CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

FOR
HILLSBOROUGH COUNTY
Public Works Department/Engineering Division
Stormwater Management Section

BY
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EXECUTIVE SUMMARY

The Curiosity Creek watershed basin is approximately 4 (four) square miles and is located in the northwest part of Hillsborough County and in the City of Tampa. The northern two-thirds (approximately) of the watershed lies within the limits of Hillsborough County and is bounded by Country Club Drive to the south (Hillsborough County boundary), Interstate I-275 on the east, Lake Magdalene Boulevard on the north and the lakes of Magdalene, Carroll and Platt on the west, (see Figure 1-2). The remaining one third of the watershed lies in the City of Tampa. The system contains many small lakes, ponds and depressional areas. The larger lakes in the watershed include Gass, Golden Trout, Butler, Cedar East, Cedar West, Pine, Eckels and Noreast. Lake Gass is the largest lake in the watershed and is approximately 33 acres in area. The entire watershed drains to the Blue Sink, which is a sinkhole located in the City of Tampa.

The drainage system of Curiosity Creek can be divided into three segments, the Northwest Lake System, the Curiosity Creek Main Channel and the Forest Hills Basin. The Northwest Lake System comprises an area of approximately 530 acres. This area has been developed mostly into residential land use and contains many interconnected lakes. Runoff from the Northwest Lake System originates in the area north of Fletcher Avenue, south of Bearss Avenue and west of Rome Avenue. Most of the lakes in this system transfer flow through pipes and ditches discharging into Curiosity Creek approximately one-half mile north of the crossing at Fowler Avenue (Country Club Drive). It should be noted that not all of the lakes in this system (and throughout the watershed) have positive outfalls. These areas are known as "blinds" and may discharge in an out of bank condition during storm conditions.

Kisinger Campo & Associates Corp. and Scheda Ecological Associates, Inc. were retained by Hillsborough County to update the Curiosity Creek Stormwater Management Plan as a part of the County's overall watershed management program. **The area of evaluation was limited to the watershed area within the Hillsborough County limits, which contain lakes or that actually discharge to the creek**. Therefore, much of the Forest Hills area is not included in this work. The objectives of the plan were to describe existing flooding, water quality, natural systems, and water supply conditions within the watershed and to develop alternatives to improve areas not currently meeting the County's level of service.

Existing conditions were based on: the existing infrastructure and the analysis of computed water surface elevations and flows; historical stream, groundwater and lake water quality data; and natural systems information in the basin. Survey data and construction drawings were used to identify existing stormwater features. Available land use, soils and topographic maps were employed to derive runoff parameters and were also used in water quality modeling and natural systems evaluations. Hydraulic input data for the County stormwater model was then developed based on the physical characteristics of the watershed and was then calibrated to known storms from the past to ensure the accuracy of the model. The results from the calibrated existing conditions model were then used to evaluate the location and degree of expected flooding within the study area to determine the existing conditions for the 2.33-year, 5-year, 10-year, 25-year, 50 year and 100 year design storms. The model was then used to evaluate the existing conditions Level of Service (LOS) for the watershed. 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.

Upon completion of the existing conditions analysis, an analysis of alternatives to alleviate flooding, water quality, natural systems, and water supply problems was performed. These alternatives were evaluated to produce recommendations that will meet or increase the County's level of service for flood protection as well as integrate important water quality, natural systems, and water supply improvements.

Hillsborough County has a targeted level of service for the primary conveyance features that will protect homes and limit street and yard flooding during the 25 year 24 hour duration storm event. The calibrated existing condition model was used to simulate possible alternatives and evaluate results. Those alternatives with a potential water quality, natural systems, and/or water supply benefit were given priority. All alternatives were considered for possible permitting issues, construction issues, and public acceptance. Planning level costs have also been developed for the suggested improvements.

The Preferred Plan for the Curiosity Creek watershed is a combination of alternatives derived from the master planning process and Capital Improvement Projects (CIP) that have already been identified by Hillsborough County staff for Fiscal Year 2000. There are two CIP's in the Preferred Plan that have already been identified by the County Stormwater staff. These are the improvements associated with Taliaferro Street and the gravity outfall system associated with Round Lake, Lake Sophia, Pine Lake, and Pine Pond .

The two CIP's currently have funding identified for Fiscal Year 2000, therefore these projects were automatically included in the Preferred Plan at the request of County staff. The remaining projects were ranked according to their respective scoring in the *Alternative Analysis Decision Matrix* from Chapter 13. The projects are listed in the recommended order that they should be constructed in accordance with the recommendations shown in Chapter 16, and are shown in the following table.

Preferred Plan *for the* Curiosity Creek Watershed

#	Alternative Number	Project Name	Planning Level Costs	Overall Score	Remarks
1	11	Taliaferro St. Floodplain Reclamation and Stormwater Treatment Pond	525K	16.2	Hills Co. CIP #47001 Storage Element
2	9	Floodplain Reclamation at Mobile Home Community	665K	15.1	
3	6	Lake Golden Trout Excavation and Upland/Wetland Restoration	569K	13.4	Storage Element
4	16	Preserve Upland/wetland Buffer at Cedar Lake East	412K	13.3	
5	4	Lake Cedar West Shoreline Re-Vegetation	25K	13.2	
6	13	Floral Avenue Channel Improvements	147K	11.4	Maintenance Element
7	12	Floral Avenue Improvements	2197K	11	Storage & Conveyance Elements
8*	*7*	*Country Club Drive Structures*	*195K**	*14.7*	*Conveyance Element (see notation below)*
9	8	122nd Ave. Structures	72K	14.8	Conveyance Element
10	3	Lake Cedar West Stormwater Treatment	165K	4.1	
11	5	Lake Dorsett Stormwater Treatment/Sewer Connections	81K	3.4	
12	1C	Gravity System Outfall for NW	255K	3.3	Hills Co. CIP# 47238,47220,47294
13	10B	Channel Improvements and Floodplain Reclamation at 131st near Fletcher Ave.	1020K	8.8	Storage and Conveyance Elements
14	14	Tyrone MHP Improvements	2944K	6.6	Storage and Conveyance Elements

*** Country Club Drive Project is located within the City of Tampa Limits. Shown here for informational purposes only. Should not be considered as a Hillsborough County Project without cooperation of City of Tampa.**

CHAPTER 1
INTRODUCTION

1.1 PROJECT LOCATION AND DESCRIPTION

The Curiosity Creek watershed basin is approximately 4 (four) square miles and is located in the northwest part of Hillsborough County and in the City of Tampa (see Figure 1-1). The northern two-thirds (approximately) of the watershed lies within the limits of Hillsborough County and is bounded by Country Club Drive to the south (Hillsborough County boundary), Interstate I-275 on the east, Lake Magdalene Boulevard on the north and the lakes of Magdalene, Carroll and Platt on the west, (see Figure 1-2). The remaining one third of the watershed lies in the City of Tampa. The system contains many small lakes, ponds and depressional areas. The larger lakes in the watershed include Gass, Golden Trout, Butler, Cedar East, Cedar West, Pine, Eckels and Noreast. Lake Gass is the largest lake in the watershed and is approximately 33 acres in area.
The entire watershed drains to the Blue Sink, which is a sinkhole located in the City of Tampa.

This watershed is highly developed with few areas that have not undergone some type of land alteration. Much of the area has been developed with single family homes that predate the 1960's. The areas near the major roadways are highly developed with commercial businesses, apartment complexes and mobile home parks. The land use for these areas has been commercially oriented for decades. The drainage basin is characterized by a mostly flat topography, with high water tables, natural and man made lakes, many ditched outfalls and few remaining isolated wetlands. As with most highly urbanized watersheds, much of the main channel system has been artificially constrained by manmade development, and pipes and ditches connect most of the lakes.

The drainage system of Curiosity Creek can be divided into three segments, the Northwest Lake System, the Curiosity Creek Main Channel and the Forest Hills Basin, (see Figure 1-3). The Northwest Lake System comprises an area of approximately 530 acres. This area has been developed mostly into residential land use and contains many interconnected lakes. Runoff from the Northwest Lake System originates in the area north of Fletcher Avenue, south of Bearss Avenue and west of Rome Avenue. Most of the lakes in this system transfer flow through pipes and ditches discharging into Curiosity Creek approximately one-half mile north of the crossing at Fowler Avenue (Country Club Drive). It should be noted that not all of the lakes in this system (and throughout the watershed) have positive outfalls. These areas are known as "blinds" and may discharge in an out of bank condition during storm conditions.

The main channel of Curiosity Creek originates at a borrow pit in the headwaters of the basin and moves through the system in generally a southerly direction until ultimately discharging directly to the Blue Sink area which is located in the City of Tampa. The Blue Sink is a sinkhole located south of Fowler Avenue (Country Club Drive) and west of Florida Avenue. The storage capacity of the sink is limited, although the flood attenuation volume has been expanded by the construction of a large pond to the south. The sink itself currently has very limited seepage characteristics and the water surface elevations are controlled by a pump station operated by the City of Tampa. At present the Blue Sink has no other outfall other than the pump station.

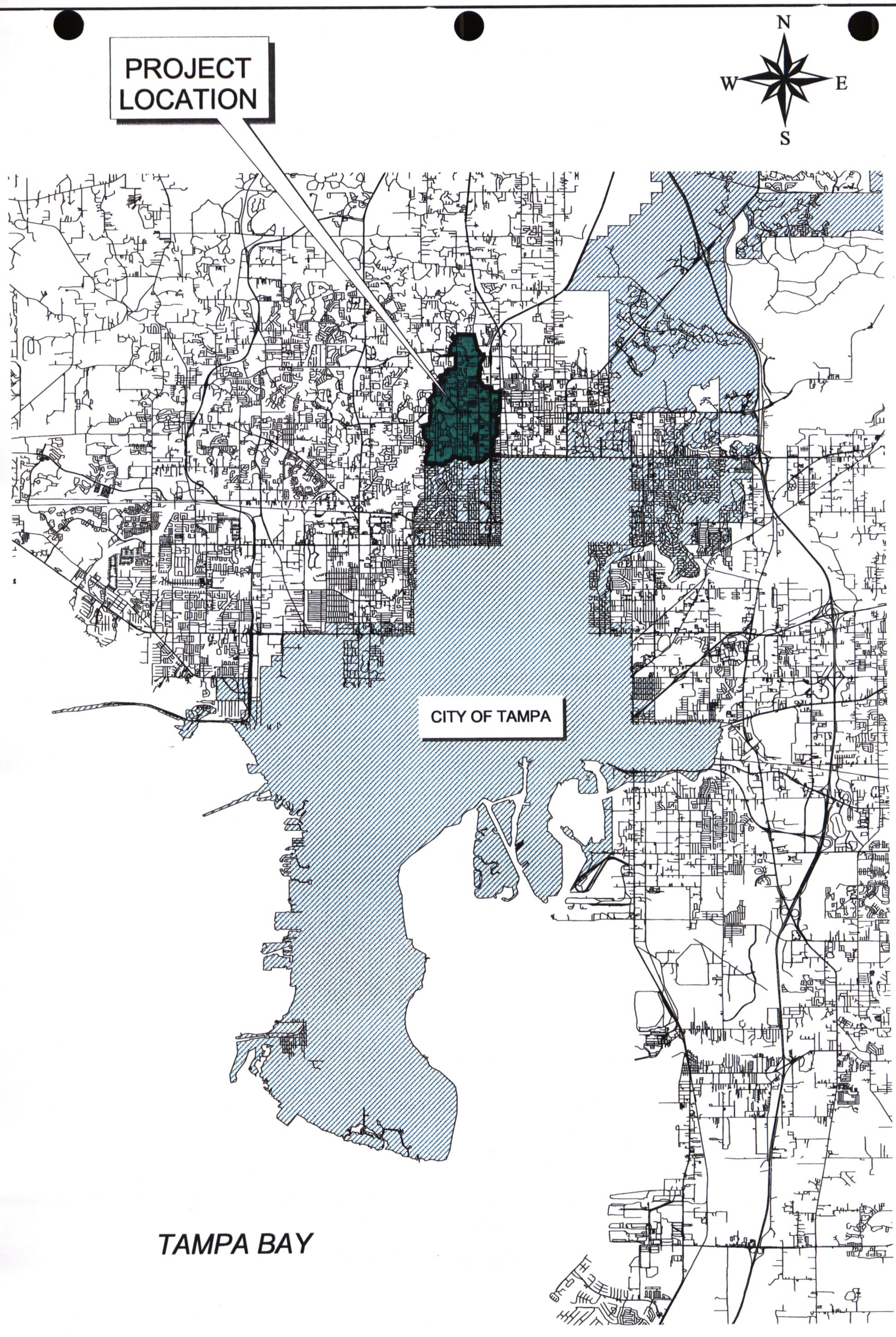

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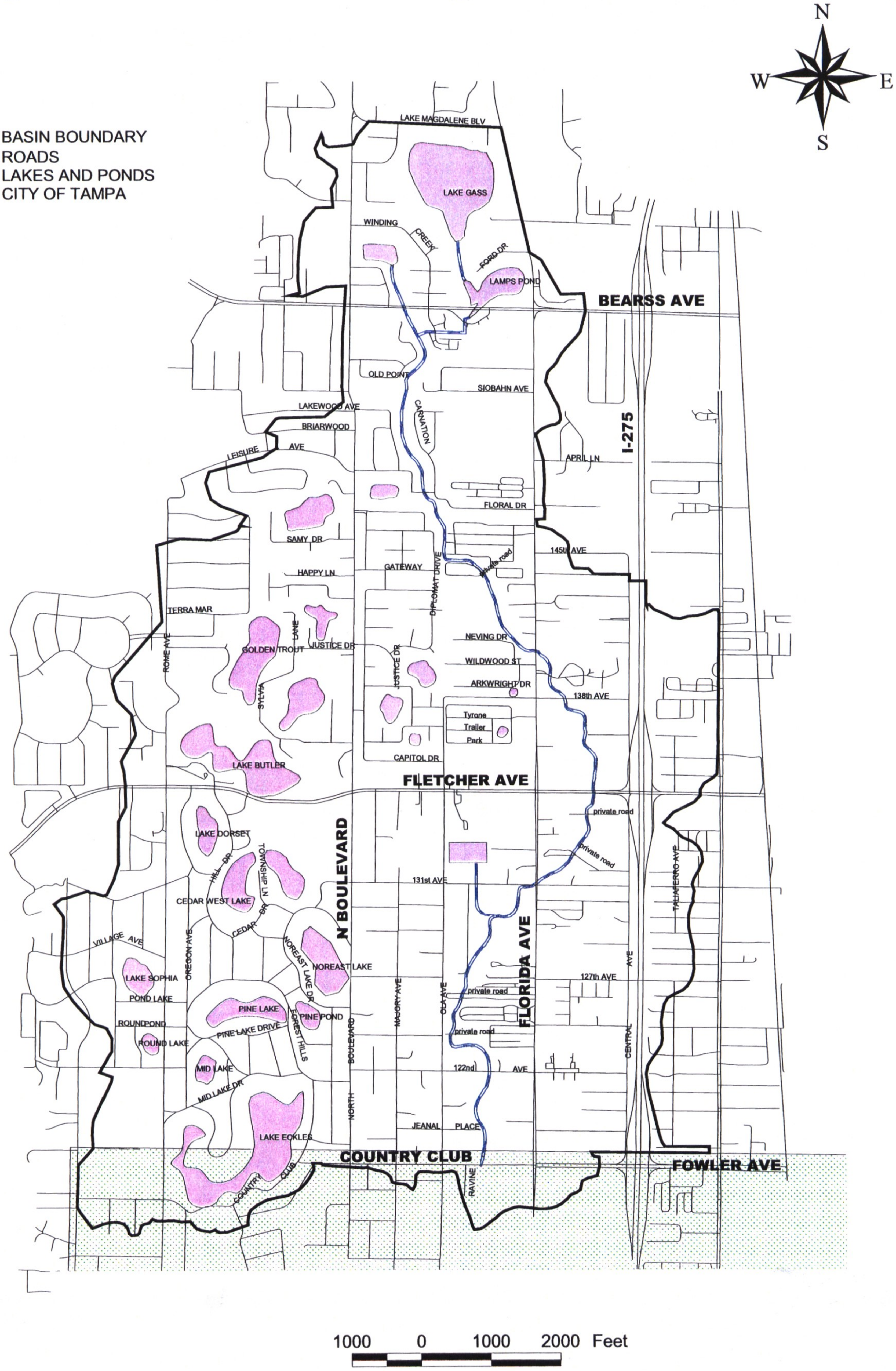
FIGURE 1-1

LOCATION MAP



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curiosity_creek_view

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FIGURE 1-2

WATERSHED MAP

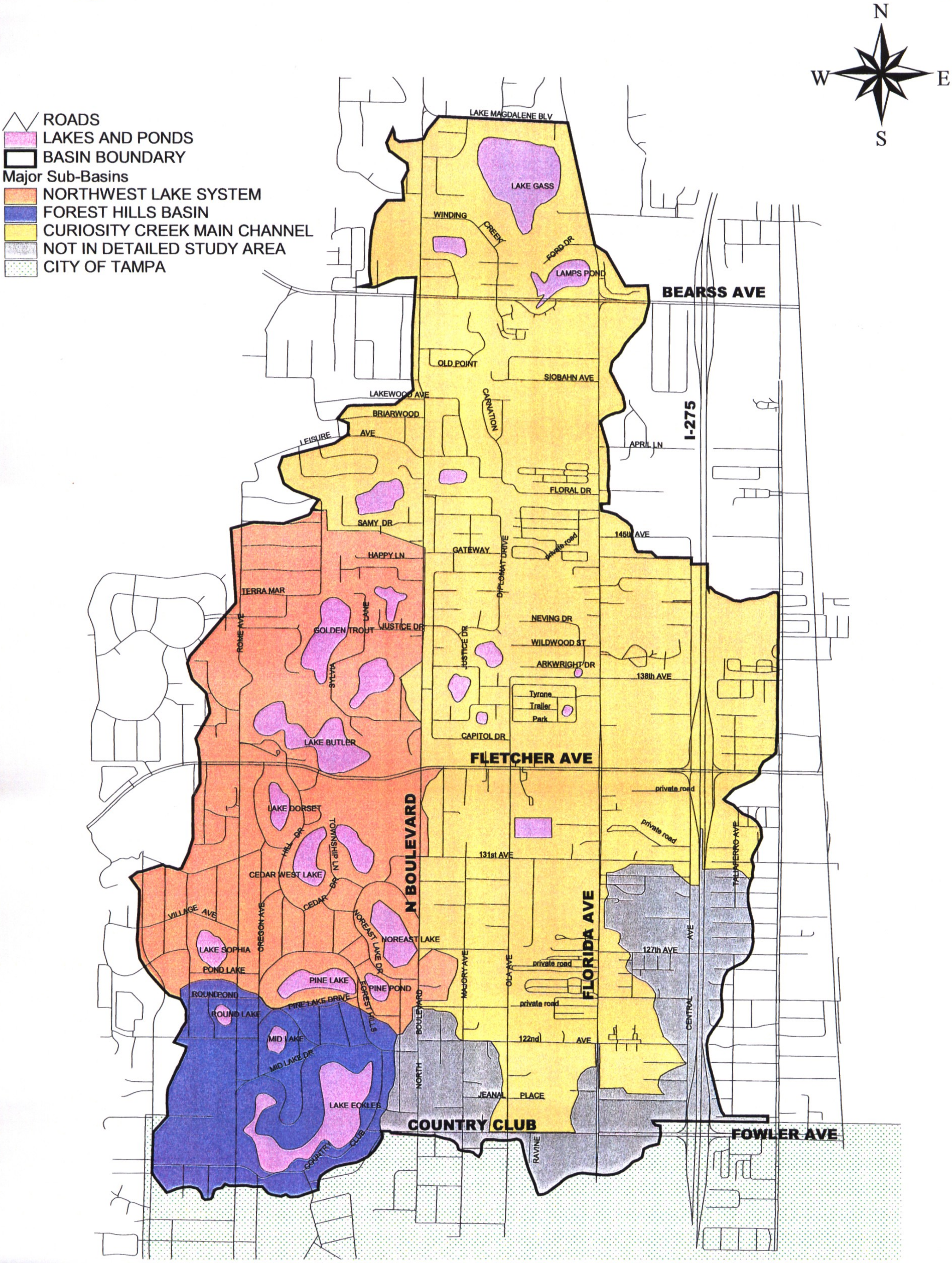

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FIGURE 1-3

MAJOR SUB-BASINS

Most of the Forest Hills Basin is in the City of Tampa. However, there is an area within Hillsborough County that contributes runoff to this basin. This area includes those lakes within Hillsborough County that discharge to the Forest Hills Basin either by conveyance, or direct runoff. Round Lake, Mid Lake, and Lake Eckels are part of the Forest Hills Basin.

Curiosity Creek was studied in 1982 for the Southwest Florida Water Management District, Hillsborough County and the City of Tampa in response to the severe and prolonged flooding that occurred in September 1979. This master plan was used in the development of the expanded flood storage detention area to the south of the Blue Sink (Curiosity Creek Detention Pond, FLD&E, 1987 for the City of Tampa, Project 10683.00), as well as other improvements in the watershed.

1.2 SCOPE OF THE PROJECT

Kisinger Campo & Associates Corp. and Scheda Ecological Associates, Inc. were retained by Hillsborough County to update the Curiosity Creek Stormwater Management Plan as a part of the County’s overall watershed management program. **The area of evaluation was limited to the watershed area within the Hillsborough County limits, which contain lakes or that actually discharge to the creek** (see Figure 1-4). Therefore, much of the Forest Hills area is not included in this work. The objectives of the plan were to describe existing flooding, water quality, natural systems, and water supply conditions within the watershed and to develop alternatives to improve areas not currently meeting the County’s level of service.

Existing conditions were based on: the existing infrastructure and the analysis of computed water surface elevations and flows; historical stream, groundwater and lake water quality data; and natural systems information in the basin. Survey data and construction drawings were used to identify existing stormwater features. Unless specified otherwise, all elevations are referenced to NGVD (National Geodetic Vertical Datum), 1929. Available land use, soils and topographic maps were employed to derive runoff parameters and were also used in water quality modeling and natural systems evaluations. Hydraulic input data for the County stormwater model was then developed based on the physical characteristics of the watershed and was then calibrated to known storms from the past to ensure the accuracy of the model. The results from the calibrated existing conditions model were then used to evaluate the location and degree of expected flooding within the study area to determine the existing conditions for the 2.33-year, 5-year, 10-year, 25-year, 50 year and 100 year design storms. The model was then used to evaluate the existing conditions Level of Service (LOS) for the watershed. 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.

Recently, a number of watershed-level planning efforts have been developed within the Tampa Bay area to address issues related to flood protection, water quality, natural systems, and water supply. These efforts are summarized in Hillsborough County’s Comprehensive Plan (Stormwater Management, Conservation and Aquifer Recharge, and Coastal Management Elements); the Southwest Florida Water Management District’s Comprehensive Watershed Management Plan (CWM) and Surface Water Improvement and Management (SWIM) Plan, and the; Tampa Bay Estuary Program’s Comprehensive Conservation Management Plan. With this

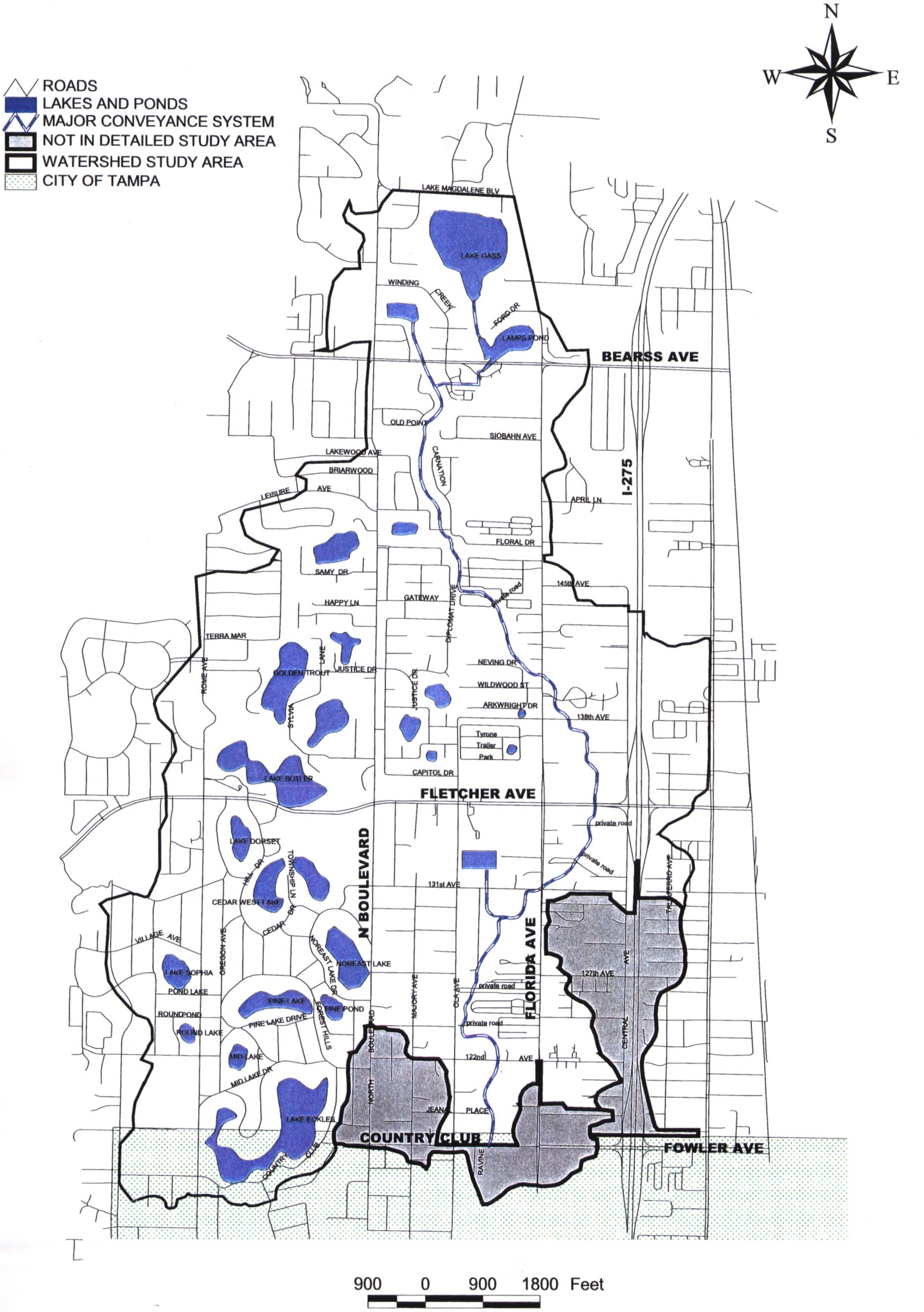

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FIGURE 1-4

WATERSHED STUDY AREA

framework in mind, water quality, natural systems, and water supply issues were analyzed in concert with flooding issues/problem areas to avoid potential conflicts in the development of flood protection alternatives and to increase the overall benefits of projects developed for the watershed.

Upon completion of the existing conditions analysis, an analysis of alternatives to alleviate flooding, water quality, natural systems, and water supply problems was performed. These alternatives were evaluated to produce recommendations that will meet or increase the County's level of service for flood protection as well as integrate important water quality, natural systems, and water supply improvements. Hillsborough County has a targeted level of service for the primary conveyance features that will protect homes and limit street and yard flooding during the 25 year 24 hour duration storm event. The calibrated existing condition model was used to simulate possible alternatives and evaluate results. Those alternatives with a potential water quality, natural systems, and/or water supply benefit were given priority. All alternatives were considered for possible permitting issues, construction issues, and public acceptance. Planning level costs have also been developed for the suggested improvements.

1.3 BACKGROUND AND DATA COLLECTION

To properly describe the watershed area, information was compiled from a variety of sources. This data included previous studies, existing survey information, depiction of additional survey, land use and soils coverage, rainfall and, streamflow data, construction plans, floodprone area documentation, existing water quality information and a limited field investigation. The following is a discussion of the sources and a listing of the literature review. The following agencies were contacted and information /data requests made:

- Hillsborough County
- Southwest Florida Water Management District (SWFWMD)
- Hillsborough County Environmental Protection Commission (HCEPC)
- United States Army Corps of Engineers (USACOE)
- City of Tampa (COT)
- Florida Department of Transportation (FDOT)
- Federal Emergency Management Agency (FEMA)
- United States Geological Survey (USGS)

The literature/data search yielded the following;

Soil Survey of Hillsborough County

A detailed Soil Survey for Hillsborough County was issued by the Soil Conservation Service in May of 1989, a Branch of the United States Department of Agriculture. This report classifies soil types for engineering and planning purposes. This data was in the GIS format and delivered by Hillsborough County.

Land Use

Existing land use coverage was in a Geographical Information System (GIS) format, and provided by Hillsborough County as obtained from the Southwest Florida Water Management

District. These coverages were based on the Florida Land Use Cover Classification System (FLUCCS) 1995.

Roadway Plans

Several county, state and federal roadway drainage systems are contained within the study area. Record drawings of these roadways were collected to obtain information on subbasin delineations as well as conveyance features. These included:

- Florida Avenue- State Roadway
- Interstate 275- Federal Roadway
- Fletcher Avenue-County Roadway
- Bearss Avenue-County Roadway
- I-275 Widening: South of Fowler to South of Fletcher, Design Document/ Environmental Resource Permit Package, Sept 1998

Aerial Photography and Contour Maps

KCA obtained aerial photographs from Hillsborough County (1997) and Aerial Photographs with Contours from the Southwest Florida Water Management District (1981).

Existing Studies

KCA performed a literature search for documents that may contain usable information pertaining to the study area.

The literature search yielded the following:

- Flood Insurance Study-Hillsborough County, Federal Emergency Management Agency- Community Number 120112, Aug. 1992
- Contamination of Sulphur Springs, Tom Cardinale, Environmental Protection Commission of Hillsborough County, March 1993
- Hillsborough River Comprehensive Watershed Management Atlas –Draft, SWFWMD, 1999
- Hillsborough River Comprehensive Watershed Management Plan-Draft, SWFWMD, 1999
- Curiosity Creek Detention Pond (F100C), E. McQuire, Florida Land Design, 11-1986, Project number 10683.00
- Dye Test and Water Quality Sampling Final Report Sulphur Springs Pool, January – October 1989, Environmental Engineering Consultants, Inc. May 1990
- Hydrologic Investigation and Stormwater Management Plan for the Curiosity Creek Watershed, Piercefield Amaden and Assoc., Reynolds Smith and Hills, Sept 1982.
- Curiosity Creek Watershed-Greiner, 1960. (copy not recovered)
- Hillsborough County Public Works Department Drainage Inventory-Date unk.
- Flooding in Northwestern Hillsborough County and Southern Pasco Counties, Florida, in 1979, W.R. Evans, Jr., R.P. Evans, J.K. Whalen, United States Geological Survey, 1984

Construction Plans

KCA obtained the following construction plans of significance in the watershed area;

- 132nd Street and Central Avenue-Hillsborough County Public Works Department,1998
- Windwood Oaks Apartments Ph. II- Post, Buckley, Schuh and Jernigan, 1998
- Ed Morse Cadallic (Bay Cadallic)-engineer of record unknown. 1985
- Bob Wilson Dodge – date unk.

Problem Area Documentation

Documentation for the reported flood prone areas was derived from several sources. Primarily this information was obtained through County records. These records were in GIS format and in hard copy stored in County records. Much of the data related to the events and problems associated with the El Nino storms of 1997 and 1998, during the months of September, December, and January (1998). In addition, KCA performed a limited document search through the files of the Hillsborough County Stormwater Management Section. The documentation of problem areas generally consisted of only an address. Little, if any, information was found about the nature of the problem, nor was there any information on the depth or duration of any flooding problems.

Any questions, comments, or other inquiries regarding the content of this report or the project in general should be directed to the Hillsborough County Public Works Department, Engineering Division, Stormwater Management Section. The computer model, input/output data files, and drawings developed during the study are available, and will be provided upon written request.

CHAPTER 2
WATERSHED DESCRIPTION

2.1 GENERAL DESCRIPTION

2.1.1 Climate

The climate in Hillsborough County can be classified as subtropical. The average rainfall for the county is approximately 50 inches per year. The rainy season generally begins in the month of June and lasts until September. The summer months are hot and humid with high temperatures in the 90's. During the summer months, late afternoon thunderstorms are common. These storms are generally of high intensity but short duration.

2.1.2 Topography

The topography in the Curiosity Creek watershed can be characterized as relatively flat. The ground elevations vary little from the upper portion of the study area to the County boundary. The ground elevations around Lake Gass (upper watershed area) are approximately 56 feet above the National Geodetic Vertical Datum (NGVD) while the ground elevations around the Blue Sink (lower watershed area) are approximately 35 feet (NGVD). This gives the basin area an average slope of approximately 0.0015 ft/ft (see Figure 2-1).

2.1.3 Soils

According to the Natural Resource Conservation Service (NRCS) there are 13 different types of soils that occur within the Curiosity Creek Watershed Area (see Figure 2-2) that are mapped in the Soil Survey of Hillsborough County. The various types of soils have been grouped into four hydrologic soil groups designated as A through D. These groups are used in watershed planning to estimate runoff from rainfall. Soil properties that determine the group that a soil will be placed into are: depth to seasonal high water table, infiltration rate and permeability after prolonged wetting, and depth to confining layer. A description of these groups is as follows:

- **Hydrologic Soil Group A (low runoff potential):** Soils that have high infiltration rates even when thoroughly wetted and a high rate of water transmission.
- **Hydrologic Soil Group B (moderately low runoff potential):** Soils that have moderate infiltration rates when thoroughly wetted and a moderate rate of water transmission.
- **Hydrologic Soil Group C (moderately high runoff potential):** Soils that have a slow infiltration rate when thoroughly wetted and a slow rate of water transmission.
- **Hydrologic Soil Group D (high runoff potential):** Soils having very slow infiltration rates when thoroughly wetted and a very slow rate of water transmission.

Some soils are classified as belonging to dual hydrologic groups (for example B/D). These soils when wet are rated as D in their natural condition. These soils can be adequately drained and that drainage improves the hydrologic soils group by at least two classes. (from D to B). The

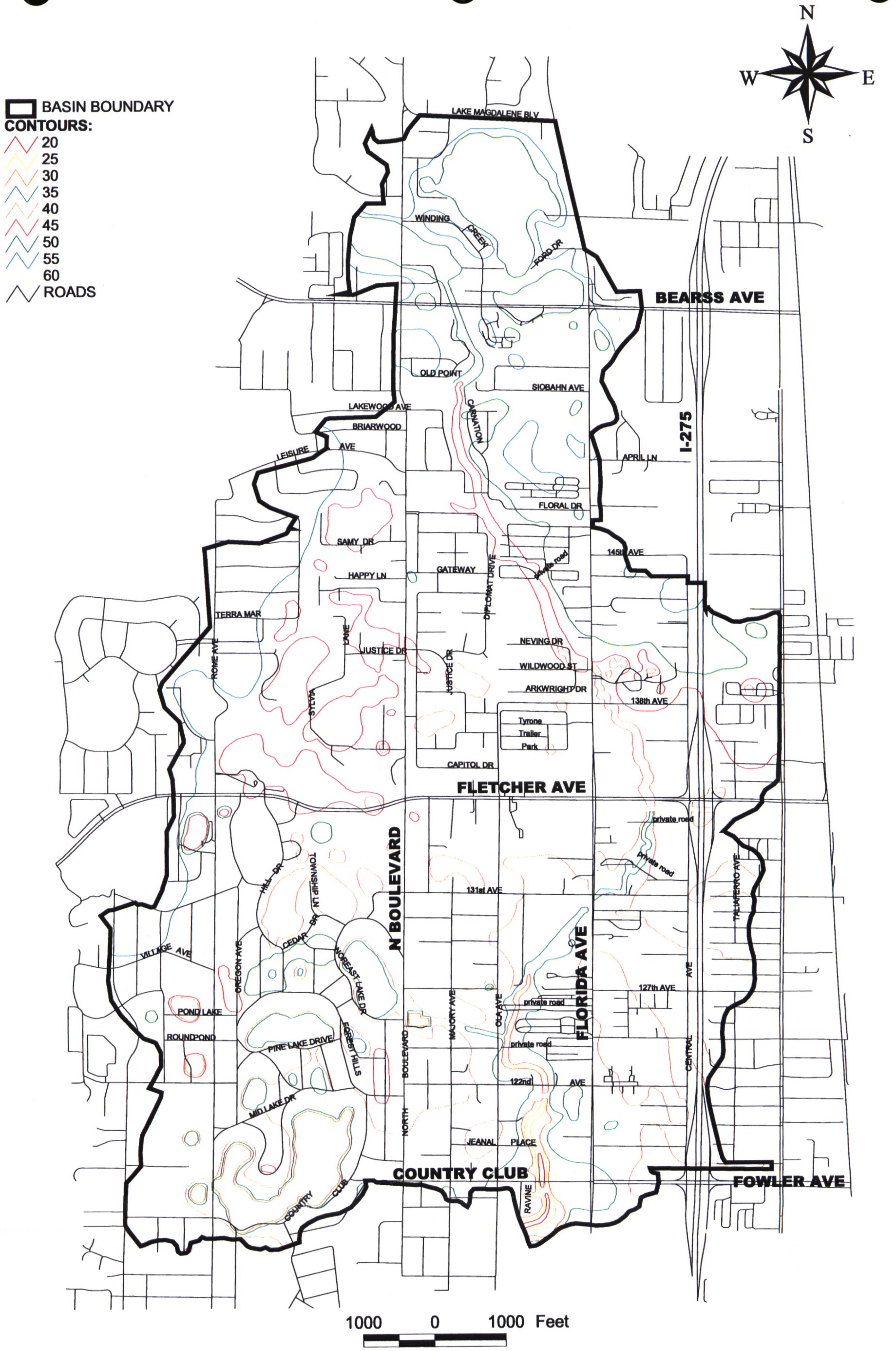

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FIGURE 2-1

TOPOGRAPHY

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FIGURE 2-2

SOIL CLASSIFICATION MAP

first letter in the designation applies to the drained condition. The distribution of the hydrologic soil types for each subbasin was determined using the coverages in the GIS database and the digitized subbasin delineations. A designation for water bodies is also included in the GIS coverage (see Figure 2-3).

2.1.4 Land Use/Coverage

1995 Land Use/Land Cover for this project was obtained from the Southwest Florida Water Management District (SWFWMD) Geographical Information System database. The information contained in the database is based on the Florida Land Use and Cover Classification System (FLUCCS) (see Figure 2-4).

The SWFWMD FLUCCS mapping database indicates that approximately 49.4% of the Curiosity Creek watershed is classified as high density residential. Multiple family and high density single family residential development are included in this designation. It was estimated that only 2.5% of the basin is classified as low and 11.0% was classified as medium density residential. Less than 1.6% of the watershed remains as open land. Approximately 6.2% of the basin is made up of waterbodies and wetlands which serve to store stormwater runoff during extreme flooding events. The Land Use distribution for the 1995 land use coverage is shown in Table 2.1. The Existing Land Use (Hillsborough County Property Appraiser) and the Generalized Future Land Use (Hillsborough Planning Commission) are shown in Figure 2-5 and Figure 2-6 respectively.

Table 2.1 - 1995 Land Use Distribution

Land Use Category	*FLUCCS / Designation*	*Area (Ac.)*	*Percentage*
Residential Low Density	1100	55.435	2.5
Residential Medium Density	1200	242.006	11.0
Residential High Density	1300	1087.706	49.4
Commercial and Services	1400	296.005	13.4
Extractive	1600	0.539	0.0
Institutional	1700	75.335	3.4
Recreational	1800	12.553	0.6
Open Land	1900	34.625	1.6
Tree Crops	2200	17.396	0.8

Table 2.1 - 1995 Land Use Distribution (Cont.)			
Land Use Category	**FLUCCS / Designation**	**Area (Ac.)**	**Percentage**
Hardwood and Conifer Mixed	4340	109.383	5.0
Lakes	5200	81.820	3.7
Reservoirs	5300	50.724	2.3
Wetland Forested Mixed	6300	6.587	0.3
Freshwater Prairie	6410	4.882	0.2
Wet Prairies	6430	0.686	0.0
Emergent Aquatic Vegetation	6440	44.469	2.0
Intermittent Ponds	6530	0.775	0.0
Transportation	8100	81.780	3.7
Total		2202.706	100.00

2.2 FEATURES

The most notable natural features in the watershed area are the lakes and the channel of Curiosity Creek. The largest lakes that are totally contained within the limits of Hillsborough County are Lake Gass and Lake Butler. Lake Gass has a surface area of approximately 55 acres. Lake Butler is a smaller lake that lies to the south of Lake Gass and has a surface area of approximately 16 acres. The most notable roadway features in the study area are Florida Avenue and Interstate 275. Florida Avenue is a four-lane state highway that gives access to many commercial and residential centers in the study area (see Figure 2 -7).

2.3 HISTORICAL SYNOPSIS OF FLOODING IN THE WATERSHED

March 1960- Heavy rains cause flooding in the Forest Hills area. Many families are forced to evacuate. References indicate that flooding also occurred during the previous fall of 1959 in the Forest Hills area.

May 1979- Rainfall totals from May 7, 1979 were reported as 11.45 inches in 24 hours, and may have been as high as 15 inches. However only minor and localized flooding was reported. This was attributed to the relatively dry conditions of the basin at the time the storm occurred.

September 1979- Approximately 36 to 38 inches of rain fell in the months of August and September. Heavy rainfall (similar to that of May 1979) caused severe flooding in areas of the

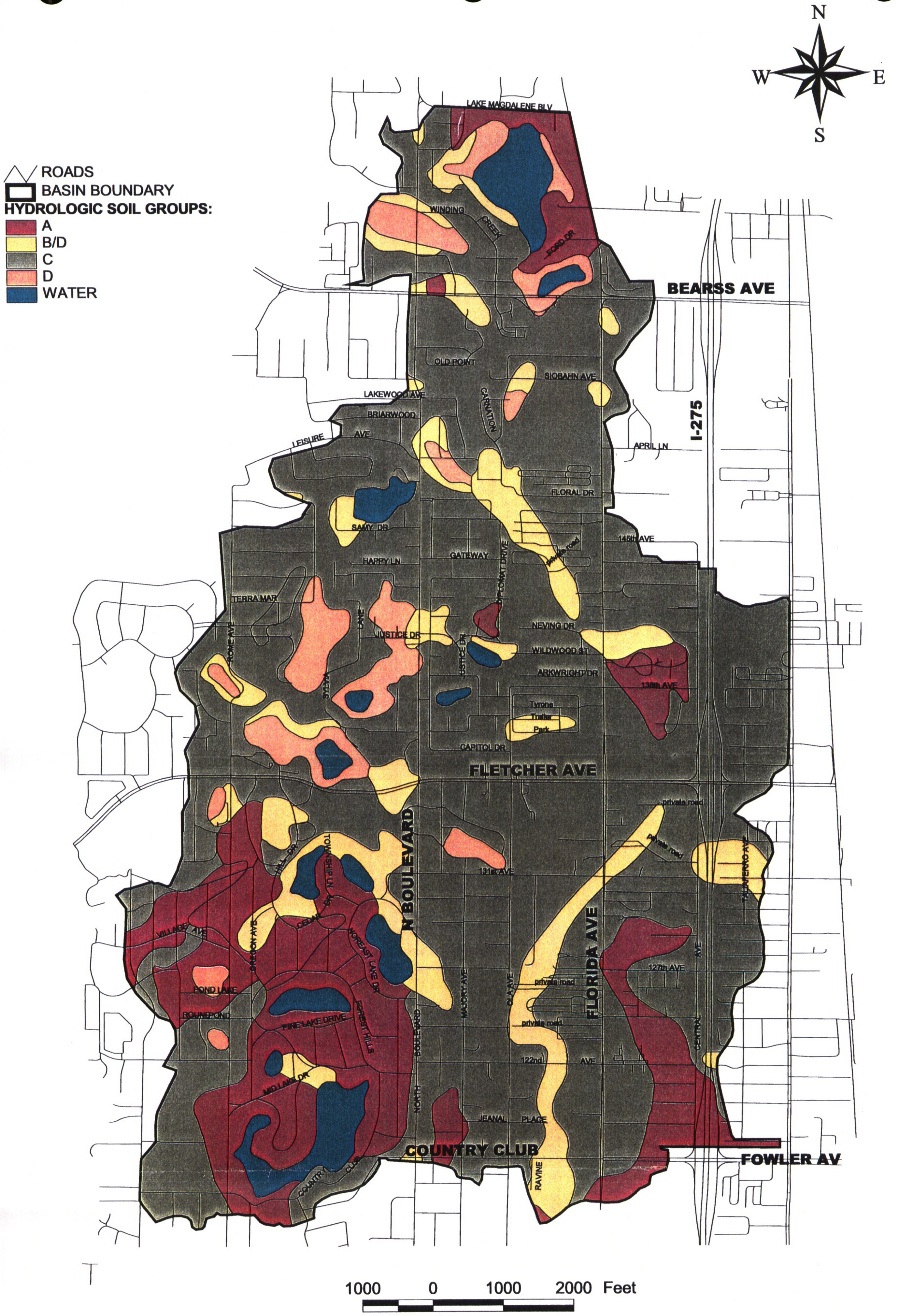

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FIGURE 2-3

HYDROLOGIC SOIL GROUPS

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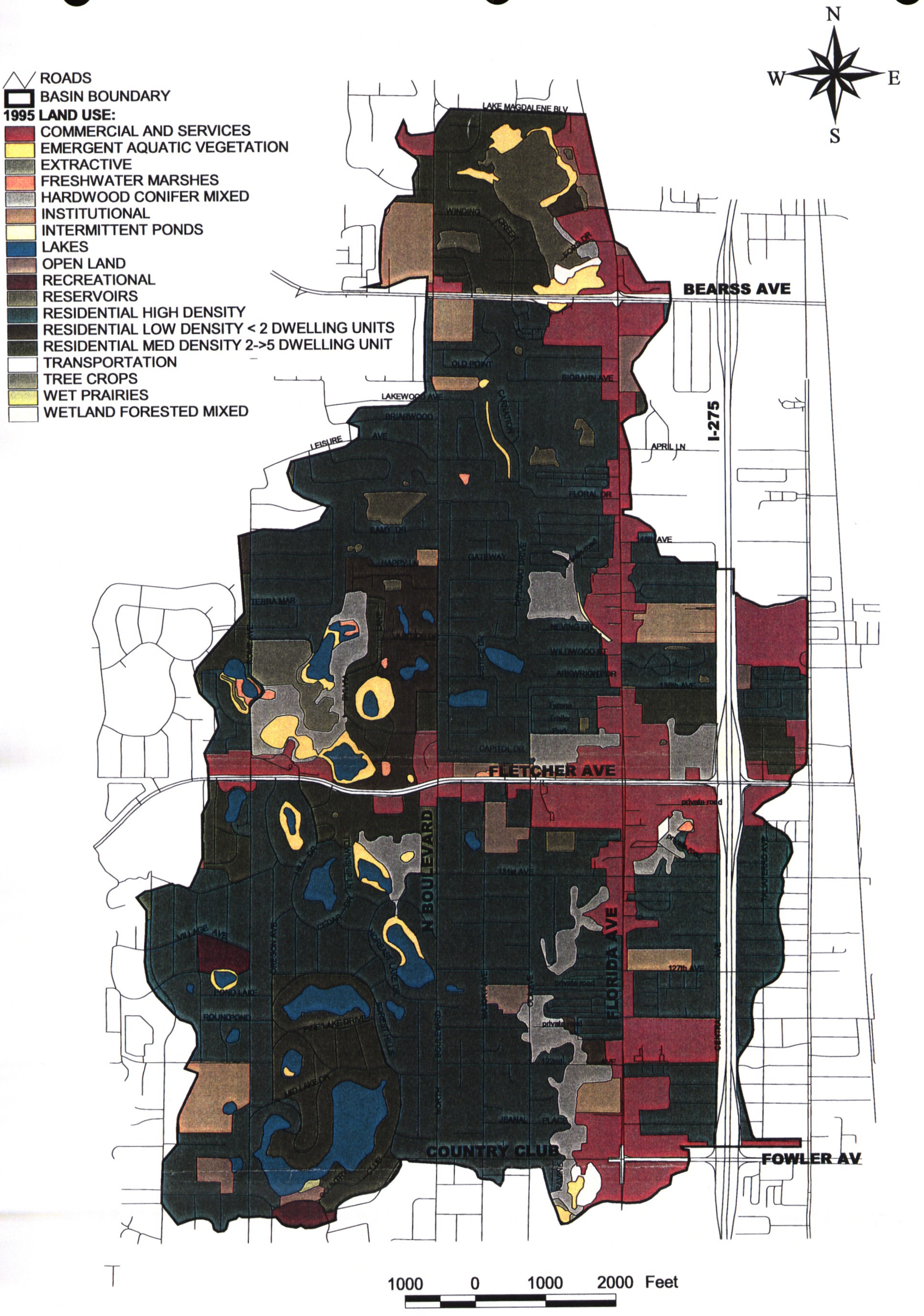

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FIGURE 2-4

1995 LAND USE

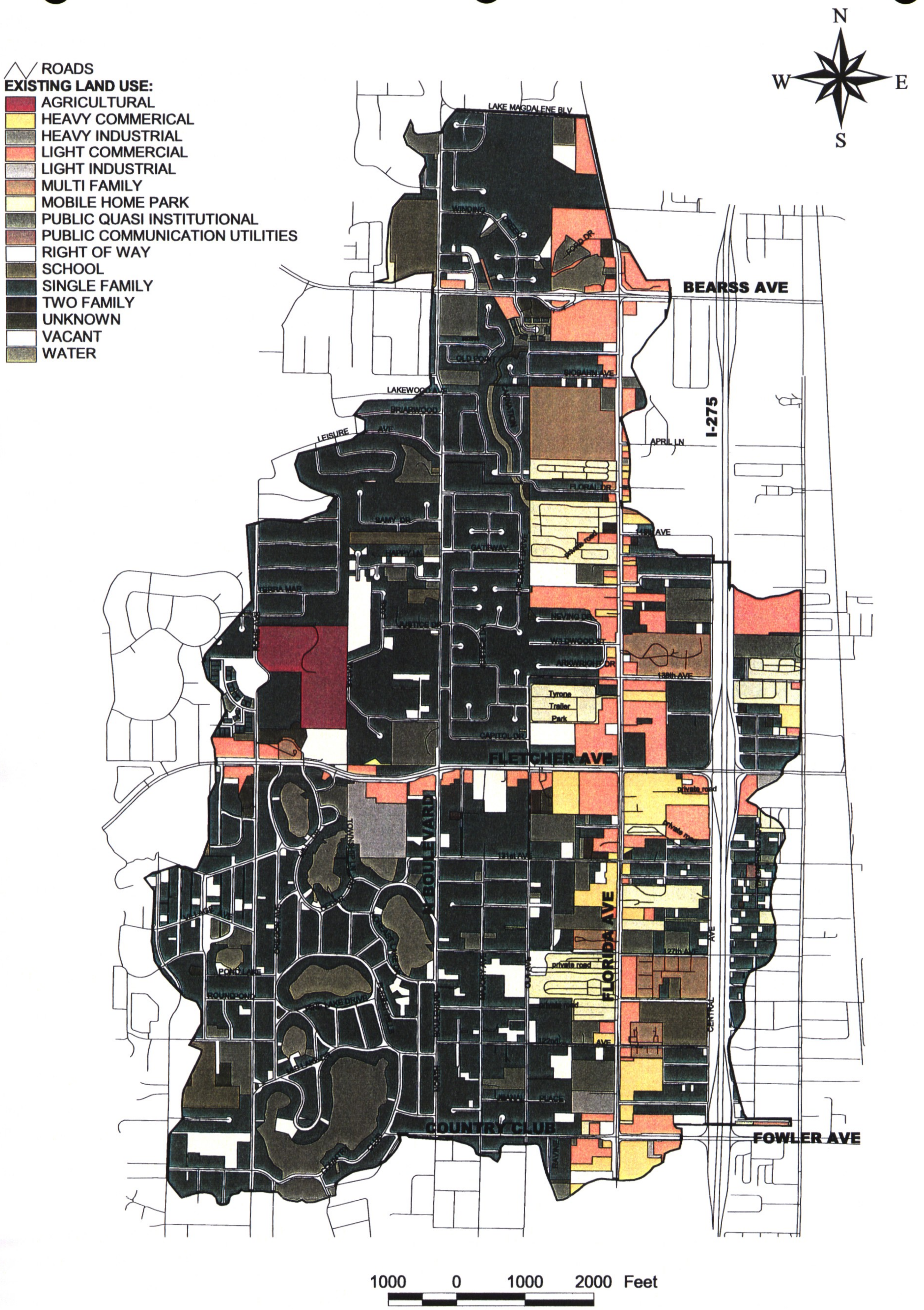

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FIGURE 2-5

EXISTING LAND USE

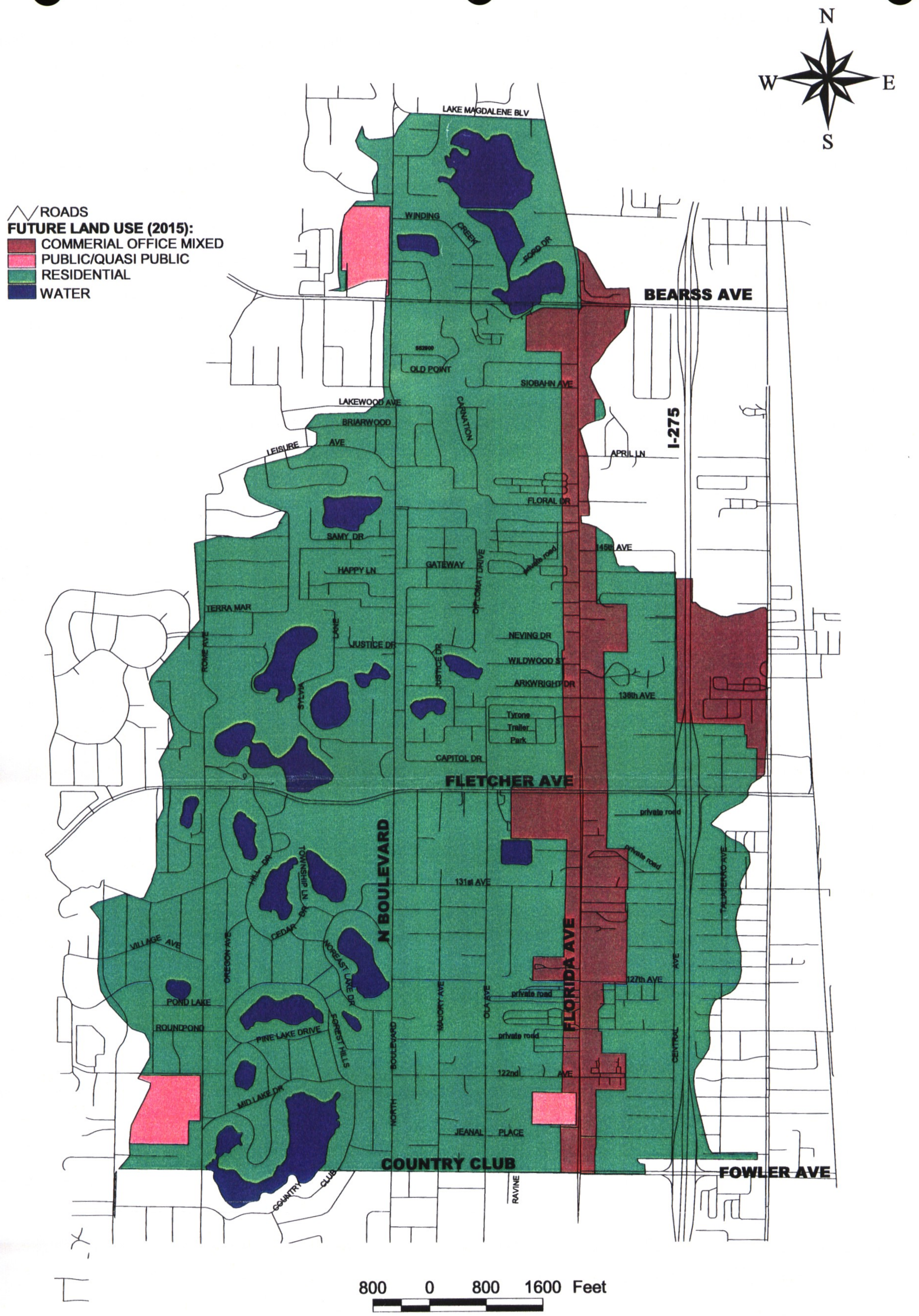

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FIGURE 2-6

FUTURE LAND USE (2015)

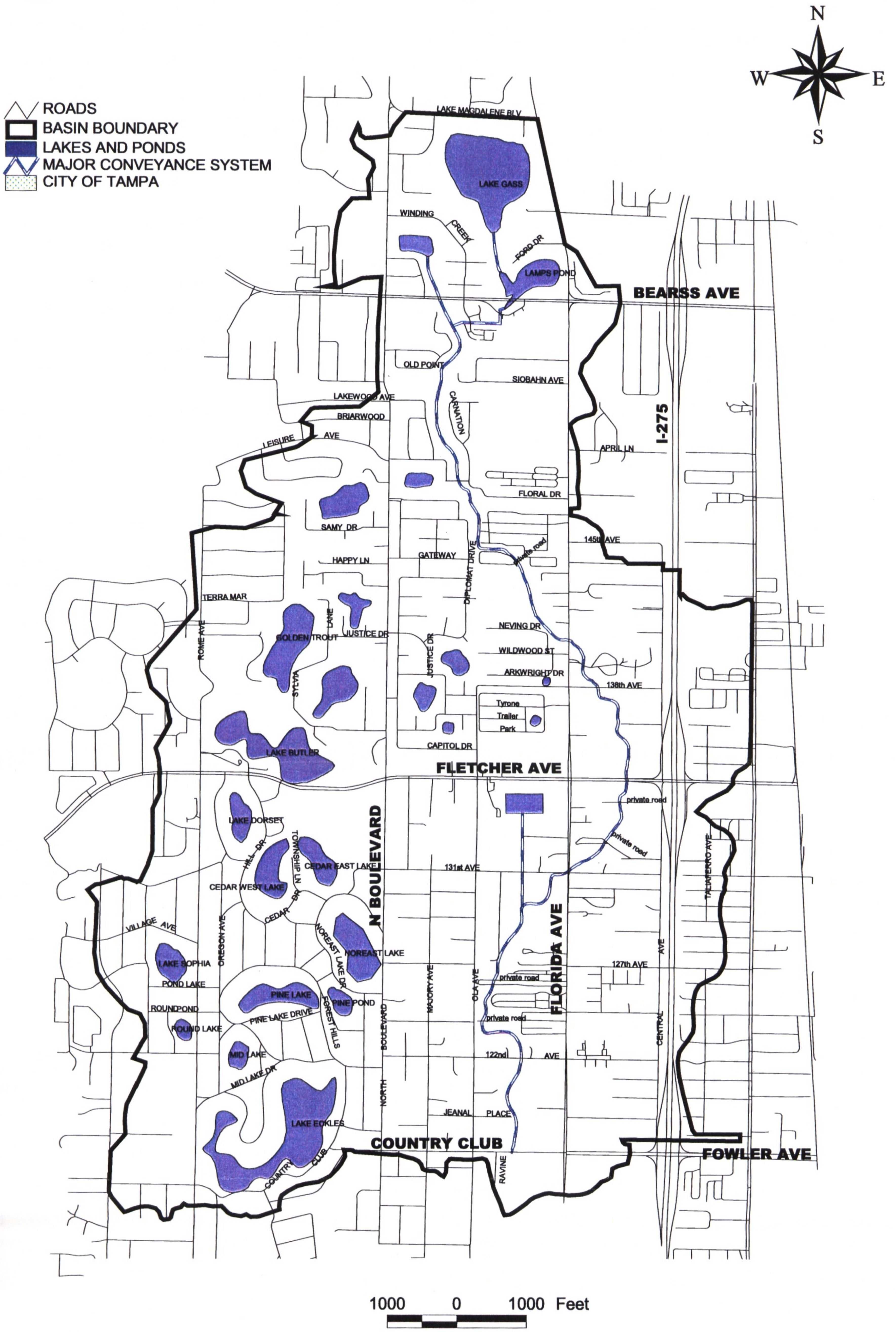

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FIGURE 2-7

FEATURES MAP

Curiosity Creek basin which were already saturated from previous rainfall events. Widespread flooding of Forest Hills and the Tyrone Trailer Park forced residents from their homes.

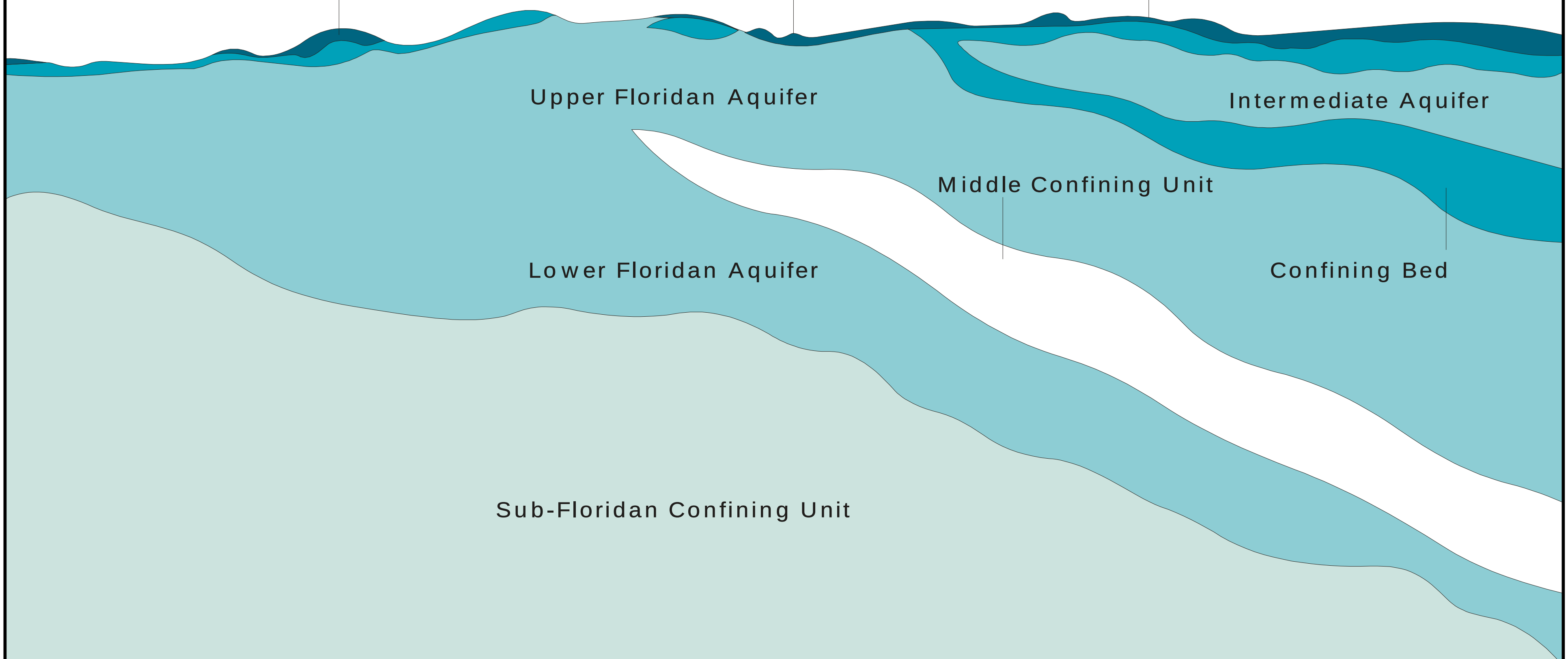
September 1997 to January 1999 –The El Nino winter of 1997 was arguably the strongest El Nino on record. The normal total rainfall for the month of December is 2.14 inches. December of 1997 produced 15.01 inches of rainfall, which is 701% higher than normal for that month (ref. SWFWMD Daily Rainfall Report 29-Dec-97; Regional Summary, Northwest Hillsborough). This event produced records of reported flooding problems that are mostly related to areas with no outfall or maintenance issues within the creek. These flood reports were concentrated around the lakes in the Northwest Lake System. Although there does not appear to have been any house flooding, there were reports of prolonged street and yard flooding. Ground saturation led to problems with septic systems, and concerns about well contamination.

2.4 HYDROGEOLOGY

Undifferentiated surficial deposits of silt, sand, and clay that vary in thickness from 40 to 70 feet underlie the Curiosity Creek Watershed area. The lower part of these deposits consists of clay, sandy clay, and clayey sand and act as a confining layer over the Floridan acquifer throughout most of the area (Stewart and Mills, 1984). The Floridan acquifer system consists of several hundred feet of limestone and dolomite formations and is separated into the Upper Floridan Acquifer, the Middle Confining Unit, and the Lower Floridan Acquifer (see Figure 2-8). The formations that make up this system include in descending order, the Tampa Limestone, the Suwannee Limestone, Ocala Limestone, Avon Park Limestone, and the Oldsmar Limestone.

Groundwater flow within the surficial acquifer is generally south, but will vary locally in relation to Curiosity Creek and the many lakes and ponds in the area. Flow within the Floridan is generally to the south also, but can vary due to extensive cavity systems that occur within the upper part of the Floridan acquifer. Due to the cavernous nature of the upper limestone units, many sinkholes occur in the watershed, especially in the southern part. These include Blue Sink into which the creek discharges, and numerous other sinkholes, most of which occur to the south and east of Blue Sink. Several dye tracer studies have been performed in Blue Sink dating back at least to the 1950's. These tests have shown that many of the sinkholes are connected via underground cavities, and that the groundwater eventually discharges to Sulphur Springs in the City of Tampa. The velocity of the groundwater within these cavity systems is very high, and based on the past dye tests have shown ranged from approximately 5,000 feet/day to over 7,000 feet/day (Cardinale, 1993). However, the connection from Blue Sink to Sulphur Springs has been severely impacted over the years due to increasing clogging of the sink from erosion and sedimentation, trash, and other debris.

SWFWMD HYDROGEOLOGIC CROSS-SECTION



PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
STORMWATER MANAGEMENT SECTION

KISINGER CAMPO & ASSOCIATES CORP.

FIGURE 2.8

CHAPTER 3
MAJOR CONVEYANCE SYSTEMS

3.1 INTRODUCTION

The purpose of this chapter is to describe and define the area of analysis presented in this report. The major conveyance areas of the Curiosity Creek Watershed area are as follows:

- The Northwest Lake System
- The Curiosity Creek Main Channel
- The Forest Hills Basin

3.2 THE NORTHWEST LAKE SYSTEM

This system of lakes lies in the northwest section of the watershed. It is bordered by Leisure Avenue on the north, Rome Avenue on the west, North Boulevard on the east, and on the south by Pine Lake and Village Drive. The total drainage area for this portion of the watershed is approximately 530 acres. The major lakes in the system are Golden Trout, Butler, Dorset, Cedar West, Cedar East, Noreast and Pine (see Figure 3-1).

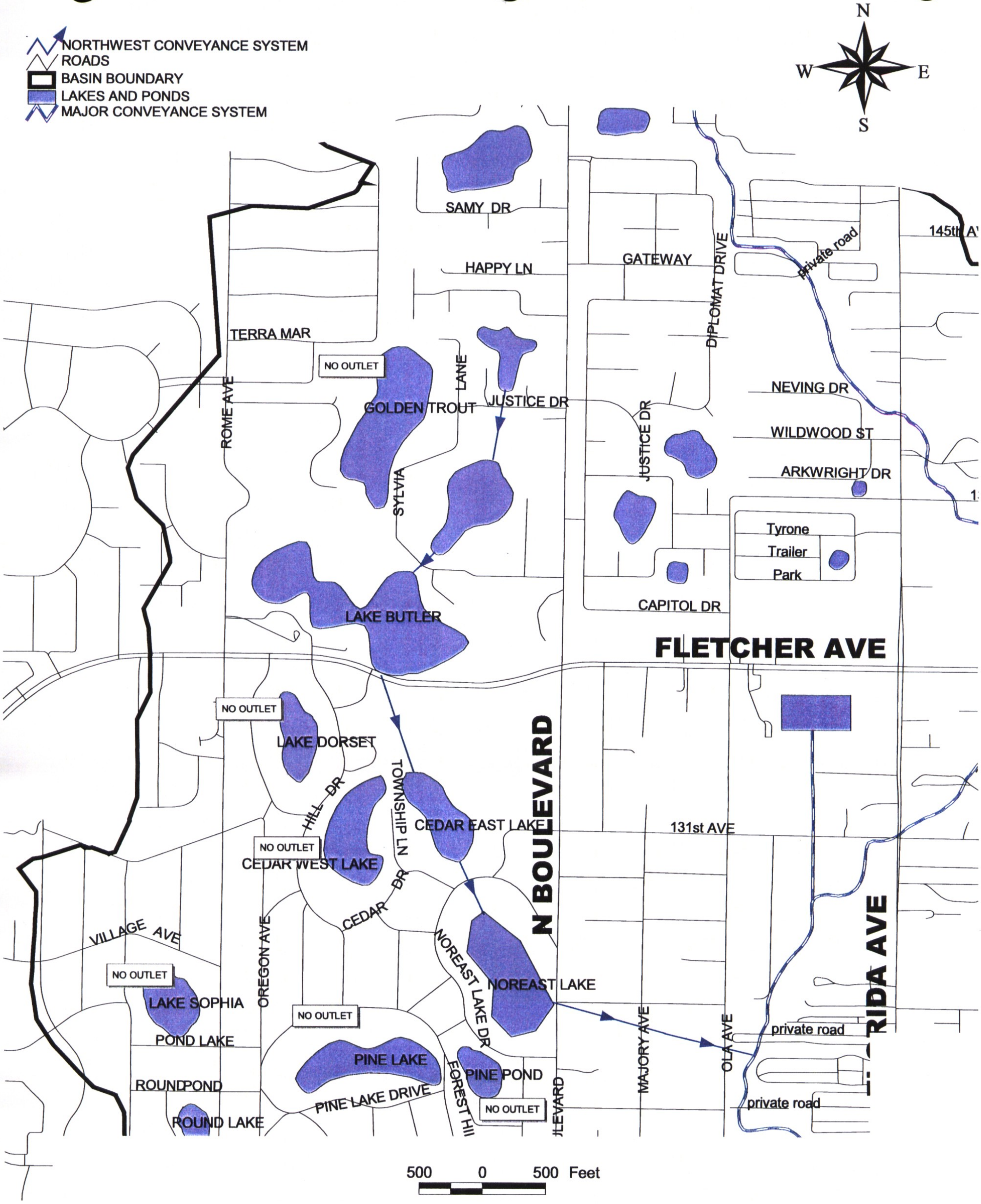
The upper most lake in the Northwest Lake System is Lake Golden Trout. This lake is approximately 45 acres and discharges to an unnamed lake that is located to the southeast of Golden Trout. At stages above elevation 45.8 this lake will discharge in an overland manner to the unnamed lake. Lake Golden Trout does not have a stormwater control structure to regulate water levels. Water from the unnamed lake discharges through a 24-inch reinforced concrete pipe (RCP) to Lake Butler. This lake has a control structure and delivers excess runoff through a pipe system under Fletcher Avenue to a small lake immediately to the south. There is a series of small lakes with interconnected pipes that ultimately, deliver water to Lake Cedar East. From Cedar East, water is discharged through a pipe to Lake Noreast that is located to the southeast. Lake Noreast has a discharge pipe that is directly connected to Curiosity Creek.

Lakes Dorset, Cedar West, Pine, Sophia, Burnes, Pine Pond, as well as several other unnamed lakes, are all land locked water bodies with no outfall. These lakes accumulate rainfall during the wet months and have historically been slow to recover. Toward the end of the rainy season many of these lakes have lost considerable storage volume due to the compounding of storm events. It is at this time that the system has the greatest potential for flooding.

3.3 THE CURIOSITY CREEK MAIN CHANNEL

3.3.1 The Main Channel

The headwater of Curiosity Creek begins at a small pond north of Bearss Avenue and east of North Boulevard (see Figure 2-7). Historically, the headwaters were connected to the Sweetwater Creek watershed at a point somewhere between Lake Platt and Lake Magdalene. This connection appears to have been severed sometime in the late 1950’s. From the small pond, the



HILLSBOROUGH COUNTY FLORIDA

CURIOSITY CREEK WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES CORP.

FIGURE 3-1

NORTHWEST LAKE SYSTEM

channel flows southeast and passes under Bearss Avenue. This section of channel is straight and has steep sideslopes, with a flat bottom, and is typical of urban ditch conveyance systems. After Bearss Avenue the channel receives discharge from Lake Gass and Lake Blue Gill. This runoff is discharged to the creek through an 18-inch RCP and enters the creek from the east at a point about 500 feet south of the Bearss Avenue crossing.

The channel continues to flow to the south and enters an area bounded by residential land use. This portion of the creek widens and has been excavated. This portion of the system is straight, and is wet, with very little apparent flow. The survey of this portion of the creek indicated that the depth of the water in some areas under normal conditions was approximately 6 feet. The channel vegetation is made up of wetland type species and is very heavily saturated with algae. The sideslopes are steep and there is evidence of erosion. This section of the channel has a silty bottom. The creek continues to flow to the southeast until after it crosses under the roadway of Floral Drive.

At a point approximately 500 feet downstream of the Floral Drive crossing, the creek turns due south. This appears to be an unnatural change in direction. There is a mobile home community at this location, which altered the creek as a result of development, (Hydrologic Investigation and Stormwater Management Plan for the Curiosity Creek Watershed; Reynolds, Smith and Hills 1982). The creek follows the western edge of the development and turns sharply to the east passing through the mobile home community. This portion of the channel is well maintained. The difference in elevation from the top of bank on the right to that on the left is approximately 5 feet. The contour maps, which predate the portion of the development to the south, indicate that this large difference in elevation is a natural condition and not totally the result of fill. It also appears that the mobile homes that are to the north of the channel may be located within the floodplain limits.

After passing under a private roadway within the mobile home community, the creek turns again to the south. It is bordered on the east by a berm for a FDOT stormwater detention pond. This pond serves the roadway of Florida Avenue and discharges through a pipe system to a point immediately upstream of the crossing at Curiosity Creek and Florida Avenue (north crossing). The creek continues to flow toward the southeast and passes under a private dirt drive. Approximately 200 feet downstream of the dirt driveway crossing, the creek flows adjacent to a non-regulated dumping site. Field reconnaissance did not determine the exact nature of the debris but it appears to be comprised of construction and non-garbage related materials. The channel in this portion is straight with a silty bottom and has sideslopes that are vegetated with small brush and trees.

The channel continues to flow to the southeast and eventually passes under Florida Avenue through twin 8 foot by 4-foot box culverts. Downstream of the Florida Avenue crossing, the channel takes on a more natural appearance. The channel begins to meander and is very incised and is narrower than the upstream sections. This configuration continues as it flows through an apartment complex development and toward the crossing at 138th Avenue. The creek begins to turn due south after passing under 138th Avenue where another FDOT roadway detention pond for Florida Avenue discharges to the system. This was the location of a USGS gaging station from 1981 to 1988.

The system continues and passes under Fletcher Avenue via twin 7 foot by 6-foot box culverts. These box culverts are set very deep. The culvert inverts at Fletcher Avenue are approximately 4.6 feet deeper than the next downstream structure (driveway crossing for an automobile dealership) and approximately 5.1 feet deeper than the next upstream structure (138th Avenue). The channel bottom, in the vicinity of the Fletcher Avenue crossing, is approximately 4 feet higher than the inverts of the box culverts.

After passing under Fletcher Avenue, the channel straightens again and passes under two driveway crossings. The first is a driveway crossing for an automobile dealership and the second is a driveway crossing for a mobile home community. It is interesting to note that the structure under the upstream driveway, (the dealership), utilizes a 4 foot by 8 foot box culvert while the downstream driveway structure, (the mobile home community), utilizes 3 foot diameter CMP with a cover of less than 1 foot. It would generally be expected that the smaller pipes in a conveyance system would be found upstream of larger pipes as flow generally increases in a system from upstream to downstream. The creek at this point begins to turn to the southwest. The sideslopes are rather steep with little vegetation in the actual bottom, but the channel is vegetated with brush and trees along the top of bank. The system then passes under Florida Avenue at 131st Avenue via twin 72 inch RCP's. Downstream of the southern Florida Avenue crossing, the channel appears to have been altered and the flow area encroached upon by fill. Approximately 200 feet downstream of the Florida Avenue crossing, are the remains of a washed-out road crossing. This road crossing is now abandoned, but was mentioned in the 1982 RS&H study as existing and apparently functional at that time. The nearly totally exposed 60 inch RCP remains in the streambed.

Between 131st Avenue and 122nd Avenue the stream receives discharge from two additional systems. The first is a FDOT detention pond that is located north of 131st Avenue and south of Fletcher Avenue. This pond receives runoff from both Fletcher Avenue and Florida Avenue. The second is the Northwest Lake System that discharges to Curiosity Creek through a 36-inch pipe from Noreast Lake at a point approximately 2300 feet north of Country Club Drive. This section of the creek system has several crossings ranging from small wooden footbridges to driveway crossings. All of these crossings appear to be privately owned and constructed. There are some older mobile home communities existing in very close proximity to the top of bank of the creek. Much of the creek system appears to have been constrained by development.

Downstream of the crossing of 122nd Avenue the channel is well vegetated with a rather narrow bottom width (approximately 7 feet). The creek passes behind many private residences as it flows in a southerly direction to Country Club Drive. At Country Club Drive the creek receives direct runoff from Florida Avenue and the adjacent residential areas. The creek delivers runoff to the Blue Sink south of this location. When the Blue Sink exceeds it's retention capacity it discharges over an earthen berm of over 80 feet in width to a large retention facility owned by the City of Tampa. The retention area also receives runoff from the basin containing Forest Hills. The overflow berm elevation for the Blue Sink was set at 25.50 (Curiosity Creek Detention Pond F100C Comprehensive Design, Florida Land Design and Engineering, 1987). A summary of the Curiosity Creek Main Channel Conveyance Features is shown in Table 3.1

3.3.2 Tyrone Mobile Home Park Area

The Tyrone Mobile Home Park Area lies north of Fletcher Avenue and west of Florida Avenue, (see Figure 3-2). This area includes the mobile home park and the five lakes and ponds that store runoff from the adjacent basins. This area does not have an outfall. Runoff from the surrounding area drains into the small retention area within the park. The capacity of this small pond is quickly diminished and subsequent flooding occurs. The lakes adjacent to the mobile home park also do not have the ability to adequately store flood volume. Therefore, when these adjacent lakes exceed their ability to store water they overtop and discharge floodwater over the roads and into the mobile home park, where the natural depressional storage for this area is located. The pond on Arkwright Street (north of the Tyrone Mobile Home Park) also lacks sufficient volume to store significant storm events, and therefore, will also overtop and contribute to the flooding being experienced at the mobile home park. Should the capacity of the storage volume in this area be exceeded, Fletcher Avenue may be overtopped and flood water will sheetflow to the south and into the FDOT retention pond that is south of Fletcher Avenue. Flood stages must reach an approximate elevation of 44.5 before the overtopping of Fletcher Avenue is possible.

3.4 FOREST HILLS BASIN

The Hillsborough County portion of the Forest Hills Basin contains Lake Eckles, Mid Lake, and Round Lake (see Figure 3-3). In addition, there is a small area to the north of Country Club Drive and west of the main channel of Curiosity Creek that discharges through a collection system to the south side of the crossing of Country Club Drive and Curiosity Creek.

Round Lake is landlocked but may discharge floodwater (overland) to Mid Lake. Mid Lake is east of Round Lake and has a pipe connection to Lake Eckles. Lake Eckles is also a land locked water body that has experienced flooding due to a lack of an adequate outfall. This lake is split by the political boundaries of Hillsborough County and the City of Tampa. At the present time, a pump station operated by the City of Tampa maintains water elevations on the lake. Lake Eckles has a high out of bank overflow to the south at approximate elevation of 34.50. Should the lake overflow, it will discharge to Penalty Pond to the south which is located within the City limits.

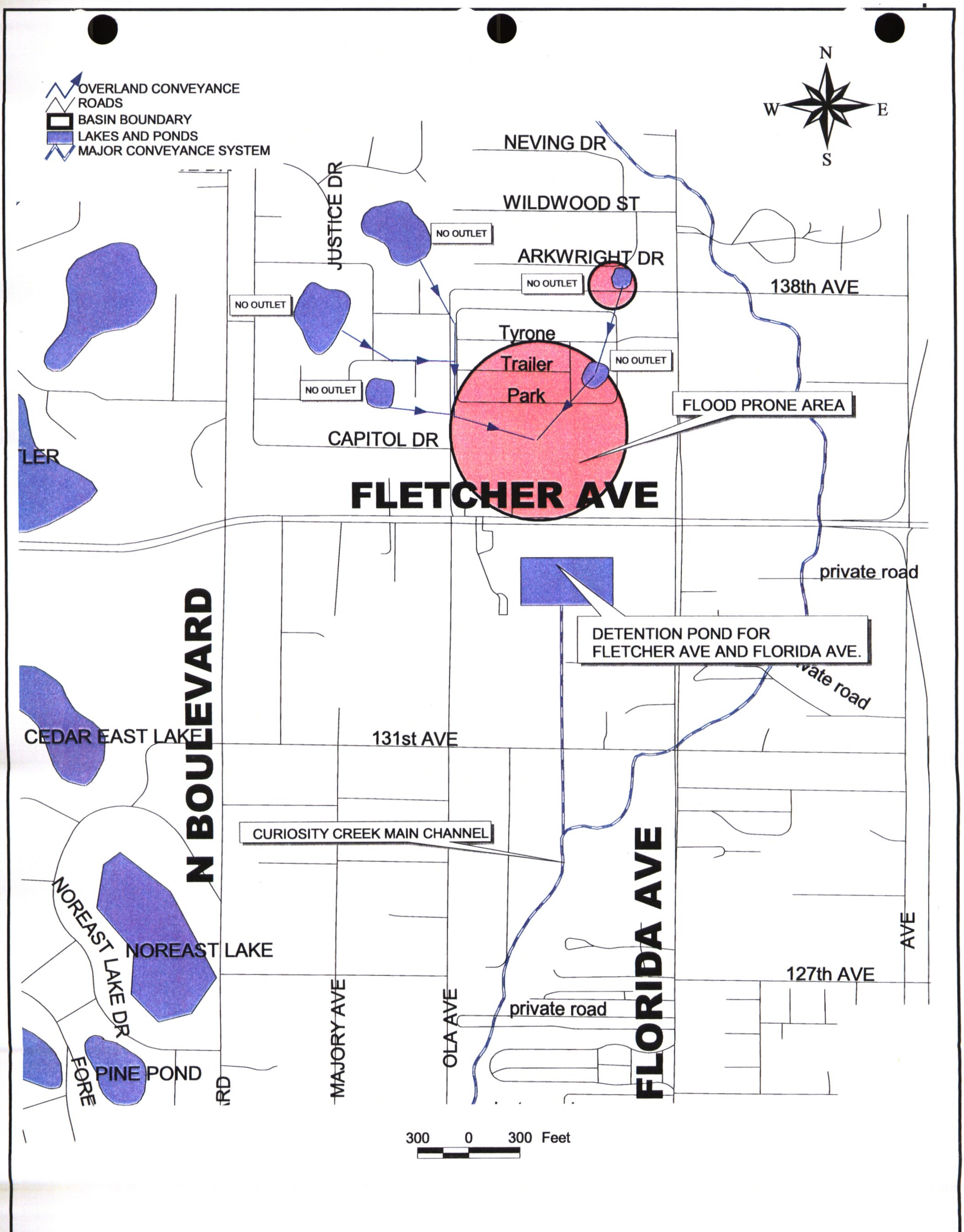
Table 3.1 - Summary of Major Conveyance Features
Curiosity Creek Main Channel

Description	***Reach Number***	***Length (feet)***	***Upstream***	***Downstream***
(conduits listed downstream to upstream)			*Invert*	*Invert*
78 inch RCP at Country Club Drive	1550100	40	19.29	18.73
60 inch RCP at 122nd Avenue	1550300	33	24.88	24.79
48 inch RCP at Dirt Road	1550500	20	28.62	28.55

Table 3.1 - Summary of Major Conveyance Features ***Curiosity Creek Main Channel (Cont.)***				
Description	***Reach Number***	***Length (feet)***	***Upstream***	***Downstream***
(conduits listed downstream to upstream)			*Invert*	*Invert*
48 inch RCP at Dirt Road (MHP)	1550700	20	28.69	28.4
60 inch RCP - partially washed out	1550875	17	32.85	32.53
72 inch (2) RCP at Florida Ave. (south)	1550900	152	31.74	31.52
	2550900	152	31.97	31.54
36 inch CMP at Dirt Road (MHP)	1551100	21	36.31	35.39
4 FT X 9 FT Box culvert (auto dealer)	1553100	54	35.42	35.71
	2553100	54	31.29	31.51
7 FT X 6 FT Box culverts (2) at Fletcher Ave.	1551400	86	31.33	31.53
	2551400	86	31.29	31.51
65 inch X 40 inch CMP at 138th Ave.	1551800	51	37.54	36.49
4 FT X 8 FT Box culvert (Apt complex)	1551900	55	38.79	38.45
3.6 FT X 7 FT (2) Box culvert At Florida Ave. (north)	1552100	83	40.33	40.56
	2552100	83	40.39	40.3
48 inch (2) RCP at Dirt Road	1552300	20	39.45	39.59
	2552300	20	39.13	39.42
24 inch RCP (2) at MHP	2552400	24	42.72	42.52
	3552400	24	42.85	42.54
60 inch RCP at MHP	1552400	24	40.01	39.98

Table 3.1 - Summary of Major Conveyance Features
Curiosity Creek Main Channel (Cont.)

Description	***Reach Number***	***Length (feet)***	***Upstream***	***Downstream***
(conduits listed downstream to upstream)			*Invert*	*Invert*
48 inch RCP (2) at Floral Drive	1552700	39	40.72	40.76
	2552700	39	40.75	40.71
60 inch RCP (2) at Bearss Ave.	1553000	91	44.75	43.79
	2553000	92	45.04	43.74



HILLSBOROUGH COUNTY
FLORIDA

CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

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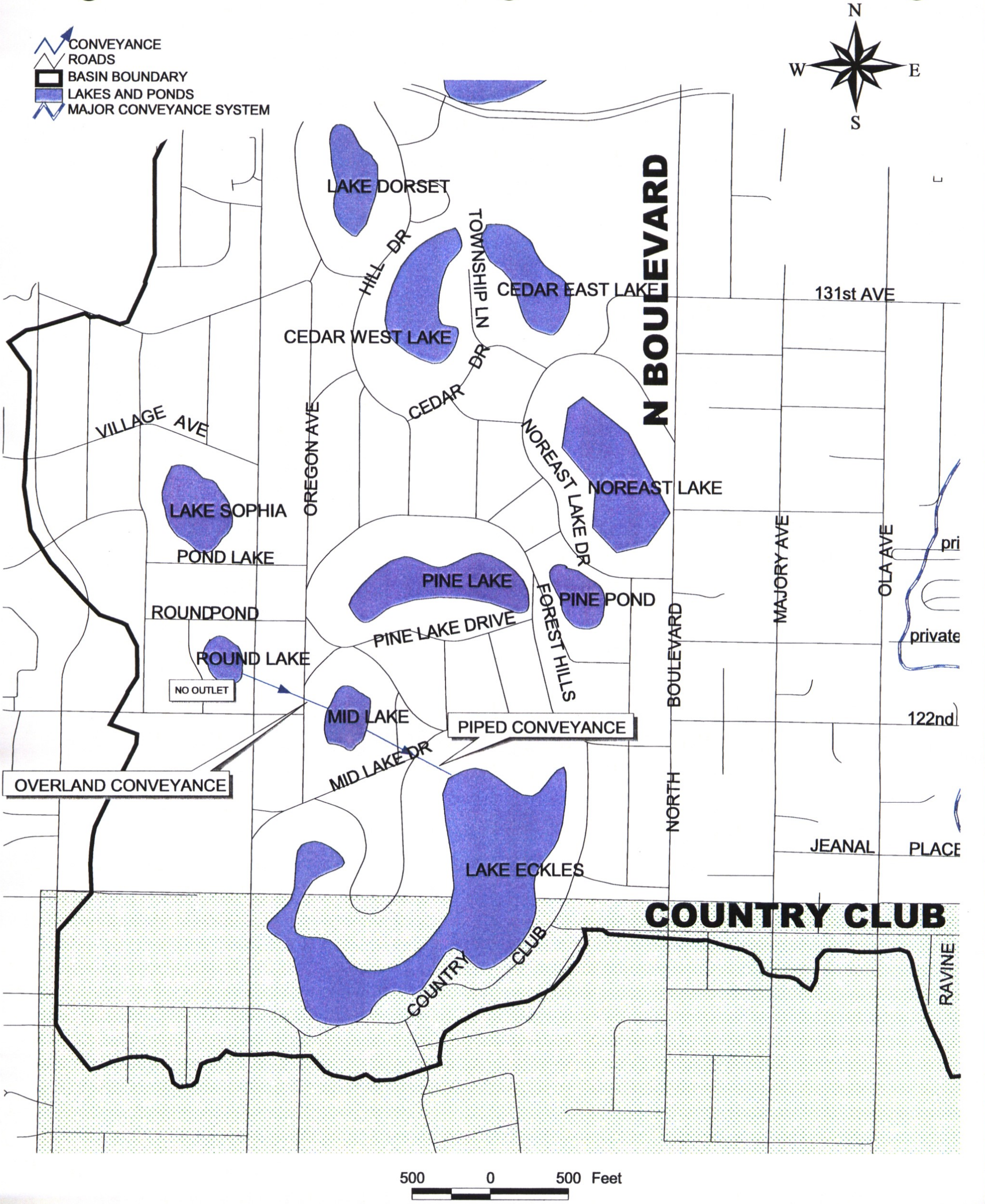
FIGURE 3-2

TYRONE MOBILE HOME PARK AREA



HILLSBOROUGH COUNTY FLORIDA

CURIOSITY CREEK WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES CORP.

FIGURE 3-3

FOREST HILLS BASIN

CHAPTER 4
HYDRAULIC/HYDROLOGIC MODEL METHODOLOGY

4.0 GENERAL HYDROLOGY/HYDROLOGIC MODEL- DATABASE DEVELOPMENT

The U.S. Soil Conservation Service (SCS) Runoff Curve Number (CN) method was used to convert storm rainfall into runoff. This method uses soil and land cover characteristics to estimate runoff. The runoff hydrographs were developed using the U.S. Soil Conservation Dimensionless Unit Hydrograph Method. A modified version of the HEC-1 (U.S. Army Corps of Engineers) computer program was utilized to generate runoff hydrographs.

The inflow hydrographs were then assigned to the hydraulic model at corresponding node-basin junctions. The discharges were routed through the hydraulic system utilizing a modified version of the EPA Stormwater Management Model v4.31a (SWMM) Extended Transport Block (EXTRAN).

4.1 HYDROLOGY

4.1.1 Hydrologic Model

The HEC-1 hydrologic computer model was modified by Hillsborough County staff to account for the flat terrain of the County. The Hillsborough County Stormwater Technical Manual specifies that a shape factor of 256 be utilized for hydrologic analysis relating to areas within the County because of the flat terrain. Therefore, the HEC-1 hydrologic model was modified to utilize a 256 shape factor instead of the 484 factor that is normally associated with this hydrologic package. An initial abstraction of 0.2 was utilized throughout the study area as the initial soil abstraction. This value was not altered during calibration. The soil storage was computed as a function of the curve number according to SCS guidelines and literature.

4.1.2 Rainfall Depths, Rainfall Distribution and Initial Abstraction

The rainfall depths used for the design events were taken from the SWFWMD isoheytal maps published in the Environmental Resource Permitting Information Manual (ERPM).

The rainfall depths shown are for the 24-hour event (See Chart):

The design storm events utilized the SCS Florida Modified Type II rainfall distribution as specified by Hillsborough County and by the SWFWMD.

Storm Event- 24 hour Duration	*Rainfall depth*
Mean Annual - 2.33 Year	4.5 inches
5-year	5.6 inches
10-year	7.0 inches
25-year	8.0 inches
50-year	10.0 inches
100-year	11.0 inches

4.1.3 Subbasin Delineations

The determination of the subbasin boundaries within the watershed was made on the basis of the existing physical features such as the drainage areas (topography), storage areas and conveyance elements (pipes, control structures etc.) which make up the system network. Several sources were used to define the individual subbasins, based on this network. The main source was the SWFWMD one-foot contour aerial topograhic maps (1"=200' scale). The SWFWMD aerial contour mapping used in the development of the subbasins for the Curiosity Creek Watershed Management Plan are dated 1981. This information was used to determine most of the subbasin delineation's and the overland connections between subbasins.

In some instances, development or re-development had occurred after the date of the aerial contour maps. Development in the watershed sometimes resulted in the construction of stormwater ponds, or additional conveyance features (pipe systems gutters, ditches, etc.) which potentially altered the indicated flow patterns as determined from the aerial contour maps. In these cases, construction plans (when obtainable) were used to assist in developing the subbasins, by taking into account land alteration activities. Available data used to assist in the development of the subbasin delineations included State and County roadway plans, private development plans, and County inventories of stormwater collection systems and road crossings. A limited review of the permitted activities on file with the SWFWMD and the Hillsborough County Planning and Growth Management Department to evaluate potential developments of significance was also performed.

In addition, a limited field verification of the subbasin delineations was conducted to resolve conflicting information from data sources, inspect for additional large developments, inspect for potential new large scale construction not yet permitted, verify outer limits of the watershed area, and to resolve questions related to subbasin delineations.Recent aerial photographs were also used as a tool to indicate potential changes to the subbasin delineations. These aerial photographs were obtained from Hillsborough County and were dated 1997. The aerial photographs indicated new construction, additional creek crossings, and potential alterations to the drainage patterns indicated in the 1981 aerial contour maps.

It should be noted that the detail of the subbasin delineations represented in this report reflect planning level functions. Should it become necessary to evaluate specific, individual developments, a higher degree of definition may be required.

The final step in the delineation process was to digitize the subbasins into GIS format. This was accomplished by utilizing the GIS software package known as ArcView, (ESRI-ver 3.1), and was stored as a shape (*.shp) file, with an associated polygon attribute table, which contained the geometric parameters (area, perimeter, etc) resulting from the digitization. In addition, each subbasin was given a unique six digit character nomenclature as specified by the Hillsborough County Stormwater Management Master Plan Hydrologic and Hydraulic Model Set-Up Standard, (Hillsborough County Stormwater Management Section, Engineering Division, Public Works Department, 2/11/99). The attribute table was then enhanced to include the necessary data fields to bring it into compliance with the GIS data format outlined by the Southwest Florida Water Management District Watershed Data Management System for Engineering, (SWFWMD Engineering and GIS Section, May,1999).

4.1.4 Runoff Curve Numbers

The SCS Runoff Curve Number (CN) method was used to generate runoff from rainfall. The method estimates runoff on the basis of soil and land cover characteristics. Runoff curve numbers are related to land use and hydrologic soil group. Land use polygon coverages were overlaid with hydrologic soil group polygon coverages utilizing GIS union techniques. This procedure generated unique polygons within subbasin polygons that were assigned a land-use, subbasin number and soil type. These polygons were aggregated into a weighted CN for each subbasin using a database script and a lookup table. The procedure calls for a polygon element within a subbasin to be assigned a CN value based on soil type and land use (see Table 4.1). Based on this, a composite (area weighted) CN for each subbasin was calculated and assigned.

Table 4.1 – GIS Lookup Table for Curve Numbers Based on Soils and Land Use Data

	FLUCS ID	***SOIL GROUP***					
Description		***A***	***B***	***C***	***D***	***B_D***	***W***
Residential Low Density <2 Dwelling Units	1100	50	68	79	84	81.5	100
Residential Med Density 2->5 Dwelling Units	1200	57	72	81	86	83.5	100
Residential High Density	1300	77	85	90	92	91	100
Commercial & Services	1400	89	92	94	95	94.5	100
Industrial	1500	81	88	91	93	92	100
Extractive	1600	77	86	91	94	92.5	100
Institutional	1700	69	81	87	90	88.5	100
Recreational	1800	49	69	79	84	81.5	100
Open Land	1900	39	61	74	80	77	100
Cropland & Pastureland	2100	49	69	79	84	81.5	100
Row Crops	2140	49	69	79	84	81.5	100
Tree Crops	2200	44	65	77	82	79.5	100
Feeding Operations	2300	73	83	89	92	90.5	100
Nurseries & Vineyards	2400	57	73	82	86	84	100
Specialty Farms	2500	59	74	82	86	84	100
Tropical Fish Farms	2550	59	74	82	86	84	100
Other Open Lands (Rural)	2600	30	58	71	78	74.5	100
Herbaceous	3100	63	71	81	89	85	100

Shrub & Brushland	3200	35	56	70	77	73.5	100
Mixed Rangeland	3300	49	69	79	84	81.5	100

Table 4.1 - GIS Lookup Table for Curve Number Based on Soils and Land Use Data (Cont.)

	FLUCS ID	***SOIL GROUP***					
Description		***A***	***B***	***C***	***D***	***B_D***	***W***
Upland Coniferous Forest	4100	45	66	77	83	80	100
Pine Flatwoods	4110	57	73	82	86	84	100
Longleaf Pine – Xeric Oak	4120	43	65	76	82	79	100
Upland Hardwood Forests – Part 1	4200	36	60	73	79	76	100
Hardwood Conifer Mixed	4340	36	60	73	79	76	100
Tree Plantations	4400	36	60	73	79	76	100
Streams & Waterways	5100	100	100	100	100	100	100
Lakes	5200	100	100	100	100	100	100
Reservoirs	5300	100	100	100	100	100	100
Bays & Estuaries	5400	100	100	100	100	100	100
Wetland Hardwood Forests	6100	98	98	98	98	98	98
Bay Swamps	6110	98	98	98	98	98	98
Mangrove Swamps	6120	98	98	98	98	98	98
Stream & Lake Swamps (Bottomland)	6150	98	98	98	98	98	98
Wetland Coniferous Forests	6200	98	98	98	98	98	98
Cypress	6210	98	98	98	98	98	98
Wetland Forests Mixed	6300	98	98	98	98	98	98
Vegetated Non-Forested Wetlands	6400	98	98	98	98	98	98
Freshwater Marshes	6410	98	98	98	98	98	98
Saltwater Marshes	6420	98	98	98	98	98	98
Wet Prairies	6430	98	98	98	98	98	98
Emergent Aquatic Vegetation	6440	98	98	98	98	98	98
Non-Vegetated	6500	98	98	98	98	98	98
Tidal Flats / Submerged	6510	98	98	98	98	98	98

Shallow Platform							
Shorelines	6520	98	98	98	98	98	98
Intermittent Ponds	6530	98	98	98	98	98	98

Table 4.1 – GIS Lookup Table for Curve Numbers Based on Soils and Land Use Data (Cont.)

	FLUCS ID	***SOIL GROUP***					
Description		***A***	***B***	***C***	***D***	***B_D***	***W***
Beaches other than Swimming Beaches	7100	77	86	91	94	92.5	100
Disturbed Land	7400	77	86	91	94	92.5	100
Transportation	8100	81	88	91	93	92	100
Communications	8200	81	88	91	93	92	100
Utilities	8300	81	88	91	93	92	100

4.1.5 Time of Concentration

The time-of-concentration for each subbasin was calculated based on the guidelines specified in the Hillsborough County Stormwater Technical Manual. The components that make up the travel time for each subbasin were derived from the following (See Chart):

Flow Regime	***Method / Assumption***
Overland Flow	Kinematic Wave Equation
Shallow Concentrated Paved	SCS Equations relating velocity to watercourse slope
Shallow Concentrated Unpaved	SCS Equations relating velocity to watercourse slope
Channel Flow	Assume 2 ft/sec
Pipe Flow	Assume 3 ft/sec

4.2 HYDRAULICS

4.2.1 Hydraulic Model

A modified version of the U.S. EPA SWMM model was used to route the hydrographs generated by the HEC-1 program through the hydraulic system. The version utilized in this study was Hillsborough County SWMM 4.31a. This version of the model employs the EXTRAN block to calculate water surfaces and flow rates as time dependent values. Modifications within the County version included provisions for assigning reach numbers to orifices and weirs, the ability to utilize elevations rather than depths above junction inverts, submergence criteria for weirs, assigning entrance and exit loss coefficients, (see Table 4.2 and Table 4.3) and enhancements to error trapping capability. This version required that all elliptical pipes be converted to equivalent round pipes based on cross-sectional area. Natural channel geometry is treated as a prismatic conduit with an irregular shape. This version also includes a multiplier to elongate conduits that experience instability. This preserves the original roughness coefficient data as conduits are adjusted by this factor to accomplish conduit elongation.

Table 4.2 - Culvert Entrance and Exit Loss Coefficients Outlet Control , Full or Partially Full
(from USDOT, FHWA, HEC-5, 1965)

Type of Structure & Design of Entrance	**Coefficient- K**
Pipe, Reinforced Concrete	
Projecting from Fill, Socket End (Groove End)	0.2
Projecting from Fill, Square Cut End	0.5
Straight Endwall	0.2
Socket End of Pipe (Groove-End)	0.5
Square Edge	0.2
Rounded Radius	0.7
Mitered to Conform to Fill Slope	0.5
End Section Conforming to Fill Slope	0.2
Beveled Edges, 33.0 deg to 45 deg	0.2
Side or Slope Tapered Inlet	0.3
Straight Sand Cement	0.7
U-type with Grate	0.5
U-type	0.3
Winged Concrete	0.5
Flared End, Concrete	0.5
Side Drain, Mitered with Grate	1
Pipe or Pipe Arch, Corrugated metal	
Straight endwall-rounded (radius=1/2D)	0.2
Projecting from fill	0.9
Headwall or headwall & wingwalls, square edged	0.5
Mitered to conform to fill slope	0.7
End section conforming to fill slope, paved or unpaved	0.5
Beveled edges, 33 deg or 45 deg bevels	0.2
Side- or slope tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square edged on three sides	0.5
Rounded on three sides to radius of 1/2	
barrell dimension or beveled edges on three sides	
Wingwalls at 30 deg to 75 deg to barrel	
Square edged at crown	0.4
Crown edge rounded to radius of 1/2 radius	
dimension ,or beveled top edge	0.2
Wingwalls at 10 deg to 25 deg to barrel , square edged	
at crown	0.5
Wingwalls parallel (extension of sides)	
Square edged at crown	
[illegible]	[illegible]

Table 4.3- Exit Loss Coefficients
(from HEC-14, FHWA)

Transition Type	**Expansion Coefficient**
Warped	0.20
Cylindrical Quadrant	0.25
Wedge	0.50
Straight Line	0.50
Square End	0.75

4.2.2 Natural Channels

The data for the channel geometry was derived mostly from the channel cross section survey data. Natural channel reaches were evaluated for out of bank conveyance capability based on aerial photographs, field photographs of the actual channel, and field evaluations. In some cases channel cross-sections were modified to account for encroachment into the conveyance portion of the channel by buildings or other obstructions. In those cases, the portion of the channel outside of the conveyance area was treated as floodplain storage with no conveyance capability. Thus, each channel was evaluated for a friction loss that related to the roughness conditions at the bottom, and the right and left out of bank. Channel roughness (Manning's coefficients) values were evaluated from literature sources provided by Hillsborough County, sources obtained from the USGS based on Manning's coefficient studies for natural channels, and from KCA staff previous experience with channel systems in Hillsborough County (see Table 4.4). Initial Manning's roughness values were either confirmed or adjusted during the calibration phase of the study.

Table 4.4 – Roughness Coefficient Values

Boundary Materials	**Coefficient**
Planed Wood	0.012
Unplaned Wood	0.013
Finished Concrete	0.012
Unfinished Concrete	0.014
Cast Iron	0.015
Brick	0.016
Earth	0.025
Gravel	0.029
Channels or Streams	
Grassland	
Short grass	0.030
Tall grass	0.035
Cultivated	
Bare ground	0.030
Mature row crops	0.035
Mature field crops	0.040
Brushy Areas	
Dense weeds w/ sparse trees	0.050
Brush-covered w/ some trees (summer)	0.050
Brush-covered w/ some trees (winter)	0.060
Dense brush (winter)	0.070
Dense brush (summer)	0.100
Forested	
Densely covered with willows (summer)	0.150
Cleared land with stumps ; no new growth	0.040
Cleared land with stumps ; dense new growth	0.060
Dense stands of large trees; flood stage below branches	0.100
Dense stands of large trees; flood stage reaching branches	0.120

4.2.3 Conduits

The way the Hillsborough County version of the EXTRAN block calculates friction loss in conduits differs from the original program by the EPA. The original version had an input for the friction loss coefficient that was the only basis for the total head loss in a conduit. It was necessary to adjust this coefficient to account for the other minor losses of the conduit such as entrance, exit, and conduit transitions. In addition, if a conduit experienced instability during a simulation, an equivalent conduit (elongated) would possibly have to be used. In such cases, the friction loss coefficient would again have to be manipulated to account for the additional "length" of the new conduit. The County version of EXTRAN has four additional data fields that allow the user to input entrance, exit, conduit transitions and an elongation factor. This allows for the preservation of the friction loss and the input data, and thus the Manning's "N" value represents the roughness of the conduit only. The creation of the equivalent conduit is internal to the model.

4.2.4 Storage-Facilities

The EXTRAN model allows the user to input variable relationships for stage-area. These areas can represent the flood storage created by ponds, depressions, lakes, wetlands, retention/detention ponds or out of bank storage. This relationship is assigned to a specific junction within the model schematic. This storage is especially important in the Curiosity Creek Area because of the many areas which contain lakes and experience out of bank conditions during high flow.

The relationship between stage and area was derived from the SWFWMD aerial contour maps. These maps were digitized using GIS software, so that the area at specific elevations could be determined. This data was then input into the computer model to represent the basin storage available during storm simulations. In those cases where development occurred after the aerial mapping, construction drawings were employed to estimate storage facilities.

4.2.5 Weirs

The overtopping of roadways at channel crossings was simulated using broad crested weirs as the conveyance mechanism. The weir invert elevations were obtained from survey or from the SWFWMD aerial contour maps if survey data was not available. The width of the weir was scaled from the aerial contour maps. After preliminary simulations were made, the weir widths were evaluated to verify or modify these initial values. Hillsborough County staff specified that the weir coefficients for roadway overtopping should be 2.0.

In some areas of the watershed, broad crested weirs were used to simulate flow that may occur in an overland fashion from basin to basin. The weir invert elevations were obtained from the SWFWMD aerial contour maps. Hillsborough County staff specified that the weir coefficients for the basin to basin interconnections should be 1.0.

The data for weir invert elevations, and widths used in conjunction with control structures was obtained from survey data, construction plans, or field estimates. Slots or orifices with a minimum dimension of less than 3 inches were not simulated.

4.2.6 Initial Water Surface Elevations

The initial water surface elevations for the lakes in the watershed were obtained through several methods. On storage facilities where a control structure exists, the starting elevation was assumed to be equal to the invert of the control weir. Starting water surface elevations for lakes or water bodies that have an inlet (DBI) without a weir slot or orifice were assumed to be the normal high water elevation. Starting water surface elevations for land locked water bodies were assumed to be the normal high water elevation.

The initial water surface elevations at the various junctions within the Curiosity Creek Main Channel were estimated by evaluating the invert elevations of the channel bottom and conduit inverts. It was assumed that the starting water surface elevation is greater than or equal to the highest invert of the channel downstream for the junction. The minimum depth at the junctions was input as 0.10 feet. This was done for model stability.

4.2.7 Dummy Junctions and Conduits

The practice of utilizing dummy or imaginary conduits within the EXTRAN input data was done to eliminate artificial warning flags in the output files. EXTRAN will generate a warning flag in the output file for any junction that does not have a conduit equal to the junction invert. It will also generate a flag for any junction that has conduits whose crown is lower than the adjacent conduit inverts. For both of these cases, dummy pipes were added to the input file to keep the output files clear from warning flag clutter. The dummy conduits were noted as such in the input data files.

Dummy storage areas are required at any junction that connects two or more conduits or weirs. In these cases, the area was non-variable with depth and assigned to be 4356.0 square feet. This was done for model stability. All dummy storage junctions were noted as such in the input data files.

4.2.8 Boundary Conditions

The issue of a reasonable boundary condition for the study required the evaluation of best available information in conjunction with certain restrictions specified within the scope. The scope specified that the study would be limited to the area of the watershed that is within Hillsborough County. Information on the characteristics of the Blue Sink and the Forest Hills Flood Detention Pond was from the 1982 study of Curiosity Creek (Hydrologic Investigation and Stormwater Management Plan for the Curiosity Creek Watershed, Piercefield, Amaden and Associates Inc.; and Reynolds, Smith and Hills, Inc. September 1982). This study published peak water surface elevations (time-stage data was not included) for the following events:

- 5-year 72 hour event, AMC III
- 10-year 72 hour event, AMC III
- 25-year 72 hour event, AMC III
- 100-year 72 hour event, AMC I

The published report did not contain any values for the 2.33 or the 50-year event, both of which were included in the scope of work for the current study as events to be simulated. An attempt was made to obtain the data files from the original modeling effort, but due to the age of the study, input data files and the computer model (RS&H Hydro-Dynamic Simulator) were not available.

Since the 1982 study was published, a large stormwater retention pond was constructed south of the Blue Sink, (Detention Area C). The USACOE published a study of the Curiosity Creek Watershed in 1991, (Lower Hillsborough River and Curiosity Creek Tampa, Florida; Reconnaissance Report, USACOE, Jacksonville, FL).

The report published peak stage values for the existing conditions that included the construction of Detention Area C, for the following storm events.

- 100-year 72 hour event
- 50-year 72 hour event

- 25-year 72 hour event
- 10-year 72 hour event
- 5-year 72 hour event
- 2-year 72 hour event

The USACOE model utilized a steady state backwater analysis (HEC-2) to calculate the peak flows in the system for the various storm events. The findings of the report indicated that "the additional detention areas reduced the peak flood stages by only a small amount". This model was calibrated and verified by the USCOE. This latest information is considered to be the best information available on the boundary condition at the Blue Sink.

These two studies/analyses make up the only available information relative to boundary conditions information. To produce a stage-time relationship at the boundary condition, a rating curve was developed utilizing a weir as a control device. The purpose of the fictitious weir was to produce a peak elevation that would match the design storms published in the USACOE report. In other words, the boundary condition weir restricts the flow leaving the system to produce the correct tailwater. The model was run in iterations and through trial and error, the weir length was adjusted until the elevations estimated by the EXTRAN model matched the elevations published in the USACOE report to within 0.10 feet for each storm event modeled. This procedure produced a unique weir length at the boundary condition for each of the design storms, (see Table 4.5)

Table 4.5 – Curiosity Creek Stage Frequency Curves, Existing Conditions & Boundary Conditions

Return Period	***USACOE HEC1 Model Peak Stage (feet-NGVD)***	***Boundary Condition Weir Length at Elev. 25.50 (feet)***	**EXTRAN Model Peak Stage (feet-NGVD)**
100 year	32.55	27.00	32.57
50 year	32.27	24.85	32.26
25 year	31.99	17.80	32.02
10 year	31.71	15.10	31.72
5 year	31.51	10.00	31.53
2 year	31.27	6.22	31.27

4.2.9 Numeric Instability

The Hillsborough County EXTRAN model is based on the solution of the St. Vennant equations for unsteady state flow in open channels. These types of hydro-dynamic models are subject to numeric instabilities. Producing a stable input data set many times requires the user to adjust the model input parameters. Adjustments can include the use of equivalent pipes, adjusting storage junction values, adjusting pipe slopes, modeling inlet control separately from outlet control on pipes, adjusting weir lengths, adjusting time steps, and adjusting initial water surface elevations. Experienced staff employed various combinations of techniques to achieve model stability. All changes that deviate from field conditions are noted in the hydraulic input data.

4.2.10 Model Schematic

The hydraulic model of the watershed consists of all of the features that make up the primary conveyance network. These features include lakes, wetlands, pipes, natural channels and control structures. The EXTRAN model uses a conduit junction concept to idealize the hydraulics of the system. The junctions within the model are the discrete locations within the watershed where the conservation of mass is maintained. These represent the storage and stage related elements of the model. The conduits are the connections between the junctions. These represent the flow and conveyance related elements of the model.

CHAPTER 5
HYDRAULIC/HYDROLOGIC MODEL CALIBRATION & VERIFICATION

Model calibration is the process of comparing simulated computer model results with a set of measured data. Streamflow and water surface elevations are obtained from gage data for a rain event from the past. The input hydrologic parameters are adjusted (rainfall and distribution) to the measured rainfall values and then the water surface elevations and flows from the model are compared to the measured values. The hydraulic model can then be adjusted so that the calculated values and the measured values closely match.

Computer models are considered well calibrated when the results from the simulation are in reasonable agreement with the recorded data from the gaging station. Model verification is the process of testing the calibrated model against measured data from storms of varying intensity without making model adjustments.

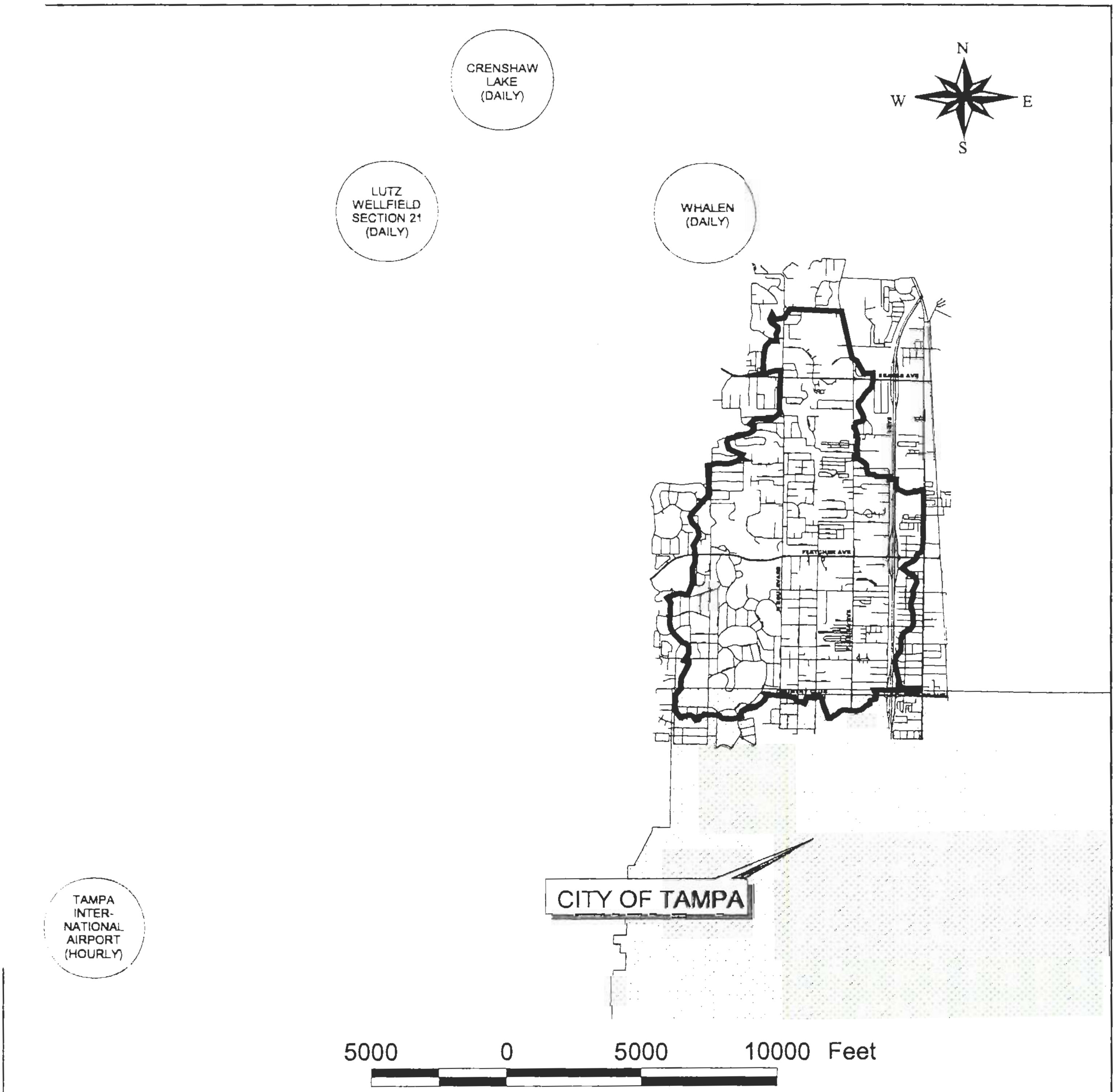
Calibration and verification storm events must be of a sufficient duration and intensity such that the associated rainfall can be accurately simulated. The calibration of the Curiosity Creek watershed model was performed using rainfall and streamflow gage data from the September 5-8,1988 storm event. The gage in Curiosity Creek was removed in 1988, and there were no other streamflow gages in the watershed until after March of 1998. Since that time, several small, high intensity, short duration storm events have occurred. These events were evaluated for possible model verification. However, none of these events were of sufficient duration or total rainfall depth to be appropriate for this process.

5.1 RAINFALL GAGE DATA

The storm event of September 5-8, 1988 was the largest event of record that occurred in the watershed where both rainfall and streamflow data are available. The rainfall gage data for this event was obtained from the Southwest Florida Water Management District. The location of the nearby gages for which data was available is shown in Figure 5-1. Four rainfall gages were evaluated for possible use in calculating the rainfall characteristics of the storm event. The first was the rainfall gage at the Tampa International Airport. This gage recorded hourly rainfall totals and was used to create the rainfall distribution (see Table 5.1). The SWFWMD rainfall gages at Crenshaw Lake, Whalen and Section 21 recorded daily total rainfall amounts that are shown in Table 5.2. It was determined that due to the proximity of the Whalen gage and the fact that the available gage locations did not distribute themselves over the watershed that this gage alone would be used to determine the rainfall depth for the calibration storm.

5.2 STREAMFLOW DATA

Streamflow Data was obtained from the USGS. There was only one gage present in the watershed during September 5-8,1988 (gage number 02305780), and it was located south of Fletcher Avenue and upstream of the box culvert for the automobile dealership. This gage recorded a peak stage of 40.11 with an estimated peak flow rate of 62 cfs (see Table 5.3).



HILLSBOROUGH COUNTY FLORIDA

CURIOSITY CREEK
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FIGURE 5-1

GAUGE STATION MAP

Table 5.1 – Calibration Rainfall Distribution from Tampa International Airport (September 5-8, 1998)

Hour	Amount of TIA Hourly Rainfall	Rainfall Distribution	Hour	Amount of TIA Hourly Rainfall	Rainfall Distribution
1			49	0.00	0.4966
2			50	0.00	0.4966
3			51	0.20	0.5191
4			52	0.07	0.5270
5			53	0.23	0.5528
6			54	0.81	0.6438
7			55	0.29	0.6764
8	0.13	0.0146	56	0.06	0.6831
9	0.08	0.0236	57	0.00	0.6831
10	0.06	0.0303	58	0.04	0.6876
11	0.04	0.0348	59	0.06	0.6944
12	0.08	0.0438	60	0.00	0.6944
13	0.13	0.0584	61	0.00	0.6944
14	0.13	0.0730	62	0.00	0.6944
15	0.02	0.0753	63	0.00	0.6944
16	0.02	0.0775	64	0.00	0.6944
17	0.30	0.1112	65	0.02	0.6966
18	0.35	0.1506	66	0.01	0.6978
19	0.04	0.1551	67	0.01	0.6989
20	0.15	0.1719	68	0.01	0.7000
21	0.01	0.1730	69	0.01	0.7011
22	0.00	0.1730	70	0.01	0.7022
23	0.00	0.1730	71	0.01	0.7034
24	0.00	0.1730	72	0.01	0.7045
25	0.00	0.1730	73	0.00	0.7045
26	0.00	0.1730	74	0.00	0.7045
27	0.00	0.1730	75	0.00	0.7045
28	0.01	0.1742	76	0.00	0.7045
29	0.03	0.1775	77	0.01	0.7056
30	0.08	0.1865	78	0.06	0.7124
31	0.05	0.1921	79	0.08	0.7213
32	0.13	0.2067	80	0.13	0.7360
33	0.13	0.2213	81	0.10	0.7472
34	0.23	0.2472	82	0.19	0.7685
35	0.53	0.3067	83	0.15	0.7854
36	0.18	0.3270	84	0.15	0.8022
37	1.19	0.4607	85	0.42	0.8494
38	0.14	0.4764	86	0.13	0.8640
39	0.03	0.4798	87	0.23	0.8899
40	0.01	0.4809	88	0.18	0.9101
41	0.07	0.4888	89	0.07	0.9180
42	0.01	0.4899	90	0.06	0.9247
43	0.03	0.4933	91	0.00	0.9247
44	0.02	0.4955	92	0.09	0.9348
45	0.01	0.4966	93	0.08	0.9438
46	0.00	0.4966	94	0.47	0.9966
47	0.00	0.4966	95	0.03	1.0000
48	0.00	0.4966	96	0.00	1.0000

Table 5.2 – Rainfall Gage Data Summary				
Total Rainfall Intensity (Inches	***Recorded Storm Event***	***Rainfall Station Name***		
		Crenshaw Lake	***Whalen***	***Section 21***
	September 5-9th	8.75”	9.95”	8.54”
Hourly Recording Data				
Daily Recording Data		X	X	X

Table 5.3 – USGS Data Summary		
Recorded Storm Event	***USGS Station Name*** ***USGS Gage at Fletcher Ave. – Gage #02305780***	
	DISCHARGE (CFS)	***STAGE (FT-NGVD)***
September 5-9th	62.09	40.11

5.3 INITIAL WATER SURFACE ELEVATIONS

The initial water surface elevations were estimated for the lakes of the watershed. Specific initial lake elevations for the calibration event were not available therefore the normal high elevations for the lakes were utilized. Initial elevations for lakes where the normal high elevation was not available were estimated by calculating the depth difference between the normal high elevations and the water surface elevations published on the SWFWMD contour aerials used in the basin delineation process. An average depth was calculated (3.4 feet), and was added to those lakes where normal high elevations were not available. The initial water surface elevation for lakes whose discharge was controlled with structures or pipes was the elevation on the control weir or the invert of the pipe. The initial water surface elevations for the lakes are shown in Table 5.4.

5.4 EXISTING CONDITIONS MODEL CALIBRATION

Most of the input data to the computer model is related to the geometry of the hydraulic system (see Exhibit 5-1) and the hydrologic parameters derived from the subbasins. Some of the parameters are not obtained from measurable quantities, namely channel roughness. Initially these parameters (Manning n coefficients) are estimated, but through the calibration process it may become necessary to adjust these coefficients to their final value.

The September 5-8, 1988 event was selected for calibration because of the availability of data and the magnitude of the storm. Because of the size of the basin it was assumed that the rainfall depth was uniformly distributed over the entire watershed, therefore, a Theissen polygon analysis was not performed on the watershed. The objective of the calibration is to attempt to match the stage and discharge of the model with the recorded data.

Table 5.4 – Lake Level Initial Conditions Elevations						
Junction	***Lake Name***	***Normal High***	***SWFWMD Elev******	***Control Elev***	***Control Type***	***Starting WSEL***
562500	N/A	N/A	45.20	49.50	High Overflow	48.60
522400	N/A	N/A	43.10	48.10	Inlet (Top)	46.50
562300	N/A	43.83	42.10	43.20	Pipe	43.20
562000	N/A	43.35	41.20	42.49	Pipe	43.71*
562100	Golden Trout	N/A	43.50	45.80	High Overflow	43.71**
561900	N/A	N/A	39.30	46.90	High Overflow	42.70
561700	Burnes	47.02	42.70	51.80	High Overflow	47.02
561200	Dorsett	43.51	39.20	46.50	High Overflow	43.51
561100	Cedar West	40.36	36.14	42.50	High Overflow	40.36
561600	N/A	N/A	37.20	45.00	High Overflow	38.00*
561500	N/A	N/A	37.10	38.00	Control Str.	38.00
561000	39.75	35.40	35.47	35.47	Pipe	35.47
560100	Noreast	38.70	33.10	34.20	Pipe	34.20
561800	Butler	43.71	41.10	44.63	Inlet (Top)	43.71
560200	Pine Lake	36.85	33.50	40.80	High Overflow	36.85
560800	N/A	N/A	42.80	51.50	High Overflow	46.20
560900	Sophia	N/A	40.80	48.50	High Overflow	44.20
560700	Round	N/A	40.30	49.70	High Overflow	43.70
560600	N/A	N/A	35.80	43.50	High Overflow	39.20
560550	N/A	N/A	29.50	36.60	High Overflow	32.90
560425	Mid	N/A	33.50	34.00	Pipe	34.00
560300	Pine Pond	34.69	31.50	38.60	High Overflow	34.69
550000	Blue Sin,	N/A	22.39	25.50	Earth Dam	22.39
580100	Lake Gass	N/A	47.90	47.43	Inlet (Top)	47.43

* Downstream Control Elevation
** Starting WSEL Taken from Adjacent Lake
*** SWFWMD Elevation Shown on Aerial Contour Maps

An important aspect of the calibration process is to establish the antecedent moisture conditions. The soil storage available can vary with water table depth and is an important factor in determining runoff. The amount of rainfall 5 days prior to a storm is commonly used as an indicator for the antecedent moisture conditions at the time of the storm. The index used with the watershed runoff estimation method is called the Antecedent Moisture Condition (AMC). There are three levels of AMC. They are:

AMC-I-Lowest runoff potential. Soils are dry, but not to wilting point; satisfactory cultivation has taken place.

AMC-II- Average conditions.

AMC-III- Highest runoff potential. Heavy rainfall, or light rainfall and low temperatures have occurred within the last five days.

See the table to the right, showing the seasonal rainfall limits for the three AMC conditions.

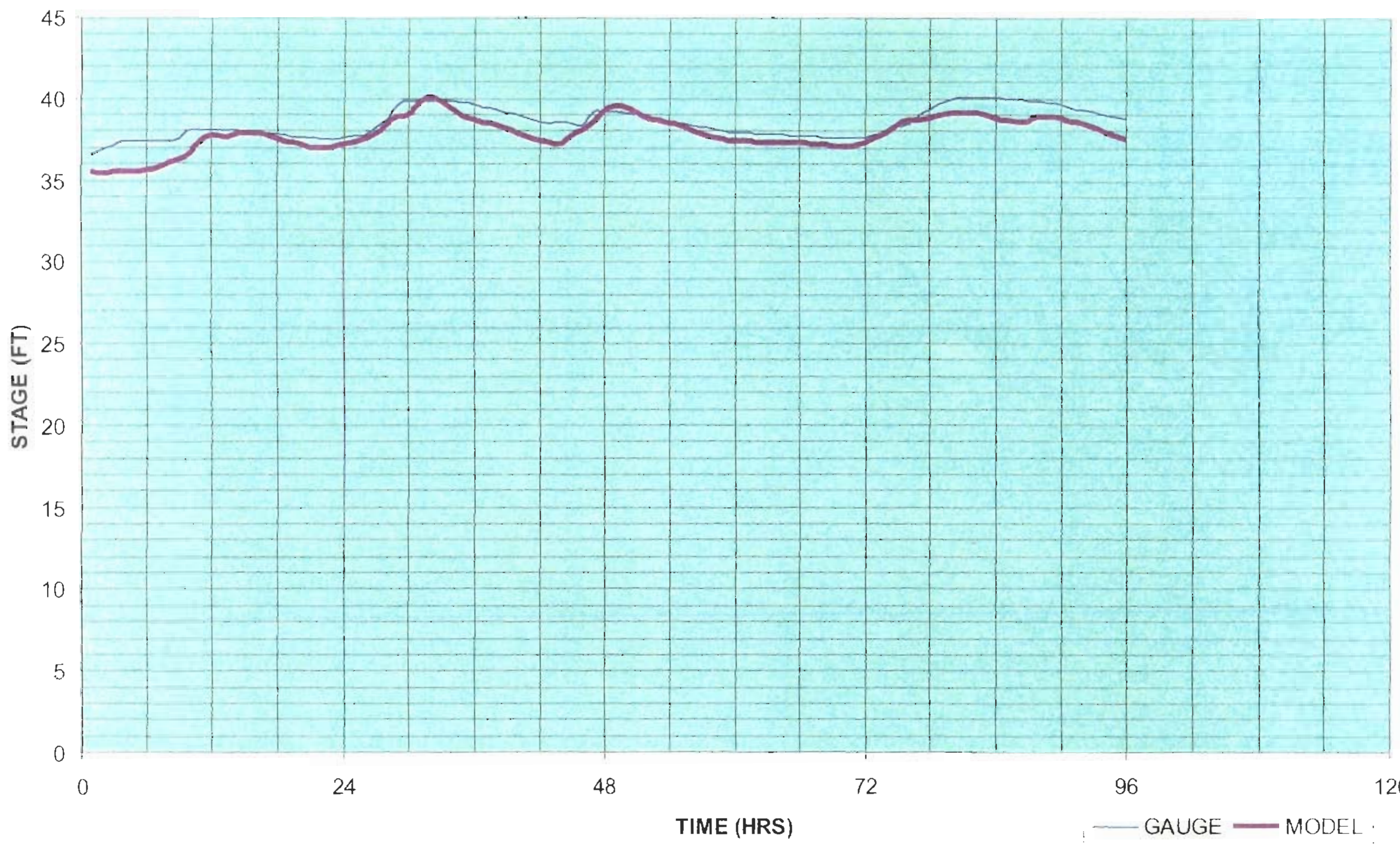
Total 5-Day Antecedent Rainfall (inches)		
AMC	***Dormant Season***	**Growing Season**
I	Less than 0.5	Less than 1.4
II	0.5 to 1.1	1.4 to 2.1
III	Over 1.1	Over 2.1

As shown in Table 5.5 the AMC condition for the September 5-8, 1988 event was calculated to be AMC condition II. There were no adjustments to the curve numbers necessary for the model calibration

Table 5.5 – Calculation of Antecedent Moisture Conditions for September 1988 Calibration Event			
	Rain Gage Daily Totals (inches)		
Date – 1988	***Crenshaw***	***Section 21***	***Whalen***
31-Aug	0.03	0.00	0.20
01-Sep	1.65	1.75	1.58
02-Sep	0.08	0.00	0.00
03-Sep	0.23	0.15	0.00
04-Sep	0.01	0.00	0.00
Total Depth	2.00	2.10	1.78

5.5 CONCLUSIONS

As evidenced by the results shown in Figure 5-3, the model accurately represents the existing conditions based on elevation. There is a discrepancy between the flows calculated by the model and the data recorded (see Figure 5-4). However, it must be understood that the gage does not actually read flow rates. The rates displayed in the recorded data are calculated based on rating curves. Conversations with the staff of the USGS about the flow calculations for this gage indicated that the staff had concerns regarding the rating curves available for this site. Therefore, their recommendation was to utilize the stage data as the foremost calibration parameter.



CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

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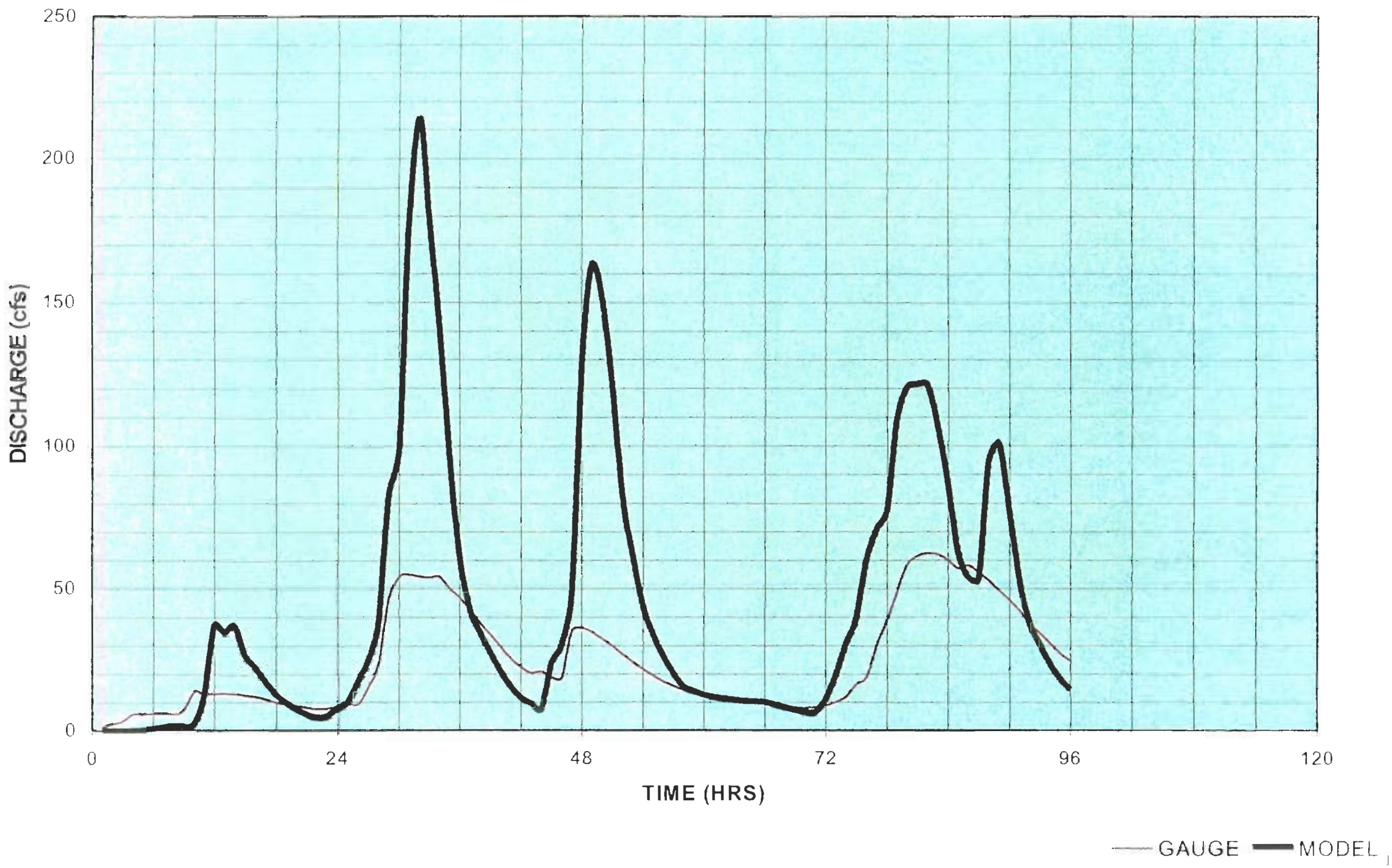
FIGURE 5-3

ELEVATION VS. TIME

CURIOSITY CREEK AT FLETCHER AVE.
SEPTEMBER 5TH TO 9TH, 1988



	CURIOSITY CREEK WATERSHED MANAGEMENT PLAN	FIGURE 5-4
	KISINGER CAMPO & ASSOCIATES CORP.	DISCHARGE VS. TIME CURIOSITY CREEK AT FLETCHER AVE. SEPTEMBER 5TH TO 9TH, 1988

CHAPTER 6
EXISTING CONDITIONS LEVEL OF SERVICE

6.1 STANDARD STORM EVENTS

Hillsborough County specified that six (6) design storm events be applied to the Curiosity Creek watershed and the system response evaluated. The design storms are as follows:

- 100 year, 24-hour duration
- 50 year, 24 hour duration
- 25 year, 24 hour duration
- 10 year, 24 hour duration
- 5 year, 24 hour duration
- 2.33 year, 24 hour duration

The rainfall distribution that was used for the various storm events was the SCS Florida Modified type II. The antecedent moisture condition was specified as AMC II (normal).

It should be noted that design elevations may be exceeded for longer duration, higher volume storms of the same frequency and under very wet conditions.

The rainfall depths for the storm events are shown in the table to the right:

Storm Event 24 hour Duration	*Rainfall Depth*
2.33-year	4.5 inches
5–year	5.6 inches
10-year	7.0 inches
25-year	8.0 inches
50-year	10.0 inches
100-year	11.0 inches

6.2 EXISTING CONDITIONS MODEL SIMULATION RESULTS

The summary results for the Curiosity Creek Model are shown in Table 6.1. The hydrodynamic model calculated time varying flows and elevations for all of the junctions and links shown in the Link junction diagram (Exhibit 5-1). The summary in Table 6.1 shows the peak flow rates and elevations for the model regardless of time. Time varying output from the model is found in the complete output file for each of the storms modeled. The hydraulic profiles for the design storms are shown on Figure 6-1. The watershed is divided into the following major sub-basins:

- The Northwest Lake System
- The Curiosity Creek Main Channel
- The Forest Hills Basin

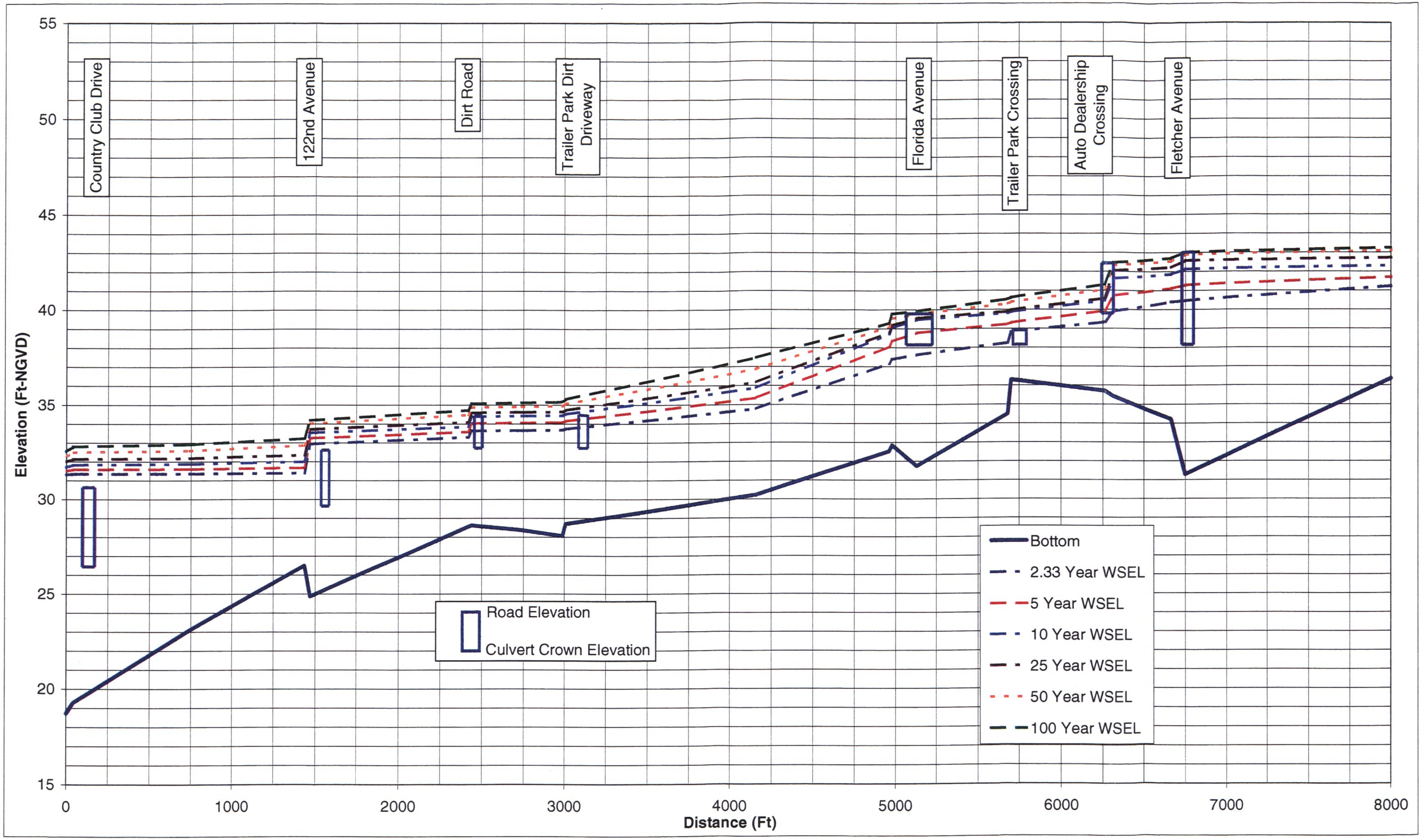
This section will present the areas and structures where the computer model indicated insufficient conveyance or storage capacity within the watershed study area. Recently reported flood areas are shown on Figure 6-2. The 100-year floodplain anticipated by the computer model is shown in Figure 6.3.

Table 6.1 - Design Storm Event Results-Existing Conditions							
Road / Name or Lake	***Model Junction ID***	***Design Storm Elevation***					
		2.33 YR	***5 YR***	***10 YR***	***25 YR***	***50 YR***	***100 YR***
Northwest Lake System							
Depressional Area at North Blvd.	560000	35.44	36.12	36.85	37.31	38.13	38.50
Lake Noreast @ North Blvd	560100	35.14	35.38	35.68	35.92	36.51	36.91
Pine Lake @ Forest Hills Dr.	560200	37.43	37.66	37.97	38.2	38.64	38.86
Pine Pond @ Noreast Dr.	560300	36.22	36.76	37.40	37.81	38.51	38.66
Unnamed Lake @ Cedar Dr.	560400	43.72	44.31	44.95	45.35	46.03	46.33
Unnamed Lake @ Oakleaf Dr.	560800	51.55	51.67	51.79	51.86	51.97	52.01
Lake Sophia @ Rome Ave.	560900	45.73	46.83	48.00	48.57	48.69	48.79
Lake Cedar East @ Lake Noreast Dr.	561000	36.82	37.75	39.17	40.2	42.03	42.76
Lake Cedar West @ Townsend Dr.	561100	42.33	42.61	42.76	42.92	43.18	43.28
Lake Dorset @ Forest Hills Dr.	561200	44.67	45.03	45.46	45.75	46.29	46.53
Unnamed Lake @ 131st Ave.	561300	40.72	40.8	40.88	40.92	42.03	42.76
Unnamed Lake @ Townsend Dr.	561400	37.95	38.19	39.26	40.28	42.17	43.16
	561475	38.13	38.48	39.43	40.43	42.52	43.97
Unnamed Lake @ Edith St.	561500	38.73	38.89	39.49	40.48	42.57	44.03
Unnamed Lake @ Forest Hills Dr.	561600	40.53	41.31	42.24	42.85	43.99	44.92
Unnamed Lake @ Rome Ave.	561700	48.64	49.19	49.89	50.36	51.16	54.51
Lake Butler @ Sylvia Lane	561800	42.82	43.2	43.64	44.07	44.85	45.57
Unnamed Lake @ Sylvia Lane	561900	44.11	44.52	45.03	45.36	45.96	46.00
Unnamed Lake @ Sylvia Lane	562000	43.71	44.13	44.93	45.62	46.5	46.62
Lake Golden Trout @ Sylvia Lane	562100	45.65	45.94	46.09	46.24	46.56	46.71
Unnamed Lake @ Rome Ave.	562200	48.63	49.09	49.57	49.62	49.79	49.91
Unnamed Lake @ Justice Dr.	562300	44.58	45.06	45.57	45.86	46.5	46.63
	562380	44.58	45.06	45.57	45.86	46.5	46.63
Unnamed Lake @ Happy Lane	562400	46.88	46.92	46.97	47	47.05	47.08
Unnamed Lake @ Samy Dr.	562500	47.14	47.68	48.3	48.39	48.61	48.78
Curiosity Creek Main Channel							
	550000	31.27	31.53	31.72	32.02	32.26	32.57
Country Club Dr.	550100	31.31	31.6	31.84	32.15	32.46	32.78
122nd Ave	550150	35.28	36.93	37.4	37.49	37.74	37.85
121st.	550175	37.51	37.54	37.59	37.63	37.75	37.86
Florida Ave	550200	31.32	31.61	31.86	32.18	32.51	32.84

Table 6.1 - Design Storm Event Results-Existing Conditions (Cont.)							
Road / Name or Lake	***Model Junction ID***	***Design Storm Elevation***					
		2.33 YR	***5 YR***	***10 YR***	***25 YR***	***50 YR***	***100 YR***
122nd Ave	550300	32.86	33.21	33.47	33.65	33.93	34.08
	550400	32.89	33.28	33.68	33.97	34.51	34.78
	550475	33.22	33.53	33.79	34.01	34.37	34.56
Private Road	550500	33.56	33.96	34.3	34.51	34.78	34.92
Private Road	550600	33.58	33.99	34.33	34.54	34.82	34.96
Florida Ave	550650	35.36	35.41	35.47	35.51	35.56	35.59
	550675	33.59	34	34.35	34.56	34.84	34.99
Private Road	550700	33.65	34.07	34.43	34.65	34.95	35.12
Marjory St.	550750	39.26	39.32	39.39	39.43	39.51	39.54
Linda Ave.	550800	34.63	35.25	35.78	36.07	36.61	37.22
	550850	37.01	37.78	38.58	38.76	39.01	39.14
	550875	37.22	38.05	39.89	39.1	39.4	39.58
131st St.	550900	37.41	38.46	39.42	39.53	39.69	39.81
Central Ave.	550950	38.24	38.94	39.55	39.79	40.6	40.77
Taliaferro St.	551000	38.26	38.95	39.55	39.8	40.27	40.41
	551075	38.13	39	39.72	39.84	40.12	43.35
Private Road	551100	38.79	39.1	39.78	39.91	40.19	40.43
	551200	38.8	39.1	39.95	39.91	40.19	40.43
	551250	39.26	39.76	40.36	40.53	40.83	41.08
Private Road	551300	39.75	40.55	41.36	41.86	42.24	42.35
	551350	40.23	40.95	41.63	42.07	42.43	42.56
137th Avenue	551400	40.3	41.11	41.88	42.39	42.82	42.92
Orange Ave	551500	42.12	42.28	42.46	42.58	42.95	43.08
Private Road	551600	45.7	45.82	45.959	46.02	46.16	46.22
	551700	43.29	43.35	43.4	43.42	43.47	43.49
	551775	41.25	41.646	42.1	42.57	43.01	43.15
138th Ave	551800	43.61	43.72	43.82	43.88	43.97	44.02
	551875	43.68	43.85	44.02	44.12	44.37	44.44
	551900	44.04	44.5	45.05	45.42	46.14	46.25
	551950	44.06	44.53	45.07	45.45	46.18	46.3
	552000	45.01	45.17	45.3	45.46	46.19	46.33
	552075	44.42	44.82	45.28	45.28	45.59	46.22
46.33	552100	44.56	45.07	45.71	46.13	46.63	46.71
Arkwright St.	552150	44.18	44.5	44.76	44.79	45.08	45.36
	552200	48.96	49.47	50.08	50.49	51.18	51.34

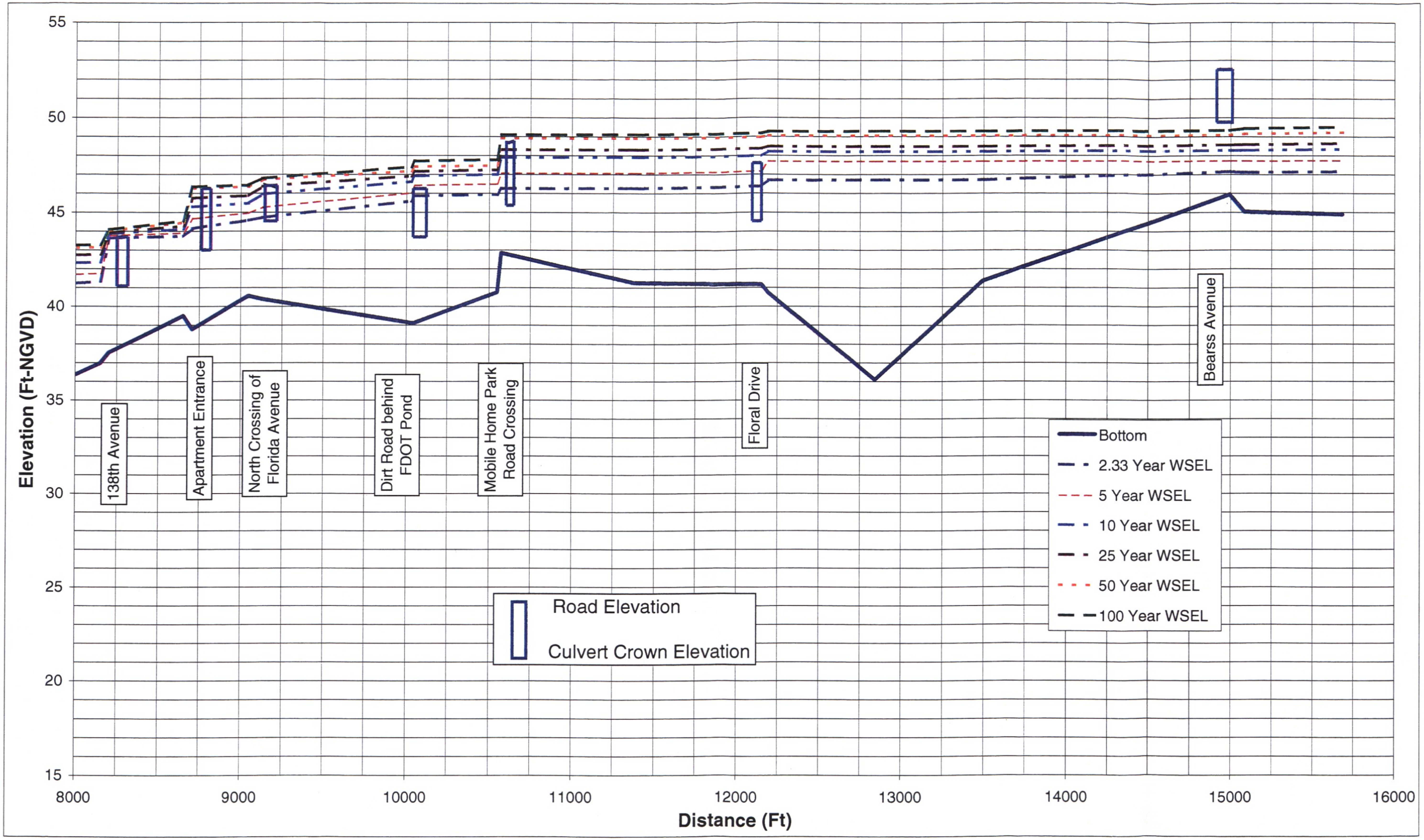
Table 6.1 - Design Storm Event Results-Existing Conditions (Cont.)

Road / Name or Lake	***Model Junction ID***	***Design Storm Elevation***					
		2.33 YR	***5 YR***	***10 YR***	***25 YR***	***50 YR***	***100 YR***
Private Road	552400	45.9	46.79	47.64	48.08	48.73	48.97
Private Road	552500	45.92	46.8	47.65	48.09	48.73	48.98
Leisure Dr.	552600	47.68	47.75	48.1	48.35	48.9	49.14
	552650	46.04	46.92	47.74	48.17	48.79	49.03
Floral Dr.	552700	46.34	47.5	48.08	48.34	48.89	49.13
	552800	50.6	51.36	52.04	52.08	52.24	52.35
	552850	46.35	47.51	48.09	48.34	48.89	49.13
Old Pointe Dr.	552900	46.35	47.51	48.09	48.34	48.89	49.13
	552975	47.12	47.57	48.14	48.41	48.91	49.15
	552980	47.13	47.58	48.72	49.07	49.78	50.12
Windingwood Cr.	553000	47.09	47.55	48.14	48.43	49.99	49.25
Windingwood Cr.	553100	47.12	47.59	48.18	48.48	49.07	49.33
	569975	34.63	35.26	35.79	36.09	36.74	37.39
131st Ave	570000	34.64	35.26	35.8	36.09	36.77	37.43
Ola Ave	570100	36.55	37.02	37.64	38.68	40.32	40.54
Private Road	570200	37.41	37.9	38.53	39.05	40.4	40.62
Ola Ave	570300	40.29	40.76	40.86	40.97	41.24	41.36
Capital Dr.	570400	40.84	41.25	41.35	41.49	41.69	41.77
Private Road	570500	43.50	44.04	44.47	44.52	44.74	44.85
Capital Dr.	570600	44.53	44.61	44.69	44.74	44.83	44.87
Capital Dr.	570700	43.71	44.47	44.78	44.84	45.06	45.16
Justice Dr.	570800	45.86	45.99	46.13	46.22	46.37	46.43
Bearss Ave	580000	48.58	48.70	48.99	49.37	50.14	50.47
	580075	48.24	48.50	48.78	48.98	49.45	49.68
Bearss Ave	580100	48.24	48.50	48.79	48.99	49.46	49.69
Forest Hills Basin							
Mid Lake@ Mid Lake Dr.	560425	34.85	35.18	35.63	35.97	36.59	36.73
Lake Eckles @ Country Club Dr.	560450	30.22	30.69	31.30	31.77	32.69	33.16
Unnamed Lake @ Jerome Dr.	560550	36.87	37.01	37.15	37.23	37.37	37.43
Unnamed Lake @ Rome Ave.	560600	42.11	42.86	43.57	43.63	43.85	43.98



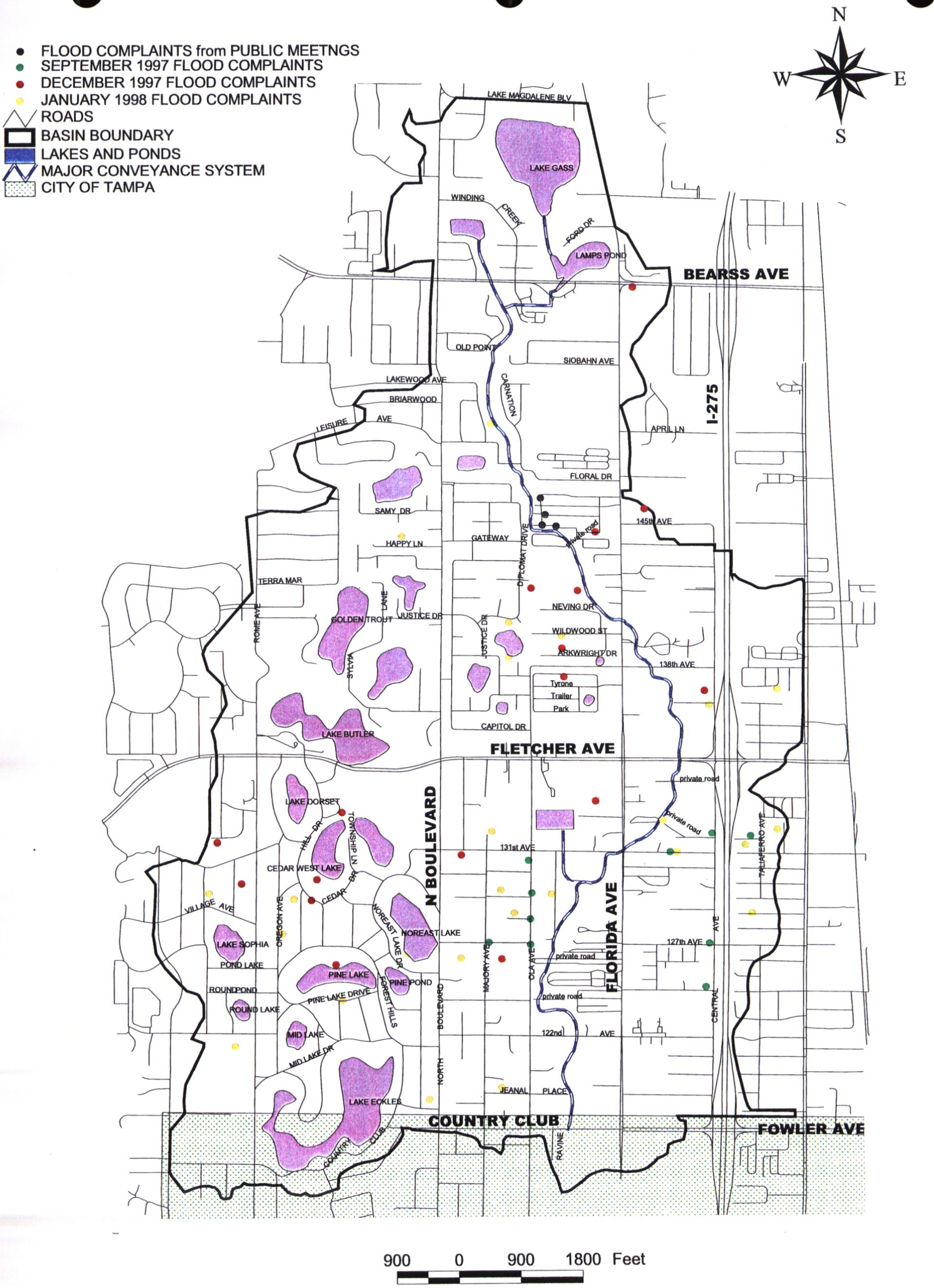
Curiosity Creek
Computed Water Surface Profiles

Figure 6-1
Curiosity Creek Main Channel
Existing Conditions Model
Sheet 1 of 2



Curiosity Creek
Computed Water Surface Profiles

Figure 6-1
Curiosity Creek Main Channel
Existing Conditions Model
Sheet 2 of 2



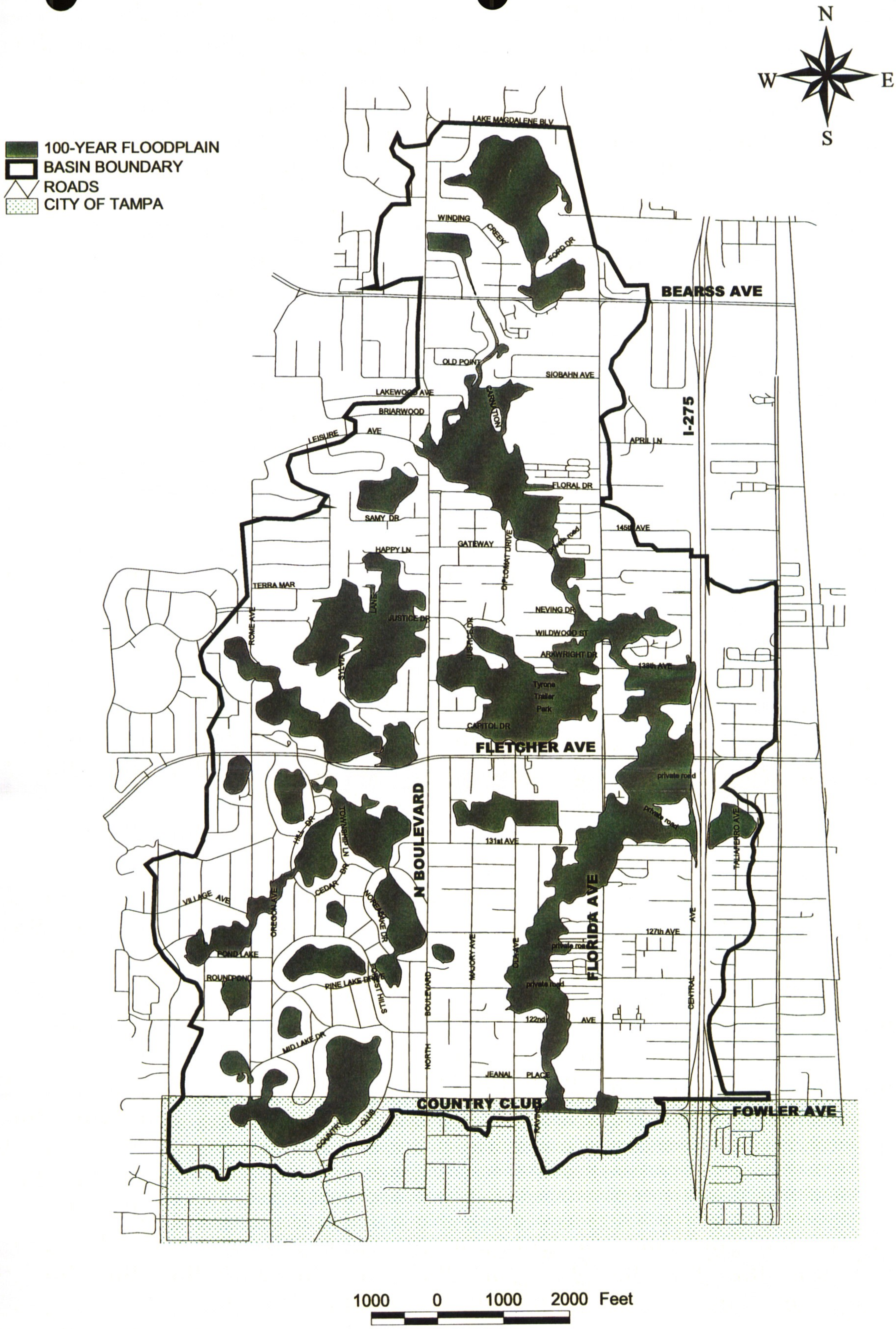
HILLSBOROUGH COUNTY
FLORIDA

CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES CORP.

FIGURE 6-2

REPORTED
FLOOD PROBLEM AREAS



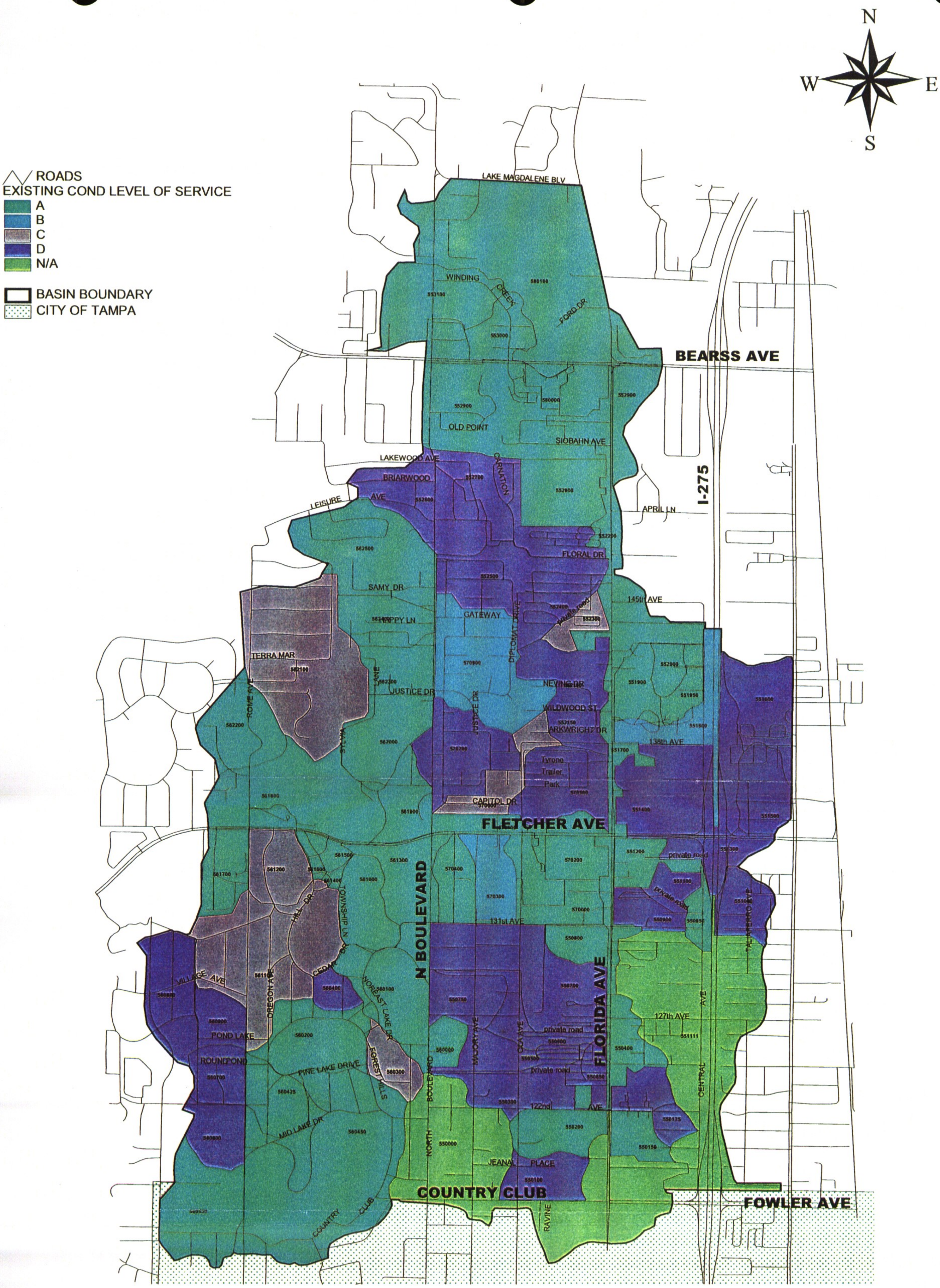
CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES CORP.

FIGURE 6-3

100-YEAR FLOODPLAIN

HILLSBOROUGH COUNTY
FLORIDA



HILLSBOROUGH COUNTY
FLORIDA

CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES CORP.

FIGURE 6-4
EXISTING CONDITIONS LEVEL OF SERVICE DIAGRAM

6.2.1 The Northwest Lake System

The Northwest Lake System lies in the northwest section of the watershed. It is bordered by Leisure Boulevard on the north, Rome Avenue on the west, North Boulevard on the east and on the south by Pine Lake and Village Drive. The drainage area for this portion of the watershed is approximately 530 acres. The major lakes in the system are Golden Trout, Butler, Dorset, Cedar West, Cedar East, Noreast and Pine.

The EXTRAN model anticipated out of bank conditions with respect to roads and drives at the following locations in the primary conveyance/storage system:

1- Unnamed lake @ Oakleaf Drive (Basin 560800); Overtopping of roadway is expected starting with the 2.33 year event. Model results indicated that the roadway would be overtopped slightly, (less than 1 inch) during the 2.33-year event. The 25-year event is expected to overtop the roadway by approximately 4 inches, and discharge runoff toward Lake Sophia in a sheetflow manner.

2- Lake Sophia @ Rome Avenue (Basin 560900); Overtopping of roadway is expected starting with the 25 year event. Model results indicated that the roadway would be overtopped slightly (less than 1 inch) during the 25-year event. The 50-year event is expected to overtop the roadway by approximately 2 inches. The County Park site located within this basin has experienced out of bank conditions for extended lengths of time in the past. The flooding of the County park is a documented and chronic problem.

3- Lake Cedar West at Townsend Drive (Basin 561100); Overtopping of roadway is expected starting with the 5 year event. Model results indicated that the roadway would be overtopped by approximately 1 inch during the 5-year event. The 25-year event is expected to overtop the roadway by approximately 5 inches. The portion of the roadway that is expected to overtop is unimproved, although it is County right-of-way. The portion of the road that is paved is not expected to experience overtopping for any of the design events.

4- Lake Golden Trout @ Sylvia Lane (Basin 562100); Overtopping of roadway is expected starting with the 5 year event. Model results indicated that the roadway would be overtopped by approximately 1 inch during the 5-year event. The 25-year event is expected to overtop the roadway by approximately 5 inches.

5- Unnamed Lake @ Rome Avenue (Basin 562200); Overtopping of roadway is expected starting with the 10 year event. Model results indicated that the roadway would be overtopped slightly (less than 1 inch) during the 10-year event. The 25-year event is expected to overtop the roadway by approximately 2 inches.

6- Pine Pond (Basin 560300); Overtopping of roadway is not expected during the 25 year event. Model results indicated that backyard and site flooding is expected for this event. Residents have reported out of bank conditions during the El Nino of 1997-1998.

7- Pine Lake (Basin 560200); Overtopping of roadway is not expected during the 25 year event. Model results indicated that backyard and site flooding is expected for this event. Residents have reported out of bank conditions during the El Nino of 1997-1998.

8- Lake Dorset (Basin 561200); Overtopping of roadway is not expected during the 25 year event. Model results indicated that backyard and site flooding is expected for this event. Residents have reported out of bank conditions and problems with septic systems at four adjacent locations on the east side of the lake.

6.2.2 The Curiosity Creek Main Channel

The main channel of Curiosity Creek originates at a borrow pit in the headwaters of the basin and moves through the system in generally a southerly direction until ultimately discharging to the Blue Sink in the City of Tampa.

The EXTRAN model anticipated out of bank conditions with respect to roads and drives at the following locations in the primary conveyance/storage system:

1- Country Club Drive (Basin 550100); Overtopping of roadway is expected starting with the 2.33 year event. Model results indicated that the roadway would be overtopped by approximately 1.6 feet during the 2.33-year event. The 25-year event is expected to overtop the roadway by approximately 2.4 feet. Tailwater from the Blue Sink is the major contributor to this overtopping. This road is in the City of Tampa.

2- 122nd Avenue (Basin 550300); Overtopping of roadway is expected starting with the 2.33 year event. Model results indicated that the roadway would be overtopped by approximately 4 inches during the 2.33-year event. The 25-year event is expected to overtop the roadway by approximately 14 inches.

3- Private Road (Basin 550500); Overtopping of roadway is expected starting with the 2.33 year event. Model results indicated that the driveway would be overtopped by approximately 13 inches during the 2.33-year event. The 25-year event is expected to overtop the driveway by approximately 24 inches.

4- Private Road (Basin 550600); Overtopping of an adjacent, private roadway to the channel is expected starting with the 2.33 year event. This out of bank flooding will affect the adjacent mobile home community. Model results indicated that the driveway would be overtopped by approximately 13 inches during the 2.33-year event. The 25-year event is expected to overtop the driveway by approximately 24 inches.

5- Private Road (Basin 550700); Overtopping of roadway is expected starting with the 2.33 year event. This out of bank flooding will affect the adjacent mobile home community. Model results indicated that the driveway would be overtopped by approximately 4 inches during the 2.33-year event. The 25-year event is expected to overtop the driveway by approximately 16 inches.

6- 131st Avenue at Florida Avenue (Basin 550900); Overtopping of roadway is expected starting with the 5 year event. Model results indicated that the roadway would be overtopped slightly (less than 1 inch) during the 5-year event. The 25-year event is expected to overtop the roadway by approximately 14 inches.

7- Taliaferro St. (Basin 551000); Overtopping of roadway is expected starting with the 2.33 year event. Model results indicated that the roadway would be overtopped by approximately 9 inches during the 2.33-year event. The 25-year event is expected to overtop the roadway by approximately 2.3 feet.

8- Private Road (Basin 551100); Overtopping of roadway is expected starting with the 2.33 year event. This out of bank flooding will affect the adjacent mobile home community. Model results indicated that the driveway would be overtopped by approximately 5 inches during the 2.33-year event. The 25-year event is expected to overtop the driveway by approximately 18 inches.

9- 137th Avenue (Basin 551400)-Overtopping of 137th Avenue is expected to overtop starting with the 10 year event. Model results indicated that the dead end of the roadway would be overtopped by approximately 5 inches for the 10-year event. The 25 year event is expected to overtop the end of the road by approximately 10 inches.

10- 138th Avenue (Basin 551800); Overtopping of roadway is expected starting with the 2.33 year event. Model results indicated that the roadway would be overtopped by approximately 5 inches during the 2.33-year event. The 25-year event is expected to overtop the roadway by approximately 8 inches.

11- Florida Avenue / Wildwood St. (Basin 552100); Overtopping of Florida Avenue at the North crossing of Florida Avenue is expected starting with the 25 year event. Model results indicated that the roadway would be overtopped by approximately 4 inches during the 25 year event. Overtopping of Wildwood Street adjacent to the channel is expected starting with the 10 year event. Model results indicated that the roadway would be overtopped slightly (less than 1 inch) during the 10-year event. The 25-year event is expected to overtop the roadway by approximately 4 inches.

12- Arkwright St. (Basin 552150); Overtopping of roadway is expected starting with the 2.33 year event. Model results indicated that the roadway would be overtopped by approximately 14 inches during the 2.33-year event. The 25-year event is expected to overtop the roadway by approximately 1.8 feet. This roadway lies in an area with no outfall, except for a small pump station. During events larger than the 25 year storm, this area will receive overbank flow from Curiosity Creek which contributes to the expected flooding. This area is a documented flood prone basin.

13- Private Road (Basin 552300); Overtopping of dirt roadway is expected starting with the 10 year event. Model results indicated that the roadway would be overtopped by approximately 4 inches during the 2.33-year event. The 25-year event is expected to overtop the roadway by approximately 8 inches.

14- Private Road (Basin 552400-552500); Out of bank conditions are expected upstream of this roadway starting with the 2.33 year event. This out of bank flooding will affect the adjacent mobile home community (Rose Lake Estates). Model results indicated that out of bank flooding would be approximately 6 inches during the 2.33-year event. The 25-year out of bank depth of flooding is expected to be approximately 2.0 feet. The actual roadway crossing is not expected to overtop until the 50-year storm event. This area is a documented flood prone basin.

15- Leisure Drive (Basin 552600); Overtopping of roadway is expected starting with the 2.33 year event. Model results indicated that the roadway would be overtopped by approximately 6 inches during the 2.33-year event. The 25-year event is expected to overtop the roadway by approximately 1.2 feet.

16- Floral Drive (Basin 552700); Overtopping of roadway is expected starting with the 10 year event. Model results indicated that the roadway would be overtopped by approximately 7 inches during the 10-year event. The 25-year event is expected to overtop the roadway by approximately 10 inches.

17- Unnamed lake @ Ola Ave. (Basin 570300); Overtopping of roadway is expected starting with the 10-year event. Model results indicated that the roadway would be slightly overtopped (less than 1 inch) during the 10-year event. The 25-year event is expected to overtop the roadway by approximately 3 inches.

18- Unnamed lake @ Private Road – Tyrone Trailer Park (Basin 570500); Overtopping of roadway is expected starting with the 2.33-year event. Model results indicated that the private internal roadway would be overtopped by approximately 2.5 feet during the 2.33-year event. The 25-year event is expected to overtop the roadway by approximately 3.5 feet. This area is a documented flood prone basin. This basin is expected to discharge across Fletcher at a depth of approximately 1 inch during the design event as well as flood Ola Avenue north of Fletcher Avenue to a depth of approximately 12 inches at the lowest point.

19- Unnamed lake @ Capital Drive (Basin 570600); Overtopping of roadway is expected starting with the 2.33-year event. Model results indicated that the roadway would be overtopped by approximately 3 inches during the 2.33-year event. The 25-year event is expected to overtop the roadway by approximately 5 inches. This overbank condition contributes to the flooding expected at Basin 570500, (Tyrone Trailer Park).

20- Unnamed lake @ Capital Drive (Basin 570700); Overtopping of roadway is expected starting with the 5 year event. Model results indicated that the roadway would be overtopped by approximately 2 inches during the 5-year event. The 25-year event is expected to overtop the roadway by approximately 6 inches. This overbank condition contributes to the flooding expected at Basin 570500, (Tyrone Trailer Park).

6.2.3 The Forest Hills Basin

Most of the Forest Hills Basin is in the City of Tampa. However, there is an area within Hillsborough County that contributes runoff to this basin. This area includes those lakes within Hillsborough County that discharge to the Forest Hills Basin either by conveyance or by direct runoff. Round Lake, Mid Lake, and Lake Eckles are part of the Forest Hills Basin.

The EXTRAN model anticipated out of bank conditions with respect to roads and drives at the following locations in the primary conveyance/storage system:

1- Unnamed lake @ Rome Ave (Basin 560600); Overtopping of roadway is expected starting with the 10-year event. Model results indicated that the roadway would be overtopped slightly (less than 1 inch) during the 10-year event. The 25-year event is expected to overtop the roadway by approximately 2 inches.

2- Round Lake @ Jerome Ave. (Basin 560700); Overtopping of roadway is expected starting with the 10-year event. Model results indicated that the roadway would be overtopped slightly (less than 1 inch) during the 10-year event. The 25-year event is expected to overtop the roadway by approximately 6 inches.

6.3 LEVEL OF SERVICE ANALYSIS

This section describes the methodology utilized in defining the Level Of Service (LOS) for the various sub-basins within the Curiosity Creek watershed study area. Figure 6-4 contains a graphical representation of the LOS for this watershed based on the 25 year 24 hour criteria.

6.3.1 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.

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. The LOS analysis used for this work evaluates the roads, sites and structures independently. Therefore it is possible to have a basin where the road does not flood, yet is designated as a D, the lowest level, because of a structure that may flood.

Level	*Hillsborough County Comp Plan Definition*	*Master Plan Definition*
A	No Significant Flooding	No Flooding
B	No Major Residential Flooding	Street Flooding is 3" or More Above Crown of Road
C	No Significant Structure Flooding	Site Flooding is 6" or More
D	No Limitation on Flooding	Structure Flooding

The Comprehensive Plan contains estimated Adopted (existing) and Ultimate (proposed) LOS designations for several watersheds in Hillsborough County. According to the current Comprehensive Plan the 10-year 24-hour/ B level has been identified for the Curiosity Creek watershed for the major conveyance system. Hillsborough County specified that the level for the analysis herein should be the 25 year 24 hour/B. The analysis of the specified (existing conditions) LOS is contained in this chapter. The LOS for the Ultimate LOS (proposed) conditions is contained in Chapter 15.

6.3.2 Establishment of Landmark Elevations

To establish the LOS for each sub basin and thus the LOS for the major sub areas, landmark elevations were determined. These elevations were established with contour aerials for the most part. In some cases survey elevation data was available and was used in those areas. Elevations relating to road crowns, site elevations and structure elevations were established for each subbasin. The structures in each subbasin were assumed to be constructed at grade. The landmark elevation is reflective of the worst case in each subbasin. Table 6.2 contains the landmark elevations and the 25-year water surface elevation associated with that subbasin.

The LOS designations were assigned to the subbasins, the major sub-basins and the overall watershed. The LOS of the Curiosity Creek watershed is reflective of the worst case for each major subbasin and the LOS for each major subbasin is reflective of the worst case for each subbasin.

Insert table 6-2

Table 6.2
Existing Conditions Level of Service
Curiosity Creek Watershed

Adjacent Road name	Basin Number	Landmark Elevations			25 year water surface	Existing Level of Service
		road	site	struct		
COUNTRY CLUB	550100	29.7	30.5	31	32.13	D
122nd	550150	37.7	37.7	38	37.51	A
121st	550175	36.3	36.3	36.3	37.64	D
FLORIDA AVE	550200	37.7	33	34	32.18	A
122ND AVE	550300	32.5	31.5	33	33.71	D
FDOT POND	550400	35.5	NA	NA	34.07	A
PRIVATE ROAD	550500	32.5	32.5	32	34.58	D
PRIVATE ROAD	550600	32.5	32.5	33	34.61	D
FLORIDA AVE	550650	35.2	34.4	35.4	35.54	D
PRIVATE ROAD	550700	33.3	33.3	33.3	34.72	D
MARJORY	550750	38.5	37.2	39	39.48	D
LINDA	550800	38	38.3	38.3	36.18	A
131 ST	550900	38.4	38.4	38.4	39.56	D
CENTRAL AVE	550950	40	40.3	40.5	39.87	A
TALIAFERRO ST	551000	37.5	37.5	37.5	39.85	D
PRIVATE ROAD	551100	38.4	38.4	38.4	39.97	D
POND FOR DEV.	551200	42.8	42	42	39.97	A
PRIVATE ROAD	551300	42	42	42	42.04	D
FLETCHER AVE/137th Ave.	551400	41.5	41.5	42	42.58	D
ORANGE AVE.	551500	41	40.4	41	42.68	D
PRIVATE ROAD	551600	44	43	44	46.05	D
FDOT POND	551700	45.4	45.4	45.4	43.46	A
138TH AVE.	551800	43.2	45	45	43.91	B
APT COMPLEX	551900	46.6	46	46.6	45.75	A
APT COMPLEX	551950	46.6	46	46.6	45.77	A
APT COMPLEX	552000	46.6	46	46.6	45.79	A
WILDWOOD	552100	45.8	45.5	46	46.37	D
ARKWRIGHT	552150	43	43	44.4	44.79	D
FDOT POND	552200	52.8	NA	NA	50.89	A
PRIVATE ROAD	552300	46.3	46.5	N/A	47.16	C
PRIVATE ROAD	552400	45.4	46	46	48.3	D
PRIVATE ROAD	552500	46	46	46	48.3	D
LEISURE AVE.	552600	47.2	47	47.3	48.49	D
FLORAL DR	552700	47.5	48	48.5	48.48	D
PRIVATE DEVEL	552800	NO DATA	NO DATA	NO DATA	52.08	A
OLD POINTE	552900	50.8	51	51.3	48.48	A
WINDING CR DR.	553000	51.4	51	53	48.59	A
WINDING CR DR.	553100	51.8	52	54.5	48.64	A
NORTH BLVD	560000	38.7	38	38	37.31	A
NORTH BLVD	560100	38.7	7	40	35.93	A
FOREST HILLS DR	560200	40.8	37.7	41.08	38.19	C
NOREAST DR	560300	38.6	37.3	39.49	37.81	C

Table 6.2 (cont.)
Existing Conditions Level of Service
Curiosity Creek Watershed

Adjacent Road name	Basin Number	Landmark Elevations			25 year water surface	Existing Level of Service
		road	site	struct		
CEDAR DR	560400	45	42.5	43	45.35	D
MIDLAKE DR	560425	36.3	38	38.5	35.97	A
COUNTRY CLUB	560450	34.5	34	34.5	31.77	A
JEROME AVE	560550	44.8	45	46	37.23	A
ROME AVE	560600	43.5	43	43.5	43.63	D
ROME AVE	560700	48.5	47	48	49.09	D
OAKLEAF DR	560800	51.5	49.5	50	51.88	D
ROME AVE	560900	48.5	47	48	48.57	D
LAKE NOREAST DR	561000	42.5	41	41.29	40.18	A
TOWNSEND LN.	561100	42.5	41	43.59	42.95	C
FOREST HILLS DR	561200	46.5	45	45.88	45.75	C
131ST AVE	561300	43.5	43	NA	40.93	A
TOWNSEND LN.	561400	42.5	43	43	40.27	A
EDITH ST.	561500	47	NA	NA	40.47	A
FOREST HILLS DR	561600	46.5	46.5	47	42.85	A
ROME AVE	561700	51.8	52	53	50.36	A
SYLVIA LN.	561800	46.3	47	47.07	44.07	A
SYLVIA LN.	561900	46.5	46.3	46.5	45.37	A
SYLVIA LN.	562000	46.5	47.41	47.41	45.63	A
SYLVIA LN.	562100	45.8	45.5	48.33	46.27	C
ROME AVE	562200	49.5	NA	NA	49.62	A
JUSTICE DR.	562300	45.8	46	47.62	45.96	A
HAPPY LN.	562400	46.7	48.5	49	47.03	A
SAMY DR	562500	48.4	49.5	49.7	48.39	A
131ST AVE	570000	38.4	38	38	36.2	A
OLA	570100	40.7	40.7	46	38.74	A
PRIVATE ROAD	570200	42	40.8	41.5	39.53	A
OLA	570300	40.7	42	43.5	40.99	B
HAMNER	570400	42.5	41.5	42.5	41.49	A
PRIVATE ROAD	570500	41	41	41.7	44.52	D
CAPITOL DR.	570600	44.3	44.3	45.5	44.74	C
CAPITOL DR.	570700	44.3	44.5	44.5	44.84	D
JUSTICE	570800	47	46	46.5	46.22	B
BEARSS AVE.	580000	52.3	52.3	53	49.37	A
BEARSS AVE.	580100	52.3	52.3	54.2	48.99	A

NA- No affected landmarks under shown category
NO DATA- Landmark elevations not available-LOS assumed =A

6.4.1 The Northwest Lake System

The Northwest lake system has a LOS of D. This is due to the anticipated structure flooding during the 25-year design storm. The model indicated road, site and structure flooding might occur within this major system at 2 subbasins. The vast majority of the Northwest Lake System had higher LOS designations.

Structure Flooding during the 25-year event: LOS D

Unnamed lake (Basin 560800)-2 to 3 homes may be affected. Portion of Oakleaf Drive overtopped, sheetflow discharged to Lake Sophia

Lake Sophia (Basin 560900)- 2 to 3 homes may be affected. County Park site and residential backyard flooding.

Site Flooding During the 25 year event; LOS C

Lake Cedar West (Basin 561100)-Unimproved County right of way overtopped

Lake Dorsett (Basin 561200)-Residential backyard flooding of 3 to 4 homes, reported septic tank problems

Lake Golden Trout (Basin 562100)- Residential yard flooding of 6 homes may be affected. Intersection of Sylvia Lane and Justice Drive may be affected.

Pine Pond (Basin 560300)- Residential backyard flooding of 2 homes.

Pine Lake (Basin 560200)- Residential backyard flooding of homes. (Reported by Hillsborough County)

6.4.2 The Curiosity Creek Main Channel

The Curiosity Creek Main Channel has a LOS of D. This is due to the anticipated structure flooding during the 25-year design event. The model anticipated that road, site and structure flooding may occur within this major system at several areas.

Structure Flooding during the 25-year event: LOS D

Country Club Drive (Basin 550100)-1 home may be affected. Approximately 550 feet of roadway may be affected.

122nd Avenue (Basin 550300)-1 home may be affected. Approximately 400 feet of roadway may be affected.

Mobile Home Community (Basin 550500)-Community adjacent to Creek.

Mobile Home Community (Basin 550600)-Community adjacent to Creek.

Mobile Home Community (Basin 550700)-Community adjacent to Creek.

131st Street (Basin 550900)-1 home and commercial property may be affected. Approximately 150 feet of roadway may be affected.

Taliaferro Street (Basin 551000)-7 homes may be affected and the adjacent streets.

Mobile Home Community (Basin 551100)-Community adjacent to Creek.

Commercial Buildings (Basin 551300)-Property adjacent to Curiosity Creek.

137th Avenue (Basin 551400)- 2 homes may be affected Residential yard flooding. Approximately 100 feet of roadway may be affected

Florida Avenue/Wildwood Street (Basin 552100)-2 homes may be affected. Approximately 130 feet of roadway may be affected.

Arkwright (Basin 552150)-5 homes may be affected. Approximately 200 feet of roadway may be affected.

Mobile Home Community (Basin 552400-552500)-Rosewood Estates

Leisure Avenue (Basin 552600)-2 homes may be affected. Approximately 1000 feet of roadway may be affected.

Floral Drive (Basin 552700)-4 homes may be affected. Approximately 2300 feet of roadway may be affected.

Capital Drive (Basin 570700)-11 homes may be affected. Approximately 300 feet of roadway may be affected

Mobile Home Community (Basin 570500)-Tyrone Mobile Home Park

<u>Site Flooding during the 25-year event:</u> LOS C

Capitol Drive (Basin 570600)- Residential yard flooding. Approximately 450 feet of roadway may be affected

Private Road (Basin 552300)-out of bank conditions

<u>Street flooding during the 25-year event:</u> LOS B

Ola Avenue (Basin 570300)- Approximately 100 feet of roadway may be affected

138th Avenue (Basin 551800)-Approximately 800 feet of roadway may be affected

6.4.3 The Forest Hills Basin

The Forest Hills Basin has a LOS of D. This is due to the anticipated structure flooding during the 25-year design event. The model anticipated that road, site and structure flooding may occur within this major system at several areas.

<u>Structure Flooding during the 25-year event:</u> LOS D

Round Lake (Basin 560700)-3 homes may be affected. Approximately 100 feet of roadway may be affected

Unnamed Lake (Basin 560600)-2 homes may be affected. Approximately 100 feet of roadway may be affected

6.5 CURIOSITY CREEK WATERSHED LEVEL OF SERVICE

The overall LOS for the Curiosity Creek watershed is level D. This is due to the worst case designations shown in the major sub basins. All of the subbasins indicated a LOS of D, for structural flooding potential.

CHAPTER 7

EXISTING WATER QUALITY CONDITIONS

7.1 OVERVIEW

The Curiosity Creek watershed is comprised of several important water resources including lakes, streams, and groundwater. The protection and conservation of these resources is an important component of a number of planning activities for this area including:

- Hillsborough County's Comprehensive Plan (Stormwater Management, Conservation and Aquifer Recharge, and Coastal Management Elements);
- Southwest Florida Water Management District's Comprehensive Watershed Management Plan (CWM) and Surface Water Improvement and Management (SWIM) Plan, and the;
- Tampa Bay Estuary Program's Comprehensive Conservation Management Plan.

Both federal (Clean Water Act [CWA]) and state (Chapter 62-302, Florida Administrative Code [F.A.C.]) initiatives have been developed to protect, restore, and maintain surface waters – a critical resource for Hillsborough County's economy and environment. The primary goals of these initiatives have been to provide water quality conditions that protect human health and are capable of supporting viable fish and wildlife populations. A classification system has been developed by the Florida Department of Environmental Protection (FDEP) which designates a waterbody based on one of five classes related to a particular waterbody's designated use (Table 7-1). Each classification has specific water quality criteria necessary for the protection and preservation of surface waters which are also consistent with minimum federal standards set by the U.S. Environmental Protection Agency (USEPA).

Table 7.1. Surface water classifications developed under Chapter 62-302, F.A.C.

SURFACE WATER CLASSIFICATION	DESIGNATED USE	WATER QUALITY CRITERIA
CLASS 1	Potable Water Supplies	Most stringent
CLASS 2	Shellfish Propagation or Harvesting	Stringent
CLASS 3	**Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife**	**Moderately stringent**
CLASS 4	Agricultural Water Supplies	Less stringent
CLASS 5	Navigation, Utility and Industrial Use	Less stringent

Discharges to surface waters may be regulated by the FDEP, Southwest Florida Water Management District (SWFWMD), Hillsborough County Environmental Protection Commission (HCEPC), or the USEPA, depending on the type and magnitude of a particular discharge. Comprehensive stormwater regulation is also required under Section 402(p) of the CWA and cities/municipalities with a population greater than 100,000 have had to develop and implement stormwater plans under Phase I of the National Pollutant Discharge Elimination System (NPDES) stormwater regulations.

Curiosity Creek and the lakes that fall within its watershed are designated Class III waters based on the FDEP's classification system. Despite this moderately stringent classification, a number of potential contaminants can be found in the creek which sometimes exceed allowable limits set by Chapter 62-302. This is primarily due to the fact that development within the watershed preceded a number of regulations implemented in the 1970s and 1980s to protect water quality. Although there are a number of stormwater remediation projects underway in other areas of Hillsborough County, a number of water quality contaminants may occur in the surface waters of the Curiosity Creek watershed. These are described below:

- Excess nutrients, primarily nitrogen and phosphorus, can cause an overabundance of nuisance aquatic weeds and blooms of algae in quiescent waters (Figure 7-1). An overabundance of aquatic weeds reduces the capacity of a stream course to provide drainage during flooding events and can impede navigation. Algae blooms can depress oxygen concentrations and may cause taste and odor problems in drinking water. Some blue-green algae can produce harmful toxins.

- Total suspended solids (TSS) may include sources of pollution with high biological or chemical oxygen demand that can reduce the availability of oxygen in the water for aquatic life. Heavy metals and pesticides are often bound to TSS and can be found in sediments of receiving waters. Excessive TSS concentrations can also reduce water clarity which can affect aquatic plant communities (which require light for photosynthesis and growth) and may interfere with the feeding efficiency of filter-feeding aquatic insects and shellfish.

Figure 7-1. Curiosity Creek at Floral Avenue looking north. Creek is quiescent at this location – note debris, noxious plant colonization, and indicators of excess nutrient loads (dense cover of algae and duckweed).

- Metals, including mercury, lead, and copper, can reach levels that are toxic to many aquatic insects and other aquatic life. In some cases, metals such as mercury may accumulate in fish, posing a threat to human health if consumed regularly.

- Toxicants, organic contaminants, and pesticides (which include insecticides, herbicides, and fungicides) can be found in residential, commercial, industrial, and agricultural areas and can be transported to surface waters via stormwater runoff. Though often undetectable in the water column, some compounds (e.g., pesticides) and their decay products may accumulate in sediments to concentrations that are harmful to aquatic life.

- Pathogens, which may include bacteria, viruses, and protozoa, can cause a number of human diseases including respiratory and gastrointestinal ailments, skin rashes, and eye and ear infections. Transport can occur via stormwater runoff or groundwater (from inadequately constructed septic tank systems) to surface waters or water supplies. Illnesses may occur if pathogens are ingested either through accidental contact by recreational users of lakes and streams or through ingestion of inadequately treated drinking water. Pathogenic organisms are not routinely monitored by most water sampling agencies, except for potable water supplies. Indicators of pathogen contamination include total and fecal coliform bacteria that are tested by some agencies (e.g., health departments) at public bathing beaches and in ambient water quality monitoring programs. Efforts are currently underway by the U.S. EPA to adopt standards for two new indicators (*E. coli* and enterococci) which better protect human health for recreational waters.

- Litter, trash, and other discarded solid objects originate from humans around shopping and commercial areas, industrial sites, landfills, automobiles, and overflowing trash cans. Litter poses a health and safety risk to humans and aquatic animals and reduces the aesthetic value of neighborhoods, streams, and lakes.

7.1.1 Pollution Sources and Transport

Excess nutrients, pathogens, and toxic contaminants can follow several different pathways to the creeks, lakes, and groundwater in the Curiosity Creek watershed including via:

- stormwater runoff from urban, residential and commercial land uses;
- on-site disposal system (i.e., septic tanks) leachate which may contribute significantly to nitrogen and pathogen loading to portions of the creek and certain lakes;
- untreated domestic wastewater (which may occur as accidental discharges during heavy rainfall events from lift station overflows); and,
- atmospheric deposition (primarily nitrogen oxides and certain heavy metals which can be transported to the creek and lakes in rainfall and dryfall).

Figure 7-2. Curiosity Creek at Country Club Drive looking east. Note red arrow pointing to 60" culvert at bottom of photo which discharges untreated stormwater runoff (from Florida Avenue) directly to the creek.

7.1.2 Indicators of Stream Water Quality and Health

In addition to the various contaminants discussed above, measures of ecosystem health can play an important role in the linkage between land use practices and water quality. Factors such as the width of riparian (streamside vegetation) zones and the abundances and diversity of plant and macroinvertebrate communities can serve as biological indicators of environmental stress and water quality. The following table summarizes a rating system that can be used to evaluate existing environmental conditions within the Curiosity Creek watershed.

Table 7.2. Rating of stream water quality and health based on existing vegetation and development activities within a watershed (from Office of the Commissioner for the Environment, Victoria, Australia, 1988) .

Rating	Vegetation	Macroinvertebrates	Physical/Chemical
Excellent	Streamside vegetation intact for minimum 100m width from the bank, with continuous cover essentially unmodified and with few exotic plants. Watershed vegetation substantially uncleared. Less than 10% of watershed developed.	Natural abundance and diversity of species.	Water clear, minimal turbidity, natural levels of nutrients, and high dissolved oxygen levels.
Good	Existing streamside vegetation communities intact, with cover essentially unmodified for, at a minimum, 30m width for over 80% of each stream segment. Infrequent exotics. Largely undisturbed by roadways. Limited permanent clearing of watershed vegetation.	Macroinvertebrate communities intact and high species abundances reflecting low level input of wastes and minor watershed modifications.	Water clear, minimal turbidity, natural levels of nutrients and high dissolved oxygen levels.
Fair	Existing streamside vegetation communities predominantly intact and exotics infrequent. Riparian zone intact for 30m width, at minimum, for over 60% of watershed.	Minor changes in macroinvertebrate communities including changes in community structure and local loss of some species, corresponding to minor influence of watershed modifications.	Slight increases in one or more of turbidity and nutrient levels. No substantial change in dissolved oxygen levels.
Poor	Existing streamside vegetation largely fragmented and exotics frequent. Riparian zone of 30m width intact for less than 60% of watershed, and frequently disturbed by roadways/development. Watershed largely cleared of native vegetation.	Marked changes in macro-invertebrates communities, including changes in structure and local loss of species reflecting significant inputs of wastes, toxicants and silt.	Marked increases in turbidity or nutrient levels. Some change in dissolved oxygen levels or significant presence of cumulative or non-cumulative toxicants present in water column.
Degraded	Little remnant streamside vegetation. Surviving patches fragmented. Exotics frequent. Riparian zone of 30m width intact for less then 25% of watershed, and frequently disturbed by roadways & development. Watershed substantially cleared of native vegetation.	Major changes in macroinvertebrate communities, including changes in structure and massive local loss of species.	Major presence of turbidity or nutrient levels, substantial change in dissolved oxygen levels. Cumulative toxicants present in water column.

Although detailed descriptions of historical and existing natural systems conditions will follow in Chapter 8, the negative impacts of development on the extent and quality of riparian vegetation has been significant in the Curiosity Creek watershed. Based on these impacts, the watershed would be characterized as "poor" using this rating system. Ongoing efforts to characterize stream conditions in both pristine and impacted watersheds are currently underway by the FDEP as part of the Nonpoint Source Bioassessment Program (1996). Currently, no stream condition data has been collected by FDEP for Curiosity Creek.

7.1.3 Superfund

Due to the highly developed nature of the Curiosity Creek watershed, a survey of excessively contaminated sites was performed by evaluating federal Superfund information. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress in 1980. The law created a tax on the chemical and petroleum industries and provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. Over five years, $1.6 billion was collected and the tax went to a trust fund for cleaning up abandoned or uncontrolled hazardous waste sites.

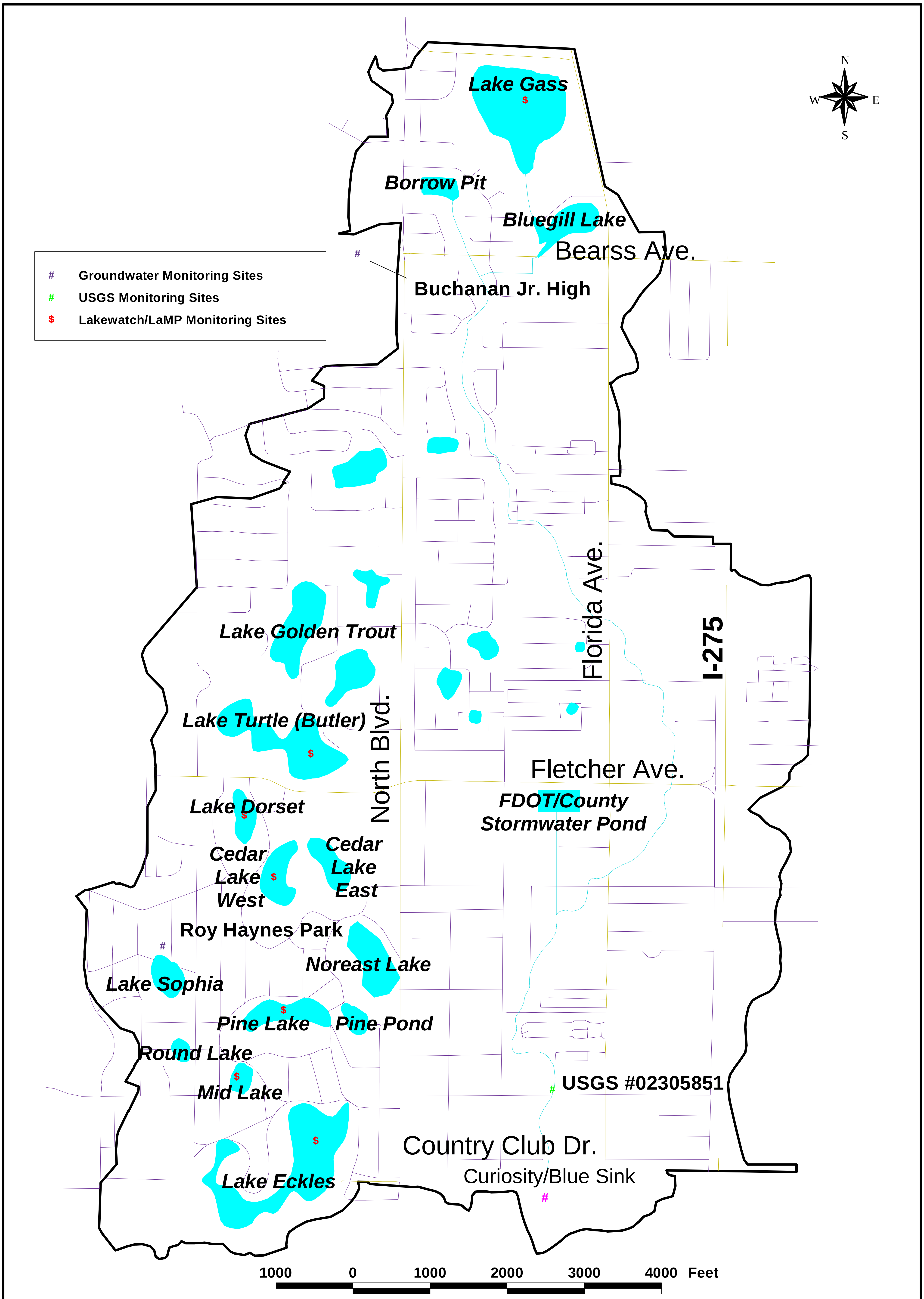
Although a number of Superfund sites do exist in Hillsborough County to the east and southeast of Curiosity Creek, a review of current FDEP and USEPA maps and reports determined that no federal Superfund sites are located within the Curiosity Creek watershed.

7.2 LAKES

A number of lakes and ponds exist in the Curiosity Creek watershed and provide flood storage and recreational and aesthetic benefits to local residents (Figure 7-3). These waterbodies fall within the Land-o-Lakes lakes region that is characterized mainly by sandy uplands intermixed with areas of poorly drained soils. The region separates the Tampa Plain and Hillsborough Valley regions and has a high density of lakes with elevations ranging from 30 to 80 feet above sea level. Historically, this area was dominated by longleaf pine and turkey oaks which has now been converted to citrus groves, residential development, and commercial land uses. The lakes in this region are neutral to slightly alkaline, have low to moderate nutrient levels, and are classified as clear water lakes.

Due to the highly developed nature of the basin, maintaining and enhancing water quality in these lakes are important issues since many are used as receiving waters for stormwater runoff from residential development. Elevated levels of nutrients (phosphorus and nitrogen) can produce algae blooms which often result in the following:

- elevated productivity (as measured by chlorophyll *a* values);
- periodic anoxic (low oxygen) conditions;
- fish kills;
- decreased light penetration (lower Secchi depth values) through the water column;
- aquatic plant die-off; and,
- increases in sedimentation rates (i.e., lake aging).



HILLSBOROUGH COUNTY
FLORIDA

CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES CORP.
SCHEDA ECOLOGICAL ASSOCIATES, INC.

Figure 7-3. Water Quality Monitoring Sites

7.2.1 Data and Assessment Methods

The SWFWMD, HCEPC, United States Geological Survey (USGS), and FDEP collect data in a number of lakes and streams in Hillsborough County. These agencies monitor such parameters as lake levels, water quality, and habitat value for a select number of lakes in the county. Unfortunately, little data has been collected by these agencies for lakes in the Curiosity Creek watershed.

Of the twelve named lakes and ponds in the Curiosity Creek watershed, water quality data has recently been collected for seven lakes (Gass, Turtle, Eckles, Mid, Pine, Dorset, and Cedar) through a volunteer water quality sampling program (Figure 7-3). This program was originally developed by the University of Florida as the LAKEWATCH Program to involve local citizens in the collection and management of water quality data for lakes throughout Florida.

Local volunteers participating in the Hillsborough Lake Management Program (LaMP) have been trained using the same protocol as the University of Florida's LAKEWATCH program and collect Secchi disk depth (water clarity) information and water quality samples at three locations in each lake. These samples are analyzed at the University of Florida's Department of Fisheries and Aquatic Sciences lab (Gainesville) for total phosphorus, total nitrogen, and chlorophyll *a* concentrations using FDEP approved methods.

In addition to the LaMP initiative, Hillsborough County has implemented a cooperative project with the SWFWMD to develop a comprehensive lake database for the county. This lake atlas was created by the University of South Florida and provides a single source of Hillsborough County lake data using an interactive, user-friendly approach. Data collected for this project includes water quality measurements, lake bottom contours, vegetation surveys, and historical data. The atlas is updated frequently to include recent water quality data collected by LaMP volunteers and can be accessed via the Internet at www.lakeatlas.usf.edu.

In order to evaluate and compare lake water quality throughout Florida, the FDEP has recommended the use of a Trophic State Index (TSI). The index was initially developed by Carlson (1977) and involves the use of three water quality indicators (total phosphorus concentration, chlorophyll *a* concentration, and Secchi depth). Carlson's index was subsequently modified by the FDEP to include total nitrogen concentrations and exclude the Secchi depth measurement due to the common occurrence of tannic lakes that have naturally colored waters that reduce water clarity.

7.2.2 Lake Water Quality

Water quality is generally good for most of the six lakes described above as reflected by relatively low mean trophic state indices (TSI) which range from a low of 25 at Lake Gass to a high of 58 at Cedar Lake West, Mid Lake and Lake Pine (Table 7-3). For comparison, the average TSI value for Lake Thonotosassa, one of the County's largest and most eutrophic lakes, is approximately 90. A TSI between 0 and 59 is "good" while a value between 60 and 69 is "fair" and 70 to 100 is "poor."

The reason for the relatively good water quality in these lakes is probably due to geological conditions in the Curiosity Creek region. This area is characterized by Zolfo fine sands which typically exhibit low nutrient concentrations, are slightly acidic, and are typically colonized by upland hardwood hammock communities. As a result of low soil nutrient concentrations, moderately vegetated shorelines, and little internal nutrient loading (from historical soil conditions), these lakes have maintained relatively good water quality despite extensive urbanization of their surrounding drainage basins. For many lakes, the drainage basins are relatively small and are characterized by single family residential areas which typically contribute lower pollutant loads than commercial and industrial land uses.

Lake Gass had the lowest TSI value and greatest mean Secchi depth (best water clarity). This is probably due to its location at the headwaters of the watershed where it probably receives low nutrient loads from a relatively small residential drainage area. Extensive cattail and floating vegetation (lilypad) growth occurs along the shoreline of Lake Gass which also has helped to maintain lower nutrient concentrations and phytoplankton growth.

Table 7.3. Water quality data for lakes in the Curiosity Creek watershed as of December 1999.

Lake Name	Area (acres)	Avg. Depth (ft.)	Max. Depth (ft.)	Mean Secchi Depth (ft.)	Mean TSI	Mean TN:TP
Lake Gass	33	5.4	14.3	7.5	26	64.1
Lake Turtle	no data	no data	no data	5.4	38	29.4
Lake Eckles	27.5	3.5	19.6	5.4	52	36.4
Mid Lake	2.1	2.8	8.4	3.3	58	19.4
Lake Pine	8.3	4.0	9.8	7.2	58	29.4
Cedar Lake West	5.7	3.8	9.9	2.9	58	26.3
Noreast Lake	9	no data	no data	no data	no data	no data
Blue Gill	no data	no data	no data	no data	no data	no data

Lakes Turtle, Cedar West, Eckles, Mid, and Pine are located in relatively dense residential areas and are interconnected, to various degrees, with one another and other drainage basins. These lakes have good water quality and clarity but have higher TSI values than Lake Gass due to either greater nutrient or chlorophyll *a* concentrations (Figure 7-4). Ratios of total nitrogen to total phosphorus can provide an indication of whether a lake is nitrogen limited, phosphorus limited, or nutrient balanced. Huber et al. (1983) developed three classes of Florida lakes based on total nitrogen to total phosphorus ratios which are as follows:

- Nitrogen-limited lakes: TN:TP < 10
- Nutrient-balanced lakes: 10 < TN:TP < 30
- Phosphorus-limited lakes: TN:TP > 30

Based on existing data, Mid Lake appears to be a nutrient-balanced lake while Lake Turtle Cedar Lake West, and Lake Pine border upon being nutrient-balanced and phosphorus-limited lakes. Lakes Gass and Eckles appear to be phosphorus-limited. As a result, additional

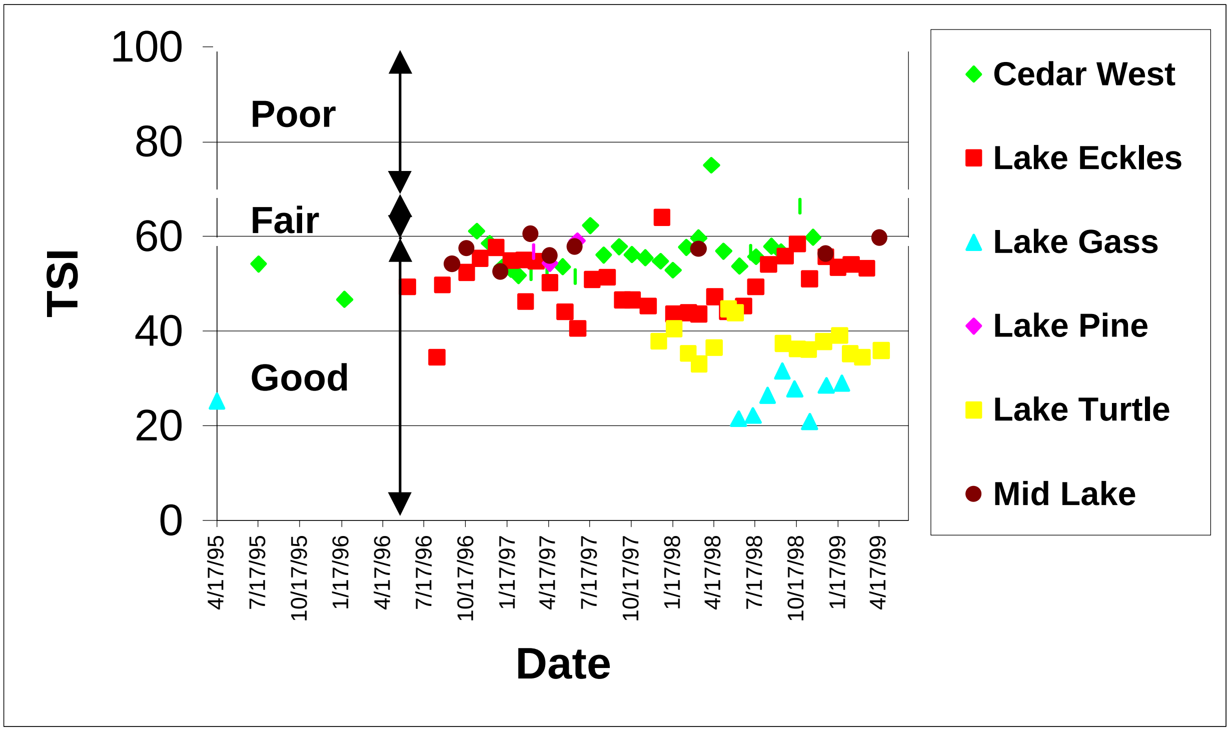


Figure 7-4. Plot of trophic state indices over time for lakes sampled within the Curiosity Creek watershed.

inputs of phosphorus to most of these lakes could lead to increased phytoplankton growth and, ultimately, hypereutrophic conditions.

The greatest mean TSI value of 58 was calculated for Cedar Lake West, Mid Lake, and Pine Lake which is the result of greater concentrations of total phosphorus, total nitrogen, and chlorophyll *a* than any of the other lakes. These lakes are surrounded by residential development which currently receive no stormwater treatment. Pine Lake consistently had the highest concentrations of total nitrogen which may be a result of surrounding wastewater management practices. Most, if not all of the homes surrounding the lake are still serviced by on-site disposal systems (septic tanks). Spikes in total nitrogen, total phosphorus and chlorophyll *a* occurred in Cedar Lake West during the El Nino event in early 1998 which was probably the result of a large input of nutrients from stormwater runoff.

Information provided by nearby residents also indicates that Cedar Lake West was stocked with over 100 grass carp during the 1980s to reduce aquatic macrophyte populations. The overabundance of grass carp resulted in the loss of most of the emergent and submersed aquatic vegetation which appears to have converted the lake from a macrophyte dominated system to one controlled mainly by phytoplankton growth. This process can produce poorer water clarity, higher nutrient concentrations, and greater phytoplankton growth (reflected in higher chlorophyll *a* values), thereby resulting in greater TSI values.

To evaluate the effects of shoreline vegetation loss on water quality, TSI values were plotted against vegetation zone widths measured by Lakewatch volunteers for several lakes in the watershed (Figure 7-5). An inverse relationship exists between TSI and shoreline vegetation zone widths that was further confirmed by regression analysis ($r^2 = 0.92$, $p < 0.05$). This trend suggests that lakes with greater extents of shoreline vegetation have better overall water quality. This relationship has also been shown for other lakes in Florida (Canfield and Hoyer, 1992).

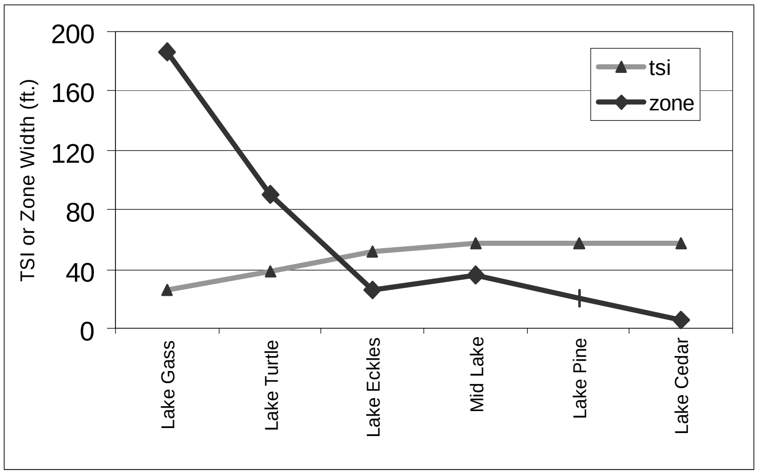


Figure 7-5. Plot of mean TSI versus shoreline vegetation zone width for several lakes in the Curiosity Creek watershed.

Water clarity in most lakes is controlled by phytoplankton, color, and TSS. Lakes with low phytoplankton concentrations and low color values often have high water clarity. As phytoplankton and color levels increase, a reduction in water clarity occurs and aquatic macrophytes may become light limited. As less light becomes available, the size of the littoral zone can decrease. Alternately, the size of the littoral zone can increase if phytoplankton or color levels decrease which can occur where management efforts reduce nutrient concentrations in a lake.

A plot of Secchi depth versus chlorophyll *a* from several lakes in the watershed (Cedar, Mid, Eckles, Gass) shows a strong, inverse relationship between water clarity and phytoplankton growth (Figure 7-6). Although color (which can play a significant role in light attentuation) values are not measured by LaMP volunteers, this analysis suggests that chlorophyll *a* concentration plays an important role in limiting water clarity. Proper control and management of excess nutrient loads will play a significant role in maintaining light availability to littoral vegetation in these lake systems.

7.3 STREAMS

Curiosity Creek is the primary stream system in the Curiosity Creek watershed. No other major streams or waterways exist other than man-made ditches or conveyance systems (pipes) which drain into the creek or surrounding lakes.

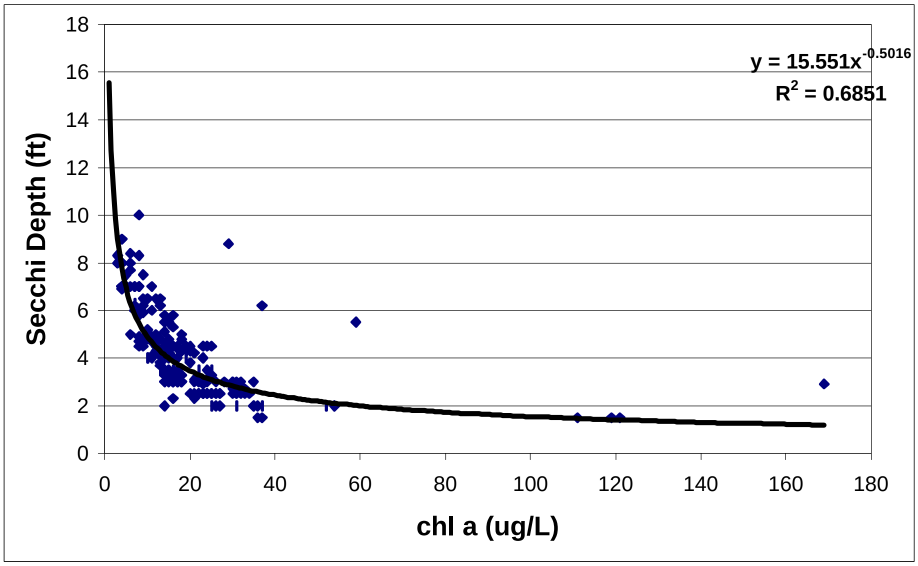


Figure 7-6. Secchi depth versus chlorophyll a values for several lakes in the Curiosity Creek watershed.

7.3.1 Data and Assessment Methods

Currently, no long-term water quality data set exists for Curiosity Creek. Sporadic data are available from both the USGS and the HCEPC for common water quality parameters and bacteria (Figure 7-3). The longest water quality data set available was obtained from the USGS for station #2305780 (Curiosity Creek near Sulphur Springs). USGS staff collected samples at this station from October 1980 to September 1984 (Table 7-4).

Figure 7-7. USGS gaging station #02305851 at 122nd Avenue on Curiosity Creek.

The HCEPC established a monthly sampling station at 122nd Avenue (also the site of a new USGS gaging station) in early 1999 (Figure 7-7). However, due to low flow conditions during the sampling dates established by the HCEPC, no samples were collected during the year and the monitoring at this site was discontinued. Fortunately, this creek has been included in the

County's Stream Waterwatch program and will be monitored by volunteers into the future. A few storm event samples have been collected by both County staff and consultants between April and September 1999. Although this data set is limited both spatially and temporally, it can be used for comparison with the earlier USGS data as well as other nearby stream systems.

7.3.2 Stream Water Quality

Stream water quality was assessed using the historical USGS data as well as more recent data collected by County staff as part of a recently developed volunteer ambient water quality monitoring program. The Stream Waterwatch program is a network of volunteers who will be collecting water quality data at various creeks and streams in the County similar to the efforts of the Lakewatch program described earlier. A list of water quality parameters and concentration ranges for the USGS data set is summarized in Table 7-4. Mean values for common parameters analyzed for the more recent Stream Waterwatch data set are shown in Table 7-5.

To assess water quality within Curiosity Creek, the Florida Water Quality Index (WQI) developed by Hand et al. (1992) was used. The index is based on six categories of water quality including clarity, dissolved oxygen, oxygen-demanding substances, bacteria, nutrients, and biological diversity. Index values are based on raw data (e.g., annual averages) from a particular sampling location and converted to values ranging from 0 to 99 for the six categories. Each categorical value corresponds to the percentile distribution of water quality data collected from streams throughout Florida. An overall score is generated based on the average of any of the six categories for which data is available, however, the index is more reliable as more categories are used. Cutoff values for the overall WQI score is as follows:

- 0 to <45 = Good
- 45 to <60 = Fair
- 60 to 99 = Poor

Based on FDEP's WQI criteria, water quality in Curiosity Creek in the 1980 to 1984 period was characterized as being "good" (WQI = 44) compared to other Florida streams. The Stream WQI calculated using the most recent data was a value of 71, which would characterize water quality in the creek as "poor."

7.3.2.1 Nutrients

Recent (1999) mean total nitrate and nitrite concentrations are approximately 50% lower than historical (1980-1984) values and are similar to other nearby, urbanized creeks. Recent mean ammonia values are greater than historical values and all of the other urbanized creeks. For total Kjeldahl nitrogen, the recent mean value was similar to values found at Rocky Creek and East Lake Canal. Recent total nitrogen values were greater than historical values at Curiosity Creek and also greater than at East Lake Canal, Rocky Creek, and Brushy Creek. The recent total phosphorous mean was less than the historical mean, but was greater than Rocky Creek, Brushy Creek, and East Lake Canal values. No data exists for comparison of recent and historical mean values for orthophosphorous, however, recent mean values in Curiosity Creek were fairly similar to values reported for Brushy Creek, Rocky Creek, and East Canal.

Table 7.4. List of USGS water quality parameters and statistics of data collected between 1980 and 1984 at Curiosity Creek.

Parameter	Min.	Max.	Median	Mean	St. Dev.
Water Temperature (Degrees C)	15.80	29.00	22.50	22.68	3.86
Instantaneous Discharge (Cfs)	0.05	6.60	0.76	1.32	1.68
Gage Height (Feet)	35.25	37.20	36.20	36.21	0.51
Turbidity (Ntu)	0.50	2.50	1.00	1.21	0.67
Conductivity (Us/Cm @ 25C)	130.00	400.00	223.00	235.77	63.23
Dissolved Oxygen (mg/L)	2.20	10.60	5.00	5.16	2.27
Dissolved Oxygen %Saturation	32.00	83.00	64.00	61.64	18.12
BOD 5-Day (mg/L)	0.30	3.20	1.20	1.33	0.71
PH	5.80	7.90	6.80	6.80	0.58
Total Nitrogen (mg/L As N)	0.39	1.70	0.84	0.87	0.35
Organic Nitrogen (mg/L As N)	0.21	1.20	0.57	0.60	0.26
Ammonia (mg/L As N)	0.02	0.41	0.07	0.10	0.11
Nitrite (mg/L As N)	0.00	0.05	0.01	0.02	0.02
Nitrate (mg/L As N)	0.02	0.41	0.12	0.16	0.14
Nitrogen Amm+Org (mg/L As N)	0.27	1.30	0.66	0.70	0.30
NO_2 + N O_3 Total (mg/L As N)	0.02	0.45	0.16	0.17	0.12
NO_2 + N O_3 Dissol (mg/L As N)	0.00	0.52	0.17	0.22	0.17
Total Phosphorus (mg/L As P)	0.11	0.50	0.25	0.28	0.14
Total Organic Carbon (mg/L As C)	0.10	16.00	8.10	8.02	3.66
Hardness Total (mg/L As Cao3)	67.00	99.00	77.00	79.92	9.79
Calcium Dissolved (mg/L As Ca)	24.00	33.00	27.00	27.54	2.90
Magnesium Dissolved (mg/L As mg)	1.70	4.00	2.50	2.69	0.66
Sodium Dissolved (mg/L As Na)	5.30	12.00	8.50	8.58	1.95
Potassium Dissolved (mg/L As K)	2.30	6.20	3.80	3.72	1.14
Chloride Dissolved (mg/L As Cl)	11.00	20.00	13.00	14.38	2.66
Sulfate Dissolved (mg/L As So4)	12.00	27.00	20.00	19.38	4.05
Silica Dissolved (mg/L As Sio2)	1.20	5.30	2.60	2.91	1.25
Cadmium Total (µg/L As Cd)	0.00	30.00	10.00	11.43	9.00
Iron Total (µg/L As Fe)	110.00	120.00	115.00	115.00	7.07
Lead Total (µg/L As Pb)	0.00	100.00	100.00	85.71	37.80
Zinc Total (µg/L As Zn)	10.00	40.00	20.00	22.86	11.13
Total Coliforms (Cfu/100 ml)	100.00	4500.00	1500.00	1932.31	1360.75
Fecal Coliforms (Cfu/100 ml)	76.00	1400.00	320.00	450.50	425.64
Fecal Streptococcus (Cfu/100 ml)	100.00	1700.00	370.00	658.46	554.90

Table 7.5. Mean values of water quality data collected by USGS (Curiosity Creek '80-'84) and the Hillsborough County Stream Waterwatch ambient water quality monitoring program from urban creek systems in Hillsborough County.

		Curiosity Creek ('80-'84)		Curiosity Creek (1999)		Rocky Creek (1999)		Brushy Creek (1999)		East Lake Canal (1999)	
Parameter	**Units**	***mean***	***s.d***	***Mean***	***s.d.***	***mean***	***s.d.***	***mean***	***s.d.***	***Mean***	***s.d.***
Temperature	Degrees Celsius	**22.68**	*3.86*	**24.43**	*2.40*	**22.40**	*2.38*	**24.01**	*3.54*	**24.55**	*2.76*
Conductivity	µmhos/cm @ 25ºC	**235.77**	*63.23*	**210.09**	*9.15*	**248.70**	*68.97*	**247.43**	*33.03*	**348.33**	*62.10*
PH	Standard Units	**6.80**	*0.58*	**6.84**	*0.80*	**7.36**	*0.66*	**7.31**	*0.74*	**7.28**	*1.03*
Dissolved Oxygen	mg/L	**5.16**	*2.27*	**4.30**	*2.25*	**3.62**	*1.50*	**6.62**	*1.01*	**3.30**	*0.00*
TSS	mg/L	**No data**	*No data*	**12.29**	*16.10*	**17.67**	*16.13*	**3.38**	*1.71*	**22.20**	*22.38*
BOD_5	mg/L	**1.33**	*0.71*	**2.83**	*1.10*	**4.90**	*3.66*	**No data**	*No data*	**4.70**	*0.75*
Fecal Coliform	CFU / 100 ml	**450.56**	*425.64*	**595.25**	*527.67*	**303.33**	*173.88*	**390.00**	*270.74*	**384.67**	*481.23*
Fecal Streptococcus	CFU / 100 ml	**658.46**	*554.90*	**1,060.00**	*621.93*	**315.00**	*434.22*	**740.00**	*254.56*	**368.00**	*294.84*
Nitrate	mg/l	**0.16**	*0.14*	**0.08**	*0.12*	**0.10**	*0.09*	**0.05**	*0.05*	**0.05**	*0.04*
Nitrite	mg/l	**0.02**	*0.02*	**0.01**	*0.00*	**0.02**	*0.02*	**0.01**	*0.00*	**0.01**	*0.01*
TKN	mg/l	**0.18**	*N/A*	**1.74**	*1.15*	**1.71**	*0.52*	**0.66**	*0.15*	**1.72**	*0.38*
Ammonia	mg/l	**0.10**	*0.11*	**0.64**	*0.30*	**0.31**	*0.27*	**0.10**	*0.00*	**0.11**	*0.01*
Total Nitrogen	mg/l	**0.87**	*0.35*	**1.54**	*1.43*	**1.43**	*0.92*	**0.38**	*0.38*	**0.76**	*0.95*
Total Phosphorous	mg/l	**0.28**	*0.14*	**0.25**	*0.14*	**0.27**	*0.09*	**0.14**	*0.04*	**0.22**	*0.06*
Ortho-Phosphorous	mg/l	**No data**	*No data*	**0.09**	*0.02*	**0.10**	*0.00*	**0.10**	*0.00*	**0.10**	*0.00*

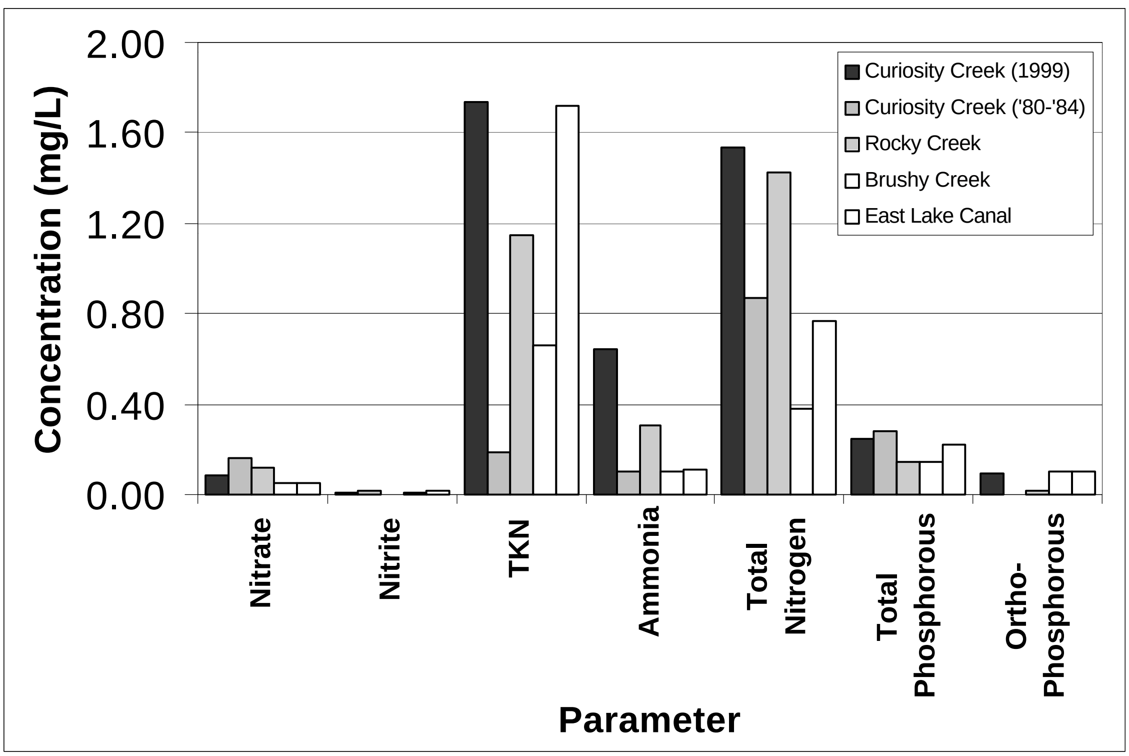


Figure 7-8. Comparison of select stream water quality data between recent Curiosity Creek data (1999), earlier (1980-1984) sampling by USGS, and with other urbanized streams in Hillsborough County.

7.3.2.2 Metals/Pesticides

No long term data set is available for metals. However, cadmium, lead, and zinc data were collected by USGS between 1980 and 1984 and the County has collected a small number of samples in the upper portion of the watershed (near Bearss Avenue) for cadmium, lead, copper, and zinc. The mean cadmium value for the downstream USGS station was greater than the Class III standard of 0.95 µg/L. Cadmium at the upstream station was typically in the parts per trillion range or below detection limits. Lead was greater than the Class III standard of 2.4 µg/L in the lower watershed but was typically below detection limits in the upper watershed. Zinc was less than the 87.7 µg/L standard in both the upper and lower watershed stations. Based on current land use and increased drainage to the creek from major roadway projects, potentially greater concentrations of these and other metals may be found in the creek during typical storm events. No pesticide data was available for any stream reaches in the watershed.

7.3.2.3 Bacteria

The HCEPC has collected and analyzed a number of water samples throughout the Curiosity Creek watershed between 1987 and 1997. These data were typically collected in response to citizen complaints and are widely distributed throughout the creek both spatially and temporally. As a result, analyses and interpretation of trends in bacteria concentrations are somewhat difficult. However, these data do indicate occasional exceedences (>800 cfu/100 ml) of single sample maximum bacteria concentration standards for Class III (recreational) waters in several areas of the watershed. Figure 7-9 represents total and fecal coliform bacteria concentrations over time. Each series of values for a given date represents a range of sampling locations throughout the creek. The greatest proportion of samples were taken in May 1991. Many of the samples were taken either near the intersection of Bearss Avenue at the northern extent of the watershed or at Blue Sink at the downstream end of the creek. Although not definitive, these data suggest potential health risks may occur through bodily contact with the creek over time. The causes of these exceedences have not been identified, but contaminated urban stormwater runoff (Kurz, 1998) and/or overflows from sewer lift stations are likely sources.

High levels of fecal coliform bacteria have been associated with increased risk of certain illnesses including gastrointestinal disease, upper respiratory infections, and skin infections (Gold et al., 1990; Haile et al., 1996). In order to confirm the presence of pathogenic microorganisms, additional sampling will be required using specialized assay techniques. Typically, this type of sampling has been cost-prohibitive and logistically unfeasible (due to a lack of specialized training) for most water quality monitoring programs. The development of newer, more reliable indicators of human disease are currently underway by both the USEPA and local research organizations (including the University of South Florida).

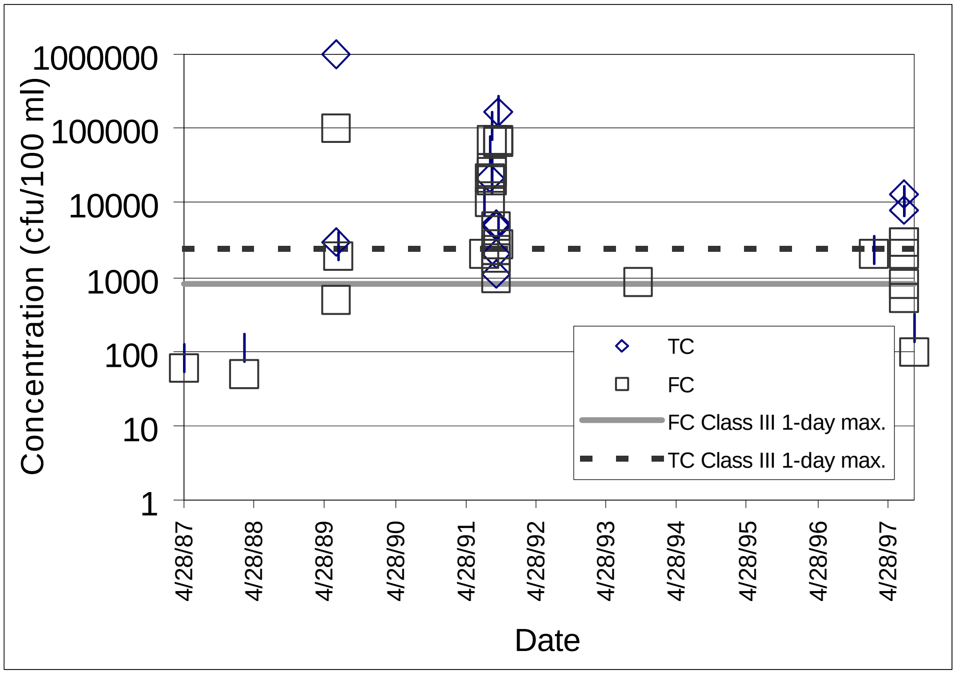


Fig. 7-9. Concentrations of total and fecal coliform bacteria over time at various sampling locations in Curiosity Creek. The dashed and bold solid lines indicate the "not to exceed" concentrations for total coliforms and fecal coliforms, respectively, for Class III waters based on a single sampling event.

7.4 GROUNDWATER

The quality and quantity of groundwater in the Curiosity Creek watershed may play an important role in future local water supply planning and management efforts in the Hillsborough River basin. Historically, streamflow from Curiosity Creek entered the Blue Sink area just south of Country Club Drive. Dye tracer studies conducted in 1989 (Environmental Engineering Consultants, Inc., 1990) indicated that Blue Sink and several other nearby sink formations to the southeast were hydraulically connected to Sulphur Springs located downgradient and adjacent to the Hillsborough River. Since the 1950s, many of the local sinkhole formations (including Blue Sink) in the area have been closed or filled. As a result, groundwater flows to Sulphur Springs have shown a steady decline from about 60 cfs in the 1960s to approximately 40 cfs in the 1990s (Figure 7-10).

A study to evaluate the feasibility of reopening Blue Sink was initiated in 1998 through a cooperative project between the City of Tampa and the SWFWMD (P. Schreuder, personal communication). If the study shows reopening the sink is environmentally, technically, and economically feasible, flows from Curiosity Creek may reenter the sink and eventually be transported via the aquifer system to Sulphur Springs and, ultimately, the Hillsborough River. Restoring and maintaining water quality in the creek itself will become imperative in order to avoid contamination of groundwater and surface water resources (downstream at the Hillsborough River). This additional groundwater/surface water volume could eventually be used to augment the Hillsborough River reservoir (via an existing pump at Sulphur Springs) or to increase freshwater flows critical to the ecology of the lower Hillsborough River and Tampa Bay.

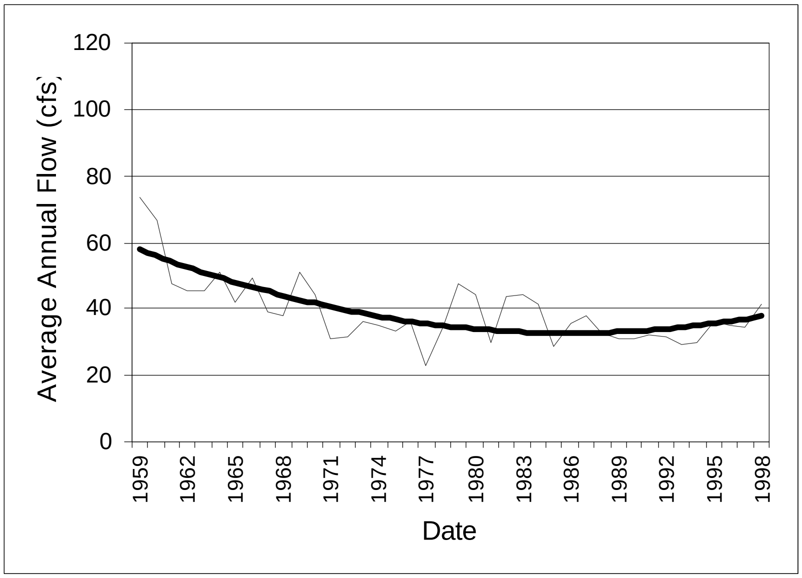


Figure 7-10. Historical trends in flow at Sulphur Springs (USGS Station #02306000). Fine line represents average annual flow, bold line represents polynomial regression of flow.

7.4.1 Data and Assessment Methods

Earlier studies by Environmental Engineering Consultants (EEC) and HCEPC were reviewed to evaluate historicial groundwater conditions within the vicinity of Curiosity Creek and Blue Sink (Curiosity Sink). In addition, GIS maps provided by the SWFWMD were evaluated to determine the potential for groundwater recharge and pollution based on existing hydrogeologic conditions in the watershed. Maps developed by the USGS (1988) indicate that the entire Curiosity Creek watershed falls into a zone capable of recharge to the Floridan aquifer of a range between 1 to 10 inches per year.

A second data set developed by the U.S. Environmental Protection Agency (U.S. EPA) was evaluated to determine groundwater pollution potential. This methodology, termed DRASTIC, evaluates seven parameters including: Depth to water; net Recharge; Aquifer media; Soil media; Topography; Impact of the vadose zone; and hydraulic Conductivity. Based on this map, the entire watershed had relatively high DRASTIC values (i.e., high potential for groundwater contamination) with the northern section of the watershed (from approximately Bearss Avenue north) having slightly greater values than the southern section (Bearss Avenue south to Country Club Drive). It should be noted that the DRASTIC index is independent of actual sources of pollution and does not necessarily mean that groundwater contamination is occurring. It only indicates that pollution could occur if an actual pollutant source were present and free in the environment. In certain cases, the methodology has been found to overestimate pollution potential such as for wetlands in the Hillsborough River basin and coastal discharge areas elsewhere in the SWFWMD boundary (SWFWMD, 1999).

To evaluate current groundwater conditions in the watershed, groundwater data was obtained from the SWFWMD's Ambient Groundwater Quality Monitoring Program (AGWQMP). Data were available for two sampling locations within or near the Curiosity Creek watershed for the period between 1990 and 1999.

7.4.2 Groundwater Quality

Groundwater quality was first assessed using the recent AGWQMP data. A list of water quality parameters, number of samples analyzed, minimum, maximum, and mean concentrations, and standard deviations of means are summarized in Table 7-6.

The surficial aquifer in the Hillsborough River watershed, which includes the Curiosity Creek basin, consists of unconsolidated fine-grained sand deposits ranging in thickness from 0 to 60 feet (SWFWMD, 1999). This upper hydrogeologic zone is affected by land use practices to a greater degree than the Floridan since it is less confined/separated from direct precipitation, septic tank systems, and irrigation (from golf courses, agriculture practices, etc.). As a result, groundwater in this zone may contain greater concentrations of nutrients (including nitrates). Water quality data were available for surficial and Floridan aquifer zones at both the Buchanan Jr. High and Roy Haynes sampling sites (Figure 7-3).

Nitrate in drinking water at levels greater than the federal and state standard of 10 parts per million (10 mg/L) can cause a potentially fatal condition in infants commonly known as "blue-baby" syndrome (methemoglobinemia). Excess nitrates can also cause algal blooms in nitrate-limited surface waters that receive groundwater flows (e.g., Tampa Bay). Mean concentrations of nitrate did not exceed the drinking water standard at either of the wells sampled, however, a maximum concentration of 20.74 mg/L was observed in the surficial well sampled at the Buchanan Jr. High site.

Earlier studies by EEC and HCEPC focused primarily on the causes of elevated total and fecal bacteria concentrations at Sulphur Springs and a series of sinkholes (Orchid, Poinsettia, Blue Sink) which were previously shown to be connected to the springs. However, other parameters including nutrients were evaluated for data collected by EPC in 1992 to evaluate pollutant loads originating from Sulphur Springs to the Hillsborough River. The average total nitrogen value for Sulphur Springs that year was 0.82 mg/L compared to a range of means from 0.19 to 4.03 mg/L from the upgradient wells sampled between 1990 and 1999 in the Curiosity Creek watershed. Mean total phosphorus concentrations range between 0.02 and 0.26 mg/L in the Curiosity Creek wells compared to a mean concentration of 0.09 mg/L at Sulphur Springs. Greater mean total nitrogen concentrations were typically found in surficial wells while greater mean total phosphorus concentrations were found in Floridan wells in the Curiosity Creek watershed.

Table 7.6. Water quality in surficial and Floridan aquifer wells in the Curiosity Creek watershed area. (N = number of samples analyzed between 1990 and 1999.

	BUCHANAN JR HIGH WRAP-Floridan					BUCHANAN JR HIGH WRAP-Surficial					ROY HAYNE Floridan					ROY HAYNE Surficial				
PARAMETER	**N**	**Min.**	**Max.**	**Mean**	**Std. Dev.**	**N**	**Min.**	**Max.**	**Mean**	**Std. Dev.**	**N**	**Min.**	**Max.**	**Mean**	**Std. Dev.**	**N**	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Ammonia, Total (as N)	33	0.01	0.17	0.09	0.03	32	0.01	0.11	0.03	0.02	31	0.01	0.13	0.08	0.02	33	0.29	0.85	0.58	0.14
Bicarbonate Alkalinity, Total (as CaCO3)	33	23.00	198.00	171.55	30.34	32	12.00	110.00	47.81	24.06	31	163.00	194.00	183.84	7.04	33	2.00	56.00	6.64	9.12
Calcium, Dissolved	33	62.30	89.60	72.16	5.89	32	37.90	79.00	54.01	11.68	35	70.00	92.90	75.63	3.80	37	1.10	22.00	4.23	3.18
Chloride, Dissolved	33	5.14	10.00	8.09	1.46	32	5.11	35.40	16.81	8.88	33	7.70	12.00	10.32	0.87	35	2.90	12.50	6.62	2.61
Color	33	5.00	10.00	5.91	1.96	32	5.00	85.00	39.22	21.93	31	5.00	15.00	6.13	2.49	33	5.00	20.00	5.91	3.18
Eh, Field, (hydrogen electrode)	16	-225.30	206.40	-9.11	123.42	16	-35.70	427.40	215.88	149.83	16	-115.00	4.10	-68.18	32.68	16	-45.30	83.90	7.72	37.63
Fluoride, Dissolved	0					0					2	0.12	0.20	0.16	0.06	2	0.10	0.20	0.15	0.07
Fluoride, Total	11	0.01	0.14	0.04	0.03	10	0.00	1.01	0.12	0.31	10	0.00	0.15	0.07	0.04	11	0.01	0.21	0.05	0.06
Hardness, Total	34	160.46	231.00	187.16	15.74	33	85.00	207.00	143.78	31.55	31	180.00	238.00	194.23	9.51	33	7.50	59.10	12.86	8.79
Iron, Dissolved	33	91.00	211.00	164.21	27.89	32	30.00	853.00	128.99	152.88	34	146.00	222.00	189.29	21.96	36	32.00	400.00	141.31	77.65
Iron, Total	1	<101	<101	<101		1	<252	<252	<252		1	<243	<243	<243		1	<130	<130	<130	
Magnesium, Dissolved	33	1.19	1.80	1.48	0.13	32	1.29	4.23	2.48	0.86	34	1.20	1.64	1.37	0.11	36	0.20	1.00	0.48	0.21
Nitrate, Dissolved (as N)	33	0.01	0.19	0.02	0.03	32	0.01	20.74	5.62	6.05	32	0.01	0.02	0.01	0.00	33	0.01	0.01	0.01	0.00
Nitrate+Nitrite, Dissolved (as N)	0					0					3	0.01	0.05	0.04	0.03	3	0.01	0.05	0.04	0.03
Nitrogen, Total	8	0.10	0.29	0.19	0.08	7	1.00	9.40	4.03	3.19	7	0.17	0.27	0.21	0.04	8	0.49	1.00	0.75	0.20
Organic Carbon, Total	33	0.77	2.41	1.43	0.30	32	2.41	26.80	11.35	5.59	33	1.21	4.50	1.95	0.65	35	2.36	7.60	3.31	0.99
Oxygen, Dissolved, Field	15	0.03	0.17	0.09	0.04	15	0.16	0.96	0.43	0.25	15	0.03	0.27	0.09	0.05	15	0.04	0.39	0.16	0.08
pH, Field	31	6.78	8.10	7.26	0.23	32	5.05	6.90	5.79	0.41	33	6.85	7.53	7.21	0.12	32	4.33	5.94	4.87	0.29
Phosphorus, Total (as P)	33	0.01	0.24	0.12	0.04	32	0.01	0.23	0.06	0.05	32	0.16	0.53	0.26	0.07	33	0.01	0.27	0.02	0.05
Potassium, Dissolved	33	0.40	0.70	0.56	0.08	32	0.50	2.30	1.42	0.51	34	0.34	4.00	0.57	0.63	36	0.91	4.97	2.26	0.78
Sodium, Dissolved	33	3.95	5.50	4.86	0.41	32	2.53	20.70	10.26	4.28	34	4.00	5.50	4.44	0.27	36	1.80	5.09	2.97	0.79
Specific Conductance	10	318.00	367.00	341.90	19.59	9	272.00	437.00	345.56	66.07	10	374.00	400.00	385.80	9.25	11	53.20	102.00	78.01	12.25
Specific Conductance, Field	32	331.00	407.00	380.94	20.33	32	170.00	522.00	355.34	76.10	34	340.00	403.00	392.76	12.84	34	40.00	150.00	68.31	19.53
Strontium, Dissolved	31	50.00	50.00	50.00	0.00	29	50.00	400.00	101.72	106.47	32	50.00	400.00	72.84	68.67	34	10.00	50.00	47.09	9.62
Sulfate, Dissolved	33	7.30	15.00	10.06	1.56	32	18.50	117.00	73.31	27.41	33	4.33	8.40	5.14	0.69	35	4.10	14.00	9.35	2.69
Sulfide, Total	17	0.00	0.11	0.06	0.03	16	0.01	0.14	0.06	0.03	15	0.05	0.23	0.16	0.06	16	0.10	9.00	3.00	3.29
Temperature	32	23.50	27.10	24.85	0.75	32	19.90	28.50	24.72	1.53	34	23.50	25.80	24.87	0.56	34	20.10	26.00	23.41	1.38
Turbidity, Lab	33	0.30	46.00	8.06	12.08	32	1.20	112.00	32.32	30.15	31	0.05	11.20	3.87	2.47	33	0.05	0.40	0.13	0.10
Water Level Elevation (from mse)	32	38.12	46.08	42.70	1.75	32	40.83	52.49	48.91	2.23	32	36.96	43.84	40.27	1.72	32	41.88	48.38	44.86	1.73

7.5 WATER QUALITY ISSUES/AREAS OF CONCERN

The primary water quality issues/areas of concern for all of the water resources in the Curiosity Creek watershed are related to the highly developed nature of the landscape. Intense urbanization and commercial development have resulted in the following negative impacts:

- increased impervious surface area (construction of roads, buildings, etc.);
- decreased stormwater infiltration to replenish and maintain groundwater levels in the aquifer;
- increases in peak flows which can cause stream bank erosion, sedimentation, and increased pollutant loading;
- extreme losses of riparian and upland buffer areas which can protect streams and lakes from water quality degradation;
- increases in surface water pollution from both stormwater runoff and atmospheric deposition; and
- potential contamination of groundwater from stormwater runoff and septic tank systems.

Additional, more specific issues for lakes, streams, and groundwater are discussed below.

7.5.1 Lakes

The primary concerns for several lakes in the Curiosity Creek watershed are the potential for additional urban development (and subsequent water quality degradation) and the lack of data for several smaller lakes to evaluate current and historical water quality trends. Although water quality is generally good in most lakes (with the exception of Cedar Lake West, Mid Lake, and Pine Lake where TSI values are bordering on fair), several smaller lakes and Noreast Lake are not currently sampled by local governments or volunteers. Data for Noreast Lake are especially critical since this is the last of a chain of lakes that drains directly into Curiosity Creek near 127th Avenue. Data from this lake could be important for developing pollutant load reduction strategies since the watershed that drains to Noreast represents a relatively large area of the Curiosity Creek basin and the most immediately upstream lake (Cedar Lake East) is also not monitored by the LaMP. It is likely that water quality in Noreast Lake is similar to other nearby lakes (e.g., Pine Lake, Mid Lake) since most have the same surrounding land use (residential).

Development surrounding most of the lakes in the watershed is primarily residential. Field surveys of several of these lakes indicates that a significant loss of emergent shoreline vegetation has occurred which could eventually lead to shifts in trophic structure resulting in phytoplankton or algae dominated systems. This shift could result in decreased water clarity, anoxic bottom conditions, hypereutrophication, and possibly, accelerated aging of certain lakes.

7.5.2 Streams

One main area of concern for Curiosity Creek is the lack of consistent, long-term data to evaluate historical trends in water quality. Although many other tributaries within Hillsborough County have been monitored for as many as several decades, Curiosity Creek has not been sampled with any regular frequency since the early 1980s. Only recently has the county's Stream Waterwatch program been implemented to evaluate water quality trends in the watershed. Pollutant loads will be estimated in Chapter 10 of this report using a variety of subbasin specific parameters such as land use, soils, and existing treatment. This analysis should provide an indirect mechanism for identifying and ranking specific areas of the basin in need of additional water quality treatment independent of a large, historical database.

Despite the lack of a continuous historical database, the adverse impacts of urbanization and commercial development on the health and quality of the creek's aquatic ecosystem is obvious. It is most apparent at the downstream receiving basin at Blue Sink where oils and greases, trash, and the effects of excess nutrient loads (eutrophication) are visible. In many areas of the creek (e.g., the creek crossing at Floral Drive), standing or slow moving water occurs frequently leading to widespread floating plant and algae blooms and the proliferation of nuisance aquatic vegetation. Riparian vegetation, which can act as a buffer to surrounding development, has been lost along approximately 60% of the existing creek's length. All of these impacts have collectively altered the hydrology and natural systems of the creek to a condition that will require significant and strategic remediation to improve water quality.

7.5.3 Groundwater

The primary groundwater issues and areas of concern are related to the relatively high potential for groundwater contamination in the watershed and, specifically, the potential impacts of reopening the Blue Sink system. The USEPA's DRASTIC analysis indicates that most of the Curiosity Creek watershed may be highly susceptible to groundwater pollution. Previous research has shown that bacterial contamination can often occur in karst aquifers (Thorn and Coxon, 1992) similar to the geologic conditions present in the Curiosity Creek watershed. Evaluation of current groundwater data also suggests that nutrient concentrations in the surficial aquifer can be quite high. This could impact both lake and stream water quality if these systems receive contributions from shallow groundwater sources.

The collection of additional water quality data will be an important concern if the Blue Sink is reopened. No recent data for pesticides, toxicants, or pathogens capable of posing health risks are available for Curiosity Creek which could ultimately become a portion of the source waters for Sulphur Springs. If significant nitrogen and phosphorus loads are originating in the Curiosity Creek watershed and exported to groundwater, reopening the Blue Sink system could also have adverse impacts downgradient at Sulphur Springs and, ultimately, to the nutrient-limited systems of the Hillsborough River Reservoir and

Tampa Bay. Additional nutrient concentration and flow data will be necessary to calculate loads entering the Blue Sink area to evaluate these potential impacts.

Other areas of concern include the potential (and currently unknown) impacts that may occur from nutrient and pathogen loading to lakes and streams (via groundwater) resulting from inadequately constructed or maintained septic tank systems. At this time, however, the distribution of septic tank systems has not been mapped for the watershed and additional groundwater sampling would be required to determine actual nutrient and public health impacts.

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CHAPTER 8

EXISTING NATURAL SYSTEMS CONDITIONS

8.1 OVERVIEW

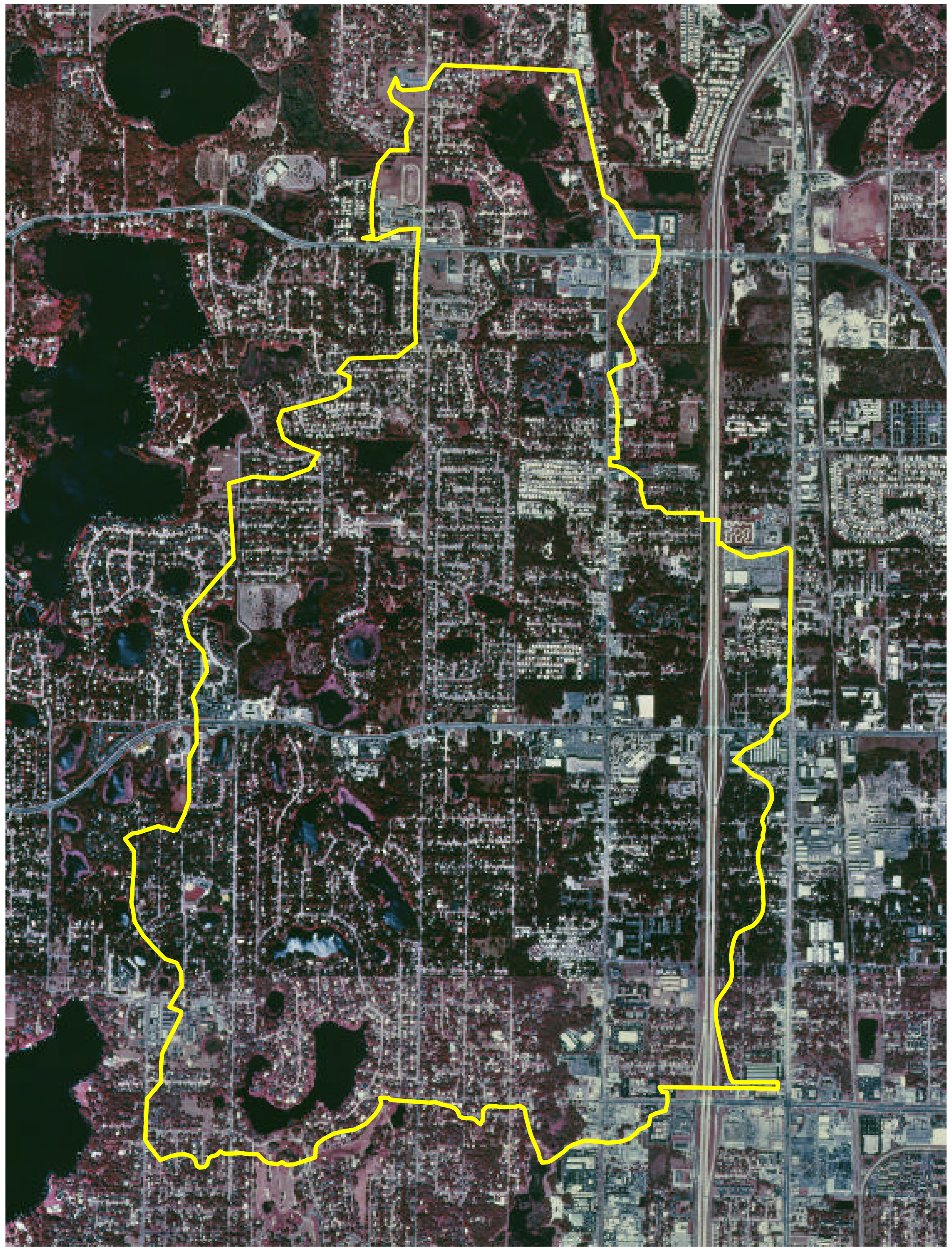
The Curiosity Creek watershed once harbored a diverse ecosystem. During the past several decades, urbanization has spread from the downtown areas of Tampa to the north, resulting in significant losses of upland and wetland habitats. Fragmentation of contiguous forests and riparian corridors has probably resulted in significant declines in wildlife populations and an overall decline in ecosystem health. The loss of natural systems can result in other adverse impacts including declining water quality, increases in runoff volume and timing, and the lack of recreational areas. Recent research has shown that with as little as 10% imperviousness (developed roads, buildings, parking lots, etc.) in a watershed, dramatic declines in biological health can occur as a result of changes in channel morphology, hydrologic regimes, habitat quality, and water quality (Horner et al., 1999).

One of the objectives of this watershed management program is to identify opportunities to restore and protect natural systems which are important in preventing excessive runoff volumes and pollutant loadings, maintaining terrestrial and aquatic biodiversity, protecting stream channel stability, and reducing stream bank erosion. The first step toward this goal is to identify and describe historical and existing natural systems. Subsequently, the issues and areas of concern for specific habitat types will be determined, and the opportunities for improvements will be investigated.

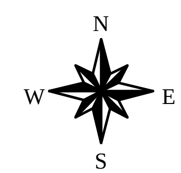
8.2 HISTORICAL AND EXISTING HABITAT TYPES

This section identifies the historical and remaining upland, wetland, and aquatic natural systems in the Curiosity Creek watershed. Historical and recent photography were obtained from the HCEPC and the SWFWMD, respectively (Figure 8-1). In addition, historical land use data (i.e., pre-1900s) was obtained from the SWFWMD (Figure 8-2). This data layer depicts historical vegetation based on mapped soils and the associated indigenous vegetative communities. Existing land use conditions (1995) within the Curiosity Creek watershed were determined from land use/land cover GIS coverages also obtained from the SWFWMD. These coverages are based on the Florida Land Use and Cover Classification System (FLUCCS). Table 8-1 demonstrates the historical and existing land use acreages, the relative habitat loss based on the total available area of the natural systems, and the total area of the watershed.

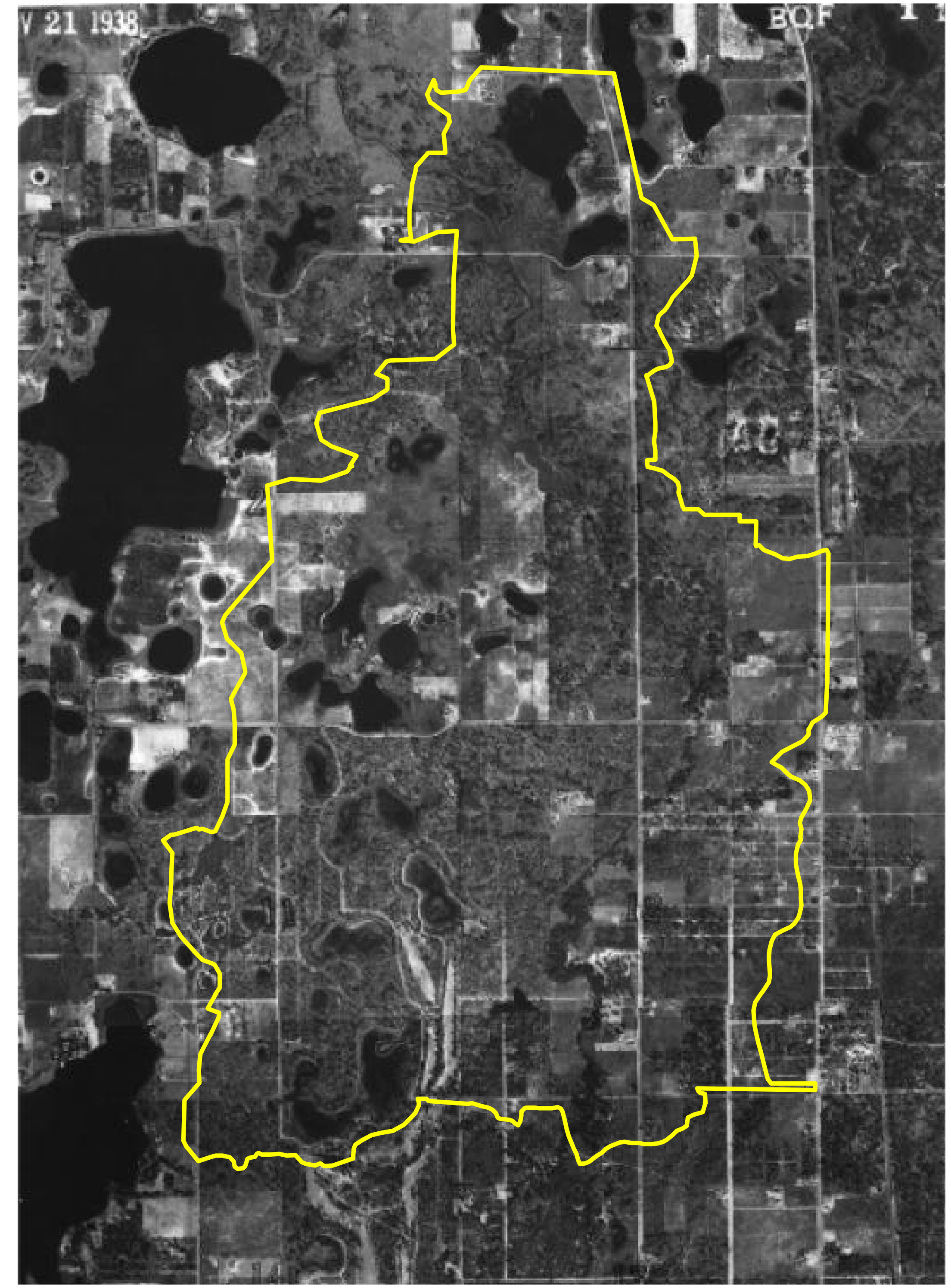
1995 Digital Orthophotograph



(Source: USGS)



Historical Aerial (1948)



(Source: HCEPC)

1 0 1 Miles

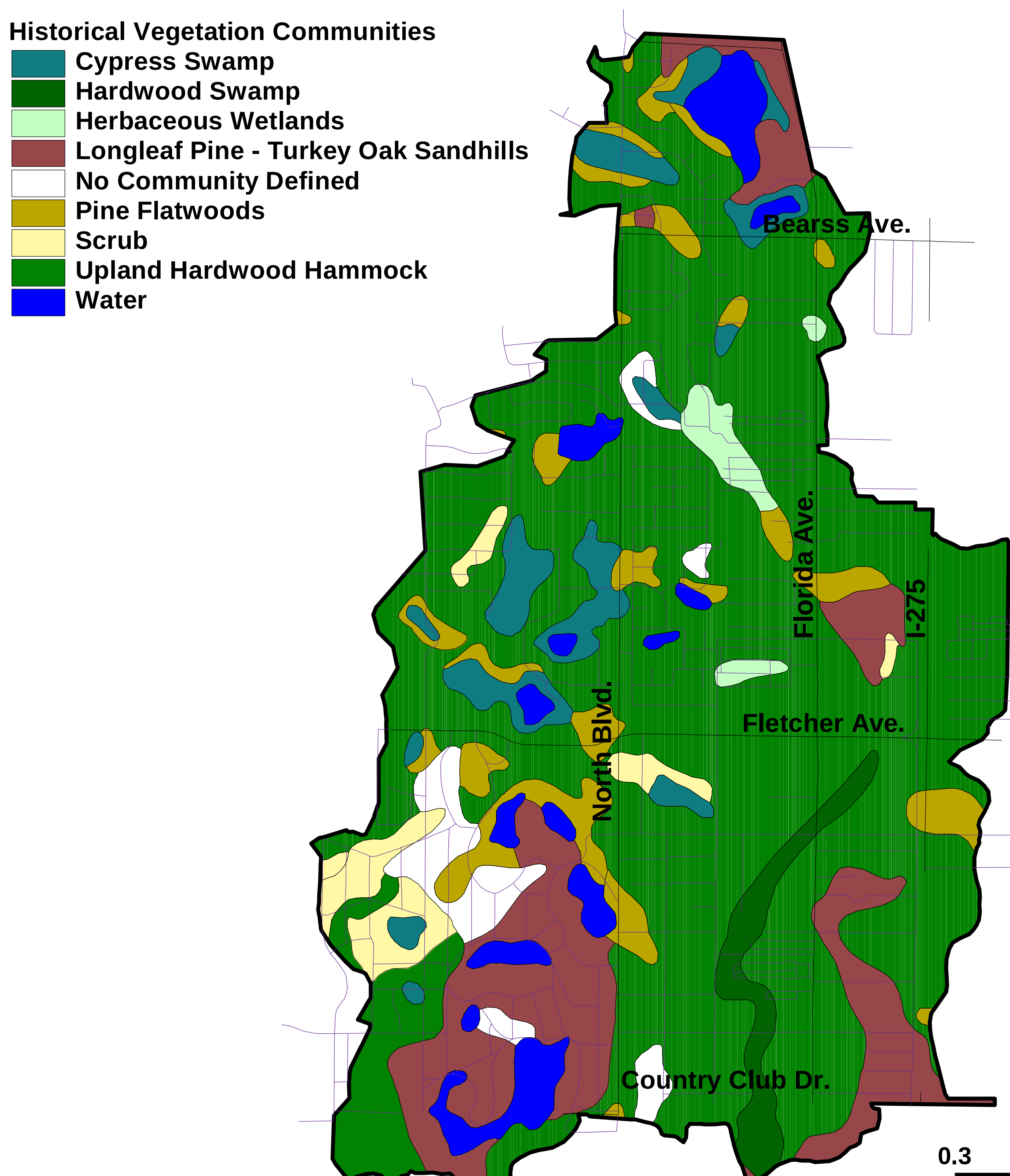
HILLSBOROUGH COUNTY
FLORIDA

CURIOSITY CREEK WATERSHED MANAGEMENT PLAN

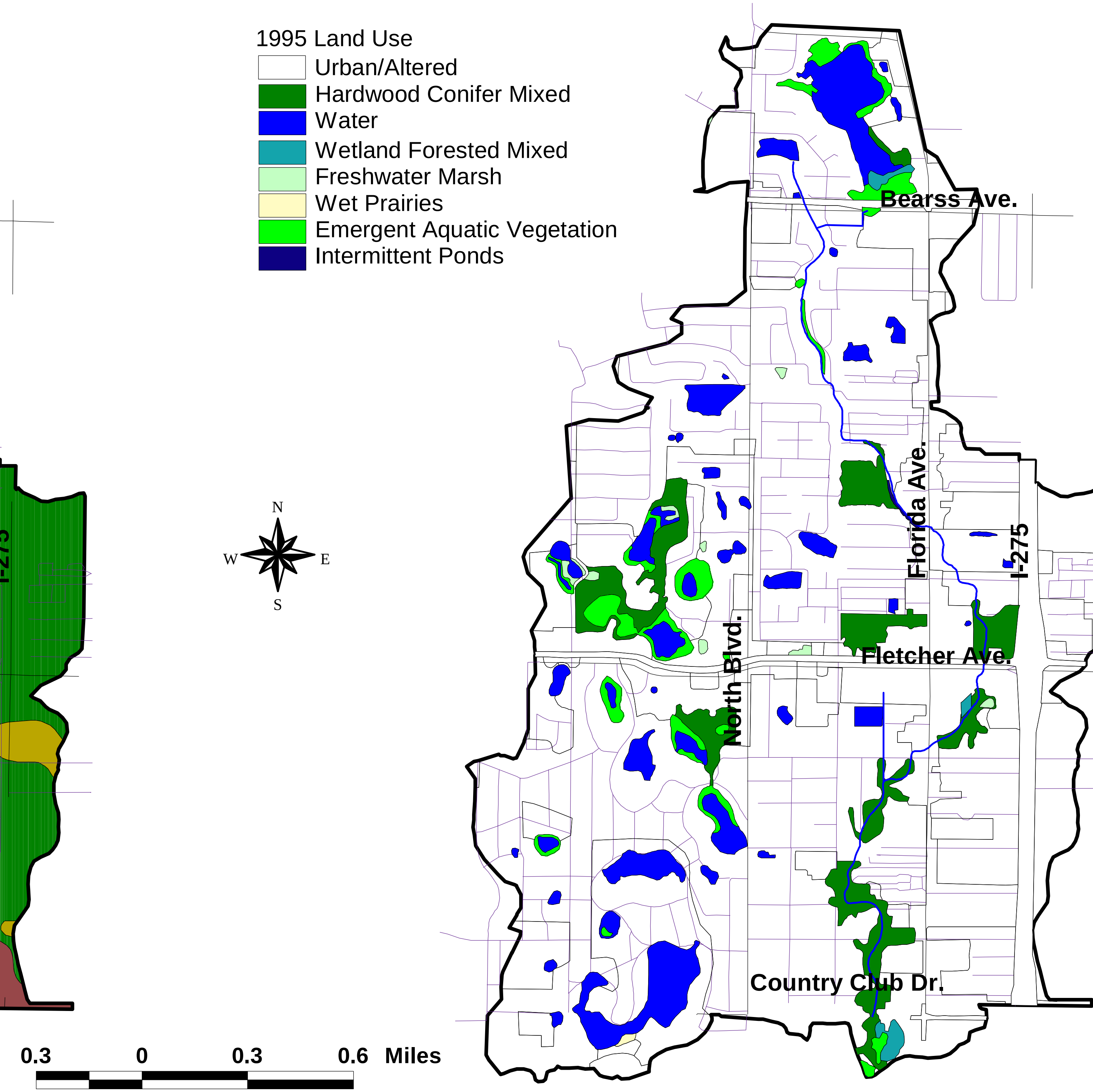
KISINGER CAMPO & ASSOCIATES, CORP.
SCHEDA ECOLOGICAL ASSOCIATES, INC.

Figure 8-1. Recent and Historical Aerial Photography of the Curiosity Creek Watershed.

Historical Vegetation



Existing Natural Land Cover



HILLSBOROUGH COUNTY
FLORIDA

CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES, CORP.
SCHEDA ECOLOGICAL ASSOCIATES, INC.

Figure 8-2. Historical and Recent Natural Land Cover in the Curiosity Creek Watershed.

Table 8.1. Land use trends based on comparisons of historical (pre-1900s) vegetation communities (developed by SWFWMD from soil maps) with existing (1995) land use data based on the Florida Land Use and Cover Classification System (FLUCCS).

Land Use	**Historical (acres)**	**Existing (acres)**	**% Change**
Uplands			
Longleaf Pine - Turkey Oak Sandhills	274.0	0.0	
Pine Flatwoods	141.2	0.0	
Scrub	62.7	0.0	
Upland Hardwood Hammock	1372.2	0.0	
Hardwood Conifer Mixed	-	109.4	
Subtotal	1850.2	109.4	**-94.1%**
Wetlands			
Cypress Swamp	108.5	0.0	
Hardwood Swamp	50.4	0.0	
Herbaceous Wetlands	28.0	-	
Wet Prairies	-	0.7	
Intermittent Ponds	-	0.8	
Freshwater Marshes	-	4.9	
Emergent Aquatic Vegetation	-	44.6	
Wetland Forested Mixed	-	6.6	
Subtotal	186.9	57.5	**-72.7%**
Lakes	99.0	81.9	**-17.3%**
Developed Land	0.0	1954.0	**88.7%**
Undefined~	*65.8*	*0*	
Total*	2202.0	2203.0	

~Some historical vegetation areas are undefined due to significant development-associated soil changes.

*Totals do not match due to slight differences caused by rounding.

8.2.1 Upland Natural Systems

8.2.2.1 Historical Upland Systems

The following upland habitat descriptions are based on the historical vegetation map of the Curiosity Creek watershed and the corresponding vegetation descriptions from the Soil Survey of Hillsborough County (1989).

Longleaf pine-turkey oak sandhills

Long leaf pine-turkey oak sandhills are associated with Tavares-Millhopper fine sands having slopes of 0 to 5%. These nearly level to gently sloping, moderately well drained soils are common in low-lying areas of the uplands and on low ridges of the flatwoods. Natural canopy vegetation consists of bluejack oak (*Quercus incana*), turkey oak (*Quercus laevis*), live oak (*Quercus virginiana*), and longleaf pine (*Pinus palustris*). Understory species include creeping bluestem (*Andropogon* sp.), lopsided indiangrass (*Sorghastrum secundum*), panicum (*Panicum* sp.), and pineland threeawn (*Aristida* sp.).

Pine flatwoods

Pine flatwoods are associated with Myakka fine sand and St. Johns fine sand. These soils are nearly level and poorly drained, and are found in broad, low-lying plains on the flatwoods. Longleaf pine and slash pine (*Pinus elliottii*) are the common canopy species; gallberry (*Ilex glabra*), running oak (*Quercus pumila*), saw palmetto (*Serenoa repens*), pineland threeawn, and wax myrtle (*Myrica cerifera*) are the typical understory constituents.

Scrub

Scrub habitats are associated with Pomello fine sands having slopes of 0 to 5% and Archbold fine sand. These are nearly level to gently sloping, moderately well drained soils on low ridges in the flatwoods. Pomello fine sands typically have canopy species of longleaf pine, sand pine (*Pinus clausa*), and slash pine, and understory species of running oak, saw palmetto, and pineland threeawn. The natural vegetation associated with Archbold fine sand is sand pine, pineland threeawn, prickly pear cactus (*Opuntia humifusa*), and saw palmetto.

Upland hardwood hammock

Upland hardwood hammocks are typically associated with Zolfo fine sands which are nearly level, somewhat poorly drained soils common to broad, low ridges of the flatwoods. The natural canopy species are live oak, turkey oak, longleaf pine, slash pine, broomsedge (*Andropogon virginicus*), bluestem, lopsided indiangrass, saw palmetto, and pineland threeawn.

8.2.1.2 Existing Upland Systems

The following upland habitat descriptions are based on the existing land use map of the Curiosity Creek watershed and the corresponding vegetation descriptions from the FLUCCS (1985).

Hardwood-conifer mixed forest

Upland hardwood-conifer mixed forests are defined by FLUCCS as forested areas in which neither upland conifers nor hardwoods obtain a 66% dominance in the canopy. By definition, these areas typically occur on well-drained but non-droughty soils, and are often the result of fire suppression in pine flatwoods. Mixed forests are often successional to upland hardwood forests.

Approximately 109 acres of upland hardwood-conifer mixed forest vegetation are present in this watershed, constituting 44% of the remaining natural systems and 5% of the total watershed area. Although all upland forests within the Curiosity Creek watershed were identified according to FLUCCS as upland hardwood-conifer mixed forests, ground-truthing of these areas demonstrated basically two types of upland forests, described below.

The predominant forest type is upland hardwoods consisting of live oak and laurel oak *(Quercus laurifolia*) with occasional long-leaf pine, slash pine, or cabbage palm (*Sabal palmetto*) (Figure 8-3). Melaleuca (*Melaleuca quinquenervia*) and Australian pine (*Casuarina equisetifolia*) were also present, particularly along lake perimeters.

Figure 8-3. Example of a hardwood hammock located adjacent to Curiosity Creek at the Shadow Oaks apartment complex.

A second forest type is located between Bearss Avenue and Fletcher Avenue, west of and adjacent to the creek. The species of this isolated forest consists predominantly of live oak, long-leaf pine, and sand pine, with rare occurrences of myrtle oak (*Quercus myrtifolia*). The understory species, where present, is predominantly saw palmetto (Figure 8-4). Mixed species and oak-dominated forests containing sand pine are often the result of long-term fire suppression in sand pine scrub. Sand pine scrub associations are one of the most endangered Florida natural habitats (Wolfe and Drew, 1990). A brief reconnaissance of this habitat revealed the presence of one active and several abandoned gopher tortoise burrows, demonstrating the ecological value of this property.

Figure 8-4. Example of one of the only remaining scrub habitats located adjacent to Curiosity Creek near Florida Avenue.

8.2.2 Wetland/Aquatic Natural Systems

Wetlands are protected by federal (CWA, Section 404), state (FAC, Chapter 62-340), and local (Hillsborough County Land Development Code, Article IV, Rules of the Environmental Protection Commission of Hillsborough County Chapter 1-11) regulations. These regulations are designed to protect wetlands from dredging, filling, draining, impounding, channeling, and numerous other human disturbances.

The following wetland habitat descriptions are based on the historical vegetation map of the Curiosity Creek watershed and the corresponding vegetation descriptions from the Soil Survey of Hillsborough County (1989).

8.2.2.1 Historical Wetland/Aquatic Systems

Cypress swamps
Cypress swamps in the Curiosity Creek watershed were associated with depressional Basinger, Holopaw, and Samsula soils, which are nearly level and very poorly drained. The typical vegetation canopy species is cypress (*Taxodium distichum* or *T. ascendens*) with understory species of bluestem, maidencane (*Panicum hemitomon*), panicum, sawgrass (*Cladium jamaicense*), and cutgrass (*Leersia* sp.).

Hardwood swamps
Hardwood swamps are associated with frequently flooded Winder fine sand. This nearly level, poorly drained soil is often isolated by stream channels and steep escarpments. The vegetation usually includes coastal plain willow (*Salix caroliniana*), red maple (*Acer rubrum*), cabbage palm, and sweetgum (*Liquidambar styraciflua*). The understory consists of buttonbush (*Cephalanthus occidentalis*), maidencane, sawgrass, smartweed (*Polygonum* sp.), and sedges (*Cyperus* spp).

Herbaceous wetlands
Herbaceous wetlands in the Curiosity Creek watershed are associated with Malabar fine sand, which is nearly level and poorly drained. It is common in low-lying sloughs and shallow depressions within flatwoods. According to the Soil Survey of Hillsborough County, the natural vegetation of this soil commonly consists of cabbage palm, longleaf pine, slash pine, broomsedge, bluestem, maidencane, saw palmetto, and wax myrtle. However, the herbaceous classification of this area and its association with the creek indicates that the likely species may have included maidencane species, pickerelweed (*Pontederia cordata*), bulrush (*Scirpus* spp.), smartweed, arrowhead (*Sagittaria* spp.), fire flag (*Thalia* spp.), sawgrass, and/or rushes (*Juncus* spp.).

Open water
The historical perennial water bodies were based on presence of mapped water bodies and are associated with the current lakes in the watershed.

8.2.2.2 Existing Wetland/Aquatic Systems

The following wetland habitat descriptions are based on the existing land use map of the Curiosity Creek watershed and the corresponding vegetation descriptions according to FLUCCS (1995). The Curiosity Creek watershed wetland and aquatic systems identified include mixed forest, freshwater marshes, wet prairies, emergent aquatic vegetation, intermittent ponds, and lakes. The Curiosity Creek channel was not identified by the existing land use map as a stream or waterway, but as other land uses due to dense vegetation cover and the intermittent nature of the creek (Figure 8-5).

Figure 8-5. Wetland vegetation along the banks of Curiosity Creek at 122nd Avenue.

Wetland forested mixed

Mixed wetland forests are defined by FLUCCS as communities in which neither conifers nor hardwoods obtain a 66% dominance in the canopy. This type of habitat may include species such as cypress, water oak (*Quercus nigra*), laurel oak, sweet gum, Florida elm (*Ulmus americana* var. *floridana*), red maple, or cabbage palm (Wolfe and Drew, 1990). The subcanopy and understory species of these communities may be diverse and are dependent upon the local hydrologic regime.

Approximately 6.6 acres of mixed wetland forest are present in the Curiosity Creek watershed, constituting 2.7% of the remaining natural systems and 0.3% of the total watershed area. The mixed wetland forest within the watershed is a cypress and oak association near the southern end of Lake Gass (Figure 8-6). The historical interpretation of soils indicates that this area would have been a cypress swamp.

Figure 8-6. Existing mixed wetland forest at Lake Gass. Note small cypress trees in center of photo.

Freshwater marshes

This habitat usually occurs as open expanses of grasses, sedges, rushes, and other herbaceous species in soils that are usually saturated or covered with surface water for two or more months during the year (Brown et al., 1990). Freshwater marshes are defined by FLUCCS as having one or more of the following predominate species: sawgrass, cattail (*Typha* spp.), arrowhead, maidencane, buttonbush, cordgrass (*Spartina bakeri*), switchgrass (*Panicum virgatum*), bulrush, needlerush (*Juncus effusus*), reed (*Phragmites* spp.), and fire flag. The species composition of freshwater marshes often occurs in zones and is dependent upon soil type, hydroperiod, water depth, and successional stage (Wolfe and Drew, 1990).

Approximately 4.9 acres of freshwater marsh were identified in the Curiosity Creek watershed, constituting 2.0% of the remaining natural systems and 0.2% of the total watershed area. In actuality, the freshwater marshes in the watershed are predominantly stormwater ponds, vegetated by primrose willow (*Ludgwigia* spp.), sedges, water hyacinth (*Eichhorina crassipes*), coastal plain willow, cattail, and broomsedge. Most of these species, common to disturbed and man-made water features, are considered nuisance and invasive species which out-compete native beneficial vegetation.

Emergent aquatic vegetation

Emergent aquatic vegetation land use is defined by FLUCCS as areas having both floating vegetation, and vegetation that is partially or completely above the surface of the water. Typically, these habitats are associated with the deepwater portions of freshwater marshes and may include species such as water lettuce (*Pistia stratiotes*), spatterdock (*Nuphar* spp.), water hyacinth, duckweed (*Lemna* sp.), and water lilies (*Nymphaea* sp.).

Approximately 44.6 acres of emergent aquatic vegetation were identified in the Curiosity Creek watershed, constituting 17.9% of the remaining natural systems and 2.0% of the total watershed area. The emergent aquatic vegetation areas within the Curiosity Creek watershed are predominantly water lilies and cattails at the perimeter or within the lakes (Figure 8-7). Occasional occurrences of water hyacinth, torpedo grass (*Panicum repens*), primrose willow, pennywort (*Hydrocotyle* sp.), needlerush, and redroot (*Lachnanthes caroliniana*) were also noted at the lake edges. Many areas of the creek bed were also identified as emergent aquatic vegetation according to FLUCCS. The shallow and open water zones of these areas are vegetated by a variety of species including duckweed, water spangles (*Salvinia minima*), cattails, primrose willow, and dayflower (*Commelina* sp.). None of these species are found in typical flowing water conditions, and the presence of duckweed and water spangles is particularly indicative of the still, stagnant water regime of Curiosity Creek. The slopes of the creek banks include wild taro (*Colocasia esculenta*), paragrass (*Brachiaria mutica*), and elderberry (*Sambucus canadensis*). Wild taro and paragrass, both invasive exotics, and elderberry are common inhabitants of disturbed wet habitats.

Wet prairies

Wet prairies are usually open, mixed grass-forb associations, which occur in areas of periodic flooding, and are distinguished from marshes as having shorter herbaceous species and longer, drier hydroperiods (Wolfe and Drew, 1990). This land use is defined by FLUCCS as having one or more of following predominant species: sawgrass, maidencane, cordgrasses, spike rushes (*Eleocharis* sp.), beak rushes (*Rhynchospora* sp.), St. John's wort (*Hypericum* sp.), spiderlily (*Hymenocallis palmeri*), swamplily *(Crinum americanum*), yellow-eyed grass (*Xyris ambigua*), and whitetop sedge (*Dichromena colorata*).

Approximately 0.7 acres of wet prairie were identified in the Curiosity Creek watershed, constituting 0.3% of the remaining natural systems and 0.03% of the total watershed area. This wet prairie feature constituted a small area of shoreline along the southern shoreline of Lake Eckles.

Lakes

Lakes are defined by FLUCCS as inland water bodies excluding reservoirs. Lakes in the Tampa Bay area typically have a maximum depth of less than 5 meters, and are naturally bordered by freshwater marsh, wet prairie, mixed swamp forests, or a combination of these habitats (Wolfe and Drew, 1990).

Lakes are the most dominant natural features in the Curiosity Creek watershed (81.9 acres), constituting 32.9% of the remaining natural systems and 3.7% of the total watershed area. The 81.9 acres are not inclusive of the other lake-associated habitats (i.e. emergent aquatic vegetation) that were identified according to the existing land use maps. In general, most of the lakes in the watershed are open water bodies with fringes of emergent aquatic vegetation consisting primarily of water lilies and nuisance species including cattails (Figure 8-7). Exotic species including Melaleuca are common especially around Lake Gass and Lake Butler.

Figure 8-7. Existing emergent aquatic vegetation along the shoreline of Lake Gass (note cattails on right side of photo, a solitary Melaleuca tree at the center, and lilypads at the lower half of the photo).

Currently, there is minimal beneficial littoral and wetland vegetation common to natural healthy freshwater systems within most of the lakes in the watershed (Table 8-2). A list of shoreline vegetation species can be found in Appendix 8-A for the 5 lakes surveyed by Hillsborough County Lake Assessment teams.

These data are all inclusive of the lake body and their adjacent habitats. The following collective species were catalogued as occurring more than 50% of the time: spikerushes, pennywort, torpedo grass, climbing hempvine (*Mikania scandens*), primrose willow, spatterdock, laurel oak, Asian pennywort (*Centella asiatica*), cattails, stonewort (*Nitella* sp.), sedges, dog fennel (*Eupatorium capillifolium*), willow, white water lilies, red maple, rushes (*Fuirena* sp.), bladderwort (*Utricularia* sp.), southern niad (*Najus guadelupensis*), grapevine (*Vitis* sp.), melaleuca, and wax myrtle.

Table 8.2. Abundances, zone widths, exotic plant coverage, and species diversity of littoral vegetation of lakes surveyed by Lakewatch teams in the Curiosity Creek watershed.

Lake	Emergent Zone Biomass (lbs/ft2)	Floating Zone Biomass (lbs/ft2)	Submersed Zone Biomass (lbs/ft2)	Zone Width (ft.)	% Exotic Coverage	Plant Diversity
Turtle	0.27	0.24	1.19	90.50	20	30
Bluegill	-	-	-	-	-	-
Cedar	0.00	0.02	0.00	5.40	22	50
Eckles	0.19	0.00	0.14	25.85	22	76
Gass	-	-	-	-	-	-
Mid	0.03	0.16	0.00	36.50	17	29
Noreast	-	-	-	-	-	-
Pine	0.05	0.00	0.00	19.80	28	39
Average	**0.11**	**0.08**	**0.27**	**35.61**		

% Exotics – this value is the percentage of total plant species sampled that are considered exotic plants.
Plant diversity equals the number of species observed during lake surveys.

Intermittent ponds

Intermittent ponds are defined by FLUCCS as seasonal waterbodies which may exist for only portions of the year, and depend on water inflows of precipitation, runoff, or spring flow.

Approximately 0.8 acres were identified in the Curiosity Creek watershed as intermittent ponds, constituting 0.3% of the remaining natural systems and 0.04% of the total watershed area. Actually, the mapped intermittent pond is a portion of Curiosity Creek.

8.2.2.3 Trends

The purpose of this section is to summarize the relative loss of natural habitat between pre-1900 and 1995 land uses. A “type for type” habitat loss is difficult to estimate due to differences in classifications used for historical and existing land use, as well as successional changes in habitat types. Historical and existing land use types were consolidated into general habitats of uplands, wetlands, or lakes for the purpose of estimating habitat loss.

Uplands

Prior to the 1900s, approximately 1850.2 acres of the Curiosity Creek watershed was upland habitat, including longleaf pine-turkey oak sandhills, pine flatwoods, scrub, and upland hardwood hammock. In 1995, 109.4 acres of upland habitat remained, representing a net loss of 94.1%. The majority of the upland habitat was lost to residential and commercial development. The remaining upland habitat of mixed hardwood-conifer forest exists as fragmented parcels throughout the watershed. The vegetation associated with this mixed upland habitat is indicative of succession of the original upland habitats as a result of fire suppression, as well as, the reclassification of historical hardwood swamp as upland forest.

Wetlands

Approximately 186.9 acres of wetland habitats, including cypress swamps, hardwood swamps, and herbaceous wetlands, existed in the Curiosity Creek prior to the 1900s. As of 1995, approximately 57.5 acres of wetland habitat remained, representing a net loss of 72.7%.

Cypress swamps may have been destroyed as a result of logging, dewatering, or development. The minimal cypress remaining in the watershed is primarily associated with the mixed wetland forest at the southern end of Lake Gass. Anecdotal information and aerial photography indicate that, at one time, Lake Gass was bisected by a constructed roadway which would have served as a berm, severing the lake in two and severely altering the natural hydrologic regime. Mixed cypress and hardwood associations are often the result of altered hydrologic regimes and/or logging of cypress, which creates an environment more conducive for the germination and establishment of hardwood species. The historical soils interpretation indicates that many of the existing areas classified as emergent aquatic vegetation and wet prairie may have been cypress swamps.

The historical herbaceous wetlands and hardwood swamps were associated directly with Curiosity Creek. These original habitats have either been destroyed or altered due to channelization of the stream, alterations in the volume and direction of streamflow, development of the land, or succession of habitat associated with changes in hydrology.

8.3 LISTED SPECIES WITHIN THE WATERSHED

Many native fauna and flora are protected from activities that harm or interfere with them or their habitat by both federal and state regulations. Fauna and flora are both federally protected by the United States Fish and Wildlife Service (USFWS) under Title 50 Code of Regulations (CFR) 17 and 23. Federally protected species are categorized as threatened or endangered. State protection of fauna is administered by the Florida Fish and Wildlife Conservation Commission (FFWCC) under FAC, Rules 39-27.003, 39-27.004, and 39-27.005. State protected faunal species are categorized as species of special concern, threatened, or endangered. The Florida Department of Agriculture and Consumer Services administers F.A.C., Chapter 5B-40. State protected floral species are categorized as commercially exploited, threatened, or endangered.

The presence of wildlife or plant species is often considered indicative of the presence and health of the natural systems. Many animal species, both protected and unprotected, have been observed in the Curiosity Creek watershed in recent years (K. Holland, personal communication, see Appendix 8-B). The species discussed in the following text are ones that are currently listed as protected by either state or federal regulations that may potentially occur in the Curiosity Creek watershed (Table 8-3).

Table 8.3. Protected species that may occur in the Curiosity Creek watershed.

		Status[1]			Habitat Preference[3]				
Scientific Name	**Common Name**	**State**	**Federal**	**Observed[2]**	**HCM**	**WFM**	**FM**	**WP**	**EAV/ L/P**
Avian									
Ajaia ajaja	Roseate spoonbill	SSC					X		
Aramus guarauna	Limpkin	SSC					X		
Egrettta caerulea	Little blue heron	SSC		X			X		
Egretta thula	Snowy egret	SSC		X			X		
Egretta tricolor	Tricolored heron	SSC		X			X		
Eudocimus albus	White ibis	SSC		X			X	X	
Falco peregrinus tundrius	Arctic peregrine falcon	E			X		X		
Falco sparverius paulus	Southeastern American kestrel	T		X	X			X	
Grus canadensis pratensis	Florida sandhill crane	T		X			X	X	
Haliaeetus leucocephalus	Bald eagle	T		X			X		X
Mycteria americana	Wood stork	E	E	X			X		
Pandion haliatetus	Osprey	SSC		X	X				X
Mammals									
Sciurus niger shermani	Sherman's fox squirrel	T		X	X	X			
Reptiles and Amphibians									
Alligator mississippiensis	American alligator	SSC	T(S/A)				X		X
Drymarchon corais couperi	Eastern indigo snake	T	T		X				
Gopherus polyphemus	Gopher tortoise	SSC		X	X				
Stilosoma extenuatum	Short-tailed snake	T			X				
Rana capito	Gopher frog	SSC			X				
Flora									
Asclepias curtissii	Curtiss' milkweed	E			X				
Chionanthus pygmaeus	Pygmy fringe tree	E	E		X				
Glandularia tampensis	Tampa vervain	T				X			
Pteroglossaspis ecristata	Wild coco	T			X				
Triphora latifolia	Broad-leaved nodding-caps	E				X			

1 **Status -** State fauna are listed by Florida Fish and Wildlife Conservation Commission (FFWCC)
State flora are listed by the Florida Department of Agriculture and Consumer Services (FDA)
Federal fauna and flora are listed by the United State Fish and Wildlife Service (USFWS)
SSC = Species of Special Concern, T = Threatened, E =Endangered, S/A = Similarity of Appearance

2 Observed
Hillsborough County Staff (1981-present)
Scheda Ecological Associates, Inc. (1999)

3 Habitat Preference (Based on literature and observations within the watershed)
HCM Hardwood Conifer Mixed
WFM Wetland Forested Mixed
FM Freshwater Marsh
WP Wet Prairies
EAV/L/P Emergent Aquatic Vegetation/Lakes/Intermittent Ponds

Avifauna

The following nesting and feeding habitat requirements are from Rodgers et al. (1996). Protected wading birds that may occur in the watershed include roseate spoonbill (*Ajaia ajaja*), little blue heron (*Egrettta caerulea*), snowy egret (*Egretta thula*), tricolored heron (*Egretta tricolor*), wood stork (*Mycteria americana*), and white ibis (*Eudocimus albus*).

Most of these species require relatively shallow water habitats for foraging, although the white ibis is known to forage in pastures and lawns. Many of these species nest in marine habitats, but freshwater habitats, including cypress, wetland hardwoods, or shrub swamps, are also important nesting habitats. Wood storks more specifically feed in calm, relatively unvegetated water that is 5 to 40 cm deep, and nest in woody vegetation over standing water or on islands. Degradation of both nesting and foraging habitats has contributed to population declines in these species.

Other protected wetland dependent avian species that may occur in the watershed are the Florida sandhill crane (*Grus canadensis pratensis*) and limpkin (*Aramus guarauna*). The two most important habitat requirements for sandhill cranes are shallow pickerelweed/maidencane freshwater marshes and adjacent open, low herbaceous uplands. The apple snail, which may be found in lakes, marshes, broad swales, and impoundments, is the most important feeding habitat requirement of limpkins. They are known to nest among tall grasses, such as bulrush, between the knees of cypress, in vine-covered shrubs, or in the tops of cabbage palms or cypress.

Protected birds of prey that may occur in the watershed include the bald eagle (*Haliaeetus leucocephalus*), Arctic peregrine falcon (*Falco peregrinus tundrius*), southeastern American kestrel (*Falco sparverius paulus*), and osprey (*Pandion haliatetus*). The bald eagle is found in a variety of habitats, but prefers high water-to-land edge ratios where prey is concentrated. The Arctic peregrine falcon winters in Florida. It is found in open terrain, including lake and river margins, prairies, marshes, and urban areas, that permits the detection and capture of avian prey. The southeastern American kestrel is a second cavity-nester, nesting in cavities formed by woodpeckers in long-leaf pine, sand pines, turkey oaks, or live oaks; they require open fields for foraging. Ospreys require open, relatively clear water to locate and capture fish; nesting habitats are the tops of large living or dead trees including cypress, pine, and swamp hardwoods.

Mammals

The only protected mammal that may occur in the watershed is Sherman's fox squirrel (*Sciurus niger shermani*). The Sherman's fox squirrel typically inhabits areas of fire-maintained longleaf pine-turkey oak sandhills, and flatwoods (Humphrey, 1992). The fox squirrel was identified by Cox et al. (1994) as an indicator of remaining natural communities including sandhill, mixed pine-hardwood, dry prairie, and open pine flatwoods.

Reptiles and Amphibians

Protected reptiles and amphibians that may occur in the Curiosity Creek watershed are the American alligator *(Alligator mississippiensis*), eastern indigo snake (*Drymarchon corais* *couperi*), gopher tortoise (*Gopherus polyphemus*), short-tailed snake (*Stilosoma extenuatum*), and gopher frog (*Rana capito*).

The American alligator is a resident of river swamps, lakes, marshes, bayous, and other bodies of water. The required habitat of the short-tailed snake is longleaf pine-turkey oak associations and adjacent upland hammocks or sand pine scrub.

Figure 8-8. Active gopher tortoise burrow observed in scrub habitat in October, 1999.

Based on Moler (1992), gopher tortoises typically prefer well-drained loose soils, low-growing herbs, and open sunlit sites. They are usually associated with the xeric habitats of sandhills, sand pine scrub, live oak, and pine flatwoods, or mixed hardwood-pine (Figure 8-8). The eastern indigo snake is found in a variety of habitats including wet prairies, xeric pinelands, and scrub. The gopher frog is found in many of the same habitats as the gopher tortoise, but require seasonally flooded ponds and cypress heads for breeding purposes. Both the eastern indigo snake and the gopher frog are known to utilize gopher tortoise burrows.

Flora

The habitats of the following floral species are based on data from the Florida Natural Areas Inventory (FNAI, 1997). Protected floral species that may occur in the watershed include Curtiss' milkweed (*Asclepias curtissii*), pygmy fringe tree (*Chionanthus pygmaeus*), Tampa vervain (*Glandularia tampensis*), wild coco (*Pteroglossaspis ecristata*), and broad-leaved nodding-caps (*Triphora latifolia*). Curtiss' milkweed and pygmy fringe tree are most adapted to xeric habitats and, if present in the watershed, would most likely occur in the upland sand pine association. Wild coco is indigenous to upland hardwood forests and mesic flatwoods. The preferred habitats of Tampa vervain are mesic flatwoods and hydric hammocks. Broad-leaved nodding-caps are most likely to be found in hydric hammocks.

8.4 NATURAL SYSTEMS ISSUES/AREAS OF CONCERN

8.4.1 Environmental Lands Acquisition and Protection Program

The Environmental Lands Acquisition and Protection Program (ELAPP) was established by Hillsborough County in 1987 for the purpose of acquiring, preserving, and protecting endangered and environmentally sensitive lands, beaches, parks, and recreational lands. Although, resource protection is the primary purpose of acquiring sensitive lands in the county, public use that is compatible with the preservation and protection of such lands has been allowed on select parcels. The program is administered through the county's Parks and Recreation Department and is overseen by an advisory committee composed of both local citizens and public agency staff. Parcels deemed environmentally sensitive are evaluated and ranked on a site by site basis through an annual nomination process.

Currently, the only ELAPP parcel acquired in the Curiosity Creek watershed is the Hamner Tower site located at the northwest corner of the intersection of North Boulevard and Fletcher Avenue (Figure 8-9). This 9-acre parcel was acquired from the Department of Agriculture in 1993. An additional 60 acres adjacent to this parcel is on ELAPP's approved acquisition list and has been under consideration, however, delays in negotiations may result in this site being placed on a "suspended" acquisition status. Only three new sites have been nominated for acquisition by ELAPP in 1999. These parcels are all located in the southern areas of the County (Bahia Beach, Cockroach Bay, and Bullfrog Creek areas) and no new sites have been nominated within the Curiosity Creek watershed.

8.4.1 Habitat Loss, Degradation, and Fragmentation

Approximately 90% of the historical natural systems, including upland forests, wetland forests, and herbaceous/freshwater marshes, have been lost to development over the past century in the Curiosity Creek watershed. All three of these habitats serve functional roles in the attenuation, storage, and treatment of surface water runoff. Ironically, some of the major flooding problems and water quality issues for the watershed are related to attenuating, storing, and treating stormwater runoff.

Significant habitat fragmentation has also occurred particularly along the main creek channel. The protection of wildlife corridors and major routes between two or more core and/or remnant areas of wildlife habitat is critical for the long-term survival of a wide range of plant and animal species. A wildlife corridor may be defined as any wildlife habitat or cover, usually linear, that offers a safe route from one habitat to another (Johnson and Beck 1988). The need for and use of wildlife corridors became apparent as early as the 1930s (Edminster 1938) and corridors have been used widely ever since for the benefit of game species (McElfres, et al. 1980) as well as non-game animals (Maher, 1990). Identification and protection of remaining wildlife corridors is essential to restoring natural areas in this watershed.

In their ecological characterization of the Tampa Bay area, Wolfe and Drew (1990) stressed that the ecological condition of any lake depends on the surrounding land use configuration, its land use history, and the intensity of land use and hydrologic modifications. The vegetative cover in a given lake is also influenced by water levels, intraspecific competition, weed control, and nutrients. The relationship between vegetation loss and its effect on water quality, discussed previously in Chapter 7, may play a significant role in the ecology of many of the lakes in the Curiosity Creek watershed. Residential development of lakefront property has resulted in the expansive loss of native vegetation and habitat in several lakes that may result in declining water quality in the future.

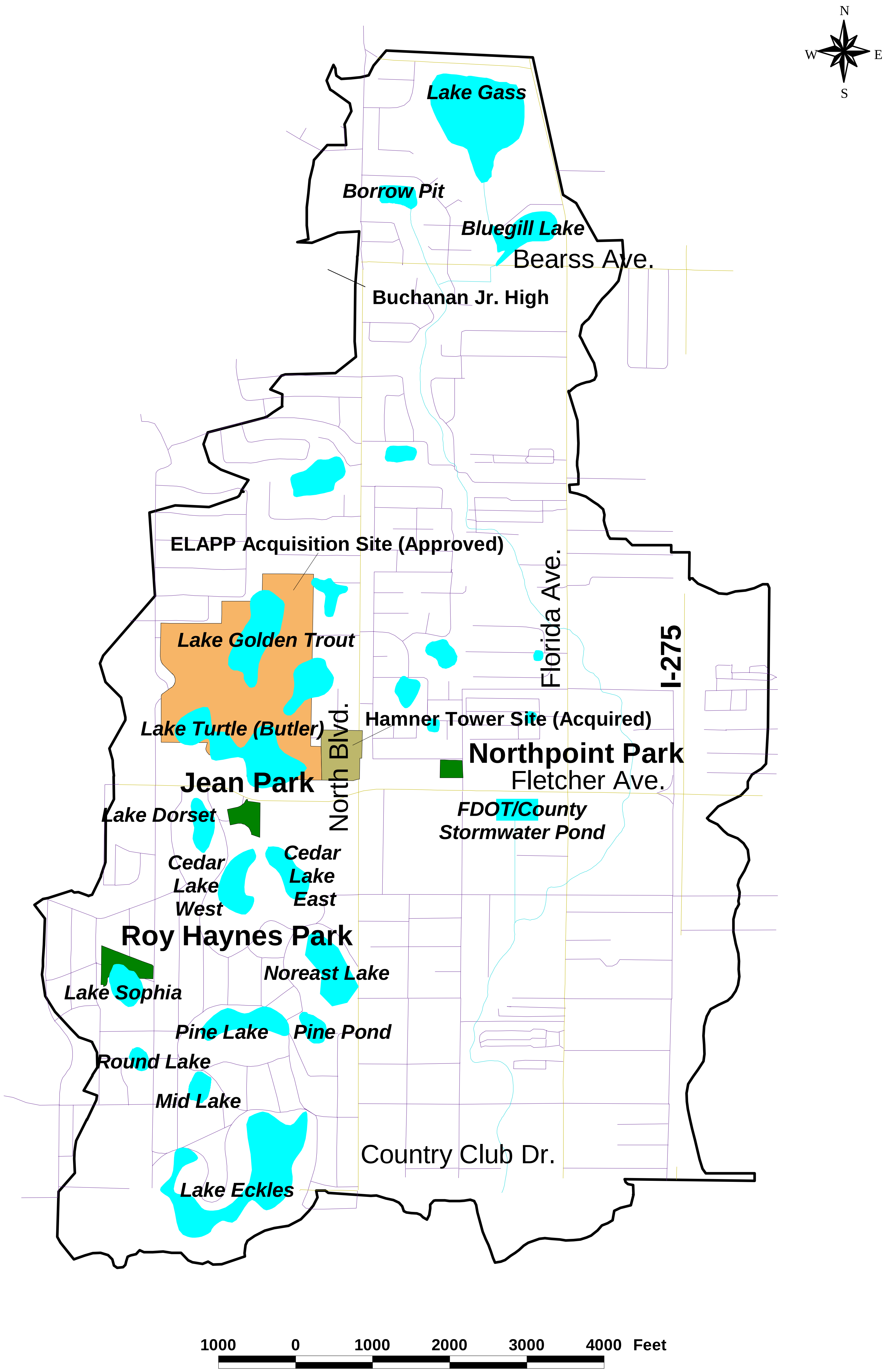


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Figure 8-9. ELAPP Sites and County Parks.

8.4.3 Exotic Species

Since the late 1800s, hundreds of exotic plant species have been imported into Florida for agriculture, horticulture, or accidentally. As a result, exotic plant infestation can be found throughout Hillsborough County in both urban and rural areas. Once established, several of the most aggressive exotic plant species have spread across Florida. In 1993, the Florida Exotic Pest Plant Council (EPPC) compiled a list of Florida's most invasive exotic plant species and grouped them according to degree of invasiveness.

The Curiosity Creek watershed has been particularly susceptible to these invasions. Urbanization, along with the spread of agricultural and industrial operations, led to widespread soil disturbance, road construction, and other pathways that resulted in the establishment of invasive exotic plant species within the watershed. Some of the most invasive species currently found within the watershed include melaleuca (Figure 8-10), Brazilian pepper (*Schinus terebinthifolius*), air potato (*Dioscorea bulbifera*), skunk vine (*Paederia foetida*), tropical soda apple (*Solanum viarum*), cattails, Australian pine (*Casuarina* sp.), wild taro, and several species of bamboo.

Figure 8-10. Melaleuca at the perimeter of Lake Gass. Invasive exotics displace native species (cypress and hardwoods) and provide poor quality habitat for indigenous wildlife.

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CHAPTER 9

WATER SUPPLY

9.1 OVERVIEW

The Curiosity Creek watershed is within both the Tampa Service area (serviced by the City of Tampa) and the Hillsborough County Urban Service Area. Both the City of Tampa and Hillsborough County are members of Tampa Bay Water, whose primary directive is to assist county and municipal services in developing, supplying, and storing water. Data regarding service areas, permitted water use, and water withdrawal points within the watershed were obtained from the SWFWMD (Figure 9-1).

9.2 GROUNDWATER USE

The primary water source for the Urban Service Area is groundwater from Tampa Bay Water which receives its groundwater supply through a series of water supply wellfields located throughout Hillsborough, Pasco, and Pinellas counties.

According to the SWFWMD GIS data layers and collaborative permit data, there is only one current water withdrawal permit inside the watershed boundaries (Table 9.1). This permit is for groundwater withdrawal for recreational and aesthetic uses for golf course, lawn, and landscape irrigation. The other permits included in the SWFWMD database are either expired and/or exempt, or outside the watershed boundaries. The Tampa Bay Water permit has been withdrawn from the SWFWMD permit files and, according to Tampa Bay Water staff (personal communication), there are no production wells within the watershed.

Table 9.1. Water Use Permits based on SWFWMD permit data.

Permit Number	Permit Owner	Predominant Use	Average Use (gpd)	Peak Monthly Use (gpd)	Notes
6676.03	Tampa Bay Water	Public			No data
3572.00	Charles Bearss	Public			Expired/Exempt
2156.00	Paul & Mary Bearss	Irrigation			Expired/Capped
6334.02	Lake Morley Improvements Assoc.	Recreational	4,400	17,300	Outside watershed
6100.01	City of Tampa Tampa Sports Authority Babe Zaharias Golf Course	Recreational	205,000	512,000	Current

9.3 SURFACE WATER USE

The majority of the Curiosity Creek watershed is within the Tampa Service Area which receives its potable water supply from the City of Tampa. The primary water source for this area is surface water withdrawal from the Hillsborough River. Based on available permit data, it does not appear that any surface water withdrawals occur for any of the waterbodies within the Curiosity Creek watershed.

9.4 WATER SUPPLY ISSUES/AREAS OF CONCERN

Many of the regional public water supply issues associated with groundwater withdrawal and the environmental health of lakes and wetlands do not effect the Curiosity Creek watershed. The most significant related water supply issue within this watershed is the reopening of Blue Sink. Although this event would not affect the water supplied to residents and commercial users within the watershed, it would affect regional water supply issues by augmenting the Hillsborough reservoir and increasing freshwater flows to the Hillsborough River and Tampa Bay.

9.4.1 Aquifer Recharge

The Curiosity Creek watershed lies within an area that recharges to the Floridan aquifer at an estimated rate of 1 to 10 inches per year (SWFWMD, 1999). The hydrogeological formations within the Curiosity Creek area contain karst areas with numerous sinkholes (Figure 9-1). As such, protection of recharge areas in the watershed is critical to protecting regional groundwater sources and meeting regional water supply demands.

9.4.2 Impacts Due to Water Withdrawals

No groundwater or surface water withdrawal permits were found within the Curiosity Creek watershed. Currently there are no known impacts to water bodies within the watershed associated with regional groundwater supply wellfieds.

9.4.3 Minimum Flows and Levels

Minimum flows and levels is a term defined as a series of flow events necessary to prevent significant environmental harm to lakes, wetlands, and streams. Establishment of minimum flow criteria and values for each event constitutes the minimum flow regime and the establishment of the required minimum flows and levels. The Hillsborough County Comprehensive Plan (Coastal Management Element) requires cooperation between the County and the SWFWMD to ensure that the minimum freshwater flows needed to support natural, optimal diversity and productivity in estuarine areas are scientifically determined and maintained. The reopening of Blue Sink may provide additional groundwater/surface water volume that would increase freshwater flows that are critical to the ecology of the lower Hillsborough River and Tampa Bay.

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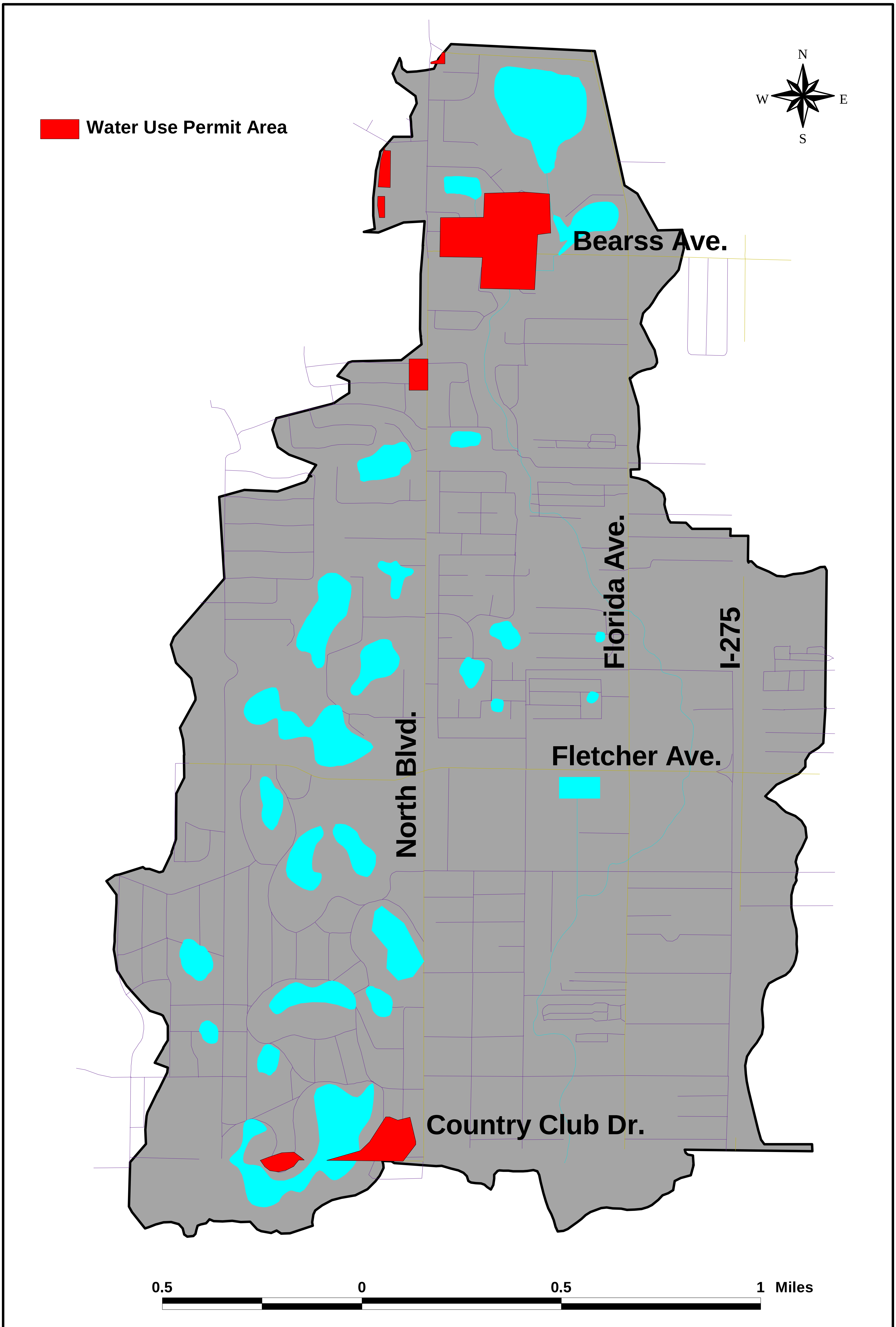

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Figure 9-1. Water Use Permit Locations

CHAPTER 10

POLLUTANT LOADING AND REMOVAL MODEL

10.1 OVERVIEW

Potential water quality impacts resulting from stormwater runoff were evaluated using the Pollutant Loading and Removal Model previously developed by Parsons Engineering Science, Inc. in conjunction with the Hillsborough County Publics Works/Stormwater Management Environmental Team. The model was developed to facilitate the assessment of potential water quality impacts resulting from existing land use and soils conditions and to evaluate levels of service for existing stormwater runoff discharges at the watershed, basin, and subbasin levels. The model was also developed to facilitate the evaluation of future water quality conditions based on potential improvements or alternatives within a watershed.

10.2 POLLUTANT LOADING AND REMOVAL MODEL

The Pollutant Loading and Removal Model has three main components: calculation of gross pollutant loads, estimation of net loads based on existing treatment, and evaluation of levels-of-service. GIS coverages of land use and hydrologic soil characteristics were used together with subbasin delineations to determine runoff characteristics (Figure 10-1). A gross pollutant load for each subbasin is calculated as the product of the runoff volume and the stormwater event mean concentrations (EMC) for each pollutant of interest. A total of six EMC values were measured during previous stormwater characterization studies performed by Hillsborough County, and later submitted as part of the County's National Pollutant Discharge Elimination System (NPDES) permit.

Net pollutant loads are estimated by evaluating each subbasin based on an estimate of existing stormwater treatment by land use within each subbasin. Levels-of-service for each subbasin, described in greater detail in the following chapter, are based on the comparison of existing net loads to a benchmark condition represented by the pollutant load produced by designating untreated low/medium density residential land use for the entire watershed.

The model used in this water quality evaluation calculates loads for a total of 12 different parameters (pollutants) including:

- Biological Oxygen Demand (BOD_5)
- Total Suspended Solids (TSS)
- Total Kjeldahl Nitrogen (TKN)
- Nitrate + Nitrite (NO_3+NO_2)
- Total Nitrogen (TN)
- Total Phosphorus (TP)
- Total Dissolved Phosphorus (TDP)
- Oil and Grease
- Cadmium (Cd)
- Copper (Cu)
- Lead (Pb)
- Zinc (Zn)

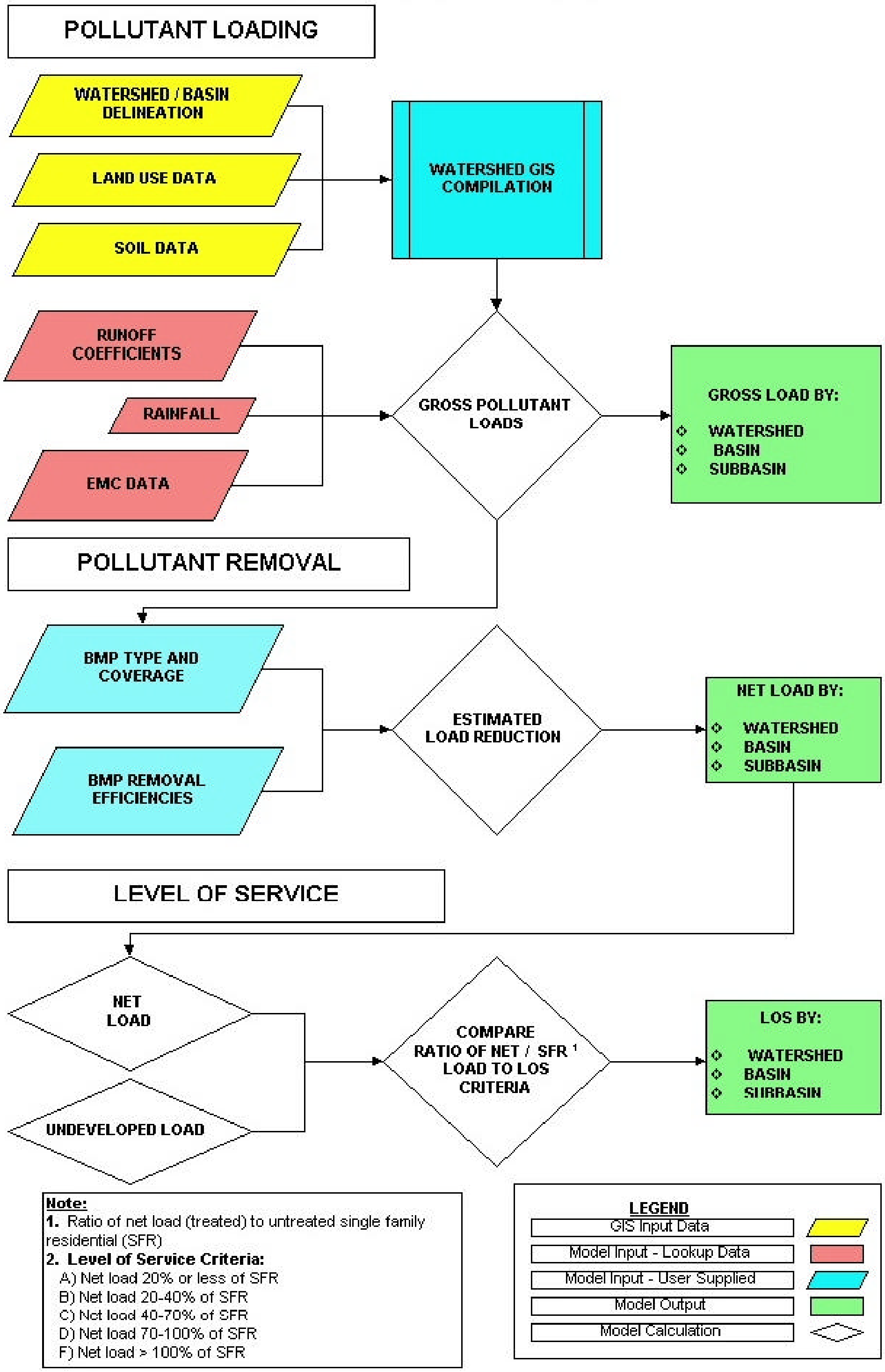


Figure 10-1. Hillsborough County Pollutant Loading and Removal Model. (Source: Parsons Engineering Science, Inc.)

10.2.1 Land Use

The percentage of impervious land surface area is typically determined by land use composition (e.g., transportation = roads = high proportion of impervious area). The degree of imperviousness can then be used to determine the volume of runoff expected from various subbasins within a watershed. The 1995 land use coverage provided by the SWFWMD was used in this modeling effort to determine land use types in each subbasin. For pollutant loading estimates, land use categories were aggregated to correspond with Hillsborough County's current NPDES permit. The land use categories evaluated for the pollutant loading model include:

- low/medium density residential
- high density residential
- light industrial
- agricultural
- commercial
- institutional
- highway/utility
- recreational
- open land, and
- extractive (mining)/disturbed

Acreages and percentages of land uses based on these general categories for the Curiosity Creek watershed are summarized below.

Table 10.1. Aggregated land use distributions used in the Pollutant Loading Model for the Curiosity Creek watershed.

Land Use	**Acres**	**Percent**
Agricultural	17.40	0.79%
Commercial	295.98	13.44%
Extractive (Mining)/Disturbed	0.54	0.02%
High Density Residential	1087.70	49.38%
Highway/Utility	81.78	3.71%
Institutional	75.33	3.42%
Low/Medium Density Residential	297.44	13.50%
Open Land	34.63	1.57%
Recreational	12.55	0.57%
Upland Forest	109.39	4.97%
Water	132.55	6.02%
Wetland Forest	6.59	0.30%
Wetland Non-Forested	50.82	2.31%
Grand Total	**2202.69**	**100.00%**

10.2.2 Soil Characteristics

Soil type is another important component of runoff calculations since different soils have varying capacities for infiltration. Also, the distribution of soils can vary significantly throughout a watershed. Hydrologic soils groups are typically used to classify soils based on runoff potential. Soils are grouped into four hydrologic soil groups (A through D), which reflect varying levels of infiltration rates and soil moisture capacities. Descriptions of these soil groups are as follows:

- **Group A** (low runoff potential): Soils with high infiltration rates even when thoroughly wetted and which have a high rate of water transmission. Has a typical maximum infiltration rate of 10 in/hr when dry and 0.5 in/hr when saturated.
- **Group B** (moderately low runoff potential): Soils that have moderate infiltration rates when thoroughly wetted and a moderate rate of water transmission. Has a typical maximum infiltration rate of 8 in/hr when dry and 0.4 in/hr when saturated.
- **Group C** (moderately high runoff potential**):** Soils that have a slow infiltration rate when thoroughly wetted and a slow rate of water transmission. Has a typical maximum infiltration rate of 5 in/hr when dry and 0.25 in/hr when saturated.
- **Group D** (high runoff potential): Soils having very slow infiltration rates when thoroughly wetted and a very slow rate of water transmission. Has a typical infiltration rate of 3 in/hr when dry and 0.10 in/hr when saturated.

In Florida, certain soils can have dual hydrologic soil group classifications (A/D or B/D) due to the presence of a high surficial water table during the wet season. Even though a soil might be a type A or B, the lack of infiltration results in the soil acting as a D soil. During dry periods, when the water table is lower, the soil acts as an A or B soil.

Runoff volume calculations were based on the application of runoff coefficients by soil and land use type. Most of the coefficients, listed by land use, can be found in the FDOT drainage manual. Runoff coefficients used in this analysis are summarized in Appendix 10-A.

10.2.3 Basin Delineation

During the hydraulic analyses described earlier in Chapter 4, the Curiosity Creek watershed was divided into 79 subbasins representing approximately 2,203 acres. These same subbasins were also used in the pollutant loading model by comparing hydrologic, hydraulic, and runoff water quality characteristics of the different areas. The subbasins range in size from approximately one acre to more than 100 acres with an average size of about 28 acres. Watershed areas outside of unincorporated Hillsborough County (e.g., within the City of Tampa) were not included in this evaluation.

10.2.4 Pollutant Concentrations

The chemicals of interest for pollution loading analysis were based on the same parameters required for NPDES permitting of stormwater discharges for Hillsborough County, as listed in

Table 10.2. The annual load of a specific constituent generated from each basin during cumulative annual rainfall events was calculated as the product of the annual runoff volume times the corresponding event mean concentration (EMC). The EMC is the mean concentration of a chemical parameter expected in the stormwater runoff discharged from a particular land use category during a typical (average) storm event. The calculated constituent mass represents the pollutant load.

For watershed analyses in Hillsborough County, the EMC values reported in the County's NPDES permit applications for stormwater discharges and supporting documents were used, if available. For land use categories or parameters not reported by Hillsborough County, EMC data from other studies in Florida were used. EMC values were available for many land uses for numerous pollutants including five-day biological oxygen demand (BOD_5), total suspended solids (TSS), total kjeldahl nitrogen (TKN), nitrite plus nitrate (NO_2+NO_3), total nitrogen (TN), total and dissolved phosphorous (TP and TDP), oil and grease, cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn). EMC values used to estimate pollutant loads are summarized in Table 10.2. Literature reviews performed by Parsons Engineering Science, Inc. for the Northwest Hillsborough and Pemberton/Baker Creek watershed reports in 1999 included comparisons of pollutant values in Hillsborough County to other Florida and national studies. Summaries of these comparisons are provided in the following paragraphs:

- "BOD_5 data found in Hillsborough County samples tend to be lower, or similar, than those found in other areas in Florida, except for agriculture. The agriculture EMC for BOD_5 is approximately five times larger than other values reported in Florida. In general, Hillsborough County agricultural land use EMCs for a number of parameters, tend to be much higher than those reported elsewhere in Florida. For most parameters, these elevated EMCs increase estimated load calculations significantly where agricultural land use is found."

- "Nitrogen from residential land uses tends to be higher in Florida and Hillsborough County than nationally due to the increased application of lawn fertilizer by homeowners and golf course managers. Slightly higher TKN and TP values for multi-family sites may reflect more intensive landscape maintenance for these land uses. Commercial land uses also have nitrogen values that are higher than national averages. This may reflect primarily atmospheric deposition, as studies in Florida have shown that commercial sites produce elevated nitrogen loads even if little green area is present. Phosphorous runoff tends to be lower in Florida than the U.S. average, although data from Hillsborough County studies differs somewhat. Phosphorous runoff from residential and commercial land uses are higher than Florida average, while runoff from industrial land uses are similar to Florida and national averages. As with nitrogen, elevated loads from multi-family land uses could reflect more intensive landscape maintenance."

- "The Hillsborough County data indicate that total nitrogen and total phosphorus EMCs for the agricultural land use are 74 and 586 percent higher, respectively,

Table 10.2. Event mean concentration (EMC) values by land use in the Curiosity Creek watershed (Parsons Engineering Science, Inc.).

Land Use	NPDES Conventional WQ (mg/l)																NPDES Metals (mg/l)						
	BOD_5		TSS		TKN		NO_3 $+NO_2$		TN		TP		TDP		Oil and Grease		Cd		Cu			Zn	
Low/Medium Density Residential	1.0	e	19		1.082		0.281		1.363	g	0.401		0.282		1.08		0.001	e	0.013			0.022	
High Density Residential	2.6		29		1.368		0.679		2.047	g	1.337		0.552		1.073		0.001	e	0.047			0.058	
Light Industrial	2.87		18.2		2.088		0.187		2.275	g	0.332		0.187		3.663		0.001	e	0.024			0.096	
Agricultural	18.3		12.7		2.167		0.803		2.970	g	2.349		1.223		0.5	e	0.013		0.041		e	0.017	
Commercial Office	2.62		36.5		2.207		0.171		2.378	g	0.305		0.182		0.793		0.001	e	0.014		e	0.036	
Commercial Retail	2.72		9.33		1.083		0.603		1.686	g	0.253		0.132		0.5	e	0.001	e	0.021			0.015	
Commercial, combined	2.67		22.92		1.65		0.39		2.032	g	0.28		0.16		0.65		0.001		0.02			0.03	
Institutional	2.67	f	22.92	f	1.65	f	0.39	f	2.032	g	0.28	f	0.16	f	0.65	f	0.001	f	0.02	f	f	0.03	f
Highway/Utility	24	a	261	a	2.99	a	1.140	a	4.130	g	0.120	a	0.300	d	0.4	d	0.040	a	0.103	a	a	0.410	a
Recreational	3.8	b	11.1	b	2.09	b	0.508	b	2.598	g	0.050	b	0.13	c	0.9	d	0.007	b	0.041	b	b	0.004	b
Open Land	3.8	f	11.1	f	2.09	f	0.03	c	2.598	g	0.19	c	0.13	f	0.9	f	0.0003	c	0.001	c	c	0.006	
Extractive (Mining)/Disturbed	28.94	c	13.2	c	3.50	c	0.03	c	3.530	g	0.19	c	0.13	c	0.9	d	0.0003	c	0.001	c	c	0.006	c
Upland Forest	0	h	0	h	0	h	0	h	0	h	0	h	0	h	0	h	0	h	0	h	h	0	h
Wetland Forest	0	h	0	h	0	h	0	h	0	h	0	h	0	h	0	h	0	h	0	h	h	0	h
Wetland Non-Forested	0	h	0	h	0	h	0	h	0	h	0	h	0	h	0	h	0	h	0	h	h	0	h

Note:

NPDES parameters: BOD5, COD, TSS, TDS, TKN, NO3+NO2, TP, DP, Oil and Grease; cadmium, copper, lead, zinc.

All EMC values without footnotes were obtained from samples collected for the Hills. Co. NPDES Permit Application (1993).

For parameters not detected in all samples, EMCs were calculated using half the reporting limit for nondetects.

For pollutants not reported by Hills. Co. (1993), additional sources were used as noted:

a. Average values used by Hillsborough Co. (1994) (from Smith and Lord (1990), provided in Wanielista and Yousef (1993).

b. Literature value reported as EMC in Hillsborough Co. 1994.

c. Calculated value from Sarasota County stormwater samples.

d. Orange County, 1993.

e. Surrogate based on 1/2 DL for values reported as BDL.

f. EMCs for open land use were assumed to be less than or equal EMCs for recreational land use.

g. Total nitrogen (TN) estimated as the sum of NH_3 + organic-N (TKN) and oxidized-N (NO_2+NO_3).

h. EMCs for upland forest, wetland forest, and non-forested wetland were assumed to zero for benchmark comparisons.

EMCs reported as representative of agricultural land use were used for all subcategories of agricultural land use (e.g., pastures, crops, and groves).

than that for low/medium family residential uses. The total nitrogen EMC is similar to that found for other locations in Florida. However, the EMC for total phosphorus is six times as high as the average EMC found for various agricultural sites in Florida. This situation makes agriculture one of the main contributors of nutrient loadings."

- "TSS data for Hillsborough County are comparable to other Florida locations and lower than U.S. averages. TSS results from soil erosion, with construction sites a major contributor along with agricultural practices. Additional primary sources of TSS include vehicle emissions and atmospheric deposition."

- "BOD data for Hillsborough County is somewhat low relative to other locations in Florida and across the U.S. Low levels of organic matter may reflect the low organic matter typically present in Florida soils."

- "Lead data for Hillsborough County are lower than other locations in Florida and across the U.S. Relatively low lead concentrations may reflect fate and transport characteristics of the particular systems sampled and/or decreased emissions due to the use of unleaded gasoline. Copper data for Hillsborough County are higher than other locations in Florida, but similar to the nationwide average. Relatively high values were observed for residential land uses. Transportation-related activities, particularly releases from brake linings, have been identified as primary sources for copper. Copper is also a common element in algaecides and fungicides, and many fertilizers contain copper. Zinc data are much lower for Hillsborough County and Florida in general than the rest of the U.S. Sources of zinc include industrial processes, transportation-related activities, atmospheric deposition and fertilizers. Relatively low zinc concentrations may reflect fate and transport characteristics of the particular systems sampled and/or the presence of fewer industrial processing facilities in Hillsborough County than other parts of the U.S."

10.2.5 Existing Stormwater Treatment

The type and coverage of best management practices (BMPs) providing pollutant removal were also determined to estimate net loads from each basin. BMP coverage data were developed for each aggregate land use within each subbasin based on field surveys and photointerpretation of digital orthophotography provided by the SWFWMD. BMPs used to reduce loads generated by various land uses included wet ponds, percolation ponds (dry retention basins), grassed swales, and infiltration trenches.

For each land use within a subbasin, a percent cover of the area treated by a particular BMP was estimated. Load removal was then calculated based on removal efficiencies supplied with the model (see Table 10.3). The majority of BMPs identified in the Curiosity Creek watershed were wet detention ponds. Several large wet detention ponds were constructed within the last decade by the FDOT to treat roadway improvement projects, primarily along

Florida and Fletcher Avenues. A few smaller wet detention ponds were found in newer residential areas constructed in the late 1980s and early 1990s after rules requiring on-site storage and treatment of runoff were enacted by the State of Florida. A smaller number of percolation ponds and grass swales were also observed, however, no infiltration trenches were identified within the watershed based on field surveys.

Table 10.3. Estimated pollutant removal efficiencies for typical stormwater BMPs.

BMP Type	BOD_5	TSS	TKN	NO_3+ NO_2	TN	TP	TDP	Oil &Grease	Cd	Cu	Pb	Zn
Wet-detention	60% [1]	85% [1]	30% [1]	80% [1]	30% [1]	65% [1]	80% [3]	35% [2]	75% [2]	65% [1]	75% [1]	85% [1]
Percolation	80% [1]	80% [1]	80% [1]	80% [1]	80% [1]	80% [1]	80% [3]	80% [3]	80% [3]	80% [1]	80% [1]	80% [1]
Infiltration Trench		75% [4]				60% [4]					65% [4]	65% [4]
Grass Swale		60% [4]	10% [4]	15% [4]	10% [4]	20% [4]					70% [4]	60% [4]

Source:
1. Harper, H.H. 1995. "Pollutant removal efficiencies for typical stormwater management systems in Florida." In: Proceedings of the 3rd Biennial Stormwater Research Conference. Southwest Florida Water Management District, Brooksville, Florida.
2. Kadlec, R.H. and R.L. Knight, 1996. "Treatment Wetlands." CTC Press, Inc. Boca Raton, Florida.
3. USEPA, 1993. "Guidance specifying management measures for sources of nonpoint pollution in coastal waters." U.S. Environmental Protection Agency, Office of Water, Washington, D.C.
4. Parsons Engineering Science, Inc. Unpublished Data.

10.3 POLLUTANT LOADS

The EPA Simple Method (USEPA, 1992) was used in the spreadsheet model to calculate pollutant loads. According to the Simple Method, non-point source pollutant loads are calculated using the following formula:

$$\mathbf{L_I} = (0.227)(P)(CF)(Rv_I)(C_I)(A_I)$$

where:

L_I = annual pollutant load per basin (lb/yr)
P = annual average precipitation (in/yr)
Rv_I = weighted average runoff coefficient based on impervious area
C_I = event mean concentration of pollutant (mg/L)
A_I = catchment area contributing to outfall (acres)
CF = correction factor for storms that do not produce runoff
(assumed CF=0.9, 10 percent of storms do not produce runoff)

The runoff characteristics discussed above were used with EMC values for specific land uses to calculate gross pollutant loads. All EMCs, runoff coefficients, and BMP efficiency values were incorporated into lookup tables provided with the Pollutant Loading and Treatment Model. Data generated in GIS by the union of subbasin area, hydrologic soils groups, and land use were then used to estimate average annual runoff. This runoff value was calculated as the product of the annual rainfall amount times the corresponding weighted runoff coefficient for a given subbasin. A correction factor of 0.9 was used to account for the numerous small rainfall events (possibly less than 0.1 inch) that occur throughout the year but do not result in any runoff as a result of abstraction. Each subbasin's contribution in terms of stormwater runoff volume was then calculated by multiplying the runoff coefficient times the average annual rainfall value for the Tampa Bay area (52.4 inches x correction factor or 0.9 = 47.16 inches).

10.3.1 Gross Pollutant Loads

Estimates of gross pollutant loads were calculated for each subbasin using the 1995 land use and hydrologic soils information. These calculations were performed assuming no stormwater treatment occurred within any of the 79 subbasins (Appendix 10-B). These data were used to compare untreated versus treated runoff conditions in the watershed.

10.3.2 Net Pollutant Loads

Estimates of net pollutant loads were subsequently calculated for each subbasin using the 1995 land use and hydrologic soils information and the stormwater treatment BMP coverage file (Appendix 10-C). These calculations resulted in lower pollutant loading values for those subbasins which received one of the four types of stormwater treatment. Based on the assumed treatment efficiencies provided in the model, load reductions for various pollutants ranged from about 2% (for total phosphorus) to 54% (for lead) (Table 10.4).

Table 10.4. Summary of gross and net pollutant loads and percent reductions as a result of existing stormwater BMPs in the Curiosity Creek watershed.

Load	BOD5 (lbs/yr)	TSS (lbs/yr)	TKN (lbs/yr)	NO3 +NO2 (lbs/yr)	TN (lbs/yr)	TP (lbs/yr)	TDP (lbs/yr)	Oil and Grease (lbs/yr)	Cd (lbs/yr)	Cu (lbs/yr)	Pb (lbs/yr)	Zn (lbs/yr)
Gross Loads	41,544	436,729	16,962	6,801	23,763	10,727	4,835	10,687	35	451	627	737
Net Loads	35,532	322,066	15,989	6,162	22,515	10,501	4,629	10,357	26	420	289	567
% Reduction	**14%**	**26%**	**6%**	**9%**	**5%**	**2%**	**4%**	**3%**	**27%**	**7%**	**54%**	**23%**

CHAPTER 11

WATER QUALITY TREATMENT LEVEL OF SERVICE

11.2 OVERVIEW

This chapter describes the results of the pollutant loading analysis performed in Chapter 10. Based on these results, a water quality treatment level of service was determined for each subbasin within the Curiosity Creek watershed. This type of analysis will facilitate prioritization of water quality improvement alternatives (projects) within the watershed.

Water quality treatment levels-of-service (LOS) criteria were used as part of this watershed study to allow comparisons of existing and proposed stormwater treatment conditions to pollutant loading goals. A pollutant load reduction goal has previously been established for the Tampa Bay watershed (which includes Curiosity Creek, due to its location within and association with the broader Hillsborough River watershed) by the Tampa Bay National Estuary Program (now called the Tampa Bay Estuary Program [TBEP]) and a consortium of local government and private industries. This reduction goal has targeted nitrogen, specifically, as it is the limiting nutrient for phytoplankton growth in the bay.

Excess nitrogen can stimulate algal growth resulting in reduced light penetration through the water column and subsequent shading and loss of seagrasses. The nitrogen reduction goal is based on loads generated by several potential inputs including point sources, atmospheric deposition, and non-point source runoff from various land uses. The intent of this management effort is to protect water quality and, ultimately, valuable natural resources in the bay (Tampa Bay National Estuary Program, 1996). Currently, the goal for the Tampa Bay watershed is to "hold the line" or maintain levels of nitrogen loads based on 1995 land use conditions.

Although little runoff from the Curiosity Creek watershed is expected to enter the Tampa Bay estuary directly, the identification of problem areas and pollutant load reduction goals is an important step in protecting the creek, lakes, and groundwater within the watershed. These areas will require the assessment of other parameters, such as phosphorus (which is often a limiting nutrient for lake systems), heavy metals, and/or bacteria. If further efforts to reopen Blue Sink are successful, assessing potential nitrogen loads originating from Curiosity Creek - flowing via groundwater to Sulphur Springs and ultimately discharging to the Hillsborough River and Tampa Bay - will be an important step in meeting the TBEP's pollutant load reduction goal.

The modeling effort in this study focuses only on land use as a basis for evaluating pollutant loads. For comparison purposes, pollutant loads based on stormwater runoff from single family (low to medium density) residential land use were selected as the standard for comparison. In this manner, the calculation of pollutant loads is consistent with the concept of standard residential unit (SRU) used for stormwater utility assessments.

The procedure to identify a level-of-service designation for each subbasin consisted of the following steps:

1. Net pollutant loads were calculated for each pollutant of interest based on 1995 land uses and existing stormwater treatment BMPs (completed in Chapter 10);

2. Benchmark pollutant loads were calculated for each pollutant based on the assumption that 100% of the watershed area was developed for low/medium residential land uses and there is no existing treatment;

3. Ratios of net load/gross load were calculated;

4. Criteria described below were applied to each subbasin and pollutant to determine the LOS for the subbasin.

Based on the following ranges, water quality LOS criteria were defined as a score from A through F:

- **LOS A**, net load equivalent to 20% or less of untreated single family residential. A LOS equal to A for a subbasin would indicate the presence of a high percentage of undisturbed natural systems, or high percentages of developed areas treated with BMPs capable of removing pollution levels to those representing natural systems. Areas where typical land uses (residential) exhibit stormwater treatment levels above the minimum required per 62-40.432(5) F.A.C. (Water Policy) would also receive LOS A.

- **LOS B**, net load equivalent to between 20 and 40% of untreated single family residential areas. A LOS equal to B would indicate the presence of BMPs with removal efficiencies consistent with those representing adequately designed and maintained conditions and a relatively even mix of developed and natural land uses.

- **LOS C**, net load equivalent to between 40 and 70% of untreated single family residential areas. A LOS equal to C would indicate the presence of treatment systems showing removal efficiencies consistent with those representing average to poorly maintained conditions and a greater percentage of developed versus natural land uses.

- **LOS D**, net load equivalent to between 70 and 100% of untreated single family residential areas. A LOS equal to D would indicate minimal treatment of sub-basin discharges and relatively high percentage of developed land uses.

- **LOS F**, net load equal to or greater than 100% of untreated single family residential areas. A LOS equal to F would indicate no treatment for sub-basin discharges, or the presence of extensive areas of land uses producing larger pollution loads per unit area than typical residential land uses.

11.2.1 Water Quality Levels-of-Service Pollutant Load Calculations

Benchmark pollutant loads were calculated for each pollutant based on the assumption that 100% of the watershed area was developed for low/medium residential land uses and no existing stormwater treatment existed in any of the subbasins. A summary of loads for the entire basin is shown below (Table 11.1). Detailed pollutant load estimates for each subbasin are presented in Appendix 11-A.

Based on the difference between net loads (Table 10.4) and untreated single family gross loads, reduction of pollutant loads from current land use conditions to simply achieve the benchmark water quality LOS conditions would be relatively high (>40%) for nearly all 12 parameters. Considering existing stormwater BMP removal efficiencies, achieving these goals would require an extremely aggressive implementation program and, possibly, the use of newer technologies such as alum treatment.

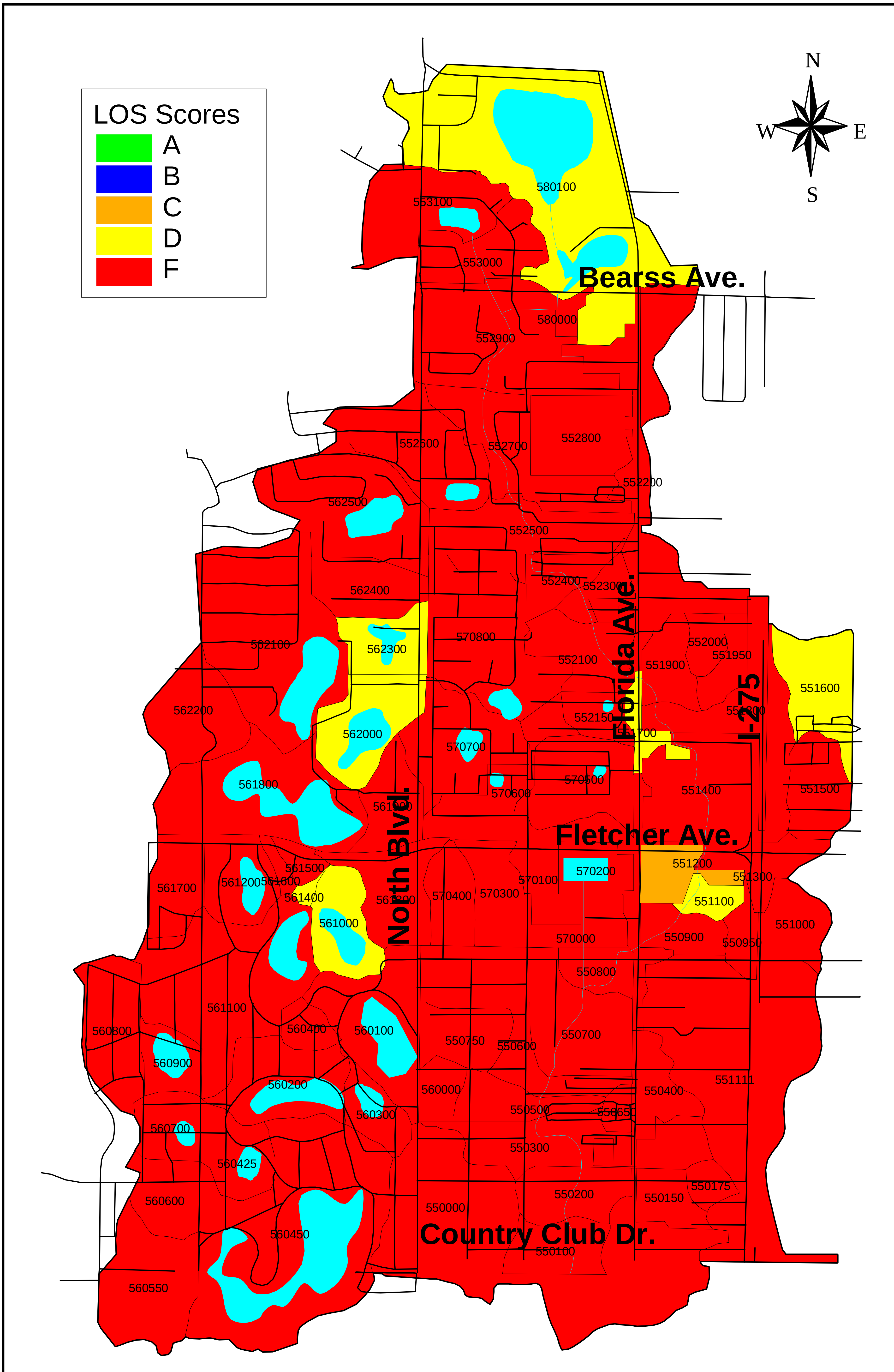
Table 11.1. Estimated water quality LOS (low/medium density residential, untreated) loads and percent reductions needed to equal LOS loads.

Load	**BOD5 (lbs/yr)**	**TSS (lbs/yr)**	**TKN (lbs/yr)**	**NO3 +NO2 (lbs/yr)**	**TN (lbs/yr)**	**TP (lbs/yr)**	**TDP (lbs/yr)**	**Oil and Grease (lbs/yr)**	**Cd (lbs/yr)**	**Cu (lbs/yr)**	**Pb (lbs/yr)**	**Zn (lbs/yr)**
LOS Loads	8,452	160,588	9,145	2,375	11,520	3,389	2,383	9,128	8	110	68	186
Reduction needed to achieve LOS	**76%**	**50%**	**43%**	**61%**	**49%**	**68%**	**49%**	**12%**	**67%**	**74%**	**77%**	**67%**

11.2.2 Water Quality Level-of-Service Scores

The water quality LOS designations based on a comparison of existing land use conditions (net) loads to the low/medium density residential benchmark are provided in Appendix 11-B. Overall LOS scores for the watershed were “F” for all parameters combined (Figure 11-1, Table 11.2) which indicates that pollutant loads from existing conditions were equal to or higher than that of untreated residential land use. These results reflect the fact that much of the watershed is heavily urbanized and was developed prior to regulations requiring on-site treatment and storage of stormwater runoff.

Of the 79 subbasins, only one overall “C” score was calculated, followed by eight “D” and seventy “F” scores. The distribution of scores for all parameters was heavily weighted towards lower values with only a single “A” score calculated for total dissolved phosphorus in a commercial area located east of Florida Avenue and south of Fletcher Avenue (subbasin #551200). Only four “B” scores and thirty-one “C” scores were calculated with the majority of scores ranked as either “D” (100) or “F” (811). Although a few large parcels of undeveloped land still occur within the basin, these areas typically fell within larger subbasin areas that were also comprised of highly developed land. As a result, low scores were distributed fairly evenly throughout the watershed with every subbasin achieving at least one “F” score for at least one pollutant.



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CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

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Figure 11-1. Existing Overall Water Quality Treatment LOS

Table 11.2. Frequencies and percentages of water quality level-of-service scores for modeled pollutants in the Curiosity Creek watershed.

	LOS	BOD_5	TSS	TKN	$NO_3 + NO_2$	TN	TP	TDP	Oil and Grease	Cd	Cu	Pb	Zn
COUNT	A	0	0	0	0	0	0	1	0	0	0	0	0
	B	0	1	0	0	0	0	0	0	1	0	1	1
	C	0	2	0	2	0	3	3	7	4	0	10	1
	D	2	9	7	5	4	7	11	22	7	3	19	4
	F	77	67	72	72	75	69	64	50	67	76	49	73
	No. of Subbasins	79	79	79	79	79	79	79	79	79	79	79	79
	Overall LOS	***F***	***F***	***F***	***F***	***F***	***F***	***F***	***F***	***F***	***F***	***F***	***F***
PERCENT	A	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%
	B	0%	1%	0%	0%	0%	0%	0%	0%	1%	0%	1%	1%
	C	0%	3%	0%	3%	0%	4%	4%	9%	5%	0%	13%	1%
	D	3%	11%	9%	6%	5%	9%	14%	28%	9%	4%	24%	5%
	F	97%	85%	91%	91%	95%	87%	81%	63%	85%	96%	62%	92%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Equally disturbing is the large proportion of "F" values in closed subbasins which drain to several lakes and ponds (e.g., several subbasins in the 560000 series). Based on the model, these areas are assumed to receive relatively high pollutant loads with little to no treatment and no flushing. As a result, continued loading to these surface waters could result in significant water quality degradation in the future if remediation measures are not implemented. Evidence of this trend can be seen in several lakes in the western portion of the basin (Cedar West, Eckles, Mid, Pine) which are trending from "good" to "fair" water quality conditions.

In addition, several important parameters, including TN (Figure 11-2), TSS (Figure 11-3), and most of the heavy metals attained "D" or "F" scores in most subbasins. A "B" score for TSS was achieved in subbasin #551200 which is a commercial area that has stormwater treatment. These pollutants are of particular concern in the Tampa Bay region as they relate directly to water quality, clarity, and public health goals established through the TBEP's comprehensive management plan (1996). Efforts to reduce loading of these pollutants to Curiosity Creek, surrounding lakes, and to groundwater should be incorporated into future management activities for the watershed. These efforts may include: implementation of stormwater best management practices (BMP's - wet detention ponds, baffle boxes, etc.), source reduction (e.g., education programs for home and business owners to reduce fertilizers and illicit discharges), improved wastewater treatment practices (extending centralized sewer systems to areas treated by on-site disposal systems or septic tanks), and restoration/conservation of natural lands and riparian buffer areas to reduce current and future pollutant loads.

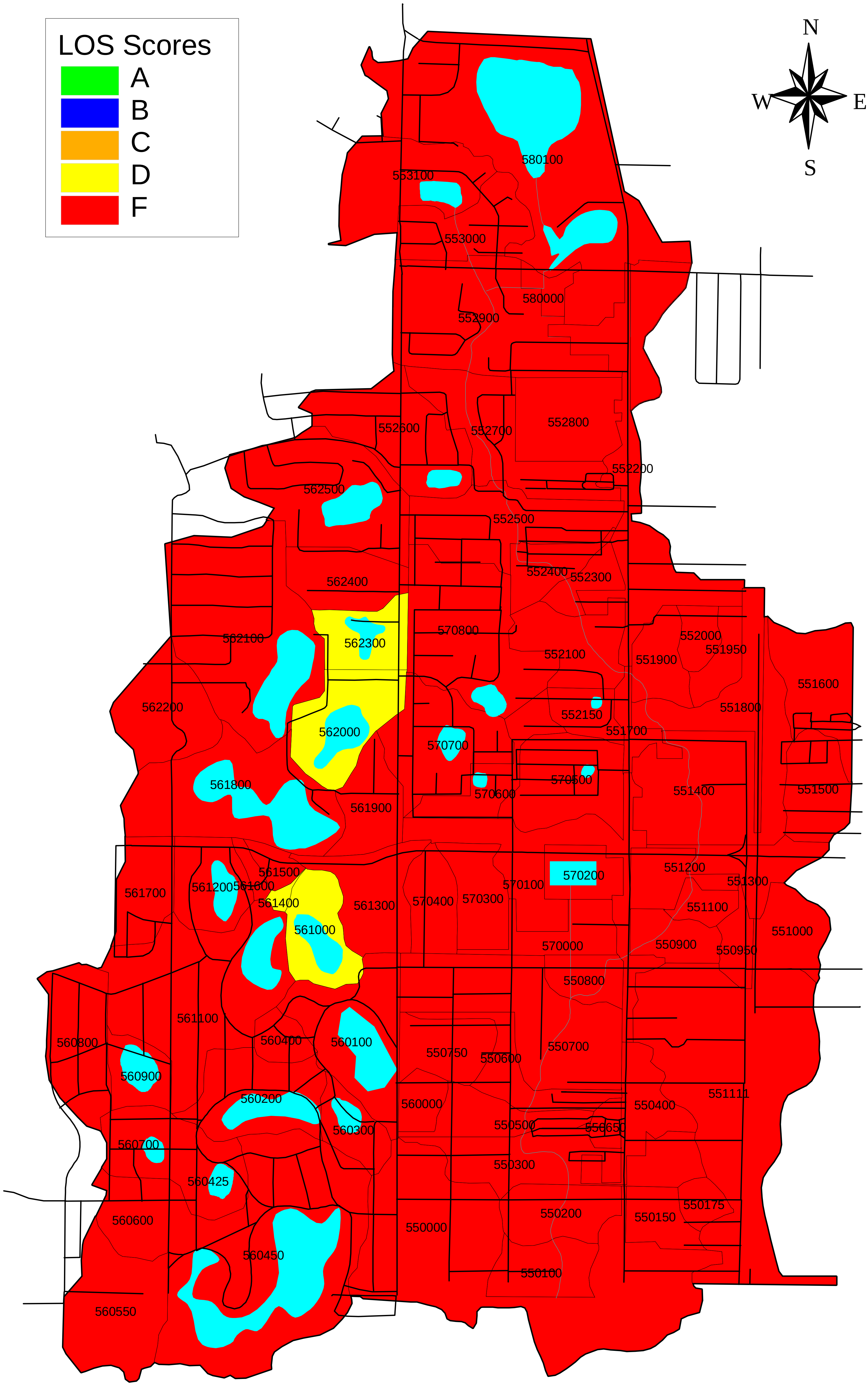

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Figure 11-2. Existing Water Quality Treatment LOS for Total Nitrogen

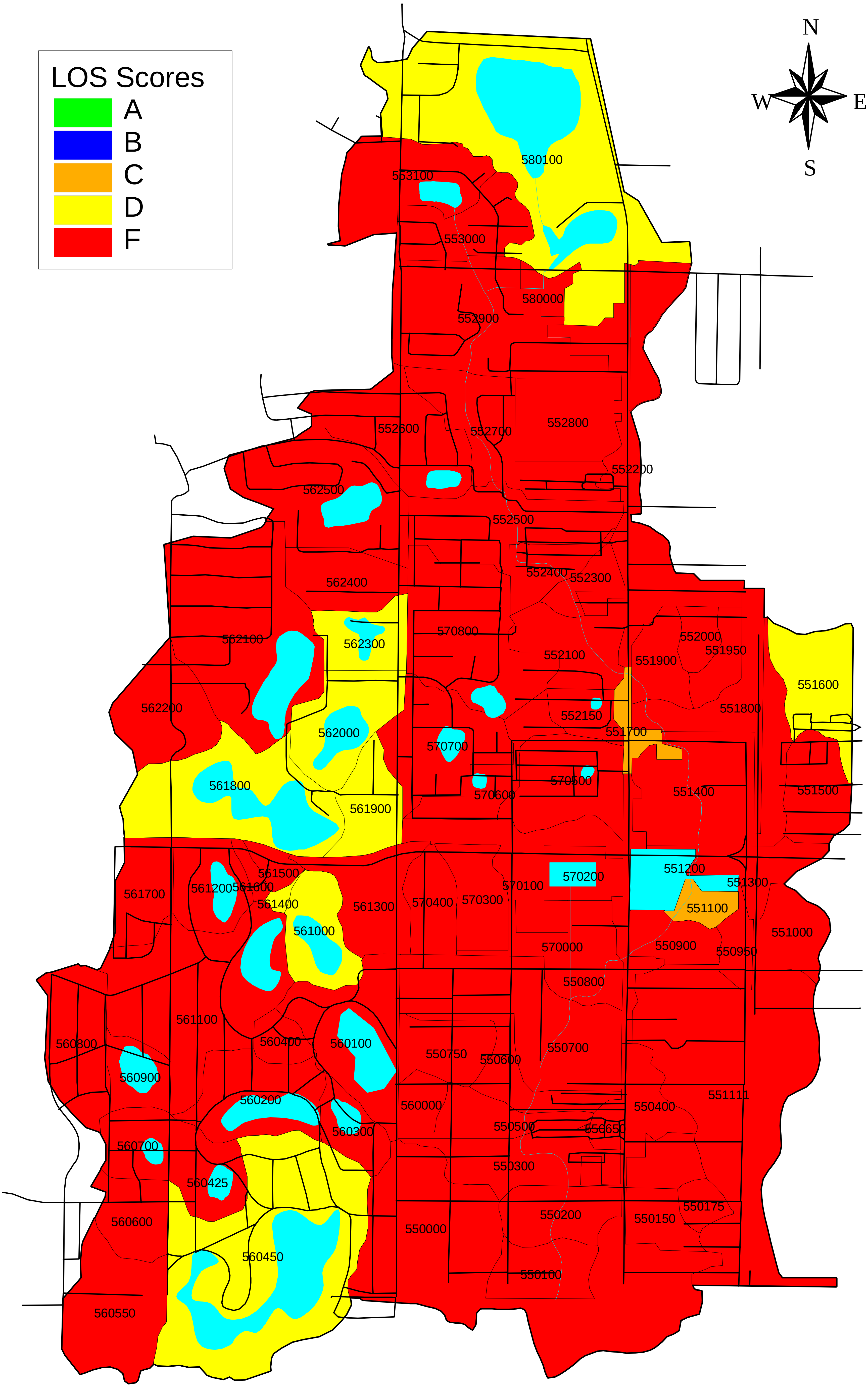

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Figure 11-3. Existing Water Quality Treatment LOS for Total Suspended Solids

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Tampa Bay National Estuary Program. 1996. Charting the Course for Tampa Bay -- Comprehensive Conservation and Management Plan. Tampa Bay National Estuary Program, St. Petersburg.

CHAPTER 12
PUBLIC MEETING

On September 23, 1999, the First Public Meeting was held in the Media Center of Buchanan Middle School (Hillsborough County, Florida). The meeting began at approximately 6:00 p.m. EDT and ended at approximately 9:00 p.m. EDT.

The stated purpose of the meeting was to share collected data on the Curiosity Creek Watershed with the interested or affected public. Additional purposes included informing the public on the nature and extent of this project and the public involvement program.

The meeting format was informal. Displays were set up that consisted of maps and figures depicting the state of knowledge of the existing conditions in the watersheds (as of the date of the public meeting). One of the illustrations included "reported problem areas" and the public were encouraged to examine that figure and to add to or recommend changes in the location of problem (predominantly, flooding) areas. A continuously running audiovisual display was provided to summarize the entire project scope of services and to explain what was happening at the first public meeting as well as to describe the general design of the remaining public involvement program. Little specific watershed data was given in the audiovisual display, in preference to illustrating the data on the figures and displays. Some related displays were included in the meeting area, including a display by the Blue Sink/Curiosity Creek Coalition and the Adopt-a-pond/Lake Watch program.

Handout information included data on the project, how to contact project officials, and how to submit comments. Public comments were recorded by project staff at the meeting, as impromptu, anecdotal comments. The public were encouraged to submit written comments either in person at the meeting, or by mail, facsimile, or electronic mail afterwards. Comments were accepted and are reported in the following table through November 2, 1999.

While the comments are summarized in the following table, all comment sheets were copied and circulated among the project staff so that they could make their own evaluation and interpretation. Copies of all comment sheets were retained in the project files.

A total of 126 attendees signed in on forms provided to document attendance at the First Public Meeting. A total of 34 narrative comments were received. The narrative comments are summarized in the following table. The comments are grouped into two subdivisions: suggestions for changes to Curiosity Creek system; and, conditions and observations about the Curiosity Creek system.

Curiosity Creek Watershed Plan	
First Public Meeting – September 23, 1999 at Buchanan Middle School, 6:00-9:00 P.M.	
Public Comments Summary	
Total number of attendees (names signed on attendance sheets)	*126*
Total number of unique written comment sheets as of 11/02/1999	*34*
General description or category of comment	number of
	times stated
Suggestions for Changes to Curiosity Creek System	
need to do something about flooding	17
need to clear and clean creek	9
need to excavate or open up ditch (creek)	5
add or improve off-line retention/detention areas	3
do not take water from Lake Magdalene or Sweetwater Creek system for Curiosity Creek	2
include Lake Magdalene or Sweetwater Creek system in Curiosity Creek	2
need to open up Blue Sink	2
revegetate areas near channel with native vegetation	2
add vegetated littoral zones along channel	1
coordinate this study with COT's	1
piping of water from east of I-275 causing flooding	1
provide for additional flow in Curiosity Creek by pumped augmentation	1
reestablish entire Curiosity Creek to Hillsborough River (i.e., "old" channel)	1
should include COT, Blue Sink and Sulphur Springs in this study	1
use prision labor to keep clean	1
want to volunteer for channel clean-up work	1
Conditions and Observations About the Curiosity Creek System	
problem with mosquitos & insects	6
problem with overgrown with weeds	6
problem with rubish and debris	6
problem with foul odor from creek	5
water flow has been cut off, need to restore flow in creek	5
problem with snakes & rats	4
lack of development controls in watershed causing flooding	3
poor water quality or appearance	3
condition of creek affecting property values or opportunity to sell	2
improperly designed, constructed, or operated stormwater management systems	1
lack of flood control causing property owner to have to purchase flood insurance	1
public safety in or near creek	1
too many studies not enough action	1
waste of potential water source	1

CHAPTER 13

ALTERNATIVES ANALYSIS

13.1 INTRODUCTION

This chapter describes a series of alternatives that were developed for flooding, water quality, natural systems, and, if applicable, water supply issues that were identified in Chapters 2-11. In addition, issues and alternatives that were suggested by the public during meetings held within the watershed in September and November 1999 are also discussed. In order to evaluate alternatives on an individual project basis, a decision matrix was developed to rank each project based on its positive and negative impacts for flood control, water quality, natural systems, water supply, public acceptance, feasibility, and cost.

This chapter also describes the existing conditions performance of the major conveyance systems with potential and documented flood level of protection deficiencies as well as level of service deficiencies for water quality. Potential flooding problem areas for the existing condition as presented in Chapter 6 will be discussed according to the major conveyance systems in the study area. These conveyance systems are as follows:

- The Northwest Lake System
- The Curiosity Creek Main Channel
- The Forest Hills Basin

The problem areas have been identified by analyzing the results of model simulations (quality and quantity) for the existing conditions with respect to the County's adopted flood level of service criteria (LOS). Known flooding and water quality problems in the study area were also evaluated based on a review of complaint information compiled from Hillsborough County staff and from public meetings. The model results of the existing conditions and the flooding complaint records were identified and combined to create a set of LOS deficiencies that were to be addressed in the Curiosity Creek Watershed Management Plan. Also, maintenance needs were identified from field observations of the primary drainage system and incorporated into the master plan development.

Alternatives designed to address the LOS deficiencies were then developed for each problem area. These alternatives include structural and non-structural improvements as well as maintenance needs. Cost estimates were developed for each alternative and included in a matrix which ranked all the alternatives.

All alternatives were developed within the following constraints: 1) the Curiosity Creek watershed does not have a surface discharge and 2) the watershed is a closed system. The stormwater discharge permit regulations within the Curiosity Creek Watershed were considered to be volume sensitive, and follow the requirements for the criteria for a closed drainage basin. This was an anticipated permit requirement in the development of the alternatives. This is because the Curiosity Creek system terminates in the City of Tampa and all stormwater discharge into the City's system is conveyed out by mechanical means (i.e. pumping). Therefore, all alternatives must not cause an increase in the rate or volume of runoff.

The locations of the proposed alternatives are shown in Figure 13-1.

13.2 THE NORTHWEST LAKE SYSTEM

13.2.1 Unnamed Lake (Basin 560800) and Lake Sophia (Basin 560900)

<u>Flooding LOS Deficiency</u>

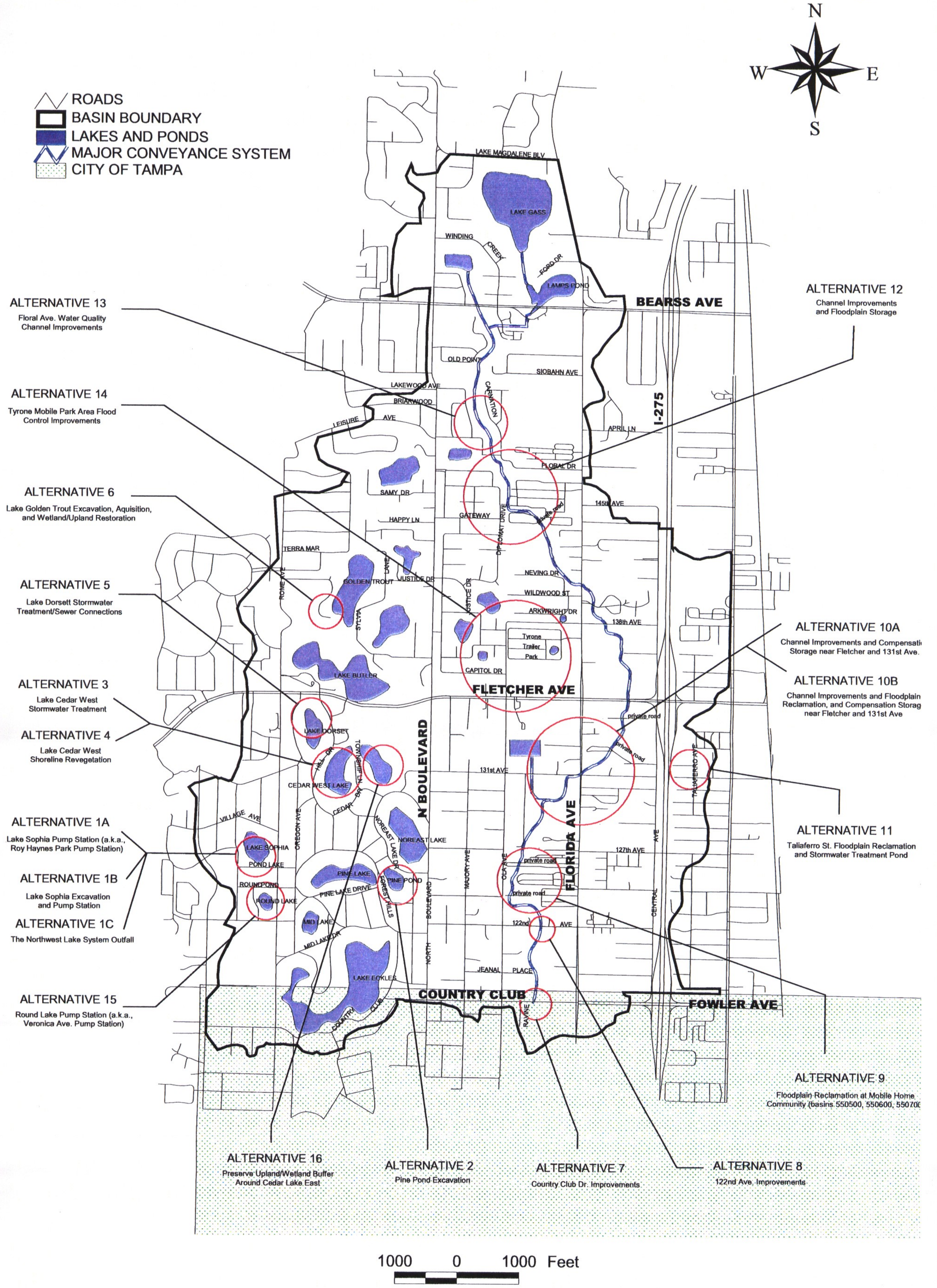
Existing Condition LOS-D. The 25 year design event is expected to overtop Oakleaf Drive by approximately 4 to 5 inches. Excess flood water is anticipated to discharge from this small lake over the road and toward Lake Sophia through residential property. Site flooding is expected to a depth of approximately 2.3 feet in the rear yards of the properties adjacent to the Unnamed Lake. House flooding is a potential at 2 to 3 homes, although finished floor elevations have not been established. There is no documentation of flooding associated with the unnamed lake in Basin 560800. Lake Sophia is the lake that is east of Basin 560800. Lake Sophia is expected to overtop Rome Avenue (lowest adjacent road), but to a depth of less than 1 inch. The County park site within this basin has a history of flooding for extended lengths of time. The Hillsborough County West Service Unit reported that they have performed pumping operations on this lake on a seasonal basis to alleviate flooding on Pond Lake Avenue (the east-west road south of the lake) even though the aerial contour estimates this road to be higher than Rome Avenue. Excess floodwater is anticipated to flood the County park (Roy Haynes Park) as well as residential back yards to a depth of approximately 1.5 feet. House flooding is a potential at 2 to 3 homes, although finished floor elevations have not been established.

<u>Water Quality LOS Deficiency</u>

Based on pollutant loading modeling, these urbanized basins are designated as LOS-F and have a high potential as a source of pollutants and increased runoff. These basins also receive little to no stormwater treatment and the existing lake systems function as the primary catchment basins for excess runoff. Currently no data exists to evaluate existing water quality in the unnamed lake or Lake Sophia nor the effects that stormwater runoff may be having on trophic conditions. However, based on estimated pollutant loads for residential land uses, improvements in stormwater treatment for this area should result in improved water quality over time.

<u>Natural Systems Deficiency</u>

This basin also has little remaining natural habitat except for the existing herbaceous wetland habitat along the shoreline around Lake Sophia and scattered patches of upland forest within the existing residential neighborhoods.



HILLSBOROUGH COUNTY FLORIDA

CURIOSITY CREEK WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES CORP.

FIGURE 13-1

ALTERNATIVES LOCATION MAP

Alternatives-

Alternative 1A-Construct a Pump Station on Lake Sophia to Discharge to Lake Noreast. Construct High Overflow System From the Unnamed Lake to Lake Sophia.

Water Quantity Issues

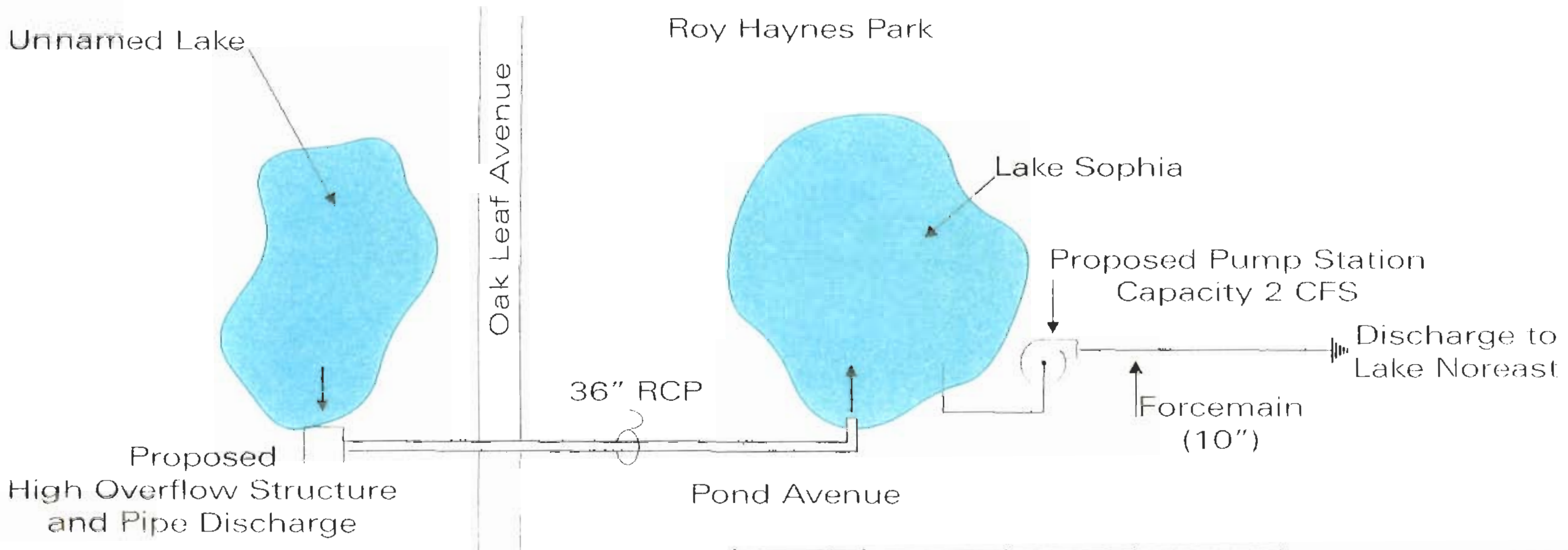
The flooding potential at Basin 560800 (Unnamed lake) and at Basin 560900 (Lake Sophia) are interrelated because the excess floodwater from the unnamed lake is expected to sheetflow to Lake Sophia during the design event. Increasing the volume capacity at Lake Sophia can be accomplished by controlling the initial water surface elevation with a pump station. This action would preserve the lake volume for higher intensity storm events. The excess volume discharged from the unnamed lake can be prevented from sheetflowing to Lake Sophia by utilizing an inlet and pipe system to deliver the excess volume to Lake Sophia in a controlled manner.

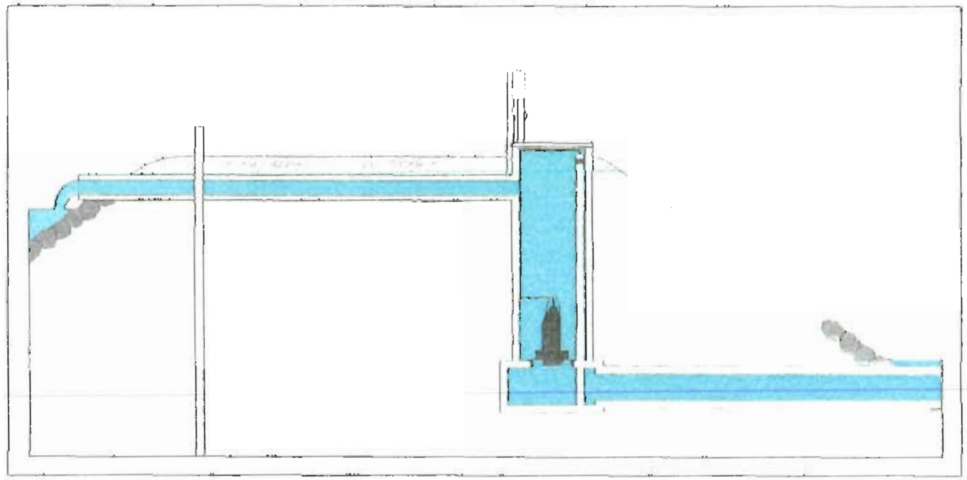
It should be noted that Pine Lake is much closer to Lake Sophia than Lake Noreast but was not considered as a potential outfall. This is due to the closed basin nature of Pine Lake (i.e. Pine Lake has no outfall). Discharging volume to Pine Lake has the potential of raising water surface elevations on that lake.

A pump station would maintain Lake Sophia at a maximum level of 41.30, which would preserve storage and increase the LOS to C. It has yet to be determined through scientific means if this maximum elevation is advisable from an environmental standpoint. With the initial water surface elevation of Lake Sophia simulated at elevation 41.30 it is anticipated that Pond Lake Avenue and Rome Avenue would not be overtopped. However, rear yard flooding is still expected. Structure flooding based on the SWFWMD contour aerials is also not expected, although finished floor elevations have not been established by a recent survey. The capacity of the pump station was simulated at 2.0 cfs and is expected to completely recover the volume from the design event in approximately 100 hours with the water surface lowered by 2 feet in approximately 42 hours. The control elevation on the unnamed lake was simulated with a 14.0 foot weir at elevation 50.10. This weir would discharge through a 36 RCP to Lake Sophia. The initial water surface elevation of this lake was simulated at elevation 46.20, which corresponds to the existing condition water surface elevation.

The high overflow outlet (weir at elevation 50.10) at the unnamed lake (Basin 560800) would have no effect on the LOS designation (D), but is expected to prevent Oakleaf Drive from becoming overtopped as excess floodwater would be discharged to Lake Sophia through the proposed high over flow system. Yard flooding is still expected. Structure flooding based on the SWFWMD contour aerials is still a potential; although finished floor elevations have not been established by a recent survey.

It must be remembered that the Curiosity Creek Watershed does not have a surface discharge and is a closed system. This closed system terminates in the City of Tampa, and all stormwater discharge into the retention system of the City is recovered by mechanical means. Therefore, the storm volume collected in Lake Sophia can only be discharged to Lake Noreast when the City of Tampa is in a position to accept the additional volume. In other words, the pump station at Lake





PUMP STATION CROSS SECTION

	PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION STORMWATER MANAGEMENT SECTION	CURIOSITY CREEK ALTERNATIVE 1-A SCHEMATIC
	KISINGER CAMPO & ASSOCIATES CORP.	PUMP STATION ON LAKE SOPHIA WITH HIGH OVERFLOW FROM UNNAMED LAKE

Sophia should not be operated until the City of Tampa has determined that there is no threat from flooding.

Alternative 1A			
Description	Basin Number	Existing Elev. 25-yr	Proposed Elev. 25-yr
	560800	51.9	51.2
Lake Sophia	560900	48.6	47.9

Water Quality/Natural Systems Issues

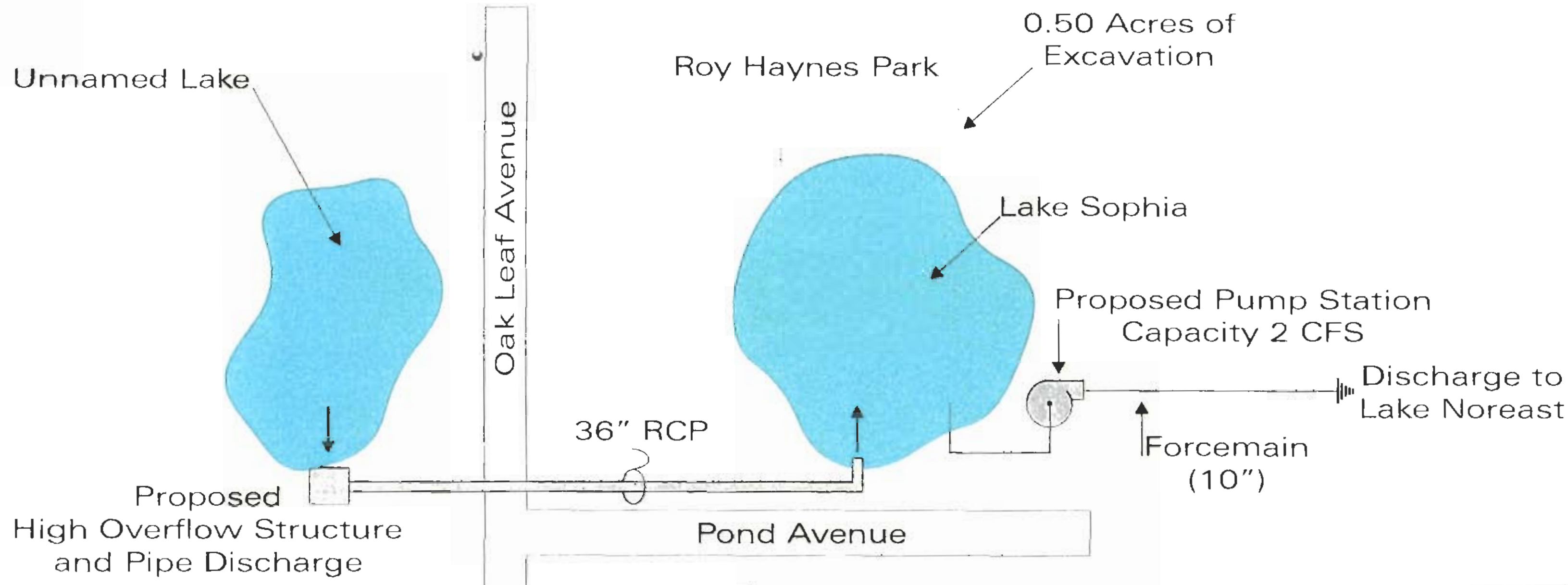
No significant water quality or natural systems improvements are anticipated with this alternative. However, the intake and outfall structures for this and other pump stations identified in this plan should be located in such a manner as to avoid disturbing bottom sediments in any of the lake systems. Nutrients, metals, and other pollutants (including pathogens) are often bound to sediments and could easily be transferred between lakes or transported downstream to Curiosity Creek if sediments are resuspended as a result of pumping activities. Nutrients may also be released into the water column if sediments are resuspended which could result in algal blooms.

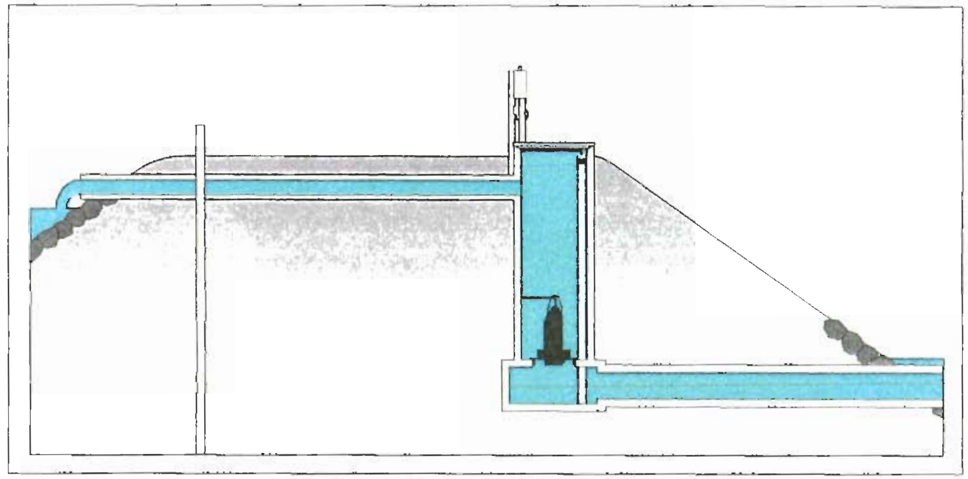
Alternative 1B- Provide Additional Volume at Lake Sophia by the Excavation of 0.5 Acres Adjacent to the Lake. Construct a Pump Station on Lake Sophia to Discharge to Lake Noreast. Construct a High Overflow System From the Unnamed Lake to Lake Sophia

Water Quantity Issues

Increasing the volume capacity at Lake Sophia can be accomplished by controlling the initial water surface elevation with a pump station. This action would preserve the lake volume for higher intensity storm events. The initial water surface elevation of the lake was simulated at elevation 41.30. Additional volume can be obtained by excavating approximately 0.5 acres adjacent to the Lake below elevation 47.0 which would be needed to raise the LOS to A. Some open space is potentially available at Roy Haynes Park and along the northeast side of the Lake. The additional volume gained in Lake Sophia would also be utilized by the unnamed lake to increase the LOS in that basin. A high overflow consisting of an inlet and pipe system would be used to transfer excess volume from the unnamed lake to Lake Sophia at an elevation that would increase the designated LOS to A. The capacity of the pump station was simulated at 2.0 cfs and is expected to completely recover the volume from the design event in approximately 100 hours with the water surface lowered by 2 feet in approximately 42 hours. The control elevation on the unnamed lake was simulated with a 14.0 foot weir at elevation 48.80. This weir would discharge through a 36 RCP to Lake Sophia. The initial water surface elevation of this lake was simulated at elevation 46.20, which corresponds to the existing condition water surface elevation

It must be remembered that the Curiosity Creek Watershed does not have a surface discharge and is a closed system. This closed system terminates in the City of Tampa, and all stormwater





PUMP STATION CROSS SECTION

PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
STORMWATER MANAGEMENT SECTION

KISINGER CAMPO & ASSOCIATES CORP.

CURIOSITY CREEK
ALTERNATIVE 1-B SCHEMATIC

PUMP STATION ON LAKE SOPHIA
WITH HIGH OVERFLOW FROM
UNNAMED LAKE

discharge into the retention system of the City is recovered by mechanical means. Therefore, the storm volume collected in Lake Sophia can only be discharged to Lake Noreast when the City of Tampa is in a position to accept the additional volume. In other words, the pump station at Lake Sophia should not be operated until the City of Tampa has determined that there is no threat from flooding.

Alternative 1B			
Description	Basin Number	Existing Elev. 25-yr	Proposed Elev. 25-yr
	560800	51.9	49.9
Lake Sophia	560900	48.6	47.5

Water Quality/Natural Systems Issues

In concert with the excavation of additional volume at Lake Sophia, water quality could be improved by creating vegetated littoral zones in the excavated area to provide pollutant (nutrient) uptake. The creation of wetland habitat would also provide habitat for wildlife such as wading birds and juvenile fish.

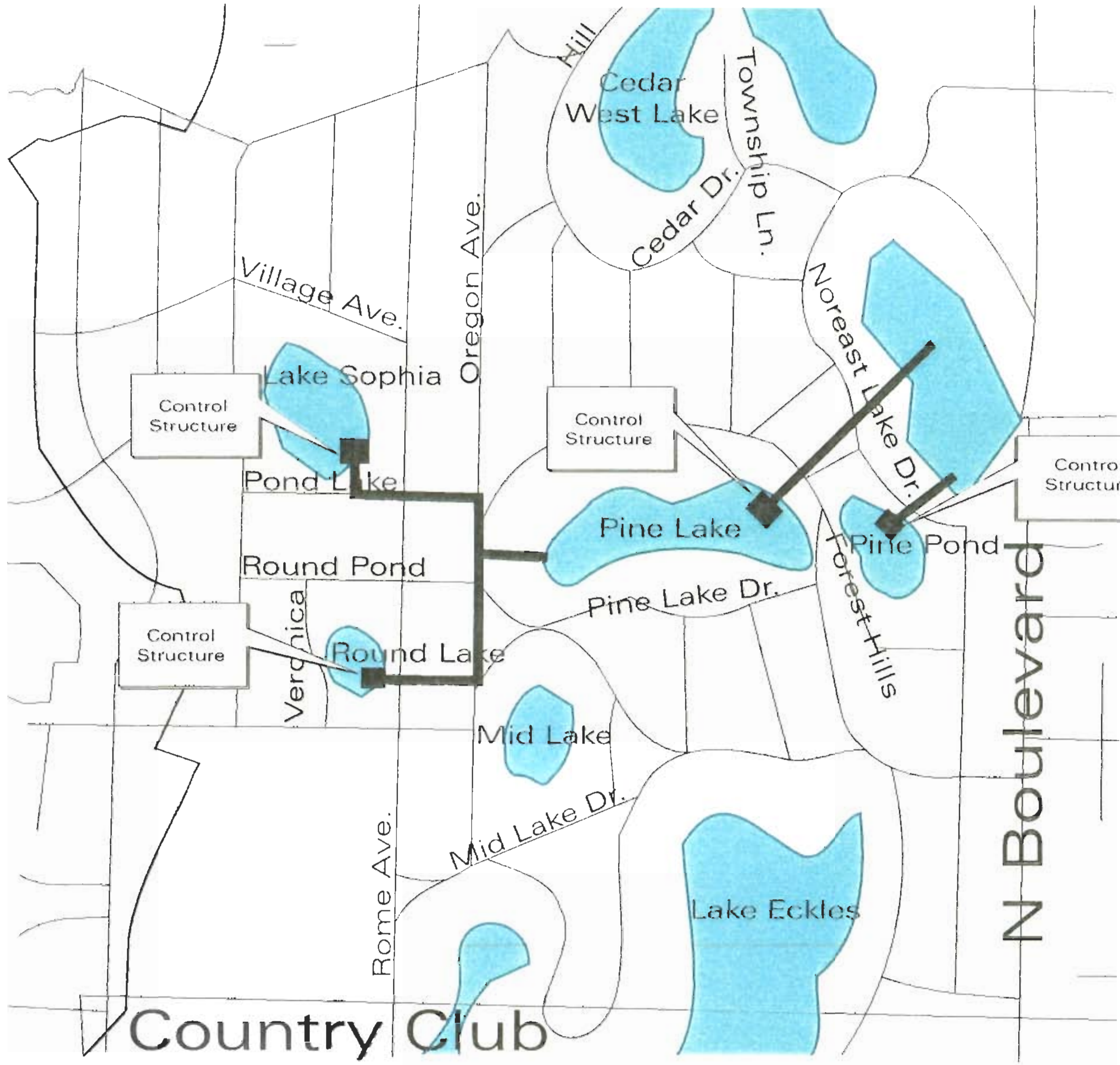
Alternative 1C- Provide Additional Volume at Lake Sophia by Inter-Connecting Lake Sophia, Round Lake, and Pine Lake with a Pipe Network and Operable Control Structures. In Addition, Construct an Operable Control Structure on Pine Pond. The Outfall for the Proposed Gravity Systems is Lake Noreast. Construct a High Overflow System From the Unnamed Lake to Lake Sophia.

NOTE: This alternative was investigated at the specific request of the Hillsborough County Stormwater Management Section, Department of Public Works.

Water Quantity Issues

Increasing the volume capacity at Lake Sophia can be accomplished by controlling the initial water surface elevation with an operable control structure. This action would preserve the lake volume for higher intensity storm events. The initial water surface elevation of the lake was simulated at elevation 41.30. The LOS of the Basin containing Lake Sophia would be raised to a C with no anticipated road flooding. A high overflow consisting of an inlet and pipe system (same configuration as alternative 1A) would be used to transfer excess volume from the unnamed lake to Lake Sophia. Round Lake would also be fitted with an operable control structure. The discharge from Lake Sophia and Round Lake would be delivered to Pine Lake. Pine Pond would be fitted with a control structure as well and would also deliver discharge to Lake Noreast.

Simulations were performed to determine what would be the maximum amount of flow that could be delivered through the interconnected lake system and not cause an adverse impact to the receiving lakes namely Pine Lake and Lake Noreast. The results of the simulation are as follows:



PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
STORMWATER MANAGEMENT SECTION

KISINGER CAMPO & ASSOCIATES CORP.

CURIOSITY CREEK
ALTERNATIVE 1-C

THE NORTHWEST LAKE
SYSTEM OUTFALL

Summary of Gravity System Outfall Simulations The Northwest Lake System Outfall 25 year 24-hour Conditions								
Name	Basin #	Existing Cond. Initial WS Elev	Proposed Initial WS Elev.	Control Elev.	Peak Q At Control Gates	25 yr Exist WS Elev.	25 yr Post WS Elev.	Recovery Time (HRS)
Unamed Lake	560800	46.2	46.2	50.1	N/A	51.8	51.1	N/A
Lake Sophia	560900	44.2	41.3	41.3	26	48.5	48.0	72
Round Lake	560700	43.7	40.8	40.8	22	49.0	47.9	48
Pine Lake	560200	36.8	36.0	36.0	17	38.1	37.4	60
Lake Noreast	560100	34.2	34.2	N/A	N/A	35.9	35.9	42
Pine Pond	560300	34.6	34.1	34.1	4	37.8	37.4	80+

Discharging the lake system into Lake Noreast has the potential to raise the water surface elevation. Therefore, the time at which the water is discharged is critical. Lake Noreast must be allowed to recover to at least **elevation 35.0** before the discharges in the table can be released. If Lake Noreast receives the above lake discharges upon recovering to elevation 35.00, the lake will **rise** to elevation **35.8** which is below the peak 25 year existing condition elevation of **35.9**. It was assumed that elevation 35.9 on Lake Noreast was an elevation that does not adversely impact any properties. It should also be noted that Pine Pond may at times be lower in elevation than Lake Noreast. Operation of the Pine Pond structure would have to take this potential into account to prevent a reverse flow condition.

Recovery time was estimated without considering baseflow. It was also assumed that the watershed (with the exception of the above mentioned lakes) had recovered to initial conditions, prior to the release of stormwater volume from the proposed system described in Alternative C.

Meetings with the City of Tampa indicated that the lake system could be discharged at a maximum rate of 5 cfs if the City of Tampa was in a position to accept the runoff. The recovery simulations indicated that approximately 17 cfs could be delivered to Lake Noreast under the restrictions mentioned. However, further analysis of conditions within the City should be made to determine if the maximum discharge to Lake Noreast would be tolerable within the City of Tampa. Reducing the discharge from the lakes would increase the recovery time needed. This configuration of operable gates would have to be operated “in concert” with one another so that Pine Lake would not become flooded with the stormwater discharged from Lake Sophia and Round Lake. The City of Tampa and Hillsborough County would have to coordinate efforts to recover the lakes mentioned. Volume recovery could only take place a time when the City of Tampa was in a position to accept the additional volume without causing an adverse impact.

Water Quality Issues

The primary water quality issue for this alternative is related to the transfer of water from the western lake systems into Lake Noreast. Currently no data exists to evaluate existing water quality in Lake Noreast, Pine Pond, the unnamed lake, or Lake Sophia. Depending on the differences in pollutant concentrations in these various lake systems, transport of water and measurable pollutant loads may occur with the interconnection of these aquatic systems. This transfer could result in the degradation of downstream receiving waterbodies (Lake Noreast, Curiosity Creek, Blue Sink) either through hypereutrophication from excess nutrient loads or potential health risks associated with heavy metals, pesticides, or bacteria (pathogens). If substantial pollutant loads would be transferred to more pristine waterbodies, pretreatment may be necessary (e.g., using alum flocculation) prior to discharge to downstream waterbodies. Additional data collection will be necessary to fully evaluate the effects of connecting these lakes for both planning and permitting purposes.

No significant natural systems improvements are anticipated with this alternative.

13.2.2 Pine Pond (Basin 560300)

Flooding LOS Deficiency

Existing Condition LOS-C. The 25 year design event is not expected to overtop any adjacent roadways. The Hillsborough County West Service Unit reported that they have performed pumping operations on Pine Pond only twice in recent record and then only as an emergency action authorized by the Board of County Commissioners to alleviate the potential flooding at one residence. A resident who lives on the north side of the lake reported yard flooding and sandbagged their home during the El Nino storms of 1997-1998, this was confirmed by the maintenance unit. Excess floodwater is anticipated to inundate residential back yards to a depth of approximately 1.5 feet. House flooding is not expected based on the 1982 study on Curiosity Creek by Reynolds Smith and Hills that estimated the lowest floor to be above the 25 year flood elevation, but it is not known to which house this elevation should be applied.

Water Quality LOS Deficiency

Based on pollutant loading modeling, this urbanized basin is designated as LOS-F and has a high potential as a source of pollutants and increased runoff. This basin also receives little to no stormwater treatment with the existing pond functioning as a catchment basin for excess runoff. Currently no data exists to evaluate existing water quality in Pine Pond nor the effects that stormwater runoff may be having on trophic conditions. However, water quality in nearby lakes with similar land uses have some of the highest TSI values for the watershed. Based on estimated pollutant loads for residential land uses, improvements in stormwater treatment for this area should result in improved water quality over time.

Natural Systems Deficiency

This basin also has little remaining natural habitat except for the existing herbaceous wetland habitat along the shoreline around Pine Pond and scattered patches of upland forest within the existing residential neighborhoods.

Alternatives-

Alternative 2- Excavate Additional Volume at Pine Pond

Water Quantity Issues

Additional volume can be obtained by excavating a portion of vacant land adjacent to Pine Pond. Simulations indicated that approximately 0.26 acres of land adjacent to the Pond below elevation 39.0 would need to be excavated to raise the LOS to A. There appears to be one lot left that fronts the lake. Acquisition of this area adjacent to the lake would serve two purposes. The area could be excavated to increase the volume of Pine Pond and thus raise the LOS to A. The second is that the location of the area is at or very near to the location of the natural basin overflow of the lake. This natural pop-off elevation of the lake should be preserved. Construction activity in this area if not carefully monitored may artificially increase the lakes overbank elevation (connection from Pine Pond to Lake Noreast) as it is a common practice to place fill material on residential lots. Raising the pop-off elevation could increase the design storm elevation and decrease the LOS.

Alternative 2			
Description	Basin Number	Existing Elev. 25-yr	Proposed Elev. 25-yr
Pine Pond	560300	37.8	37.5

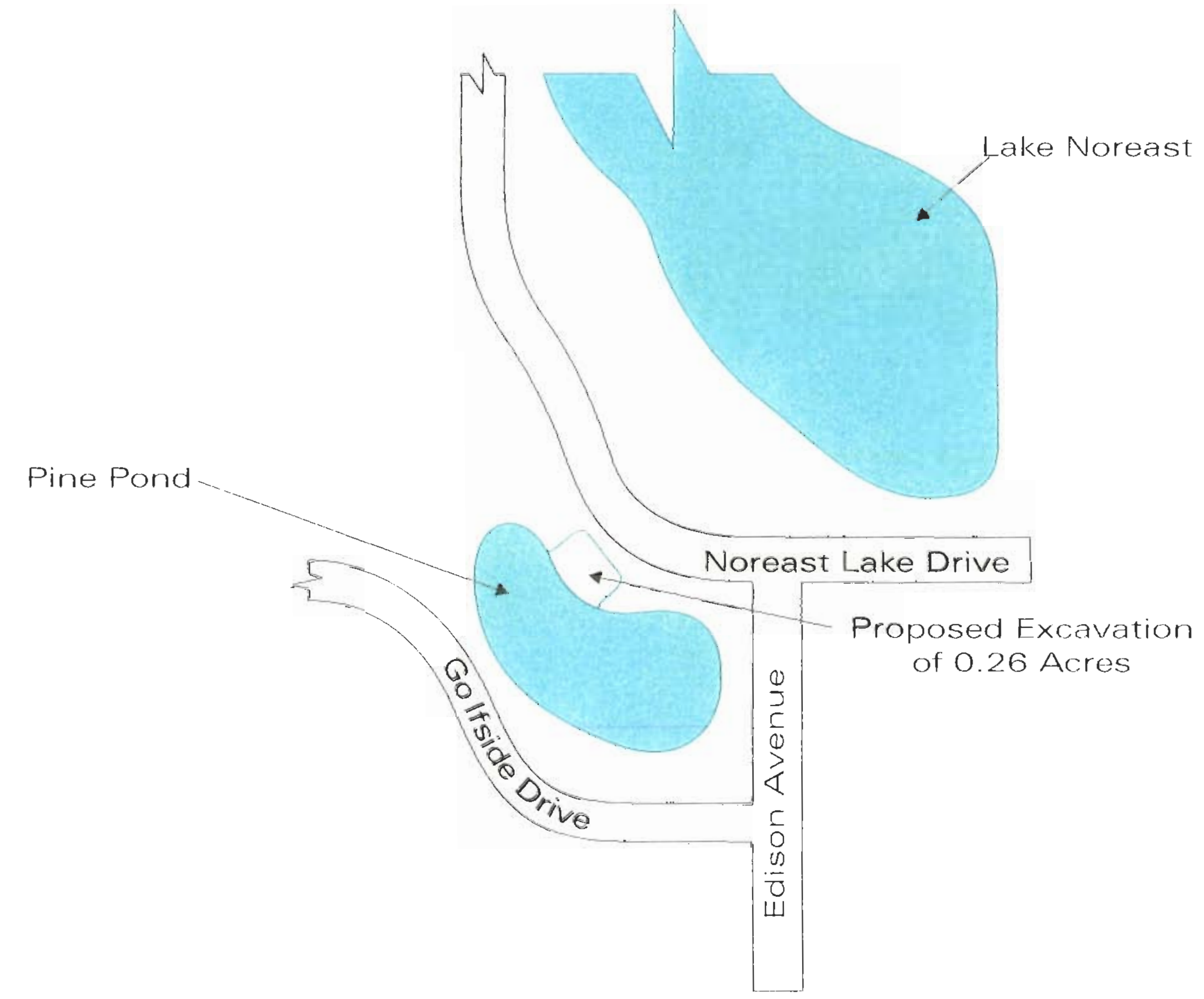
Water Quality/Natural Systems Issues

In concert with the excavation of additional volume at Pine Pond, water quality could be improved by creating vegetated littoral zones in the excavated area to provide pollutant (nutrient) uptake. The creation of wetland habitat would also provide habitat for wildlife such as wading birds and juvenile fish. The existing vacant lot that would be used for this proposed alternative is currently colonized by several large trees and herbaceous wetlands along the shoreline. Mitigation for the loss of the existing wetland system may be required by permitting agencies.

13.2.3 Lake Cedar West (Basin 561100)

Water Quality LOS Deficiency

Based on pollutant loading modeling, this urbanized basin is designated as LOS-F and has a high potential as a source of pollutants and increased runoff. This basin also receives little to no stormwater treatment with the existing lake functioning as a catchment basin for excess runoff. Water quality data for Lake Cedar West indicates that this system is becoming a phytoplankton-dominated system due to the loss of shoreline vegetation and, possibly, nutrient loading from residential runoff.



PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
STORMWATER MANAGEMENT SECTION

KISINGER CAMPO & ASSOCIATES CORP.

CURIOSITY CREEK
ALTERNATIVE 2

EXCAVATION OF ADDITIONAL
VOLUME ON PINE POND

Natural Systems Deficiency

This basin also has little remaining natural habitat except scattered patches of upland forest within the existing residential neighborhoods. Much of the herbaceous wetland habitat that historically occurred along the shoreline of Lake Cedar West has been denuded by lake-front residents.

Alternatives-

Alternative 3- Construct Stormwater Treatment Ponds/Structures at Lake Cedar West

Water Quality/Natural Systems Issues

If land were available, stormwater treatment ponds could be constructed at strategic locations to intercept residential/roadway runoff prior to entering Lake Cedar West. However, this area is nearly completely developed and so lack of available land may preclude any attempts at implementing wet detention ponds/sumps that require relatively large surface areas. Smaller structural treatment systems such as baffle boxes or vortex settling units (CDS units) could be installed within the existing drainage system, however, these systems typically are not as efficient as alum treatment or wet detention ponds for the removal of dissolved nutrients such as phosphorus. Acquisition of land for wet detention ponds would require the purchase of either vacant lots or residential homes adjacent to Lake Cedar West.

Alternative 4- Encourage Revegetation of Lake Cedar West Shoreline

Water Quality/Natural Systems Issues

Based on analyses performed in Chapter 7 of this report, loss of shoreline vegetation appears to be highly correlated with poor water quality and greater trophic state indices for lakes in the Curiosity Creek watershed. Replanting of the Lake Cedar West shoreline may result in shifting the trophic structure of the lake from a phytoplankton-dominated system to an emergent/submerged aquatic plant dominated system. Aquatic plants can remove significant amounts of nutrients from the water column, provide fish and wildlife habitat, and can be aesthetically enhancing to lakefront homeowners if properly maintained. Community grants, homeowner's associations or volunteer programs such as LaMP could assist in the purchase/installation of plants for the lake's shoreline.

13.2.4 Lake Dorsett (Basin 561200)

Flooding LOS Deficiency

Existing Condition LOS-C. The 25 year design event is not expected to overtop any adjacent roadways. This basin has been assigned a LOS designation of C based on residential reports of rear yard flooding. The computer simulation model could not be accurately extended to this lake/basin because of the lack of survey data. House flooding is not expected although recent finished floor elevations have not been established. Until accurate survey of the hydraulic connection between this lake and the outfall system can be obtained, a meaningful flood analysis cannot be made.

Water Quality LOS Deficiency

Based on pollutant loading modeling, this urbanized basin is designated as LOS-F and has a high potential as a source of pollutants and increased runoff. This basin also receives little to no stormwater treatment with the existing lake functioning as a catchment basin for excess runoff. Several homes surrounding the lake utilize septic tanks for on-site wastewater disposal. Considering the reported septic tank problems reported by residents, a high probability exists that these systems may be failing (i.e., drainfields inundated) during high water conditions. Unfortunately, no data exists to evaluate existing water quality in Lake Dorsett nor the effects that either septic tanks or stormwater runoff may be having on lake water quality. However, based on estimated pollutant loads for residential land uses and known adverse public health impacts associated with failing septic tanks, improvements in stormwater treatment and wastewater disposal for this area should result in improved water quality over time.

Natural Systems Deficiency

This basin also has little remaining natural habitat except for the existing herbaceous wetland habitat along the shoreline around Lake Dorsett and scattered patches of upland forest within the existing residential neighborhoods. A small park west of Lake Dorsett contains patchy pine forest and poor quality natural and created herbaceous wetlands.

Alternatives-

Alternative 5- Construct Stormwater Treatment Ponds/Structures at Lake Dorsett and/or Connect Affected Residential Homes to City Sewer Service

Water Quantity Issues

No significant water quantity systems improvements are anticipated with this alternative.

Water Quality/Natural Systems Issues

If land were available, stormwater treatment ponds could be constructed at strategic locations to intercept residential/roadway runoff prior to entering Lake Dorsett. However, this area is nearly completely developed and so lack of available land may preclude any attempts at implementing wet detention ponds/sumps that require relatively large surface areas. Smaller structural treatment systems such as baffle boxes or vortex settling units (CDS units) could be installed within the existing drainage system, however, these systems typically are not as efficient as wet detention ponds for the removal of dissolved nutrients such as phosphorus. Acquisition of land for wet detention ponds would require the purchase of existing residential homes adjacent to Lake Dorsett. Connecting affected residential homes to City sewer service could eliminate future complaints related to septic tank failures, however, both initial and future costs for this alternative may be prohibitive. Additional data collection will be necessary to develop specific alternatives for this subbasin.

13.2.5 Lake Golden Trout (Basin 562100)

Flooding LOS Deficiency

Existing Condition LOS-C. The 25 year design event is expected to overtop the intersection of Sylvia Lane and Justice Drive. The intersection is expected to be flooded to a maximum depth of approximately 6 inches. Excess floodwater is anticipated to inundate residential back yards to a depth of approximately 10 inches. House flooding is not expected, although recent finished floor elevations have not been established.

Water Quality LOS Deficiency

Based on pollutant loading modeling, this urbanized basin is designated as LOS-F and has a high potential as a source of pollutants and increased runoff. This basin also receives little to no stormwater treatment with the existing lake functioning as a catchment basin for excess runoff. Currently no data exists to evaluate existing water quality in Lake Golden Trout nor the effects that stormwater runoff may be having on trophic conditions. Water quality data has been collected for an adjacent lake (Lake Turtle) which had relatively good (low TSI) water quality compared to other lakes in the watershed. However, due to the close proximity of residential land uses and associated runoff, Lake Golden Trout may be more susceptible to pollutant loading than Lake Turtle. Based on estimated pollutant loads for residential land uses, improvements in stormwater treatment for this area should result in improved water quality over time.

Natural Systems Deficiency

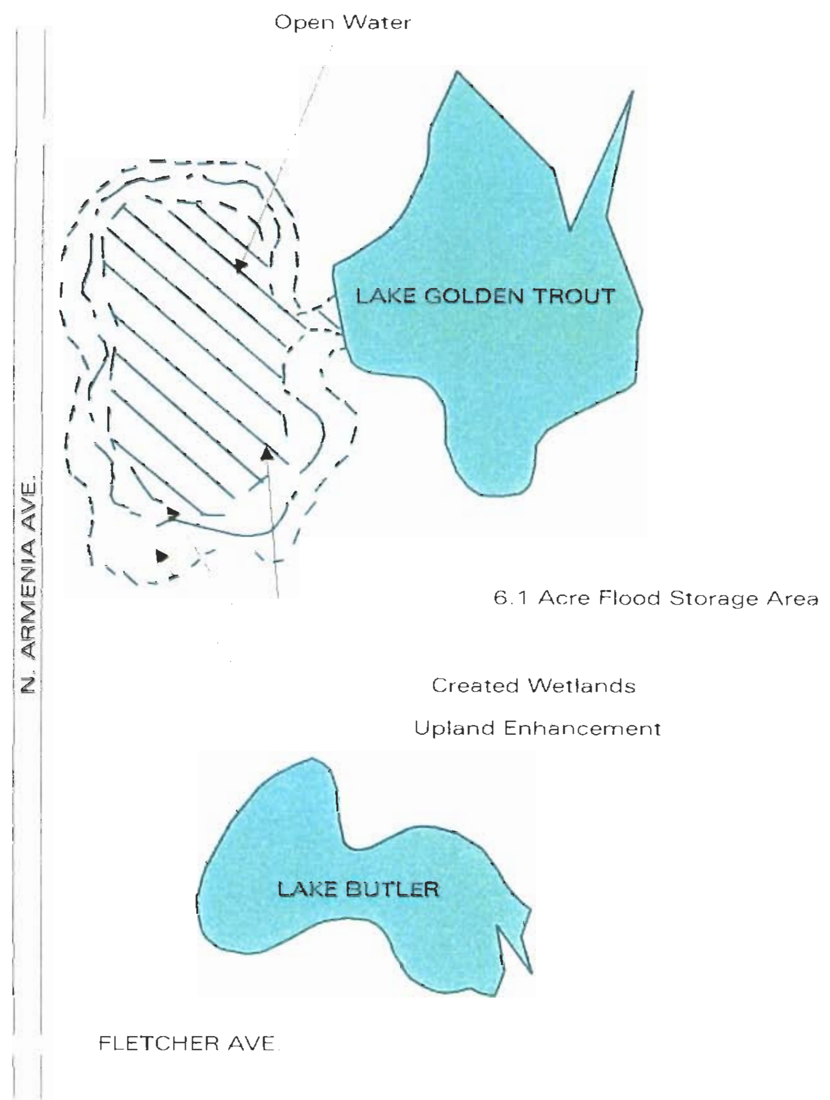
Despite heavy urbanization in other parts of this basin, the areas surrounding Lake Golden Trout are comprised of extensive forested and herbaceous wetlands and upland forest. Based on ongoing residential/commercial development in the basin, this area will probably be lost to development if it is not preserved through public acquisition. Some scattered patches of upland forest still exist within adjacent residential neighborhoods. Open land (old citrus groves) also exists adjacent to the lake that could be restored to natural habitat.

Alternatives-

Alternative 6- Purchase Existing Parcels Surrounding Lake Golden Trout and Lake Butler, Excavate 6.1 Acres of Additional Volume to Create Stormwater Treatment Ponds and Wetlands, Restore Upland Buffer Areas

Water Quantity Issues

Additional volume can be obtained by excavating a portion of vacant land adjacent to Lake Golden Trout. Simulations indicate that approximately 6.1 acres of land adjacent to the Lake



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would be need to be excavated to raise the LOS to A. The additional volume would be sufficient to reduce the road flooding to approximately 2 inches, and reduce yard flooding to less than 6 inches. This is sufficient to change the LOS designation. The flood complaint information obtained from County records did not contain reports of flooding in this area. This could relate to the assumptions surrounding the initial water surface elevations used in the simulations. The County Maintenance Department did not report any flooding problems relating to this basin during the El Nino 1997-1998.

Alternative 6			
Description	Basin Number	Existing Elev. 25-yr	Proposed Elev. 25-yr
Lake Golden Trout	562100	46.3	45.9

Water Quality/Natural Systems Issues

Several large parcels totaling approximately 60 acres surround Lake Golden Trout and Lake Butler (Turtle) and have been identified for acquisition by ELAPP. These parcels include the existing lakes as well as adjacent natural forested uplands, wetlands, low density residential, and agricultural areas (abandoned citrus groves). Although flood attenuation in this subbasin is not as critical as other areas of the watershed, this site offers an excellent opportunity to create a multi-functional alternative that would address flooding, water quality improvements, and natural systems restoration. If purchased by the County, portions of these parcels could be converted from citrus groves or open land to open water or wetlands to provide storage for flood attenuation, physical (via enhanced detention times) and biological (via uptake of nutrients by emergent and submersed vegetation) treatment of stormwater, and additional upland forest to provide buffer habitat for wildlife. ***This site could also serve as a wetland mitigation area for impacts that may occur with other alternatives proposed within the watershed.***

To simulate the potential water quality treatment improvements that could occur with this alternative, the pollutant loading model described in Chapters 10 and 11 was run using the proposed land use changes and stormwater treatment BMPs for this and other alternatives listed below. Based on the results of the model, the land use conversion in this basin would result in the reduction of annual pollutant loads by approximately 89.5 lbs. of total nitrogen and 382.9 lbs. of TSS (Table 13.1).

Table 13.1. Estimated change in pollutant loads with implementation of water quality treatment alternatives in the Curiosity Creek watershed.

Subbasin ID	Area (acres)	BOD5	TSS	TKN	NO3 +NO2	TN	TP	TDP	Oil and Grease	Cd	Cu	Pb	Zn
550500	15.6	-11.9	-133.2	-6.3	-3.1	-9.4	-6.1	-2.5	-4.9	0.0	-0.2	0.0	-0.3
550600	16.2	-35.3	-393.5	-18.6	-9.2	-27.8	-18.1	-7.5	-14.6	0.0	-0.6	-0.1	-0.8
550700	54.5	-14.5	-161.4	-7.6	-3.8	-11.4	-7.4	-3.1	-6.0	0.0	-0.3	0.0	-0.3
550900	12.3	-11.4	-127.7	-6.0	-3.0	-9.0	-5.9	-2.4	-4.7	0.0	-0.2	0.0	-0.3
551000	15.8	-240.0	-3512.4	-34.0	-23.6	-48.6	-20.4	-11.6	-18.0	-0.4	-1.6	-9.8	-5.6
551100	6.6	-11.9	-132.8	-6.3	-3.1	-9.4	-6.1	-2.5	-4.9	0.0	-0.2	0.0	-0.3
552400	12.5	-35.2	-392.9	-18.5	-9.2	-27.7	-18.1	-7.5	-14.5	0.0	-0.6	-0.1	-0.8
552500	36.9	-21.1	-235.8	-11.1	-5.5	-16.6	-10.9	-4.5	-8.7	0.0	-0.4	0.0	-0.5
562100	77.6	-551.7	-382.9	-65.3	-24.2	-89.5	-70.8	-36.9	-15.1	-0.4	-1.2	-0.1	-0.5
570500	30.0	-133.3	-1486.7	-70.1	-34.8	-104.9	-68.5	-28.3	-55.0	-0.1	-2.4	-0.3	-3.0
Net Watershed Reduction =		***-1066.4***	***-6959.2***	***-243.8***	***-119.5***	***-354.4***	***-232.5***	***-106.8***	***-146.4***	***-0.9***	***-7.8***	***-10.5***	***-12.3***

13.3 THE CURIOSITY CREEK MAIN CHANNEL

13.3.1 Country Club Drive (Basin 550100)

NOTE: Country Club Drive is within the limits of the City of Tampa. Because not all of Basin 550100 is within the City limits, an alternative for this basin is evaluated.

Flooding LOS Deficiency

Existing Condition LOS-D. The 25 year design event is expected to overtop Country Club Drive by approximately 2.4 feet at the lowest point in the road. The overtopping of this road is strongly influenced by the tailwater conditions expected in the Blue Sink and the City of Tampa Retention Facility. Site flooding is expected to a depth of approximately 1.6 feet in the yards and properties adjacent to the Creek. House flooding may be a potential at 1 home, although finished floor elevations have not been established.

Water Quality LOS Deficiency

Based on pollutant loading modeling, this urbanized basin is designated as LOS-F and has a high potential as a source of pollutants and increased runoff. This basin also receives little to no stormwater treatment of the adjacent roadway drainage from Florida Avenue. The Blue/Curiosity Sink area (City of Tampa) is the primary receiving water for this runoff and water quality in this system appears to be severely degraded. Currently, no data exists to evaluate existing water quality in the surface waters overlying Blue Sink. However, based on estimated pollutant loads for residential land uses, improvements in stormwater treatment for this area should result in improved water quality over time.

The outfall for roadway drainage from Florida Avenue is on the south side of Country Club Drive and, therefore, lies outside of the County boundary. This area is; however, within the City of Tampa's political boundary and further efforts to improve water quality in Blue Sink will require additional coordination between the County, City, and the FDOT.

Natural Systems Deficiency

The lower reaches of Curiosity Creek pass through this basin. A narrow band of riparian habitat still exists along the creek and is dominated by hardwood forest. Most, if not all, of this area is owned by numerous private homeowners/businesses. Exotic vegetation occurs throughout this channel length. Little remaining natural upland habitat exists except for scattered patches of pine and oak forest within the existing residential neighborhoods.

Alternatives-

Alternative 7-Increase Capacity of Conduits under Country Club Drive. Increase the Roadway Elevation.

Water Quantity Issues

Increasing the size of the conduits under Country Club Drive to twin 10 X 12 foot box culverts and raising the roadway elevation to 32.10 from 30.00 will prevent the roadway from being overtopped during the design event. The roadway should be elevated because the tailwater condition at the Blue Sink is a primary reason for the inundation of the roadway. The potential for flooding of the single residence should be verified with survey data to determine if the finished floor is below the expected 25 year design event elevation. Until finished floor elevations can be verified the proposed LOS is D. The proposed LOS for Basin 551400 would remain the same as the existing condition.

Simulations indicate yard flooding is expected to the same degree as the existing conditions because the tailwater from the Blue Sink controls the water surface elevation in this area of the basin.

Alternative 7

Description	Basin Number	Existing Elev. 25-yr	Proposed Elev. 25-yr
Country Club Drive	550100	32.1	32.0

Water Quality/Natural Systems Issues

No significant water quality or natural systems improvements are anticipated with this alternative.

13.3.2 122nd Avenue (Basin 550300)

Flooding LOS Deficiency

Existing Condition LOS-D. The 25 year design event is expected to overtop 122nd Avenue by approximately 1.2 feet at the lowest point in the road. Site flooding is expected to a depth of approximately 2.1 feet in the yards and properties adjacent to the Creek. House flooding may be a potential for 1 home, although finished floor elevations have not been established.

Water Quality LOS Deficiency

Based on pollutant loading modeling, this urbanized basin is designated as LOS-F and has a high potential as a source of pollutants and increased runoff. This basin also receives little to no stormwater treatment and so excess runoff typically discharges directly to Curiosity Creek. Currently little data exists to evaluate existing water quality at this reach of the creek since it has typically remained dry during recent efforts by HCEPC to collect samples. Efforts to improve water quality in this area should focus on source reduction and other alternatives upstream where land may be more readily available for constructing stormwater treatment systems.

Natural Systems Deficiency

The middle to lower reaches of Curiosity Creek pass through this basin. A narrow band of riparian habitat also exists along this reach of the creek and is dominated by hardwood forest. Most, if not all, of this area is owned by numerous private homeowners/businesses. Exotic vegetation occurs throughout this channel length. Little remaining natural upland habitat exists except for scattered patches of pine and oak forest within the existing residential neighborhoods.

Alternatives-

Alternative 8- Increase Capacity of Conduits under 122nd Avenue. Raise the Roadway Elevation.

Water Quantity Issues

Increasing the size of the conduits under 122nd Avenue to twin 5 X 7 foot box culverts and raising the roadway elevation to 33.50 from 32.80 will prevent the roadway from being overtopped during the design event. The potential for flooding of the single residence should be verified with survey data to determine if the finished floor is below the expected 25 year design event elevation. Until finished floor elevations can be verified the proposed LOS is D. Simulations indicated that yard flooding in the properties adjacent to the Creek is still expected with the proposed alternatives. The proposed LOS for Basin 550300 would remain the same as the existing condition.

Alternative 8			
Description	Basin Number	Existing Elev. 25-yr	Proposed Elev. 25-yr
122nd Street Avenue	550300	33.7	33.3

<u>Water Quality/Natural Systems Issues</u>

No significant water quality or natural systems improvements are anticipated with this alternative.

13.3.3 Mobile Home Community (Basin 550500, 550600 and 550700)

NOTE: Alternatives for these basins are interrelated and will be discussed together. These three mobile home communities are adjacent to the Creek and exist in the three basins mentioned above.

<u>Flooding LOS Deficiency</u>

Basin 550500 - Existing Condition LOS-D. The 25 year design event is expected to overtop a private road within the southern mobile home park by approximately 1.4 to 2.0 feet and exists in Basin 550500. Site flooding is expected to a depth of approximately 2.0 feet within the park and in the yards and properties adjacent to the Creek. Mobile home flooding is a potential for approximately 0.9 acres of the community, although finished floor elevations have not been established. Because of the nature of the construction of mobile homes it should be mentioned that damage to air conditioning units and ductwork could occur below the finished floor elevations.

Basin 550600 - Existing Condition LOS-D. The middle mobile home community exists in Basin 550600. The 25 year design event is expected to overtop a private road within the mobile home community by approximately 2 feet. Site flooding is expected to a depth of approximately 2 feet within the park and in the yards and properties adjacent to the Creek. Mobile home flooding is a potential for approximately 2.2 acres of the community, although finished floor elevations have not been established.

Basin 550700 - Existing Condition LOS-D. The 25 year design event is expected to overtop a private road within the mobile home park by approximately 1.4 feet. Site flooding is expected to a depth of approximately 1.4 feet within the park and in the yards and properties adjacent to the Creek. Mobile home flooding is a potential for approximately 0.6 acres of the community, although finished floor elevations have not been established.

Water Quality LOS Deficiency

Based on pollutant loading modeling, these urbanized basins are designated as LOS-F and have a high potential as a source of pollutants and increased runoff. These basins also receive little to no stormwater treatment and so excess runoff typically discharges directly to Curiosity Creek. Currently little data exists to evaluate existing water quality within this reach of the creek.

Natural Systems Deficiency

The middle reach of Curiosity Creek passes through this basin. A narrow band of riparian habitat exists along this reach of the creek and is dominated by hardwood forest. Most, if not all, of this area is owned by numerous private homeowners/businesses. Exotic vegetation occurs throughout this channel length. Little remaining natural upland habitat exists except for scattered patches of pine and oak forest within the existing residential neighborhoods.

Alternatives-

Alternative 9- Reclamation of the Floodplain

Water Quantity Issues

Reclamation of the floodplain must be considered in this case as a possible alternative. This alternative would increase the LOS to C, with no change in water surface elevation. Excavation of the purchased floodplain would serve no purpose from a water quantity standpoint because the area of the mobile home parks is too small to have a significant impact on the regional system. The flooding problem would be eliminated because the community would no longer exist in the floodplain. Approximately one third of the mobile home communities and the residences to the south would have to be acquired to raise the LOS to C. Some potential site flooding would still be expected to exist on the properties adjacent to the Creek.

Water Quality/Natural Systems Issues

Excavation and reclamation of developed areas (mobile home parks) in subbasins 550500, 550600, and 550700 would eliminate approximately 3.75 acres of high density land use. Based on the results of the pollutant loading model, this land use conversion would result in the reduction of annual pollutant loads in the basin by approximately 48.6 lbs. of total nitrogen and 688.0 lbs. of TSS (Table 13.1).

This area could be replanted with native riparian/wetland vegetation to create additional habitat along the main corridor for the creek. Reclamation and revegetation of riparian buffers would help reduce pollutant loading by eliminating an existing source (mobile homes within floodplain) and should help to improve water quality and wildlife habitat within the creek.

13.3.4 131st Street (Basin 550900), Mobile Home Community (Basin 551100), Private Road (Basin 551300), 137th Avenue (Basin 551400), and 138th Avenue (Basin 551800)

NOTE: Alternatives for the these basins are interrelated and will be discussed together

<u>Flooding LOS Deficiency</u>

131st Avenue (Basin 550900)-Existing Condition LOS-D. The 25 year design event is expected to overtop 131st Street at the intersection of Florida Avenue by approximately 1.2 feet. Site flooding is expected to a depth of approximately 1.2 feet in the yards and properties adjacent to the Creek. The surrounding property is occupied by commercial businesses and residential homes. House flooding may be a potential for 1 home located near the creek, although finished floor elevations have not been established.

Mobile Home Community (Basin 551100)-Existing Condition LOS-D. The 25 year design event is expected to overtop the private internal road by approximately 1.6 feet. Site flooding is expected to a depth of approximately 1.6 feet in the yards and properties internal to the community. Mobile home flooding is a potential for approximately three-quarters of the community, although finished floor elevations have not been established. Because of the nature of the construction of mobile homes it should be mentioned that damage to air conditioning units and ductwork could occur below the finished floor elevations. The owner of the mobile home community verified the flooding during an interview at the first project public meeting. The road crossing of Curiosity Creek internal to the community utilizes a 36 inch CMP with very little cover. The next upstream conduit is a 4 foot by 9 foot concrete box culvert. The 36 inch CMP is grossly undersized but should not cause a significant adverse impact upstream because of the low overtop elevation associated with the crossing.

Private Road (Basin 551300)-Existing Condition LOS-D. The 25 year design event is expected to slightly overtop this private road by less than 1 inch. This road services an automobile dealership and the crossing of the Creek is utilized to access the east half of the property. Site flooding is expected to a depth of less than one inch for the design storm. It is assumed that the buildings adjacent to the creek are constructed at grade and therefore may experience minor flooding. Finished floor elevations need to be established for the site to verify the flooding potential of the buildings. It was estimated that the site, structure and roadway (private) were very close to the peak elevation of the 25 year design event (within 1 inch). More accurate finished floor, and site elevations may show that the designated LOS is higher than estimated, and could be as high as A.

137th Avenue (Basin 551400)-Existing Condition LOS-D. The 25 year design event is expected to overtop the west end of 137th Avenue by approximately 1 foot. This street is a dead end road whose terminus is at Curiosity Creek. It is expected that the western 100 feet of the roadway will be overtopped during the design event. County records from the El Nino event of 1997-1998 indicated that some flood reports were made in the area but the reports appear to be associated with the intersection of Central Avenue and 137th Avenue, possibly indicating a localized problem. This was verified at the third public meeting. The two homes at the western end of the street are anticipated to experience flooding according to the SWFWMD contour aerials. Finished floor elevations are needed to make an exact determination. Site flooding is expected to a depth of approximately 1 foot.

138th Avenue (Basin 551800)-Existing Condition LOS-B. 138th Avenue is expected to be overtopped to a depth of approximately 8 inches for the 25 year design event. The culverts that convey water under the roadway are undersized and exhibit a headloss of approximately 1 foot. Simulations indicate that approximately 800 feet of roadway may become flooded during the 25 year event to a maximum depth of 8 inches. The elevations of the adjacent sites were taken from the aerial contour maps and flooding is not expected for the 25 year design event. The adjacent apartment complex is not expected to flood during the design event, although finished floor elevations have not been established. There are no residential homes within this subbasin.

<u>Water Quality LOS Deficiency</u>

Based on pollutant loading modeling, basins 550900, 551300, 551400, and 551800 are designated as LOS-F and basin 551100 is designated as LOS-D. These basins have a high potential as a source of pollutants and increased runoff. These basins also receive little to no stormwater treatment and so excess runoff typically discharges directly to Curiosity Creek. Currently no data exists to evaluate existing water quality within this reach of the creek.

<u>Natural Systems Deficiency</u>

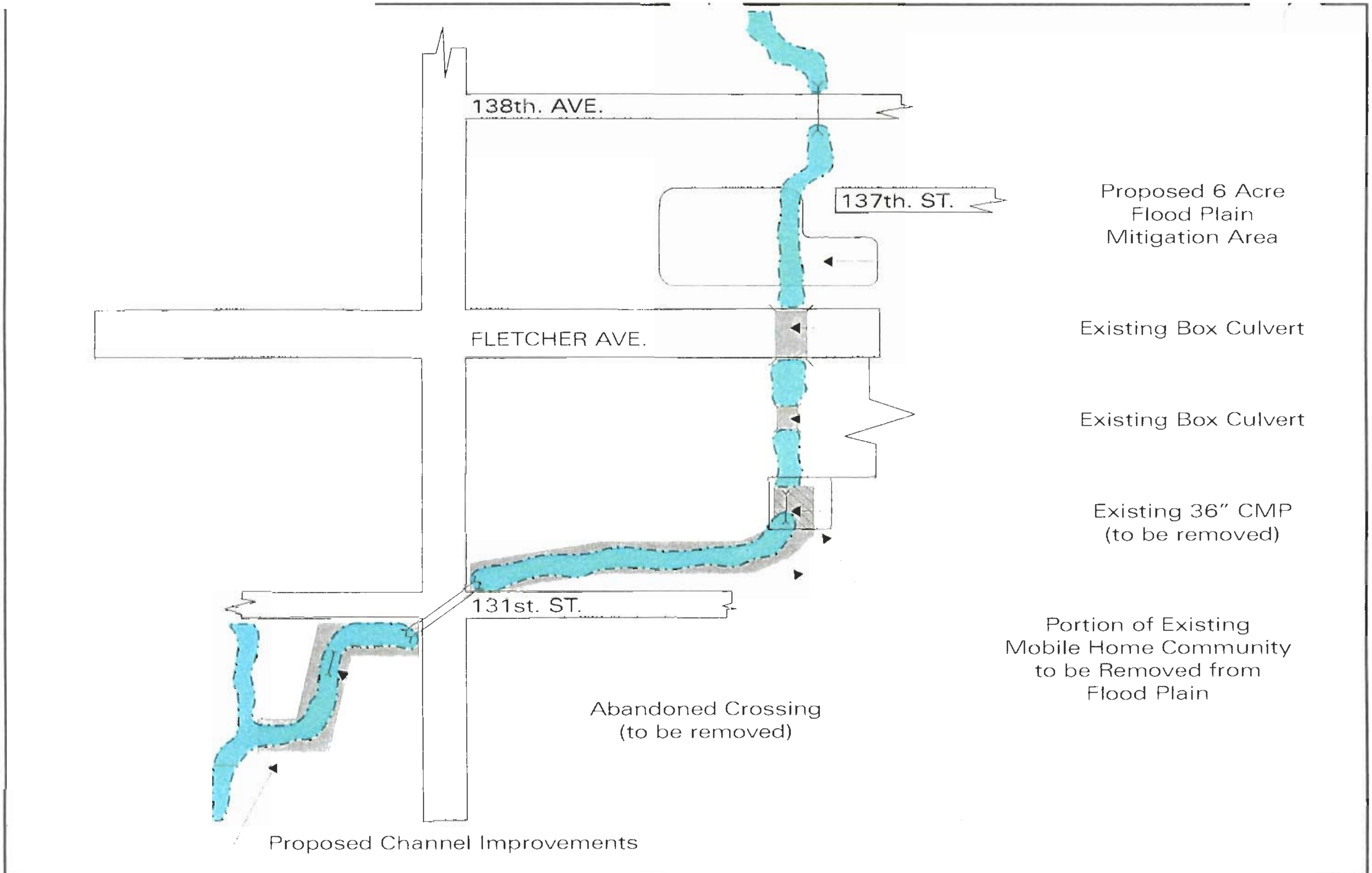
The middle reach of Curiosity Creek passes through this basin. A narrow band of riparian habitat exists along this reach of the creek and is dominated by hardwood forest. Most, if not all, of this area is owned by numerous private homeowners/businesses. Exotic vegetation occurs throughout this channel length. Little remaining natural upland habitat exists except for scattered patches of pine and oak forest within the existing residential neighborhoods.

Alternatives- The two alternatives described for these interrelated basins differ in one major aspect. Alternative 10A attempts to develop a plan where the LOS designation is achieved by lowering the floodplain through storage and conveyance improvements with a minimal of residential acquisition (floodplain reclamation). Alternative 10B utilizes floodplain reclamation as the primary means of achieving improvements in LOS.

Alternative 10A-Construct Channel Improvements Downstream of Florida Avenue. Construct Channel Improvements Upstream of Florida Avenue. Construct 6 Acre Compensation Storage Upstream of Fletcher Avenue. Improve Conveyance under 138th Avenue.

<u>Water Quantity Issues</u>

Simulations of the 25 year design event indicated a large headloss occurring downstream of the crossing of Curiosity Creek at Florida Avenue. Encroachment into the channel by development and the accumulation of debris and abandoned crossings are expected to create a tailwater induced flood problem at the upstream side of Florida Avenue. The removal of abandoned and neglected crossings along with the widening and cleaning of the channel will reduce the headwater condition expected at 131st Avenue. The channel improvement is estimated to be



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sufficient to raise the LOS of Basin 550900 to A. The proposed channel cross section downstream of Florida Avenue was simulated as 800 feet long with a 10 foot bottom width, a 61 foot top width, a depth of approximately 6 feet and a 4:1 grassed sideslope. The channel improvement would begin at the downstream end of the culverts under Florida Avenue and extend to the confluence with the north/south ditch that conveys flow under 131st Avenue from the FDOT retention pond. Additional channel improvements upstream of Florida Avenue are needed to reduce the level of flooding at the mobile home community. The proposed cross section for the channel upstream of Florida Avenue was simulated as 560 feet long with a 20 foot bottom width, a 60 foot top width, and a depth of approximately 5 feet with 4:1 grassed sideslopes. This channel improvement would begin at the northern limits of the MHP and extend to the upstream side of the culverts at Florida Avenue. An access berm of 20 feet in width on both sides of the proposed channel improvements will be necessary for maintenance. The portion of the mobile home community that is east of the internal crossing of Curiosity Creek would have to be acquired to facilitate the construction of the channel improvements. The private crossing would be removed. In addition, the widened channel section would facilitate the acquisition of properties adjacent to Florida Avenue at the crossing of the Creek. The channel improvements upstream of Florida Avenue to the mobile home community are needed to raise the LOS of Basin 551100 to A.

Alternative 10A			
Description	Basin Number	Existing Elev. 25-yr	Proposed Elev. 25-yr.
131st Street	550900	39.6	37.8
Mobile Home Comm.	551100	39.9	38.4
Private Road	551300	42.1	41.3
137th Avenue	551400	42.6	41.9
138th Avenue	551800	43.9	43.2

Further conveyance improvements are needed at the roadway crossing at 138th Avenue. The 25 year design event is expected to overtop 138th Avenue by approximately 8 inches (at the deepest point) with an impact distance of over 500 feet. This crossing was simulated with a single 5 X10 box culvert at 138th Avenue. Improving this roadway crossing increases the LOS designation for Basin 551800 to A.

The channelization of the Creek in the vicinity of Florida Avenue as well as the conveyance improvements under 138th Avenue will have the effect of reducing the floodplain storage and increasing conveyance in this section of the basin. This floodplain displacement must be mitigated in order to prevent downstream impacts. The creation of floodplain compensation storage was simulated in the area north of Fletcher Avenue. This area is largely undeveloped and is already part of the floodplain. The excavation of approximately 6 acres at elevation 31.30 was simulated to compensate for the impacts associated with the downstream improvements, and to provide the additional storage necessary to lower the expected flood elevations and raise the LOS characterization for the effected basins, without the need for floodplain reclamation.

This alternative achieves significant increases in LOS for the basins described with minimal utilization of residential disturbance. Increases in LOS are achieved through providing storage and conveyance improvements.

Water Quality/Natural Systems Issues

The proposed floodplain mitigation area could also serve as an in-line stormwater treatment system thereby providing water quality improvements for basin 551400 and other basins upstream. The channelization of the creek could be configured such that additional in-line sump areas could be created to allow for sediment retention and biological uptake of pollutants.

The proposed channelization north of 131st Street could impact existing riparian habitat along the edge of the creek including reduction in canopy. If channelization occurs, the banks of the creek should be replanted with native vegetation including a variety of wetland and upland plants to replace and, possibly, improve riparian habitat in this area.

Alternative 10B- Construct Channel Improvements Downstream of Florida Avenue. Reclaim Floodplain at MHP, and Excavate As Partial Compensation Storage. Construct Remainder of Necessary Compensation Storage Upstream of Fletcher Avenue. Improve Conveyance under 138th Avenue.

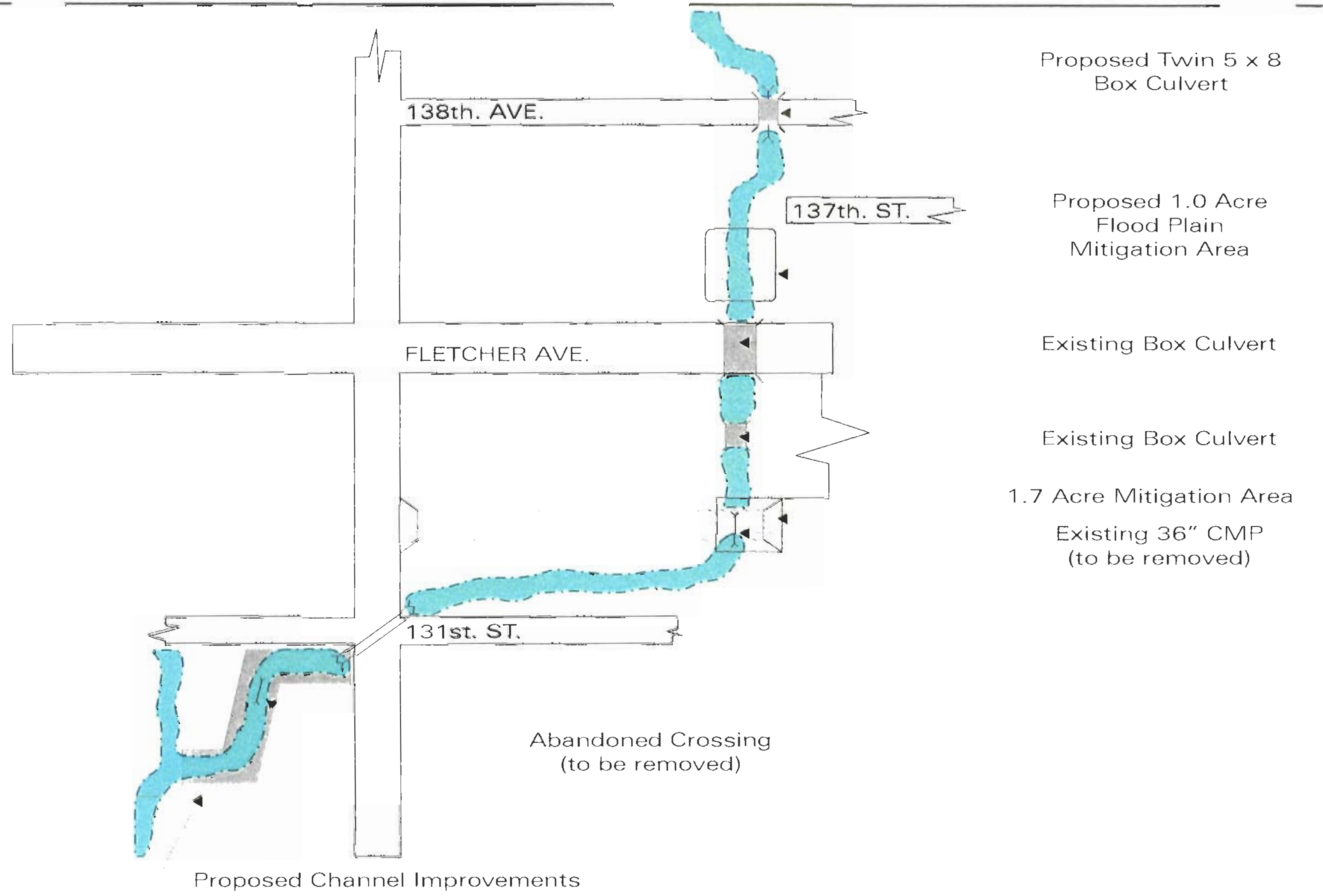
Water Quantity Issues

Simulations of the 25 year design event indicated a large headloss occurring downstream of the crossing of Curiosity Creek at Florida Avenue. Encroachment into the channel by development and the accumulation of debris and abandoned crossings are creating a tailwater induced flood problem at the upstream side of Florida Avenue. The removal of abandoned and neglected crossings along with the widening and cleaning of the channel will reduce the headwater condition expected at 131st Avenue. The channel improvement is sufficient to raise the LOS of Basin 550900 to A. The proposed cross section for the channel downstream of Florida Avenue

Alternative 10B			
Description	Basin Number	Existing Elev. 25-yr	Proposed Elev. 25-yr.
131st Street	550900	39.6	38.3
Mobile Home Comm.	551100	39.9	39.6
Private Road	551300	42.1	41.8
137th Avenue	551400	42.6	42.4
138th Avenue	551800	43.9	43.1

was simulated as 800 feet long with an 8 foot bottom width, a 58 foot top width, a depth of approximately 6 feet and a 4:1 grassed sideslope.

Reclaiming the floodplain within the mobile home park upstream of Florida Avenue would remove the homes within that area from the flood prone area. The property (approximately 1.7 acres) was simulated as being excavated to create a flood detention/mitigation area that would



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partially mitigate for the impacts of the channelization downstream of Florida. This alternative would increase the LOS in Basin 551100 to A, because the community would no longer exist in the floodplain and help minimize the area needed upstream of Fletcher Avenue for floodplain mitigation.

The excavation of the approximately one (1) additional acre upstream of Fletcher Avenue is needed to compensate for the channelization downstream of Florida Avenue. The potential flooding of the two residences should be verified with survey data to determine if the finished floor is below the expected 25 year design event elevation. Until finished floor elevations can be verified the proposed LOS is D. The proposed LOS for Basin 551400 would remain the same as the existing condition.

Finally, the conveyance under 138th Avenue would be increased to prevent the overtopping of that street. Twin 5 X 8 foot box culverts were simulated under 138th Avenue. The conveyance improvements raised the LOS designation for Basin 551800 to A.

This alternative achieves significant increases in LOS for the basins through floodplain reclamation and conveyance\mitigation measures. Floodplain reclamation is an alternative that disturbs residential areas yet should be considered in basins with limited opportunity for structural solutions to flooding.

Water Quality/Natural Systems Issues

With this alternative, water quality improvements should be gained through the creation of the two in-line ponds as well as the source reduction resulting from the conversion of the existing 2.75 acres of high density residential land use (mobile home park) to open water, wetlands, and an upland buffer. Based on the results of the pollutant loading model, this land use conversion would result in the reduction of annual pollutant loads in the basin by approximately 18.4 lbs. of total nitrogen and 260.5 lbs. of TSS (Table 13.1). Additional treatment of upstream basins should also occur with the construction of both in-line ponds; however, estimates of pollutant load reduction cannot be calculated without additional, specific information regarding pond detention times.

The channelization of the creek south of 131st Street could be configured such that additional in-line sump areas could be created to allow for sediment retention and biological uptake of pollutants. These deeper open water features could be stabilized with rip rap to reduce erosion and resuspension of sediments within the creek.

The proposed channelization of the creek south of 131st Street could impact existing riparian habitat along the edge of the creek including reduction in canopy. If channelization occurs, the banks of the creek should be replanted with native vegetation including a variety of wetland and upland plants to provide riparian habitat.

13.3.5 Taliaferro Street (Basin 551000)

Flooding LOS Deficiency

Existing Condition LOS-D. The 25 year design event is expected to overtop Taliaferro Street by approximately 2.1 feet. Site flooding is expected to a depth of approximately 2.1 feet in the yards and properties. This basin is connected to Curiosity Creek via a 30 inch RCP that is located under Interstate-275 and a collection/conveyance system for 132nd Street. Simulations indicate that water will flow backwards from Curiosity Creek through the collection system in 132nd Street into the Taliaferro Street area through the 30 inch RCP. After the creek has peaked and has begun to recede, the floodwater can reverse direction and begin to discharge back through the 30 inch RCP toward the Creek. However, the control elevation in the 132nd Street system is 36.00 and therefore, any flood volume below that elevation is contained within the basin. This area has documented chronic flooding problems. The reverse flow condition anticipated by the model, has been verified in the field by the County staff. House flooding may be a potential for 6 to 7 homes located in the area, based on the 25 year design event.

Water Quality LOS Deficiency

Based on pollutant loading modeling, this urbanized basin is designated as LOS-F and has a high potential as a source of pollutants and increased runoff. This basin also receives little to no stormwater treatment and so excess runoff typically discharges to Curiosity Creek via an existing pipe system. Currently no data exists to evaluate existing water quality within this reach of the creek.

Natural Systems Deficiency

Despite extensive development in this basin, some relatively large oak trees exist within the existing residential neighborhood near Taliaferro Street. However, due to fragmentation by the residential neighborhood and roads, this forested area probably does not provide significant wildlife habitat.

Alternatives-

Alternative 11 - Reclamation of the Floodplain

Water Quantity Issues

Reclamation of the floodplain must be considered in this case as a possible alternative. This alternative would increase the LOS to A, with no change in water surface elevation. Excavation of the purchased floodplain would serve no purpose from a water quantity standpoint because the area of the home flooding is too small to have a significant impact on the regional system, aside from the fact that the flooding is caused by a reverse flow condition. The flooding problem would be eliminated because the community would no longer exist in the floodplain. The affected homes would have to be acquired to raise the LOS to A.

It is important to realize that excavating the area where the reclamation is proposed to occur does not lower the flood levels significantly. This is because of the reverse flow of Curiosity Creek. The Creek system has the hydraulic advantage on the Taliaferro area. Increasing the storage causes more volume to reverse flow into the area and has little effect on the regional system. Small events (the 3 year storm) may see some advantage to the construction of a pond because the system does not reverse flow for this event. But larger events (5 year and higher) display the reverse effect, and therefore would extract little benefit from the excavation.

Efforts to implement this alternative have been initiated by the County to relieve several homeowners of repetitive flooding in the basin. Funding requests have been submitted to several agencies including FEMA and SWFWMD to purchase affected homes in the floodplain and to construct a wet detention pond to treat stormwater runoff from adjacent residential and commercial land uses. Based on hydraulic modeling, the pond should function for up to the 3- year design event, after which water will backflow from Curiosity Creek into the Taliaferro Street area. Future design of this system should take this phenomenon into account as the reverse flows may affect pollutant removal efficiencies for this pond.

Alternative 11			
Description	Basin Number	Existing Elev.	Proposed Elev.
Taliaferro Street	551000	39.9 (25-yr)	39.9 (25-yr)
Taliaferro Street	551000	37.0 (2 inch rain)	36.8 (2 inch rain)

<u>Water Quality/Natural Systems Issues</u>

Based on the results of the pollutant loading model, conversion of land use (approximately 2.0 acres of high density residential land use to open water and wetland) and construction of the wet detention pond (treating approximately 16 acres of high density residential and commercial land uses) would result in the reduction of annual pollutant loads in the basin by approximately 48.6 lbs. for total nitrogen and 3,512.4 lbs. for TSS (Table 13.1).

If possible, the stormwater treatment pond would be designed to incorporate a littoral zone planted with native wetland vegetation to help uptake pollutants (nutrients) and provide wildlife habitat. An upland buffer area should also be preserved and planted with native vegetation to provide additional wildlife habitat adjacent to the pond. This site has additional recreational and educational opportunities due to its proximity to residential neighborhoods and schools (including the University of South Florida).

13.3.6 Mobile Home Community –Rose Lake Estates (Basin 552400 and Basin 552500), Basin 552300, Leisure Avenue (Basin 552600), Floral Drive (Basin 552700) and Florida Avenue/Wildwood Street (Basin 552100)

NOTE: Alternatives for the these basins are interrelated and will be discussed together

<u>Flooding LOS Deficiency</u>

Rose Lake Estates MHP -Basin 552400 and Basin 552500 - Existing Condition LOS-D. The 25 year design event is expected to overtop the private internal roads adjacent to the Creek by approximately 2.9 feet. Site flooding is expected to a depth of approximately 2.9 feet in the yards and properties internal to the community. Mobile home flooding is a potential for approximately one-half the community, although finished floor elevations have not been established. Because of the nature of the construction of mobile homes it should be mentioned that damage to air conditioning units and ductwork could occur below the finished floor elevations. The driveway crossing of the Creek is not expected to be overtopped, but simulations indicated that there is a headloss across the structure of approximately 0.9 feet. The private driveway crossing is contributing to the flooding that is experienced in the mobile home community. Approximately half of the community is located within the 100 year floodplain. The mobile homes located next to the creek are at the greatest risk of flooding with the top of bank being approximately 2 feet above the bottom of the creek. Although this portion of the creek is well maintained, much of the associated community is at an elevation that is too low to keep from being flooded on a frequent basis. Simulations indicated that out of bank conditions are expected for storm frequencies as low as the 3 year event.

Basin 552300 - Existing Condition LOS-C. The 25 year design event is expected to slightly overtop the private road crossing by approximately 10 inches. This road serves as access to property on the east and west sides of the Creek. Site flooding is also expected to a depth of approximately 8 inches for the design storm. There are no structures associated with this property. Because the unimproved roadway overtops at such a low elevation, it does not cause a severe impact on the upstream properties, even though the culverts at this location (twin 48 inch RCP's) are undersized.

Florida Avenue/Wildwood Street- Basin 552100 - Existing Condition LOS-D. Curiosity Creek in the vicinity of Florida Avenue/Wildwood Street is expected to flow out of bank for the 25 year design event. The overtopping of the south bank is anticipated to be approximately 6 inches. Since Wildwood Street is adjacent to the creek it was also assumed to be at the same elevation as the top of bank. The elevation of the adjacent sites was taken from the aerial contour maps and flooding is expected to be approximately 1 foot for the design storm. House flooding is a potential for 2 homes, although finished floor elevations have not been established. Florida Avenue is also expected to overtop at this location by approximately 3 inches.

Leisure Avenue Basin-552600 - Existing Condition LOS-D. Leisure Avenue is expected to be flooded by the pond that is adjacent to the roadway in this closed basin for the 25 year design event. The small pond that is located in the southeast corner of the basin does not contain enough volume to store the design event without overtopping. Simulations indicated that once the volume of the pond had been exceeded, the excess runoff would travel east toward Curiosity Creek. Simulations indicated that approximately 100 feet of roadway might become flooded during the 25 year event to a maximum depth of 1.3 feet. The elevation of the adjacent sites was taken from the aerial contour maps and flooding is expected to be approximately 1.6 feet at the deepest point for the design storm. House flooding is a potential for 2 homes, although finished floor elevations have not been established.

Floral Drive Basin -552700 - Existing Condition LOS-D-. The 25 year design event is expected to overtop the road by approximately 1.0 foot. Some areas of the roadway (near inlets and catch basins) could experience flooding to a depth of nearly 2.3 feet. Site flooding is expected to a depth of approximately 0.5 to 1.5 feet in the yards and properties nearest to the Creek. House flooding is a potential for 4 homes, although finished floor elevations have not been established. The anticipated flooding conditions at Floral Drive appear to be caused by the tailwater by conditions in the Creek downstream of the Floral Drive crossing. The simulations indicate that the crossing at Rose Lake Estates is contributing to the expected flooding at Floral Drive. The difference in water surface elevation from the upstream side of the crossing at Rose Lake Estates to the downstream side of Floral Drive is approximately 2 inches. The headloss at the Rose Lake Estates crossing is expected to be 0.9 feet, however it should be recognized that while the Rose Lake Estates crossing is contributing to the problem at Floral Drive, limited channel capacity and flood storage within this portion of the watershed are also contributing to the flooding.

Water Quality LOS Deficiency

Based on pollutant loading modeling, these urbanized basins are designated as LOS-F and have a high potential as a source of pollutants and increased runoff. These basins also receive little to no stormwater treatment and so excess runoff typically discharges directly to Curiosity Creek. Currently little data exists to evaluate existing water quality within this reach of the creek.

Natural Systems Deficiency

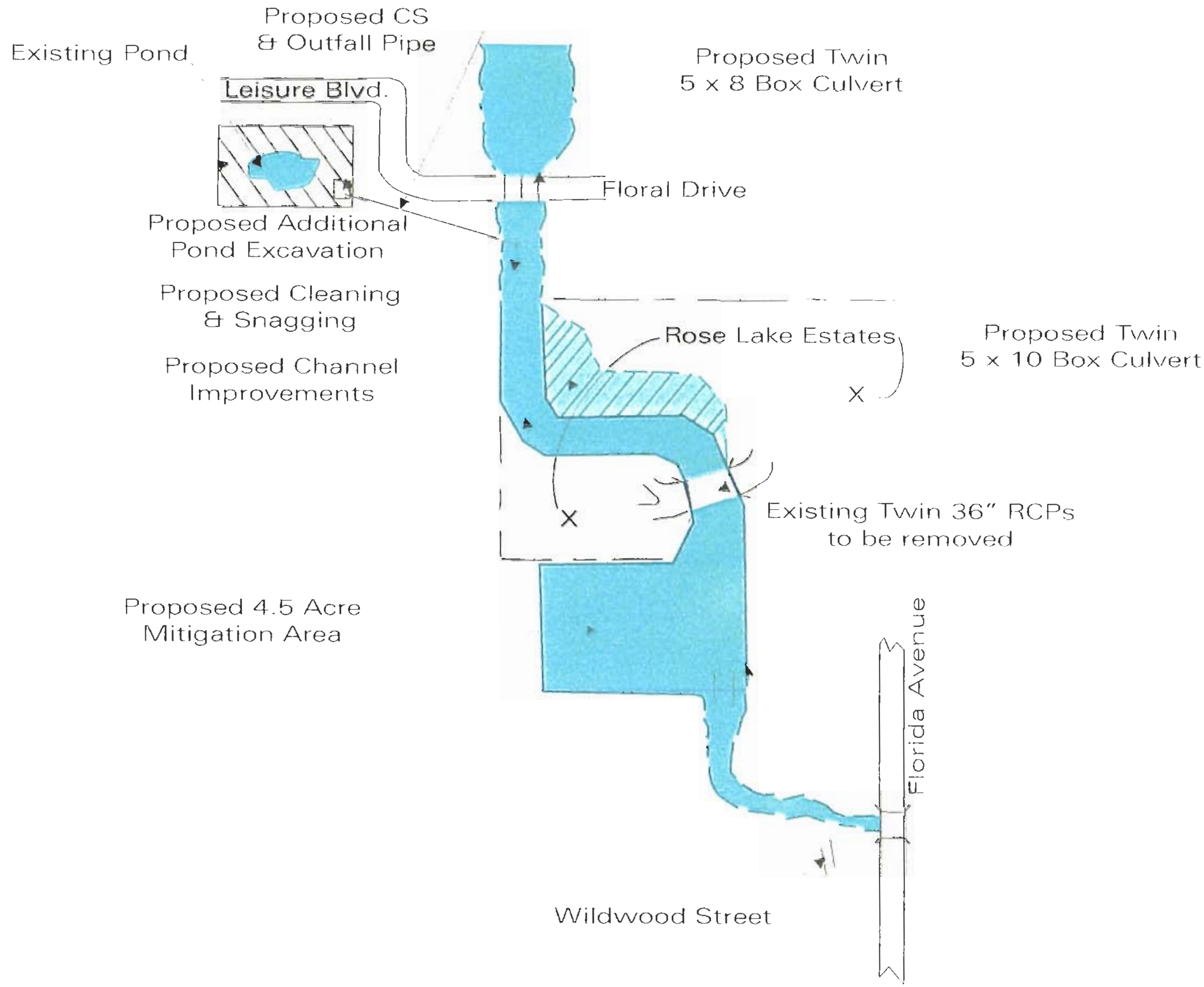
Despite heavy urbanization in other parts of this basin, one of the largest, intact natural areas is located adjacent to and south of the Rose Lake Estates MHP. This approximately 10 acre site is comprised of sensitive upland and riparian habitat that will probably be lost to development if it is not preserved through public acquisition. Except for this area, the majority of the remaining subbasins have been highly impacted by development and harbor only scattered uplands and herbaceous wetlands within residential/commercial areas.

Alternatives-

Alternative 12- Excavate Additional Storage. Construct Control Structure in Retention Pond Located South of Leisure Avenue. Clean and Snag Channel Downstream of Floral Drive to Rose Lake Estates MHP. Construct Channel Improvements Within Rose Lake Estates MHP. Increase Conveyance of Conduits under Internal Private Drive within Rose Lake Estates. Excavate 4.5 Acre Floodplain Mitigation Pond Downstream of the Rose Lake Estates MHP and Construct Control Structure. Remove Existing Dirt Road Drive Behind FDOT Retention Pond.

Water Quantity Issues

Improvements to the conveyance capability of the creek and increasing the floodplain storage are necessary to raise the LOS in these interrelated basins. Essentially, the floodwater at Floral Drive, Leisure Avenue and in Rose Lake Estates MHP must be relocated to a proposed floodplain mitigation area south of Rose Lake Estates MHP. Providing storage for this volume reduces the flood elevations expected downstream at Florida Avenue and Wildwood Street.



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In the simulations, the existing retention pond that is located south of Leisure Drive was excavated to maximize storage capability. The area of excavation was 1.4 acres at elevation 47.0. A control structure and discharge pipe will be needed to discharge the pond at a point on the downstream side of the crossing at Floral Drive. Twin 5 X 8 foot box culverts were simulated at the road crossing of Floral Drive and Curiosity Creek. This improvement is expected to reduce the flood elevations upstream of the road and prevent roadway overtopping. The channel downstream of Floral Drive was simulated as having a reduced roughness coefficient reflective of proposed cleaning and snagging operations. This is expected to allow for more efficient conveyance of floodwater. Channel widening through the Rose Lake Estates MHP is necessary to convey the upstream floodwater to the proposed floodplain mitigation site. The additional floodplain storage proposed within the MHP (approximately 3.2 acres) was simulated as being baffled with no conveyance capability. This was done to simulate an environmental area proposed within the limits of the re-configured creek bottom. The existing internal road crossing within the MHP was simulated with a proposed twin 5 X 10 foot box culverts to minimize headloss at that crossing. The proposed channel widening and mitigation within the Rose Lake Estates MHP will require the acquisition of properties that are below elevation 47.00. A proposed floodplain mitigation pond of approximately 4.5 acres was simulated to provide additional storage and to lower the expected elevations at Florida Avenue/Wildwood Drive. An armored 40 foot berm was modeled as the control device on the 4.5 acre mitigation pond.

These improvements are expected to raise the existing LOS within Basins 552700, 552600, 552500, 552400, 552300 and 552100 to an anticipated LOS of A. Some small degree of street flooding around the catch basins in Carnation Drive may still occur during the design event. The number of homes projected to be at risk by the design event within Rose Lake Estates MHP was reduced from 88 (structures below or at elevation 48.30) to 56 (structures below elevation 47.05) This is a reduction in expected water surface elevation of 1.2 feet. The 56 structures remaining within the limits of the design storm floodplain were estimated to be below elevation 47.0. The construction of the channel and floodplain mitigation improvements within the MHP would require that these structures be relocated. These measures would leave the remainder of the MHP intact and increase the designated LOS within Basin 552500 and 552400 to A.

NOTE: Simulations indicated that further reduction in the expected water surface elevation in this portion of the watershed was of little benefit to Rose Lake Estates for the following reasons:

1) Enlarging the proposed 4.5-acre mitigation pond would not eliminate the need for a channel improvement within the Rose Lake Estates MHP. Conveyance through the community is necessary to transport floodwater to the only available area for floodplain mitigation.
2) Expanding the proposed mitigation pond from 4.5 acres to 9.6 acres (utilizing all of the undeveloped land south of the MHP) reduces the expected water surface elevation within the MHP by approximately an additional 12 inches (elevation 46.01). However, the area of flooding was reduced by only approximately 0.75 acres. This is because of the area within the park between elevation 46.00 and 47.00. The number of homes within the MHP park that would benefit from increasing the mitigation pond to 9.6 acres and reducing the expected design storm water surface elevation by another 12 inches was approximately 16.
3) To substantially reduce the number of affected homes within Rose Lake Estates, the projected water surface would have to be reduced to a value of approximately elevation 45.40. Due to the lack of practical open land for pond construction, and the closed basin constraints of Curiosity Creek, this elevation is unattainable.

Alternative 12			
Description	Basin Number	Existing Elev. 25-yr	Proposed Elev. 25-yr
Rose Lake Estates	552400	48.3	46.8
Rose Lake Estates	552500	48.3	46.8
	552300	47.1	46.7
Leisure Avenue	552600	48.5	47.1
Floral Drive	552700	48.5	47.0
Florida/Wildwood Ave.	552100	46.4	45.7

<u>Water Quality/Natural Systems Issues</u>

The existing channelized creek in this area of the watershed has been highly disturbed. The proposed alternative could result in the preservation of an existing and rare sand pine scrub habitat (and associated gopher tortoise population) south of Rose Lake Estates since the parcels needed for the construction of the mitigation ponds also include this habitat. Additional wetland habitat could be created within the existing pond features and within the floodplain mitigation area adjacent to Rose Lake Estates. The proposed area for baffling of channel flow adjacent to Rose Lake Estates could be planted with native wetland vegetation including cypress trees, red maple trees, or emergent species such as pickerelweed. Based on the results of the pollutant loading model, stormwater treatment and land use conversion from high density residential to wetland/upland habitat would result in the reduction of annual pollutant loads in basin 552400 by approximately 27.7 lbs. of total nitrogen and 392.9 lbs. of TSS (Table 13.1). Approximately 16.6 lbs. of nitrogen and 235.8 lbs. of TSS would be reduced in basin 552500.

Illegal dumping of what appears to be household trash has occurred along the creek at the southern end of the existing undeveloped parcels south of Rose Lake Estates. If further data collection deems this area suitable (i.e., no potentially hazardous wastes present), the footprint of the mitigation pond could be located over the existing trash dump so that this area can be cleaned up in concert with the pond excavation. Depending on the extent of the properties acquired by the County for this alternative, a passive recreational park could be developed at this site which would provide numerous environmental education possibilities including boardwalks and signage located in strategic locations along the creek and adjacent to the sand pine scrub habitat. The site could provide local schools and community groups an opportunity to experience one of the last few natural areas in the watershed as well as the benefits of preserving environmentally-sensitive habitat, habitat restoration, stormwater treatment, and the adverse effects of urban development on flooding.

13.3.7 Floral Drive Channel Improvements (Basin 555700)

Water Quality/Natural Systems Issues

Due to the presence of exotic vegetation upstream, this proposed wetland restoration site will require periodic maintenance to prevent the regrowth of exotic plants. High flows resulting from the reconfiguration of the creek banks may increase the potential for erosion and loss of planted vegetation. Baffles, similar to those proposed in Alternative 8 could be constructed to allow planted vegetation to survive extreme storm events. Acquisition of right-of-way or conservation easement through a number of private properties would be necessary to construct this alternative which may be cost-prohibitive or logistically unfeasible.

Alternatives-

Alternative 13 – Acquire right-of-way or conservation easement and regrade existing channel north of Floral Avenue to Lakewood/North Iris Avenue

The existing channelized creek in this area of the watershed has been highly disturbed. The original creek has been widened and deepened which has resulted in the creation of a linear open water feature from Floral Avenue to the Lakewood/North Iris Avenue area. Since water now travels more slowly through this area, pollutants and trash now accumulate within this reach of the creek. The existing wetland habitat within the main creek channel north of Floral Avenue has also become overgrown by exotic vegetation (cattails). Regrading the existing channel to create shallower side slopes would result in increased flows (and less stagnant conditions) through this area and would allow for the revegetation of littoral wetland habitat that could be planted with native vegetation to help uptake pollutants.

13.3.8 Tyrone Mobile Home Community (Basin 570500), Unnamed Lake (Basin 570600) Capitol Drive (Basin 570700), Unnamed Lake (Basin 570800) Ola Avenue (Basin 570300) and Arkwright Street (Basin 552150)

Alternatives for the these basins are interrelated and will be discussed together

Flooding LOS Deficiency

Tyrone Mobile Home Community - Basin 570500 - Existing Condition LOS-D. The 25 year design event is expected to overtop the private streets internal to this mobile home community by as much as 3.5 feet. The small pond that is located in the southeast corner of this closed basin does not contain enough volume to store the design event without overtopping. Simulations indicate that once the volume of the pond has been exceeded, the excess floodwater will encroach into the adjacent low-lying area that is north of Fletcher Avenue and east of Ola Avenue. The 25 year event is expected to flood approximately 100 feet of the portion of Ola Avenue that is north of Fletcher Avenue to a maximum depth of approximately 12 inches. The simulations indicated that the flooding problems at the MHP are worsened by the response of the adjacent basin to the west (namely Basin 570600, 570700 and 570800). When the storage capacity of the three adjacent lakes to the west is exceeded, it is anticipated that the basins will discharge toward the mobile home park in a sheetflow manner. During the initial portion of the storm, this discharge is expected to accumulate on the property south of the MHP. When this limited storage is exceeded, the floodwater is expected to surcharge into the community and eventually cause the overtopping of Ola Avenue. Simulations indicated that flood conditions are expected for this basin for storm frequencies as low as the 3 year event.

NOTE: During the design event some floodwater is expected to sheetflow across Fletcher Avenue (roadway elevations estimated from aerial contour maps, survey not available) but only to a depth of approximately 1 inch. This sheetflow will continue in a southerly direction and discharge into the FDOT retention pond that is south of Fletcher and east of Ola Street (Basin 570100). This is mentioned because the depth of flooding (less than 1 inch) does not exceed the threshold depth for street flooding (3 inches minimum) according to the Hillsborough County LOS interpretation for street flooding. However, because of the importance of Fletcher Avenue and the high traffic volumes experienced by this roadway, overtopping due to sheet flow should be addressed.

Mobile home flooding is a potential for approximately 100 percent of the community for the design event, although finished floor elevations have not been established. Because of the nature of the construction of mobile homes it should be mentioned that damage to air conditioning units and ductwork could occur below the finished floor elevations. The mobile home community is at the bottom of the natural storage area for the runoff for this basin and the adjoining basins.

Unnamed Lake-Existing Condition - Basin 570600 - LOS-C. This lake is expected to flood the roadway in this closed basin for the 25 year design event. The pond is located in the middle of the basin and does not contain enough volume to store the design event without overtopping. Simulations indicate that when the volume of the pond has been exceeded, the excess runoff will travel east toward the Tyrone Mobile Home Park. Simulations indicate that approximately 400 feet of roadway may become flooded during the 25 year event to a maximum depth of approximately 10 inches at the low points in the road. The elevation of the adjacent sites was taken from the aerial contour maps and flooding is expected to be approximately 10 inches. House flooding is not expected; although finished floor elevations have not been established.

Capitol Drive - Basin 570700 - Existing Condition LOS-D. Capital Drive is expected to be flooded by the pond that is adjacent to the roadway in this closed basin for the 25 year design event. The pond is located in the middle of the basin and does not contain enough volume to store the design event without overtopping. Simulations indicate that when the volume of the pond has been exceeded, the excess runoff will travel east toward the Tyrone Mobile Home Park. Simulations indicate that approximately 300 feet of roadway may become flooded during the 25 year event to a depth of approximately 6 to 9 inches. The elevation of the adjacent sites was taken from the aerial contour maps and flooding is expected to be approximately 4 to 12 inches at the deepest point for the design storm. House flooding is a potential for 11 homes, although finished floor elevations have not been established.

Unnamed Lake Basin 570800 - Existing Condition LOS-C. This lake is expected to overtop its banks and flood Ola Avenue in this closed basin for the 25 year design event. The overbank floodwater from this lake is expected to discharge onto the north end of Ola Avenue and flow south. The aerial contours indicate that a low point exists immediately south of the Tyrone Mobile Home Community. When the capacity of the natural storage at this location is exceeded, the high water will flood the mobile home community.

Ola Avenue-Basin 570300 – Existing Condition LOS-B. Ola Avenue (south of Fletcher) is expected to be flooded by the pond that is adjacent to the roadway in this closed basin for the 25 year design event. The pond that is located to the west of Ola Avenue does not contain enough volume to store the design event without overtopping. Simulations indicate that when the volume of the pond has been exceeded, the excess runoff will sheetflow to the east into the FDOT detention pond. From there the floodwater is discharged through the ponds control structure into Curiosity Creek. Simulations indicate that approximately 100 feet of roadway may become flooded during the 25 year event to a maximum depth of 4 inches. The elevation of the adjacent sites was taken from the aerial contour maps and flooding is not expected for the 25 year design event. House flooding is not expected; although finished floor elevations have not been established.

Arkwright Street- Basin 552150 - Existing Condition LOS-D. Arkwright Street is expected to be flooded by the pond that is adjacent to the roadway in this closed basin for the 25 year design event. The small pond that is located in the southeast corner of the basin does not contain enough volume to store the design event without overtopping. Simulations indicate once the volume of the pond has been exceeded, the excess runoff will travel overland to the south in the Tyrone Mobile Home Park Area.

The pond on Arkwright Street has a small pump station, but the capacity of the pump station is inadequate to provide relief from flooding during the design event. Overtopping of the roadway is anticipated to be approximately 1.8 feet. The elevation of the adjacent sites was taken from the aerial contour maps and flooding is expected to be approximately 1.8 feet at the deepest point for the design storm. House flooding is a potential for 5 homes, although finished floor elevations have not been established.

Water Quality LOS Deficiency

Based on pollutant loading modeling, these urbanized basins are designated as LOS-F and have a high potential as a source of pollutants and increased runoff. These basins receive little to no stormwater treatment with the existing lakes functioning as catchment basins for excess runoff. Currently no data exists to evaluate existing water quality in any of the unnamed lakes. However, based on estimated pollutant loads for residential land uses, improvements in stormwater treatment for this area should result in improved water quality both to the creek and the lake systems in this area.

Natural Systems Deficiency

This basin also has little remaining natural habitat except for the existing herbaceous wetland habitat along the shorelines of several small ponds and scattered, fragmented patches of upland forest within the existing residential neighborhoods. A small parcel south of the Tyrone MHP contains a relatively undisturbed hardwood forest that will probably be lost to development if not preserved through public acquisition.

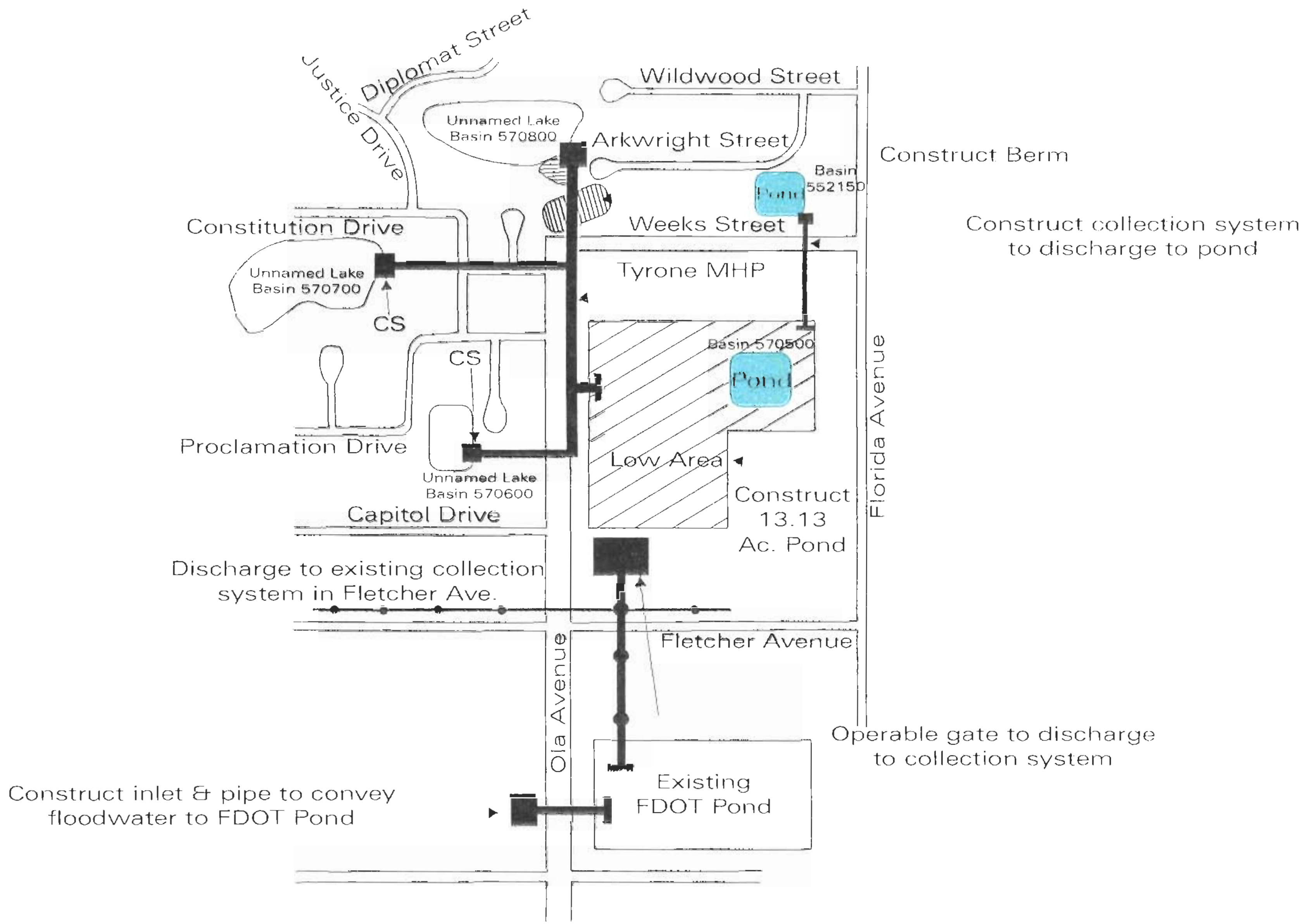
Alternatives-

Alternative 14- Excavate Additional Storage Below 43.00 within the Tyrone MHP (approximately 6.2 Acres) and on the Adjacent Property (Approximately 4.9 Acres) to the South. Construct an Operable Control Structure on Proposed Retention Pond that Discharges into the Collection System of Fletcher Avenue. Construct a Berm at Ola Avenue and West Street to Prevent Sheetflow Discharge from Entering Ola Avenue. Construct Control Structures and Conveyance Systems from the three lakes West of Ola Avenue (Basins 570800, 570700, 570600) and the Pond on Arkwright Street (Basin 552150) to the Proposed 11.1 Acre Retention Pond within Tyrone Mobile Home Park. Construct Inlet and Pipe Connection from Basin 550300 to FDOT Retention Pond.

Water Quantity Issues

Improvements in this area of the watershed are necessary due to the lack of available storage. A regional retention pond was simulated to provide storage for the three lakes west of Ola Avenue and the pond on Arkwright Street. Unfortunately the lowest property within the adjacent basins is located on a portion of the Tyrone Mobile Home Park Community property (Basin 570500) and on the adjacent vacant land immediately to the south. Simulations indicated that approximately 11.1 acres of storage area is required to raise the LOS in the affected basins to A. The vacant land south of the MHP is not large enough to provide all of the storage area necessary to lower the flood elevations to a point where the MHP would not be affected by the design event. Some portion of the MHP must be utilized as additional storage area. This alternative requires that the homes within the MHP that are at or below elevation 43.00 be relocated. This would mean that approximately two-thirds of the MHP (approximately 6.2 acres) would be removed from the flood area and this portion excavated along with the estimated 4.9 acres of upland that is south of the MHP. This proposed regional retention pond would recover storm volume with an operable control structure. It must be remembered that the Curiosity Creek Watershed does not have a surface discharge and is a closed system. This closed system terminates in the City of Tampa, and all stormwater discharge into the retention system of the City is recovered by mechanical means. Therefore, the storm volume collected in the regional retention pond can only be discharged to the collection system of Fletcher Avenue when the City of Tampa is in a position to accept the additional volume. In other words, the control structure at the regional retention pond should not be operated until the City of Tampa has determined that there is no threat from flooding. The control structure (when operated) will discharge to the collection system of Fletcher Avenue at a time after the storm event has passed and the system has recovered. Field investigation has indicated that there is an existing 60 inch RCP under Fletcher Avenue which conveys stormwater to the downstream retention pond. This pond has a control structure that discharges to Curiosity Creek. The proposed alternatives will raise the LOS of Basin 570500 to A.

The existing ponds west of Ola Street and North of Fletcher Avenue (Basins 570800, 570700, and 570600) were simulated with control structures to convey excess floodwater to the proposed regional system. The weir lengths and inverts are as shown below. It should be noted that the control structure inverts are not proposed at the initial water surface elevation. This was done in an effort to maximize the existing storage in the lakes. The control structures act as overflows to



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prevent sheetflow and transport the excess floodwater to the proposed regional pond. This means that the recovery of the ponds after the storm events is through natural means (i.e. percolation).

The pond within basin 570800 in addition to the control structure was simulated with a raised berm on the southwest corner. This berm prevents the floodwater from discharging into Ola Avenue, and forces the water into the control structure without raising the existing design event water surface elevation. These improvements raised the expected LOS to A for these basins. An additional control structure and piped conveyance system on the pond on Arkwright Street raised the expected LOS in basin 552150 to an A. An inlet and pipe system are also required in Basin 550300 to convey water under Ola Avenue and prevent overtopping. This inlet elevation was simulated at 39.30.

The weir lengths and elevations simulated are as follows:

Basin Number	Weir Length (Feet)	Weir Invert (Elevation)
570800	15	44.40

570700	15	43.80
570600	15	43.20
552150	15	41.00

A weir 2 feet in length at invert elevation 37.80 was simulated as the operable gate on the regional system and was expected to recover the flood volume in approximately 72 hours. The recovery of the pond on Arkwright Street and the proposed regional pond will recover together because of the control elevations on the respective ponds. The ponds that are west of Ola (Basin 570800, 570700, 5706000) were simulated with control structure elevations above the high water elevation expected in the regional pond. The FDOT pond (Basin 570100) was expected to also recover in approximately 72 hours. The FDOT pond is expected to have a peak elevation during the recovery operation of 38.1, which is lower than the expected high water elevation during the design event that peaked at 38.7.

Alternative 14			
Description	Basin Number	Existing Elev. 25-yr	Proposed Elev. 25-yr
Tyrone Mobile Home Community	570500	44.5	42.0
Rose Lake Estates	570600	44.7	44.2
	570700	44.8	44.5
Leisure Avenue	570800	46.2	46.1
Floral Drive	570300	41.0	40.4
Florida/Wildwood Ave.	552150	44.8	42.0

Water Quality/Natural Systems Issues

Excavation and reclamation of developed areas (mobile home park) would convert approximately 7.6 acres of high density land use to wetlands/open water. Based on the results of the pollutant loading model, this land use conversion would result in the reduction of annual pollutant loads in the basin by approximately 104.9 lbs. of total nitrogen and 1,486.7 lbs. of TSS (Table 13.1). In concert with the excavation of additional volume for the storage pond, water quality could be improved by creating vegetated littoral zones in the excavated area to provide pollutant (nutrient) uptake. The creation of wetland habitat would also provide habitat for wildlife such as wading birds and juvenile fish.

13.4 THE FOREST HILLS BASIN

13.4.1 Round Lake (Basin 560700)

Flooding LOS Deficiency

Existing Condition LOS-D. The 25 year design event is expected to overtop Veronica Avenue by approximately 7 inches. It is anticipated that approximately 150 feet of roadway will be flooded during the design event. Round Pond does not contain enough volume to store the design event without overtopping. Site flooding is expected to a depth of approximately 2.0 feet in the rear yards of the properties adjacent to the lake. House flooding is a potential at 3 homes, although finished floor elevations have not been established. This basin has been a chronic flood problem because it is a closed basin with no outfall with slow recovery characteristics. As the rainy season progresses available flood storage is used up. As the available storage is diminished in the lake, the potential for flooding increases. This lake recovers flood volume slowly and has had to be pumped by the Hillsborough County Maintenance Units to prevent flooding and /or relieve flooding nearly every wet season.

Water Quality LOS Deficiency

Based on pollutant loading modeling, this urbanized basin is designated as LOS-F and has a high potential as a source of pollutants and increased runoff. This basin also receives little to no stormwater treatment with Round Lake functioning as a catchment basin for excess runoff. Currently no data exists to evaluate existing water quality in Round Lake nor the effects that stormwater runoff may be having on trophic conditions. However, water quality in nearby lakes with similar land uses have some of the highest TSI values for the watershed. Based on estimated pollutant loads for residential land uses, improvements in stormwater treatment for this area should result in improved water quality over time.

Natural Systems Deficiency

This basin also has little remaining natural habitat except for the existing herbaceous wetland habitat along the shoreline around Round Lake and scattered patches of upland forest within the existing residential neighborhoods.

Alternatives-

Alternative 15-Construct a Pump Station on Round Lake to Discharge to Lake Noreast.

Water Quantity Issues

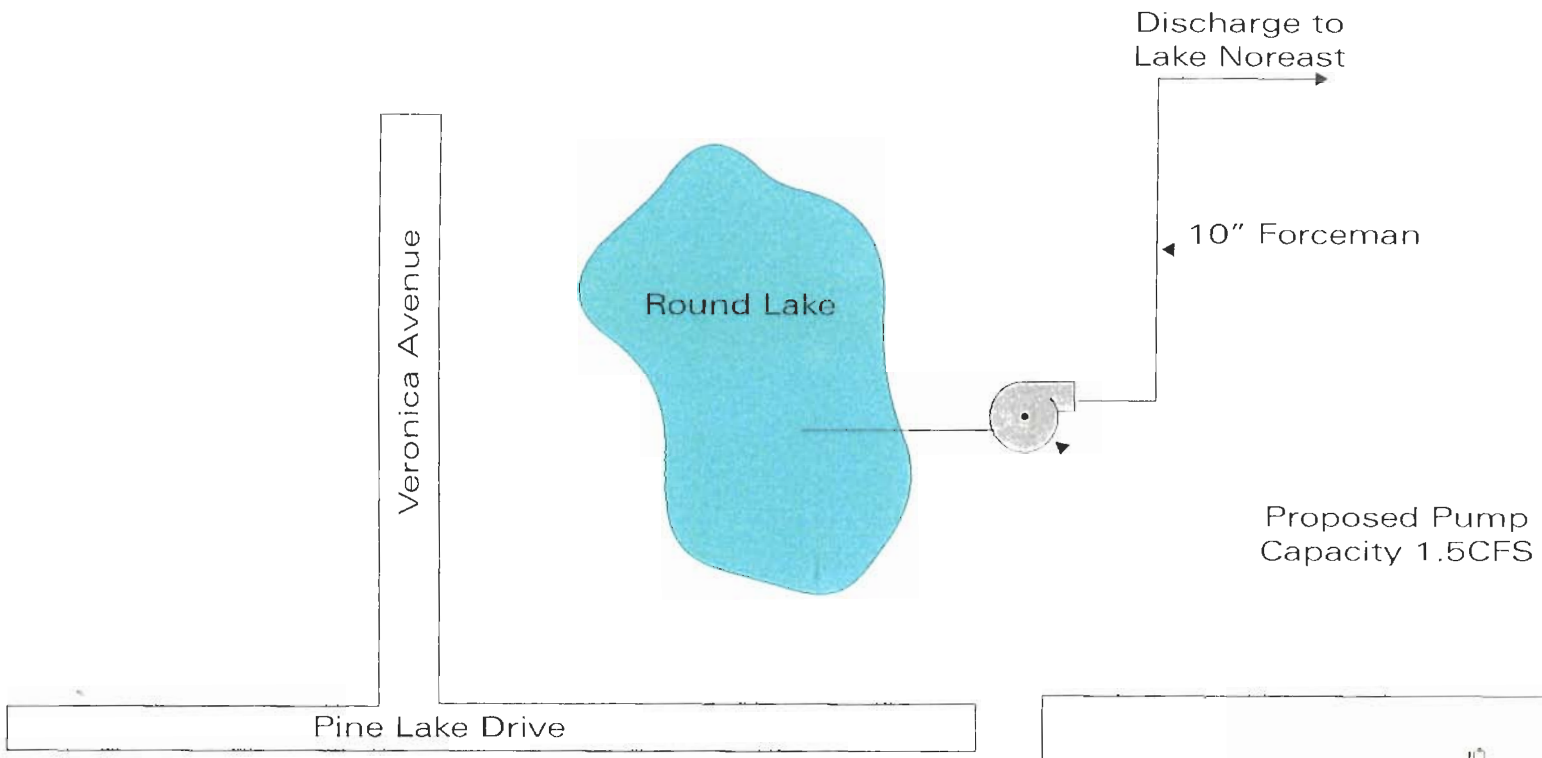
Increasing the volume capacity at Round Lake can be accomplished by controlling the initial water surface elevation with a pump station to elevation 40.80. The pump station would keep Round Lake at an initial water surface elevation so that the roadway of Veronica Avenue would not be overtopped. However since the homes are lower than the road, structural flooding would still remain a potential. There would be no change in the LOS of the basin and it would remain a D. Land available for stormwater ponds is necessary to increase the expected LOS.

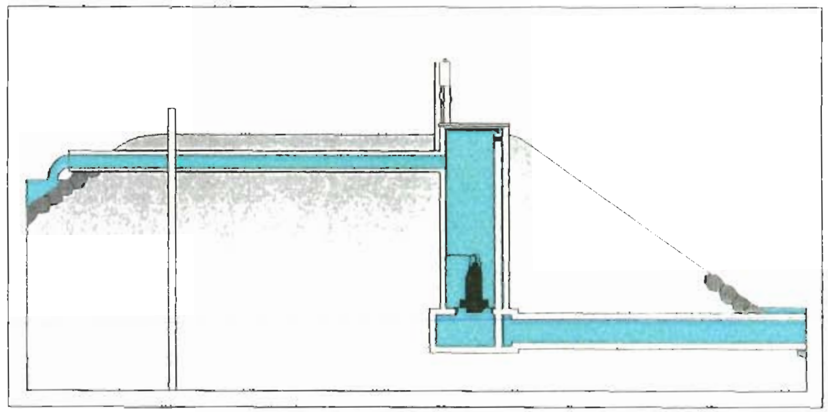
It must be remembered that the Curiosity Creek Watershed does not have a surface discharge and is a closed system. This closed system terminates in the City of Tampa, and all stormwater discharge into the retention system of the City is recovered by mechanical means. Therefore, the storm volume collected in Round Lake can only be discharged to Lake Noreast when the City of Tampa is in a position to accept the additional volume. In other words, the pump station at Round Lake should not be operated until the City of Tampa has determined that there is no threat from flooding.

Alternative 15			
Description	Basin Number	Existing Elev. 25-yr	Proposed Elev. 25-yr
Round Lake	560700	49.1	48.0

Water Quality/Natural Systems Issues

No significant water quality or natural systems improvements are anticipated with this alternative.





PUMP STATION CROSS SECTION

PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION
STORMWATER MANAGEMENT SECTION

KISINGER CAMPO & ASSOCIATES CORP.

CURIOSITY CREEK
ALTERNATIVE 15

13.5 ADDITIONAL NATURAL SYSTEMS ALTERNATIVES

Alternative 16 - Preserve Upland /Wetland Buffer Around Cedar Lake East.

Due to the complexity involved in developing a Level of Service for natural systems, a separate list of alternatives and recommendations was developed for this component of the watershed plan. Due to the intense urbanization that has occurred in the Curiosity Creek watershed during the past several decades, the ability to protect and preserve natural habitats is extremely limited, especially since much of the undeveloped land along the main creek channel is under private ownership by numerous landowners. The few remaining fragments of undeveloped uplands and wetlands (primarily riparian and lake shoreline areas) are surrounded by development and serve as relatively poor habitat for wildlife. These areas are also vulnerable to exotic plant infestation and many areas (e.g., shoreline of Lake Gass) are slowly being overtaken by exotic growth.

However, several ecologically-valuable parcels have been identified both through the County ELAPP program and by project ecologists. All of these parcels have been identified in the following table.

Site	Approximate Size (acres)
Undeveloped parcels around Lake Turtle/Golden Trout (on ELAPP list)	60
Undeveloped pine scrub habitat near Rosewood Estates MHP	10
Undeveloped parcels surrounding Cedar Lake East	12
Undeveloped parcel at Fletcher and I-275	7
Undeveloped parcel adjacent and south of Tyrone MHP	5

Conservation of these lands could serve a number of purposes including:

- providing flood storage and/or water quality improvement if portions of the parcels were used as stormwater treatment facilities,
- reducing future pollutant loads within the watershed since these parcels would no longer be available for development;
- providing natural habitats and corridors for the existing wildlife populations still remaining in the watershed (see Chapter 8 for a more detailed description), and
- passive recreational areas that provide environmental education opportunities for local schools.

In addition, some parcels may have a mix of natural and disturbed areas which could be restored into contiguous tracts of natural habitat through removal of exotic vegetation, replanting of native vegetation, and/or excavation of wetland systems, where appropriate.
Following is a list of sites/parcels that could be acquired to improve and preserve the natural systems of the Curiosity Creek watershed. All of these parcels have been identified to varying degrees in the alternatives listed above; however, their acquisition is not dependent upon the implementation of a flood protection or water quality improvement project:
Another natural systems protection alternative is the acquisition of land using less-than-fee techniques. Less-than-fee involves the acquisition of limited interests in property, as opposed to outright, or fee simple, purchase. Conservation easements are probably the best known example of this type of protection. By purchasing such an easement, the County would obtain and retire certain rights from the landowner, such as the right to erect structures, clear native vegetation, dredge/fill, or conduct other activities inconsistent with the conservation and protection of natural resources on the property.

Less-than-fee methods may provide several benefits since only certain rights associated with a property are acquired, resource protection should be less costly, and the protection of more land can be accomplished with limited funds. Since less-than-fee lands continue in private ownership, they remain on the local property tax rolls. Also, the County would not incur the costs of land management, since management would remain the responsibility of the landowner. Potential disadvantages of less-than-fee methods include less control over the use and management of acquired properties, the necessity to monitor and enforce less-than-fee agreements, the possibility of divergent goals when properties are sold, fewer opportunities for long-term restoration, and reduced or prohibited public access for recreation.

Less-than-fee techniques can be used to supplement fee simple land acquisition; however, pristine lands with the most sensitive natural habitat or complex management requirements should be acquired using fee simple purchase (such as the parcels listed above). Given the numerous landowners within the main creek channel, less-than-fee acquisition may be a viable alternative to preserve the remaining natural riparian habitat in the watershed and may also provide opportunities for additional restoration (e.g., native vegetation plantings, hydrologic restoration/maintenance).

13.6 LAND ACQUISITION

Following is a list of sites/parcels that could be acquired to improve and preserve the natural systems of the Curiosity Creek watershed. All of these parcels have been identified to varying degrees in the alternatives listed above; however, their acquisition is not dependent upon the implementation of a flood protection or water quality improvement project:

Site	Approximate Size (acres)
Undeveloped parcels around Lake Turtle/Golden Trout (on ELAPP list)	60
Undeveloped pine scrub habitat near Rosewood Estates MHP	10
Undeveloped parcels surrounding Cedar Lake East	12
Undeveloped parcel at Fletcher and I-275	7
Undeveloped parcel adjacent and south of Tyrone MHP	5

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Less-than-fee methods may provide several benefits since only certain rights associated with a property are acquired, resource protection should be less costly, and the protection of more land can be accomplished with limited funds. Since less-than-fee lands continue in private ownership, they remain on the local property tax rolls. Also, the County would not incur the costs of land management, since management would remain the responsibility of the landowner. Potential disadvantages of less-than-fee methods include less control over the use and management of acquired properties, the necessity to monitor and enforce less-than-fee agreements, the possibility of divergent goals when properties are sold, fewer opportunities for long-term restoration, and reduced or prohibited public access for recreation.

Less-than-fee techniques can be used to supplement fee simple land acquisition; however, pristine lands with the most sensitive natural habitat or complex management requirements should be acquired using fee simple purchase (such as the parcels listed above). Given the numerous landowners within the main creek channel, less-than-fee acquisition may be a viable alternative to preserve the remaining natural riparian habitat in the watershed and may also provide opportunities for additional restoration (e.g., native vegetation plantings, hydrologic restoration/maintenance).

13.7 ALTERNATIVES/ISSUES IDENTIFIED AT PUBLIC MEETINGS

A list of alternatives/issues that were identified at the public meetings held in the Curiosity Creek watershed in September and November 1999 can be found in Appendix 13-A. Each alternative has been reviewed and a recommendation or response has been developed to address each item. Finally, alternatives were categorized based on general topics or issues that were discussed (and were expressed as being important) during the public meetings. Please note that the alternatives have not been ranked or prioritized but are simply numbered for organizational purposes.

13.8 PREFERRED ALTERNATIVES ANALYSIS

This section ranks the possible solutions and improvements that were previously described. The various alternative evaluations were conducted to produce a list of recommendations for the stormwater management system improvements.

The following factors were considered in the development of the flood control/water quality and natural systems recommendations.

Flood Control

- Public Right-of-Way Improvement – Alternatives potential impact on public roadways
- Level of Service- Alternatives impact on Flood Level of Service. Scoring in this category is only positive as no projects were considered that lowered LOS.Maintenance – Potential for varying levels of maintenance for an alternative (e.g., periodic sediment removal of stormwater treatment pond, removal of nuisance vegetation that could affect the performance of a flood control feature).

Water Quality

- Pollutant Loading – Potential reduction in pollutant loading resulting from implementation of alternative. Pollutant load reduction could be accomplished either through a structural stormwater BMP (flood storage area configured as a wet detention pond) or by the conversion of land use (i.e., from one having a high potential for pollutant loading [high density residential] to one that has a lower potential for pollutant loading [created wetland or upland]).
- Maintenance – Potential for varying levels of maintenance for an alternative (e.g., periodic sediment removal of stormwater treatment pond, removal of nuisance vegetation that could affect the performance of a BMP).

Natural Systems

- Habitat Improvement – Potential for improving (through restoration) or preservation of existing natural systems.

- Maintenance – Potential for an alternative to increase the necessity for maintenance of a natural system (e.g., widening of an existing channel may result in removal of forest canopy and creation of bare ground which may be colonized by exotic vegetation).

Water Supply

- Groundwater Recharge – Potential for an alternative to increase or decrease recharge to a groundwater system (aquifer) or to increase or decrease water use.

Public Acceptance

- Public Acceptance – Based on feedback from Third Public Meeting

Implementation Considerations

- Constructability- Evaluation of degree of difficulty with construction including access, maintenance of traffic and mobility.
- Permittability- Evaluation of degree of difficulty in obtaining permit(s) for construction including wetland mitigation considerations.
- Cost- Construction Costs Estimation

13.9 ALTERNATIVES ANALYSIS DECISION MATRIX

Scores for the alternative matrix were based on hydraulic model results, water quality data (if available), and site-specific field information (See Table 13-2).

Criteria for scoring for Flood Control were developed as follows:

Public Rights of Way

+3 = significant reduction in flooding on Public Roads. No Flooding for design event

+2 = moderate reduction in flooding on Public Roads. Roadway overtops less than 3 inches during the design event.

+1 = small reduction in flooding. Roadway overtops more than 3 inches but less than existing conditions

0 = No change in roadway overtopping

Level of Service (LOS)

+3 = positive net improvement in LOS designation of 3 classifications (example from D to A)

+2 = positive net improvement in LOS designation of 2 classifications (example from C to A)

+1 = positive net improvement in LOS designation of 1classification (example from B to A)

0 = no net change on LOS classification

Maintenance

+3 = maintenance of system will be significantly less than existing conditions

+2 = maintenance of system will be moderately less than existing conditions

+1 = maintenance of system will be slightly less than existing conditions

0 = Maintenance of system will be same as existing conditions

-1 = maintenance of system will be slightly more than existing conditions

-2 = maintenance of system will be moderately more than existing conditions

-3 = maintenance of system will be significantly more than existing conditions

Criteria for scoring for Water Quality were developed as follows:
Pollutant Loading

+3 = significant reduction in pollutants expected and/or maintenance of system will not be problematic

+2 = moderate reduction in pollutants expected and/or maintenance of system will not be problematic

+1 = small reduction in pollutants expected and/or maintenance of system will not be problematic

0 = no reduction in pollutants expected

-1 = small increase in pollutants expected and/or maintenance of system will be slightly problematic

-2 = moderate increase in pollutants expected and/or maintenance of system will be moderately problematic

-3 = significant increase in pollutants expected and/or maintenance of system will be significantly problematic

Criteria for scoring for Natural Systems were developed as follows:
Habitat Improvement:

+3 = significant protection/preservation/restoration of natural systems expected and/or maintenance of system will not be problematic

+2 = moderate protection/preservation/restoration of natural systems expected and/or maintenance of system will not be problematic

+1 = low level of protection/preservation/restoration of natural systems expected and/or maintenance of system will not be problematic

0 = no protection/preservation/restoration of natural systems expected and no negative impact (loss/disturbance) to natural systems expected

-1 = low level of negative impact (loss/disturbance) to natural systems and/or maintenance of system will be slightly problematic

-2 = moderate level of negative impact (loss/disturbance) to natural systems and/or maintenance of system will be moderately problematic

-3 = significant level of negative impact (loss/disturbance) to natural systems and/or maintenance of system will be significantly problematic

Criteria for scoring for Water Supply were developed as follows:
Groundwater Recharge:

+3 = significant potential for recharge to surface and/or groundwater supplies or significant reduction in water use resulting from project implementation

+2 = moderate potential for recharge to surface and/or groundwater supplies or moderate reduction in water use resulting from project implementation

+1 = small potential for recharge to surface and/or groundwater supplies or small reduction in water use resulting from project implementation

0 = no change in recharge to surface and/or groundwater supplies or no reduction in water use resulting from project implementation

-1 = small potential for losses from surface and/or groundwater supplies or small increase in water use expected as a result of project implementation

-2 = moderate potential for losses from surface and/or groundwater supplies or moderate increase in water use expected as a result of project implementation

-3 = significant potential for losses from surface and/or groundwater supplies or significant increase in water use expected as a result of project implementation

Criteria for scoring Public Acceptance were developed as follows:
Public Acceptance:
+3 = public response significantly in favor of this alternative
+2 = public response moderately in favor of this alternative
+1 = public response slightly in favor of this alternative
0 = no reaction positive or negative for this alternative
-1 = public response significantly against this alternative
-2 = public response moderately against this alternative
-3 = public response significantly against this alternative

Criteria for scoring Constructability considerations were developed as follows:
Construction:
+3 = construction of system appears to be significantly simplistic
+2 = construction of system appears to be moderately simplistic
+1 = construction of system appears to be slightly simplistic
0 = construction of system appears to be neither simplistic nor complex
-1 = construction of system appears slightly complex
-2 = construction of system appears to be moderately complex
-3 = construction of system appears to be significantly complex

Permittability:
+3 = permitting of system is anticipated to be highly feasible
+2 = permitting of system is anticipated to be moderately feasible
+1 = permitting of system is anticipated to be somewhat feasible
0 = permitting of system is not feasible

Cost: no ranking given –costs estimate totals only, See Appendix 13 B for cost breakdown

Table 13.2

uriosity Creek Watershed Management Plan

lternatives Analysis Decision Matrix

#	PROJECT	PROJECT DESCRIPTION	FLOOD CONTROL			WATER QUALITY	NATURAL SYSTEMS	WATER SUPPLY	PUBLIC ACCEPTANCE	IMPLEMENTATION CONSIDERATIONS			OVERALL SCORE
			Public Right-of-Way Improvements	Change in LOS	Maintenance	Pollutant Loading/Maintenance	Habitat Improvement/Maintenance	Groundwater Recharge	Public Acceptance	Constructability	Permittability	Cost (thousands)	
1A	Lake Sophia Pump Station (a.k.a., Roy Haynes Park Pump Station	*Construct pump station to recover volume at Lake Sophia and basin 560800*	3	2	-2	1	0	0	1	-1	1	321	5
1B	Lake Sophia Excavation and Pump Station	*Excavate additional volume at Lake Sophia and install pump station. Restore/create wetland habitat within storage area.*	3	3	-2	1	2	0	1.4	-1	1	337	8.4
1C	Gravity System Outfall for NW	*Construct gravity outfall for Basin 560800, Lake Sophia, Round Lake , Pine Lake, Pine Pond to Lake Noreast*	3	2	0	0	0	0	1.3	-3	0	457	3.3
2	Pine Pond Storage	*Acquire vacant lot and excavate additional volume at Pine Pond. Restore/create wetland habitat within storage area.*	0	2	1	1	0	0	1.7	1	1	20	7.7
3	Lake Cedar West Stormwater Treatment	*Implement stormwater treatment bmp's at strategic locations (existing inlets/junction boxes) .*	0	0	0	2	1	0	2.1	-3	2	165	4.1
4	Lake Cedar West Shoreline Revegetation	*Encourage homeowners to revegetate lake shoreline.*	0	0	0	2	3	0	2.2	3	3	25	13.2
5	Lake Dorsett Stormwater Treatment/Sewer Connections	*Implement stormwater treatment bmp's at strategic locations (existing inlets/junction boxes) and connect residences using septic tank systems to main sewer line.*	0	0	0	2	1	0	1.4	-3	2	65	3.4
6	Lake Golden Trout Excavation, Acquisition, and Wetland/Upland Restoration	*Purchase existing parcels surrounding Lake Golden Trout and Lake Butler, excavate 6.1 acres of additional volume for stormwater treatment, and create wetland and upland habitat.*	2	2	-1	2	3	2	2.4	-1	2	569	13.4
7	*Country Club Dr. Structures**	*Install twin box culverts, and raise road.**	*3*	*3*	*3*	*0*	*0*	*0*	*1.7*	*1*	*3*	*195*	*14.7*
8	122nd Ave. Improvements	*Install twin box culverts, and raise road.*	3	3	3	0	0	0	1.8	1	3	72	14.8
9	Floodplain Reclamation at Mobile Home Community (basins 550500, 550600, 550700)	*Purchase and remove existing mobile homes in floodplain, restore floodplain habitat by replanting with native vegetation.*	0	1	3	2	2	0	2.1	2	3	665	15.1
A	Channel Improvements and Compensation Storage near Fletcher and 131st Ave.	*Construct channel improvements upstream and downstream of Florida Ave. Construct 6 acre compensation storage upstream of Fletcher Ave. Improve conveyance under 138th Ave. Restore/create wetland/riparian habitat along creek and within storage pond.*	3	3	-1	2	-1	0	1.6	-2	1	3808	6.6
10B	Channel Improvements and Reclaim Floodplain, and Compensation Storage near Fletcher and 131st Ave.	*Construct channel improvements downstream of Florida Ave. Reclaim floodplain at MHP and excavate as partial compensation storage upstream of Fletcher Ave. Improve Conveyance under 138th Ave. Restore/create wetland/riparian habitat along creek and within storage pond.*	3	3	-2	2	2	0	1.8	-2	1	1020	8.8
11	Taliaferro St. Floodplain Reclamation and Stormwater Treatment Pond	*Purchase homes in floodplain and provide additional storage and treatment. Restore/create wetland habitat within storage pond.*	3	3	-1	3	2	0	2.2	1	3	525	16.2
12	Floral Ave. Improvements	*Acquire sand pine scrub habitat for preservation, excavate additional storage, construct control structure in retention pond south of Leisure Ave. Construct channel improvements within Rose Lakes Estates MHP, increase conveyance of conduits under internal private drive in Rose Lake Estates, excavate 4.5 acre floodplain mitigation pond downstream of Rose Lake Estates, Clean and snag channel, construct control structure, remove existing dirt road behind FDOT detention pond.*	2	3	-2	3	3	0	2	-1	1	2197	11
13	Floral Ave. Channel Improvements	*Regrade existing channel north of Floral Ave. to Lakewood/North Iris Ave. Restore/create wetland/riparian habitat along channel.*	3	0	3	2	2	0	2.4	-2	1	147	11.4
14	Tyrone Mobile Park Area Flood Control Improvements	*Purchase mobile homes and create 11 acre flood storage pond. Construct operable control structure on proposed storage pond that discharges to Fletcher Ave. collection system. Construct berm at Ola Ave. and West St. Construct control structures and conveyance systems from three lakes west of Ola Ave. and pond on Arkwright St. to the proposed storage pond. Construct inlet and pipe connection from basin 550300 to FDOT detention pond. Restore/create wetland/riparian habitat within storage pond.*	2	2	-2	2	1	0	1.6	-2	2	2944	6.6
15	Round Lake Pump Station	*Construct pump station to recover volume at Round Lake*	3	2	-2	0	0	0	1.1	-2	2	526	4.1
16	Preserve upland/wetland buffer around Cedar Lake East	*Purchase open land around Cedar Lake East to preserve from future development, enhance wildlife utilization, and reduce pollutant loading. Portions of site may be used for stormwater treatment for adjacent untreated residential runoff. Site could be converted to a passive recreational area/park.*	0	0	0	3	2	1	2.3	2	3	412	13.3

*** Country Club Drive Project is located in the City of Tampa.**
Shown here for informational purposes only. Should not be considered
as a Hillsborough County Project without cooperation of the City of Tampa.

CHAPTER 14
SECOND PUBLIC MEETING

Curiosity Creek Watershed Management Plan

The following tables summarize the raw, unabridged, comments and suggestions received at the Second Public Meeting (Workshop) held at Buchanan Middle School on Saturday, November 6, 1999. There were a total of 36 people who signed the attendance forms. Some of those in attendance preferred to observe rather than to participate in the exercises.

Four working groups formed. Membership in a working group ocasionally changed, but the nominal group size was seven to eight members. Two groups chose internal members as facilitators. Two groups used the services of external facilitators. The working groups that had external facilitators attempted to respond to both exercises. The two groups with internal facilitators focused almost exclusively on alternatives.

The working groups were charged with first brainstorming and then prioritizing (multi-voting was suggested as a method for prioritizing, although only one working group used that technique) their responses to the questions “What Criteria should be considered when evaluating alternatives (to determine which is optimum)?” and “What sort of alternatives should be considered when developing a recommendation for the final watershed management plan?” The following tables are the contract scope of services wordings, and the raw, unabridged comments from each working group. Orders are approximate, with the top item in the table generally higher in priority than the lowest item.

CRITERIA – From Comments and Suggestions from Second Public Meeting (Workshop) – November 6, 1999

ALTERNATIVES – From Comments and Suggestions from Second Public Meeting (Workshop) – November 6, 1999

SCOPE OF SERVICES DOCUMENT	PUBLIC MEETING #2 - GROUP 1	Public Meeting #2 - Group 2	Public Meeting #2 - Group 3	Public Meeting #2 - Group 4
regional detention areas to control peak flood flows	work with city to fix flooding	Blue Sink plugged (unplug)	trash disposal	restore old flow system for (inside) Curiosity Creek
regional detention areas to enhance water quality	build outfall from Blue Sink to river	habitat restoration - native plants		restore old flow from (discharge) Curiosity Creek to Hillsborough River through Blue Sink
channel improvements	continue to seek ways to open Blue Sink to relieve flooding	stormwater evaluation		no diversion of water from Lake Magdalene
structure crossing improvements	cooperate with FDOT on maintenance and design	buy sensitive areas (ELAPP)		restore Floral St. section (cleanup)
floodplain property acquisition	build retention ponds that are more like natural wetlands	flooding - natural areas		restore flow from lake north of Bearss and open spring at Connie Street
floodproofing of structures	when fixing flooding, do not disturb creek	control fertilization		integrate (County) study with City study
revised water quantity regulations	do not divert water from Sweetwater Creek Basin	no diversion of water from Sweetwater Creek		prevent road runoff and trash (FDOT and County)
revised floodplain regulations	when fixing flooding by retention, do not keep water too high too long - kills trees	beautification		provide City or County wastewater sewers
regional stormwater treatment facilities	buy flooded property from willing land-owners - use for retention	need access to creek		provide accessible sources for "friendly" plants
pollutant source control measures	store more water in lakes if possible	control and pick-up trash		provide more (intensive) education
biofiltration swales and filter strips	determine inflow from south of Blue Sink - if this causes flooding	cut down over-growth		water quality neighborhood watch (lakes and creek)
stormwater retrofitting of existing developments	install trash and sediment separators in existing storm inlets	re-establish native plants		

CRITERIA – From Comments and Suggestions from Second Public Meeting (Workshop) – November 6, 1999

SCOPE OF SERVICES DOCUMENT	PUBLIC MEETING #2 - GROUP 1	PUBLIC MEETING #2 - GROUP 2	PUBLIC MEETING #2 - GROUP 3	PUBLIC MEETING #2 - GROUP 4
flood protection level of service		water quality	flooding	
water quality level of service		overdeveloping sensitive areas	maintenance	
natural systems level of service		lack of City - County cooperation	water quality	
public education			vermin control	
public recreation benefits			mosquito control	
initial cost estimates				
operation and maintenance requirements				
easement and right of way requirements				
regulatory constraints				
water supply enhancement				
natural systems enhancement				

CHAPTER 15

PROPOSED LEVEL OF SERVICE

Proposed level of service determinations were developed for both water quantity and water quality treatment using models described in Chapters 4 and 10, respectively. Alternatives in Chapter 13 were developed based on repeated simulations of the hydraulic model. Water quality modeling was based on the alternatives established for water quantity.

Water Quantity

The proposed recommendations from Chapter 13 were simulated using the design storm event described in Chapter 4 (25 year, 24 hour event). The results of the simulations were compared against the landmark flood elevations described and established in Chapter 6. As a result a proposed level of service was established for the subbasins and the overall watershed. The proposed LOS of the Curiosity Creek watershed is reflective of the worst case for each major subbasin and the LOS for each major subbasin is reflective of the worst case for each subbasin. The proposed LOS for each subbasin is shown in Table 15-1.

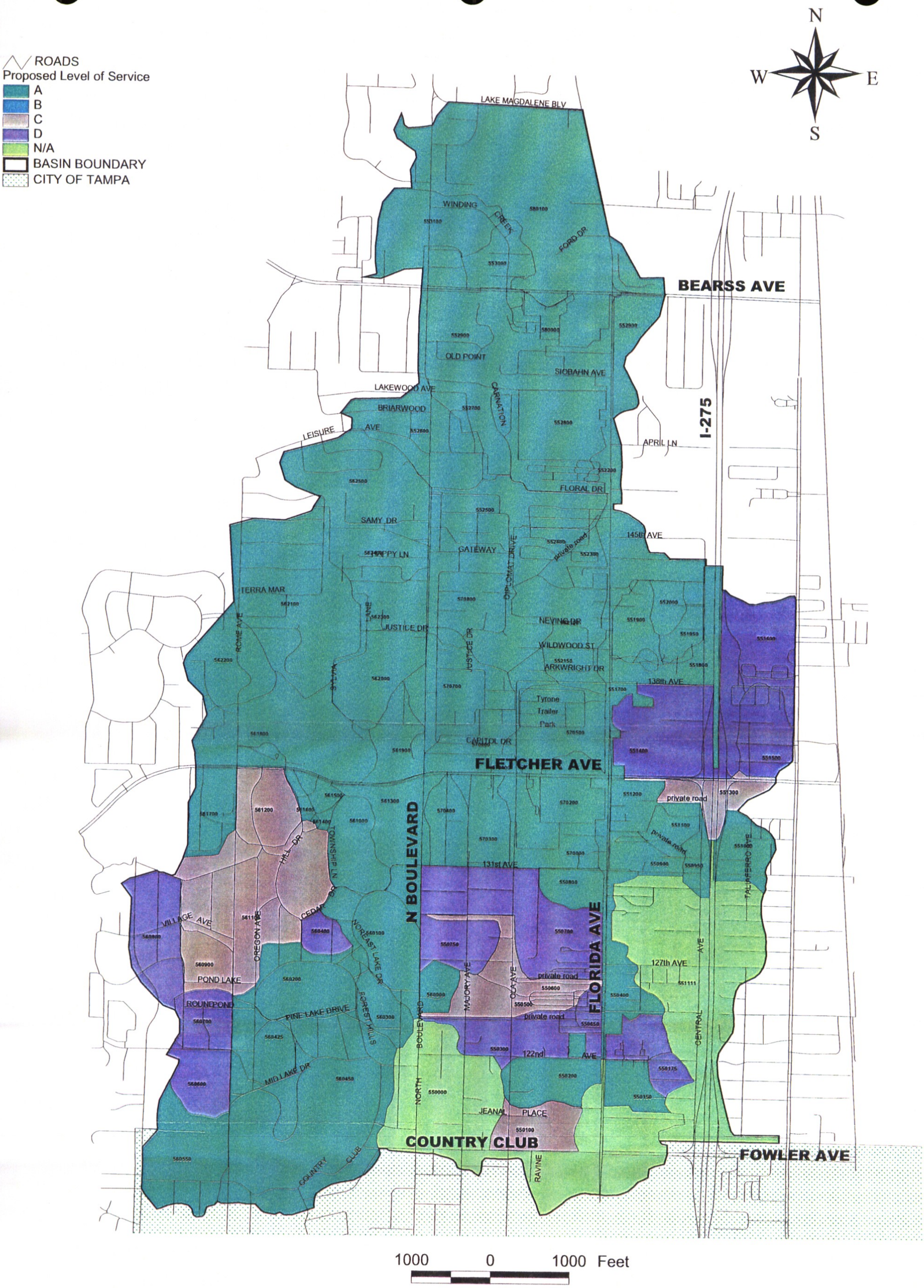
Water Quality

Recommended alternatives from Chapter 13 were included in a new pollutant loading model simulation which incorporated both land use conversions and stormwater treatment impacts. Since pollutant loads are heavily influenced by land use, changes from urbanized land cover (e.g., high density residential, commercial) to natural land cover (e.g., uplands, wetlands, open water) were expected to have significant effects on improving water quality within a basin. Several alternatives propose land use conversions in concert with the implementation of stormwater treatment systems (flood storage ponds). The proposed flood storage ponds are assumed to have an extended detention time and were simulated using the wet detention removal efficiencies described in the model.

15.1 THE NORTHWEST LAKE SYSTEM PROPOSED LEVEL OF SERVICE

Water Quantity

The Northwest Lake System has a Proposed LOS of D. Approximately five of the subbasins with this major system are not components of the primary conveyance system. Some of these were designated as LOS D. Further study or recent finished floor elevations within these subbasins may indicate that the structures are higher than expected. This may change the expected LOS. These offline systems were not part of the more detailed study area and may have hydraulic connections to the conveyance system that could not be simulated.



CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES CORP.

FIGURE 15-1

PROPOSED FLOOD
LEVEL OF SERVICE DIAGRAM

HILLSBOROUGH COUNTY
FLORIDA

Table 15.1
Existing vs. Proposed Conditions Level of Service
Curiosity Creek Watershed

Adjacent Road name	Basin Number	Existing Level of Service	Proposed Level of Service
COUNTRY CLUB	550100	D	D
122nd	550150	A	A
121st	550175	D	D
FLORIDA AVE	550200	A	A
122ND AVE	550300	D	D
FDOT POND	550400	A	A
PRIVATE ROAD	550500	D	C
PRIVATE ROAD	550600	D	C
FLORIDA AVE	550650	D	D
PRIVATE ROAD	550700	D	C
MARJORY	550750	D	D
LINDA	550800	A	A
138TH	550900	D	A
CENTRAL AVE	550950	A	A
TALIAFERRO ST	551000	D	A
PRIVATE ROAD	551100	D	A
POND FOR DEV.	551200	A	A
PRIVATE ROAD	551300	D	C
FLETCHER AVE	551400	C	D
ORANGE AVE.	551500	D	D
PRIVATE ROAD	551600	D	D
FDOT POND	551700	A	A
138TH AVE.	551800	B	A
APT COMPLEX	551900	A	A
APT COMPLEX	551950	A	A
APT COMPLEX	552000	A	A
WILDWOOD	552100	D	A
ARKWRIGHT	552150	D	A
FDOT POND	552200	A	A
PRIVATE ROAD	552300	C	A
PRIVATE ROAD	552400	D	A
PRIVATE ROAD	552500	D	A
LEISURE AVE.	552600	D	A
FLORAL DR	552700	D	A
PRIVATE DEVEL	552800	A	A
OLD POINTE	552900	A	A
WINDING CR DR.	553000	A	A
WINDING CR DR.	553100	A	A
NORTH BLVD	560000	A	A
NORTH BLVD	560100	A	A
FOREST HILLS DR	560200	C	A
NOREAST DR	560300	C	A

Table 15.1
Existing vs. Proposed Conditions Level of Service
Curiosity Creek Watershed

Adjacent Road name	Basin Number	Existing Level of Service	Proposed Level of Service
CEDAR DR	560400	D	D
MIDLAKE DR	560425	A	A
COUNTRY CLUB	560450	A	A
JEROME AVE	560550	A	A
ROME AVE	560600	D	D
ROME AVE	560700	D	D
OAKLEAF DR	560800	D	D
ROME AVE	560900	D	C
LAKE NOREAST DR	561000	A	A
TOWNSEND LN.	561100	C	C
FOREST HILLS DR	561200	C	C
131ST AVE	561300	A	A
TOWNSEND LN.	561400	A	A
EDITH ST.	561500	A	A
FOREST HILLS DR	561600	A	A
ROME AVE	561700	A	A
SYLVIA LN.	561800	A	A
SYLVIA LN.	561900	A	A
SYLVIA LN.	562000	A	A
SYLVIA LN.	562100	C	C
ROME AVE	562200	A	A
JUSTICE DR.	562300	A	A
HAPPY LN.	562400	A	A
SAMY DR	562500	A	A
131ST AVE	570000	A	A
OLA	570100	A	A
PRIVATE ROAD	570200	A	A
OLA	570300	B	A
HAMNER	570400	A	A
PRIVATE ROAD	570500	D	A
CAPITOL DR.	570600	C	A
CAPITOL DR.	570700	D	A
JUSTICE	570800	B	A
BEARSS AVE.	580000	A	A
BEARSS AVE.	580100	A	A

NA- No affected landmarks under shown category

NO DATA- Landmark elevations not available-LOS assumed =A

[shaded box] Indicates increase in LOS over Existing Conditions

Water Quality

Based on water quality modeling, this area has a proposed LOS of F. Both total nitrogen (TN) and total suspended solids (TSS) LOS were also scored as F. None of the proposed alternatives improved the LOS scores for any of the subbasins in this area.

15.2 THE CURIOSITY CREEK MAIN CHANNEL PROPOSED LEVEL OF SERVICE

Water Quantity

The Curiosity Creek Main Channel has a Proposed LOS of D. Approximately four of the subbasins within this major system are not components of the primary conveyance system. Some of these were designated as LOS D. Further study or recent finished floor elevations within these subbasins may indicate that the structures are higher than expected. This may change the expected LOS. These offline systems were not part of the more detailed study area and may have hydraulic connections to the conveyance system that could not be simulated.

Water Quality

Based on water quality modeling, this area has a proposed LOS of F. However, implementation of the alternative in subbasin 551100 resulted in an improvement of that subbasin's overall LOS from D to B, the TN LOS from F to D, and the TSS LOS from C to A (Table 15.2). Implementation of the alternative in subbasin 570500 resulted in that subbasin's overall LOS changing from F to D, TN from F to D, and TSS from F to C.

15.3 THE FOREST HILLS PROPOSED LEVEL OF SERVICE

Water Quantity

The Forest Hills Basin has a Proposed LOS of D. It appeared that one subbasin within this major system is not a component of the primary conveyance system. Further study or recent finished floor elevations within these subbasins may indicate that the structures are higher than expected. This may change the expected LOS. These offline systems were not part of the more detailed study area and may have hydraulic connections to the conveyance system that were not simulated.

Water Quality

The proposed LOS for this area was F. Both TN and TSS LOS were also scored as F. None of the proposed alternatives improved the LOS scores for any of the subbasins in this area.

15.4 THE CURIOSITY CREEK WATERSHED PROPOSED LEVEL OF SERVICE

Water Quantity

The Curiosity Creek Watershed has a Proposed LOS of D. It should be noted that not all the subbasins within the study area were evaluated with the same level of detail. The subbasins that were not connected to the major conveyance network could not be evaluated with a higher degree of accuracy because accurate survey was not available for those basins. This made the estimation of LOS more speculative in some basins and would tend to skew the analysis toward the lower LOS designations. Within the study area, approximately 13 percent of the basins did not have accurate enough information to formulate an alternative that would increase the LOS. Many of these subbasins were designated as LOS D.

Therefore, according to the definition for the overall LOS designation, it may appear that the alternatives produce no results. This is because the existing LOS and the proposed LOS are both D. It should be noted that it would take only one subbasin with a reduced LOS to produce this designation for the entire watershed. While this does produce a consistent standard, it may not be showing an accurate picture of the performance of the proposed alternatives.

Figure 15-1 shows the Proposed Level of Service for the Curiosity Creek Watershed. It is evident that the majority of the subbasins have a Proposed LOS of A. If an area weighted method is utilized to establish an average LOS for the watershed, the results are much different. An area weighted approach to achieve an overall designation requires that a value be set on each letter designation. With A=4 and D=1 the overall score for the watershed is 3.6 which is close to an A designation and appears to be more representative of Figure 15-1.

Water Quality

The proposed water quality treatment LOS for the watershed is F. Several factors contribute to this low score including both the historical changes in the watershed as well as the methodology (LOS scoring criteria, loading calculations) used in the pollutant loading model. Extensive urbanization and development have occurred in this watershed which has resulted in almost exponential increases in pollutant loads (based on model calculations) compared to undeveloped conditions. With increasing impervious surface area, runoff coefficients also increase dramatically resulting in higher pollutant loading rates. In addition to simulations using the proposed alternatives, a simulation of the model was performed assuming 100% treatment of all the land uses within every subbasin using wet detention. Despite this level of treatment, the overall LOS for the watershed did not change. Barring significant land use changes (converting residential/commercial areas to upland forests or wetlands) it will be extremely difficult to improve the existing LOS standards.

Unfortunately, the model used in this study does not account for the timing or variability of rainfall that can occur throughout the year (which can influence annual pollutant loads) nor the effects of pollutants on specific waterbodies (lakes, streams). However, the model does serve as a good planning-level tool and can help identify areas in need of water quality improvement. Intuitively, the strategic implementation of stormwater BMP's should have a positive effect on improving water quality in both the creek and lake systems within the watershed. These improvements will not necessarily be reflected in the output of the pollutant loading model and will need to be assessed using field collected data (e.g., stations representing the various reaches of the creek). Additional discussion regarding monitoring is addressed in Chapter 18.

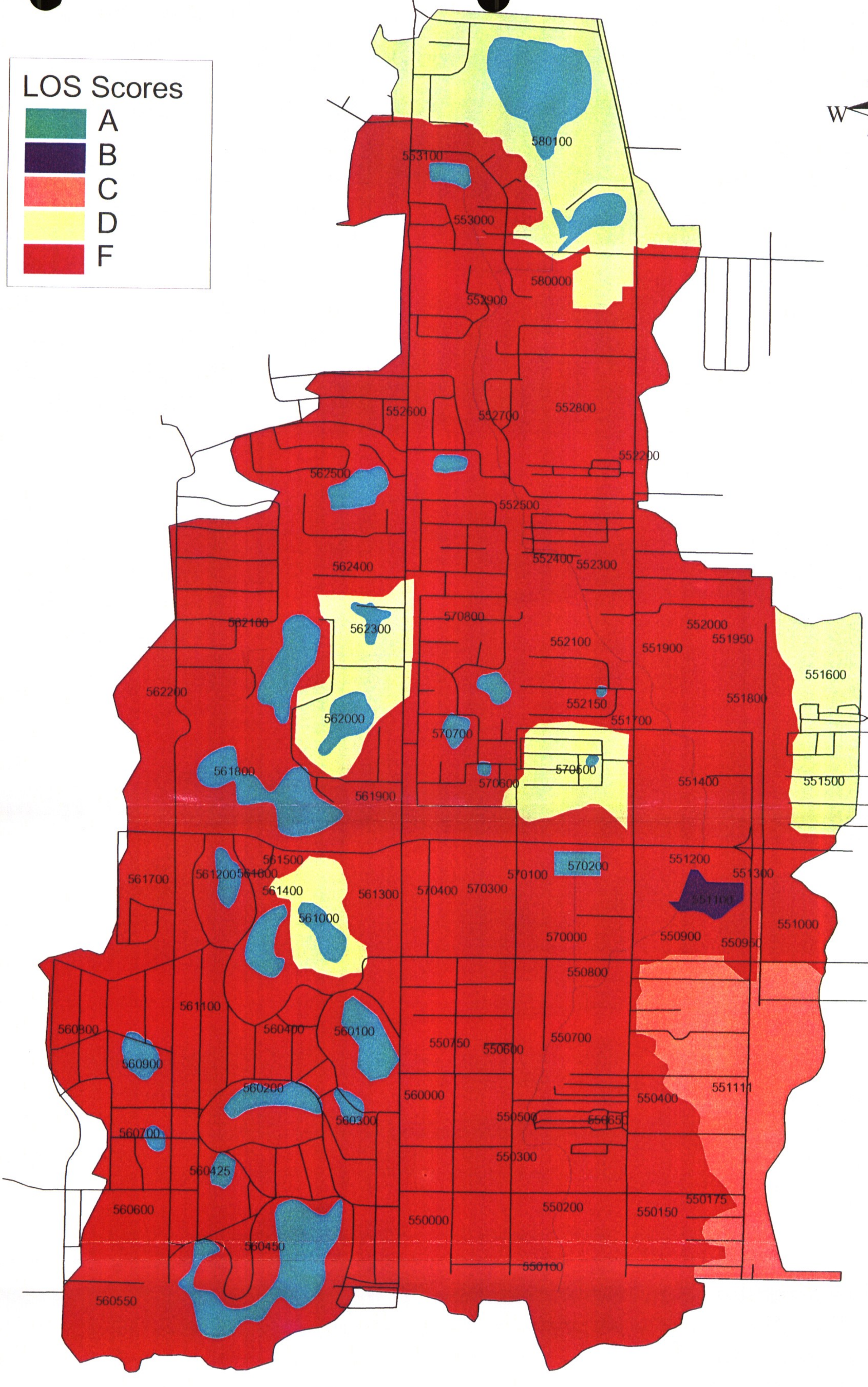
Table 15.2
Existing vs. Proposed Water Quality Treatment Level of Service
Curiosity Creek Watershed

	Basin Number	Existing TN LOS	Proposed TN LOS	Existing TSS LOS	Proposed TSS LOS	Existing Overall LOS	Proposed Overall LOS
ARKWRIGHT	552150	F	F	F	F	F	F
FDOT POND	552200	F	F	F	F	F	F
PRIVATE ROAD	552300	F	F	F	F	F	F
PRIVATE ROAD	552400	F	F	F	F	F	F
PRIVATE ROAD	552500	F	F	F	F	F	F
LEISURE AVE.	552600	F	F	F	F	F	F
FLORAL DR	552700	F	F	F	F	F	F
PRIVATE DEVEL	552800	F	F	F	F	F	F
OLD POINTE	552900	F	F	F	F	F	F
WINDING CR DR.	553000	F	F	F	F	F	F
WINDING CR DR.	553100	F	F	F	F	F	F
NORTH BLVD	560000	F	F	F	F	F	F
NORTH BLVD	560100	F	F	F	F	F	F
FOREST HILLS DR	560200	F	F	F	F	F	F
NOREAST DR	560300	F	F	F	F	F	F
CEDAR DR	560400	F	F	F	F	F	F
MIDLAKE DR	560425	F	F	F	F	F	F
COUNTRY CLUB	560450	F	F	D	D	F	F
JEROME AVE	560550	F	F	F	F	F	F
ROME AVE	560600	F	F	F	F	F	F
ROME AVE	560700	F	F	F	F	F	F
OAKLEAF DR	560800	F	F	F	F	F	F
ROME AVE	560900	F	F	F	F	F	F
LAKE NOREAST DR	561000	D	D	D	D	D	D
TOWNSEND LN.	561100	F	F	F	F	F	F
FOREST HILLS DR	561200	F	F	F	F	F	F
131ST AVE	561300	F	F	F	F	F	F

Table 15.2
Existing vs. Proposed Water Quality Treatment Level of Service
Curiosity Creek Watershed

	Basin Number	Existing TN LOS	Proposed TN LOS	Existing TSS LOS	Proposed TSS LOS	Existing Overall LOS	Proposed Overall LOS
TOWNSEND LN.	561400	D	D	D	D	D	D
EDITH ST.	561500	F	F	F	F	F	F
FOREST HILLS DR	561600	F	F	F	F	F	F
ROME AVE	561700	F	F	F	F	F	F
SYLVIA LN.	561800	F	F	D	D	F	F
SYLVIA LN.	561900	F	F	D	D	F	F
SYLVIA LN.	562000	D	D	D	D	D	D
SYLVIA LN.	562100	F	F	F	F	F	F
ROME AVE	562200	F	F	F	F	F	F
JUSTICE DR.	562300	D	D	D	D	D	D
HAPPY LN.	562400	F	F	F	F	F	F
SAMY DR	562500	F	F	F	F	F	F
131ST AVE	570000	F	F	F	F	F	F
OLA	570100	F	F	F	F	F	F
PRIVATE ROAD	570200	F	F	F	F	F	F
OLA	570300	F	F	F	F	F	F
HAMNER	570400	F	F	F	F	F	F
PRIVATE ROAD	570500	F	D	F	C	F	D
CAPITOL DR.	570600	F	F	F	F	F	F
CAPITOL DR.	570700	F	F	F	F	F	F
JUSTICE	570800	F	F	F	F	F	F
BEARSS AVE.	580000	F	F	F	F	F	F
BEARSS AVE.	580100	F	F	D	D	D	D

[shaded box] = Indicates Location of Water Quality Alternative/Change in Land Use

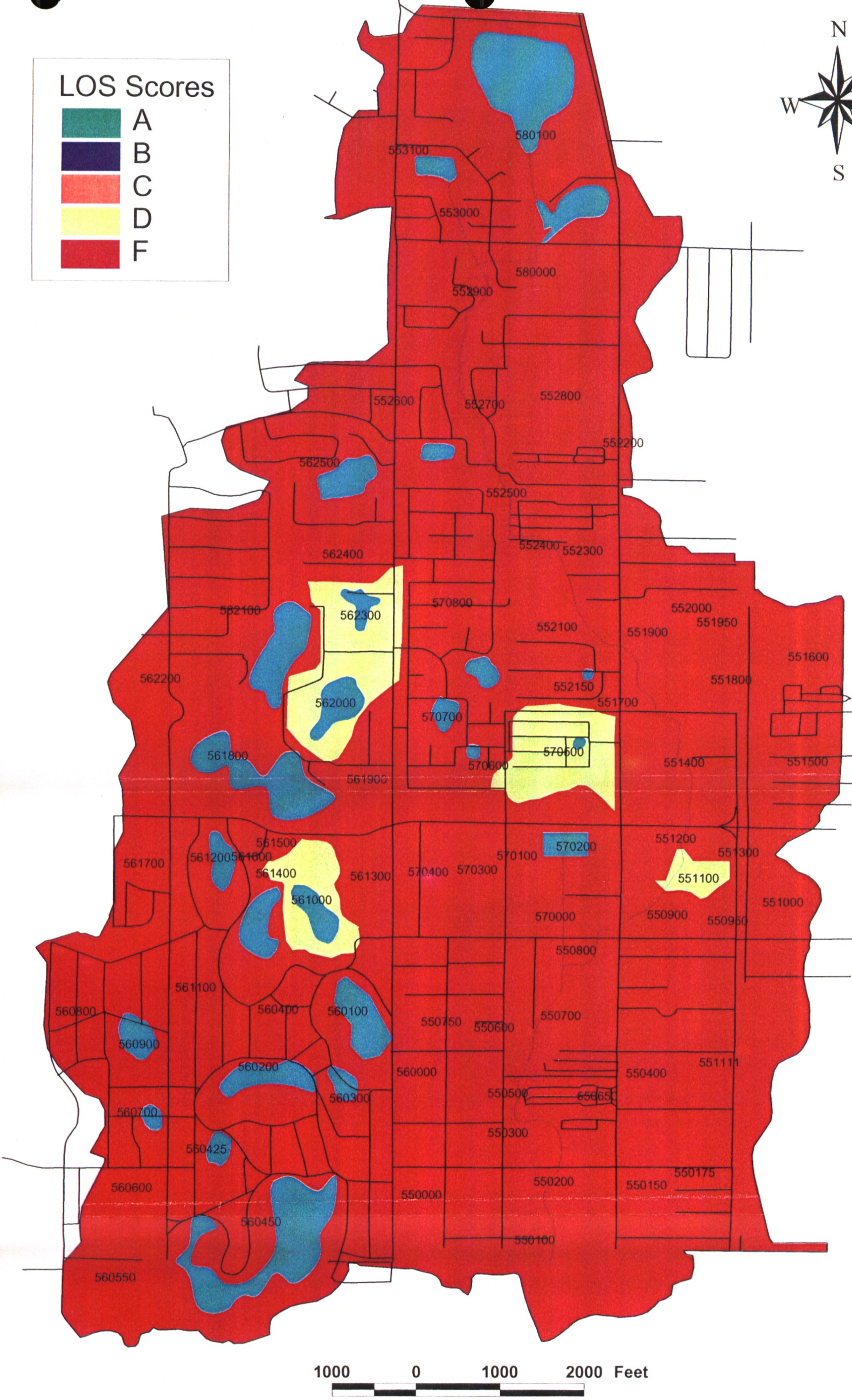


HILLSBOROUGH COUNTY
FLORIDA

CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES, CORP.
SCHEDA ECOLOGICAL ASSOCIATES, INC.

Figure 15-2. Proposed Water Quality Treatment Overall LOS

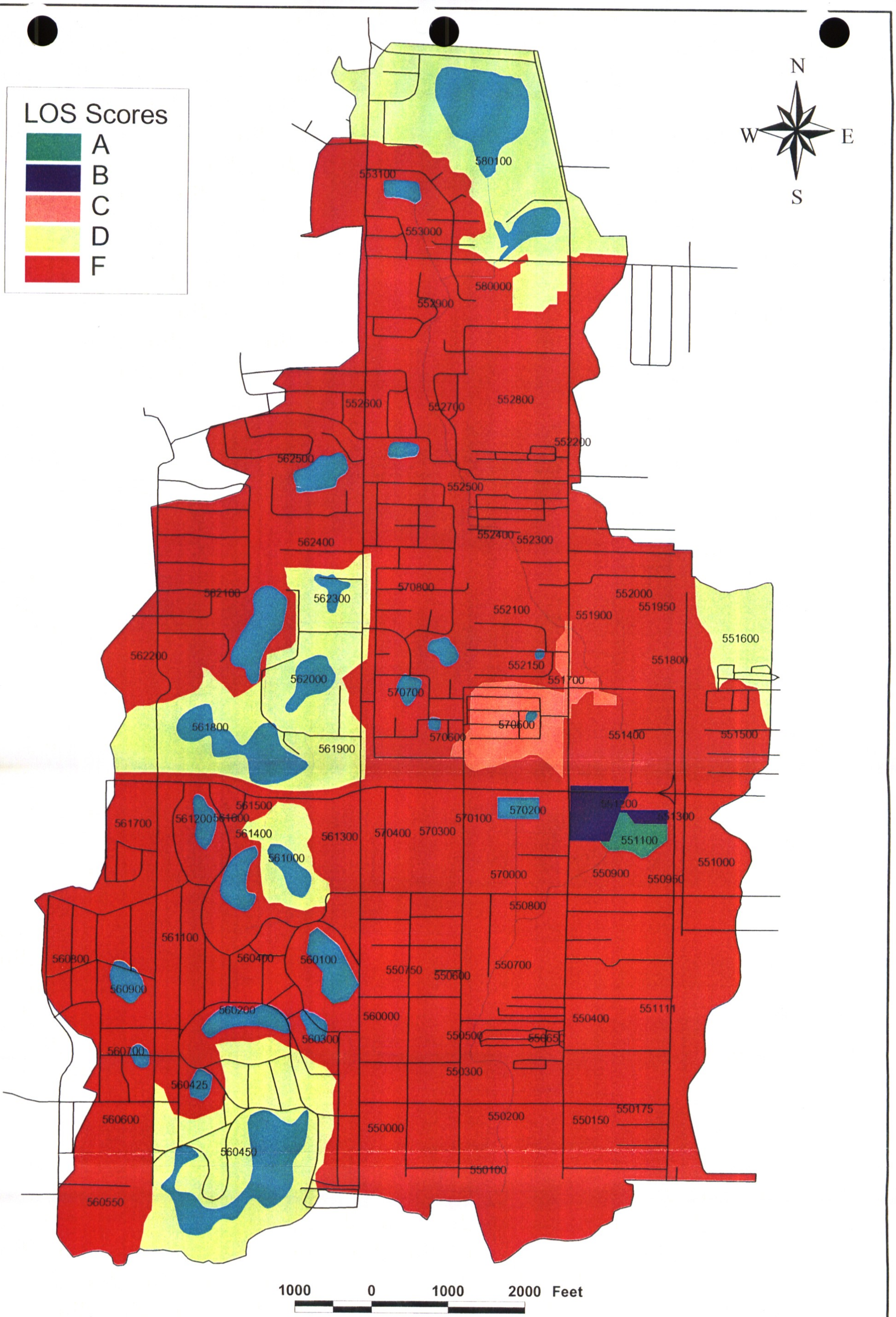


HILLSBOROUGH COUNTY
FLORIDA

CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES, CORP.
SCHEDA ECOLOGICAL ASSOCIATES, INC.

Figure 15-3. Proposed Water Quality Treatment LOS for Total Nitrogen



HILLSBOROUGH COUNTY FLORIDA	**CURIOSITY CREEK WATERSHED MANAGEMENT PLAN** KISINGER CAMPO & ASSOCIATES, CORP. SCHEDA ECOLOGICAL ASSOCIATES, INC.	Figure 15-4. Proposed Water Quality Treatment LOS for TSS

CHAPTER 16

PROPOSED RECOMMENDATIONS

This list of recommendations is produced in an effort to identify issues related to the watershed plan ***above and beyond those projects included in the alternatives analysis*.** Many of the recommendations are based upon staff experience in dealing with the planning, implementation and maintenance of watershed plans. Some of the recommendations were made at the request of Hillsborough County staff in an effort to identify future needs related to the Curiosity Creek Watershed Plan.

Water Quantity

- It is recommended that the proposed storage features within the watershed be implemented first. Upon completion of the storage features, conveyance features can be constructed starting at the downstream end of the watershed first and moving upstream.
- It is recommended that the existing conditions model be updated with as-built information as improvements are implemented within the watershed.
- The portion of Curiosity Creek that resides within the City of Tampa should be incorporated into the watershed model. The modeling effort should be of the same "philosophy" as the County portion in order to maintain consistency. This effort would be valuable in further defining the capacity of the watershed as it relates to the closed nature of the basin.
- Additional calibration data should be obtained and utilized to produce additional verification simulations of the computer model. The Curiosity Creek Watershed could benefit from additional gaging stations. The additional stations should be located farther upstream than the existing station at 122nd Avenue. Two potential gage stations are the crossing at Rose Lake Estates and the crossing at 131st Avenue and Curiosity Creek.
- The outfall of Lake Dorsett should be surveyed and incorporated into the computer model. If necessary, an alternative should be formulated to address any level of service deficiency that is estimated from the simulations.
- Hillsborough County should implement a strategy to periodically update/maintain the watershed plan. Watershed plans are utilized by many agencies and consultants in the engineering community. Without proper maintenance these plans quickly become outdated, thus requiring an effort to re-study the watershed.
- It is recommended that maintenance activities be integrated into the overall GIS database of the watershed. Frequency of inspection, maintenance activities, and progress of ongoing inventory investigation should constantly be integrated into the overall watershed objective.
- Hillsborough County and the City of Tampa should continue to strive to maintain open lines of communication on issues concerning the watershed. It is realized that nature does not recognize political boundaries and therefore continual effort must be made with these as well as other governmental entities to achieve overall watershed objectives.

- Agencies such as the Southwest Florida Water Management District and the Florida Department of Transportation, the United States Army Corps of Engineers and the City of Tampa should be introduced to the Curiosity Creek Watershed Management Plan and be educated on the potential usage of the data and products available.
- Hillsborough County should implement the Maintenance Plan in Appendix 18-A to at a minimum fulfill the requirements of the County's NPDES permit regarding maintenance activities and to meet the criteria of the National Flood Insurance Program's Community Rating System for maintenance of drainage systems which should reduce the insurance premiums within the County.

Water Quality

Due to extensive development, which occurred prior to the establishment of regulations that protect water resources, water quality within the main channel of Curiosity Creek is relatively poor compared to other stream systems in less developed watersheds in the County. This assessment was based on both field-collected data and model estimates for pollutant loads. Efforts to improve water quality should be focused on non-point sources (i.e., stormwater runoff) since no major point sources of pollution (e.g., wastewater treatment plants) occur within the watershed. Implementation of stormwater best management practices (BMPs) should be carried out wherever logistically and economically feasible, particularly in high density residential and commercial areas. Many of the proposed water quantity alternatives in this plan include storage of surface runoff. With minor design modifications, these same storage areas can be used for stormwater detention and treatment and have been proposed as recommended alternatives for this study. Current research by the SWFMWD suggests that longer detention times suggest that times (e.g. 14 day residence times) result in greater treatment efficiency for stormwater pollutants. Use of longer detention times is recommended where appropriate and feasible within the proposed flood detention areas identified in this plan. As additional, site-specific information becomes available, other BMPs should be implemented to protect water quality, particularly in urbanized areas adjacent to Curiosity Creek and lake systems that currently receive no stormwater treatment.

Natural Systems

The effect of extensive development within the watershed has also had a profound effect on existing natural systems. Less than 20% of natural land cover still exists in the watershed and is comprised of highly fragmented upland and wetland habitats. Those large parcels that still exist in the watershed should be targeted for preservation and several have been identified in the list of proposed alternatives as potential conservation areas. Future efforts to protect natural systems will require the management of acquired lands to prevent infestation by exotic plant and animal species. Protection and restoration of both riparian (stream) and littoral (shoreline) habitats will also play an important role in providing wildlife corridors and also the protection of water quality within Curiosity Creek and the various lake systems, respectively.

CHAPTER 17

THIRD PUBLIC MEETING

Curiosity Creek Watershed Management Plan
Public Meeting Number 3
Chamberlain High School, Tampa Florida
March 21, 2000, 6:30-9:00 p.m.

On Tuesday, March 21, 2000, the third public meeting was held at Chamberlain High School. The format for the meeting was a presentation of the various alternatives being considered for the final recommended plan followed by a question and response period. Members of the Blue Sink Curiosity Creek Coalition assisted with greeting and handing out materials, as the public entered the auditorium.

The purposes for this meeting included:

- Presenting descriptive information on each alternative including:
  - The problem or issue that required solution
  - The features or characteristics that defined the solution
  - How this alternative solved the problem or issue
- Answering questions about the details of the presentation
- Assessing the public's acceptance or support for the alternative
- Providing a method for more detailed feedback, in the form of written comments, on any aspect of the presentation or the project.

A total of 48 people signed the meeting attendance sheets. Of the 48, a total of 34 handed in voting sheets (i.e., ballots). A total of ten, written, comment sheets were received by March 29, 2000.

The voting scale corresponded to the evaluation matrix scale as follows:

"Strongly Agree"	=	+3
"Agree"	=	+2
"Somewhat Agree"	=	+1
"Neither Agree or Disagree"	=	0
"Somewhat Disagree"	=	-1
"Disagree"	=	-2
"Strongly Disagree"	=	-3
"No Opinion"	=	[blank]

The average vote for all responses to all alternatives was 1.8, with a statistical variance of 1.88. This may be interpreted as slightly less than "Agree" (+2). The following table summarizes the voting responses, by alternative number. The average response, for all responses to each alternative, is given along with the statistical variance for the voting. The importance of the statistical variance number is that it is an indication of the tendency for the votes to cluster around the mean value. A very low number indicates closely grouped votes (i.e., votes spread over a narrow range of responses). A large number indicates widely varied voting (i.e., votes spread over a wide range of responses).

Alternative Number	Average Response	Statistical Variance
1A	1.0	2.41
1B	1.4	2.61
1C	1.3	2.33
2	1.7	1.33
3	2.1	0.99
4	2.2	1.32
5	1.4	1.77
6	2.4	0.87
7	1.7	2.66
8	1.8	1.94
9	2.1	1.64
10A	1.6	1.55
10B	1.8	2.69
11	2.2	0.67
12	2.0	2.55
13	2.4	0.72
14	1.6	2.04
15	1.1	1.86
16	2.3	0.98

In addition to voting, the public submitted written comment sheets. Many of the written comments expressed the opinion that the material was well presented and the overall plan well coordinated; however, those attitudes are more accurately documented and reported in the previous analysis. The summary of the more critical comments, and suggestions, include the following:

- The plan would benefit from inclusion of the goal of restoring Blue Sink to its native state as a pristine recreational place, including clear, clean water
- Consider the effect of the various alternatives on wetland hydroperiod in existing wetlands
- Reclaiming floodplain properties should happen on a “willing seller” basis

- Work with the City of Tampa to ensure coordination of this plan with their efforts relating to Blue Sink
- Concern was expressed about erosion, along the drainage easement of Curiosity Creek
- Property owners with mobile home parks that would be affected by certain alternatives objected to losing lots or requiring relocation of mobile homes
- Include consideration of wildlife crossings at major roads such as Country Club Drive
- Clean up the debris in the channel, during the current period of low water and drought

CHAPTER 18

PREFERRED PLAN

The Preferred Plan for the Curiosity Creek watershed is a combination of alternatives derived from the master planning process and Capital Improvement Projects (CIP) that have already been identified by Hillsborough County staff for Fiscal Year 2000. There are two CIP's in the Preferred Plan that have already been identified by the County Stormwater staff. These are the improvements associated with Taliaferro Street (Taliaferro St. Floodplain Reclamation and Stormwater Treatment Pond- Alternative 11) and the gravity outfall system associated with Round Lake, Lake Sophia, Pine Lake, and Pine Pond (Gravity System Outfall for NW-Alternative 1C).

The two CIP's currently have funding identified for Fiscal Year 2000, therefore these projects were automatically included in the Preferred Plan at the request of County staff. The remaining projects were ranked according to their respective scoring in the *Alternative Analysis Decision Matrix* from Chapter 13. The projects are listed in the recommended order that they should be constructed in accordance with the recommendations shown in Chapter 16, and are shown in Table 18-1.

Table 18.1 Preferred Plan *for the* Curiosity Creek Watershed

#	Alternative Number	Project Name	Planning Level Costs	Overall Score	Remarks
1	11	Taliaferro St. Floodplain Reclamation and Stormwater Treatment Pond	525K	16.2	Hills Co. CIP #47001 Storage Element
2	9	Floodplain Reclamation at Mobile Home Community	665K	15.1	
3	6	Lake Golden Trout Excavation and Upland/Wetland Restoration	569K	13.4	Storage Element
4	16	Preserve Upland/wetland Buffer at Cedar Lake East	412K	13.3	
5	4	Lake Cedar West Shoreline Re-Vegetation	25K	13.2	
6	13	Floral Avenue Channel Improvements	147K	11.4	Maintenance Element
7	12	Floral Avenue Improvements	2197K	11	Storage & Conveyance Elements
8*	*7*	*Country Club Drive Structures*	*195K**	*14.7*	*Conveyance Element* *(see notation below)*
9	8	122nd Ave. Structures	72K	14.8	Conveyance Element
10	3	Lake Cedar West Stormwater Treatment	165K	4.1	
11	5	Lake Dorsett Stormwater Treatment/Sewer Connections	81K	3.4	
12	1C	Gravity System Outfall for NW	255K	3.3	Hills Co. CIP# 47238,47220,47294

13	10B	Channel Improvements and Floodplain Reclamation at 131st near Fletcher Ave.	1020K	8.8	Storage and Conveyance Elements
14	14	Tyrone MHP Improvements	2944K	6.6	Storage and Conveyance Elements

*** Country Club Drive Project is located within the City of Tampa Limits. Shown here for informational purposes only. Should not be considered as a Hillsborough County Project without cooperation of City of Tampa.**

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APPENDIX

Appendix

Appendices | Number

APPENDIX A

USGS

science for a changing world

Fax Cover Sheet

U.S. Department of the Interior
U.S. Geological Survey

ROGER C.
Jim D.

Date: Aug. 4, 1999

Total number of pages including cover sheet: 12

RECEIVED
AUG - 4 1999
KISINGER CAMPO & ASSOCIATES CORP.

To:

Name: Roger Cox

Office/Center: Kissinger/Campo

Fax number: 871-5135

Phone number:

From:

Name: Jamie Todd

Program/Center: U.S. Geological Survey

Fax number: 813-889-9811

Phone number: 813-884-9336

Email:

Mailing address: 4710 Eisenhower Blvd Ste B-5
Tampa, FL 33634

Message: Curiosity Creek Data

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - TAMPA FLORIDA 08/04/1999

STATION NUMBER 02305780 CURIOSITY CREEK NEAR SULPHUR SPRINGS FL STREAM SOURCE AGENCY USGS
LATITUDE 280407 LONGITUDE 0822724 DRAINAGE AREA 1.37 DATUM STATE 12 COUNTY 057

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	e1.5	e.26	.32	.05	.26	.10	.27	.45	.00	.20	.25	4.0
2	e1.0	e.30	.29	.04	.23	.09	.24	.24	.00	.16	1.2	5.6
3	e.80	e.32	.26	.04	.21	.07	.21	.15	.00	.12	1.1	2.0
4	e.70	e.37	.25	.04	.18	.10	.19	.09	.00	.08	.57	1.3
5	e.63	e.32	.22	.04	.17	.73	.17	.06	.00	.05	.97	5.3
6	e.56	e.25	.20	.04	.25	1.5	.12	.03	.00	.03	.53	27
7	e.48	e.25	.19	.05	.21	.68	.10	.02	.00	.03	.68	22
8	e.43	e.24	.20	.05	.53	.41	.08	.01	.00	.02	.96	29
9	e.42	e.23	.18	.17	.38	.51	.06	.00	.00	.01	1.6	24
10	e.41	e.27	.17	.16	.32	1.8	.05	.00	.00	.01	.98	7.1
11	e.44	e.20	.19	.10	.26	.79	.09	.00	.00	.00	.85	4.9
12	e.80	e.16	.15	.08	.26	.56	.14	.00	.00	.00	.69	3.7
13	e.75	.13	.13	.06	.21	.98	.11	.00	.00	.00	.49	3.1
14	e.60	.12	.13	.04	.19	.82	.07	.00	.35	.00	.36	2.8
15	e.47	.13	.19	.04	.51	.61	.04	.00	.01	.00	.42	3.1
16	e.40	.10	.24	.03	.51	.47	.02	.00	.00	.00	1.7	3.1
17	e.35	1.0	.17	.03	.27	.42	.02	.00	.01	.00	5.4	2.6
18	e.43	1.7	.14	.03	.23	1.4	.02	.00	.00	2.3	1.8	2.2
19	e.33	.95	.12	.02	.19	2.1	1.2	.00	.00	2.4	1.6	1.8
20	e.35	.80	.12	.02	.19	1.1	.51	.00	1.6	.48	1.0	1.7
21	e.34	.45	.11	.44	.34	.82	.24	.00	4.4	.20	.98	1.5
22	e.32	.38	.11	.29	.24	.69	.14	.00	.77	.60	.91	1.3
23	e.29	.33	.12	.16	.20	.55	.09	.00	.60	.24	.77	1.1
24	e.33	.31	.10	.17	.19	.36	.06	.00	.26	.16	.57	.97
25	e.32	.34	.10	3.0	.15	.40	.04	.23	3.1	7.9	.40	.84
26	e.26	.35	.10	1.1	.16	.38	.05	.04	2.6	3.2	.41	.75
27	e.25	.86	.09	.62	.13	.37	.04	.01	1.5	.79	.68	.94
28	e.24	.46	.08	.45	.12	.34	.02	.00	.66	.81	.72	.74
29	e.23	.38	.07	.37	.11	.30	.01	.00	.49	.76	.48	.69
30	e.22	.33	.07	.33	---	.28	.47	.00	.27	.40	.50	.68
31	e.23	---	.06	.30	---	.26	---	.00	---	.31	2.6	---
TOTAL	14.88	12.30	4.87	8.36	7.20	20.19	4.87	1.33	16.62	21.26	32.27	165.81
MEAN	.48	.41	.16	.27	.25	.65	.16	.043	.55	.69	1.04	5.53
MAX	1.5	1.7	.32	3.0	.53	2.1	1.2	.45	4.4	7.9	5.4	29
MIN	.22	.10	.06	.02	.11	.07	.01	.00	.00	.00	.25	.68
AC-FT	30	24	9.7	17	14	40	9.7	2.6	33	42	64	329

e Estimated

SEPTEMBER 1988

Rainfall and Gage Data

TIA AND S-155 HOURLY RAINFALL DATA

DATE			TIME	TIA HOURLY	S-155 HOURLY	TIA TOTAL	S-155 TOTAL
				RAINFALL	RAINFALL	RAINFALL	RAINFALL
			(HOURS)	(INCHES)	(INCHES)	(INCHES)	(INCHES)
1988	5	9	1		0	0	0
			2		0	0	0
			3		0	0	0
			4		0	0	0
			5		0	0	0
			6		0	0	0
			7		0	0	0
			8	0.13	0	0.13	0
			9	0.08	0.47	0.21	0.47
			10	0.06	0	0.27	0.47
			11	0.04	0	0.31	0.47
			12	0.08	1.08	0.39	1.55
			1	0.13	0.11	0.52	7.02
			2	0.13	0.32	0.65	1.98
			3	0.02	0.03	0.67	2.01
			4	0.02	0.01	0.69	2.02
			5	0.3	0.09	0.99	2.11
			6	0.35	0	1.34	2.11
			7	0.04	0.91	1.38	3.02
			8	0.15	0.11	1.53	3.13
			9	0.01	0.03	1.54	3.16
			10		0.02	1.54	3.18
			11		0	1.54	3.18
			12		0.01	1.54	3.19
1988	6	9	1		0	1.54	3.19
			2		0.04	1.54	3.23
			3		0.01	1.54	3.24
			4	0.01	0.08	1.55	3.32
			5	0.03	0.01	1.58	3.33
			6	0.08	0.03	1.66	3.36
			7	0.05	0.08	1.71	3.44
			8	0.13	0.23	1.84	3.67
			9	0.13	0.19	1.97	3.86
			10	0.23	0.11	2.2	3.97
			11	0.53	0.3	2.73	4.27
			12	0.18	0.76	2.91	5.03
			1	1.19	0.4	4.1	5.43
			2	0.14	0.29	4.24	5.72
			3	0.03	0.05	4.27	5.77
			4	0.01	0.02	4.28	5.79
			5	0.07	0.49	4.35	6.28
			6	0.01	0.09	4.36	6.37
			7	0.03	0.02	4.39	6.39
			8	0.02	0.01	4.41	6.4
			9	0.01	0.05	4.42	6.45
			10		0	4.42	6.45
			11		0	4.42	6.45
			12		0.01	4.42	6.46
1988	7	9	1		0	4.42	6.46
			2		0	4.42	6.46

date			TIA Hourly		distribution
1988	5	1			rainfall
		2			
		3			
		5			
		6			
		7			
		8	0.13	0.014607	0.014607
		9	0.08	0.008989	0.023596
		10	0.06	0.006742	0.030337
		11	0.04	0.004494	0.034832
		12	0.08	0.008989	0.04382
		13	0.13	0.014607	0.058427
		14	0.13	0.014607	0.073034
		15	0.02	0.002247	0.075281
		16	0.02	0.002247	0.077528
		17	0.3	0.033708	0.111236
		18	0.35	0.039326	0.150562
		19	0.04	0.004494	0.155056
		20	0.15	0.016854	0.17191
		21	0.01	0.001124	0.173034
		22	0	0	0.173034
		23	0	0	0.173034
		24	0	0	0.173034
		25	0	0	0.173034
		26	0	0	0.173034
		27	0	0	0.173034
		28	0.01	0.001124	0.174158
		29	0.03	0.003371	0.177528
		30	0.08	0.008989	0.186517
		31	0.05	0.005618	0.192135
		32	0.13	0.014607	0.206742
		33	0.13	0.014607	0.221349
		34	0.23	0.025843	0.247191
		35	0.53	0.059551	0.306742
		36	0.18	0.020225	0.326967
		37	1.19	0.133708	0.460674
		38	0.14	0.01573	0.476405
		39	0.03	0.003371	0.479776
		40	0.01	0.001124	0.480899
		41	0.07	0.007865	0.488764
		42	0.01	0.001124	0.489888
		43	0.03	0.003371	0.493259
		44	0.02	0.002247	0.495506
		45	0.01	0.001124	0.496629
		46	0	0	0.496629
		47	0	0	0.496629
		48	0	0	0.496629
		49	0	0	0.496629
		50	0	0	0.496629
		51	0.2	0.022472	0.519101

52	0.07	0.007865	0.526967
53	0.23	0.025843	0.552809
54	0.81	0.091011	0.64382
55	0.29	0.032584	0.676405
56	0.06	0.006742	0.683146
57	0	0	0.683146
58	0.04	0.004494	0.687641
59	0.06	0.006742	0.694382
60	0	0	0.694382
61	0	0	0.694382
62	0	0	0.694382
63	0	0	0.694382
64	0	0	0.694382
65	0.02	0.002247	0.696629
66	0.01	0.001124	0.697753
67	0.01	0.001124	0.698877
68	0.01	0.001124	0.7
69	0.01	0.001124	0.701124
70	0.01	0.001124	0.702247
71	0.01	0.001124	0.703371
72	0.01	0.001124	0.704495
73	0	0	0.704495
74	0	0	0.704495
75	0	0	0.704495
76	0	0	0.704495
77	0.01	0.001124	0.705618
78	0.06	0.006742	0.71236
79	0.08	0.008989	0.721349
80	0.13	0.014607	0.735955
81	0.1	0.011236	0.747191
82	0.19	0.021348	0.76854
83	0.15	0.016854	0.785394
84	0.15	0.016854	0.802247
85	0.42	0.047191	0.849438
86	0.13	0.014607	0.864045
87	0.23	0.025843	0.889888
88	0.18	0.020225	0.910113
89	0.07	0.007865	0.917978
90	0.06	0.006742	0.924719
91	0	0	0.924719
92	0.09	0.010112	0.934832
93	0.08	0.008989	0.94382
94	0.47	0.052809	0.996629
95	0.03	0.003371	1
96	0	0	1
rainfall total	**8.9**		

Roger Cox

From: Janice M Todd, Hydrologic Technician, Tampa, FL [jtodd@usgs.gov]
Sent: Monday, September 13, 1999 9:43 AM
To: RCox@kcaeng.com
Cc: Janice M Todd, Hydrologic Technician, Tampa, FL
Subject: curiosity creek unit value data

Please find hourly unit values of discharge and gage height below.
A DECIMAL POINT MUST BE INSERTED IN THE GAGE HEIGHT VALUES ex. 37.17
gage height
TIME SERIES RECORD

YEAR	MONTH	DAY	MINUTE	U02305780.00065
1988	9	1	60	3717
1988	9	1	120	3717
1988	9	1	180	3716
1988	9	1	240	3714
1988	9	1	300	3711
1988	9	1	360	3709
1988	9	1	420	3706
1988	9	1	480	3703
1988	9	1	540	3700
1988	9	1	600	3698
1988	9	1	660	3696
1988	9	1	720	3693
1988	9	1	780	3691
1988	9	1	840	3689
1988	9	1	900	3690
1988	9	1	960	3692
1988	9	1	1020	3689
1988	9	1	1080	3687
1988	9	1	1140	3731
1988	9	1	1200	3736
1988	9	1	1260	3752
1988	9	1	1320	3756
1988	9	1	1380	3783
1988	9	1	1440	3777
1988	9	2	60	3775
1988	9	2	120	3774
1988	9	2	180	3772
1988	9	2	240	3767
1988	9	2	300	3762
1988	9	2	360	3757
1988	9	2	420	3752
1988	9	2	480	3747
1988	9	2	540	3743
1988	9	2	600	3738
1988	9	2	660	3735
1988	9	2	720	3731
1988	9	2	780	3727
1988	9	2	840	3723
1988	9	2	900	3720
1988	9	2	960	3717
1988	9	2	1020	3714
1988	9	2	1080	3711
1988	9	2	1140	3709
1988	9	2	1200	3705

1988	9	2	1260	3702
1988	9	2	1320	3700
1988	9	2	1380	3698
1988	9	2	1440	3696
988	9	3	60	3695
1988	9	3	120	3693
1988	9	3	180	3691
1988	9	3	240	3690
1988	9	3	300	3689
1988	9	3	360	3687
1988	9	3	420	3686
1988	9	3	480	3684
1988	9	3	540	3682
1988	9	3	600	3680
1988	9	3	660	3679
1988	9	3	720	3677
1988	9	3	780	3676
1988	9	3	840	3675
1988	9	3	900	3673
1988	9	3	960	3672
1988	9	3	1020	3671
1988	9	3	1080	3670
1988	9	3	1140	3688
1988	9	3	1200	3680
1988	9	3	1260	3677
1988	9	3	1320	3674
1988	9	3	1380	3672
1988	9	3	1440	3671
1988	9	4	60	3669
1988	9	4	120	3668
1988	9	4	180	3667
1988	9	4	240	3666
1988	9	4	300	3665
1988	9	4	360	3664
1988	9	4	420	3663
1988	9	4	480	3662
1988	9	4	540	3661
1988	9	4	600	3660
1988	9	4	660	3659
1988	9	4	720	3659
1988	9	4	780	3658
1988	9	4	840	3657
1988	9	4	900	3657
1988	9	4	960	3657
1988	9	4	1020	3656
1988	9	4	1080	3656
1988	9	4	1140	3655
1988	9	4	1200	3655
1988	9	4	1260	3655
1988	9	4	1320	3654
1988	9	4	1380	3654
1988	9	4	1440	3654
1988	9	5	60	3654
1988	9	5	120	3654
1988	9	5	180	3654
1988	9	5	240	3653
1988	9	5	300	3653
1988	9	5	360	3653
1988	9	5	420	3652
1988	9	5	480	3652
1988	9	5	540	3652
1988	9	5	600	3657 ←

1988	9	5	660	3690
1988	9	5	720	3711
1988	9	5	780	3739
988	9	5	840	3738
988	9	5	900	3741
1988	9	5	960	3740
1988	9	5	1020	3739
1988	9	5	1080	3751
1988	9	5	1140	3810
1988	9	5	1200	3803
1988	9	5	1260	3805
1988	9	5	1320	3806
1988	9	5	1380	3804
1988	9	5	1440	3799
1988	9	6	60	3795
1988	9	6	120	3787
1988	9	6	180	3779
1988	9	6	240	3771
1988	9	6	300	3766
1988	9	6	360	3760
1988	9	6	420	3756
1988	9	6	480	3755
1988	9	6	540	3763
1988	9	6	600	3771
1988	9	6	660	3776
1988	9	6	720	3827
1988	9	6	780	3870
1988	9	6	840	3962
1988	9	6	900	3987
1988	9	6	960	3989
988	9	6	1020	3987
988	9	6	1080	3986
1988	9	6	1140	3987
1988	9	6	1200	3974
1988	9	6	1260	3964
1988	9	6	1320	3949
1988	9	6	1380	3932
1988	9	6	1440	3916
1988	9	7	60	3898
1988	9	7	120	3879
1988	9	7	180	3864
1988	9	7	240	3853
1988	9	7	300	3855
1988	9	7	360	3843
1988	9	7	420	3842
1988	9	7	480	3921
1988	9	7	540	3926
1988	9	7	600	3920
1988	9	7	660	3910
1988	9	7	720	3899
1988	9	7	780	3886
1988	9	7	840	3873
1988	9	7	900	3860
1988	9	7	960	3848
1988	9	7	1020	3835
1988	9	7	1080	3824
1988	9	7	1140	3814
1988	9	7	1200	3806
988	9	7	1260	3798
1988	9	7	1320	3793
1988	9	7	1380	3787
1988	9	7	1440	3784

1988	9	8	60	3780
1988	9	8	120	3776
1988	9	8	180	3772
988	9	8	240	3768
988	9	8	300	3764
1988	9	8	360	3761
1988	9	8	420	3759
1988	9	8	480	3761
1988	9	8	540	3767
1988	9	8	600	3781
1988	9	8	660	3796
1988	9	8	720	3829
1988	9	8	780	3844
1988	9	8	840	3901
1988	9	8	900	3936
1988	9	8	960	3971
1988	9	8	1020	4000
1988	9	8	1080	4008
1988	9	8	1140	4011
1988	9	8	1200	4010
1988	9	8	1260	4004
1988	9	8	1320	3996
1988	9	8	1380	3999
1988	9	8	1440	3992
1988	9	9	60	3983
1988	9	9	120	3972
1988	9	9	180	3961
1988	9	9	240	3948
1988	9	9	300	3932
1988	9	9	360	3918
988	9	9	420	3903
988	9	9	480	3887
1988	9	9	540	3875
1988	9	9	600	3862
1988	9	9	660	3852
1988	9	9	720	3843
1988	9	9	780	3835
1988	9	9	840	3828
1988	9	9	900	3820
1988	9	9	960	3814
1988	9	9	1020	3807
1988	9	9	1080	3801
1988	9	9	1140	3796
1988	9	9	1200	3792
1988	9	9	1260	3788
1988	9	9	1320	3784
1988	9	9	1380	3780
1988	9	9	1440	3776
1988	9	10	60	3773
1988	9	10	120	3770
1988	9	10	180	3767
1988	9	10	240	3765
1988	9	10	300	3762
1988	9	10	360	3760
1988	9	10	420	3758
1988	9	10	480	3756
1988	9	10	540	3754
1988	9	10	600	3752
988	9	10	660	3750
1988	9	10	720	3748
1988	9	10	780	3747
1988	9	10	840	3745

1988	9	10	900	3744
1988	9	10	960	3742
1988	9	10	1020	3741
988	9	10	1080	3739
988	9	10	1140	3738
1988	9	10	1200	3737
1988	9	10	1260	3736
1988	9	10	1320	3736
1988	9	10	1380	3735
1988	9	10	1440	3734

UNIT VALUE DISCHARGE
TIME SERIES RECORD

YEAR	MONTH	DAY	MINUTE	U02305780.00060
1988	9	1	60	3.995538
1988	9	1	120	3.995538
1988	9	1	180	3.937344
1988	9	1	240	3.766131
1988	9	1	300	3.545269
1988	9	1	360	3.437475
1988	9	1	420	3.228523
1988	9	1	480	3.028329
1988	9	1	540	2.836645
1988	9	1	600	2.743942
1988	9	1	660	2.653299
1988	9	1	720	2.521154
1988	9	1	780	2.435559
1988	9	1	840	2.351941
1988	9	1	900	2.393495
1988	9	1	960	2.478099
1988	9	1	1020	2.351941
1988	9	1	1080	2.270275
1988	9	1	1140	5.144057
1988	9	1	1200	5.644518
1988	9	1	1260	7.251898
1988	9	1	1320	7.606336
1988	9	1	1380	10.30702
1988	9	1	1440	9.659004
1988	9	2	60	9.449219
1988	9	2	120	9.345452
1988	9	2	180	9.140269
1988	9	2	240	8.640574
1988	9	2	300	8.15952
1988	9	2	360	7.696749
1988	9	2	420	7.251898
1988	9	2	480	6.741211
1988	9	2	540	6.334528
1988	9	2	600	5.793266
1988	9	2	660	5.49835
1988	9	2	720	5.144057
1988	9	2	780	4.805444
1988	9	2	840	4.482053
1988	9	2	900	4.234126
1988	9	2	960	3.995538
1988	9	2	1020	3.766131
1988	9	2	1080	3.545269
1988	9	2	1140	3.437475
1988	9	2	1200	3.127358
1988	9	2	1260	2.979626

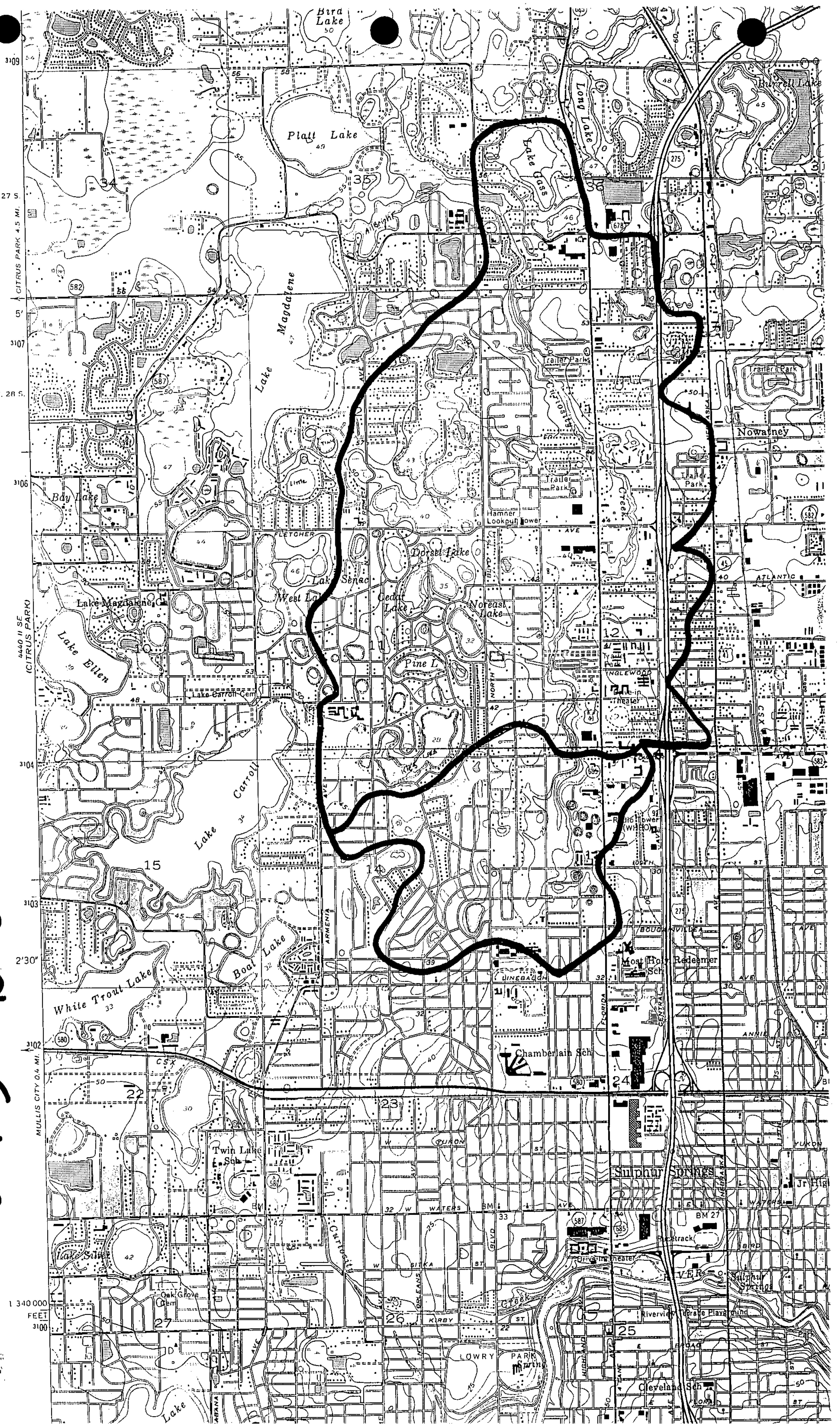
1988	9	2	1320	2.836645
1988	9	2	1380	2.743942
1988	9	2	1440	2.653299
988	9	3	60	2.608751
988	9	3	120	2.521154
1988	9	3	180	2.435559
1988	9	3	240	2.393495
1988	9	3	300	2.351941
1988	9	3	360	2.270275
1988	9	3	420	2.230176
1988	9	3	480	2.151397
1988	9	3	540	2.074513
1988	9	3	600	1.999499
1988	9	3	660	1.962693
1988	9	3	720	1.890441
1988	9	3	780	1.854989
1988	9	3	840	1.82
1988	9	3	900	1.74997
1988	9	3	960	1.715646
1988	9	3	1020	1.681794
1988	9	3	1080	1.648399
1988	9	3	1140	2.310873
1988	9	3	1200	1.999499
1988	9	3	1260	1.890441
1988	9	3	1320	1.784745
1988	9	3	1380	1.715646
1988	9	3	1440	1.681794
1988	9	4	60	1.615446
1988	9	4	120	1.582955
1988	9	4	180	1.550899
1988	9	4	240	1.519298
1988	9	4	300	1.488127
1988	9	4	360	1.457404
1988	9	4	420	1.427115
1988	9	4	480	1.397246
1988	9	4	540	1.367814
1988	9	4	600	1.338797
1988	9	4	660	1.310211
1988	9	4	720	1.310211
1988	9	4	780	1.282032
1988	9	4	840	1.254278
1988	9	4	900	1.254278
1988	9	4	960	1.254278
1988	9	4	1020	1.226925
1988	9	4	1080	1.226925
1988	9	4	1140	1.199987
1988	9	4	1200	1.199987
1988	9	4	1260	1.199987
1988	9	4	1320	1.167665
1988	9	4	1380	1.167665
1988	9	4	1440	1.167665
1988	9	5	60	1.167665
1988	9	5	120	1.167665
1988	9	5	180	1.167665
1988	9	5	240	1.135976
1988	9	5	300	1.135976
1988	9	5	360	1.135976
1988	9	5	420	1.104939
1988	9	5	480	1.104939
1988	9	5	540	1.104939
1988	9	5	600	1.254278
1988	9	5	660	2.393495

1988	9	5	720	3.545269
1988	9	5	780	5.944619
1988	9	5	840	5.793266
1988	9	5	900	6.098598
988	9	5	960	6.021263
1988	9	5	1020	5.944619
1988	9	5	1080	7.165028
1988	9	5	1140	13.61567
1988	9	5	1200	12.6852
1988	9	5	1260	12.94651
1988	9	5	1320	13.0785
1988	9	5	1380	12.81543
1988	9	5	1440	12.17615
1988	9	6	60	11.68926
1988	9	6	120	10.75485
1988	9	6	180	9.871895
1988	9	6	240	9.038837
1988	9	6	300	8.542899
1988	9	6	360	7.972229
1988	9	6	420	7.606336
1988	9	6	480	7.51667
1988	9	6	540	8.254245
1988	9	6	600	9.038837
1988	9	6	660	9.553703
1988	9	6	720	16.06568
1988	9	6	780	23.5606
1988	9	6	840	46.18332
1988	9	6	900	54.07624
1988	9	6	960	54.74388
1988	9	6	1020	54.07624
1988	9	6	1080	53.74456
1988	9	6	1140	54.07624
1988	9	6	1200	49.86847
1988	9	6	1260	46.78449
1988	9	6	1320	42.40075
1988	9	6	1380	37.7736
1988	9	6	1440	33.73784
1988	9	7	60	29.53752
1988	9	7	120	25.38251
1988	9	7	180	22.3965
1988	9	7	240	20.36467
1988	9	7	300	20.7244
1988	9	7	360	18.62933
1988	9	7	420	18.46148
1988	9	7	480	34.96646
1988	9	7	540	36.22451
1988	9	7	600	34.71843
1988	9	7	660	32.3018
1988	9	7	720	29.7681
1988	9	7	780	26.86382
1988	9	7	840	24.15768
1988	9	7	900	21.64247
1988	9	7	960	19.48391
1988	9	7	1020	17.31536
1988	9	7	1080	15.61322
1988	9	7	1140	14.16759
1988	9	7	1200	13.0785
1988	9	7	1260	12.05319
1988	9	7	1320	11.45075
1988	9	7	1380	10.75485
1988	9	7	1440	10.4178
1988	9	8	60	9.979486

1988	9	8	120	9.553703
1988	9	8	180	9.140269
1988	9	8	240	8.739037
988	9	8	300	8.349737
988	9	8	360	8.065532
1988	9	8	420	7.879692
1988	9	8	480	8.065532
1988	9	8	540	8.640574
1988	9	8	600	10.08786
1988	9	8	660	11.80972
1988	9	8	720	16.37218
1988	9	8	780	18.79815
1988	9	8	840	30.22506
1988	9	8	900	38.83045
1988	9	8	960	48.92952
1988	9	8	1020	58.51408
1988	9	8	1080	61.36192
1988	9	8	1140	62.45333
1988	9	8	1200	62.08804
1988	9	8	1260	59.92678
1988	9	8	1320	57.12369
1988	9	8	1380	58.16434
1988	9	8	1440	55.75549
1988	9	9	60	52.75733
1988	9	9	120	49.24116
1988	9	9	180	45.88475
1988	9	9	240	42.11869
1988	9	9	300	37.7736
1988	9	9	360	34.2258
1988	9	9	420	30.67863
988	9	9	480	27.08004
988	9	9	540	24.5614
1988	9	9	600	22.01729
1988	9	9	660	20.18642
1988	9	9	720	18.62933
1988	9	9	780	17.31536
1988	9	9	840	16.21842
1988	9	9	900	15.02357
1988	9	9	960	14.16759
1988	9	9	1020	13.21145
1988	9	9	1080	12.42749
1988	9	9	1140	11.80972
1988	9	9	1200	11.33271
1988	9	9	1260	10.86879
1988	9	9	1320	10.4178
1988	9	9	1380	9.979486
1988	9	9	1440	9.553703
1988	9	10	60	9.242503
1988	9	10	120	8.938162
1988	9	10	180	8.640574
1988	9	10	240	8.445926
1988	9	10	300	8.15952
1988	9	10	360	7.972229
1988	9	10	420	7.787845
1988	9	10	480	7.606336
1988	9	10	540	7.427718
1988	9	10	600	7.251898
1988	9	10	660	7.078888
988	9	10	720	6.908666
1988	9	10	780	6.741211
1988	9	10	840	6.576527
1988	9	10	900	6.495175

1988	9	10	960	6.255197
1988	9	10	1020	6.176565
1988	9	10	1080	6.021263
1988	9	10	1140	5.944619
1988	9	10	1200	5.793266
1988	9	10	1260	5.718583
1988	9	10	1320	5.718583
1988	9	10	1380	5.644518
1988	9	10	1440	5.571129

APPENDIX B



Sulphur Springs
28082-A4-TFL-024

APPENDIX C

JANUARY 1991

LOWER HILLSBOROUGH RIVER AND CURIOSITY CREEK TAMPA, FLORIDA

RECONNAISSANCE REPORT

US Army Corps of Engineers
Jacksonville District

TABLE B-5
HEC-1 MODEL DATA

U.S.G.S. Gage

D.A. (sq. mile)	Percent	CN	AMC Number	S (Soil Index)	SCS LAG (Hours)
0.75	0.138	93	III	0.752688	3.28
		83	II	2.048193	4.83
		67	I	4.925373	7.69

FOREST HILLS AREA
HEC-1 MODEL DATA

D.A. (sq. mile)	Percent	CN	AMC Number	S (Soil Index)	SCS LAG (Hours)
3.41	0.155	93	III	0.752688	2.96
		83	II	2.048193	4.36
		67	I	4.925373	6.94

MODEL CALIBRATION

The HYDROLOGIC INVESTIGATION AND STORMWATER MANAGEMENT PLAN FOR CURIOSITY CREEK WATERSHED by Piercefield, Amaden and Associates, Inc. and Reynolds, Smith and Hills(September 1982) indicates that Blue Sink in the Forest Hills area is essentially a dead-end receiving basin for flows from Curiosity Creek. As of September 1982 outflow from the system(other than a small amount of seepage) is from pumping. The city of Tampa operates and maintains a 7500 GPM (16.7 cfs) pump station at Blue Sink sinkhole that is used primarily to control low-flow water stages. Another pump station is located at the sinkhole on Seneca Avenue and Florida Avenue. This pump has a 7500 GPM(16.7 cfs) capacity, but the flow is constricted by the 30 inch storm sewer to which it discharges. Two 16 inch force mains are located between North Boulevard and OlA Avenue on Bouganvillea Avenue. September 1979 was the only time this system was used, and it had very little effect upon the duration of flooding. Usually one to two weeks of pumping are required to bring the flood elevations below 31.1 feet-NGVD back to normal.

The September 1982 report indicates that stage elevations in the Forest Hills basin rise until an overflow elevation of 31.1 feet-NGVD is reached at a point located south of 103rd Avenue between Ashley Street and Florida Avenue. The report indicated that it was modelled as a broad-crested weir, but the exact size was not revealed.

To obtain a HEC1 model for existing conditions Detention area C was included as additional storage area, and after viewing a city map showing the September 1979 and March 1960 flooded areas a 100-foot broad- crested weir at elevation 31.1 feet-NGVD was used to duplicate the overflow point. Because the watershed is fully developed, a curve number(CN) of 93 was used.

The existing conditions as shown by the HEC model which included the Detention area C agrees with existing conditions as shown in the September 1982 report. As shown in Table B-6 the additional Detention areas reduced the peak flood stages by only a small amount.

TABLE B-6

Curiosity Creek
Forest Hills Area
Stage Frequency Curve
Existing Conditions

Return Period	Exceedence Probability	HEC1 Model Peak Stage (feet-NGVD)	September 1982 Report Peak Stage (feet-NGVD)
SPF	------	33.67	-----
100-Year	.01	32.55	33.0
50-Year	.02	32.27	-----
25-Year	.04	31.99	32.7
10-Year	.1	31.71	32.1
5-Year	.2	31.51	31.6
2-Year	.5	31.27	-----

In order to verify the HEC1 model the U.S.G.S. Gage Curiosity Creek near Sulphur Springs(Fletcher Avenue) recorded a maximum discharge of 46 cfs on September 7,1982. By using the recorded rainfall at the Tampa WSCMD Airport and assuming AMC I(dry conditions) for September 6-8, 1982 the HEC1 model computed a flow of 48 cfs.

EXISTING DISCHARGES

Table B-7 shows the existing peak discharges for the model:

TABLE B-7
CURIOSITY CREEK PEAK DISCHARGES
EXISTING CONDITIONS

Location	D.A. (sq. mile)	Peak Discharges (cfs) SPF	100-year	50-year	25-year	10-year	5-year	2-year
Bearss Ave.	0.05	62	38	32	26	21	17	13
Floral Dr.	0.24	276	168	143	118	94	77	56
Grover Pl.	0.47	547	333	283	234	186	152	111
Fletcher Ave.	0.75	871	531	451	372	296	242	177
131th Ave.	1.94	2245	1367	1161	959	762	625	457
122nd Ave.	2.53	2927	1783	1514	1251	994	815	596
West Fowler	3.17	3669	2234	1898	1568	1245	1021	747
Forest Hills	4.16	4811	2930	2489	2056	1633	1339	979

APPENDIX D

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

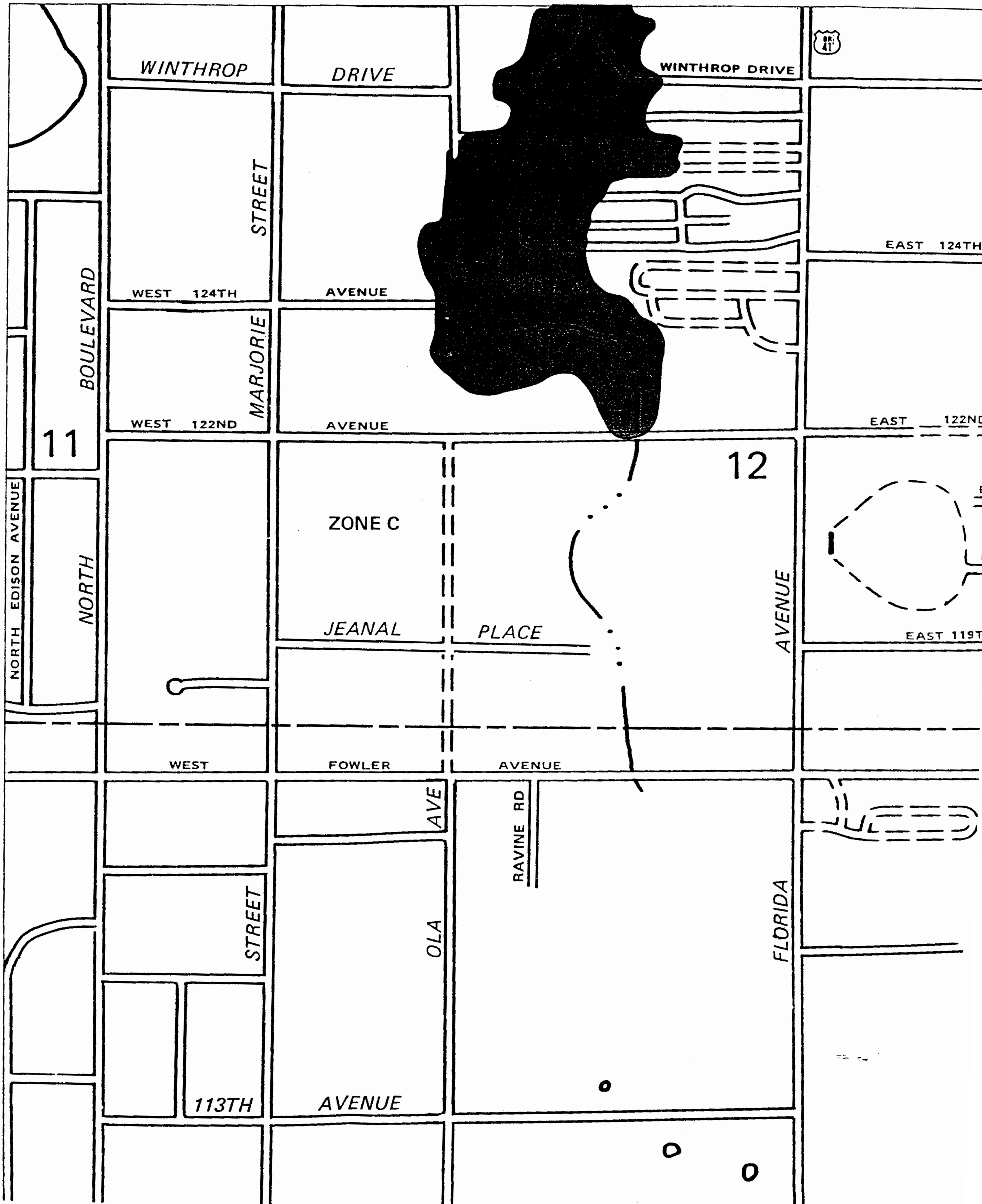
HILLSBOROUGH COUNTY, FLORIDA
(UNINCORPORATED AREAS)

PANEL 205 OF 825
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
120112 0205 C

MAP REVISED:
APRIL 17, 1984

Federal Emergency Management Agency



WINTHROP
DRIVE
WINTHROP DRIVE
41
STREET
BOULEVARD
WEST 124TH
AVENUE
EAST 124TH
MARJORIE
WEST 122ND
AVENUE
EAST 122ND
11
12
ZONE C
NORTH EDISON AVENUE
NORTH
AVENUE
JEANAL
PLACE
EAST 119T
WEST
FOWLER
AVENUE
AVE
RAVINE RD
STREET
OLA
FLORIDA
113TH
AVENUE

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

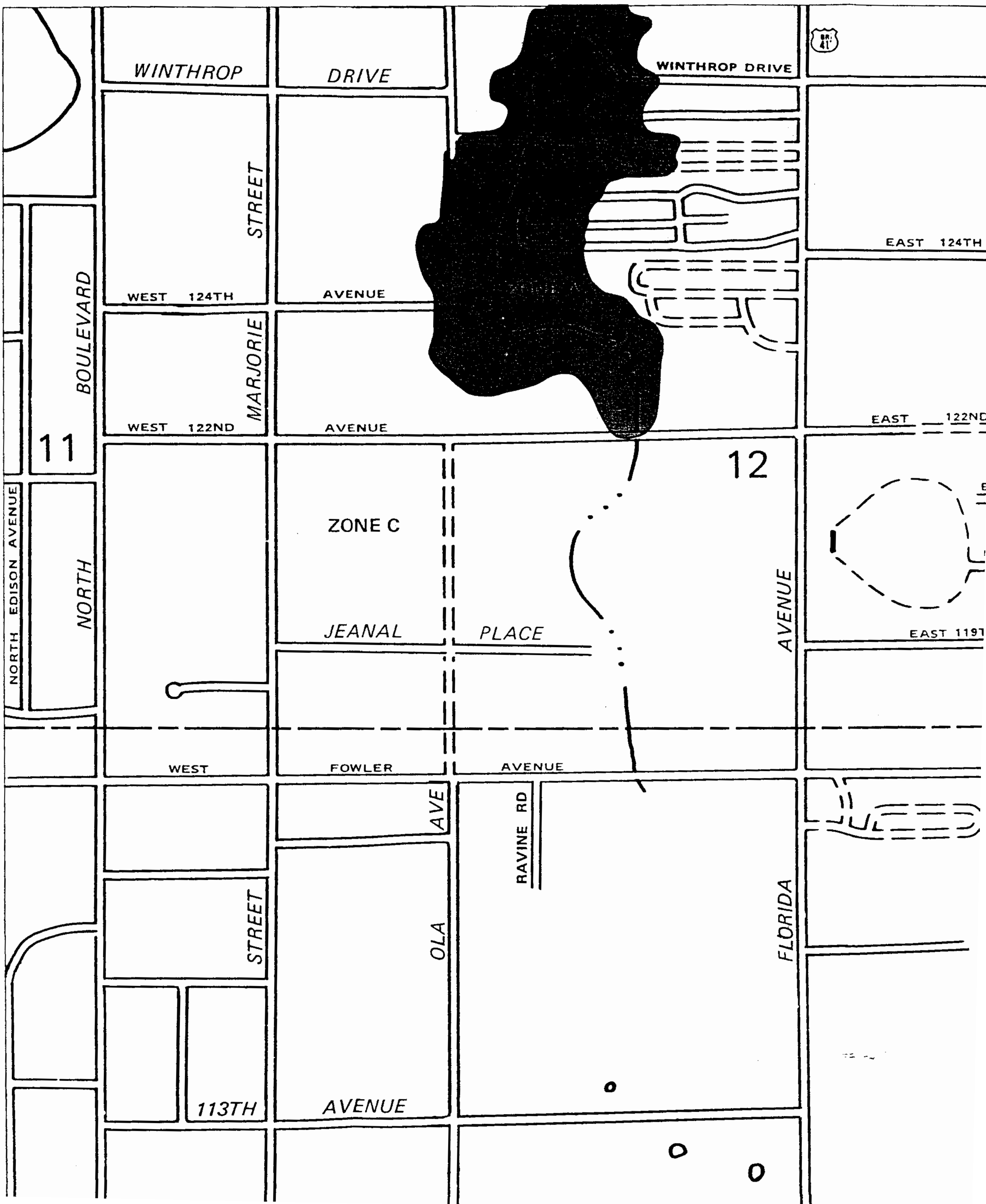
HILLSBOROUGH COUNTY, FLORIDA
(UNINCORPORATED AREAS)

PANEL 212 OF 825
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
120112 0212 C

MAP REVISED:
APRIL 17, 1984

Federal Emergency Management Agency


WINTHROP DRIVE
WINTHROP DRIVE
41
STREET
WEST 124TH AVENUE
EAST 124TH
BOULEVARD
MARJORIE
WEST 122ND AVENUE
EAST 122ND
11
12
ZONE C
NORTH EDISON AVENUE
NORTH
JEANAL PLACE
AVENUE
EAST 119T
WEST FOWLER AVENUE
AVE
RAVINE RD
STREET
OLA
FLORIDA
113TH AVENUE

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

HILLSBOROUGH COUNTY, FLORIDA

(UNINCORPORATED AREAS)

PANEL 205 OF 825

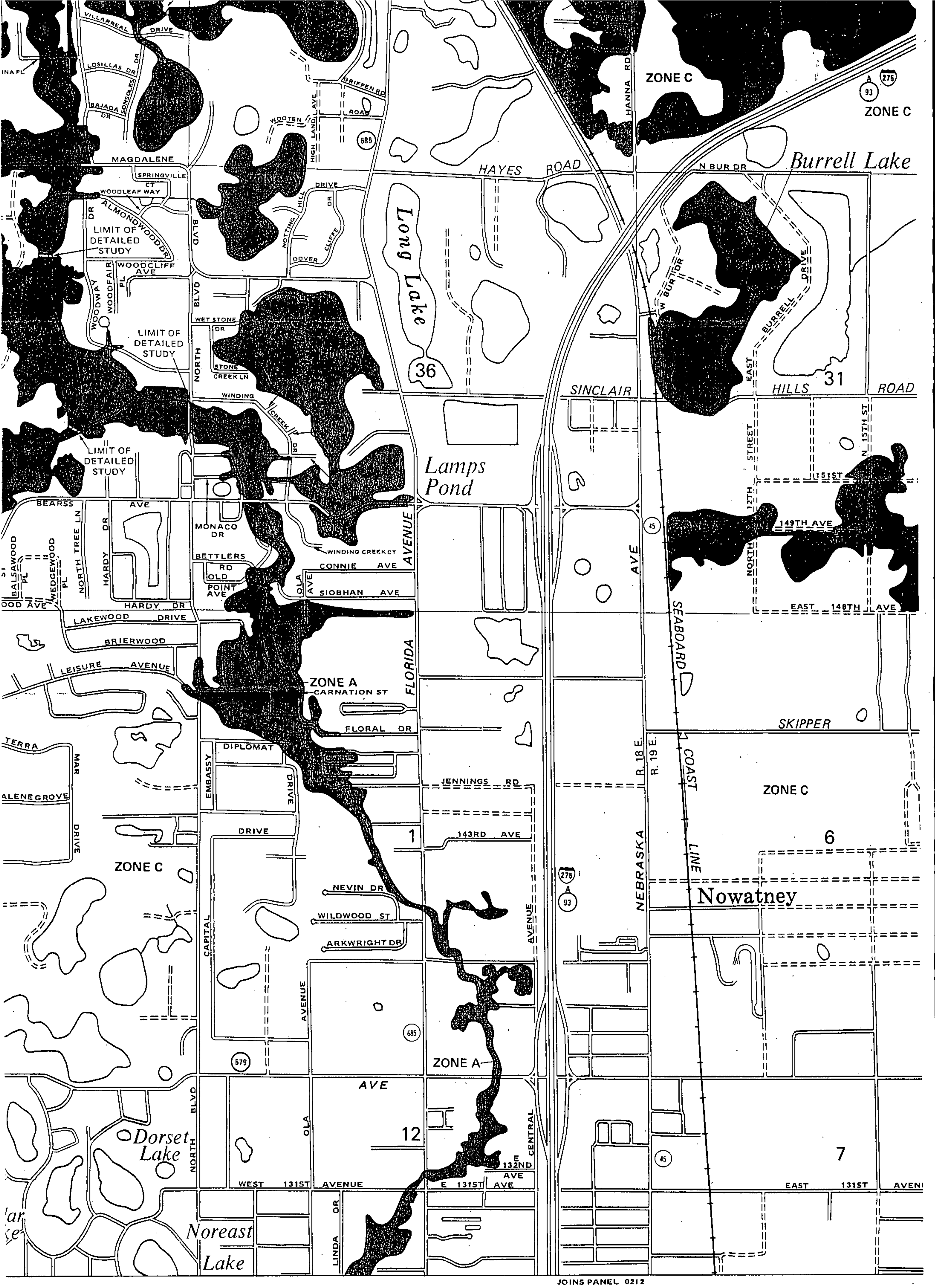
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
120112 0205 C

MAP REVISED:
APRIL 17, 1984

FEDERAL EMERGENCY MANAGEMENT AGENCY

Federal Emergency Management Agency



ZONE C
ZONE C
Burrell Lake
HAYES ROAD
HANNA RD
N BUR DR
W BUR DR
BURRELL DRIVE
EAST 12TH STREET
NORTH
N 15TH ST
151ST
149TH AVE
EAST 148TH AVE
SINCLAIR HILLS ROAD
31
Long Lake
36
Lamps Pond
MAGDALENE
SPRINGVILLE CT
WOODLEAF WAY
ALMONDWOOD DR
LIMIT OF DETAILED STUDY
WOODCLIFF AVE
WOODFAIR PL
WOODWAY
VILLARREAL DRIVE
LOSILLAS DR
BAJADA DR
SONSOLES DR
GRIFFEN RD
ROAD
WOOTEN
HIGH LAND AVE
885
NOTTING HILL DRIVE
CLIFFE DR
DOVER
WET STONE DR
NORTH BLVD
STONE CREEK LN
WINDING CREEK DR
BEARSS AVE
MONACO DR
WINDING CREEK CT
BETTLERS RD
OLD POINT AVE
CONNIE AVE
SIOBHAN AVE
OLA AVE
HARDY DR
NORTH TREE LN
WEDGEWOOD PL
BALSAWOOD PL
LAKEWOOD DRIVE
BRIERWOOD
LEISURE AVENUE
ZONE A
CARNATION ST
FLORAL DR
FLORIDA AVENUE
TERRA MAR DRIVE
ALENE GROVE
DIPLOMAT DRIVE
EMBASSY DRIVE
CAPITAL DRIVE
JENNINGS RD
143RD AVE
1
NEVIN DR
WILDWOOD ST
ARKWRIGHT DR
AVENUE
685
579
ZONE A
ZONE C
AVE
12
E 132ND AVE
E 131ST AVE
CENTRAL AVENUE
WEST 131ST AVENUE
Dorset Lake
Noreast Lake
LINDA DR
45
275
A
93
NEBRASKA AVE
R. 18 E.
R. 19 E.
SEABOARD COAST LINE
SKIPPER
ZONE C
6
Nowatney
7
EAST 131ST AVENUE
JOINS PANEL 0212

APPENDIX E

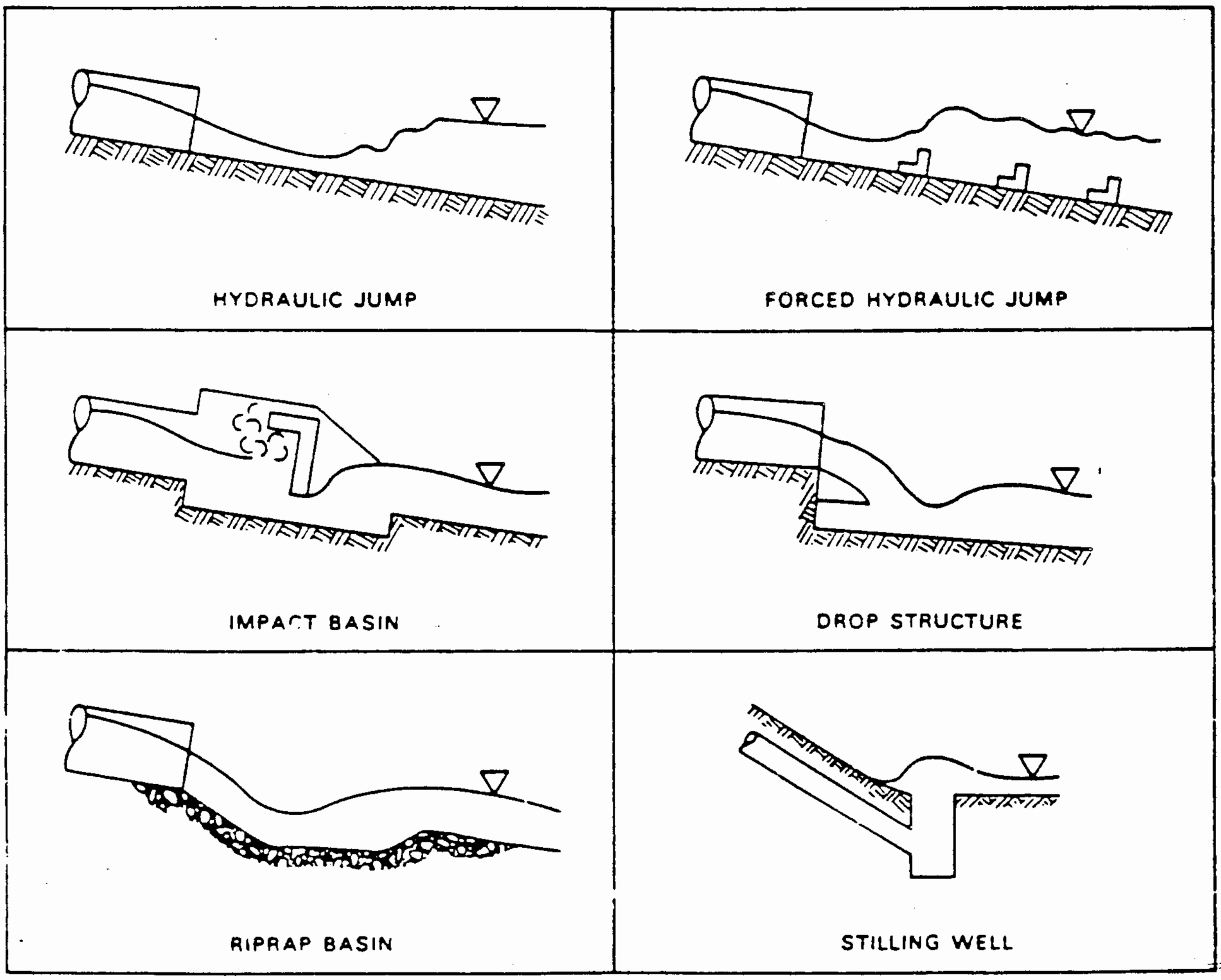
Hydraulic Design of Energy Dissipators for Culverts and Channels

Hydraulic Engineering
Circular No. 14

September 1983

U.S. Department
of Transportation

Federal Highway
Administration



increase and will reach y_n if the culvert is long enough. In the expansion (section 3 to 4), the depth increases to y_n of the downstream channel, section 4.

Associated with both transitions are energy losses which are proportional to the change in velocity head in the transitions. The energy loss in the contraction (H_{LC}) is:

$$H_{LC} = C_c(V_2^2/2g - V_1^2/2g) \quad \text{IV-A-3}$$

and in the expansion

$$H_{Le} = C_e(V_3^2/2g - V_4^2/2g) \quad \text{IV-A-4}$$

where C_c and C_e are found from table IV-A-1.

TABLE IV-A-1. TRANSITION LOSS COEFFICIENTS (IV-A-4)

Transition Type	Contraction C_c	Expansion C_e
Warped	0.10	0.20
Cylindrical quadrant	0.15	0.25
Wedge	0.30	0.50
Straight line	0.30	0.50
Square end	0.30	0.75

The depth in the culvert y_3 can be found by trial and error using the energy equation with $y_4=y_n$ in the downstream channel and assuming $H_{f2}=0$ (see figure IV-A-6). The streambed elevation is equal to z.

$$z_4+y_4+V_4^2/2g+H_{Le}+H_{f2}=z_3+y_3+V_3^2/2g$$

$$H_{f2}=0, \quad V_3=Q/W_3y_3, \quad V_4=Q/W_4y_4$$

$$z_4+y_4+V_4^2/2g+C_e(V_3^2/2g-V_4^2/2g)=z_3+y_3+V_3^2/2g$$

$$z_4+y_4+(1-C_e)V_4^2/2g=z_3+y_3+(1-C_e)V_3^2/2g$$

$$z_4-z_3+y_4+(1-C_e)(Q/W_4y_4)^2/2g=y_3+(1-C_e)(Q/W_3y_3)^2/2g. \quad \text{IV-A-5}$$

When known values are used in equation IV-A-5, the equation reduces to

$$C_1=y_3+C_2/y_3^2$$

which has two constants C_1 and C_2 and can be quickly solved by trail and error.

HILLSBOROUGH COUNTY

STORMWATER MANAGEMENT TECHNICAL MANUAL

APPROVED

SIGNED Frederick B. Karl
County Administrator

DATE 4/5/93

TABLE 5-4

CULVERT ENTRANCE LOSS COEFFICIENTS
OUTLET CONTROL, FULL OR PARTIALLY FULL
(FROM USDOT, FHWA, HEC-5, 1965)

Type of Structure and Design of Entrance	Coefficient K_e
Pipe, Reinforced Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, square cut end	0.5
Straight headwall	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
End section conforming to fill slope [a]	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side- or slope-tapered inlet	0.2
Straight sand-cement	0.3
U-type with grate	0.7
U-type	0.5
Winged concrete	0.3
U-type sand-cement	0.5
Flared end concrete	0.5
Side drain, mitered with grate	1.0
Pipe or Pipe-Arch, Corrugated Metal	
Straight endwall-rounded (radius =- 1/12D)	0.2
Projecting from fill (no headwall) or HW	0.9
Headwall or headwall and wingwalls, square-edge	0.5
Mitered to conform to fill slope	0.7
End section conforming to fill slope,.paved or unpaved	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side- or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on three edges	0.5
Rounded on three edges to radius of 1/12 barrel dimension, or beveled edges on three sides	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwalls at 10° to 25° to barrel, square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side- or slope-tapered inlet	0.2

APPENDIX F

A GUIDE TO HYDROLOGIC ANALYSIS USING SCS METHODS

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Hydrology and Floodplain Analysis

Second Edition

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RICE UNIVERSITY

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TABLE 4.2

Estimates of Manning's Roughness Coefficients for Overland Flow

SOURCE	GROUND COVER	n	RANGE
Crawford and Linsley (1966)*	Smooth asphalt	0.012	
	Asphalt of concrete paving	0.014	
	Packed clay	0.03	
	Light turf	0.20	
	Dense turf	0.35	
	Dense shrubbery and forest litter	0.4	
Engman (1986)†	Concrete or asphalt	0.011	0.01–0.13
	Bare sand	0.01	0.01–0.016
	Graveled surface	0.02	0.012–0.03
	Bare clay-loam (eroded)	0.02	0.012–0.033
	Range (natural)	0.13	0.01–0.32
	Bluegrass sod	0.45	0.39–0.63
	Short-grass prairie	0.15	0.10–0.20
	Bermuda grass	0.41	0.30–0.48

* Obtained by calibration of Stanford Watershed Model.

† Computed by Engman (1986) by kinematic wave and storage analysis of measured rainfall-runoff data.

Rewriting equations in terms of flow per unit width for overland flow, we have

$$q_0 = \alpha_0 y_0^{m_0}, \tag{4.44}$$

where

$$\alpha_0 = \frac{1.49}{N}\sqrt{S_0} = \text{conveyance factor},$$

$m_0 = 5/3$ from Manning's equation,

S_0 = average overland flow slope,

y_0 = mean depth of overland flow.

The continuity equation is

$$\frac{\partial y_0}{\partial t} + \frac{\partial q_0}{\partial x} = i - f, \tag{4.45}$$

where

$i - f$ = rate of excess rainfall (ft/s),

q_0 = flow rate per unit width (cfs/ft),

y_0 = mean depth of overland flow (ft).

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HYDRAULIC ENGINEERING CIRCULAR NO. 22

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WASHINGTON, DC

NOV 96

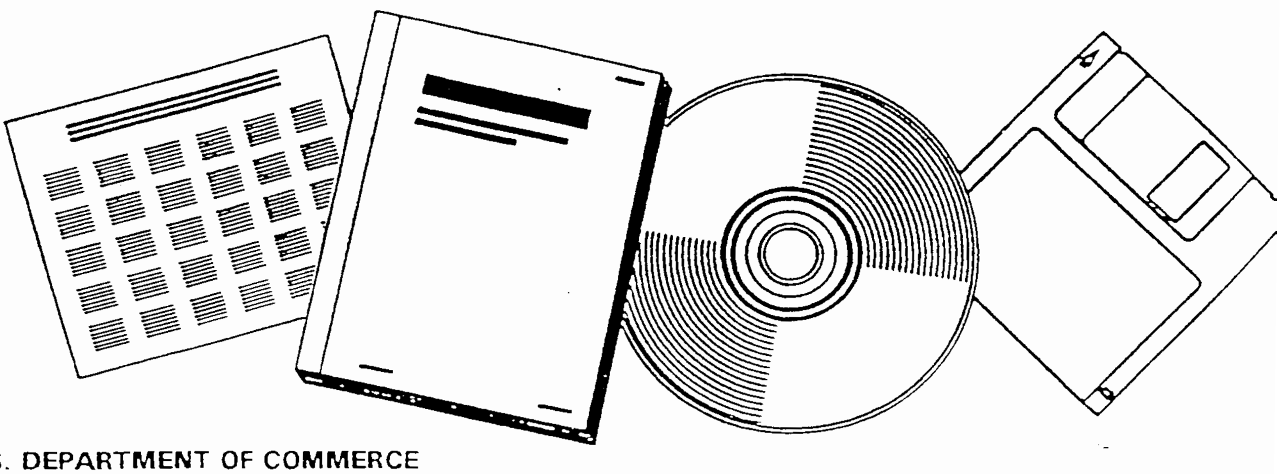

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Table 3-2. Manning's roughness coefficient (n) for overland sheet flow. [6]

Surface Description	n
Smooth asphalt	0.011
Smooth concrete	0.012
Ordinary concrete lining	0.013
Good wood	0.014
Brick with cement mortar	0.014
Vitrified clay	0.015
Cast iron	0.015
Corrugated metal pipe	0.024
Cement rubble surface	0.024
Fallow (no residue)	0.05
Cultivated soils	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Range (natural)	0.13
Grass	
Short grass prairie	0.15
Dense grasses	0.24
Bermuda grass	0.41
Woods*	
Light underbrush	0.40
Dense underbrush	0.80

* When selecting n, consider cover to a height of about 30 mm. This is the only part of the plant cover that will obstruct sheet flow

where: n = roughness coefficient (see table 3-4)
V = velocity, m/s (ft/s)
R = hydraulic radius (defined as the flow area divided by the wetted perimeter), m (ft)
S = slope, m/m (ft/ft)
K_c = units conversion factor equal to 1 (1.49 in English units)

For a circular pipe flowing full, the hydraulic radius is one-fourth of the diameter. For a wide rectangular channel (w > 10 d), the hydraulic radius is approximately equal to the depth. The travel time is then calculated as follows:

$$T_{ti} = \frac{L}{60V} \tag{3-6}$$

where: T_{ti} = travel time for segment i, min
L = flow length for segment i, m (ft)
V = velocity for segment i, m/s (ft/s)

Table 3-4. Values of Manning coefficient (n) for channels and pipes. [15

Conduit Material	Manning n*
Closed conduits	
Asbestos-cement pipe	0.011 - 0.015
Brick	0.013 - 0.017
Cast iron pipe	
Cement-lined & seal coated	0.011 - 0.015
Concrete (monolithic)	0.012 - 0.014
Concrete pipe	0.011 - 0.015
Corrugated-metal pipe (1/2-in x 2 1/2-in corrugations)	
Plain	0.022 - 0.026
Paved invert	0.018 - 0.022
Spun asphalt lined	0.011 - 0.015
Plastic pipe (smooth)	0.011 - 0.015
Vitrified clay	
Pipes	0.011 - 0.015
Liner plates	0.013 - 0.017
Open channels	
Lined channels	
a. Asphalt	0.013 - 0.017
b. Brick	0.012 - 0.018
c. Concrete	0.011 - 0.020
d. Rubble or riprap	0.020 - 0.035
e. Vegetal	0.030 - 0.40
Excavated or dredged	
Earth, straight and uniform	0.020 - 0.030
Earth, winding, fairly uniform	0.025 - 0.040
Rock	0.030 - 0.045
Unmaintained	0.050 - 0.14
Natural channels (minor streams, top width at flood stage < 100 ft)	
Fairly regular section	
Irregular section with pools	0.03 - 0.07
	0.04 - 0.10

* Lower values are usually for well-constructed and maintained (smoother) pipes and channels.

DETERMINATION OF ROUGHNESS COEFFICIENTS FOR STREAMS IN WEST-CENTRAL FLORIDA

U.S. GEOLOGICAL SURVEY

Open-File Report 96-226

Prepared in cooperation with

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

Horse Creek near Myakka Head

Hydraulic Data

[ft = foot; ft^2 = square foot; ft/s = foot per second; ft^3/s = cubic foot per second; ft/ft = foot per foot]

Date	Gage height (ft)	Discharge (ft^3/s)	Average values for reach: Area (ft^2)	Width (ft)	Hydraulic radius (ft)	Velocity (ft/s)	Percent wetted perimeter vegetated	Water surface slope (ft/ft)	Friction slope (ft/ft)	Type of flow regime	Manning's *n*
09-02-94	17.53	529	232	62.1	3.43	2.40	76	0.00160	0.00171	Upper	0.060
04-01-93	17.14	495	208	57.0	3.36	2.50	74	0.00147	0.00158	Upper	0.054
08-11-92	17.05	488	203	55.7	3.35	2.50	73	0.00160	0.00171	Upper	0.056
03-13-93	13.36	211	73.3	19.4	3.00	2.89	37	0.00163	0.00168	Upper	0.044
09-17-92	10.85	69	31.1	14.1	1.84	2.24	8	0.00150	0.00154	Lower	0.039
10-13-92	10.12	37	22.9	13.2	1.49	1.60	0	0.00227	0.00227	Lower	0.058
02-04-93	9.76	22	18.3	12.7	1.28	1.20	0	0.00241	0.00239	Lower	0.071

Within flow range | Out of flow range

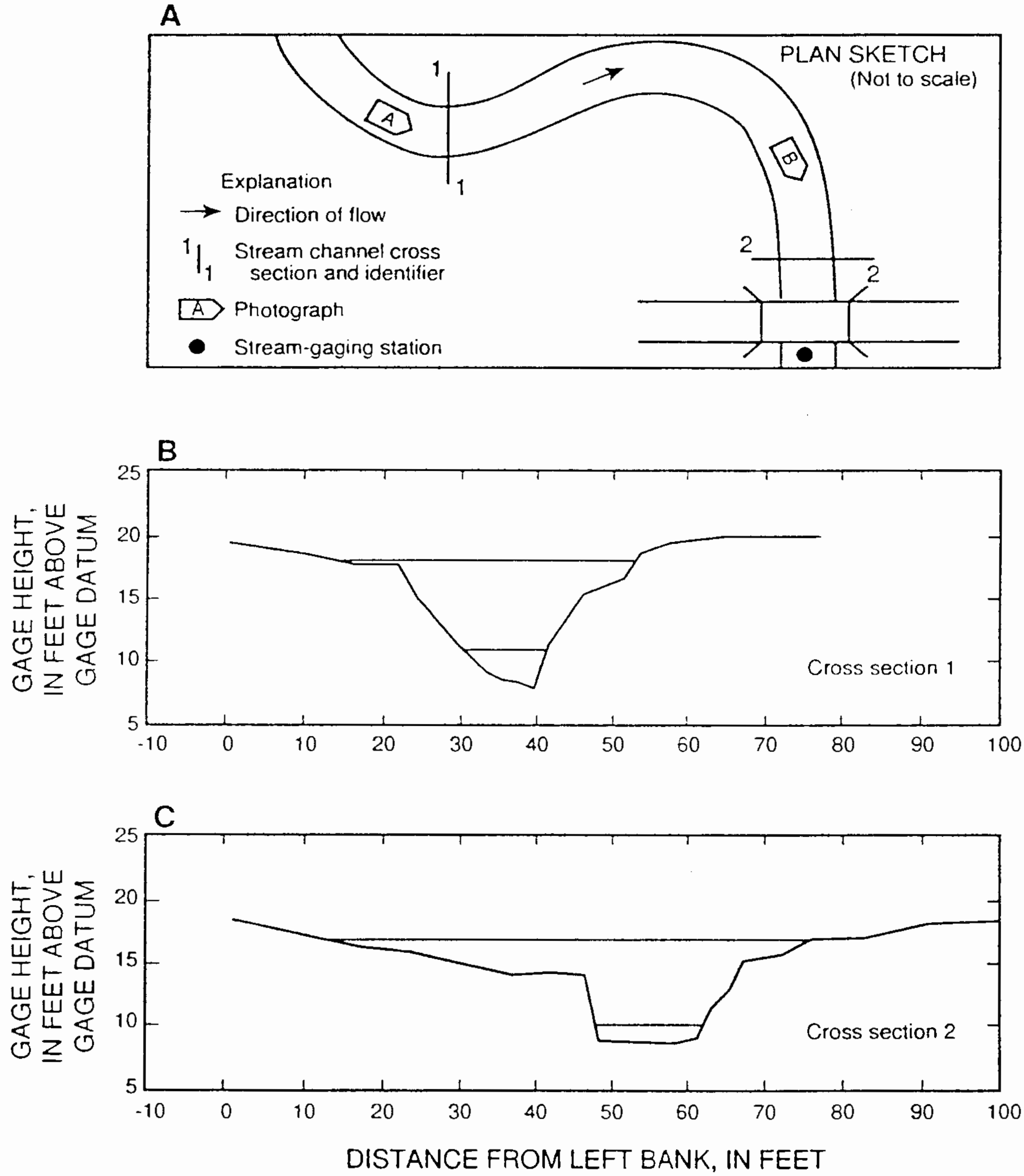


Figure 16. Horse Creek near Myakka Head. (A) plan sketch, (B) cross section 1, and (C) cross section 2.

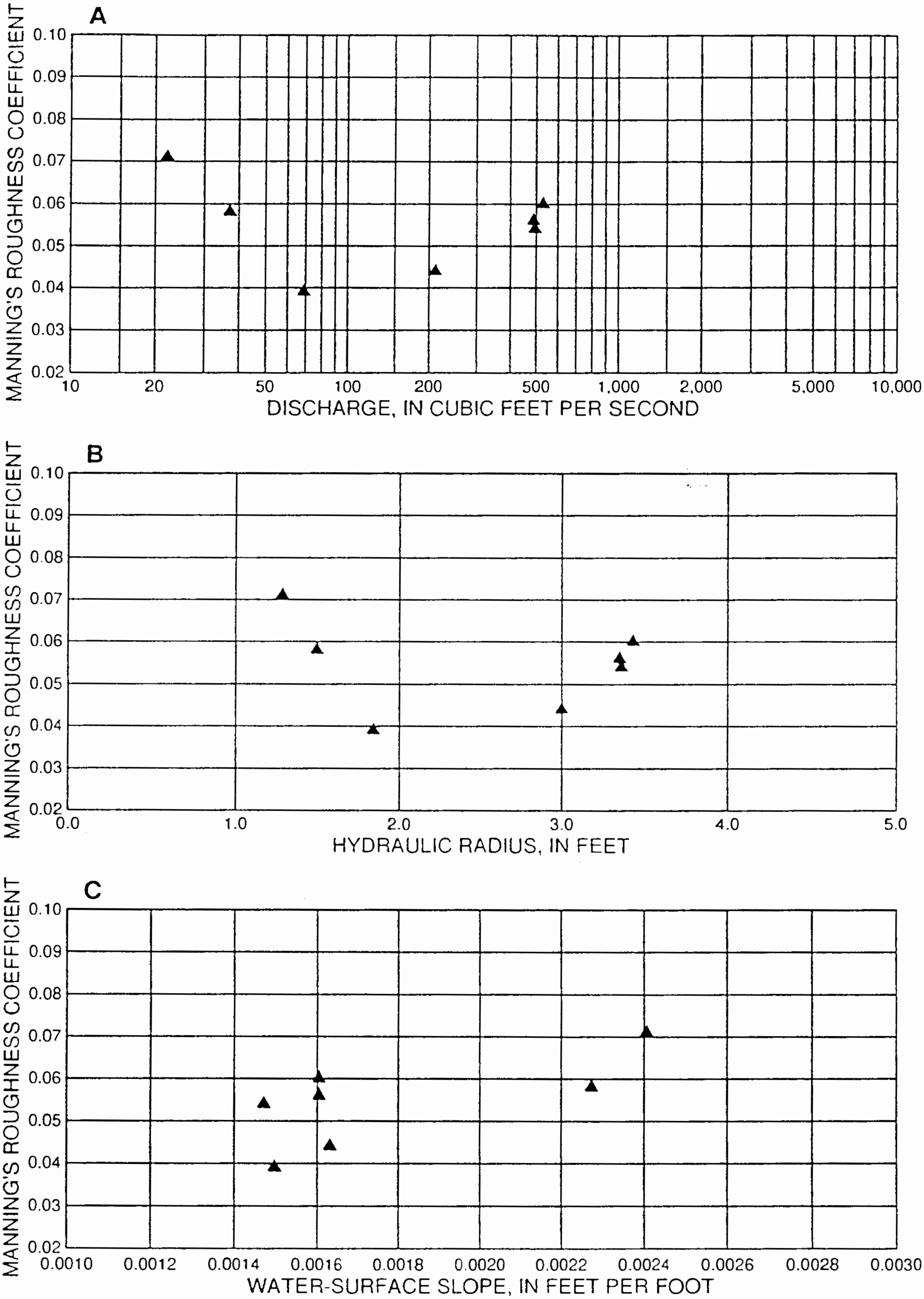
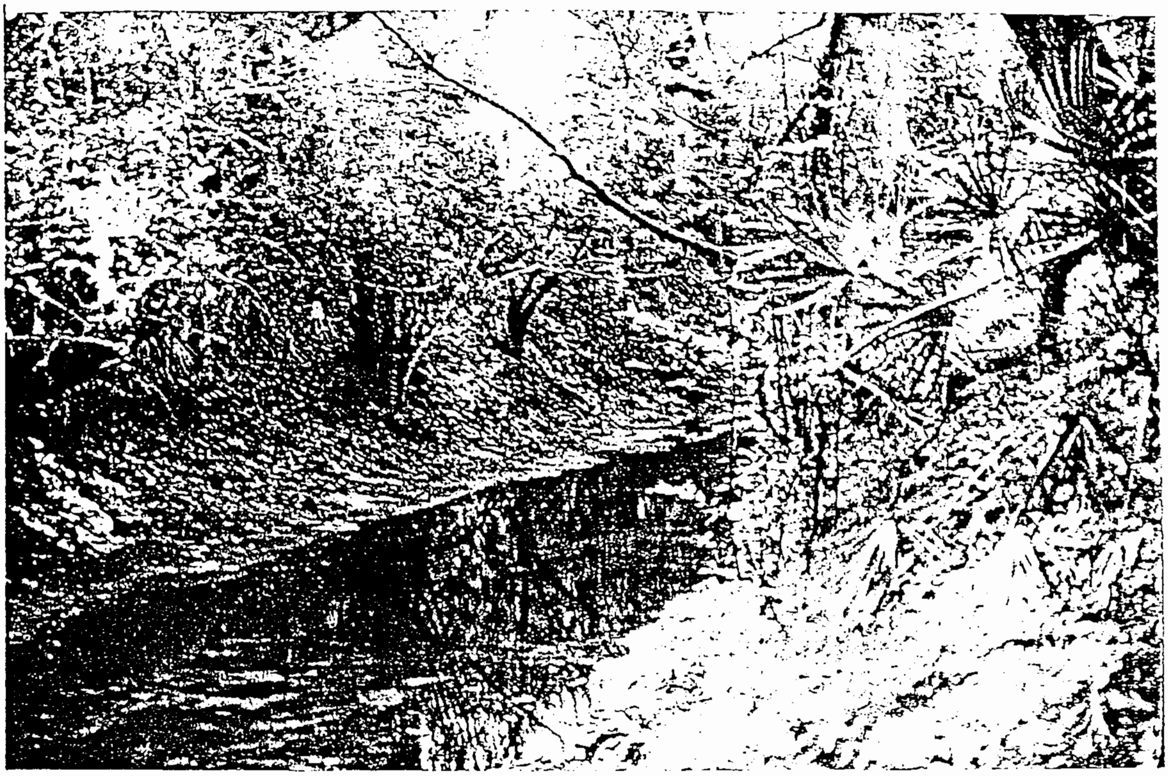


Figure 17. Horse Creek near Myakka Head. Relation of Manning's roughness coefficient to (A) discharge, (B) hydraulic radius, and (C) water-surface slope.

A



B

Figure 18. Horse Creek near Myakka Head. Photographs of channel looking (A) downstream from above cross section 1 and (B) looking downstream from above cross section 2.

Hydraulic Engineering

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Table 9-4 Values of Manning's n to Be Used for Overbank Areas Along Streams or Rivers

Channel Description		Average Value of n
Grassland		
Short grass		0.030
Tall grass		0.035
Cultivated ground		
Bare ground		0.030
Mature row crops		0.035
Mature field crops		0.040
Brushy areas		
Dense weeds and sparse brush		0.050
Brush-covered with some trees	(winter)	0.050
Brush-covered with some trees	(summer)	0.060
Dense brush	(winter)	0.070
Dense brush	(summer)	0.100
Forested		
Densely covered with willows	(summer)	0.150
Cleared land with stumps; no new growth		0.040
Cleared land with stumps; dense new growth		0.060
Dense stands of large trees; flood stage below branches		0.100
Dense stands of large trees; flood stage reaching branches		0.120

in the overbank area is generally much smaller than the average velocity in the main channel. Thus Eq. (4-28) with α included is written between two sections a distance Δx apart as

$$y_a + \frac{\alpha_a V_a^2}{2g} + S_0 \Delta x = y_b + \frac{\alpha_b V_b^2}{2g} + S_f \Delta x \tag{9-2}$$

or, in the form of Eq. (4-33),

$$E_a - E_b = (S_f - S_0)\Delta x \tag{9-3}$$

In Eq. (9-2), y_a and y_b are depths at sections a and b, respectively, and can be in either the main channel or the overbank channel. To evaluate α, the definition given by Eq. (5-2), page 242, is applied in finite increment form:

$$\alpha = \frac{1}{V^3 A} \sum_{i=1}^{N} V_i^3 A_i \tag{9-4}$$

where the subscript i indicates the subarea of which V_i and A_i are the average velocity and cross-sectional area, respectively, and N indicates the number of subareas that the section is divided into. V and A are, respectively, the average

GUIDE FOR SELECTING ROUGHNESS COEFFICIENT

"n" VALUES FOR CHANNELS

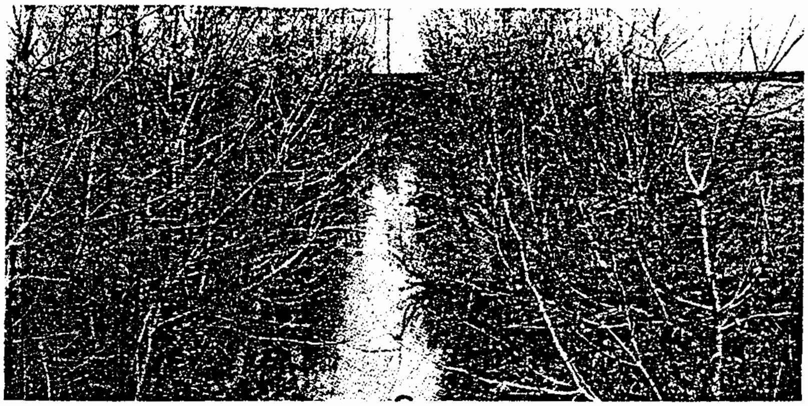
UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

DECEMBER 1963

INDEX

Kaskaskia Mutual Dredged Channel near Bondville, Illinois. Approximate bottom width 10 feet. Picture taken April 1925.



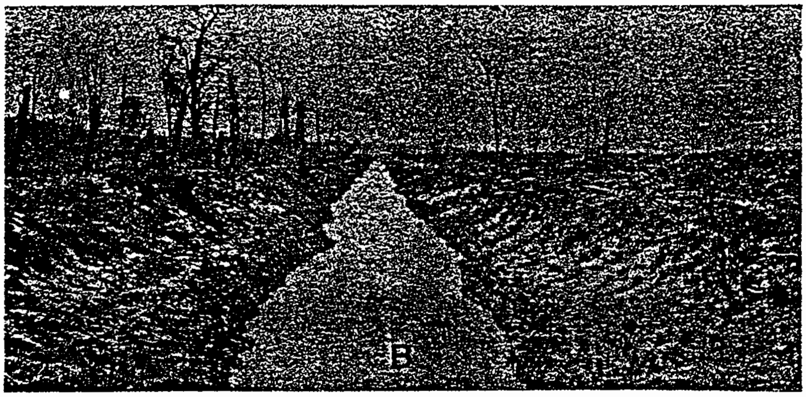
Date of observation	Average maximum depth	Average surface width	Discharge	Average cross section	Mean velocity	Mean hydraulic radius	Slope of water surface	Coefficient of roughness n	Description of channel
Feb. 7, 1925	2.1	16.5	21.9	24.6	0.89	1.36	0.000473	0.040	*Course*, straight; 330 feet long. *Cross section*, some variation in shape; for variation in size, see Figure 20, G. *Side slopes*, rather irregular. *Bottom*, rather irregular. *Soil*, lower part, black clay; upper part, dark-gray silty clay loam. *Condition*, badly obstructed by trees 1 to 6 inches in diameter on side slopes and edges of bottom; some weeds but practically no grass; no foliage. *Constructed*, 1902; cleared, about 1910. (Pl. 27, C and fig. 19, G.)
Mar. 16, 1925	3.0	18.9	45.5	39.6	1.15	1.89	.000424	.039	
Mar. 29, 1924	5.3	27.6	106.7	92.8	1.15	3.00	.000367	.051	
Feb. 25, 1926	5.7	29.6	100.7	105.7	.95	3.19	.000394	.067	
Aug. 24, 1924	4.1	23.0	67.1	64.0	1.05	2.50	0.000494	0.056	*Condition*, as described above, but with summer foliage, and water weed on bottom along one-tenth of course.
June 6, 1924	4.4	24.1	72.2	71.9	1.00	2.66	.000409	.056	
do	5.0	26.8	85.6	88.1	.97	2.95	.000373	.060	
Aug. 21, 1924	6.1	30.9	120.4	116.6	1.03	3.36	.000427	.067	
Aug. 20, 1924	8.4	41.0	206.1	200.3	1.03	4.35	.000536	.094	

Kaskaskia Mutual Dredged Channel near Bondville, Illinois. Approximate bottom width 10 feet. Picture taken July 1927.

Date of observation	Average maximum depth	Average surface width	Discharge	Average cross section	Mean velocity	Mean hydraulic radius	Slope of water surface	Coefficient of roughness n	Description of channel
Sept. 28, 1926	4.3	23.8	48.0	68.8	0.70	2.58	0.000645	0.097	*Course*, nearly straight; 330 feet long. *Cross section*, some variation in shape; for variation in size, see Figure 20, F. *Side slopes*, irregular. *Bottom*, irregular. *Soil*, lower part, black clay; upper part, dark-gray silty clay loam. *Condition*, badly obstructed by trees 2 to 12 inches in diameter covering side slopes, except intervals aggregating half length of right bank occupied by large weeds and bushy willows; no foliage. *Constructed*, 1902; cleared, about 1910.
Sept. 9, 1926	7.5	34.3	111.5	157.8	.71	4.05	.000388	.110	
Oct. 2, 1926	8.0	36.6	132.3	176.4	.75	4.24	.000409	.111	
do	8.6	40.0	160.6	200.9	.80	4.43	.000421	.109	
	[1] 9.0								
									Condition, as in summer of 1924, but worse. (Pl. 27, B.)

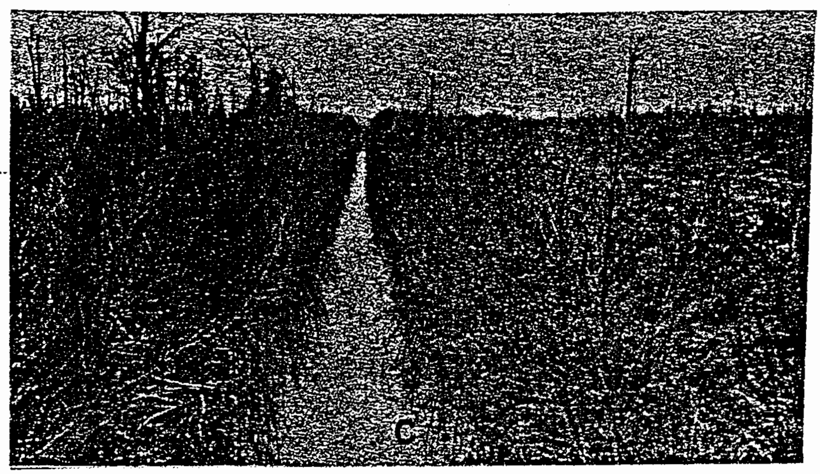
[1] Average maximum depth at bankful stage.

Ditch No. 1 of Little River Drainage District near Chaffee, Missouri. Approximate bottom width 10 feet. Picture taken April 1923.



Date of observation	Average maximum depth	Average surface width	Discharge	Average cross section	Mean velocity	Mean hydraulic radius	Slope of water surface	Coefficient of roughness *n*	Description of channel
Jan. 26, 1923	3.2	17.7	26.6	39.0	0.68	2.00	0.000058	0.025	*Course*, straight; 800 feet long. *Cross section*, very little variation in shape; for variation in size, see figure 18, D. *Side slopes*, quite regular. *Bottom*, fairly regular. *Soil*, dark, heavy, tenacious clay. *Condition*, newly cleared channel, practically no vegetation. *Constructed*, December, 1914. (Pl. 21, B and fig. 17, D.)
Jan. 25, 1923	3.5	18.4	34.9	45.1	.77	2.18	.000070	.026	
Mar. 6, 1923	3.8	19.2	43.9	50.7	.87	2.34	.000086	.027	
Jan. 24, 1923	4.5	21.0	57.9	62.6	.92	2.64	.000080	.027	
Apr. 13, 1923	5.2	23.2	91.6	78.8	1.16	3.01	.000108	.028	
Jan. 23, 1923	5.8	25.2	91.9	93.8	.98	3.28	.000069	.028	
Jan. 31, 1923	6.4	26.7	140.9	107.8	1.31	3.67	.000110	.029	
Mar. 13, 1923	6.8	28.2	148.2	121.6	1.22	3.77	.000096	.029	
Feb. 3, 1923	7.6	30.2	184.2	143.3	1.29	4.06	.000109	.031	
Jan. 22, 1923	7.7	30.4	182.1	146.3	1.24	4.10	.000099	.031	
Mar. 12, 1923	7.8	30.5	220.1	148.2	1.49	4.13	.000144	.031	
Feb. 1, 1923	7.9	30.8	230.8	152.8	1.51	4.21	.000139	.031	
Jan. 21, 1923	8.0	31.0	228.0	155.5	1.47	4.26	.000128	.031	

Ditch No. 1 of Little River Drainage District near Chaffee, Missouri. Approximate bottom width 10 feet. Picture taken December 1925.



Date of observation	Average maximum depth	Average surface width	Discharge	Average cross section	Mean velocity	Mean hydraulic radius	Slope of water surface	Coefficient of roughness *n*	Description of channel
									Course, straight; 800 feet long. *Cross section*, very little variation in shape; for variation in size, see figure 18, D. *Side slopes*, quite regular. *Bottom*, fairly regular. *Soil*, dark, heavy, tenacious clay. *Condition*, newly cleared channel, practically no vegetation. *Constructed*, December, 1914.
Nov. 29, 1925	6.6	27.4	81.7	115.0	0.71	3.66	27.2	0.069	Same channel as above with about 2 years' growth of willows. (Pl. 21, C.)
Nov. 28, 1925	7.4	29.7	99.6	136.5	.73	3.98	26.4	.073	
	[1] 8.0								

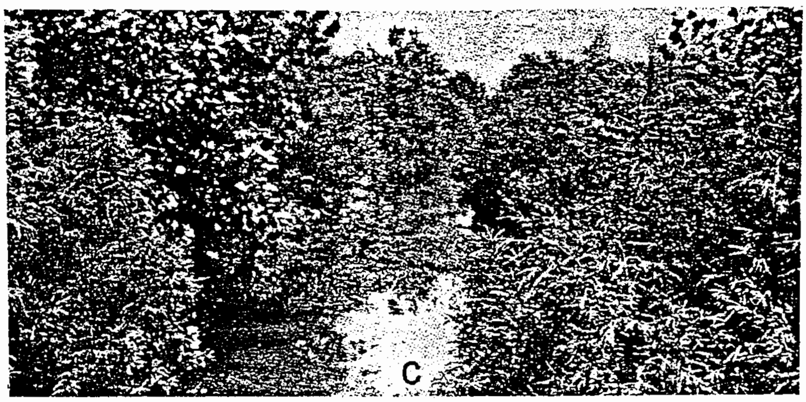
[1] Average maximum depth at bankful stage.

Kaskaskia River Dredged Channel near Sadorus, Illinois. Approximate bottom width 15 feet. Picture taken May 1926.

Date of observation	Average maximum depth	Average surface width	Discharge	Average cross section	Mean velocity	Mean hydraulic radius	Slope of water surface	Coefficient of roughness n	Description of channel
Jan. 18, 1926	5.2	37.6	249.1	130.6	1.91	3.15	0.000383	0.033	*Course*, crooked; 600 feet long. *Cross section*, considerable variation in shape; for variation in size, see fig. 20, H. *Side slopes*, very irregular and uneven. *Bottom*, fairly even and regular. *Soil*, lower part, light bluish gray clay, which is hard, waxy, and slippery at the bottom; upper part, gray silt loam. *Condition*, very young growth and stubble on upper part of slopes, none on lower part; channel cleared in September, 1925. *Constructed*, 1907; vegetation cut about every 2 years. (Pl. 26, C and fig 19, H.)
Feb. 26, 1926	6.2	43.0	321.0	169.5	1.89	3.58	.000485	.041	
Feb. 25, 1926	7.1	47.1	415.6	210.0	1.98	4.04	.000515	.044	
Apr. 7, 1926	7.6	49.2	454.4	236.8	1.92	4.35	.000463	.046	
June 12, 1926	2.8	25.6	70.7	56.2	1.26	2.02	53.6	0.030	*Condition*, left slope covered with weeds, right slope with willows, except near bottom.
Sept. 17, 1926	3.2	26.8	69.8	66.8	1.04	2.28	44.4	.037	
Sept. 7, 1926	4.2	31.5	99.3	95.1	1.04	2.74	38.7	.044	
Sept. 13, 1926	4.9	36.2	138.4	120.5	1.15	3.04	39.1	.045	
Sept. 6, 1926	6.4	43.8	197.1	177.5	1.11	3.68	35.2	.053	
Sept. 5, 1926	7.4	48.3	260.2	225.4	1.15	4.22	28.9	.068	
Sept. 11, 1926	8.4	51.6	320.8	273.2	1.17	4.76	28.3	.072	
----------	[1] 9.0	----------	----------	----------	----------	----------	----------	----------	

Average maximum depth at bankful stage.

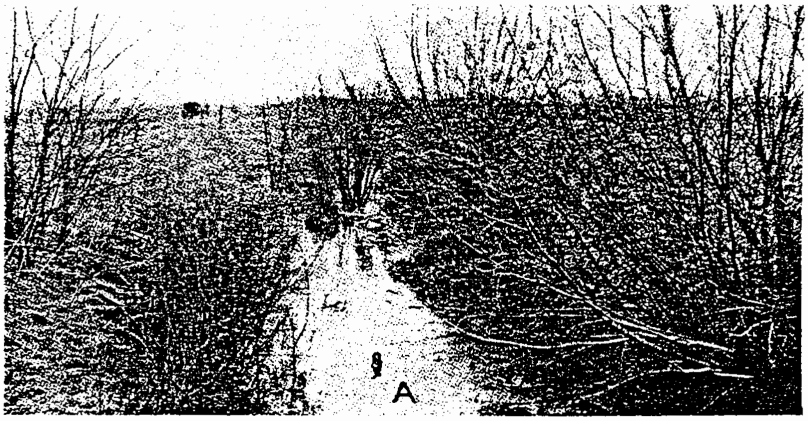
Camp Creek Dredged Channel near Seymore, Illinois. Approximate bottom width 15 feet. Picture taken July 1927.



Date of observation	Average maximum depth	Average surface width	Discharge	Average cross section	Mean velocity	Mean hydraulic radius	Slope of water surface	Coefficient of roughness n	Description of channel
	Feet	*Feet*	*Second-feet*	*Sq. ft.*	*Ft. per sec.*	*Feet*			*Course*, straight; 661 feet long. *Cross section*, very little variation in shape; for variation in size, see fig. 20, J. *Side slopes*, fairly regular. *Bottom*, uneven and irregular. *Soil*, lower part, yellowish gray clay; upper part, light gray silty clay loam. *Condition*, in 1924, newly cleaned leaving weeds and stubble on side slopes; in 1926, sides covered with trees and vines without foliage. *Constructed*, 1906; cleaned, winter of 1923-24.
Sept. 10, 1926	4.6	28.6	60.9	87.9	0.69	2.84	0.000516	0.095	
Oct. 2, 1926	7.3	36.0	164.9	175.7	.94	4.37	.000546	.104	
----------	[1] 8.5	----------	----------	----------	----------	----------	----------	----------	*Condition*, side slopes covered with heavy growth of poplar trees 2 to 3 inches in diameter, large willows, and climbing vines; thick growth of water weed on bottom. (Pl. 29, C.)

[1] Average maximum depth at bank-full stage.

Two Mile Slough Dredged Channel near Sadorus, Illinois. Approximate bottom width 15 feet. Picture taken April 1925.



Date of observation	Average maximum depth	Average surface width	Discharge	Average cross section	Mean velocity	Mean hydraulic radius	Slope of water surface	Coefficient of roughness *n*	Description of channel
Mar. 13, 1925	2.7	18.3	25.6	32.6	0.79	1.64	0.000558	0.056	*Course*, straight; 360 feet long. *Cross section*, considerable variation in shape; for variation in size, see fig. 20, I. *Side slopes*, irregular. *Bottom*, very irregular. *Soil*, lower part, black slippery clay; upper part, gray silty clay loam. *Condition*, about 100 feet of course covered with dense growth of bushy willows, some in bottom; remainder of both slopes covered with weeds and a scattering growth of willows and poplars 1 to 6 inches in diameter; no foliage; some silting in bottom. *Constructed*, redredged 1905; cleared, 1921. (Pl. 28, A and fig. 19, I.)
Jan. 19, 1926	4.0	22.3	44.2	59.7	.74	2.43	.000550	.081	
Mar. 14, 1925	5.6	27.2	86.4	99.2	.87	3.25	.000464	.081	
Feb. 25, 1926	5.8	27.9	101.4	107.0	.95	3.41	.000447	.076	
Mar. 19, 1925	5.8	28.1	105.1	106.6	.99	3.38	.000422	.070	
Jan. 18, 1926	6.0	28.4	92.7	111.4	.83	3.49	.000531	.096	
Apr. 7, 1926	7.5	32.7	159.5	158.7	1.01	4.24	.000500	.091	

East Lake Fork Dredged Channel near Ivesdale, Illinois. Approximate bottom width 15 feet. Picture taken July 1927.

Date of observation	Average maximum depth	Average surface width	Discharge	Average cross section	Mean velocity	Mean hydraulic radius	Slope of water surface	Coefficient of roughness *n*	Description of channel
Sept. 7, 1926	5.2	28.4	64.0	101.6	0.63	3.24	0.000326	0.093	*Course*, straight; 800 feet long. *Cross section*, very little variation in shape; for variation in size, see Figure 20, E. *Side slopes*, rather irregular. *Bottom*, uneven and rather irregular. *Soil*, lower part, yellowish gray clay; upper part dark-gray silt loam. *Condition*, dead weeds and stubble on side slopes; channel had been cleared shortly before March, 1925. *Constructed*, 1885; redredged about 1904.
Sept. 5, 1926	6.1	30.5	77.2	126.8	.61	3.70	.000279	.100	
Sept. 13, 1926	7.2	33.5	124.6	162.1	.77	4.25	.000330	.097	
Sept. 11, 1926	8.8	41.3	170.8	222.2	.77	4.75	.000308	.103	
----------	[1] 9.5	----------	----------	----------	----------	----------	----------	----------	*Condition*, left side rather steep, showing some tendency to cave; brush larger on side slopes; foliage on all vegetation. (Pl. 26, B.)

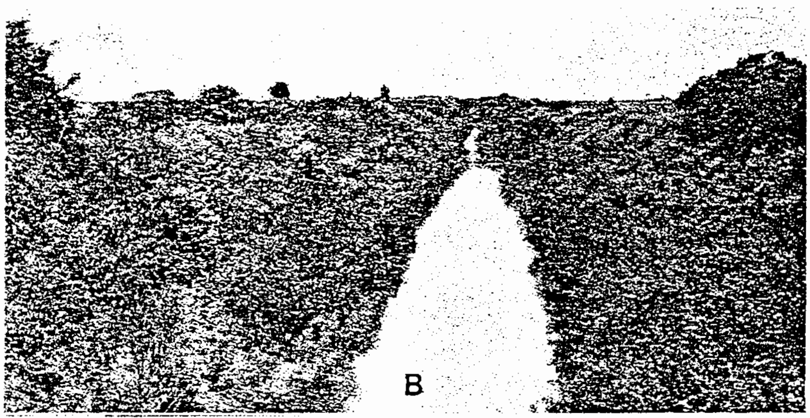
[1] Average maximum depth at bankful stage.

South Forked Deer River Dredged Channel near Henderson, Tennessee. Approximate bottom width 20 feet. Picture taken in 1916.

Date of observation	Average maximum depth	Average surface width	Discharge	Average cross section	Mean velocity	Mean hydraulic radius	Slope of water surface	Coefficient of roughness n	Description of channel
Mar. 30, 1916	3.2	26.1	115.2	73.3	1.57	2.46	0.000257	0.028	*Course*, straight; 624 feet long. *Cross section*, very little variation in shape; for variation in size, see Fig. 6, C. *Side slopes*, slightly irregular. *Bottom*, fairly regular; uneven in places with small depressions. *Soil*, heavy clay near bottom; clay loam near top. *Condition*, practically no vegetation in channel. *Constructed*, November, 1914. (Pl. 7, B and fig. 5, C.)
Mar. 1, 1916	3.8	27.1	169.4	89.0	1.90	2.81	.000393	.031	
May 16, 1916	3.9	27.4	193.2	91.5	2.11	2.87	.000305	.025	
May 22, 1916	5.8	30.4	358.0	147.0	2.43	3.96	.000361	.029	
May 3, 1916	6.4	31.5	434.6	168.3	2.58	4.34	.000345	.029	
	[1] 9.3								

Average maximum depth at bankful stage.

Lake Fork Special Dredged Channel near Bement, Illinois. Approximate bottom width 25 feet. Picture taken July 1924.



Date of observation	Average maximum depth	Average surface width	Discharge	Average cross section	Mean velocity	Mean hydraulic radius	Slope of water surface	Coefficient of roughness n	Description of channel
	Feet	*Feet*	*Second-feet*	*Sq. ft.*	*Ft. per sec.*	*Feet*			*Course*, straight; 816 feet long. *Cross section*, very little variation in shape; for variation in size, see fig. 20, B. *Side slopes*, fairly regular. *Bottom*, uneven and irregular. *Soil*, lower part, light gray clay; upper part, yellowish gray clay. *Condition*, side slopes covered with dense growth of bushy willows, except near bottom; some small poplar saplings at intervals along course; one silt bar about middle of course, otherwise bottom in quite good condition. *Constructed*, 1885; redredged, 1909.
Sept. 17, 1926	6.8	48.8	185.1	221.4	0.84	4.20	0.000241	0.075	
Sept. 7, 1926	7.4	50.8	192.2	253.7	.76	4.60	.000244	.090	
Aug. 25, 1924	8.0	52.3	259.7	282.3	.92	4.94	.000286	.085	
Sept. 6, 1926	8.5	53.6	244.4	309.6	.79	5.27	.000239	.096	
Sept. 5, 1926	9.2	55.2	282.5	347.7	.81	5.71	.000228	.098	
Sept. 13, 1926	9.6	56.1	319.7	372.2	.86	5.96	.000214	.093	
Sept. 10, 1926	12.0	61.6	495.2	511.0	.97	7.33	.000236	.104	

Condition, about the same as for above measurements, except that growth was covered with foliage. This channel was cleared during fall of 1925, but there appeared to be as much growth in channel by the fall of 1926 as previous to clearing. (Pl. 25, B.)

APPENDIX 8-A

Shoreline Vegetation Data Collected by Lakewatch/USF Staff

Florida LAKEWATCH is a volunteer citizen lake monitoring program that facilitates "hands on"citizen participation in the management of Florida lakes through monthly monitoring activities. Coordinated through the University of Florida's Institute of Food and Agricultural Sciences/Department of Fisheries and Aquatic Sciences, the program has been in existence for ten years and is one of the largest lake monitoring programs in the nation, with over 1800 trained citizens monitoring 600+ lakes, in more than 40 counties.

The Hillsborough County Lake Atlas provides data on the diversity, distribution, and abundance of plants and animals whenever available. Currently, lake assessments conducted by the Hillsborough County/U.S.F. Assessment Team provide 1) an inventory of the types of plant species present, 2) the relative frequencies of occurrence of plants on each lake, and 3) an estimated measure of biomass of dominant taxa. The inventory simply documents the variety of species present at a given set of sites around the lake. The relative frequency of occurrence is a useful way of telling how common a plant is on a lake. A 100% frequency means that every site sampled around the lake had that particular plant. Biomass refers to the weight of biological material present. As the Atlas continues to grow and develop, it is hoped that these biological data will provide a better understanding of our fragile ecosystem and the influence of human population pressures on the limited aquatic resources we are fortunate to possess.

Aquatic plant surveys involve measuring the abundance and distribution of plant species in and around lakes. Numbers of various types of plants, frequency of occurrence, and mass of plants may all be used to determine the diversity and abundance. In this way, one can assess which species are dominant and which are infrequent. This can also be used to predict trends or changes in abundance and distribution over time. For example, rapid increases in the abundance of invasive plants can be monitored in this way, and appropriate action may be taken. The Hillsborough County/U.S.F. Assessment Team has identified over 130 species on Hillsborough County lakes to date. Additional plant species are routinely identified with the help of botanists at U.S.F., Lakewatch, and the Hillsborough County Environmental Protection Commission.

Aquatic plants may be found along the shore, or emerging (sticking-out) from the lake surface. Plants that are found here are termed emergent. Examples include maidencane (*Panicum hemitomon*) and pickerelweed (*Pontederia cordata*). Other aquatic plants float on the surface (water hyacinth, *Eichornia crassipes*) or possess leaves that float (spatterdock, *Nuphar luteum*). Still other types remain submerged, often attached by roots to the lake bottom, or hydrosoil. Examples of submerged plants include eelgrass (tapegrass, *Valisneria americana*) or the nuisance species, *Hydrilla verticillata*.

Plant Species Inventory Data Definitions	
Species name	The scientific name of the plant
Common Name	The common name of the plant
Frequency	Percent frequency with which the plant occurs among samples taken around the lake
Habit	Zone (emergent, floating, submergent) where plant is typically found
Status	Indigenous (native) to Florida or introduced (exotic)
EPPC Status	Exotic Plant Pest Council Status of exotic plant; I= Category I, II= Category II, NL= Not Listed

Definitions provided EPPC:
NATIVE-a species already occurring in Florida at the time of European contact (1500).
EXOTIC-a non-indigenous species, or one introduced to this state, either purposefully or accidentally; it then escaped into the wild in Florida where it reproduces on its own either sexually or asexually.
INVASIVE-is a variable condition defined by the category to which the species is assigned.
CATEGORY I-Species that are invading and disrupting native plant communities in Florida. This definition does not rely on the economic severity or geographic range of the problem, but on the documented ecological damage caused.
CATEGORY II-Species that have shown a potential to disrupt native plant communities. These species may become ranked as Category I, but have not yet demonstrated disruption of natural Florida communities.

Lakewatch vegetation data for Cedar Lake.

Plant Species	Common Name	Frequency	Habit	Status	EPPC
Eleocharis spp.	Roadgrass, Spikerushes	80%	Emergent	Native	NL
Hydrocotyle umbellata	Manyflower Marshpennywort, Water Pennywort	80%	Emergent	Native	NL
Panicum repens	Torpedo Grass	70%	Emergent	Exotic	I
Mikania scandens	Climbing Hempvine	70%	Emergent	Native	NL
Ludwigia peruviana	Peruvian Primrosewillow	60%	Emergent	Exotic	NL
Ludwigia octovalvis	Mexican Primrosewillow, Long-stalked Ludwigia	60%	Emergent	Native	NL
Nuphar lutea	Spatterdock, Yellow Pondlily	50%	Floating	Native	NL
Quercus laurifolia	Laurel Oak; Diamond Oak	50%	Emergent	Native	NL
Centella asiatica	Asian Pennywort, Coinwort	50%	Emergent	Native	NL
Typha spp.	Cattails	50%	Emergent	Native	NL
Salix spp.	Willow	40%	Emergent	Native	NL
Mormordica charantia	Wild Balsam Apple	40%	Terrestrial	Exotic	NL
Pontederia cordata	Pickerel Weed	40%	Emergent	Native	NL
Taxodium spp.	Cypress	40%	Emergent	Native	NL
Fuirena spp.	Rush Fuirena	30%	Emergent	Native	NL
Cyperus spp.	Sedge	30%	Emergent	Unknown	NL
Cinnamonium camphora	Camphor-tree	30%	Emergent	Native	I
Blechnum serrulatum	Swamp Fern	30%	Emergent	Native	NL
Scirpus cubensis	Burhead Sedge,Cuban Scirpus	30%	Emergent	Native	NL
Commelina spp.	Dayflower	30%	Emergent	Native	NL
Diodia virginiana	Buttonweed	20%	Emergent	Native	NL
Mimosa spp.	Mimosa	20%	Emergent	Exotic	NL
Magnolia virginiana	Sweetbay Magnolia	20%	Emergent	Native	NL
Wedelia trilobata	Creeping Oxeye	20%	Emergent	Exotic	II
Musa spp.	Banana Tree	20%	Emergent	Exotic	NL
Pinus spp.	Pine Tree	20%	Emergent	Native	NL
Smilax spp.	Catbriar, Greenbriar	20%	Emergent	Native	NL
Liquidamber styraciflua	Sweetgum	20%	Emergent	Native	NL
Schinus terebinthifolius	Brazilian Pepper	20%	Emergent	Exotic	I
Vitis spp.	Grapevine	20%	Emergent	Native	NL
Gordonia lasianthus	Loblolly Bay	10%	Emergent	Native	NL
Ilex cassine	Dahoon Holly	10%	Emergent	Native	NL
Eupatorium capillifolium	Dog Fennel	10%	Emergent	Native	NL
Micranthemum glomeratum	Manatee Mudflower, Baby's Tears	10%	Submersed	Native	NL
Ludwigia spp.	Water Primroses, Primrosewillow	10%	Emergent	Unknown	NL
Dioscorea bulbifera	Air Potato	10%	Emergent	Exotic	I
Canna flaccida	Golden Canna	10%	Emergent	Native	NL
Cyperus alternifolius	Umbrella Flat Sedge	10%	Emergent	Exotic	II
Brachiaria mutica	Para Grass	10%	Emergent	Exotic	I
Dryopteris ludoviciana	Shield Fern	10%	Emergent	Native	NL
Acer rubrum var. trilobum	Southern Red Maple	10%	Emergent	Native	NL
Sapium sebiferum	Chinese Tallow Tree	10%	Emergent	Exotic	I
Sambucus canadensis	Elderberry	10%	Emergent	Native	NL
Parthenocissus quinquefolia	Virginia Creeper, Woodbine	10%	Emergent	Native	NL
Periphyton spp.	Algae	10%	Submersed	Native	NL
Ludwigia repens	Creeping Primrosewillow, Red Ludwigia	10%	Emergent	Native	NL
Nyssa sylvatica var. biflora	Black Gum, Swamp Tupelo	10%	Emergent	Native	NL
Lycopus rubellus	Water-Horehound,Bugle weed	10%	Emergent	Native	NL
Nephrolepis spp.	Boston Fern	10%	Emergent	Unknown	NL
Bidens spp.	Bur Marigold	10%	Emergent	Native	NL

Lakewatch vegetation data for Lake Eckles.

Plant Species	Common Name	Frequency	Habit	Status	EPPC
Panicum repens	Torpedo Grass	80%	Emergent	Exotic	I
Hydrocotyle umbellata	Manyflower Marshpennywort, Water Pennywort	75%	Emergent	Native	NL
Nuphar lutea	Spatterdock, Yellow Pondlily	65%	Floating	Native	NL
Mikania scandens	Climbing Hempvine	60%	Emergent	Native	NL
Nitella spp.	Stonewort	60%	Submersed	Native	NL
Quercus laurifolia	Laurel Oak; Diamond Oak	50%	Emergent	Native	NL
Fuirena spp.	Rush Fuirena	45%	Emergent	Native	NL
Eupatorium capillifolium	Dog Fennel	40%	Emergent	Native	NL
Acer rubrum var. trilobum	Southern Red Maple	35%	Emergent	Native	NL
Taxodium spp.	Cypress	30%	Emergent	Native	NL
Melaleuca quinquenervia	Punk Tree, Melaleuca	30%	Emergent	Exotic	I
Centella asiatica	Asian Pennywort, Coinwort	30%	Emergent	Native	NL
Ludwigia peruviana	Peruvian Primrosewillow	25%	Emergent	Exotic	NL
Ludwigia octovalvis	Mexican Primrosewillow, Long-stalked Ludwigia	25%	Emergent	Native	NL
Cyperus spp.	Sedge	25%	Emergent	Unknown	NL
Commelina diffusa	Dayflower	25%	Emergent	Native	NL
Parthenocissus quinquefolia	Virginia Creeper, Woodbine	20%	Emergent	Native	NL
Sagittaria lancifolia	Duck Potato	20%	Emergent	Native	NL
Salix spp.	Willow	20%	Emergent	Native	NL
Emelia sonchifolia	Lilac Tasselflower	20%	Terrestrial	Exotic	NL
Vigna luteola	Hairypod Cowpea	20%	Terrestrial	Native	NL
Casuarina equisetifolia	Australian Pine	20%	Emergent	Exotic	I
Typha spp.	Cattails	20%	Emergent	Native	NL
Bacopa monnieri	Common Bacopa	15%	Submersed	Native	NL
Myrica cerifera	Wax Myrtle	15%	Emergent	Native	NL
Wedelia trilobata	Creeping Oxeye	15%	Emergent	Exotic	II
Ludwigia spp.	Water Primroses, Primrosewillow	15%	Emergent	Unknown	NL
Colocasia esculenta	Wild Taro	15%	Emergent	Exotic	I
Panicum hemitomon	Maidencane	15%	Emergent	Native	NL
Ilex cassine	Dahoon Holly	10%	Emergent	Native	NL
Nephrolepis exaltata	Sword Fern, Wild Boston Fern	10%	Terrestrial	Native	NL
Musa spp.	Banana Tree	10%	Emergent	Exotic	NL
Micranthemum umbrosum	Shade Mudflower, Baby's Tears	10%	Submersed	Native	NL
Dryopteris ludoviciana	Shield Fern	10%	Emergent	Native	NL
Fraxinus caroliniana	Carolina Ash, Water Ash, Pop Ash	10%	Emergent	Native	NL
Lycopus rubellus	Water-Horehound,Bugle weed	10%	Emergent	Native	NL
Iris virginica	Southern Blue Flag	10%	Floating	Exotic	NL
Iris spp.	Flag	10%	Emergent	Unknown	NL
Erigeron quercifolius	Oakleaf Fleabane	10%	Terrestrial	Native	NL
Vitis spp.	Grapevine	10%	Emergent	Native	NL
Schinus terebinthifolius	Brazilian Pepper	10%	Emergent	Exotic	I
Cinnamonium camphora	Camphor-tree	10%	Emergent	Native	I
Alternanthera philoxeroides	Alligator Weed	10%	Emergent	Exotic	II
Cyperus alternifolius	Umbrella Flat Sedge	5%	Emergent	Exotic	II
Bambusa spp.	Bamboo	5%	Emergent	Exotic	NL
Hydrilla verticillata	Hydrilla, waterthyme	5%	Submersed	Exotic	I
Hypericum mutilum	Dwarf St. John's-wort	5%	Emergent	Native	NL
Bidens spp.	Bur Marigold	5%	Emergent	Native	NL
Drosera capillaris	Pink Sundew	5%	Emergent	Native	NL
Canna spp.	Canna	5%	Emergent	Exotic	NL
Eleocharis spp.	Roadgrass, Spikerushes	5%	Emergent	Native	NL
Cephalanthus occidentalis	Buttonbush	5%	Emergent	Native	NL
Eclipta alba	Yerba De Tajo	5%	Emergent	Native	NL
Diodia virginiana	Buttonweed	5%	Emergent	Native	NL
Centrosema virginianum	Spurred Butterfly Pea	5%	Terrestrial	Native	NL
Brachiaria mutica	Para Grass	5%	Emergent	Exotic	I
Quercus nigra	Water Oak	5%	Emergent	Native	NL
Utricularia spp.	Bladderwort	5%	Submersed	Native	NL
Tradescantia ohiensis	Bluejacket; Ohio Spiderwort	5%	Terrestrial	Native	NL

Lake Eckles (continued)

Sabal palmetto	Sabal Palm, Cabbage Palm	5%	Terrestrial	Native	NL
Smilax spp.	Catbriar, Greenbriar	5%	Emergent	Native	NL
Stachys floridana	Florida Hedgenettle; Florida Betony	5%	Terrestrial	Native	NL
Scirpus cubensis	Burhead Sedge,Cuban Scirpus	5%	Emergent	Native	NL
Juncus effusus var solutus	Soft Rush	5%	Emergent	Native	NL
Rhexia mariana	Pale Meadowbeauty; Maryland Meadowbeauty	5%	Terrestrial	Native	NL
Pinus palustrus	Long-leafed Pine	5%	Emergent	Native	NL
Polygonum spp.	Smartweed, Knotweed	5%	Emergent	Native	NL
Phyla nodifloria	Frog-fruit, Carpetweed, Turkey Tangle Fogfruit	5%	Emergent	Native	NL
Pinus spp.	Pine Tree	5%	Emergent	Native	NL
Pontederia cordata	Pickerel Weed	5%	Emergent	Native	NL
Najas guadelupensis	Southern Naiad	5%	Submersed	Native	NL
Magnolia virginiana	Sweetbay Magnolia	5%	Emergent	Native	NL
Mimosa spp.	Mimosa	5%	Emergent	Exotic	NL
Micranthemum glomeratum	Manatee Mudflower, Baby's Tears	5%	Submersed	Native	NL
Ludwigia repens	Creeping Primrosewillow, Red Ludwigia	5%	Emergent	Native	NL
Roystonea	Royal Palm	5%	Emergent	Native	NL

Lakewatch vegetation data for Mid Lake.

Plant Species	Common Name	Frequency	Habit	Status	EPPC
Cyperus spp.	Sedge	100%	Emergent	Unknown	NL
Eleocharis baldwinii	Baldwin's Spikerush, Roadgrass	100%	Submersed	Native	NL
Hydrocotyle umbellata	Manyflower Marshpennywort, Water Pennywort	83%	Emergent	Native	NL
Ludwigia peruviana	Peruvian Primrosewillow	67%	Emergent	Exotic	NL
Quercus laurifolia	Laurel Oak; Diamond Oak	67%	Emergent	Native	NL
Mikania scandens	Climbing Hempvine	67%	Emergent	Native	NL
Eupatorium capillifolium	Dog Fennel	67%	Emergent	Native	NL
Salix spp.	Willow	50%	Emergent	Native	NL
Typha spp.	Cattails	50%	Emergent	Native	NL
Nymphea odorata	American White Water Lily, Fragrant Water Lily	50%	Floating	Native	NL
Nuphar lutea	Spatterdock, Yellow Pondlily	50%	Floating	Native	NL
Roystonea	Royal Palm	33%	Emergent	Native	NL
Bidens spp.	Bur Marigold	33%	Emergent	Native	NL
Taxodium spp.	Cypress	17%	Emergent	Native	NL
Cinnamonium camphora	Camphor-tree	17%	Emergent	Native	I
Rhexia spp.	Meadow Beauties	17%	Terrestrial	Unknown	NL
Polygonum spp.	Smartweed, Knotweed	17%	Emergent	Native	NL
Centella asiatica	Asian Pennywort, Coinwort	17%	Emergent	Native	NL
Blechnum serrulatum	Swamp Fern	17%	Emergent	Native	NL
Mimosa spp.	Mimosa	17%	Emergent	Exotic	NL
Ludwigia spp.	Water Primroses, Primrosewillow	17%	Emergent	Unknown	NL
Acer rubrum var. trilobum	Southern Red Maple	17%	Emergent	Native	NL
Cyperus odoratus	Fragrant Flatsedge	17%	Emergent	Native	NL
Musa spp.	Banana Tree	17%	Emergent	Exotic	NL
Diodia virginiana	Buttonweed	17%	Emergent	Native	NL
Colocasia esculenta	Wild Taro	17%	Emergent	Exotic	I
Fraxinus caroliniana	Carolina Ash, Water Ash, Pop Ash	17%	Emergent	Native	NL
Panicum repens	Torpedo Grass	17%	Emergent	Exotic	I
Panicum hemitomon	Maidencane	17%	Emergent	Native	NL

Lakewatch vegetation data for Lake Pine.

Plant Species	Common Name	Frequency	Habit	Status	EPPC
Acer rubrum var. trilobum	Southern Red Maple	100%	Emergent	Native	NL
Cyperus spp.	Sedge	80%	Emergent	Unknown	NL
Ludwigia peruviana	Peruvian Primrosewillow	80%	Emergent	Exotic	NL
Eupatorium capillifolium	Dog Fennel	80%	Emergent	Native	NL
Quercus laurifolia	Laurel Oak; Diamond Oak	60%	Emergent	Native	NL
Ludwigia octovalvis	Mexican Primrosewillow, Long-stalked Ludwigia	60%	Emergent	Native	NL
Hydrocotyle umbellata	Manyflower Marshpennywort, Water Pennywort	60%	Emergent	Native	NL
Eleocharis baldwinii	Baldwin's Spikerush, Roadgrass	50%	Submersed	Native	NL
Fuirena spp.	Rush Fuirena	50%	Emergent	Native	NL
Diodia virginiana	Buttonweed	40%	Emergent	Native	NL
Centella asiatica	Asian Pennywort, Coinwort	40%	Emergent	Native	NL
Nuphar lutea	Spatterdock, Yellow Pondlily	30%	Floating	Native	NL
Scirpus spp.	Sedge	30%	Emergent	Unknown	NL
Panicum repens	Torpedo Grass	30%	Emergent	Exotic	I
Mikania scandens	Climbing Hempvine	30%	Emergent	Native	NL
Mimosa spp.	Mimosa	30%	Emergent	Exotic	NL
Brachiaria mutica	Para Grass	20%	Emergent	Exotic	I
Schinus terebinthifolius	Brazilian Pepper	20%	Emergent	Exotic	I
Fraxinus caroliniana	Carolina Ash, Water Ash, Pop Ash	20%	Emergent	Native	NL
Colocasia esculenta	Wild Taro	20%	Emergent	Exotic	I
Salix spp.	Willow	20%	Emergent	Native	NL
Sambucus canadensis	Elderberry	20%	Emergent	Native	NL
Melaleuca quinquenervia	Punk Tree, Melaleuca	20%	Emergent	Exotic	I
Wedelia trilobata	Creeping Oxeye	20%	Emergent	Exotic	II
Sabal spp.	Palm	20%	Terrestrial	Unknown	
Musa spp.	Banana Tree	10%	Emergent	Exotic	NL
Eleocharis spp.	Roadgrass, Spikerushes	10%	Emergent	Native	NL
Commelina spp.	Dayflower	10%	Emergent	Native	NL
Ludwigia spp.	Water Primroses, Primrosewillow	10%	Emergent	Unknown	NL
Nephrolepis spp.	Boston Fern	10%	Emergent	Unknown	NL
Ludwigia repens	Creeping Primrosewillow, Red Ludwigia	10%	Emergent	Native	NL
Cyperus alternifolius	Umbrella Flat Sedge	10%	Emergent	Exotic	II
Taxodium spp.	Cypress	10%	Emergent	Native	NL
Panicum hemitomon	Maidencane	10%	Emergent	Native	NL
Polygonum spp.	Smartweed, Knotweed	10%	Emergent	Native	NL
Salix caroliniana	Carolina Willow	10%	Emergent	Native	NL
Sapium sebiferum	Chinese Tallow Tree	10%	Emergent	Exotic	I
Pluchea spp.	Marsh Fleabane,Camphorweed	10%	Emergent	Native	NL
Scirpus cubensis	Burhead Sedge,Cuban Scirpus	10%	Emergent	Native	NL

Lakewatch vegetation data for Lake Turtle.

Plant Species	Common Name	Frequency	Habit	Status	EPPC
Utricularia spp.	Bladderwort	100%	Submersed	Native	NL
Nymphea odorata	American White Water Lily, Fragrant Water Lily	100%	Floating	Native	NL
Typha spp.	Cattails	83%	Emergent	Native	NL
Najas guadelupensis	Southern Naiad	83%	Submersed	Native	NL
Vitis spp.	Grapevine	67%	Emergent	Native	NL
Quercus laurifolia	Laurel Oak; Diamond Oak	67%	Emergent	Native	NL
Nuphar lutea	Spatterdock, Yellow Pondlily	67%	Floating	Native	NL
Eupatorium capillifolium	Dog Fennel	50%	Emergent	Native	NL
Melaleuca quinquenervia	Punk Tree, Melaleuca	50%	Emergent	Exotic	I
Salix spp.	Willow	50%	Emergent	Native	NL
Myrica cerifera	Wax Myrtle	50%	Emergent	Native	NL
Nitella spp.	Stonewort	50%	Submersed	Native	NL
Lycopus rubellus	Water-Horehound,Bugle weed	33%	Emergent	Native	NL
Cinnamonium camphora	Camphor-tree	33%	Emergent	Native	I
Salvinia minima	Water Spangles, Water Fern	33%	Floating	Native	NL
Eleocharis baldwinii	Baldwin's Spikerush, Roadgrass	33%	Submersed	Native	NL
Chara spp.	Muskgrass	33%	Submersed	Native	NL
Phyllanthus urinaria	Sensitive Plant	33%	Terrestrial	Exotic	NL
Scirpus cubensis	Burhead Sedge,Cuban Scirpus	33%	Emergent	Native	NL
Mikania scandens	Climbing Hempvine	33%	Emergent	Native	NL
Ludwigia peruviana	Peruvian Primrosewillow	33%	Emergent	Exotic	NL
Casuarina equisetifolia	Australian Pine	17%	Emergent	Exotic	I
Acer rubrum var. trilobum	Southern Red Maple	17%	Emergent	Native	NL
Alternanthera philoxeroides	Alligator Weed	17%	Emergent	Exotic	II
Sagittaria lancifolia	Duck Potato	17%	Emergent	Native	NL
Juncus effusus var solutus	Soft Rush	17%	Emergent	Native	NL
Panicum repens	Torpedo Grass	17%	Emergent	Exotic	I
Algal spp.	Algal Mats, Floating	17%	Floating	Unknown	Unknown
Polygonum spp.	Smartweed, Knotweed	17%	Emergent	Native	NL
Periphyton spp.	Algae	17%	Submersed	Native	NL

APPENDIX 8-B

Wildlife Observations in the Curiosity Creek Watershed

CURIOSITY CREEK WATERSHED ANIMAL SURVEY
(Observations 1981 to the present)

BIRDS

- PIED-BILLED GREBE (*Podilymbus podiceps*) - native species; occasional on most lakes; year round resident & breeder
- DOUBLE-CRESTED CORMORANT (*Phalacrocorax auritus*) - native species; occasional on larger lakes; year round resident
- ANHINGA (*Anhinga anhinga*) - native species; common on most lakes; year round resident
- GREAT BLUE HERON (*Ardea herodias*) - native species; common on most lakes; year round resident & breeder
- GREAT EGRET (*Ardea alba*) - native species; common on most lakes; year round resident & breeder
- SNOWY EGRET (*Egretta thula*) - native species; common on most lakes; year round resident & breeder
- LITTLE BLUE HERON (*Egretta caerulea*) - native species; common on most lakes; year round resident & breeder
- TRICOLORED HERON (*Egretta tricolor*) - native species; common on most lakes; year round resident & breeder
- CATTLE EGRET (*Bubulcus ibis*) - naturalized* species; common on roadside & pastures; year round resident & breeder
- GREEN HERON (*Butorides virescens*) - native species; occasional on larger lakes; year round resident & breeder
- BLACK-CROWNED NIGHT-HERON (*Nycticorax nycticorax*) - native species; occasional on larger lakes; year round resident & breeder
- WHITE IBIS (*Eudocimus albus*) - native species; common in wet areas & most lakes; year round resident & breeder
- WOOD STORK (*Mycteria americana*) - native species; occasional in wet areas & most lakes; year round resident
- TURKEY VULTURE (*Cathartes aura*) - native species; roadside scavenger throughout the watershed; year round resident
- MUSCOVY DUCK (*Cairina moschata*) - introduced species; common on most lakes; year round resident & breeder
- WOOD DUCK (*Aix sponsa*) - native species; occasional in wooded wetlands and lakes; year round resident & breeder
- MOTTLED DUCK (*Anas fulvigula*) - native species; occasional on most lakes; year round resident & breeder
- MALLARD (*Anas platyrhynchos*) - domesticated species; common on most lakes; year round resident & breeder
- BLUE-WINGED TEAL (*Anas discors*) - native species; occasional on most lakes; spring/fall migrant and winter resident

BIRDS (CONTINUED)

• NORTHERN SHOVELER (*Anas clypeata*) - native species; occasional on some lakes; spring/fall migrant and winter resident
• RING-NECKED DUCK (*Aythya collaris*) - native species; occasional on some lakes; spring/fall migrant and winter resident
• LESSER SCAUP (*Aythya affinis*) - native species; occasional on some lakes; spring/fall migrant and winter resident
• OSPREY (*Pandion haliaetus*) - native species; occasional on larger lakes; year round resident & breeder
• BALD EAGLE (*Pandion haliaetus*) - native species; occasional on larger lakes; rare year round resident
• RED-SHOULDERED HAWK (*Buteo lineatus*) - native species; occasional in wooded wetlands and lakes; year round resident & breeder
• RED-TAILED HAWK (*Buteo jamaicensis*) - native species; occasional on roadsides and open areas; year round resident & breeder
• AMERICAN KESTREL (*Falco sparverius*) - native species; occasional on roadsides & pastures; spring/fall migrant and winter resident
• COMMON MOORHEN (*Gallinula chloropus*) - native species; common on most lakes; year round resident & breeder
• AMERICAN COOT (*Fulica americana*) - native species; occasional on most lakes; spring/fall migrant and winter resident
• SANDHILL CRANE (*Grus canadensis*) - native species; occasional in wet areas, pastures & lakes; year round resident & breeder
• KILLDEER (*Charadrius vociferus*) - native species; occasional in wet areas, pastures & lakeshores; year round resident & breeder
• LAUGHING GULL (*Larus atricilla*) - native species; common near malls & fast food stores; year round resident
• RING-BILLED GULL (*Larus delawarensis*) - native species; occasional near malls & fast food stores; year round resident
• ROCK DOVE (*Columba livia*) - introduced species; common city and park dweller; year round resident & breeder
• EURASIAN COLLARED-DOVE (*Streptopelia decaocto*) - introduced species; common over the watershed; year round resident & breeder
• MOURNING DOVE (*Zenaida macroura*) - native species; common throughout the watershed; year round resident & breeder
• MONK PARAKEET (*Myiopsitta monachus*) - introduced species; occasional throughout the watershed; year round resident & breeder
• COMMON NIGHTHAWK (*Chordeiles minor*) - native species; occasional over open areas and pastures; summer resident & breeder
• CHIMNEY SWIFT (*Chaetura pelagica*) - native species; occasional over open areas and lakes; summer resident & breeder

BIRDS (CONTINUED)

• BELTED KINGFISHER (*Ceryle alcyon*) - native species; occasional on larger lakes; year round resident & breeder

• RED-BELLIED WOODPECKER (*Melanerpes carolinus*) - native species; common thru out the watershed; year round resident & breeder

• YELLOW-BELLIED SAPSUCKER (*Sphyrapicus varius*) - native; rare in wooded wetlands/lakes; spring/fall migrant & winter resident

• DOWNY WOODPECKER (*Picoides pubescens*) - native species; common throughout the watershed; year round resident & breeder

• NORTHERN FLICKER (*Colaptes auratus*) - native species; occasional throughout the watershed; year round resident & breeder

• PURPLE MARTIN (*Progne subis*) - native species; occasional over open areas lakes and pastures; summer resident & breeder

• BLUE JAY (*Cyanocitta cristata*) - native species; common throughout the watershed; year round resident & breeder

• FISH CROW (*Corvus ossifragus*) - native species; common near water throughout the watershed; year round resident

• LOGGERHEAD SHRIKE (*Lanius ludovicianus*) - native species; occasional over open areas & pastures; year round resident & breeder

• TUFTED TITMOUSE (*Parus bicolor*) - native species; common in wooded wetlands and lakes; spring/fall migrant & winter resident

• CAROLINA WREN (*Thryothorus ludovicianus*) - native species; common in the watershed's wetlands; year round resident & breeder

• BLUE-GRAY GNATCATCHER (*Polioptila caerulea*) - native species; common throughout the watershed; year round resident & breeder

• AMERICAN ROBIN (*Turdus migratorius*) - native species; common in throughout the watershed; winter resident

• GRAY CATBIRD (*Dumetella carolinensis*) - native species; occasional in large thickets; spring/fall migrant & winter resident

• NORTHERN MOCKINGBIRD (*Mimus polyglottos*) - native species; common throughout the watershed; year round resident & breeder

• BROWN THRASHER (*Toxostoma rufum*) - native species; occasional throughout the watershed; year round resident & breeder

• RED-EYED VIREO (*Vireo olivaceus*) - native species; common in the watershed's wooded wetlands; summer resident & breeder

• CEDAR WAXWING (*Bombycilla cedorum*) - native species; common throughout the watershed; spring/fall migrant & winter resident

• EUROPEAN STARLING (*Sturnus vulgaris*) - introduced species; common city and park dweller; year round resident & breeder

• YELLOW-RUMPED WARBLER (*Dendroica coronata*) - native species; common in the watershed; spring/fall migrant & winter resident

BIRDS (CONTINUED)

- PALM WARBLER (*Dendroica palmarum*) - native species; common throughout the watershed; spring/fall migrant & winter resident
- BLACKPOLL WARBLER (*Dendroica striata*) - native species; occasional throughout the watershed; spring and fall migrant
- BLACK-AND-WHITE WARBLER (*Mniotilta varia*) - native species; common throughout the watershed; spring/fall migrant & winter resident
- AMERICAN REDSTART (*Setophaga ruticilla*) - native species; occasional throughout the watershed; spring and fall migrant
- OVENBIRD (*Seiurus aurocapillus*) - native species; occasional in wooded wetlands; spring/fall migrant & winter resident
- NORTHERN CARDINAL (*Cardinalis cardinalis*) - native species; common throughout the watershed; year round resident & breeder
- RED-WINGED BLACKBIRD (*Agelaius phoeniceus*) - native species; common throughout the watershed; year round resident & breeder
- BOAT-TAILED GRACKLE (*Quiscalus major*) - native species; common near water throughout the watershed; year round resident & breeder
- COMMON GRACKLE (*Quiscalus quiscula*) - native species; common throughout the watershed; year round resident & breeder
- BROWN-HEADED COWBIRD (*Molothrus ater*) - native species; occasional throughout the watershed; year round resident & breeder
- HOUSE SPARROW (*Passer domesticus*) - introduced species; common near malls & fast food stores; year round resident & breeder

MAMMALS

- OPOSSUM (*Didelphis virginiana*) - only native marsupial species; common throughout the watershed; nocturnal; breeder
- NINE-BANDED ARMADILLO (*Dasypus novemcinctus*) - naturalized* species; occasional on roadside & wet areas; breeder
- MARSH RABBIT (*Sylvilagus palustris*) - native species; occasional along roadside and in wet areas; breeder
- GRAY SQUIRREL (*Sciurus carolinensis*) - native species; common in suburban areas throughout the watershed; breeder
- SHERMAN=S FOX SQUIRREL (*Sciurus niger*) - native species; uncommon in golf courses, oak woodlands and parks
- COTTON MOUSE (*Peromyscus gossypinus*) - native species; common throughout the watershed; nocturnal; breeder
- RACCOON (*Procyon lotor*) - native species; common near water throughout the watershed; nocturnal; breeder
- GRAY FOX (*Urocyon cinereoargenteus*) - native species; rare or extirpated in the watershed; seen 1983-1985

REPTILES

ALLIGATORS

• AMERICAN ALLIGATOR - (*Alligator mississippiensis*) - native species; occasional on lakes and ponds; year round resident and breeder

TURTLES

• FLORIDA SOFTSHELL (*Trionyx ferox*) - native species; common in lakes and ponds throughout the watershed; breeder
• Other slider / cooter type turtles are commonly found in lakes in the watershed; however, none could be positively identified

LIZARDS

• MEDITERRANEAN GECKO (*Hemidactylus turcicus*) - introduced species; common throughout the watershed; nocturnal; breeder
• GREEN ANOLE (*Anolis carolinensis*) - native species; occasional throughout the watershed; breeder
• BROWN OR CUBAN ANOLE (*Anolis sagrei*) - introduced species; common throughout the watershed; breeder
• EASTERN GLASS LIZARD (*Ophisaurus ventralis*) - native species; occasional throughout the watershed; legless; breeder

SNAKES

• BANDED WATERSNAKE (*Nerodia fasciata*) - native species; common in streams, lakes and ponds throughout the watershed; breeder
• EASTERN GARTER SNAKE (*Thamnophis sirtalis*) - native species; common near wetlands throughout the watershed; breeder
• SOUTHERN RINGNECK SNAKE (*Diadophis punctatus*) - native species; occasional throughout the watershed; breeder
• BLACK RACER (*Coluber constrictor*) - native species; common throughout the watershed; breeder
• PINE WOODS OR YELLOW-LIPPED SNAKE - (*Rhadinaea flavilata*) - native species; rare in lowland pine flatwoods; year round resident; breeding status unknown, but presumed breeder.

AMPHIBIANS

TOADS AND FROGS

• SOUTHERN TOAD (*Bufo terrestris*) - native species; occasional throughout the watershed; breeder
• SQUIRREL TREEFROG (*Hyla squirella*) - native species; common in streams, lakes and ponds throughout the watershed; breeder
• GREENHOUSE FROG (*Eleutherodacylus planirostris*) - introduced species; common throughout the watershed; breeder
• EASTERN NARROW MOUTHED TOAD (*Gastrophryne carolinensis*) - native species; occasionally found year round resident and breeder

naturalized* - species which have expanded their range without the direct aid of humans

APPENDIX 10-A

Table 10A.1. Runoff coefficients by land use category and soil type used in Curiosity Creek pollutant loading analysis.

FLUCCS Code	Land Use	Hydro Class	Runoff Coefficient
1100	Low/Medium Density Residential	A	0.267
1100	Low/Medium Density Residential	B/D	0.322
1100	Low/Medium Density Residential	C	0.379
1100	Low/Medium Density Residential	D	0.430
1200	Low/Medium Density Residential	A	0.267
1200	Low/Medium Density Residential	B/D	0.322
1200	Low/Medium Density Residential	C	0.379
1200	Low/Medium Density Residential	D	0.430
1300	High Density Residential	A	0.500
1300	High Density Residential	B/D	0.566
1300	High Density Residential	C	0.634
1300	High Density Residential	D	0.700
1460	Light Industrial	A	0.500
1460	Light Industrial	B/D	0.599
1460	Light Industrial	C	0.701
1460	Light Industrial	D	0.800
1500	Light Industrial	A	0.500
1500	Light Industrial	B/D	0.599
1500	Light Industrial	C	0.701
1500	Light Industrial	D	0.800
2000	Agricultural	A	0.150
2000	Agricultural	B/D	0.233
2000	Agricultural	C	0.318
2000	Agricultural	D	0.400
1430	Commercial	A	0.450
1430	Commercial	B/D	0.549
1430	Commercial	C	0.651
1430	Commercial	D	0.750
1440	Commercial	A	0.450
1440	Commercial	B/D	0.549
1440	Commercial	C	0.651
1440	Commercial	D	0.750
1450	Commercial	A	0.450
1450	Commercial	B/D	0.549
1450	Commercial	C	0.651
1450	Commercial	D	0.750
1410	Commercial	A	0.450
1410	Commercial	B/D	0.549
1410	Commercial	C	0.651
1410	Commercial	D	0.750
1420	Commercial	A	0.450
1420	Commercial	B/D	0.549
1420	Commercial	C	0.651
1420	Commercial	D	0.750
8000	Highway/Utility	A	0.500

8000	Highway/Utility	B/D	0.599
8000	Highway/Utility	C	0.701
8000	Highway/Utility	D	0.800
1800	Recreational	A	0.100
1800	Recreational	B/D	0.166
1800	Recreational	C	0.234
1800	Recreational	D	0.300
1900	Open Land	A	0.100
1900	Open Land	B/D	0.166
1900	Open Land	C	0.234
1900	Open Land	D	0.300
1600	Extractive (Mining)/Disturbed	A	0.050
1600	Extractive (Mining)/Disturbed	B/D	0.050
1600	Extractive (Mining)/Disturbed	C	0.050
1600	Extractive (Mining)/Disturbed	D	0.050
7400	Extractive (Mining)/Disturbed	A	0.050
7400	Extractive (Mining)/Disturbed	B/D	0.050
7400	Extractive (Mining)/Disturbed	C	0.050
7400	Extractive (Mining)/Disturbed	D	0.050
4000	Upland Forest	A	0.050
4000	Upland Forest	B/D	0.050
4000	Upland Forest	C	0.050
4000	Upland Forest	D	0.050
5000	Water	A	1.000
5000	Water	B/D	1.000
5000	Water	C	1.000
5000	Water	D	1.000
6000	Wetland Non-Forested	A	0.200
6000	Wetland Non-Forested	B/D	0.200
6000	Wetland Non-Forested	C	0.200
6000	Wetland Non-Forested	D	0.200
1400	Commercial	A	0.450
1400	Commercial	B/D	0.549
1400	Commercial	C	0.651
1400	Commercial	D	0.750
1700	Institutional	A	0.450
1700	Institutional	B/D	0.549
1700	Institutional	C	0.651
1700	Institutional	D	0.750
2100	Agricultural	A	0.150
2100	Agricultural	B/D	0.233
2100	Agricultural	C	0.318
2100	Agricultural	D	0.400
2140	Agricultural	A	0.150
2140	Agricultural	B/D	0.233
2140	Agricultural	C	0.318
2140	Agricultural	D	0.400
2200	Agricultural	A	0.150
2200	Agricultural	B/D	0.233

2200	Agricultural	C	0.318
2200	Agricultural	D	0.400
2300	Agricultural	A	0.150
2300	Agricultural	B/D	0.233
2300	Agricultural	C	0.318
2300	Agricultural	D	0.400
2400	Agricultural	A	0.150
2400	Agricultural	B/D	0.233
2400	Agricultural	C	0.318
2400	Agricultural	D	0.400
2500	Agricultural	A	0.150
2500	Agricultural	B/D	0.233
2500	Agricultural	C	0.318
2500	Agricultural	D	0.400
2550	Agricultural	A	0.150
2550	Agricultural	B/D	0.233
2550	Agricultural	C	0.318
2550	Agricultural	D	0.400
2600	Agricultural	A	0.150
2600	Agricultural	B/D	0.233
2600	Agricultural	C	0.318
2600	Agricultural	D	0.400
3100	Open Land	A	0.100
3100	Open Land	B/D	0.166
3100	Open Land	C	0.234
3100	Open Land	D	0.300
3200	Open Land	A	0.100
3200	Open Land	B/D	0.166
3200	Open Land	C	0.234
3200	Open Land	D	0.300
3300	Open Land	A	0.100
3300	Open Land	B/D	0.166
3300	Open Land	C	0.234
3300	Open Land	D	0.300
4100	Upland Forest	A	0.050
4100	Upland Forest	B/D	0.050
4100	Upland Forest	C	0.050
4100	Upland Forest	D	0.050
4110	Upland Forest	A	0.050
4110	Upland Forest	B/D	0.050
4110	Upland Forest	C	0.050
4110	Upland Forest	D	0.050
4120	Upland Forest	A	0.050
4120	Upland Forest	B/D	0.050
4120	Upland Forest	C	0.050
4120	Upland Forest	D	0.050
4200	Upland Forest	A	0.050
4200	Upland Forest	B/D	0.050
4200	Upland Forest	C	0.050

4200	Upland Forest	D	0.050
4340	Upland Forest	A	0.050
4340	Upland Forest	B/D	0.050
4340	Upland Forest	C	0.050
4340	Upland Forest	D	0.050
4400	Upland Forest	A	0.050
4400	Upland Forest	B/D	0.050
4400	Upland Forest	C	0.050
4400	Upland Forest	D	0.050
5100	Water	A	1.000
5100	Water	B/D	1.000
5100	Water	C	1.000
5100	Water	D	1.000
5200	Water	A	1.000
5200	Water	B/D	1.000
5200	Water	C	1.000
5200	Water	D	1.000
5300	Water	A	1.000
5300	Water	B/D	1.000
5300	Water	C	1.000
5300	Water	D	1.000
5400	Water	A	1.000
5400	Water	B/D	1.000
5400	Water	C	1.000
5400	Water	D	1.000
6100	Wetland Forest	A	0.100
6100	Wetland Forest	B/D	0.100
6100	Wetland Forest	C	0.100
6100	Wetland Forest	D	0.100
6110	Wetland Forest	A	0.100
6110	Wetland Forest	B/D	0.100
6110	Wetland Forest	C	0.100
6110	Wetland Forest	D	0.100
6120	Wetland Forest	A	0.100
6120	Wetland Forest	B/D	0.100
6120	Wetland Forest	C	0.100
6120	Wetland Forest	D	0.100
6150	Wetland Forest	A	0.100
6150	Wetland Forest	B/D	0.100
6150	Wetland Forest	C	0.100
6150	Wetland Forest	D	0.100
6200	Wetland Forest	A	0.100
6200	Wetland Forest	B/D	0.100
6200	Wetland Forest	C	0.100
6200	Wetland Forest	D	0.100
6210	Wetland Forest	A	0.100
6210	Wetland Forest	B/D	0.100
6210	Wetland Forest	C	0.100
6210	Wetland Forest	D	0.100

6300	Wetland Forest	A	0.100
6300	Wetland Forest	B/D	0.100
6300	Wetland Forest	C	0.100
6300	Wetland Forest	D	0.100
6400	Wetland Non-Forested	A	0.100
6400	Wetland Non-Forested	B/D	0.100
6400	Wetland Non-Forested	C	0.100
6400	Wetland Non-Forested	D	0.100
6410	Wetland Non-Forested	A	0.100
6410	Wetland Non-Forested	B/D	0.100
6410	Wetland Non-Forested	C	0.100
6410	Wetland Non-Forested	D	0.100
6420	Wetland Non-Forested	A	0.100
6420	Wetland Non-Forested	B/D	0.100
6420	Wetland Non-Forested	C	0.100
6420	Wetland Non-Forested	D	0.100
6430	Wetland Non-Forested	A	0.100
6430	Wetland Non-Forested	B/D	0.100
6430	Wetland Non-Forested	C	0.100
6430	Wetland Non-Forested	D	0.100
6440	Wetland Non-Forested	A	0.100
6440	Wetland Non-Forested	B/D	0.100
6440	Wetland Non-Forested	C	0.100
6440	Wetland Non-Forested	D	0.100
6500	Wetland Non-Forested	A	0.100
6500	Wetland Non-Forested	B/D	0.100
6500	Wetland Non-Forested	C	0.100
6500	Wetland Non-Forested	D	0.100
6510	Wetland Non-Forested	A	0.100
6510	Wetland Non-Forested	B/D	0.100
6510	Wetland Non-Forested	C	0.100
6510	Wetland Non-Forested	D	0.100
6520	Wetland Non-Forested	A	0.100
6520	Wetland Non-Forested	B/D	0.100
6520	Wetland Non-Forested	C	0.100
6520	Wetland Non-Forested	D	0.100
6530	Wetland Non-Forested	A	0.100
6530	Wetland Non-Forested	B/D	0.100
6530	Wetland Non-Forested	C	0.100
6530	Wetland Non-Forested	D	0.100
7100	Wetland Non-Forested	A	0.100
7100	Wetland Non-Forested	B/D	0.100
7100	Wetland Non-Forested	C	0.100
7100	Wetland Non-Forested	D	0.100
7400	Extractive (Mining)/Disturbed	A	0.050
7400	Extractive (Mining)/Disturbed	B/D	0.050
7400	Extractive (Mining)/Disturbed	C	0.050
7400	Extractive (Mining)/Disturbed	D	0.050
8100	Highway/Utility	A	0.500

8100	Highway/Utility	B/D	0.599
8100	Highway/Utility	C	0.701
8100	Highway/Utility	D	0.800
8200	Highway/Utility	A	0.500
8200	Highway/Utility	B/D	0.599
8200	Highway/Utility	C	0.701
8200	Highway/Utility	D	0.800
8300	Highway/Utility	A	0.500
8300	Highway/Utility	B/D	0.599
8300	Highway/Utility	C	0.701
8300	Highway/Utility	D	0.800

Note: B/D used for all NC soils

APPENDIX 10-B

Table 10-A. Gross pollutant loads by subbasin in the Curiosity Creek watershed.

Subbasin ID	Area (acres)	Volume (acre-feet)	Runoff Coefficient	BOD5 (lbs/yr)	TSS (lbs/yr)	TKN (lbs/yr)	NO3 +NO2 (lbs/yr)	TN (lbs/yr)	TP (lbs/yr)	TDP (lbs/yr)	Oil and Grease (lbs/yr)	Cd (lbs/yr)	Cu (lbs/yr)	Pb (lbs/yr)	Zn (lbs/yr)
550100	17.39	32.50	0.48	225.16	2,333.30	124.73	50.74	175.47	87.36	37.16	81.19	0.09	3.27	0.46	4.14
550150	11.45	28.30	0.63	203.31	1,940.41	118.49	38.29	156.77	52.31	23.59	62.34	0.08	2.21	0.37	2.91
550175	6.05	12.06	0.51	85.40	938.11	45.44	21.65	67.09	41.61	17.27	34.29	0.03	1.48	0.19	1.83
550200	19.41	33.14	0.43	227.22	2,300.73	127.77	48.77	176.54	79.55	34.27	78.38	0.09	3.06	0.45	3.91
550300	37.20	70.44	0.48	484.66	4,970.50	274.30	105.27	379.57	173.21	74.96	172.05	0.19	6.61	1.00	8.46
550400	17.88	38.03	0.54	260.36	2,630.63	152.76	53.15	205.90	80.15	35.98	90.55	0.10	3.18	0.54	4.16
550500	15.59	26.97	0.44	198.43	1,916.91	105.33	47.22	152.55	83.93	35.71	75.62	0.07	2.94	0.38	3.68
550600	16.22	36.31	0.57	258.58	2,802.91	136.29	66.27	202.56	128.02	53.14	104.98	0.10	4.50	0.58	5.56
550650	4.29	10.69	0.63	75.60	843.24	39.78	19.74	59.52	38.88	16.05	31.20	0.03	1.37	0.17	1.69
550700	54.46	119.89	0.56	839.59	9,269.46	445.11	214.95	660.06	416.54	172.56	340.22	0.32	14.75	1.91	18.26
550750	17.17	42.01	0.62	296.98	3,312.42	156.25	77.56	233.81	152.71	63.05	122.56	0.11	5.37	0.69	6.62
550800	10.91	21.12	0.49	147.29	1,506.86	82.29	32.31	114.60	54.03	23.14	51.82	0.06	2.05	0.30	2.61
550900	12.33	21.20	0.44	146.14	1,465.32	82.69	30.71	113.40	48.85	21.18	49.46	0.06	1.90	0.29	2.44
550950	7.62	18.86	0.63	459.43	4,945.82	97.92	38.56	136.48	38.20	20.05	40.06	0.64	2.93	14.79	7.96
551000	15.82	36.99	0.60	550.09	5,998.84	161.32	72.51	233.83	110.88	49.44	95.98	0.63	5.28	13.43	10.35
551100	6.58	10.13	0.39	67.92	613.84	40.80	11.23	52.03	11.98	5.82	18.56	0.03	0.58	0.11	0.80
551111	109.08	257.05	0.60	5,013.86	54,319.61	1,222.48	517.45	1,739.93	659.35	313.26	612.16	6.51	38.59	146.25	90.14
551200	12.71	31.14	0.62	234.09	2,034.88	139.00	32.90	171.90	23.40	13.27	54.57	0.10	1.51	0.77	2.32
551300	16.06	42.75	0.68	1,718.90	18,386.66	280.02	94.71	374.72	21.93	27.69	59.04	2.69	7.68	63.60	28.36
551400	54.07	97.13	0.46	2,458.56	26,376.33	510.58	164.57	675.15	78.58	64.51	173.47	3.64	12.06	84.06	40.11
551500	19.44	39.21	0.51	217.69	2,507.29	143.84	47.51	191.35	71.91	35.54	100.86	0.11	2.74	0.65	3.73
551600	25.44	64.55	0.65	465.42	4,294.33	276.29	81.10	357.39	96.61	45.35	133.18	0.18	4.40	0.79	5.94
551700	6.91	15.02	0.55	98.16	935.36	62.53	16.29	78.83	16.36	8.77	30.96	0.04	0.80	0.20	1.15
551800	22.92	56.60	0.63	2,204.93	24,017.49	343.41	140.43	483.83	95.42	60.76	103.38	3.46	11.74	81.81	38.49
551900	13.76	32.09	0.59	226.72	2,205.43	130.66	44.58	175.24	64.98	28.80	72.26	0.09	2.65	0.42	3.45
551950	9.20	22.35	0.62	150.32	1,466.52	86.49	29.75	116.24	43.75	19.35	48.19	0.06	1.77	0.28	2.31
552000	7.29	18.08	0.63	129.98	1,235.53	75.92	24.25	100.17	32.65	14.79	39.53	0.05	1.39	0.23	1.84
552100	22.33	36.90	0.42	251.85	2,494.68	143.58	51.54	195.12	79.32	34.67	83.22	0.10	3.14	0.48	4.06
552150	9.90	24.71	0.64	174.94	1,923.17	93.04	44.41	137.45	85.47	35.46	70.35	0.07	3.04	0.39	3.76
552200	44.36	110.51	0.63	811.96	7,970.34	455.64	159.52	615.15	237.26	104.70	256.82	0.34	9.61	2.34	12.71
552300	8.10	14.95	0.47	103.09	1,107.45	55.73	25.00	80.74	46.24	19.35	39.75	0.04	1.67	0.22	2.09
552400	12.48	25.50	0.52	177.43	1,979.05	93.36	46.34	139.69	91.24	37.67	73.22	0.07	3.21	0.41	3.96
552500	36.88	89.33	0.62	632.01	7,000.13	334.26	162.83	497.09	317.15	131.24	257.58	0.24	11.20	1.44	13.85
552600	37.24	91.28	0.62	644.09	7,183.51	338.91	168.18	507.09	331.12	136.71	265.77	0.25	11.64	1.49	14.37
552700	34.59	82.39	0.61	578.92	6,417.43	306.00	149.39	455.39	291.35	120.53	236.30	0.22	10.29	1.32	12.72
552800	26.92	72.69	0.69	411.58	4,578.70	216.98	106.94	323.92	209.73	86.66	169.07	0.16	7.39	0.95	9.12
552900	72.69	172.85	0.61	1,516.32	15,599.82	703.10	281.49	984.59	451.51	196.84	434.24	0.99	18.19	15.26	26.81
553000	23.81	38.88	0.42	403.00	4,900.41	143.69	41.05	184.74	36.45	27.49	96.97	0.57	2.49	12.05	6.94
553100	34.68	79.78	0.59	388.97	3,915.13	264.88	64.16	329.04	58.03	35.50	140.82	0.18	2.94	0.94	4.43
559999	109.22	234.56	0.55	2,007.00	20,969.57	938.05	383.20	1,321.25	634.08	273.32	589.75	1.27	25.27	19.00	36.49
560000	7.83	19.13	0.62	122.72	1,368.79	64.57	32.05	96.62	63.11	26.05	50.65	0.05	2.22	0.28	2.74
560100	38.91	90.15	0.59	451.69	5,038.22	237.67	117.96	355.63	232.27	95.90	186.42	0.17	8.17	1.04	10.08
560200	31.07	66.92	0.55	158.26	2,108.42	107.58	42.20	149.78	76.43	36.65	94.50	0.09	2.64	0.61	3.52
560300	12.58	26.42	0.53	158.91	1,777.41	83.96	41.51	125.47	81.65	33.78	66.00	0.06	2.87	0.37	3.54
560400	7.51	14.75	0.50	104.27	1,163.03	54.86	27.23	82.09	53.62	22.14	43.03	0.04	1.88	0.24	2.33
560425	18.32	33.88	0.47	140.04	1,781.01	89.20	37.12	126.33	68.84	31.67	76.42	0.07	2.39	0.48	3.12
560450	113.84	224.11	0.50	569.27	7,312.99	395.95	146.08	542.03	249.86	124.44	340.98	0.37	8.94	2.24	11.66
560550	35.45	79.86	0.57	560.28	5,717.74	301.71	133.13	434.84	239.30	101.09	212.45	0.21	8.59	1.15	10.75
560600	16.58	39.92	0.61	271.60	2,394.29	165.24	42.20	207.44	38.30	19.69	70.24	0.10	2.06	0.43	2.90
560700	14.34	34.88	0.62	227.83	2,535.32	120.08	59.23	179.31	116.22	48.02	93.64	0.09	4.09	0.52	5.05
560800	27.61	60.27	0.56	412.63	4,632.69	219.25	107.84	327.09	211.75	87.87	172.86	0.16	7.44	0.97	9.20
560900	12.63	19.65	0.40	111.95	1,004.52	59.61	25.46	85.07	42.71	18.49	40.99	0.09	1.81	0.24	1.87
561000	20.57	30.52	0.38	97.21	1,243.83	64.05	25.15	89.20	45.06	21.29	53.98	0.05	1.58	0.35	2.09
561100	70.07	149.35	0.54	909.91	10,169.48	486.51	236.57	723.08	461.17	192.27	382.70	0.37	16.30	2.17	20.07
561200	20.07	41.28	0.52	335.63	3,708.69	142.86	68.84	211.70	127.06	53.45	104.00	0.24	4.83	3.99	6.98
561300	24.63	37.76	0.39	414.47	4,674.40	149.19	46.96	196.15	49.75	29.22	87.37	0.50	2.95	10.44	6.92
561400	1.52	2.23	0.37	6.07	115.27	6.56	1.70	8.27	2.43	1.71	6.55	0.01	0.08	0.05	0.13
561500	4.93	8.22	0.42	85.04	1,069.38	27.64	8.20	35.83	7.47	5.86	20.34	0.13	0.52	2.83	1.54
561600	2.89	4.26	0.38	28.67	396.92	14.03	4.05	18.07	4.86	3.40	12.03	0.04	0.23	0.77	0.55
561700	17.18	33.80	0.50	177.73	2,226.83	90.87	29.16	120.03	40.00	22.68	69.68	0.19	1.72	3.32	3.25
561800	57.25	92.67	0.41	1,134.80	9,700.45	322.15	103.66	425.81	118.79	64.70	142.90	1.22	6.54	22.49	14.53
561900	17.95	32.57	0.46	328.12	3,696.83	131.10	35.50	166.60	29.09	20.54	74.28	0.39	2.02	7.92	5.09
562000	28.19	45.04	0.41	87.61	1,634.91	92.69	24.54	117.23	35.56	24.44	92.09	0.09	1.16	0.68	1.93
562100	77.58	156.71	0.51	1,389.55	9,892.73	517.82	243.44	761.26	499.30	216.22	374.84	0.73	16.28	2.13	19.20
562200	26.93	46.87	0.44	433.62	2,041.98	126.22	51.18	177.40	108.61	52.09	86.59	0.28	3.13	0.53	3.50
562300	17.22	29.80	0.44	75.26	1,331.12	74.43	20.90	95.33	31.60	20.35	72.88	0.07	1.04	0.53	1.66
562400	20.37	43.47	0.54	211.47	2,580.15	134.54	52.73	187.27	93.10	43.22	107.48	0.10	3.31	0.68	4.35
562500	50.14	133.88	0.68	750.59	8,376.75	396.10	195.69	591.80	384.53	159.00	310.32	0.29	13.52	1.74	16.70
570000	14.14	35.12	0.63	249.01	2,652.98	134.90	59.85	194.75	109.69	46.01	95.24	0.10	3.98	0.54	4.97
570100	41.03	97.74	0.61	1,405.95	14,187.29	426.15	133.30	559.46	108.14	61.05	168.26	1.65	8.43	35.70	21.28
570200	12.60	32.29	0.65	286.21	2,595.41	147.55	35.99	183.54	24.75	14.37	56.72	0.18	1.76	2.68	3.19
570300	17.08	32.84	0.49	304.91	2,726.27	142.63	54.95	197.58	79.83	36.07	85.84	0.18	3.12	2.64	4.64
570400	14.77	38.64	0.67	251.38	2,736.07	132.73	61.64	194.37	116.27	48.46	97.51	0.10	4.18	0.74	5.25
570500	30.00	51.94	0.44	340.21	3,456.50	190.13	74.26	264.39	123.33	52.92	119.19	0.13	4.69	0.68	5.97
570600	16.65	41.20	0.63	291.18	3,247.75	153.20	76.04	229.25	149.73	61.82	120.17	0.11	5.26	0.67	6.50
570700	33.76	84.46	0.64	497.22	5,659.30	269.99	130.00	399.99	253.49	106.41	214.90	0.20	8.90	1.23	11.07
570800	51.01	128.16	0.64	824.89	9,200.74	434.02	215.42	649.45	424.19	175.13	340.43	0.32	14.91	1.90	18.40
580000	5.04	12.94	0.65	112.17	1,081.73	56.17	17.33	73.50	20.70	9.77	27.05	0.07	1.00	1.01	1.58
580100	132.03	274.21	0.53	1,679.60	17,882.56	648.05	175.76	823.81	132.18	90.70	324.70	1.90	9.89	38.68	24.72
Min.	*1.52*	*2.23*	*0.37*	*6.07*	*115.27*	*6.56*	*1.70*	*8.27*	*2.43*	*1.71*	*6.55*	*0.01*	*0.08*	*0.05*	*0.13*
Max.	*132.03*	*274.21*	*0.69*	*5,013.86*	*54,319.61*	*1,222.48*	*517.45*	*1,739.93*	*659.35*	*313.26*	*612.16*	*6.51*	*38.59*	*146.25*	*90.14*
Mean	***27.88***	***59.96***	***0.54***	***525.87***	***5,528.21***	***214.71***	***86.09***	***300.80***	***135.78***	***61.20***	***135.28***	***0.44***	***5.71***	***7.93***	***9.33***
Total	**2,202.69**	**4,736.86**	**42.85**	**41,543.87**	**436,728.89**	**16,961.70**	**6,801.35**	**23,763.04**	**10,726.88**	**4,834.52**	**10,686.93**	**35.13**	**451.32**	**626.68**	**737.36**

APPENDIX 10-C

Table 10-B. Net pollutant loads by subbasin in the Curiosity Creek watershed.

Subbasin ID	Area (acres)	Volume (acre-feet)	Runoff Coefficient	BOD5 (lbs/yr)	TSS (lbs/yr)	TKN (lbs/yr)	NO3 +NO2 (lbs/yr)	TN (lbs/yr)	TP (lbs/yr)	TDP (lbs/yr)	Oil and Grease (lbs/yr)	Cd (lbs/yr)	Cu (lbs/yr)	Pb (lbs/yr)	Zn (lbs/yr)
550100	17.39	32.50	0.48	225.16	2,333.30	124.73	50.74	175.47	87.36	37.16	81.19	0.09	3.27	0.46	4.14
550150	11.45	28.30	0.63	126.80	1,009.69	94.90	23.49	127.64	43.64	17.59	51.47	0.04	1.66	0.22	1.87
550175	6.05	12.06	0.51	85.40	938.11	45.44	21.65	67.09	41.61	17.27	34.29	0.03	1.48	0.19	1.83
550200	19.41	33.14	0.43	227.22	2,300.73	127.77	48.77	176.54	79.55	34.27	78.38	0.09	3.06	0.45	3.91
550300	37.20	70.44	0.48	484.66	4,970.50	274.30	105.27	379.57	173.21	74.96	172.05	0.19	6.61	1.00	8.46
550400	17.88	38.03	0.54	182.89	1,688.18	128.88	38.17	176.41	71.38	29.90	79.54	0.07	2.63	0.39	3.11
550500	15.59	26.97	0.44	198.43	1,916.91	105.33	47.22	152.55	83.93	35.71	75.62	0.07	2.94	0.38	3.68
550600	16.22	36.31	0.57	258.58	2,802.91	136.29	66.27	202.56	128.02	53.14	104.98	0.10	4.50	0.58	5.56
550650	4.29	10.69	0.63	75.60	843.24	39.78	19.74	59.52	38.88	16.05	31.20	0.03	1.37	0.17	1.69
550700	54.46	119.89	0.56	839.59	9,269.46	445.11	214.95	660.06	416.54	172.56	340.22	0.32	14.75	1.91	18.26
550750	17.17	42.01	0.62	296.98	3,312.42	156.25	77.56	233.81	152.71	63.05	122.56	0.11	5.37	0.69	6.62
550800	10.91	21.12	0.49	147.29	1,506.86	82.29	32.31	114.60	54.03	23.14	51.82	0.06	2.05	0.30	2.61
550900	12.33	21.20	0.44	146.14	1,465.32	82.69	30.71	113.40	48.85	21.18	49.46	0.06	1.90	0.29	2.44
550950	7.62	18.86	0.63	459.43	2,411.07	91.53	35.31	127.92	37.21	20.05	40.06	0.64	2.93	4.54	4.05
551000	15.82	36.99	0.60	550.09	5,998.84	161.32	72.51	233.83	110.88	49.44	95.98	0.63	5.28	13.43	10.35
551100	6.58	10.13	0.39	34.31	204.97	30.44	4.73	39.23	8.17	3.19	13.78	0.01	0.34	0.05	0.35
551111	109.08	257.05	0.60	2,725.17	19,518.91	1,045.05	354.07	1,501.24	631.66	266.36	571.14	1.97	27.60	38.64	36.26
551200	12.71	31.14	0.62	93.64	305.23	97.30	6.58	120.33	8.19	2.65	35.47	0.03	0.53	0.19	0.35
551300	16.06	42.75	0.68	1,638.55	17,409.18	255.25	79.17	344.13	12.83	21.39	47.62	2.65	7.11	63.45	27.27
551400	54.07	97.13	0.46	2,458.56	12,808.89	484.67	149.76	639.37	76.50	64.51	173.47	3.64	12.06	25.84	18.79
551500	19.44	39.21	0.51	217.69	2,507.29	143.84	47.51	191.35	71.91	35.54	100.86	0.11	2.74	0.65	3.73
551600	25.44	64.55	0.65	187.25	1,905.66	104.82	40.76	145.57	67.53	28.99	65.42	0.07	2.58	0.37	3.28
551700	6.91	15.02	0.55	49.24	340.26	47.46	6.83	60.20	10.82	4.93	24.00	0.02	0.46	0.11	0.49
551800	22.92	56.60	0.63	2,204.93	10,736.27	318.05	125.92	448.81	93.39	60.76	103.38	3.46	11.74	24.82	17.63
551900	13.76	32.09	0.59	226.72	2,205.43	130.66	44.58	175.24	64.98	28.80	72.26	0.09	2.65	0.42	3.45
551950	9.20	22.35	0.62	150.32	1,466.52	86.49	29.75	116.24	43.75	19.35	48.19	0.06	1.77	0.28	2.31
552000	7.29	18.08	0.63	129.98	1,235.53	75.92	24.25	100.17	32.65	14.79	39.53	0.05	1.39	0.23	1.84
552100	22.33	36.90	0.42	251.85	2,494.68	143.58	51.54	195.12	79.32	34.67	83.22	0.10	3.14	0.48	4.06
552150	9.90	24.71	0.64	168.37	1,843.23	91.01	43.14	134.95	84.73	34.95	69.41	0.06	2.99	0.38	3.67
552200	44.36	110.51	0.63	551.56	4,778.92	378.60	110.87	519.88	209.38	85.13	221.52	0.19	7.80	1.24	9.07
552300	8.10	14.95	0.47	103.09	1,107.45	55.73	25.00	80.74	46.24	19.35	39.75	0.04	1.67	0.22	2.09
552400	12.48	25.50	0.52	177.43	1,979.05	93.36	46.34	139.69	91.24	37.67	73.22	0.07	3.21	0.41	3.96
552500	36.88	89.33	0.62	632.01	7,000.13	334.26	162.83	497.09	317.15	131.24	257.58	0.24	11.20	1.44	13.85
552600	37.24	91.28	0.62	643.95	7,181.80	338.87	168.15	507.04	331.10	136.70	265.75	0.25	11.64	1.49	14.36
552700	34.59	82.39	0.61	578.92	6,417.43	306.00	149.39	455.39	291.35	120.53	236.30	0.22	10.29	1.32	12.72
552800	26.92	72.69	0.69	408.78	4,544.61	216.11	106.40	322.85	209.42	86.44	168.67	0.16	7.37	0.94	9.08
552900	72.69	172.85	0.61	1,297.73	12,129.98	679.28	263.01	953.35	448.50	192.45	428.80	0.58	17.28	5.53	21.65
553000	23.81	38.88	0.42	232.33	2,271.03	133.06	30.24	170.05	35.53	24.65	95.32	0.21	1.70	3.51	2.81
553100	34.68	79.78	0.59	388.97	3,915.13	264.88	64.16	329.04	58.03	35.50	140.82	0.18	2.94	0.94	4.43
559999	109.22	234.56	0.55	2,007.00	20,969.57	938.05	383.20	1,321.25	634.08	273.32	589.75	1.27	25.27	19.00	36.49
560000	7.83	19.13	0.62	122.72	1,368.79	64.57	32.05	96.62	63.11	26.05	50.65	0.05	2.22	0.28	2.74
560100	38.91	90.15	0.59	451.69	5,038.22	237.67	117.96	355.63	232.27	95.90	186.42	0.17	8.17	1.04	10.08
560200	31.07	66.92	0.55	158.26	2,108.42	107.58	42.20	149.78	76.43	36.65	94.50	0.09	2.64	0.61	3.52
560300	12.58	26.42	0.53	158.91	1,777.41	83.96	41.51	125.47	81.65	33.78	66.00	0.06	2.87	0.37	3.54
560400	7.51	14.75	0.50	104.27	1,163.03	54.86	27.23	82.09	53.62	22.14	43.03	0.04	1.88	0.24	2.33
560425	18.32	33.88	0.47	140.04	1,781.01	89.20	37.12	126.33	68.84	31.67	76.42	0.07	2.39	0.48	3.12
560450	113.84	224.11	0.50	569.27	7,312.99	395.95	146.08	542.03	249.86	124.44	340.98	0.37	8.94	2.24	11.66
560550	35.45	79.86	0.57	560.28	5,717.74	301.71	133.13	434.84	239.30	101.09	212.45	0.21	8.59	1.15	10.75
560600	16.58	39.92	0.61	271.60	2,394.29	165.24	42.20	207.44	38.30	19.69	70.24	0.10	2.06	0.43	2.90
560700	14.34	34.88	0.62	227.83	2,535.32	120.08	59.23	179.31	116.22	48.02	93.64	0.09	4.09	0.52	5.05
560800	27.61	60.27	0.56	412.63	4,632.69	219.25	107.84	327.09	211.75	87.87	172.86	0.16	7.44	0.97	9.20
560900	12.63	19.65	0.40	111.95	1,004.52	59.61	25.46	85.07	42.71	18.49	40.99	0.09	1.81	0.24	1.87
561000	20.57	30.52	0.38	97.21	1,243.83	64.05	25.15	89.20	45.06	21.29	53.98	0.05	1.58	0.35	2.09
561100	70.07	149.35	0.54	909.91	10,169.48	486.51	236.57	723.08	461.17	192.27	382.70	0.37	16.30	2.17	20.07
561200	20.07	41.28	0.52	335.63	3,708.69	142.86	68.84	211.70	127.06	53.45	104.00	0.24	4.83	3.99	6.98
561300	24.63	37.76	0.39	383.20	4,294.05	139.56	40.92	184.25	46.21	26.76	82.93	0.49	2.73	10.38	6.50
561400	1.52	2.23	0.37	6.07	115.27	6.56	1.70	8.27	2.43	1.71	6.55	0.01	0.08	0.05	0.13
561500	4.93	8.22	0.42	44.69	447.86	25.12	5.64	32.36	7.26	5.19	19.95	0.05	0.33	0.81	0.56
561600	2.89	4.26	0.38	18.42	239.05	13.39	3.40	17.19	4.81	3.23	11.93	0.02	0.18	0.26	0.30
561700	17.18	33.80	0.50	177.73	2,226.83	90.87	29.16	120.03	40.00	22.68	69.68	0.19	1.72	3.32	3.25
561800	57.25	92.17	0.41	737.26	3,824.31	278.41	69.21	368.82	108.83	53.65	129.05	0.51	4.51	6.11	5.70
561900	17.95	32.57	0.46	157.87	1,264.69	106.01	17.06	134.60	21.81	14.06	64.83	0.13	1.09	2.24	1.59
562000	28.19	45.04	0.41	87.61	1,634.91	92.69	24.54	117.23	35.56	24.44	92.09	0.09	1.16	0.68	1.93
562100	77.58	156.71	0.51	1,389.55	9,892.73	517.82	243.44	761.26	499.30	216.22	374.84	0.73	16.28	2.13	19.20
562200	26.93	46.87	0.44	433.62	2,041.98	126.22	51.18	177.40	108.61	52.09	86.59	0.28	3.13	0.53	3.50
562300	17.22	29.80	0.44	75.26	1,331.12	74.43	20.90	95.33	31.60	20.35	72.88	0.07	1.04	0.53	1.66
562400	20.37	43.47	0.54	194.74	2,376.64	129.38	49.50	180.90	91.20	41.91	105.10	0.10	3.19	0.65	4.12
562500	50.14	133.88	0.68	748.75	8,354.26	395.53	195.34	591.09	384.32	158.85	310.06	0.29	13.51	1.74	16.68
570000	14.14	35.12	0.63	249.01	2,652.98	134.90	59.85	194.75	109.69	46.01	95.24	0.10	3.98	0.54	4.97
570100	41.03	97.74	0.61	638.39	3,351.30	318.86	53.18	422.11	79.95	33.91	128.44	0.45	4.43	9.16	5.59
570200	12.60	32.29	0.65	251.15	2,055.32	145.37	33.77	180.53	24.56	13.79	56.38	0.11	1.60	0.93	2.35
570300	17.08	32.84	0.49	209.68	1,794.96	122.91	41.53	172.83	76.81	32.04	76.91	0.09	2.81	0.91	3.47
570400	14.77	38.64	0.67	233.03	2,503.71	127.76	58.46	188.21	114.50	47.19	95.27	0.09	4.06	0.57	4.97
570500	30.00	51.94	0.44	265.00	2,555.56	167.01	59.74	235.82	114.98	47.08	108.51	0.09	4.17	0.54	4.97
570600	16.65	41.20	0.63	291.18	3,247.75	153.20	76.04	229.25	149.73	61.82	120.17	0.11	5.26	0.67	6.50
570700	33.76	84.46	0.64	496.47	5,650.22	269.76	129.86	399.70	253.41	106.35	214.80	0.20	8.89	1.23	11.06
570800	51.01	128.16	0.64	824.89	9,200.74	434.02	215.42	649.45	424.19	175.13	340.43	0.32	14.91	1.90	18.40
580000	5.04	12.94	0.65	61.13	419.30	43.60	9.13	57.86	16.31	6.56	21.50	0.03	0.67	0.30	0.75
580100	132.03	274.21	0.53	1,062.05	8,589.38	592.81	127.78	750.57	121.48	76.19	309.67	0.72	6.85	11.08	10.51
Min.	*1.52*	*2.23*	*0.37*	*6.07*	*115.27*	*6.56*	*1.70*	*8.27*	*2.43*	*1.71*	*6.55*	*0.01*	*0.08*	*0.05*	*0.13*
Max.	*132.03*	*274.21*	*0.69*	*2,725.17*	*20,969.57*	*1,045.05*	*383.20*	*1,501.24*	*634.08*	*273.32*	*589.75*	*3.64*	*27.60*	*63.45*	*36.49*
Mean	***27.88***	***59.95***	***0.54***	***449.77***	***4,076.78***	***202.39***	***78.00***	***285.00***	***132.93***	***58.60***	***131.10***	***0.32***	***5.31***	***3.66***	***7.18***
Total	**2,202.69**	**4,736.37**	**42.85**	**35,531.55**	**322,065.99**	**15,988.68**	**6,162.16**	**22,514.81**	**10,501.14**	**4,629.32**	**10,356.72**	**25.62**	**419.66**	**289.32**	**567.16**

APPENDIX 13-A

Alternatives/issues identified at public meetings held in the Curiosity Creek watershed in October and November 1999.

No.	Public Meeting Alternatives/Issues	Recommendation/Response	Category
1	**Implement environmental education programs that inform residents of activities that can preserve/protect watershed**	*Could be implemented through existing Streamwatch/LaMP or Blue Sink Coalition groups.*	***Education***
2	**Water Quality Neighborhood Watch (similar to Streamwatch or Baywatch)**	*Ongoing project coordinated through Hillsborough County Streamwatch.*	***Education***
3	**Educate and start program - residents should be more careful in watershed**	*Could be implemented through existing Streamwatch/LaMP or Blue Sink Coalition groups.*	***Education***
4	**Educate and fund improvements on land adjacent to creek owned by private land owners – remove trash, exotic vegetation**	*Could be implemented through existing Streamwatch/LaMP or Blue Sink Coalition groups.*	***Education***
5	**Educate commercial owners adjacent to creek in watershed - improve their activities to prevent trash and pollution**	*Could be implemented through existing Streamwatch/LaMP or Blue Sink Coalition groups.*	***Education***
6	**Improve access to creek**	*Could be accomplished through ELAPP or purchase of lands adjacent to creek for Parks and Recreation use.*	***Education***
7	**Purchase flooded properties from willing landowners and use for retention**	*May be feasible through FEMA funding. Could eliminate large proportion of flooding complaints and would provide water quality improvements and natural systems restoration opportunities.*	***Flood Protection***
8	**Perform additional stormwater modeling to determine if drainage basins in City of Tampa cause flooding of Blue Sink**	*Requires additional funding and coordination between County and City.*	***Flood Protection***
9	**Integrate County/City Studies**	*Requires additional funding.*	***Flood Protection***
10	**Work with city to fix flooding**	*Same as above.*	***Flood Protection***
11	**Build outfall from Blue Sink to river**	*Would be extremely costly due to lack of public land ownership along outfall route.*	***Flood Protection***
12	**Continue to seek ways to open Blue Sink to relieve flooding**	*This area is outside of watershed plan study area. However, a study to evaluate feasibility is ongoing. Results will not be available for 1-2 years.*	***Flood Protection***
13	**Determine inflow from south of Blue Sink - if this causes flooding**	*Requires additional funding.*	***Flood Protection***

14	**Stormwater evaluation**	*This task is currently being done through the Curiosity Creek Watershed Management Plan.*	***Flood Protection***
15	**Possible stormwater structure evaluation**	*This task is currently being done through the Curiosity Creek Watershed Management Plan.*	***Flood Protection***
16	**Reopen Blue Sink to Hillsborough River**	*This area is outside of watershed plan study area. However, a study to evaluate feasibility is ongoing. Results will not be available for 1-2 years.*	***Hydrologic Restoration***
17	**Divert Flows from Sweetwater Creek back to Curiosity Creek**	*Highly controversial and would exacerbate flooding problems in Curiosity Creek.*	***Hydrologic Restoration***
18	**No Diversion from Lake Magdelene**	*Recommended due to limited capacity of existing drainage system and receiving basin.*	***Hydrologic Restoration***
19	**Restore Flow from Lake North of Bearss**	*Requires additional information. May exacerbate flooding problems downstream.*	***Hydrologic Restoration***
20	**Open Spring at Connie Street**	*Requires additional information. May cause groundwater contamination depending upon drainage basin surrounding spring.*	***Hydrologic Restoration***
21	**Store more water in lakes if possible**	*Due to differences in lake levels and interconnectedness between various lakes and Curiosity Creek, managing lake levels would need to be addressed on an individual lake basis.*	***Hydrologic Restoration***
22	**No diversion of water from Sweetwater Creek**	*At this time, there are no plans to divert flows from the Sweetwater Creek basin back to Curiosity Creek as this would increase volume of water entering the Blue Sink basin and would increase risk of flooding.*	***Hydrologic Restoration***
23	**Restore old flow system for (inside) Curiosity Creek**	*Alternatives to improve the existing creek are being evaluated in the Curiosity Creek Watershed Management Plan.*	***Hydrologic Restoration***
24	**Restore old flow from (discharge) Curiosity Creek to Hillsborough River through Blue Sink**	*Would be extremely costly due to lack of public land ownership along outfall route.*	***Hydrologic Restoration***
25	**No diversion of water from Lake Magdalene**	*At this time, there are no plans to divert water from Lake Magdalene to Curiosity Creek as this would increase volume of water entering the Blue Sink basin and would increase risk of flooding.*	***Hydrologic Restoration***
26	**restore flow from lake north of Bearss and open spring at Connie Street**	*Requires additional information.*	***Hydrologic Restoration***
27	**Cooperate with FDOT on Maintenance and Design of Stormwater Systems**	*Could be accomplished through closer coordination with County stormwater staff.*	***Maintenance***
28	**Implement maintenance program to keep creek clean**	*To be addressed through maintenance plan. Some activities are already ongoing with Blue Sink Coalition. Could be enhanced with assistance from other environmental organizations such as the Coastal Cleanup program, Sierra Club, Hillsborough River Greenways Task Force, etc.*	***Maintenance***
29	**Install trash and sediment separators in existing storm inlets**	*Can be evaluated on a site-specific basis depending on feasibility and County maintenance staff availability.*	***Maintenance***

30	**Control and pick-up trash**	*Already ongoing with Blue Sink Coalition. Could be enhanced with assistance from other environmental organizations such as the Coastal Cleanup program, Sierra Club, Hillsborough River Greenways Task Force, etc.*	***Maintenance***
31	**Cut down over-growth**	*To be addressed through maintenance plan.*	***Maintenance***
32	**Trash disposal**	*To be addressed through maintenance plan. Can also be addressed through environmental education efforts.*	***Maintenance***
33	**Restore Floral St. section (cleanup)**	*To be addressed through maintenance plan. Already ongoing with Blue Sink Coalition. Could be enhanced with assistance from other environmental organizations such as the Coastal Cleanup program, Sierra Club, Hillsborough River Greenways Task Force, etc.*	***Maintenance***
34	**Prevent road runoff and trash (FDOT and County)**	*To be addressed through maintenance plan.*	***Maintenance***
35	**Remove sedimentation from creek north of Floral and regrade to make natural marsh**	*Addressed in Chapter 13. Will require additional data collection to appropriately design system.*	***Natural Systems***
36	**Vegetate Lakes (inlcuding golf course lakes)**	*Could be accomplished through volunteer efforts (possibly coordinated through LaMP), plant donations from County or grant funding obtained by Blue Sink Coalition from other agencies such as the Adopt-A-Pond Program, SWFWMD, Tampa Bay Estuary Program, Ducks Unlimited, etc.).*	***Natural Systems***
37	**Purchase Environmentally Sensitive Areas (via ELAPP)**	*Ongoing through ELAPP, however, sites not identified in ELAPP plan must be recommended by interested citizens to be considered for purchase.*	***Natural Systems***
38	**Re-establish Native Plants (volunteer plantings)**	*County could provide list of nurseries or contact at Native Plant Society. Volunteer plantings could be implemented through existing groups such as Blue Sink Coalition, Hillsborough River Greenways Task Force, Sierra Club, Native Plant Society, etc.*	***Natural Systems***
39	**Establish Stream Buffer Zones**	*Difficult due to numerous private land owners. Could be implemented for larger tracts along creek. Opportunities to purchase creekside parcels should be implemented whenever possible.*	***Natural Systems***
40	**Provide Accessible Sources for "Friendly" Plants**	*Provide interested residents the Association of Florida Native Nurseries Native Plant & Service Directory*	***Natural Systems***
41	**Build retention ponds that are more like natural wetlands**	*Could be accomplished through closer coordination with County stormwater staff.*	***Natural Systems***
42	**When fixing flooding, do not disturb creek**	*Could be accomplished through closer coordination with County stormwater staff.*	***Natural Systems***
43	**When fixing flooding by retention, do not keep water too high too long - kills trees**	*Requires additional, site-specific information. Could be accomplished through closer coordination with County stormwater staff.*	***Natural Systems***
44	**Create urban wildlife refuge south of Blue Sink**	*This area is outside of watershed plan study area. However, a study to evaluate feasibility could be implemented in concert with study evaluating reopening of Blue Sink.*	***Natural Systems***
45	**Flooding - natural areas**	*Requires additional information.*	***Natural Systems***

46	**Beautification**	*Provide list of nurseries or contact at Native Plant Society and implement volunteer plantings.*	***Natural Systems***
47	**Re-establish native plants**	*Provide list of nurseries or contact at Native Plant Society and implement volunteer plantings.*	***Natural Systems***
48	**Improve Sanitary Lift Stations at Country Club and Floral that Flood During Rain Events**	*Requires additional information and feasibility analysis.*	***Water Quality***
49	**Expand sanitary sewers into areas currently using septic tanks**	*May require large capital expenditure and substantial costs to local residents. Could implement additional data collection and analysis to determine whether septic tanks are failing.*	***Water Quality***
50	**Control Fertilization**	*Could be accomplished by implementing a "Florida Yards and Neighbors" program (via Tampa Bay Estuary Program) in the neighborhood.*	***Water Quality***
51	**Provide City or County wastewater sewers**	*Requires additional information and feasibility analysis.*	***Water Quality***

APPENDIX 13-B

Curiosity Creek Stormwater Management Master Plan
Recommended Capital Improvement Projects Contruction Cost Estimates

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 1-A: Lake Sophia Pump Station					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$23,407.04	$23,407
	Pump Station & Wet Well for 2 CFS Pump System (896 GPM)	EA	1	$100,000.00	$100,000
430-961-220	10" Plastic Pipe - SDR21 (200 PSI)	LF	2,700	$32.60	$88,020
160-4	Stabilization Type B	SY	54	$5.46	$295
285-711	Optional Base Group 11	SY	54	$13.00	$702
300-1-3	Bituminous Material (Tack Coat)	GA	3	$0.96	$3
331-72-26	Asphalt Concrete Type S (2-3/4")	SY	54	$7.34	$396
430-12238	36" RCP	LF	300	$53.52	$16,056
425-1531	Modified Type-C Inlet (Gravity System Control Box)	EA	1	$1,363.93	$1,364
430-984238	36" MES	EA	1	$1,190.00	$1,190
425-2071	J-7 MH	EA	3	$3,026.18	$9,079
575-1	Sodding (Match Existing)	SY	5,995	$2.83	$16,966
	Total Construction Costs				$234,070
Total					**$257,477**
Total including 25% engineering, permitting, and contingencies					**$321,847**
Alternative 1-B: Lake Sophia Excavation and Pump Station					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$24,563.81	$24,564
	Pump Station & Wet Well for 2 CFS Pump System (896 GPM)	EA	1	$100,000.00	$100,000
430-961-220	10" Plastic Pipe - SDR21 (200 PSI)	LF	2,700	$32.60	$88,020
160-4	Stabilization Type B	SY	54	$5.46	$295
285-711	Optional Base Group 11	SY	54	$13.00	$702
300-1-3	Bituminous Material (Tack Coat)	GA	3	$0.96	$3
331-72-26	Asphalt Concrete Type S (2-3/4")	SY	54	$7.34	$396
430-12238	36" RCP	LF	300	$53.52	$16,056
425-1531	Modified Type-C Inlet (Gravity System Control Box)	EA	1	$1,363.93	$1,364
430-984238	36" MES	EA	1	$1,190.00	$1,190
425-2071	J-7 MH	EA	3	$3,026.18	$9,079
575-1	Sodding (Match Existing)	SY	5,995	$2.83	$16,966
120-001	Excavation	CY	4,836	$2.08	$10,059
	Water Quality Vegitation (15% OF Excavation Cost)	LS	1	$1,508.83	$1,509
	Total Construction Costs				$245,638
Total					**$270,202**
Total including 25% engineering, permitting, and contingencies					**$337,752**

***** Obtained from Florida Department of Transportation Payitem Cost Report Jan. 1999-Jan. 2000***

Curiosity Creek Stormwater Management Master Plan
Recommended Capital Improvement Projects Contruction Cost Estimates

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 1-C: Construct Gravity Outfall for Basin 560800, Lake Sophia, Round Lake, Pine Lake,					
	and Pine Pond to Lake Noreast.				
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$16,168.74	$16,169
430-12238	36" RCP	LF	300	$53.52	$16,056
430-12329	24"RCP	LF	1,450	$30.66	$44,457
430-12325	18" RCP	LF	950	$19.50	$18,525
430-982229	24" MES	EA	3	$760.93	$2,283
430-984238	36" MES	EA	1	$1,190.00	$1,190
425-2071	J-7 MH	EA	3	$3,026.18	$9,079
160-4	Stabilization Type B	SY	1,266	$5.46	$6,912
285-711	Optional Base Group 11	SY	1,266	$13.00	$16,458
331-72-26	Asphalt Concrete Type S (2-3/4")	SY	1,266	$7.34	$9,292
425-2071	TYPE-P Manhole	EA	9	$3,401.73	$30,616
425-1531	Modified Type-C Inlet (Gravity System Control Box)	EA	5	$1,363.93	$6,820
	Purchase Land	AC.	0.4	$60,000.00	$26,400
	Total Construction Costs				$161,687
Total					**$204,256**
Total including 25% engineering, permitting, and contingencies					**$255,320**

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 2: Pine Pond Storage					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$547.77	$548
	Purchase Land	Acre	0.25	$40,000.00	$10,000
120-001	Excavation	CY	2,290	$2.08	$4,763
	Water Quality Vegitation (15% OF Excavation Cost)	LS	1	$714.48	$714
	Total Construction Costs				$5,478
Total					**$16,025**
Total including 25% engineering, permitting, and contingencies					**$20,032**

***** Obtained from Florida Department of Transportation Payitem Cost Report Jan. 1999-Jan. 2000***

Curiosity Creek Stormwater Management Master Plan
Recommended Capital Improvement Projects Contruction Cost Estimates

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 3: Lake Cedar West Stormwater Treatment					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$12,000.00	$12,000
	CDS units	EA	4	$5,000.00	$20,000
	Installation costs/unit	EA	4	$25,000.00	$100,000
	Total Construction Costs				$120,000
Total					**$132,000**
Total including 25% engineering, permitting, and contingencies					**$165,000**
Alternative 4: Lake Cedar West Stormwater Treatment					
	Public Education Program		1	$20,000.00	$20,000
Total					**$20,000**
Total including 25% contingencies					**$25,000**
Alternative 5: Lake Dorsett Sewer Service Connections and Stormwater Treatment BMP's					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$5,900.00	$5,900
	Forcemain to City point of connection*	LF	2,000	$10.00	$20,000
	Sanitary Sewer Lift Station	EA	1	$25,000.00	$25,000
	Const of gravity system (PVC)	LF	600	$10.00	$6,000
	Impact fees*	EA	4	$2,000.00	$8,000
	Total Construction Costs				$59,000
Total					**$64,900**
Total including 25% engineering, permitting, and contingencies					**$81,125**

**** City of Tampa sewer service area***

***** Pricing from vendor- CSR Stormcepter***

Curiosity Creek Stormwater Management Master Plan
Recommended Capital Improvement Projects Contruction Cost Estimates

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 6: Lake Golden Trout Excavation					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$19,256.56	$19,257
	Purchase Land	Acre	6.1	$40,000.00	$244,000
120-001	Excavation	CY	80,504	$2.08	$167,448
	Water Quality Vegitation (15% OF Excavation Cost)	LS	1	$25,117.25	$25,117
	Total Construction Costs				$192,566
Total					**$455,822**
Total including 25% engineering, permitting, and contingencies					**$569,778**

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 7: Country Club Drive Structures*					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$14,225.72	$14,226
	Double 10 x 12 Concrete Box Culvert (Length = 58.8 ft)	EA	1	$102,409.00	$102,409
120-2-2	Excavation, Borrow	CY	1,556	$3.10	$4,830
160-4	Stabilization Type B	SY	1,334	$5.46	$7,284
285-711	Optional Base Group 11	SY	1,334	$13.00	$17,342
300-1-3	Bituminous Material (Tack Coat)	GA	54	$0.96	$52
331-72-26	Asphalt Concrete Type S (2-3/4")	SY	1,334	$7.34	$9,792
575-1	Sodding (Match Existing)	SY	194	$2.83	$549
	Total Construction Costs				$142,257
Total					**$156,483**
Total including 25% engineering, permitting, and contingencies					**$195,604**

***** Obtained from Florida Department of Transportation Payitem Cost Report Jan. 1999-Jan. 2000***

***Project is in the City of Tampa Limits. Should not be considered a County project without Cooperation of City of Tampa**

Curiosity Creek Stormwater Management Master Plan
Recommended Capital Improvement Projects Contruction Cost Estimates

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 8: 122nd Avenue Improvements					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$5,282.13	$5,282
	Double 5 x 7 Concrete Box Culvert (Length = 40.1 ft)	EA	1	$31,200.00	$31,200
120-2-2	Excavation, Borrow	CY	257	$3.10	$798
160-4	Stabilization Type B	SY	800	$5.46	$4,368
285-711	Optional Base Group 11	SY	800	$13.00	$10,400
300-1-3	Bituminous Material (Tack Coat)	GA	32	$0.96	$31
331-72-26	Asphalt Concrete Type S (2-3/4")	SY	800	$7.34	$5,872
575-1	Sodding (Match Existing)	SY	54	$2.83	$153
	Total Construction Costs				$52,821
Total					**$58,103**
Total including 25% engineering, permitting, and contingencies					**$72,629**

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 9: Reclamation of the Floodplain at the Mobile Home Community					
	Purchase Land	Acre	0.92	$125,000.00	$115,000
	Purchase Land	Acre	2.50	$125,000.00	$312,500
	Purchase Land	Acre	0.70	$150,000.00	$105,000
Total					**$532,500**
Total including 25% engineering, permitting, and contingencies					**$665,625**

***** Obtained from Florida Department of Transportation Payitem Cost Report Jan. 1999-Jan. 2000***

Curiosity Creek Stormwater Management Master Plan
Recommended Capital Improvement Projects Contruction Cost Estimates

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 10A: Channel Improvements and Storage Near Fletcher and 137th Ave					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$32,581.53	$32,582
	Purchase Land	Acre	6.0	$435,600.00	$2,613,600
	Purchase Land	Acre	0.5	$150,000.00	$75,000
	5 x 10 Concrete Box Culvert (Length = 51 ft)	EA	1	$32,707.00	$32,707
160-4	Stabilization Type B	SY	112	$5.46	$612
285-711	Optional Base Group 11	SY	112	$13.00	$1,456
300-1-3	Bituminous Material (Tack Coat)	GA	5	$0.96	$5
331-72-26	Asphalt Concrete Type S (2-3/4")	SY	112	$7.34	$822
120-001	Excavation	CY	100,350	$2.08	$208,728
120-005	Excavation	CY	5,395	$8.03	$43,322
	Water Quality Vegitation (15% OF Excavation Cost)	LS	1	$37,807.48	$37,807
575-1	Sodding (Match Existing)	SY	126	$2.83	$357
	Total Construction Costs				$325,815
Total					**$3,046,997**
Total including 25% engineering, permitting, and contingencies					**$3,808,746**
Alternative 10B: Channel Improvements, Floodplain Reclamation and Compensation Storage					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$11,461.75	$11,462
	Purchase Land	Acre	1.7	$150,000.00	$255,000
	Purchase Land	Acre	1.0	$435,600.00	$435,600
	Double 5 x 8 Concrete Box Culvert (Length = 51 ft)	EA	1	$42,752.00	$42,752
160-4	Stabilization Type B	SY	122	$5.46	$666
285-711	Optional Base Group 11	SY	122	$13.00	$1,586
300-1-3	Bituminous Material (Tack Coat)	GA	5	$0.96	$5
331-72-26	Asphalt Concrete Type S (2-3/4")	SY	122	$7.34	$895
120-001	Excavation	CY	12,342	$2.08	$25,671
120-005	Excavation	CY	4,202	$8.03	$33,742
	Water Quality Vegitation (15% OF Excavation Cost)	LS	1	$8,912.01	$8,912
575-1	Sodding (Match Existing)	SY	137	$2.83	$388
	Total Construction Costs				$114,618
Total					**$816,679**
Total including 25% engineering, permitting, and contingencies					**$1,020,849**

***** Obtained from Florida Department of Transportation Payitem Cost Report Jan. 1999-Jan. 2000***

Curiosity Creek Stormwater Management Master Plan
Recommended Capital Improvement Projects Contruction Cost Estimates

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 11: Reclamation of the Floodplain at Taliaferro Street and Treatment Pond					
	Purchase Land (Folio #18051.0000)	Home	7.0	$60,000.00	$420,000
Total					**$420,000**
Total including 25% engineering, permitting, and contingencies					**$525,000**
Alternative 12: Floral Avenue Improvements at Rose Lake Estates					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$93,442.91	$93,443
	Purchase Land	Acre	3.2	$200,000.00	$640,000
	Purchase Land	Acre	4.5	$20,000.00	$90,000
120-001	Excavation	CY	74,375	$2.08	$154,700
120-005	Excavation	CY	68,179	$8.03	$547,477
	Water Quality Vegitation (15% OF Excavation Cost)	LS	1	$105,326.61	$105,327
110-1-1	Clearing and Snagging	Acre	0.58	$12,000.00	$6,960
425-1531	Modified Type-C Inlet (Gravity System Control Box)	EA	1	$1,363.93	$1,364
	Double 5 x 8 Concrete Box Culvert (Length = 39 ft)	EA	1	$35,010.00	$35,010
	Double 5 x 10 Concrete Box Culvert (Length = 24 ft)	EA	1	$38,571.00	$38,571
400-2-4	Armored Berm (40' x 20' x 6" of Class II Concrete)	CY	15	$352.93	$5,294
430-14242	54" RCP	LF	400	$66.00	$26,400
430-982242	54" MES	EA	1	$2,945.00	$2,945
160-4	Stabilization Type B	SY	262	$5.46	$1,431
285-711	Optional Base Group 11	SY	262	$13.00	$3,406
300-1-3	Bituminous Material (Tack Coat)	GA	11	$0.96	$11
331-72-26	Asphalt Concrete Type S (2-3/4")	SY	262	$7.34	$1,923
575-1	Sodding (Match Existing)	SY	1276	$2.83	$3,611
	Total Construction Costs				$934,429
Total					**$1,757,872**
Total including 25% engineering, permitting, and contingencies					**$2,197,340**
Alternative 13: Floral Avenue Channel Improvements					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$10,733.45	$10,733
120-2-2	Excavation, Borrow	CY	8595	$8.03	$69,018
	Water Quality Vegitation (15% OF Borrow Cost)	LS	1	$10,352.68	$10,353
550-2	Fencing (Both sides of easement)	LF	2,600	$5.73	$14,898
550-4-1	Posts	EA	8	$98.23	$786
550-3-1	Corner Posts	EA	4	$117.84	$471
550-76-31	Gates	EA	4	$500.00	$2,000
575-1	Sodding (Match Existing) for 2:1 sideslopes area only	SY	3466	$2.83	$9,809
	Total Construction Costs				$107,335
Total					**$118,068**
Total including 25% engineering, permitting, and contingencies					**$147,585**

***** Obtained from Florida Department of Transportation Payitem Cost Report Jan. 1999-Jan. 2000***

Curiosity Creek Stormwater Management Master Plan
Recommended Capital Improvement Projects Contruction Cost Estimates

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 14: Improve Tyrone Mobile Home Community by adding a 11 Ac. Retention Pond and Berm					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$47,100.74	$47,101
	Purchase Land	Acre	8.2	$200,000.00	$1,640,000
	Purchase Land	Acre	4.9	$40,000.00	$197,200
120-001	Excavation	CY	119,258	$2.08	$248,057
	Water Quality Vegitation (15% OF Excavation Cost)	LS	1	$37,208.50	$37,208
425-1531	Modified Type-C Inlet (Gravity System Control Box)	EA	1	$1,363.93	$1,364
425-1521	Type C Inlet	EA	1	$1,248.30	$1,248
425-1551	Modified Type E Inlet	EA	4	$1,665.40	$6,662
430-11243	60" RCP	LF	127	$88.64	$11,257
430-982243	60" MES	EA	1	$3,000.00	$3,000
430-12342	54" RCP	LF	400	$75.00	$30,000
430-12240	42" RCP	LF	933	$56.84	$53,032
430-982240	42" MES	EA	1	$1,219.84	$1,220
430-12238	36" RCP	LF	985	$53.52	$52,717
430-982238	36" MES	EA	1	$981.12	$981
160-4	Stabilization Type B	SY	290	$5.46	$1,583
285-711	Optional Base Group 11	SY	290	$13.00	$3,770
300-1-3	Bituminous Material (Tack Coat)	GA	12	$0.96	$12
331-72-26	Asphalt Concrete Type S (2-3/4")	SY	290	$7.34	$2,129
575-1	Sodding (Match Existing)	SY	5,925	$2.83	$16,768
	Total Construction Costs				$471,007
Total					**$2,355,308**
Total including 25% engineering, permitting, and contingencies					**$2,944,135**

***** Obtained from Florida Department of Transportation Payitem Cost Report Jan. 1999-Jan. 2000***

Curiosity Creek Stormwater Management Master Plan
Recommended Capital Improvement Projects Contruction Cost Estimates

FDOT Item No.	Cost Item	Unit	Amount	Unit Cost**	Total Cost
Alternative 15: Improve Round Lake Area and Veronica Ave. by adding a Pump Station					
	Mobilization of Equipment (10% of Construction Costs)	LS	1	$20,075.50	$20,076
	Pump Station and Wet Well for 2 CFS Pump System (896 GPM)	EA	1	$100,000.00	$100,000
430-961-220	10" Plastic Pipe - SDR21 (200 PSI)	LF	2,700	$32.60	$88,020
575-1	Sodding (Match Existing)	SY	4,500	$2.83	$12,735
	Total Construction Costs				$200,755
Total					**$220,831**
Total including 25% engineering, permitting, and contingencies					**$276,038**
Alternative 16: Preserve upland /wetland buffer around Cedar Lake East					
	Purchase Land *(land costs only)*	Acre	11.0	$30,000.00	$330,000
Total					**$330,000**
Total including 25% for contingencies					**$412,500**

***** Obtained from Florida Department of Transportation Payitem Cost Report Jan. 1999-Jan. 2000***

APPENDIX 18-A

APPENDIX 18-A

MAINTENANCE PLAN

A key component in the management of a watershed is the proper maintenance of the drainage system. In order to better conduct maintenance activities in the watershed, a maintenance plan is a must. A good maintenance plan will ensure adequate drainage to help alleviate flooding, as well as provide for improved water quality. The minimum criteria for the maintenance plan will be to meet the requirements of the County's National Pollutant Elimination Discharge System (NPDES) permit, and to fulfill the requirements of the National Flood Insurance Program's Community Rating System (CRS). Obtaining credit through the CRS can reduce the flood insurance premiums for the entire community.

Community Credit for Drainage Maintenance

The following was taken from the Federal Emergency Management Agency, National Flood Insurance Program, Community Rating System document : CRS Credit for Drainage System Maintenance Jan. 1999.

The Community Rating System (CRS) encompassed by the National Flood Insurance Program provides credit for activities that reduce or prevent flood damage to existing development. Activity 540 (Drainage System Maintenance) provides credit for maintaining the local drainage system in order to prevent flooding that is caused by blockages or reduction in floodplain storage from accumulation of debris.

Activity 540 consists of three elements.

1) Maintenance of Channels and Storage Basins.
2) Regulations that prohibit dumping in drainage ways.
3) Routine Inspection and Maintenance of Coastal erosion protection facilities.

A community requesting credit for its maintenance program must submit documentation for the following 5 key items:

1) Who is responsible
2) What part of the drainage system is covered
3) Inspection procedures
4) Maintenance procedures
5) Records

Key item number one contains two jobs which must be performed. The first is *Inspections* and the second is *Maintenance.* The documentation submitted must identify what person or office is responsible for each of these two jobs.

Key item number two must define the drainage system. It is suggested that this item be covered with a map and narrative. Descriptions of the system are required including all natural and manmade water courses, conduits and storage basins that must be maintained in order to prevent flooding and damage to buildings from smaller more frequent storm events.

Key item number three addresses the need for periodic inspection of the drainage system. In order to obtain basic CRS credit, inspection must be conducted:

- At least once a year
- After each storm event that could adversely impact the drainage system
- In response to citizen's complaints

Additional credit can be obtained if the community can identify problem sites and inspect these areas more frequently.

Key item number four identifies maintenance procedures that show how soon after an inspection an area must be cleared, what is to be removed, and how it is to be removed. This item recognizes that the maintenance of a natural stream is different from a manmade ditch. Fallen branches in a natural stream may not be a problem. However, fallen logs against a bridge crossing a canal would most likely need some type of action. The community must identify what is to be removed and how for each area of the system.

Key item number five addresses record keeping. Usually a maintenance organization keeps records of citizen complaints and other forms such as work orders or timesheets which show that the maintenance was performed. These forms are needed to demonstrate that maintenance activities are being performed and performed appropriately.

Maintenance Specific to the Curiosity Creek Watershed

<u>Water Quantity</u>

The Curiosity Creek Watershed contains few areas other than roadways that are owned and maintained by Hillsborough County. As mentioned above in order to obtain CRS credit the County may have to increase its scope of inspection/maintenance activities to include areas that may not be owned by Hillsborough County.

During the course of the watershed plan work some areas were visited in the field by professional staff. The staff made note of areas that appeared to be in need of inspection and perhaps maintenance activities. These notations should not be interpreted as an inspection by the professional staff but rather as field observations that could have a bearing on maintenance.

Field Location	*Observation*
Ola Avenue at Curiosity Creek	Concrete junction box receiving discharge from pipe system leading from Lake Noreast in need of repair
Channel Downstream of southern crossing of Curiosity Creek at Florida Avenue	Channel contained debris and abandoned crossing in need of cleaning
Channel downstream of Floral Drive	Channel in need of cleaning
Pond at end of Ola Drive	Berm may be in need of repair
Channel upstream of Ola Drive	Sideslope sloughing (*addressed in Alternative 13*)

County Maintained Facilities Within the Curiosity Creek Watershed	
Location	*Description*
Marjory Avenue south of 131st	Local stormwater retention pond
Ola Avenue at Curiosity Creek	Local stormwater retention pond
131st and Ola Avenue	Retention pond for Florida and Fletcher Ave.
Upstream of Floral Drive	Curiosity Creek Main Channel

Water Quality

LAKES

Maintenance of water quality in the lake systems of the Curiosity Creek watershed will require a concerted effort between both the County and the residents which own/use these waterbodies. The ongoing LaMP program managed by the County will provide important data to evaluate the status and trends in water quality for individual lakes and can be used to develop specific alternatives for remediation. Presently, water quality in most of the lakes sampled by LaMP have "good" to "fair" water quality with the exception of Cedar Lake West. An alternative to improve water quality in this lake has been proposed (shoreline revegetation), based on information provided by local residents and an analysis of existing water quality data. If water quality in other lakes within the watershed decline, various alternatives (e.g., alum treatment) to address specific water quality parameters will need to be investigated and implemented.

STREAMS

Maintenance of water quality in the main channel of Curiosity Creek will also require a concerted effort between both the County and the residents which live adjacent to this system. The ongoing StreamWaterwatch program managed by the County will provide important data to evaluate the status and trends in water quality for the creek and can be used to develop specific alternatives for remediation. Presently, water quality in the creek is rated as "poor" based on a number of different parameters including total nitrogen and total suspended solids. Several alternatives have been developed in this plan to improve water quality in the creek. These systems which include sedimentation sumps and open water features will require inspection and maintenance (removal and proper disposal of excess sediments) to ensure their continued effectiveness in removing pollutants.

NATURAL SYSTEMS

Several alternatives identified in this plan include the construction and revegetation of littoral areas in several natural and created lakes, ponds, and creek areas. Maintenance of these planted marsh and riparian systems will be required to prevent colonization (and, possibly, exclusion of planted vegetation) by exotic and nuisance plant species such as cattails (*Typha* spp.), primrose willow (*Ludwigia peruviana*), and Brazilian pepper (*Schinus terebinthifolius*). Periodic maintenance (using hand removal and/or herbicide treatment) and monitoring (transects, photodocumentation) should be implemented to ensure the success of these alternatives and to document and report any unexpected changes to each project that may require modification or improvement.

In addition, County-owned lands or right-of-way parcels should periodically be inspected for exotic vegetation infestation. If significant exotic plant coverage occurs, an eradication plan should be developed for the affected parcel in concert with a revegetation plan. A revegetation plan can be crucial if large areas are cleared of vegetation. These areas should be replanted with native species and inspected to prevent future recolonization by exotic species. Similar efforts should be implemented for lakes, however, most of the lakes in the watershed are privately owned. Close coordination between organizations such as LaMP and homeowner's associations will be required to implement any nuisance vegetation eradication and native planting plans.

A specific eradication plan should be implemented for the Lake Gass area which is rapidly being colonized by *Melaleuca* (punk trees). Control of *Melaleuca* at this lake will require an aggressive eradication program and should be implemented as soon as possible to minimize the spread of this extremely aggressive plant. This plan will require the participation of local residents since the County does not presently own or control any of the affected parcels surrounding the lake.

APPENDIX 18-B

APPENDIX 18-B

MONITORING PLAN

Water Quantity:

Monitoring the water levels of Curiosity Creek should be ongoing in an attempt to further quantify the volume of surface water discharge that enters in the City of Tampa from Hillsborough County. Rainfall gages that are located within the watershed would be useful in creating additional calibration data to further refine the hydraulic and hydrologic models.

In addition, lake level gages would also be useful in determining the natural recovery rates of the lakes within the Northwest Lake System. This information will be essential in determining perceived flooding levels and establishing site flooding elevation (LOS C threshold). Lakes that may be controlled with structural improvements, such as Round Lake, Lake Sophia, Pine Lake, Pine Pond and Lake Noreast should be considered for continuous data sampling station locations. A continuous lake level sampling station at these lakes could be very useful in determining operations for controlling the lake levels.

Because the Curiosity Creek watershed terminates within the City of Tampa, it would of benefit to both the City and the County to obtain real time water surface elevations at the City retention pond and in the area of the Blue Sink. This information could be used to verify and further validate the boundary conditions used in the modeling process. In addition, observing the water surface response to storm events at the Blue Sink would be valuable in determining safe elevations at which additional stormwater volumes could be released to the City from Hillsborough County.

Water Quality:

LAKES

Based on data collection efforts discussed in Chapter 7, a number of data gaps have been identified with respect to water quality monitoring. For lakes, water quality data is currently being collected for the following waterbodies:

- Lake Gass
- Lake Turtle
- Lake Eckles
- Mid Lake
- Pine Lake
- Lake Cedar West
- Lake Dorsett

However, a number of other lakes within the watershed are not currently monitored for water quality which include:

- Noreast Lake
- Lake Cedar East
- Lake Golden Trout
- Lake Sophia
- Borrow Pit (adjacent to Buchanan Middle School and at the headwaters of Curiosity Creek)

Monitoring of these other lake systems, especially Noreast Lake, is important with respect to other activities within the watershed. Noreast Lake is the last of a chain of lakes that discharges to Curiosity Creek. If more detailed loading estimates are necessary to assess the reopening of Blue Sink, existing water quality in Noreast Lake will be necessary to evaluate contributions from this portion of the watershed. Also, hydraulic connections have been proposed for several lakes/ponds (e.g., Lake Sophia) to reduce flooding in closed basins. Having water quality information for these and other lakes that may act as receiving waters will allow County staff to evaluate the potential impacts from transferring water (and possibly higher nutrient loads) from one waterbody to another. Finally, data for these other lake systems can be used to evaluate the success of alternatives proposed for the watershed. Parameters for water quality monitoring should include the suite of analytes currently being analyzed by the LaMP and should also include fecal coliform bacteria concentrations to evaluate potential public health risks.

STREAMS

An HCEPC monitoring site was added at 122nd Avenue at the existing USGS gaging station in 1999 but was subsequently discontinued for lack of flowing water in this reach of the creek. Monitoring at this location and other reaches of the creek could provide important information regarding potential sources and fate of pollutants from the surrounding watershed. Three sites are currently being monitored by the Stream Waterwatch program and should be continued to evaluate the effectiveness of future water quality improvement projects: 1) at Bearss Avenue, 2) upstream of the north crossing of Florida Avenue, and 3) upstream of the Country Club Drive crossing. An expanded sampling plan may be necessary to allow the collection of relevant water quality data for the creek including:

- Restricting sampling to storm events or during periods of unusually heavy rainfall (summer)
- Collection of samples downstream of 122nd and at the Blue Sink receiving pond

Parameters for water quality monitoring should include the suite of analytes currently being analyzed by the LaMP Program as well as oil and greases, heavy metals and fecal coliform bacteria to evaluate potential public/ecological health risks.

GROUNDWATER

Currently, only two groundwater monitoring locations exist within the watershed which are located at Buchanan Middle School and at Roy Haynes Park. Additional groundwater monitoring data may be necessary in the future if the City of Tampa implements a project to reopen Blue Sink. Analytes should include fecal coliform bacteria or other indicators of human pathogen contamination, nutrients, metals, and toxicants (pesticides, etc.) if the data will be used to evaluate this groundwater as a potential potable water source.

NATURAL SYSTEMS

Monitoring of natural systems in the Curiosity Creek watershed should be continued as part of ongoing LaMP and Streamwatch data collection activities or on an as-needed basis for specific parcels acquired by the County for preservation. A number of areas both within the creek and along the shorelines of several lakes (e.g., Lake Gass) are quickly becoming colonized by exotic vegetation. These areas can be targeted for nuisance species eradication either through neighborhood associations or by the County in areas where a County right-of-way exists.

APPENDIX 18-C

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Allen Kisinger
1904-1981

engineering • inspection • planners

MEMORANDUM

DATE: **March 22, 2000**

TO: File

cc: **Attendees, PGF**

FROM: Al Stewart

RE: Curiosity Creek Watershed Management Plan
Meeting with Southwest Florida Water Management District (SWFWMD)

KCA PROJECT NO: 19634.06

A meeting was held on March 22, 2000 at 9:00 am at SWFWMD's Tampa Office to discuss the Curiosity Creek Watershed Management Plan (WMP) altematives and general permitting requirements. Those in attendance were:

Michelle Robertson	SWFWMD
Alberto Martinez	SWFWMD
Chin-Feng Ho	Hillsborough County
David Glicksberg	Hillsborough County
Ray Kurz	Scheda Ecological Associates
Roger Cox	KCA
Al Stewart	KCA

A summary of what was discussed is listed below.

An overview of the Watershed Management Plan was given. The study boundaries are generally Lake Magdalene Blvd. on the north, Rome Avenue on the west, I-275 on the east and Country Club Drive on the south. The Curiosity Creek Watershed extends into the City of Tampa but only the portion of the watershed within Hillsborough County is being evaluated as part of the WMP.

Curiosity Creek used to discharge into a series of sinkholes including Blue Sink which have become plugged. Currently the Creek discharges into a City of Tampa stormwater pond. The volume of this pond is recovered by pumping stormwater from the pond into storm sewer systems that drain to the Hillsborough River. It was pointed out that there is a cooperative funding effort with the City of Tampa and SWFWMD to investigate the possibility of reopening Blue Sink. There are documented flooding problems throughout the County portion of the basin as well as in the City limits.

KCA has modeled the existing conditions in the basin using the County's Extran Model, along with input from area residents and County personnel to come up with existing levels of surface in regards to flood protection. The County's water quality model has been run to estimate existing Water Quality Levels of Service in the basin along with an evaluation of existing natural systems. Based on this information, alternatives have been developed to provide an improved level of flood protection for problem areas throughout the basin, improve water quality levels of service, and to enhance or restore where feasible, existing natural systems.

The County Extran Model uses the Type II Florida Modified Rainfall Distribution and a 25-year/24-hour design storm. The County is in the process of getting their model approved by FEMA (Federal Emergency Management Agency). The same model and parameters are being used for all of the Watershed Management Plans underway by the County.

The County explained that the once the Watershed Management Plan is approved, the recommended projects become eligible for incorporation into the County's Work Program. How projects are prioritized and when funding becomes available will determine when the projects are permitted and constructed. Each project will be permitted individually. The County will come in for a pre-application meeting for each of the projects prior to submitting permit applications for them.

KCA identified each of the areas where alternative improvements are proposed. The existing problem areas were described and the potential alternative solutions were discussed (See enclosed Table 13-1 and Figure 13-1 from the WMP). All of the alternative improvements are designed with the constraint of not increasing either the rate or volume of stormwater runoff being discharged to the City.

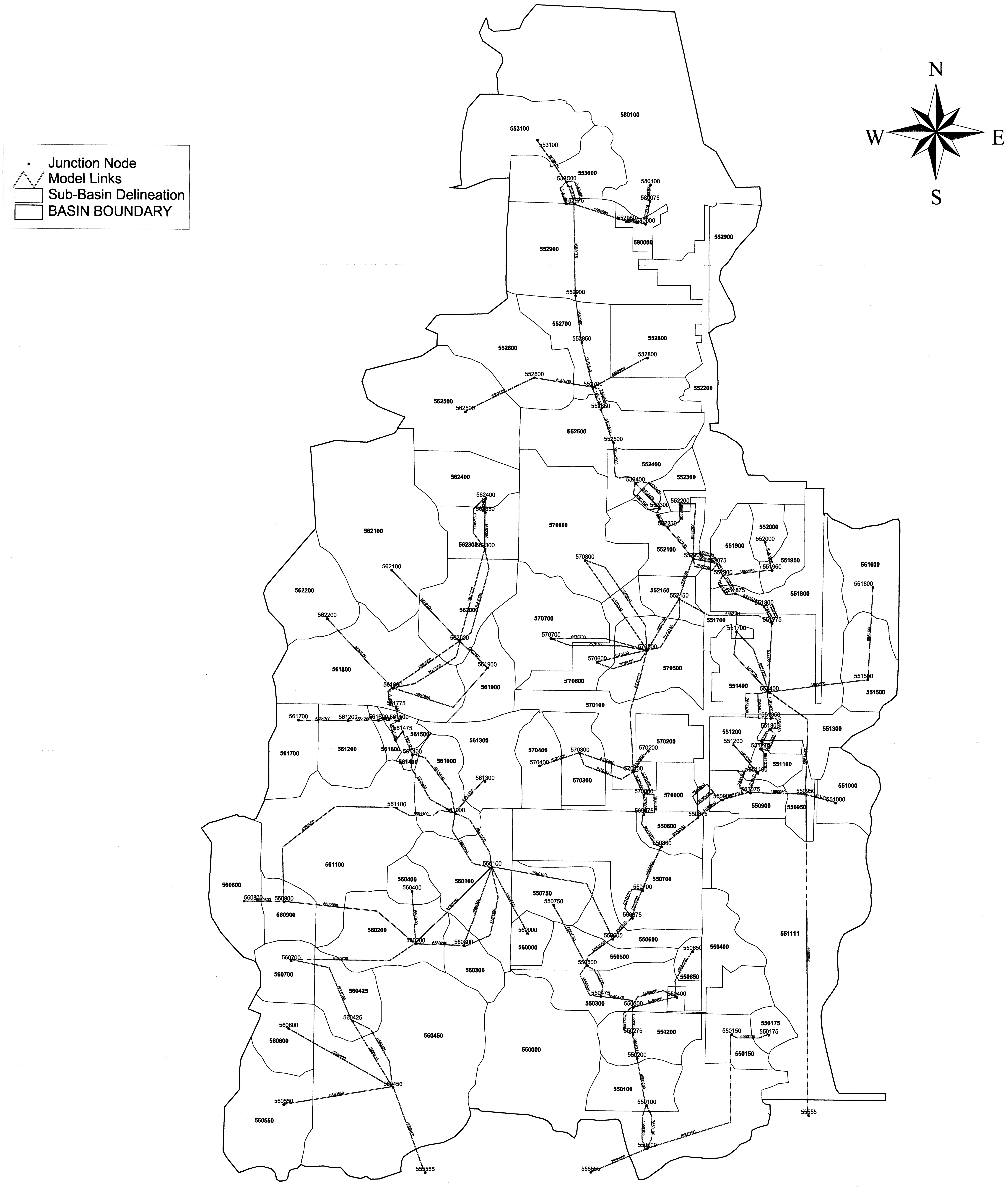
The discussion on permit requirements was general in nature. For the improvements that involve connecting lakes that may not be directly connected under existing conditions, SWFWMD will require demonstration of no adverse impacts, no increase in lake levels, calculations showing pumps (where required) will have adequate capacity. SWFWMD also indicated that for lakes that are privately owned, authorization would be required from each property owner surrounding the lake.

SWFWMD will also require demonstration that there will be no pumping of pollutants from lake to lake with the proposed improvements. Estimates of existing pollutant loading will probably be required along with documentation showing no degradation in water quality of the receiving lake. Hydroperiods of the lakes and affected wetlands will have to be determined as well.

For the projects that involve channel improvements, stormwater ponds, habitat enhancement, preservation, or restoration, and/or potential floodplain reclamation, SWFWMD was generally receptive. SWFWMD is concerned about the wetland impacts. Wetland impacts will need to be justified. Each project that impacts wetland or upland habitat areas will have to include a description of the area including the condition of the area. Since the alternative stormwater ponds would not be used to treat runoff from new development, SWFWMD indicated that wetland mitigation credit might be available for pond areas that are planted with native vegetation in their littoral areas, or for wetland areas that are created from appropriate (i.e. not significant) upland areas.

This summarizes my understanding of what was discussed.

EXHIBITS



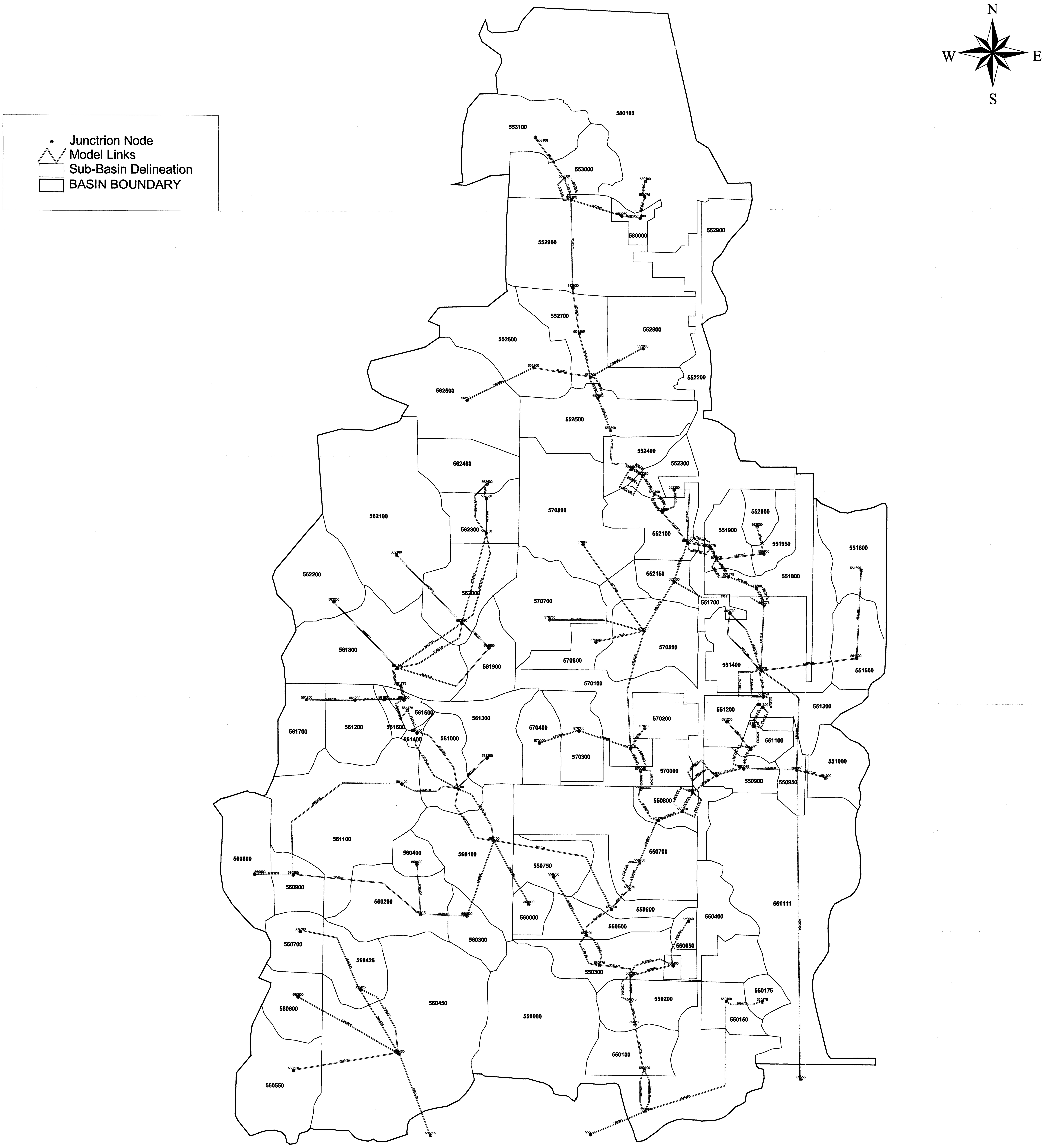
HILLSBOROUGH COUNTY
FLORIDA

CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES CORP.

EXHIBIT 18-1

PREFERRED PLAN CONNECTIVITY DIAGRAM



HILLSBOROUGH COUNTY
FLORIDA

CURIOSITY CREEK
WATERSHED MANAGEMENT PLAN

KISINGER CAMPO & ASSOCIATES

EXHIBIT 5-1
EXISTING CONDITION
CONNECTIVITY DIAGRAM