbasin 620650 near East 143rd avenue and 19th Street north experienced a simulated increase in 100-yr flood stage of four (4) feet, however flood stages remain within the banks of the water feature which is consistent with current County flood mapping
- Subbasin 624470 (Walmart) experienced a simulated increase in 100-yr flood stage of three (3) feet which just crests the banks of the water management system which is consistent with current County flood mapping

TABLE 6.4 **Comparison of Peak WSEL for the 100-yr, 1-day and 100-yr, 5-day Events**

JUNCTION	100 YR/1 DAY PEAK WSEL (ft-NAVD)	100 YR/1 DAY TIME TO PEAK (HR)	100 YR/5 DAY PEAK WSEL (ft-NAVD)	100 YR/5 DAY TIME TO PEAK (HR)	Z5D - Z1D (FT)	NOTES
620115	37.94	14.00	37.90	65.37	-0.04	
620120	38.38	14.08	38.48	65.35	0.10	
620200	40.22	13.93	41.06	65.18	0.84	
620250	40.67	13.30	41.08	65.20	0.41	
620260	43.49	12.92	41.94	61.17	-1.55	
620300	39.10	26.20	41.17	98.97	2.07	SMSA
620400	41.81	16.23	42.86	63.58	1.05	SMSA
620410	41.84	16.50	42.90	63.77	1.06	connected channel
620450	42.42	19.70	43.34	65.85	0.92	
620460	42.43	19.52	43.38	65.57	0.95	
620470	42.57	16.00	43.71	64.27	1.14	manhole
620480	42.95	14.92	44.12	63.73	1.17	manhole
620600	44.43	14.25	45.37	63.27	0.94	
620650	44.91	25.03	45.56	63.60	0.65	
621050	34.62	40.65	36.06	100.93	1.44	Duck Pond W. controls
621075	34.62	41.13	36.06	101.75	1.44	Duck Pond W. controls
621100	34.62	41.18	36.06	100.98	1.44	Duck Pond W. controls
621125	34.62	41.17	36.06	100.98	1.44	Duck Pond W. controls
621150	34.62	41.17	36.06	101.78	1.44	Duck Pond W. controls
621200	34.62	41.33	36.06	101.78	1.44	Duck Pond W. controls
621225	34.62	41.33	36.06	102.20	1.44	Duck Pond W. controls
621250	36.02	18.15	36.47	66.48	0.45	
621275	36.07	17.92	36.50	66.13	0.43	
621300	35.53	20.82	36.06	102.87	0.53	
621325	34.92	14.15	36.06	101.80	1.14	closed basin
621350	36.15	17.70	36.64	65.97	0.49	
621375	36.17	17.50	36.66	65.72	0.49	
621390	36.57	12.73	36.70	65.63	0.13	
621395	36.22	13.63	36.70	65.55	0.48	
621425	36.24	13.63	36.71	65.50	0.47	
621450	36.32	14.78	36.86	65.12	0.54	
621500	36.19	19.00	36.67	67.17	0.48	
621550	36.19	22.20	36.57	70.73	0.38	
621600	36.20	19.00	36.67	67.17	0.47	
621625	36.75	13.92	36.96	64.72	0.21	
621630	36.79	13.93	36.97	64.80	0.18	
621650	37.14	13.52	37.09	64.37	-0.05	
621675	37.87	12.85	37.49	61.22	-0.38	
621700	37.15	13.55	37.09	64.37	-0.06	
621715	39.32	13.03	39.50	64.03	0.18	
621725	41.25	14.82	41.44	63.58	0.19	
621750	44.76	12.82	44.70	61.00	-0.06	
621775	39.04	12.55	38.58	61.02	-0.46	
621800	39.09	12.55	38.62	61.02	-0.47	
621825	39.10	12.55	38.64	61.02	-0.46	
621850	44.94	13.95	44.99	62.82	0.05	
621875	44.93	14.00	44.99	62.90	0.06	
621900	36.20	22.20	36.57	70.82	0.37	
621950	44.95	14.85	45.08	62.93	0.13	
622400	34.59	39.30	36.05	99.52	1.46	Duck Pond W. controls
622500	35.35	15.55	36.05	99.20	0.70	
622600	36.25	15.77	36.37	64.17	0.12	
622700	36.89	15.53	36.90	64.52	0.01	
622800	37.38	13.98	37.23	63.07	-0.15	

TABLE 6.4 **Comparison of Peak WSEL for the 100-yr, 1-day and 100-yr, 5-day Events**

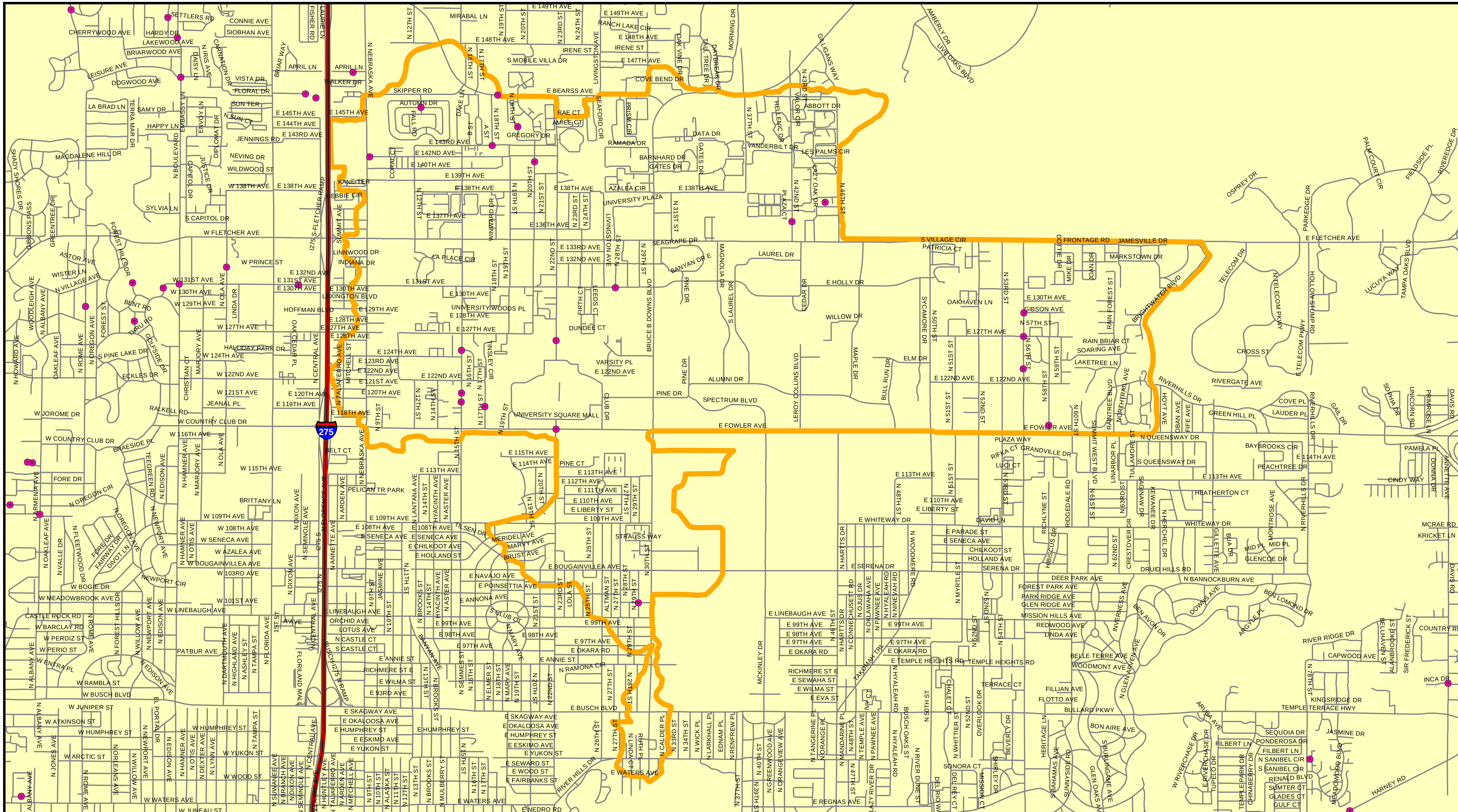
JUNCTION	100 YR/1 DAY PEAK WSEL (ft-NAVD)	100 YR/1 DAY TIME TO PEAK (HR)	100 YR/5 DAY PEAK WSEL (ft-NAVD)	100 YR/5 DAY TIME TO PEAK (HR)	Z5D - Z1D (FT)	NOTES
622850	39.69	13.13	39.59	66.93	-0.10	
622900	36.95	14.37	36.94	63.20	-0.01	
622925	37.01	17.23	37.12	62.30	0.11	
622950	36.89	15.58	36.90	64.57	0.01	
623140	35.07	28.82	36.22	82.52	1.15	Duck Pond W. controls
623150	35.32	27.27	36.31	82.38	0.99	
623160	35.66	25.62	36.41	80.67	0.75	
623170	36.88	21.90	37.52	67.92	0.64	
623190	38.04	21.75	38.71	67.70	0.67	
623200	39.11	13.87	39.58	66.93	0.47	
623210	40.06	14.35	40.59	65.93	0.53	
623215	39.51	16.05	39.71	61.78	0.20	
623220	41.00	15.42	41.56	65.42	0.56	
623225	41.50	15.53	41.86	65.42	0.36	
623230	42.23	15.47	42.30	64.90	0.07	
623240	42.86	15.35	42.86	64.40	0.00	
623243	45.04	13.75	44.52	62.80	-0.52	
623244	45.67	13.28	45.53	62.12	-0.14	
623245	45.65	13.27	45.51	62.10	-0.14	
623247	48.09	13.35	48.06	62.20	-0.03	
623248	48.25	13.33	48.22	62.18	-0.03	
623250	43.42	15.85	43.47	64.82	0.05	
623270	43.81	14.95	43.65	64.17	-0.16	
623300	37.55	21.92	38.37	66.18	0.82	
623305	37.27	21.92	38.01	66.25	0.74	
623307	37.07	21.90	37.76	66.42	0.69	
623310	38.60	13.28	39.08	65.12	0.48	
623320	39.25	12.78	39.29	65.17	0.04	
623330	41.75	24.55	42.16	68.92	0.41	
623340	41.76	24.55	42.17	68.92	0.41	
623350	41.76	24.55	42.17	68.92	0.41	
623360	41.76	24.55	42.17	68.92	0.41	
623370	42.41	13.63	42.41	62.52	0.00	
623380	42.42	13.67	42.43	62.57	0.01	
623390	42.44	15.40	42.54	63.12	0.10	
623400	39.16	13.43	39.41	64.93	0.25	
623430	39.36	13.88	39.45	64.38	0.09	
623450	39.60	13.37	39.69	64.07	0.09	
623500	40.25	13.22	40.12	63.07	-0.13	
623510	40.57	14.02	40.49	63.90	-0.08	
623550	40.65	12.83	40.34	63.08	-0.31	
623600	41.11	13.07	40.82	66.08	-0.29	
623650	41.01	13.03	40.83	66.30	-0.18	
623700	40.53	16.63	40.84	67.12	0.31	
623725	40.55	17.08	40.85	67.28	0.30	
623750	41.64	13.40	41.43	64.25	-0.21	
623800	41.99	13.22	42.06	64.07	0.07	
623850	42.56	13.23	43.45	64.03	0.89	
623900	45.63	15.07	46.63	62.65	1.00	limited discharge
624010	31.78	59.60	33.59	156.83	1.81	limited discharge
624030	32.46	55.30	33.78	154.10	1.32	limited discharge
624040	32.71	55.13	33.92	139.13	1.21	limited discharge
624050	33.00	55.12	34.08	137.70	1.08	limited discharge

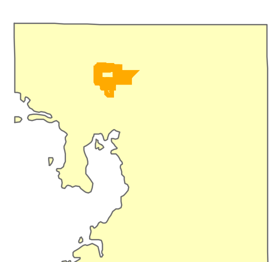
TABLE 6.4 **Comparison of Peak WSEL for the 100-yr, 1-day and 100-yr, 5-day Events**

JUNCTION	100 YR/1 DAY PEAK WSEL (ft-NAVD)	100 YR/1 DAY TIME TO PEAK (HR)	100 YR/5 DAY PEAK WSEL (ft-NAVD)	100 YR/5 DAY TIME TO PEAK (HR)	Z5D - Z1D (FT)	NOTES
624060	33.53	55.10	34.87	105.07	1.34	limited discharge
624070	34.07	53.98	35.42	104.42	1.35	limited discharge
624080	34.18	47.77	35.55	99.87	1.37	Duck Pond East
624090	34.18	47.77	35.55	99.87	1.37	lake-controlled
624100	37.22	13.40	37.26	61.90	0.04	
624190	34.59	39.38	36.05	99.67	1.46	Duck Pond West
624200	34.59	39.58	36.05	99.58	1.46	Duck Pond W. controls
624210	34.59	39.75	36.05	99.67	1.46	Duck Pond W. controls
624220	34.59	39.58	36.05	99.65	1.46	Duck Pond W. controls
624230	34.59	39.58	36.05	99.65	1.46	Duck Pond W. controls
624250	35.43	24.95	36.41	121.23	0.98	
624260	34.59	39.53	36.05	99.52	1.46	Duck Pond W. controls
624270	34.59	39.78	36.05	99.52	1.46	Duck Pond W. controls
624280	34.59	39.67	36.05	99.50	1.46	Duck Pond W. controls
624290	35.44	12.70	36.05	99.50	0.61	
624300	34.59	39.60	36.05	99.50	1.46	Duck Pond W. controls
624310	34.59	39.60	36.05	99.50	1.46	Duck Pond W. controls
624320	34.59	39.53	36.05	99.52	1.46	Duck Pond W. controls
624325	34.59	39.90	36.05	99.58	1.46	Duck Pond W. controls
624330	34.59	39.90	36.05	99.58	1.46	Duck Pond W. controls
624340	37.45	13.28	37.52	61.20	0.07	
624350	34.59	39.97	36.05	99.67	1.46	Duck Pond W. controls
624360	35.38	12.98	36.05	100.65	0.67	
624370	36.70	13.53	36.53	62.30	-0.17	
624380	36.78	13.32	36.61	62.18	-0.17	
624390	36.83	13.25	36.65	62.15	-0.18	
624400	37.19	12.72	37.04	61.30	-0.15	
624410	37.59	12.58	37.49	61.00	-0.10	
624420	37.90	12.80	37.83	61.13	-0.07	
624430	37.57	12.60	37.55	61.13	-0.02	
624440	37.42	12.83	37.33	61.80	-0.09	
624450	37.31	13.35	37.33	61.78	0.02	
624460	37.32	13.35	37.36	61.75	0.04	
624470	39.58	13.45	39.97	61.15	0.39	
624480	34.59	39.15	36.05	100.32	1.46	Duck Pond W. controls
624490	34.59	39.17	36.05	100.65	1.46	Duck Pond W. controls
624520	34.59	40.92	36.05	100.98	1.46	Duck Pond W. controls
624530	34.59	40.92	36.05	100.98	1.46	Duck Pond W. controls
624540	34.59	41.08	36.05	100.32	1.46	Duck Pond W. controls
624550	34.59	40.17	36.05	100.33	1.46	Duck Pond W. controls
624560	34.59	40.05	36.05	99.73	1.46	Duck Pond W. controls
624570	34.59	40.05	36.05	99.73	1.46	Duck Pond W. controls
625300	35.86	26.00	36.54	66.83	0.68	
626000	38.87	15.48	39.27	65.75	0.40	
628310	29.88	24.67	30.64	71.38	0.76	
628400	31.12	19.25	31.77	62.53	0.65	
628420	32.79	13.02	32.67	61.20	-0.12	
628450	34.60	15.87	35.15	65.48	0.55	
628650	27.95	12.42	27.85	12.22	-0.10	
628669	29.07	14.18	28.68	63.48	-0.39	
628670	29.10	14.18	28.70	63.47	-0.40	
628679	27.92	15.58	27.87	66.22	-0.05	
628680	27.95	15.70	27.89	66.15	-0.06	

TABLE 6.4 Comparison of Peak WSEL for the 100-yr, 1-day and 100-yr, 5-day Events

JUNCTION	100 YR/1 DAY PEAK WSEL (ft-NAVD)	100 YR/1 DAY TIME TO PEAK (HR)	100 YR/5 DAY PEAK WSEL (ft-NAVD)	100 YR/5 DAY TIME TO PEAK (HR)	Z5D - Z1D (FT)	NOTES
628684	29.67	13.10	28.92	61.15	-0.75	
628685	29.75	13.10	29.10	61.15	-0.65	
628689	32.66	12.73	30.51	61.08	-2.15	
628690	32.71	12.73	31.43	61.05	-1.28	
628699	30.58	25.55	31.30	73.17	0.72	
628700	30.62	25.55	31.33	74.45	0.71	
628729	32.62	13.17	31.83	61.92	-0.79	
628730	32.83	13.15	32.47	61.42	-0.36	
628760	34.94	14.08	35.80	62.13	0.86	
628820	33.87	16.85	34.71	66.12	0.84	
628830	34.15	15.58	35.11	64.43	0.96	
628840	34.96	14.60	35.52	63.75	0.56	
628850	34.92	14.22	35.49	62.82	0.57	
629100	31.61	13.17	32.01	62.48	0.40	
629200	33.41	13.62	33.42	62.80	0.01	
629300	31.28	14.02	32.06	62.53	0.78	
629400	37.98	25.52	38.78	66.68	0.80	
629500	32.01	13.18	32.14	62.38	0.13	
629600	36.23	12.67	35.49	61.00	-0.74	
629700	54.39	13.40	54.42	61.50	0.03	
629720	30.16	24.00	30.16	24.00	0.00	
629721	30.16	24.00	30.16	24.00	0.00	
629735	31.61	39.53	30.68	62.05	-0.93	
629740	33.23	13.53	33.91	62.17	0.68	
629760	35.76	13.63	35.97	62.05	0.21	
629780	38.22	14.05	38.33	62.87	0.11	
629800	38.35	14.05	38.44	62.87	0.09	
629820	38.37	14.07	38.46	62.88	0.09	
629825	38.38	14.07	38.48	62.88	0.10	
629840	38.88	13.12	38.80	62.08	-0.08	
629841	38.71	13.62	38.66	62.55	-0.05	
629842	38.80	13.63	38.71	62.57	-0.09	
629860	41.73	13.72	41.31	62.57	-0.42	
629880	39.29	24.97	39.95	97.47	0.66	
629900	38.89	15.53	38.92	65.03	0.03	
629920	36.56	12.83	35.03	61.17	-1.53	
629925	37.68	12.97	36.86	61.33	-0.82	
629940	38.88	13.13	38.81	62.10	-0.07	
629960	39.48	14.50	39.69	62.18	0.21	





Legend

Hurricane Frances Complaint Locations

Duck Pond Area

Notes:

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

0 0.25 0.5 1 Miles

AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637

Figure 6-2: Flooding Complaints (Hurricane Frances September 2004)

Project: 61-0100.04

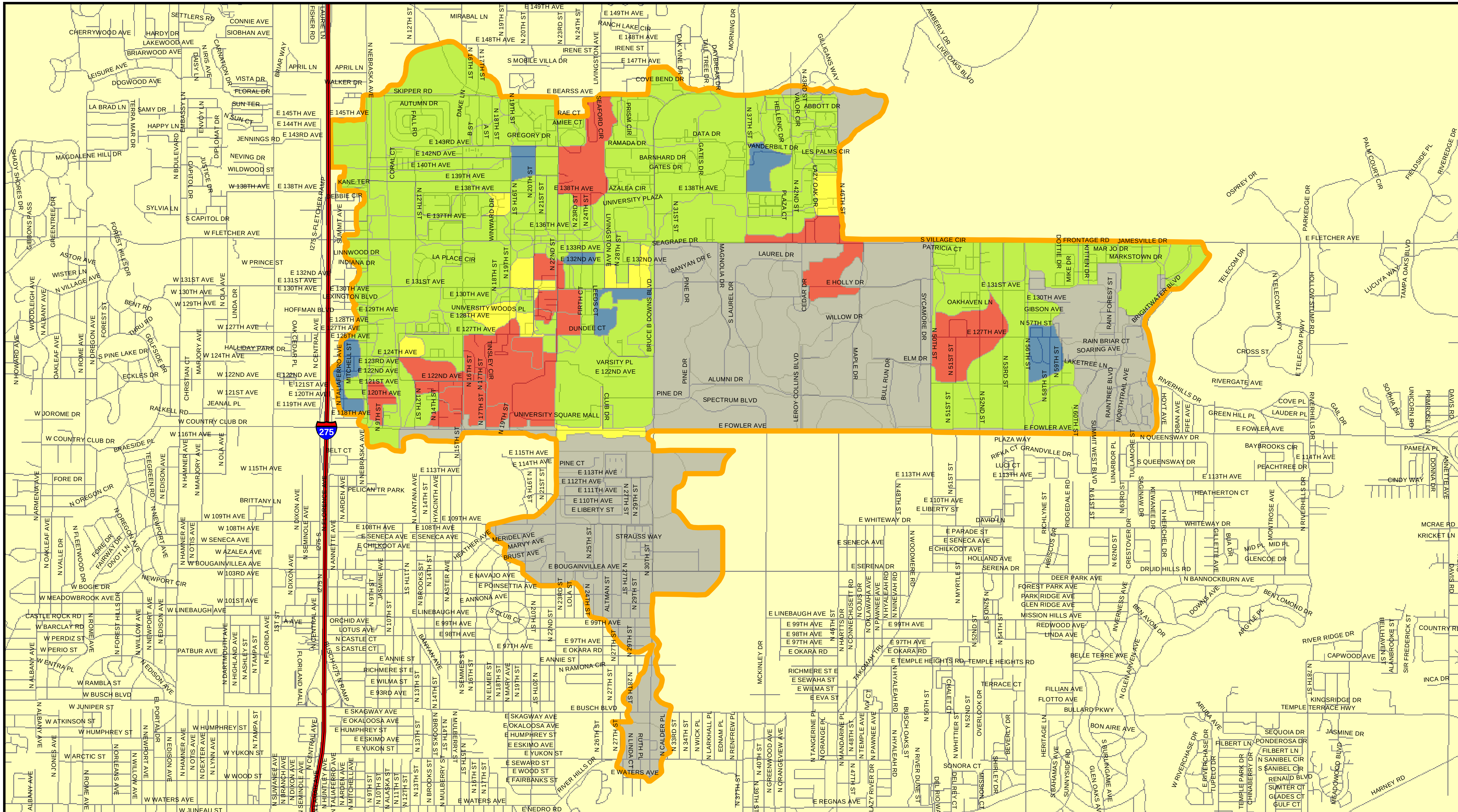
Watershed: Duck Pond Area

Hillsborough County:
WMP Update Program

Filename:	Map Date:	Map Prepared By:
Figure 6-2.mxd	Mar. 31, 2006	Ayres Associates

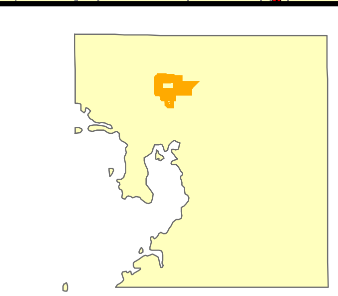
Date of Photography:

N/A



AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

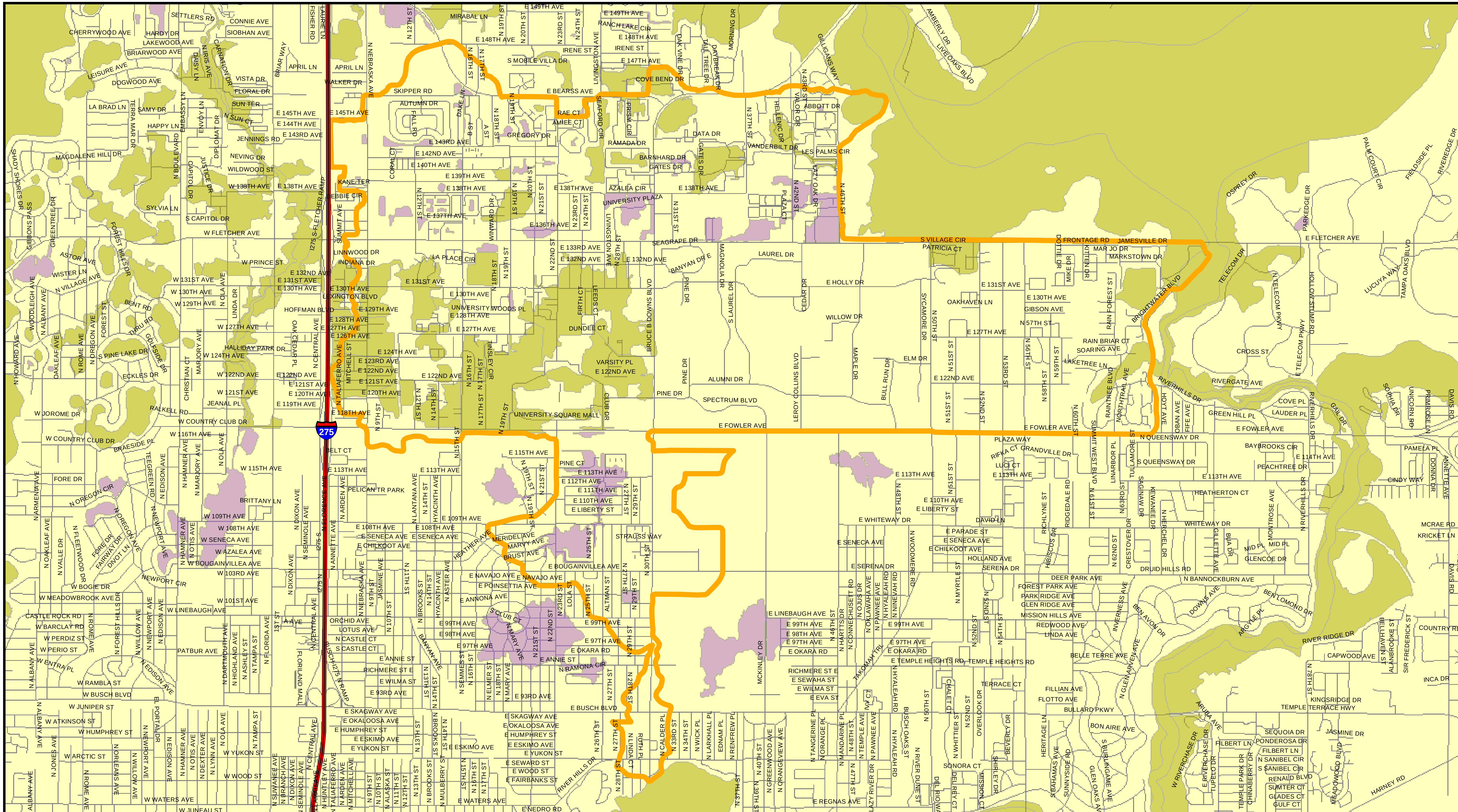
- A
- B
- C
- D
- Not in County Jurisdiction

Notes:

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

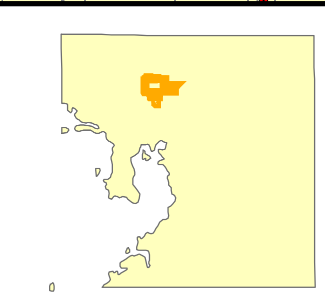
0 0.25 0.5 1 Miles

Figure 6-3: Existing Conditions 25-yr Flood Control Level of Serivce	Filename:	Map Date:	Map Prepared By:
Project: 61-0100.04	Figure 6-3.mxd	Mar. 31, 2006	Ayres Associates
Watershed: Duck Pond Area	Date of Photography:		
Hillsborough County: WMP Update Program	N/A		



AYRES ASSOCIATES

8875 Hidden River Pkwy,
Suite 200
Tampa, FL 33637



Legend

Proposed 100-yr Floodplain

Flood_Zone

- Zone A (no BFE's determined)
- Zone AE (BFE's determined)

Notes:

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

0 0.25 0.5 1
Miles

Figure 6-4: 100-year Floodplain	Filename: Figure 6-4.mxd	Map Date: Mar. 31, 2006	Map Prepared By: Ayres Associates
Project: 61-0100.04			
Watershed: Duck Pond Area	Date of Photography: N/A		
Hillsborough County: WMP Update Program			

APPENDIX A

EXISTING CONDITIONS HYDRAULIC MODEL UPDATE

TECHNICAL DATA

APPENDIX B

MODEL INPUT AND

OUTPUT SUMMARIES