ALAFIA RIVER WATERSHED MANAGEMENT PLAN

VOLUME II

Chapters 7 through 12

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CHAPTER 7

WATER QUALITY – EXISTING CONDITIONS

7.1 Introduction

The Alafia River drains an area of approximately 420 square miles and discharges to southeastern Hillsborough Bay (Figure 7.1-1). The Alafia River Watershed lies in eastern Hillsborough County and western Polk County, portions of which are experiencing rapid population growth. A variety of intensive industrial and agricultural activities (e.g., phosphate mining and processing; citrus production; truck-farming of fruits and vegetables; concentrated animal feeding operations) also occur in the watershed.

Major tributaries include the North Prong, South Prong, Turkey Creek, English Creek, Fishhawk Creek, Buckhorn Creek and Bell Creek. Two spring systems—Lithia Springs and Buckhorn Springs—discharge to the river at approximately 13.6 and 6.6 river miles (respectively) upstream of U.S. Highway 41 (Stoker et al. 1996). Lithia Springs is classified as a second-magnitude spring and discharges between 10 and 100 cubic feet per second. Buckhorn Spring, and the numerous other springs and seeps that contribute flow to the river, is substantially smaller (Stoker et al. 1996).

The majority of water quality problems that have been identified in the watershed are associated with nutrients and coliforms; in addition, low dissolved oxygen levels are problematic in some tributaries, and concerns exist in some tributaries due to metals concentrations in excess of state standards. Metals data is not available for much of the watershed, but the availability of water quality data, overall, is good compared to other watersheds in Florida.

Anthropogenic influences on water quality in the Alafia Watershed are numerous. Many of these influences are shown on Figure 7.1-2 (located in sleeve at the end of this chapter) and are described in the sections that follow.

7.1.2 Background and Setting

The Alafia River watershed is a naturally fertile area that contains extensive phosphate-bearing geological deposits (e.g., the Bone Valley Member of the Hawthorn Group) and experiences abundant seasonal rainfall and a humid subtropical climate. Phosphate is an important nutrient for terrestrial and aquatic organisms, and many lakes and streams that drain the Bone Valley region are “eutrophic” (exhibit high rates of biological productivity) as a result of the naturally elevated phosphate inputs they receive (Odum 1953, Canfield and Hoyer 1988, Griffith et al. 1997). These naturally eutrophic waterbodies have the potential to

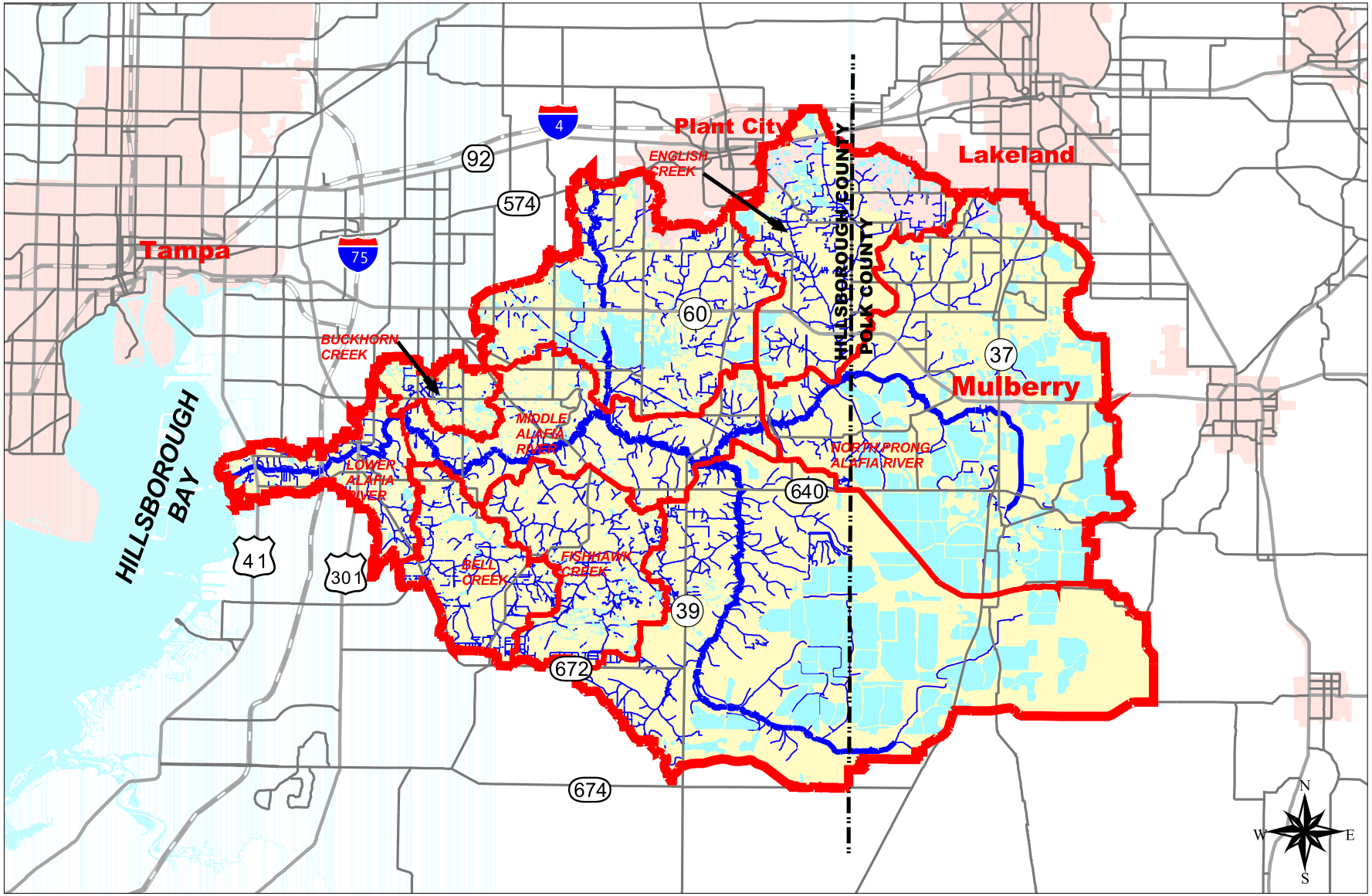

FIGURE 7.1-1
SITE LOCATION MAP

HILLSBOROUGH COUNTY
FLORIDA

Water

Alafia River Watershed

Primary road with limited access

Primary road

Secondary and connecting road

Main River Channel

Creek

0 1 2 3 4 5 Miles

Scale: 1" = 4 Miles

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become hypereutrophic—exhibiting undesirably high levels of biological productivity—if human activities cause nutrient loads to increase to excessive levels. Several historically-eutrophic lakes located in the adjacent Hillsborough River and Peace River watersheds, including Lake Thonotosassa, Lake Parker, Lake Hancock and Banana Lake, appear to have shifted to hypereutrophic productivity levels in recent decades as a result of additional, manmade nutrient loads (e.g., Brenner et al. 1996). Lakes and impoundments in the Alafia River Watershed appear susceptible to similar impacts if excessive anthropogenic nutrient loads are allowed to occur.

The climate of the area is humid subtropical, with an annual mean temperature of 72^{o}F and annual average precipitation of about 52 in. In a typical year approximately 60% of the annual precipitation falls during a four-month rainy season that extends from June through September. Rainfall in this season comes primarily from convective afternoon and evening thunderstorms. Periods of extremely heavy precipitation associated with the passage of tropical low-pressure systems and storms occur during summer and early fall in some years.

Mean monthly temperatures range from a low of approximately 60^{o}F in January to a high of approximately 82^{o}F in August. Summer high temperatures typically reach 95^{o}F, with occasional highs greater than 100^{o}F. Annual low temperatures range from 25-30^{o}F, and occur following the passage of Arctic cold fronts. Winter temperatures rarely remain below freezing during daylight hours and typically rise to 60-70^{o}F during periods between the passage of fronts.

The Brandon karst terrain (Upchurch and Littlefield 1987)—a 41 square mile area characterized by internal drainage, numerous sinkholes and relatively rapid recharge of surface water to the Floridan aquifer—occurs to the north of the Alafia River and west of Lithia Springs (Figure 7.1-3). Fertilizer use, livestock operations, septic systems and other human activities in this area have been linked to elevated and increasing nitrate concentrations in the water discharged from Lithia and Buckhorn Springs (Jones and Upchurch 1993).

Phosphate mining and the production of fertilizers and other phosphate-based products are significant activities in the watershed (Figure 7.1-4). “Barren land,” a byproduct of surface strip mining of phosphate ore, makes up a significant portion of the watershed, primarily in the South Prong sub-basin. Ore processing and fertilizer production facilities represent a significant land use in the North Prong sub-basin. In addition Cargill Fertilizer, the owner of Lithia and Buckhorn Springs, diverts approximately 14 percent of the combined flow of the springs to its phosphate processing plant and shipping facility located near the river mouth (Jones and Upchurch 1993).

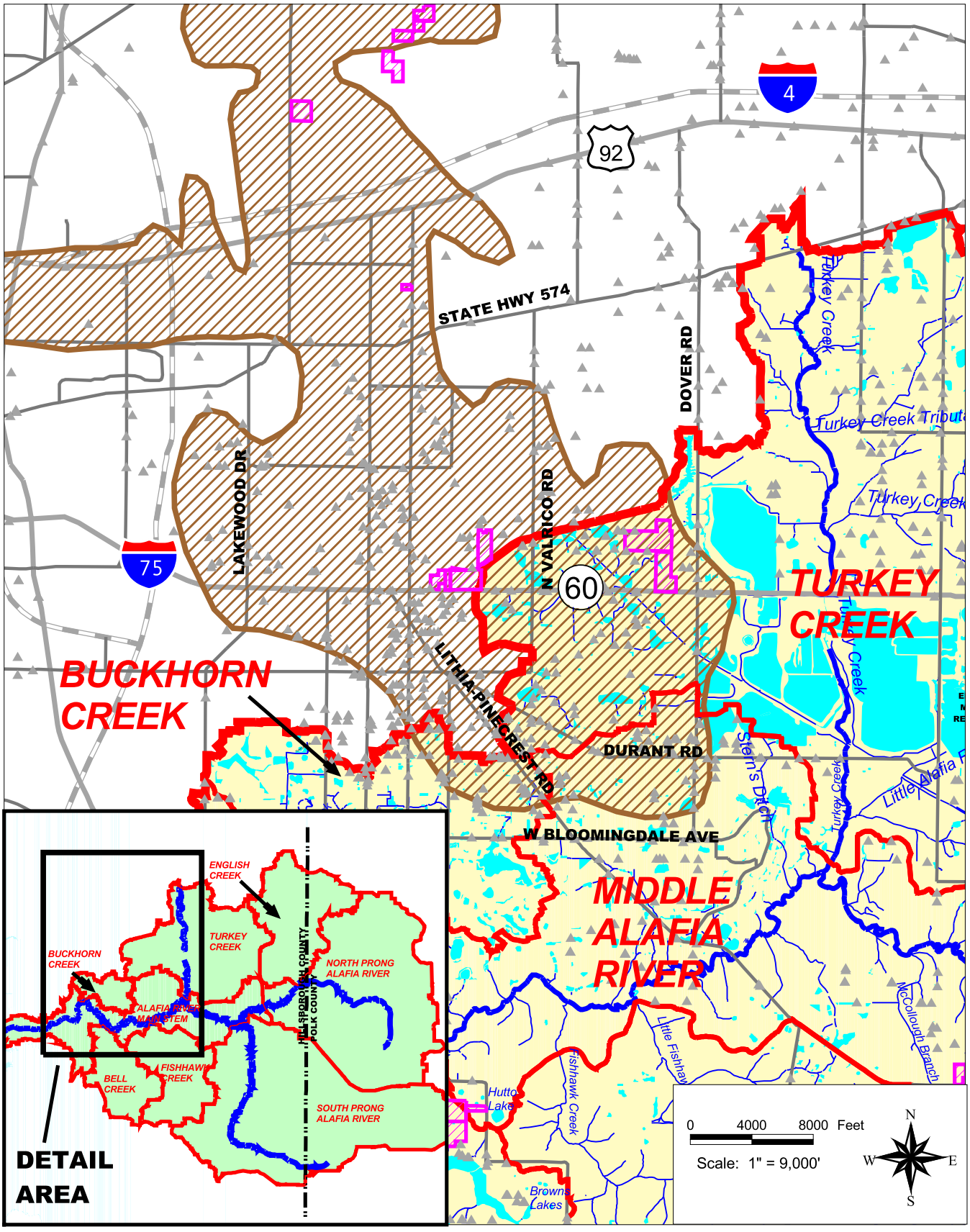

FIGURE 7.1-3
BRANDON KARST TERRAIN

HILLSBOROUGH COUNTY
FLORIDA

- Recent Septic Tank Permit Applications
- Brandon Karst Terrain
- Septage Spreading Area
- Alafia River Watershed
- Primary road with limited access
- Primary road
- Secondary and connecting road
- Main River Channel
- Creek

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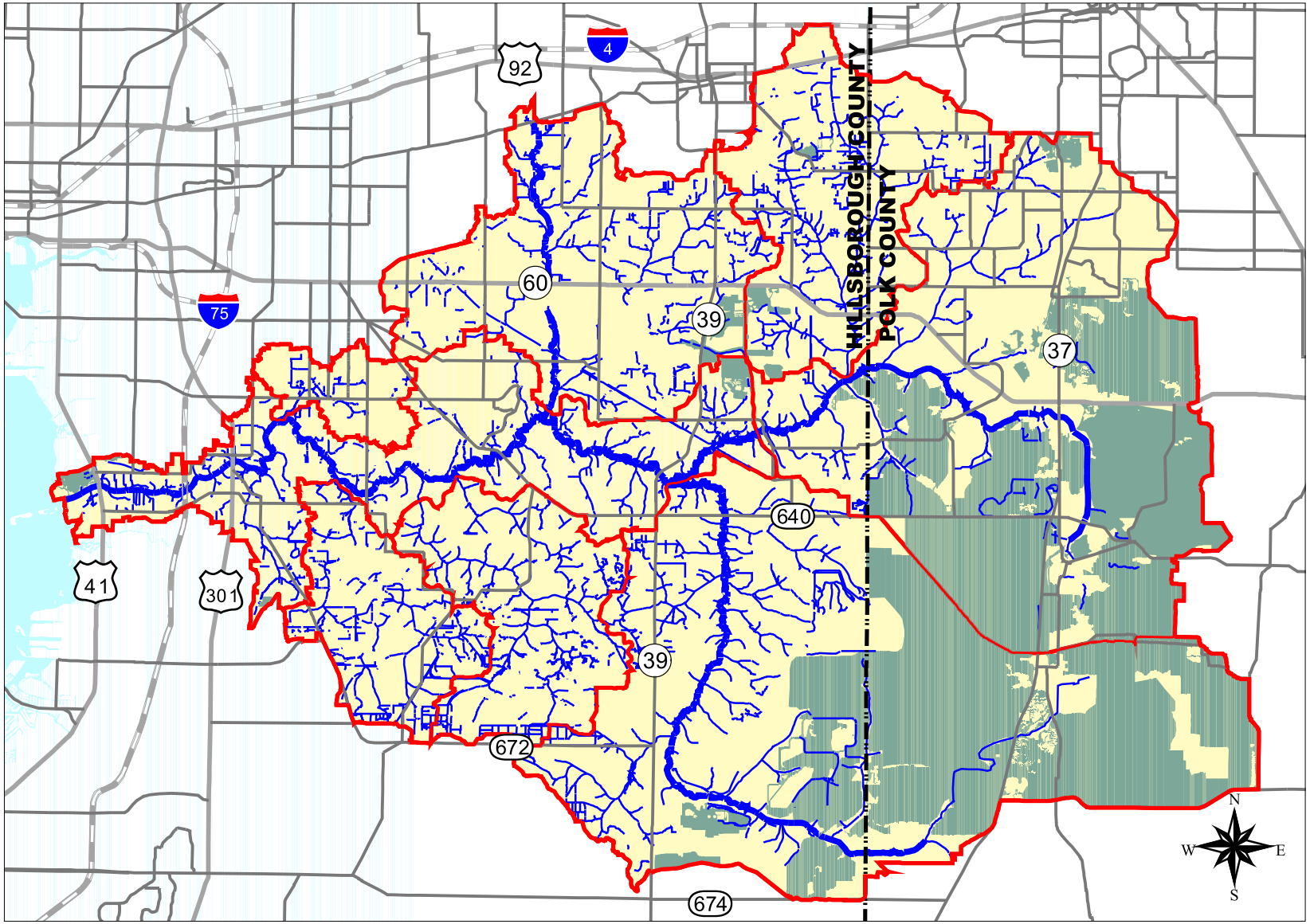

FIGURE 7.1-4
MINING

HILLSBOROUGH COUNTY
FLORIDA

Mining Land Use

Alafia River Watershed

Primary road with limited access

Primary road

Secondary and connecting road

Main River Channel

Creek

0 1 2 3 4 Miles

Scale: 1" = 4 Miles

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The mouth of the Alafia River has been modified extensively by dredge and fill activities, most of which were completed by 1930 (Fehring 1985). A deep-water channel was dredged to the river from the main ship channel in Tampa Bay to provide shipping access to a phosphate processing plant (the Cargill Phosphate plant discussed above) that is located immediately west of U.S. Highway 41. The manmade shipping channel bypassed the river's natural mouth, passing immediately to its north. The former river mouth was then partially filled with the excavated material, effectively changing the location of the mouth. Over the years sediment from a dredge-spoil area has accumulated in the historic river mouth, reducing it to a small tidal creek with little or no connection to the river (Stoker et al. 1996).

7.1.3 Pollutant Identification and Source Overview

Major pollutant sources in the watershed include point source discharges, runoff from mined and barren lands, and discharge from gypsum settling ponds. Phosphate mining has degraded the eastern Alafia River Basin. Most phosphate processors are on the North Prong; while mining occurs in both the North and South Prong, processing appears to cause worse pollution than mining. Pollutants specific to the mining process include strong acids, phosphates, fluorides, sulfates, ammonia, and low levels of radiation. Seepage from gypsum stacks degrades the surficial aquifer, and this water seeps laterally into the riverbed.

The Upper Alafia is particularly degraded; both the North and South prongs of the Alafia have high phosphorus levels. The Lower Alafia has elevated nutrients, low dissolved oxygen levels, and occasional fish kills and algal blooms. Radionuclide concentrations in the Alafia are the highest among Florida's west coast rivers; the source is unknown but likely results from phosphate-mining residues and discharges. Gypsum stack discharges have built up calcium fluoride deposits at the mouth of the Alafia and in Hillsborough Bay. Because these sediments do not support healthy biological communities, they have been partially excavated; new gypsum stacks and on-site stormwater storage treatment ponds have been constructed to decrease future loadings. In addition, water from Buckhorn and Lithia springs is very high in nitrates. Septic tanks, stormwater seepage through sinkholes, and historical citrus farming are all potential sources.

Parameters of concern (POCs) that have been identified during the course of this study are very similar to those parameters that have been identified by the state. Water quality evaluations used to develop these POCs include those reported in the 303(d) and 305(b) reports as well as additional evaluations of water quality indices (WQI), the trophic state index (estuarine station only), and comparisons to water quality criteria. Basins within the watershed have also been assigned a priority level for Total Maximum Daily Load (TMDL) development. TMDL priorities, POCs, and dominant land uses (Hillsborough County only) are summarized by basin in Table 7.1-1 and discussed briefly below.

Table 7.1-1

Summary of Parameters of Concern and Land Use by Basin

Basin	TMDL Priority	Parameters of Concern	Dominant Land Use (In Hills Co)
Lower Alafia	Low	DO, coliforms, nutrients	SFR, industrial
Buckhorn Creek	Low	Nutrients (high NOx & algal blooms)	SFR
Bell Creek	Low	DO, coliforms, nutrients	SFR/mobile, Ag
Fishhawk Creek	-	Coliforms, nutrients	Ag, SFR (N of Alafia)
Turkey Creek	Low	Coliforms, nutrients, turbidity	Ag, SFR
English Creek	Low	Coliforms, nutrients	Ag, SFR
North Prong *	Low	DO, coliforms, nutrients, metals	Ag, SFR (Hills Co)
South Prong	Low	Coliforms, nutrients, metals	Mining, Ag

Notes: SFR – single family residential, Ag – agricultural

Lower Alafia.
Dominant land uses in this basin include single family residential (SFR), mining/processing, and industrial. Water quality data exhibit an improving trend (1990-1998) for most parameters, although TSI scores remain "fair." Average salinities (15-25 ppt) have fluctuated well above the 0 to 10 ppt range identified by the Tampa Bay Estuary Program (TBEP) for maintenance of oligohaline habitats. Dissolved oxygen (DO) concentrations are adversely impacting water quality, with minimum mid-depth concentrations below 2 mg/l. Dissolved oxygen saturation was identified as a degrading condition at this location. Nutrients, particularly nitrogen, are elevated with total phosphorous exceeding screening criteria. Several annual maximums for total and fecal coliforms were substantially above water quality criteria. TMDL development priority was considered low. POCs identified for this basin include DO, nitrogen, and coliforms.

Buckhorn Creek.
Dominant land uses in this basin include SFR and mining. High NO_x levels and frequent algal blooms have been reported. TMDL development priority was considered low. POCs identified for this basin include nutrients.

Bell Creek.
Dominant land uses in this basin include SFR/mobile homes and agriculture. TMDL development priority was considered low. POCs identified for this basin include DO, nutrients, and coliforms.

English Creek.
Dominant land uses in this basin include SFR and agriculture. TMDL development priority was considered low. POCs identified for this basin include nutrients and coliforms.

Fishhawk Creek.
Dominant land uses in this basin include agriculture and SFR north of the river. Water quality data exhibit stable conditions (1990-1998), with WQI scores at the upper end of the "good" range. Nutrients do not appear to have significant adverse impacts in this area, although total phosphorous was present above screening criteria. Total and fecal coliforms were also present at levels above water quality criteria. TMDL development was not recommended for this watershed. POCs identified for this basin include coliforms.

Turkey Creek.
Dominant land uses in this basin include agriculture and SFR. Water quality data exhibit an improving trend (1990-1998), although WQI scores remain "fair." Nutrients, particularly nitrogen, continue to be a problem, and both total nitrogen and phosphorous exceeded screening criteria. Total and fecal coliforms were also present at levels substantially above water quality criteria. TMDL development priority was considered low. POCs identified for this basin include nitrogen, coliforms, and turbidity.

North Prong.
Approximately 80% of this basin is in Polk County. Dominant land uses in the Hillsborough County portion of the basin include agriculture and SFR. Water quality data exhibit stable conditions (1990-1998), with WQI scores at the upper end of the "good" range. Metals including lead, mercury, and zinc are adversely impacting water quality. Nutrient concentrations have decreased, although total phosphorous was present above water quality criteria. TMDL development priority for this basin was considered low, although the Florida Department of Environmental Protection (FDEP) Southwest district has recommended that a monitoring program be implemented for facility BMPs. POCs identified for this basin include DO, phosphorous, coliforms, lead, mercury, and zinc.

South Prong.
Approximately 30% of this basin is in Polk County. Dominant land uses in the Hillsborough County portion of the basin include mining and agriculture. Water quality data exhibit an improving trend (1990-1998), with WQI scores in the "good" range. Nutrients, particularly nitrogen, continued to be a problem, and both total nitrogen and phosphorous exceeded screening criteria. Metals including lead, mercury, and zinc appeared to be adversely impacting water quality. Total and fecal coliforms were also present at levels above water quality criteria. TMDL

development priority was considered low. POCs identified for this basin included nitrogen, lead, mercury, zinc, and coliforms.

7.1.4 Previous and Current Studies

The SWFWMD has prepared the Alafia River Comprehensive Watershed Management Plan (Alafia River CWM; SWFWMD, 2001) as part of the District's CWM initiative. The purpose of this plan is to improve the management of water and related natural resources within the watershed. A great depth and range of water resource related activities are occurring within the basin, and the CWM plan is aimed at coordinating these activities as well as identifying, quantifying, and suggesting remedial and preventative measures to improve the watershed's resources.

Wolf and Drew (1990) summarize the water quality and biological resources of the Tampa Bay watershed, which includes the Alafia River as a tributary. SWFWMD has published a report examining the potential sources of elevated and increasing nitrogen concentrations observed in Lithia and Buckhorn Springs (Jones and Upchurch 1993).

The Alafia Watershed Land and Water Linkage Committee, a facilitated work group made up of citizen volunteers and agency staff, has assessed ways and means of linking land and water management in the watershed. This committee, jointly sponsored by the Southwest Florida Water Management District and the Hillsborough County Planning and Growth Management Department, published a report (April 5, 2000) presenting "community action ideas" related to water supply, water quality, flood protection, natural systems, and growth management. The water quality "action ideas" called for increased preservation, more restrictive development, stricter water quality standards and enforcement, and a moratorium on septic tanks for new developments.

The Tampa Bay Estuary Program (TBEP), a partnership of federal, state, and local government agencies in which Hillsborough County is an active member, has developed a Comprehensive Conservation and Management Plan (CCMP) for Tampa Bay and its watershed, including long-term goals and strategies for the management of water quality and natural systems (TBEP 1996). Stormwater management goals for the Tampa Bay watershed have also been developed by the TBEP. Stormwater-related goals adopted by the TBEP participants (TBEP 1996) include:

- Cap nitrogen loadings to Tampa Bay at existing levels (1992-1994 average) to encourage the regrowth of an additional 12,350 acres of seagrass.

- Protect relatively clean areas of the bay from increases in toxic contamination, and minimize risks to marine life and humans associated with toxic contaminants in impacted areas.

- Reduce bacterial contamination in impacted areas of the bay to levels safe for swimming and shellfish harvesting.

7.1.5 TBEP Load Estimates

During the development of its Comprehensive Conservation and Management Plan (CCMP) for Tampa Bay, which was completed in 1996, the Tampa Bay Estuary Program (TBEP) computed estimates of the average annual loadings of total nitrogen (TN), total phosphorous (TP) and total suspended solids (TSS) discharged to Tampa Bay during the years 1985-1991 (TBEP 1994). The following material is an abbreviated summary of the information developed by the TBEP for the Alafia River portion of the Tampa Bay watershed. Readers interested in a more detailed summary are encouraged to consult the original technical report (TBEP 1994) from which this information was abstracted.

The TBEP (1994) loading estimates for the Alafia River watershed included three broad source categories:

1. Nonpoint sources (stormwater runoff and base flow),
2. Point source discharges (domestic and industrial), and
3. Groundwater and springs.

For nonpoint source loads from gauged portions of the watershed, measured streamflow and water quality data were used to develop monthly and annual estimates of TN, TP, and TSS loads (TBEP 1994). An empirical hydrologic model, developed using measured rainfall and streamflow data from gauged sub-basins, was employed to estimate monthly and annual streamflows in ungauged portions of the watershed. Loading estimates for the ungauged sub-basins were calculated using the modeled streamflows and land use-based concentrations of TN, TP, and TSS obtained from published studies carried out in the central and west-central regions of Florida.

Point source loads were estimated using monthly operating reports and other permit-based information obtained from the U.S. EPA and the Florida DEP. Monthly flow and pollutant concentration records were used to estimate loads discharged directly to surface waters. Loads resulting from indirect discharges (e.g., land application of effluent from domestic or industrial facilities) were estimated using information on the volume and quality of discharged effluent contained in the permitting agencies' files and on analyses of local groundwater monitoring data (TBEP 1994).

Groundwater loads discharged via named springs — such as Lithia Springs and Buckhorn Springs in the Alafia River watershed — were estimated using measured spring discharge and water quality records obtained from the U.S. Geological Survey and the Southwest Florida Water Management District. Diffuse groundwater loads occurring in gauged portions of the watershed were assumed accounted for in the stream discharge and water quality data recorded at the gauging stations. Diffuse groundwater loads occurring in ungauged portions of the watershed were not estimated (TBEP 1994).

Average annual mass loads of TN, TP, and TSS delivered to the Alafia River from its watershed during the years 1985 through 1991, estimated using the methods described above, are summarized in Table 7.1-2. Because a substantial portion (approximately one third) of the watershed falls within the jurisdiction of Polk County, the estimated loadings shown in the table are summarized by County as well as by source category.

Table 7.1-2

Estimated Annual Loads, By Category And County (Source: TBEP 1994).

Source	Constituent	Hillsborough County		Polk County		Totals	
		Estimated Load (tons/yr)	%	Estimated Load (tons/yr)	%	Estimated Load (tons/yr)	%
Non-Point Sources	TN TP TSS	245.3 232.1 3,659.6	49% 43% 64%	133.7 115.9 1,803.4	27% 21% 31%	380.0 348.0 5,463.0	76% 64% 95%
Domestic Point Sources	TN TP TSS	3.2 0.4 0.6	1% <1% <1%	18.4 43.2 69.1	4% 8% 1%	21.6 43.6 69.7	4% 8% 1%
Industrial Point Sources	TN TP TSS	1.8 9.4 18	<1% 2% <1%	24.3 136.1 196.7	5% 25% 3%	26.1 145.5 214.7	5% 27% 4%
Springs	TN TP TSS	73.0 3.0 1.0	15% 1% <1%	-- -- --	-- -- --	73.0 3.0 1.0	15% 1% <1%
Totals	TN TP TSS	323.3 244.9 6,679.2	65% 45% 64%	176.4 295.2 2,069.2	35% 55% 36%	500.7 540.1 5,748.4	

7.2 Ambient Conditions

A great deal of water quality has been collected in the watershed's streams and in the river. Data collection in the watershed's lakes has been conducted on a very limited basis. The following subsections describe these data and explain how these data were used to assess water quality in the Alafia River Watershed.

7.2.1 Existing Data

Based on a STORET retrieval (2001) for all stations and parameters for the period of record, current and historical water quality data for one-time sampling and monthly monitoring are available for numerous (182) sampling locations within the watershed. The approximate locations of these stations are provided on Figure 7.2-1 (located in sleeve at the end of this section). Appendix D provides data summaries of many of these stations.

Routine water quality monitoring is performed by the Environmental Protection Commission (EPC) of Hillsborough County at seven stations and by USGS at least at three stations in the watershed. Data collected by FDEP at numerous additional stations include short-term or one-time sampling events associated with bioassessments and compliance/enforcement activities. Current EPC and USGS routine monitoring stations are summarized in Table 7.2-1.

Table 7.2-1
Key Alafia River Watershed Water Quality Monitoring Stations

Agency	Station	Type	Location	Basin	Period	Freq.	Para.
EPC	74	Estuarine	Alafia River at U.S. 41	Lower Alafia	> 10 years	monthly	WQ1
EPC	114	Freshwater	Alafia River at Bell Shoals Road	Bell Creek	> 10 years	monthly	WQ1
EPC	111	Freshwater	Turkey Cr Br Fla Hwy No 60	Turkey Creek	> 10 years	monthly	WQ1
EPC	151	Freshwater	Turkey Creek At Durant Road	Turkey Creek	> 10 years	monthly	WQ1
EPC	115	Freshwater	N Prong Alafia R Upstrm Cnfl S P	Turkey Creek	> 10 years	monthly	WQ1 +metals
EPC	116	Freshwater	S Prng Alafia R Upstr Cnfl N Prn	S. Prong	> 10 years	monthly	WQ1
EPC	139	Freshwater	Alafia River At Bethlehem Rd.	S. Prong	> 10 years	monthly	WQ1
USGS	02301300	Freshwater	South Prong Alafia River Nr Lithia Fla	S. Prong	> 10 years	monthly	WQ2
USGS	02301500	Freshwater	Alafia River At Lithia Fla	S. Prong	> 10 years	monthly	WQ2

Note: WQ1 – Color, turb, secchi, temp., cond, pH, DO, BOD5, sal, TKN, NH3, NO3/NO2, org-N, total-N, ortho-P, total-P, Ca, Mg, K, ChlA, ChlB, ChlC, ChlT, coliforms; no organic chemicals.
WQ2 – Color, turb, secchi, temp., cond, pH, DO, NH3, NO3/NO2, org-N, total-N, ortho-P, total-P, Ca, Mg, K; trace metals, no organic chemicals.

STORET data were available for conventional parameters at all these stations. Trace metals data are available for three of the stations. Data for organic chemicals are extremely limited for this watershed.

Over the past decade the EPC has conducted monthly monitoring at one estuarine and six freshwater river or stream stations in the Alafia River Watershed (locations shown in Fig. 7.1-2). The EPC monitoring program provides measurements of standard hydrographic variables (temperature, pH, dissolved oxygen, specific conductance, salinity), major nutrient (nitrogen and phosphorus) forms, chlorophyll a, b, and c, biochemical oxygen demand (BOD_5), bacteriological indicators (total coliform, fecal coliform, fecal streptococci), and several ions and metals (e.g., Boler 1998).

Continuous stream discharge records, which are helpful in interpreting water quality observations and essential in the calculation of pollutant loading estimates, are available from three USGS stream gauging stations in the watershed (locations shown in Fig. 7.1-2).

7.2.2 Available Lake Quality Data

Searches of several commonly used databases (e.g., STORET, Florida LAKEWATCH, Hillsborough County Lake Atlas) suggest that very little information may be available at present to characterize lake water quality in the Alafia River Watershed. The Hillsborough County Lake Atlas (accessed at URL http://www.lakeatlas.usf.edu) notes that two named lakes—the Medard Reservoir and Grady Lake— occur in the watershed, but contains water quality information on neither. A STORET retrieval produced only one lake water quality data set from the watershed, which was generated by a short-term monitoring effort conducted in the Medard Reservoir by the U.S. Geological Survey between February 1985, and May 1987. It appears possible that no federal, state, or local government agencies have carried out long-term lake monitoring efforts in the watershed in the past, or have lake-monitoring efforts underway at present.

7.2.3 Available Sediment Quality Data

Limited sediment chemistry and benthos data are available for the Alafia River Watershed. Samples were collected from 1995-1998 by EPC in the lower portion of the river (Grabe and Karlen, 1999). Most of these samples were collected between US41 and I-75 with two stations each in portions between I-75 and US301 and above US301 below Kings Ave.

Based on the analyses by Grabe and Karlen (1999), sediments were classified as “healthy”, “marginal”, or “degraded.” For trace metals, portions below US41 were considered healthy, between US41 and US301, marginal, and above US301,

healthy. For pesticides (chlordane), sediments in most areas were classified as marginal, with areas below I-75 classified as degraded. For PAHs, all sediments were classified as healthy. Based on the analyses of benthic invertebrate populations, most sediments were classified as degraded, with areas above and below US41 classified as marginal. No sediment data were reported for the upper portions of the watershed.

7.2.4 Lakes and Estuary Assessment Methods

The FDEP Florida Trophic State Index (TSI) classifies lakes and estuaries based on nutrient and chlorophyll concentrations and water clarity (Hand et al. 1990). The index approach was initially developed by Carlson (1977), who used three water quality indicators (chlorophyll concentration, total phosphorus concentration, and Secchi disk depth) to summarize trophic state conditions. Carlson's index was constructed so that a ten-unit change in index value represents a doubling or halving of chlorophyll concentration (an indicator of algal biomass). The Florida TSI developed by FDEP is based on the same rationale, but also includes total nitrogen (TN) concentration as an additional trophic state indicator.

The components of the Florida Trophic State Index are calculated as follows (Hand et al. 1990):

$TSI_{CHLa} = 16.8 + (14.4 * \ln[Chl\ a])$
$TSI_{TP} = -18.4 + \ln([TP] * 1000)$
$TSI_{TN} = 56 + (19.8 * \ln[TN])$
$TSI_{SECCHI} = 60 - (30 * \ln(SD))$

where:

[Chl a] = annual average chlorophyll a concentration (ug/l);
[TP] = annual average total phosphorus concentration (mg/l);
[TN] = annual average total nitrogen concentration (mg/l).
SD = annual average Secchi disk depth (m)
ln = $\log_e$

An overall index value (TSI_{AVG}) is obtained by averaging the component values. FDEP recommends the following interpretation of calculated TSI_{AVG} values (Hand et al. 1990, 1996):

For lakes:

$0 < TSI_{AVG} < 59$ = "good" water quality
$59 < TSI_{AVG} < 69$ = "fair" water quality
$TSI_{AVG} > 69$ = "poor" water quality

For estuaries:

$0 < TSI_{AVG} > 49$	=	"good" water quality
$49 < TSI_{AVG} < 59$	=	"fair" water quality
$TSI_{AVG} > 59$	=	"poor" water quality

In recent years FDEP staff have encountered difficulties in interpreting Secchi depth data in many blackwater (tannic) Florida waterbodies, where water column transparency can be reduced by the water's natural color. As a result, Secchi depth has been dropped as an indicator in FDEP's recent TSI_{AVG} calculations (Hand et al. 1996).

Stream Assessment Methods

The Florida Department of Environmental Protection (FDEP) recommends the use of a Water Quality Index (WQI) to summarize water quality conditions in rivers and streams (Hand et al. 1996). The WQI is based on six categories of water quality indicators (water clarity, dissolved oxygen, oxygen-demanding substances, bacteria, nutrients, and biological diversity). Several categories contain multiple constituents (e.g., total organic carbon and BOD_5, within the category of oxygen-demanding substances). In such cases, data availability determines constituent(s) used in calculating the WQI. For each measured constituent, the raw data (e.g., monthly or quarterly observations) are converted to annual averages. The annual averages are then converted to percentiles, using a database constructed by FDEP staff (Hand et al. 1990, 1996) using data from 2,000 Florida stream monitoring locations. These percentile values, which range from 0 (best quality) to 100 (poorest quality), are then averaged to generate the WQI. The final averaging process ignores water quality categories for which no data are available. The WQI calculated for a given stream-monitoring site can therefore represent the average of from 1 to 6 categories. Although the index can be calculated based on a single category, the use of additional categories appears to provide greater reliability (Hand et al. 1990, 1996).

FDEP recommends the following interpretation of WQI values, based on an analysis of Florida stream data and the EPA National Profiles Water-Quality Index (Hand et al. 1996):

$0 < WQI < 45$	=	"good" water quality
$45 < WQI < 60$	=	"fair" water quality
$WQI > 60$	=	"poor" water quality.

Hand et al. (1996) provide the following summary of the WQI:

> *"The Florida Water-Quality Index has several advantages over previous measures. First, since it is based on the percentile distribution of Florida stream data, it is*

tailored to Florida. Second, the index uses the most important measures of water quality in Florida: clarity, dissolved oxygen, oxygen-demanding substances, nutrients, bacteria, and biological diversity. Third, it is simple to understand and calculate and does not require a mainframe computer or any complex data transformations or averaging schemes. Finally, the index nicely identifies areas of good, fair, and poor water quality that correspond to professional and public opinion."

Existing Water Quality

The following subsections provide descriptions of water quality in the Alafia River Watershed. These descriptions are very general for lakes since little data is available; conversely, these descriptions are very specific for the streams since a wealth of data exists.

Lakes

The watershed is thought to contain few natural lakes (Wolfe and Drew 1990, SWFWMD 1997), but numerous manmade water bodies have been created as a result of phosphate mining and other anthropogenic activities. Wolfe and Drew (1990) note, "the Edward Medard Reservoir at Pleasant Grove is one such lake, formed by a concrete dam with earthen embankments that cut across the Little Alafia River and encompass strip mine pits and tailing ponds." The EPA (see URL http://cfpub.epa.gov/surf/huc.cfm?huc_code=03100204 estimates that the Alafia River watershed currently contains more than 350 lakes and impoundments, which have a cumulative surface area of approximately 11,650 acres.

Table 7.2-2
Selected Lakes in the Hillsborough County Portion of the Alafia River Watershed

Lake	Basin	Lake Surface Area (acres)
Medard Reservoir	Turkey	616
Lake Grady	Bell	184
Unnamed (South of Coronet Pit)	English	105
Thomas Pit	Turkey	58
North William Owen	Turkey	42
Clark Lake	North Prong	41
Unnamed (West of Medard Reservoir)	Turkey	35
Coronet Pit	English	26
Christina Lake	North Prong	25
Crescent Lake	North Prong	22
Crums Pit 1	Turkey	21
Hurrah Lake	South Prong	17
Lake Hutto	Fishhawk	12
Crums Pit 2	Turkey	12
Six Pound Pond	North Prong	8
Highland Lake	North Prong	6
Total lake acreage		1230

A listing of selected lakes within the Hillsborough County portion of the watershed is shown in Table 7.2-2 above.

In addition to these existing water bodies, construction of a 900 to 1,800 acre water supply reservoir has recently been proposed on the site of a former phosphate mine located in the South Prong basin (WCRWSA 1998). If constructed as planned, this reservoir, which would be filled with surface runoff and water diverted from the Alafia River, Hillsborough River, and Tampa Bypass Canal during periods of high flow, would represent the largest lake in the watershed.

The water quality and other environmental characteristics of lakes and impoundments usually reflect the soils, physiography, geology, vegetation, climate, and land use/land cover conditions that occur in their drainage basins. Griffith et al. (1997) have divided Florida into 47 relatively homogeneous "lake regions," based on an evaluation of these factors. The Alafia River falls within two of these regions, the Lakeland/Bone Valley Upland and the Southwestern Flatwoods. Griffith et al. (1997) provide the following overview of the two regions:

Lakeland/Bone Valley Upland – includes the Lakeland Ridge, Bone Valley Uplands, and part of the Bartow Embayment physiographic sub-districts of Brooks (1981a,b, 1982). The Lakeland Ridge consists of sand hills near 200 feet in elevation with many solution depression lakes; the Bone Valley Uplands and the Bartow Embayment tend to be more poorly drained flatwood areas. All of these areas are covered by phosphatic sand or clayey sand from the Miocene-Pliocene Bone Valley Member of the Peace River Formation in the Hawthorn Group. The region generally encompasses the area of most intensive phosphate mining. As one might expect, the dominant characteristic of all lakes in this region is high phosphorus, along with high nitrogen and chlorophyll-a values. The lakes are alkaline, with some receiving limestone-influenced groundwater.

Southwestern Flatwoods – This lowland region includes barrier islands, Gulf coastal flatwoods and valleys, and gently sloping coastal plain terraces at higher elevations. The elevations range from sea level to 150 feet. Much of the pine flatwoods and wet and dry grassland prairies have been converted to extensive areas of pasture, rangeland, and young citrus groves. Urban areas are growing rapidly near the coast. Lakes in this region range from slightly acidic to alkaline, but almost all are eutrophic and have dark colored water.

Although manmade impoundments will obviously differ from natural lakes in many important respects, an understanding of the characteristics of the regions' natural lakes should prove helpful to resource managers as they work to develop management goals and strategies for the watershed's surface water bodies.

Streams and Estuary

Descriptions of water quality in the Alafia River quality standards for conventional pollutants. Data for metals is not available. Data sufficient for a confidence level of "medium" was available. Watershed are provided in the following subsections. These descriptions are presented by major subwatershed and include descriptions of the state assessment as well as additional assessments based on available water quality data.

Many of the Alafia's tributaries and the river itself have been assessed as part of the state's 305(b) {State water quality assessment} and 303(d) {Impaired waters list} compliance activities. Various attributes concerning the state's assessment are provided on the following figures (Figures 7.2-2 through 7.2-5) and described individually by subwatershed in the subsections that follow. A key, presented at right, is provided for use with the water quality index tables that follow in the watershed subsections.

Water Quality Index Table Key

DO	=	Dissolved Oxygen
BOD	=	Biochemical Oxygen Demand (5 Day)
TN	=	Total Nitrogen
NO_2+ NO_3		Nitrate + Nitrite
TP	=	Total Phosphorus
TURB		Turbidity
TSS	=	Total Suspended Solids
COD	=	Chemical Oxygen Demand
TOC	=	Total Organic Carbon
TCOLI	=	Total Coliform
FCOLI	=	Fecal Coliform
WQI	=	Composite Water Quality Index

7.2.4.1 Bell Creek

The Bell Creek Watershed, located in the southwest portion of the Alafia River Watershed, drains 19.74-square miles in south-central Hillsborough County. Major tributaries include Boggy Branch and Pellehem Creek, and Lake Grady is the only significantly sized lake (Refer to Section 5.2). Dissolved oxygen, coliform contamination, phosphorous, and NO_x are the major water quality issues associated with Bell Creek.

There have been numerous changes and impacts to this drainage system due to the significant increase of residential development over the last 20 years, and the effects of increased agricultural "improvements". One example is Lake Grady, which was created by impounding Pelleham Creek for recreational purposes. Other portions of the drainage system are in a relatively natural condition, like the channel between Lake Grady and the main channel of Bell Creek. A detailed description and detailed figures of the Bell Creek Subwatershed are provided in Chapter 5.

FIGURE 7.2-2
ALAFIA RIVER WATERSHED
305B STATE WATER QUALITY ASSESSMENT

Legend

305B Status

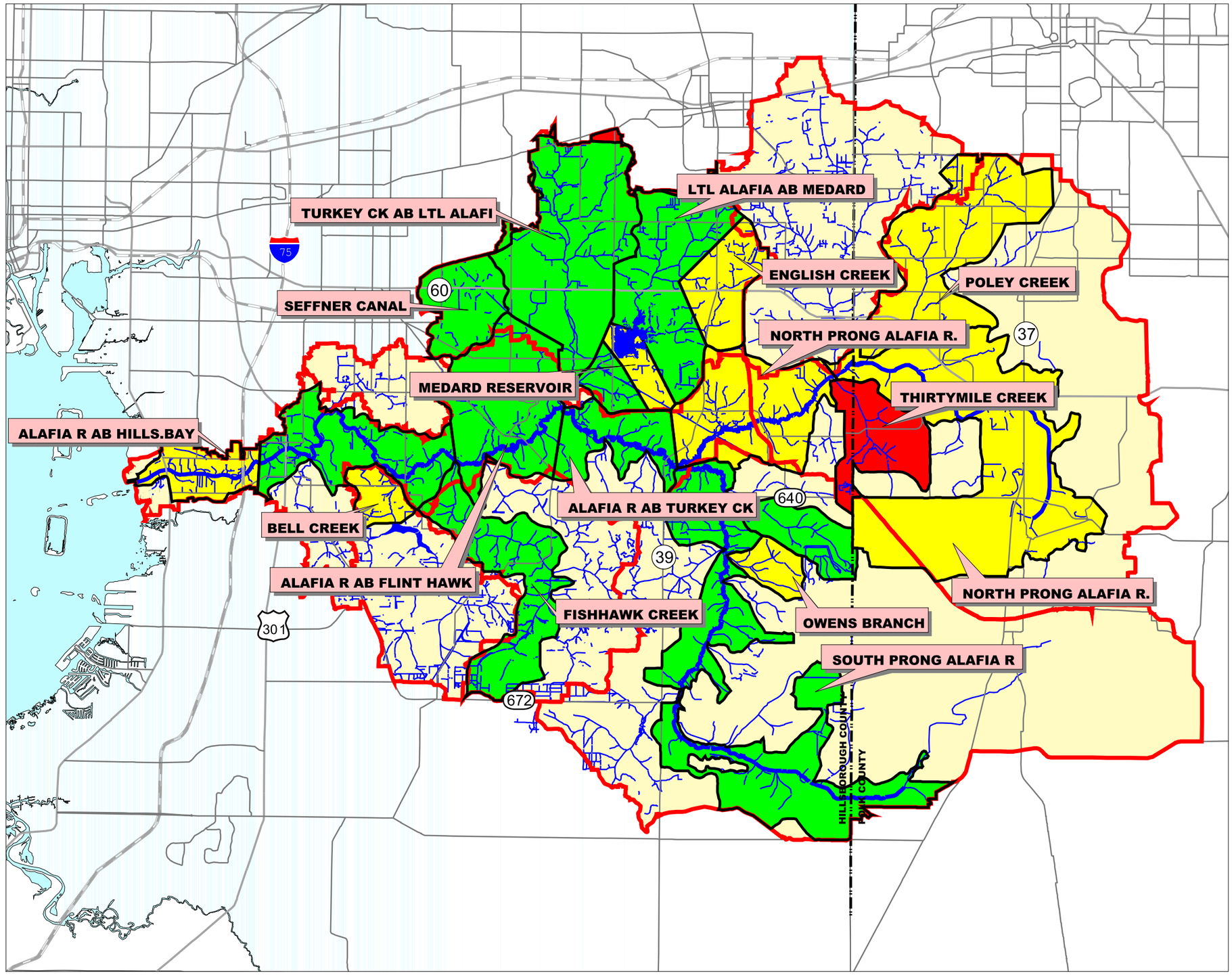
- Good
- Fair
- Poor
- No Data

Conveyance Network

- Creek
- Main River Channel

Major Roads

- Primary road with limited access
- Primary road
- Secondary and connecting road
- Subwatershed Boundary
- County Boundary



3 0 3 Miles

Scale: 1" = 3 Miles

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W E
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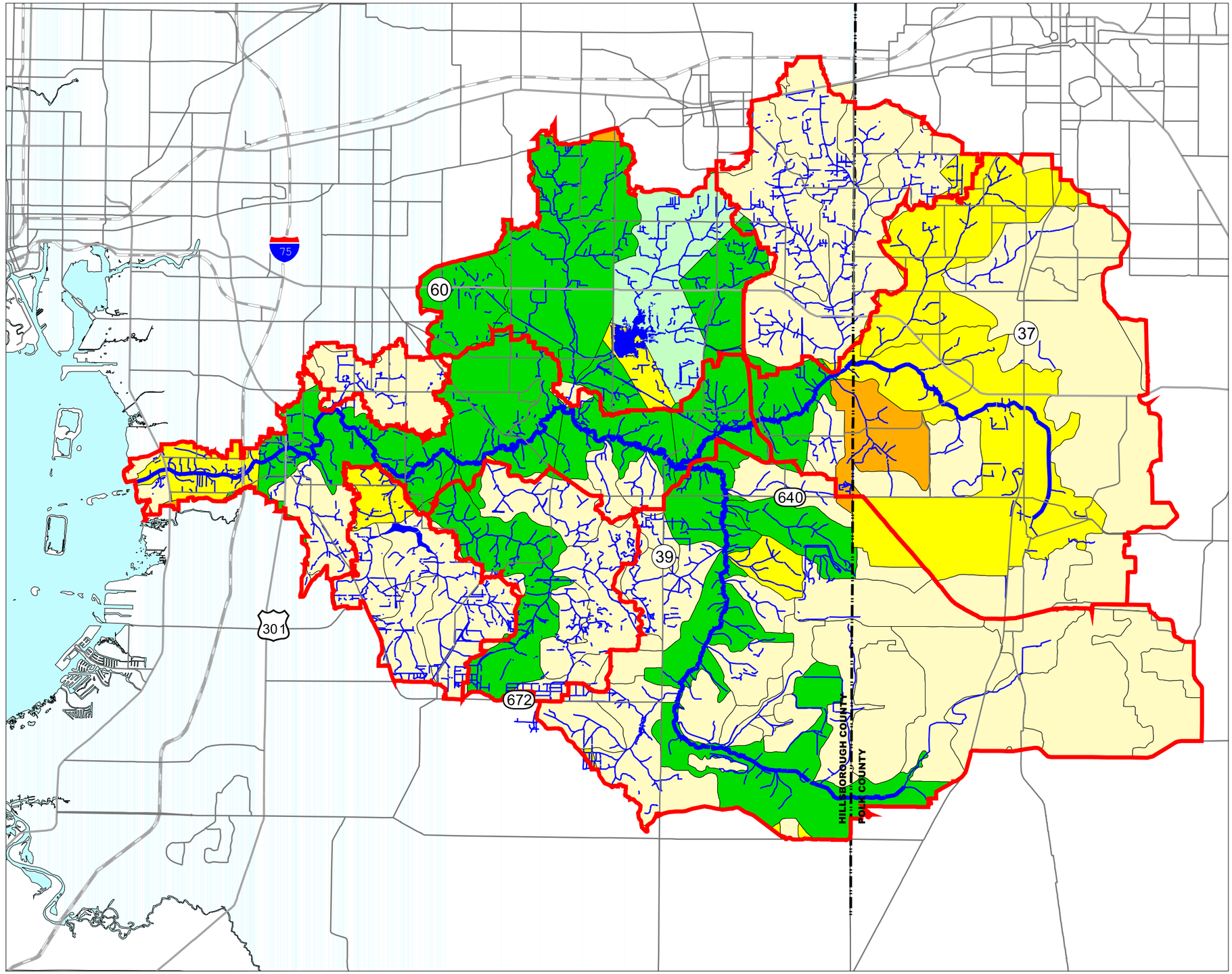
HILLSBOROUGH COUNTY
FLORIDA

PARSONS ENGINEERING SCIENCE

Fig 7.2-2 (11 X 17 back)

FIGURE 7.2-3
ALAFIA RIVER WATERSHED
305B STATE WATER QUALITY ASSESSMENT - WATER QUALITY INDEX (WQI)



PARSONS ENGINEERING SCIENCE

Fig 7.2-3 (11 X 17 back)

FIGURE 7.2-4
ALAFIA RIVER WATERSHED
305B STATE WATER QUALITY ASSESSMENT - TRENDS

Legend

305B Trend

- Much Better
- Better
- Stable

Conveyance Network

- Creek
- Main River Channel

Major Roads

- Primary road with limited access
- Primary road
- Secondary and connecting road
- Subject Subwatershed
- County Boundary

3 0 3 Miles

Scale: 1" = 3 Miles

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HILLSBOROUGH COUNTY
FLORIDA

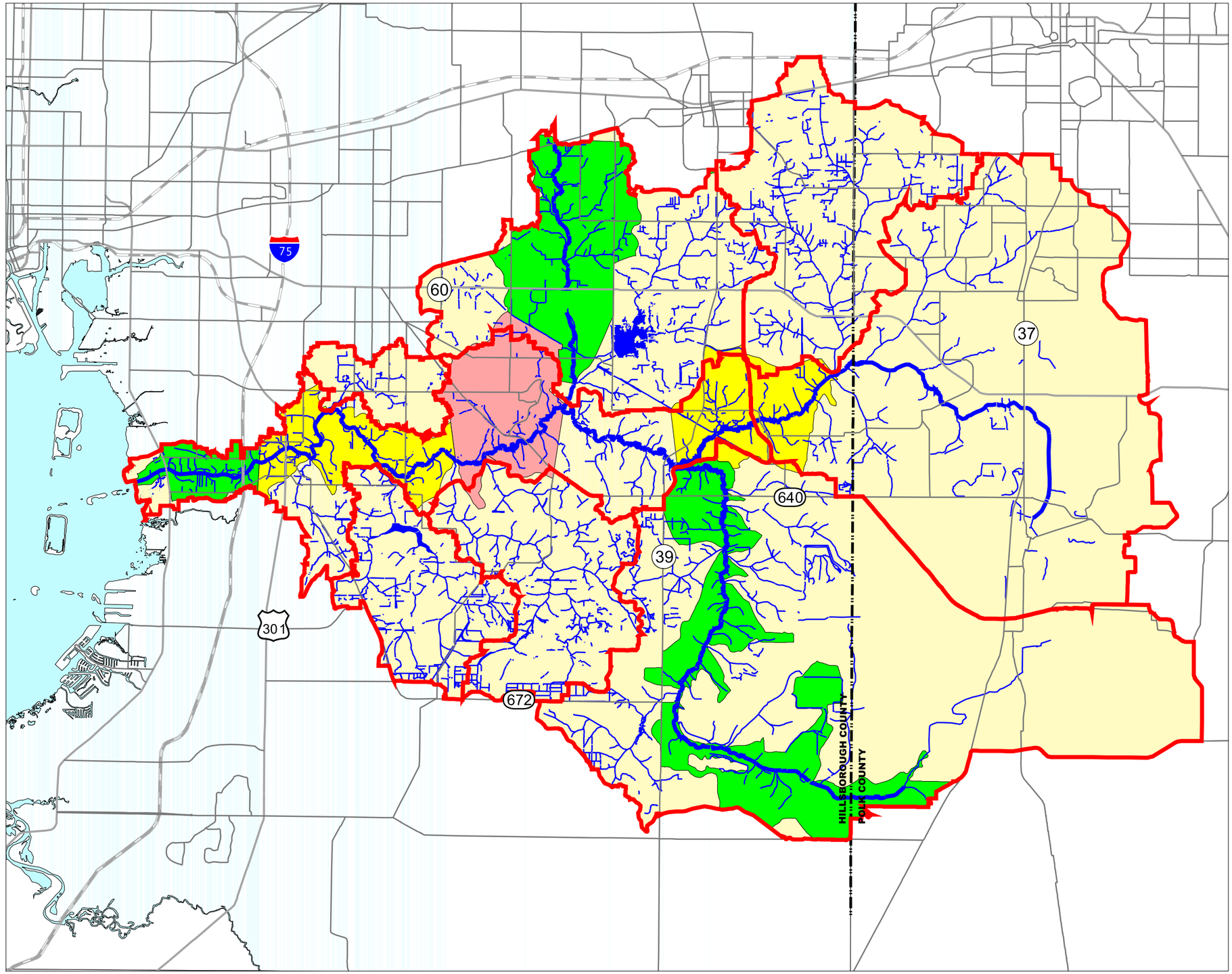

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Fig 7.2-4 (11x17back)

FIGURE 7.2-5
ALAFIA RIVER WATERSHED
303D WATER QUALITY

Legend

303D Priority

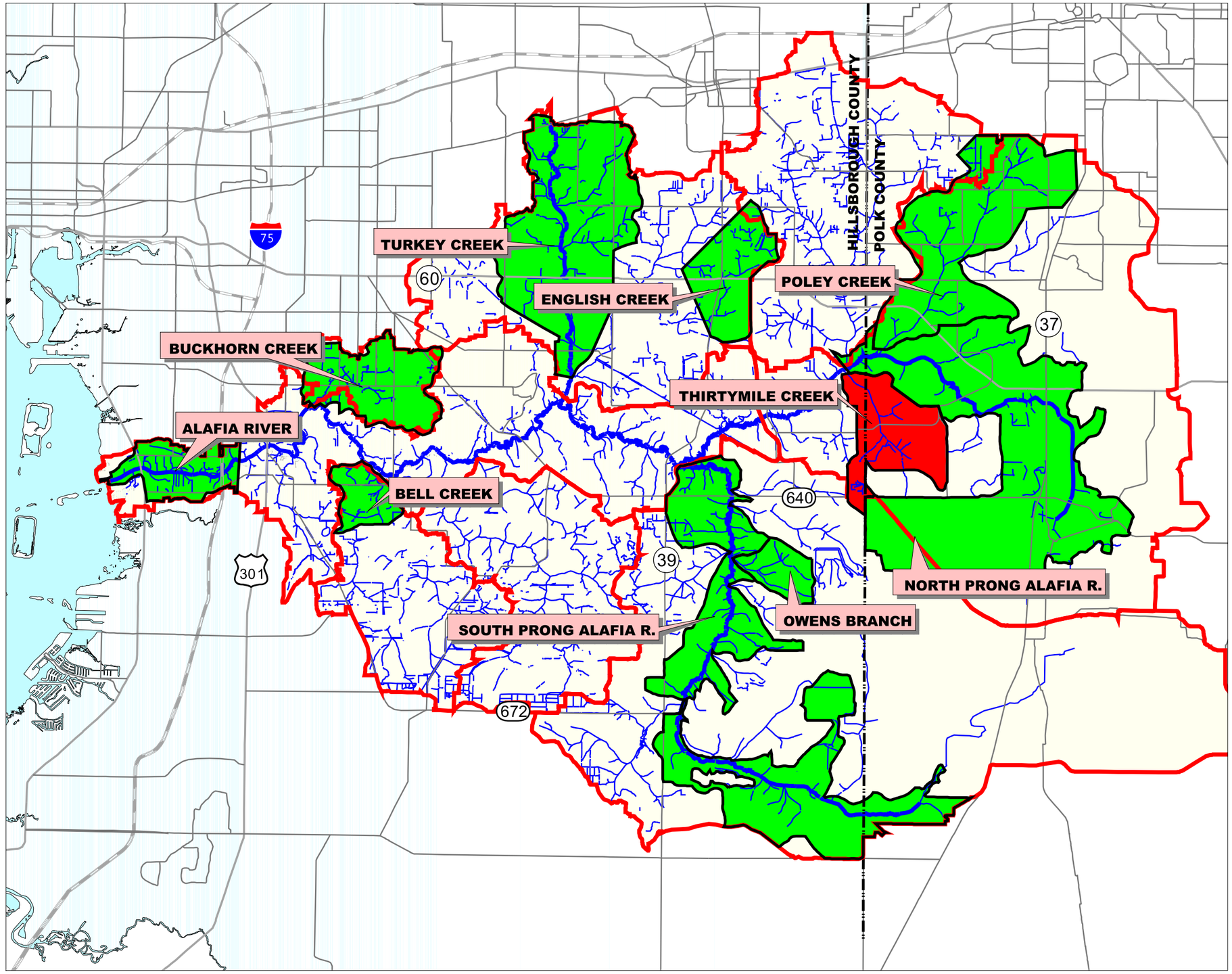
- High Priority
- Low Priority

Conveyance Network

- Creek
- Main River Channel

Major Roads

- Primary road with limited access
- Primary road
- Secondary and connecting road
- Subject Subwatershed
- County Boundary



3 0 3 Miles

Scale: 1" = 3 Miles

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HILLSBOROUGH COUNTY
FLORIDA

PARSONS ENGINEERING SCIENCE

Fig 7.2-5 (11 x 17back)

State 305(b) Assessment

Low dissolved oxygen levels, excessive coliforms, and nutrient concentrations are the primary water quality issues that have been identified by the FDEP in the watershed, and as such, water quality in Bell Creek is rated as "fair" by the state. Bell Creek partially supports its designated use with respect to the WQI, rated at 56, and water quality standards for conventional pollutants. Data for metals is not available. Data sufficient for a confidence level of "medium" was available. The nutrients of concern are phosphorous as well as nitrate and/or nitrite. Water quality with respect to total nitrogen is good suggesting that organic nitrogen levels are low. Dissolved oxygen levels are low and fecal coliforms levels are high; however, water clarity is very good with TSS and turbidity levels among the best in the state.

BELL CREEK WQI	
DO	81
BOD	61
TN	38
NO_2+NO_3	60
TP	78
TURB	13
TSS	10
COD	-
TOC	61
TCOLI	-
FCOLI	70
WQI	56

Other Data

Historic monitoring programs in the Bell Creek Basin have been few. The FDEP has conducted at least two short-term programs in the creek and several short-term and one-time sampling programs have been conducted by USGS in the creek and watershed lakes (Figure 7.2-6). These programs are very limited with respect to sample size.

The FDEP sampled in the creek at Boyette Road from 1976 through 1977 (Figure 7.2-7). This program consisted of monthly samples (Station 24020040) for one year. In regards to nutrients, there appears to be little difference between the results of this 1970's-era sampling program and the current state assessment. Both programs found high levels of phosphorous and inorganic nitrogen while total nitrogen levels are indicative of good water quality. Water clarity is much better in the more recent sampling (1992-1994 on which 305(b) assessment is based) and fecal contamination appears to be moderately improved. Dissolved oxygen levels were much higher during the older sampling program. Again, the sample size for this program was small (12-samples) and the duration was short (one year). The FDEP conducted macroinvertebrate sampling at this same location twice- once in 1953 and again in 1955. At that time, water quality was observed to be good with respect to biological diversity.

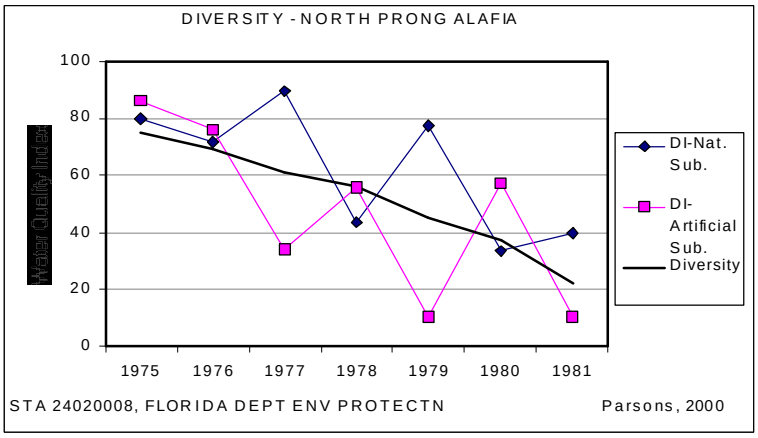

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FIGURE 7.2-6
BELL CREEK
SUBWATERSHED
KEY SAMPLING STATIONS

Legend

Water Quality Stations

- EPA/ODW
- FL FISH & WILDLIFE CONS COMM.
- FLORIDA DEPT ENV PROTECTION
- HILLSBOROUGH COUNTY EPC
- POLK COUNTY WATER RESOURCE
- SWFWMD
- USEPA REGION 4
- USGS

Watershed Boundary

- Watershed
- Subwatershed

Conveyance Network

- Creek
- Main River Channel
- Storage

Major Roads

- Primary road with limited access
- Primary road
- Secondary and connecting road
- Subject Subwatershed
- County Boundary

Station Descriptions

Station number, sample count
Start Date
End Date

4000 0 4000 Feet

Scale: 1" = 4,000'

HILLSBOROUGH COUNTY
FLORIDA

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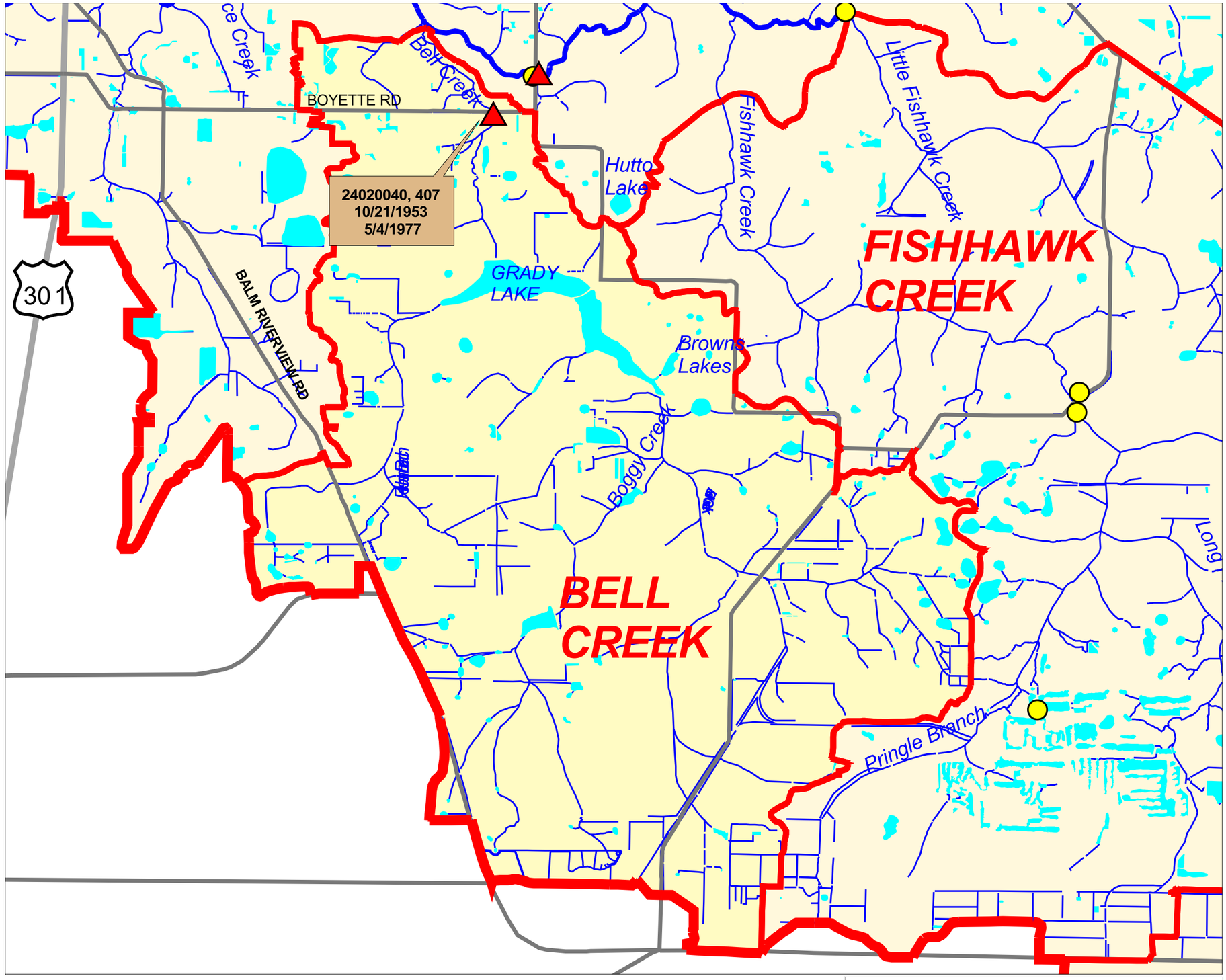
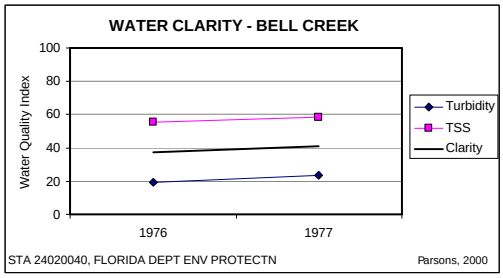
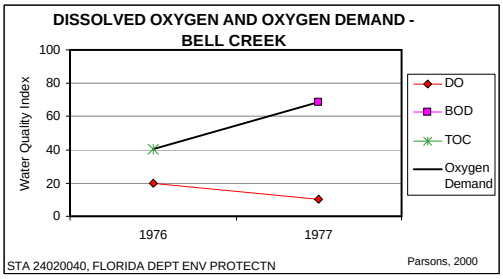
S

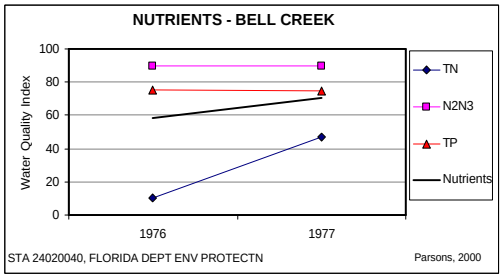


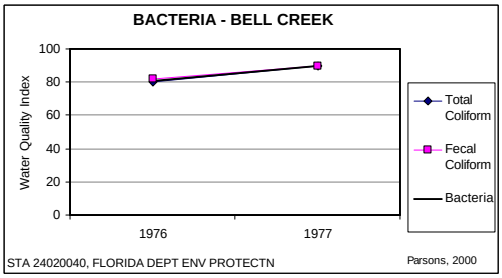
PARSONS ENGINEERING SCIENCE

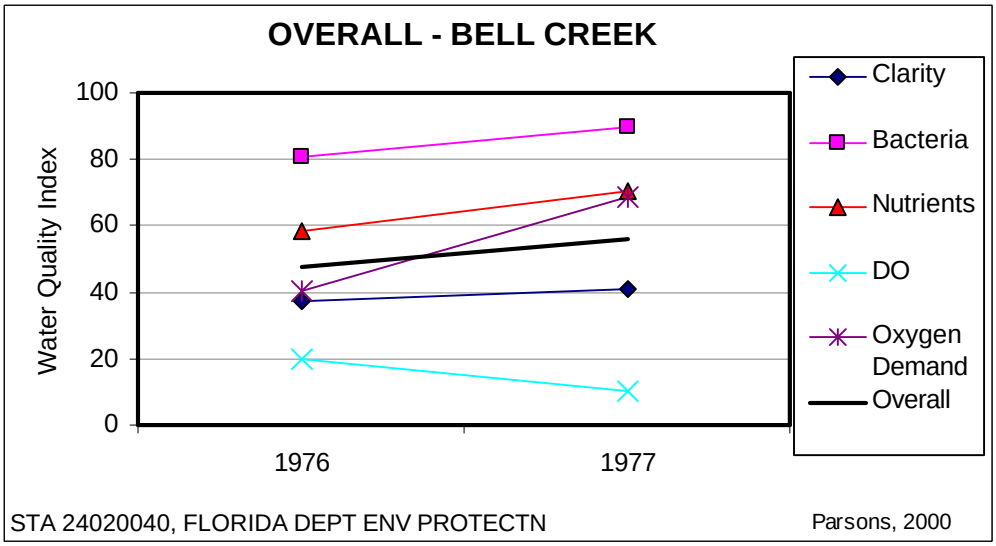
Fig 7.2-6 (11 x 17 back)











Overall						
	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1976	37	81	58	20	41	47
1977	41	90	71	10	69	56

FIGURE 7.2-7: BELL CREEK SUBWATERSHED, STATION 24020040

7.2.4.2 Buckhorn Creek

Buckhorn Creek originates in the eastern and western headwaters of the subwatershed and flows in a generally southwestern direction to its confluence with the Alafia River. The subwatershed is approximately 7.5 square miles and is located in the southern portion of the community of Brandon, Florida. The subwatershed historically was comprised of a system of lakes and wetlands draining through natural sloughs and natural channels to the main creek channel. The extensive residential and commercial development in the area has significantly altered the subwatershed so that the current primary tributaries to the channel are urban ditches and storm sewers.

State 305(b) Assessment

Sufficient data is not available to fully characterize Buckhorn Creek; therefore, the creek was not assessed as part of the 305(b) Report. Buckhorn Springs is, however, listed on the 303(d) List due to high NO_x levels that have been reported by SWFWMD.

Other Data.

Nitrate concentrations in the discharge from Buckhorn Springs average 2.1 mg/l (Jones et al. 1993). Considering that an NO_x concentration greater that 0.64 mg/l is sufficient to classify a water body in the worst 10 percent of Florida's waters, this finding is significant. Similarly high nitrate concentrations have been observed at other nearby springs including Lithia and Boyette Springs. Sampling for nitrate in the spring dates back to 1966, and based on these earlier data, collected by USGS and the Florida Bureau of Geology, SWFWMD has shown that nitrate concentrations experienced a 9-fold increase in the period between 1966 and 1991. Since the springs are located in a karst area, they are very sensitive to contaminants that result from land-based activities. Agriculture (dairy and citrus farming), sludge and septic spreading, septic tanks, stormwater runoff, and turf-maintenance activities have all been suggested as potential contributors to the problem.

7.2.4.3 English Creek

The English Creek Subwatershed drains approximately 38.4 square miles and is located in the east portion of Hillsborough County. Flow originates in the eastern and northern headwater of the subwatershed and flows in a generally southwestern direction to its outfall at the confluence with the North Prong of the Alafia River. The outfall is located approximately 6.0 miles upstream of the crossing at County Road 39.

A majority of the land use within the watershed has been modified for agricultural, phosphate mining and residential development. Historically the upper watershed consisted of a series of lakes, isolated wetlands and depressions that over flowed from one to the other and eventually discharged to the main channel segment. The

majority of these natural streams and drainage ways have been channelized over the years in an effort to improve drainage.

State 305(b) Assessment

Excessive coliform and nutrient concentrations are the primary water quality issues that have been identified by the FDEP in the watershed, and as such, water quality in English Creek is rated as "fair" by the state. The state's rating is based on eight samples collected in 1993. The collecting agency for these samples was not determined due to the absence of this data set in the STORET retrieval.

ENGLISH CREEK WQI	
DO	22
BOD	15
TN	81
NO_2+NO_3	90
TP	83
TURB	25
TSS	20
COD	-
TOC	15
TCOLI	-
FCOLI	83
WQI	45

English Creek partially supports its designated use with respect to the WQI, rated at 45, and water quality standards for conventional pollutants. Data for metals is not available. Data sufficient for a confidence level of "medium" was available. All three nutrient measurements that make up the WQI were observed at high levels- especially NO_x. Fecal coliforms levels are high.

Dissolved oxygen levels are high and oxygen demand, as measured by BOD5, was low; likewise, water clarity was very good as reflected in low concentrations of TSS and low turbidity.

Other Data.

Two key sampling stations were identified in the English Creek subwatershed (Figure 7.2-8). EPC recently added a monitoring station (Station 154) in English Creek. Two-years of data collection have taken place- 1999 and 2000 (Figure 7.2-9). The EPC program has confirmed that nutrients (nitrogen and phosphorous) and fecal contamination are the primary water quality issues in English Creek. The average NO_x concentration measured at this location by EPC is 2.01 mg/l and ammonia averages twice the state standard at 0.04 mg/l. Like the 1993-program, water clarity is found to be good, oxygen demand low, and dissolved oxygen has averaged around 7 mg/l at mid-depth. The EPC tests for lead twice annually at this station. Lead was below the MDL in all four samples during the 1999-2000 period.

The USGS maintained a monitoring station (2300978) at this same location from 1965-1970. Measurements were sporadic for some parameters. For example turbidity was only measured once; however, this single measurement (28 JTUs) indicated that, at least at the time of sampling water clarity was not good. Conversely, the more recent EPC measurements show water clarity to be good (average of 4) based on 16 measurements. Likewise, water quality with respect to phosphorus is better as measured recently by EPC.

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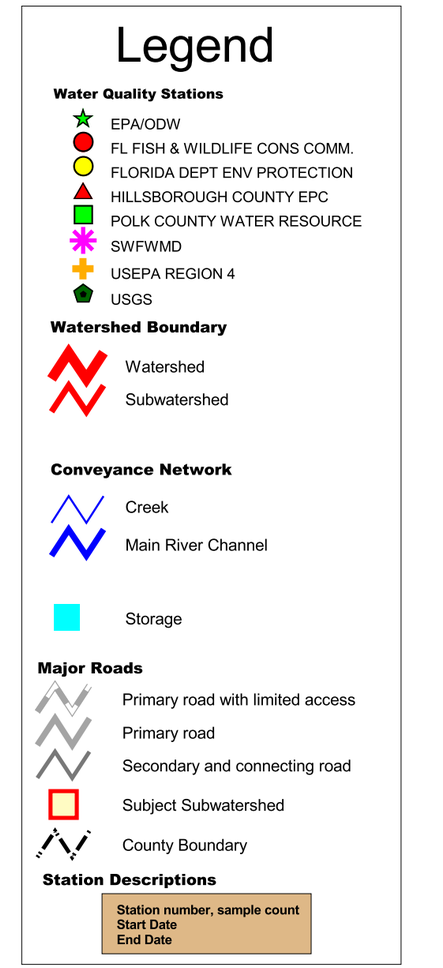
FIGURE 7.2-8
ENGLISH CREEK
SUBWATERSHED
KEY SAMPLING STATIONS



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Scale: 1" = 6,000'

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FLORIDA

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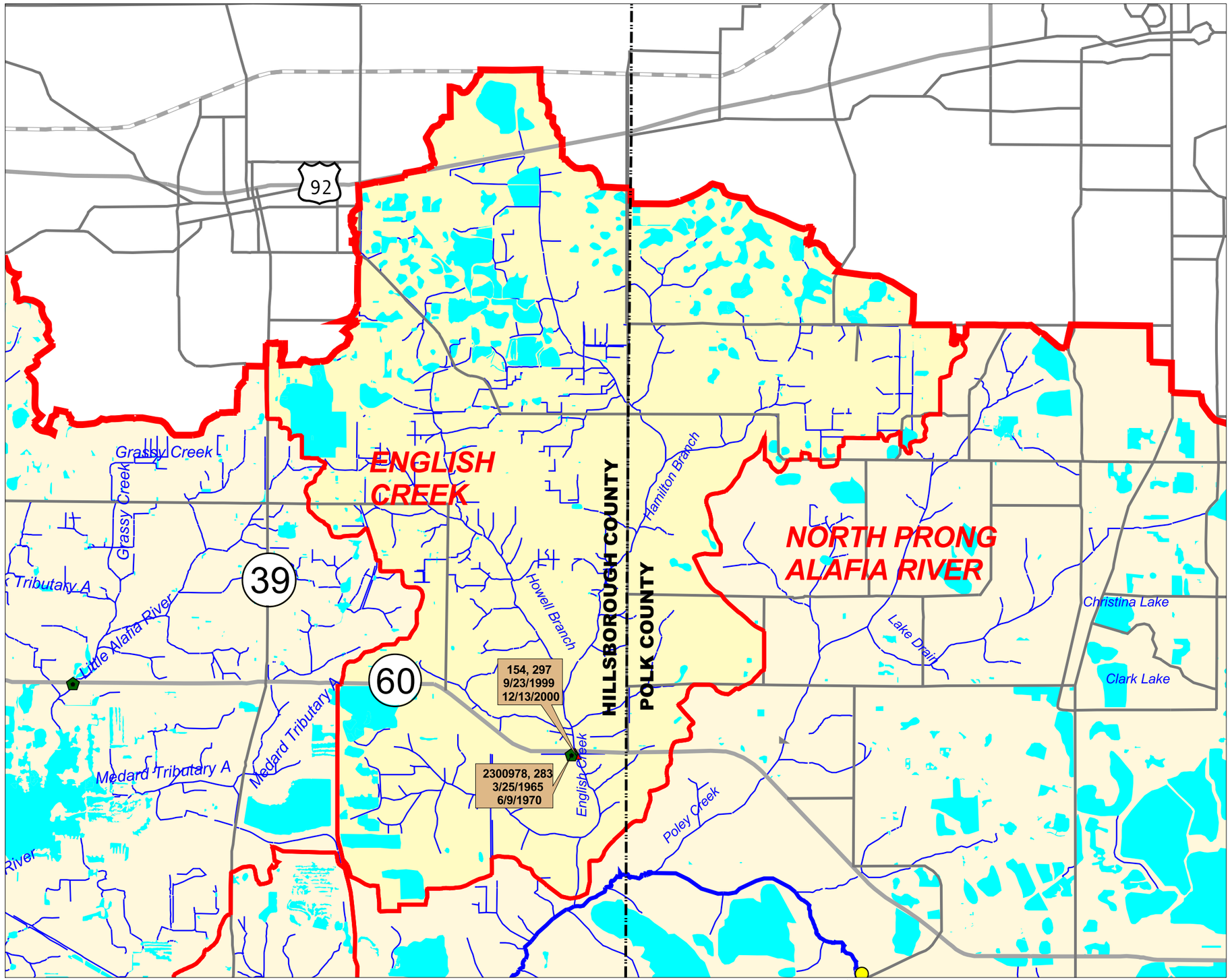

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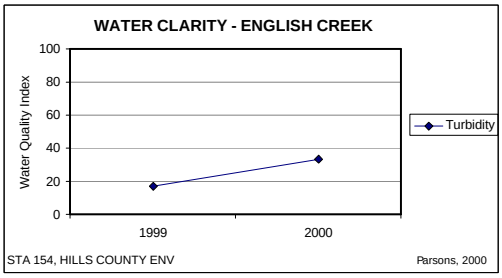
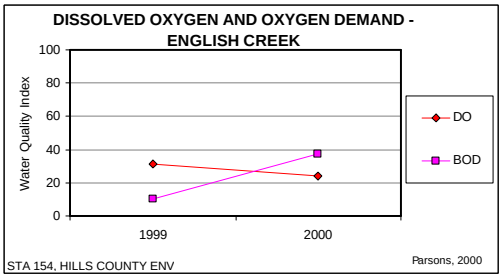
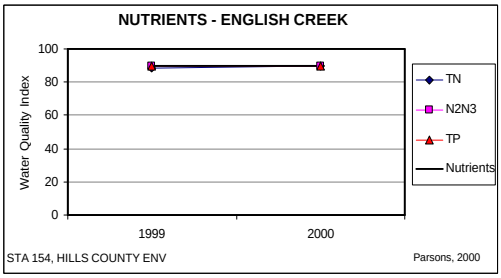
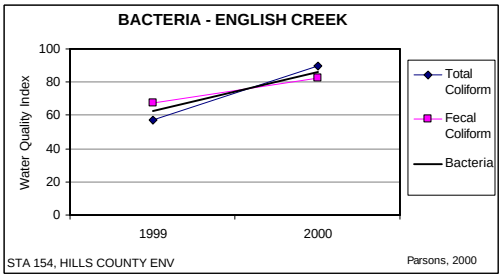
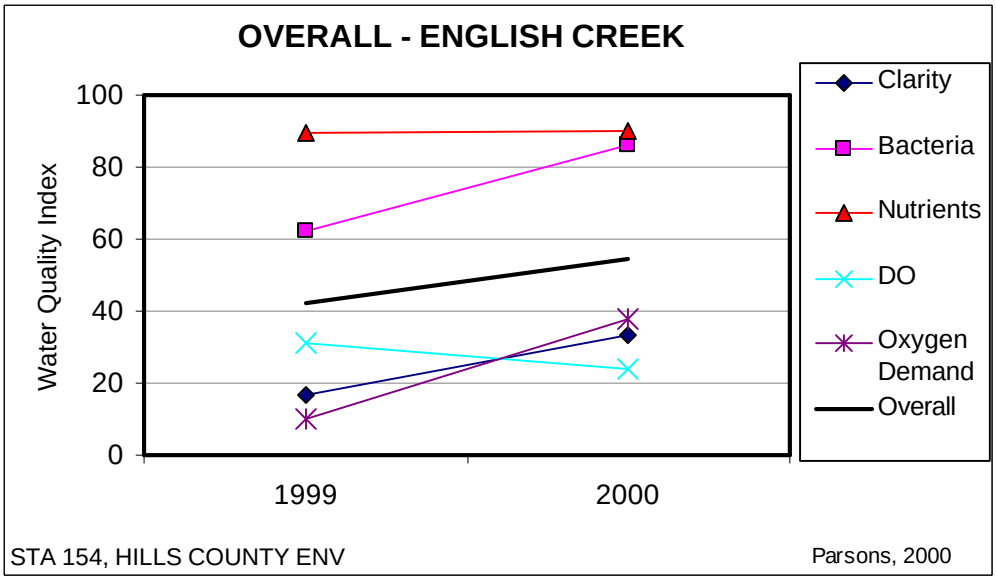
Fig 7.2-8 (11x 17back)











Overall						
Year	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1999	17	62	89	31	10	42
2000	33	86	90	24	38	54

FIGURE 7.2-9: ENGLISH CREEK SUBWATERSHED, STATION 154

The average concentration of EPC's ortho phosphate measurements is 2.19 mg/l; which is still high, but much less that the average of 10.3 mg/l that was measured with 10 samples by the USGS over a period from 1965-1966. The maximum ortho phosphate measurement taken during this program was 25 mg/l. NO_x concentrations in the EPC samples were approximately double the levels recorded earlier by the USGS. The USGS did not test for coliforms in the earlier sampling program.

7.2.4.4 Fishhawk Creek

The Fishhawk Creek Subwatershed is a 28-square mile area located in southeastern Hillsborough County. Flow originates in the southern and eastern headwaters of the subwatershed and flows in a generally northwestern direction to the subwatershed outfall at the confluence with the Alafia River, located approximately 2.15-mile upstream (east) of Bell Shoals Road.

Historically, the Fishhawk Creek Subwatershed consisted of an aggregation of lake and wetland systems overflowing through natural sloughs and small channels to Fishhawk and Little Fishhawk Creeks. Much of the historic drainage in the northern portion of the subwatershed remains semi-natural because until recently the majority of the land was under the control of two owners who used the area for cattle ranching. The southern portion of the subwatershed has been altered, however, over the past half century. Strip mining and agricultural activities have produced many changes to the landscape which is evident in the large water-filled borrow pits seen on aerial photographs. Although most of the mining activities ceased 20 to 30 years ago, their effects still remain. The Hillsborough County Southeast Landfill is about 700 acres and is located on formerly mined land in the southeastern-most corner of the subwatershed.

Until recently, development within the subwatershed was minimal. Two 250-acre portions of the 5000-acre Fishhawk Ranch subdivision are currently being constructed. The construction of the Boyette Road Extension (Fishhawk Blvd.) was planned to facilitate the development of this area.

FISHHAWK CREEK WQI	
DO	19
BOD	10
TN	69
NO_2+NO_3	84
TP	86
TURB	36
TSS	30
BOD1	10
COD	-
TOC	-
TCOLI	59
FCOLI	90
WQI	40

State 305(b) Assessment

Water quality in Fishhawk Creek is good according to the state 305(b) report. The state's rating is based on a very small sample population size (3 samples) collected during 1994 and 1995. Total nitrogen, NO_x, and phosphorous levels were high as were total and fecal coliforms counts. Water quality with respect to these parameters is poor; however, water quality with respect to dissolved oxygen, oxygen demand, and water clarity is very good causing the overall rating to fall into the "good" category.

Fishhawk Creek was found to fully support its designated use with respect to the WQI, rated at 40, and water quality standards for conventional pollutants. Data for metals is not available. Data sufficient for a confidence level of "medium" was available. Even though the sample size was small, data to grade the creek on five of the six WQIs; thus, the FDEP places a confidence level of "medium" on their assessment of Fishhawk Creek.

Other Data.
Several key stations were identified in the Fishhawk Creek subwatershed (Figure 7.2-10). The state's assessment is likely based on data collected at FDEP Station 24020134 located near Boyette Road. Data for this station was available through the STORET system for the years 1994 through 1997. An analysis of these data (Figure 7.2-11) shows consistency with the state assessment. Water quality characteristics during the additional sampling years (1996-1997) were similar to previous results with the exception of BOD. This parameter rated "good", while earlier samplings rated from fair to poor.

Records of coliform sampling in the watershed date back as early as 1950. The FDEP sampled for coliforms at Station 24020017, which is located near Station 24020134, three times from 1950 to 1951. Total coliforms at this time would have been rated as "poor" by today's state assessment methodologies, or about 15 points higher on the WQI scale. Fecal coliform was not sampled. During this same period, and on the same days, coliform samples were taken at a more upstream-location (FDEP Station 24020018). Coliform samples at this location contained fewer counts than the upstream samples, but still, counts sufficiently high to warrant a rating of ("poor") was measured. Ammonia nitrogen was high at the more upstream station averaging 0.17 mg/l on three measurements. Ammonia nitrogen was not measured at the downstream station (24020017).

7.2.4.5 North Prong

The North Prong Subwatershed consists of approximately 102.3 square miles and is located east of English Creek; south of Interstate 4; west of State Road 37; and north of Porter Road. Of the 102.3 square mile watershed, approximately 93.6 square miles is located within Polk County. Flow originates in the eastern headwaters of the watershed and flows in a generally western direction. The watershed outfalls at the confluence with the South Prong of the Alafia River, approximately 0.5 miles east of County Road 39.

Historically this subwatershed consisted of a series of hydrologically interconnected wetlands and depressions that overflowed from one to the other and eventually

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FIGURE 7.2-10
FISHHAWK CREEK SUBWATERSHED KEY SAMPLING STATIONS

Legend

Water Quality Stations

- EPA/ODW
- FL FISH & WILDLIFE CONS COMM.
- FLORIDA DEPT ENV PROTECTION
- HILLSBOROUGH COUNTY EPC
- POLK COUNTY WATER RESOURCE
- SWFWMD
- USEPA REGION 4
- USGS

Watershed Boundary

- Watershed
- Subwatershed

Conveyance Network

- Creek
- Main River Channel
- Storage

Major Roads

- Primary road with limited access
- Primary road
- Secondary and connecting road
- Subject Subwatershed
- County Boundary

Station Descriptions

Station number, sample count
Start Date
End Date

5000 0 5000 Feet

Scale: 1" = 5,000'

HILLSBOROUGH COUNTY
FLORIDA

N W E S

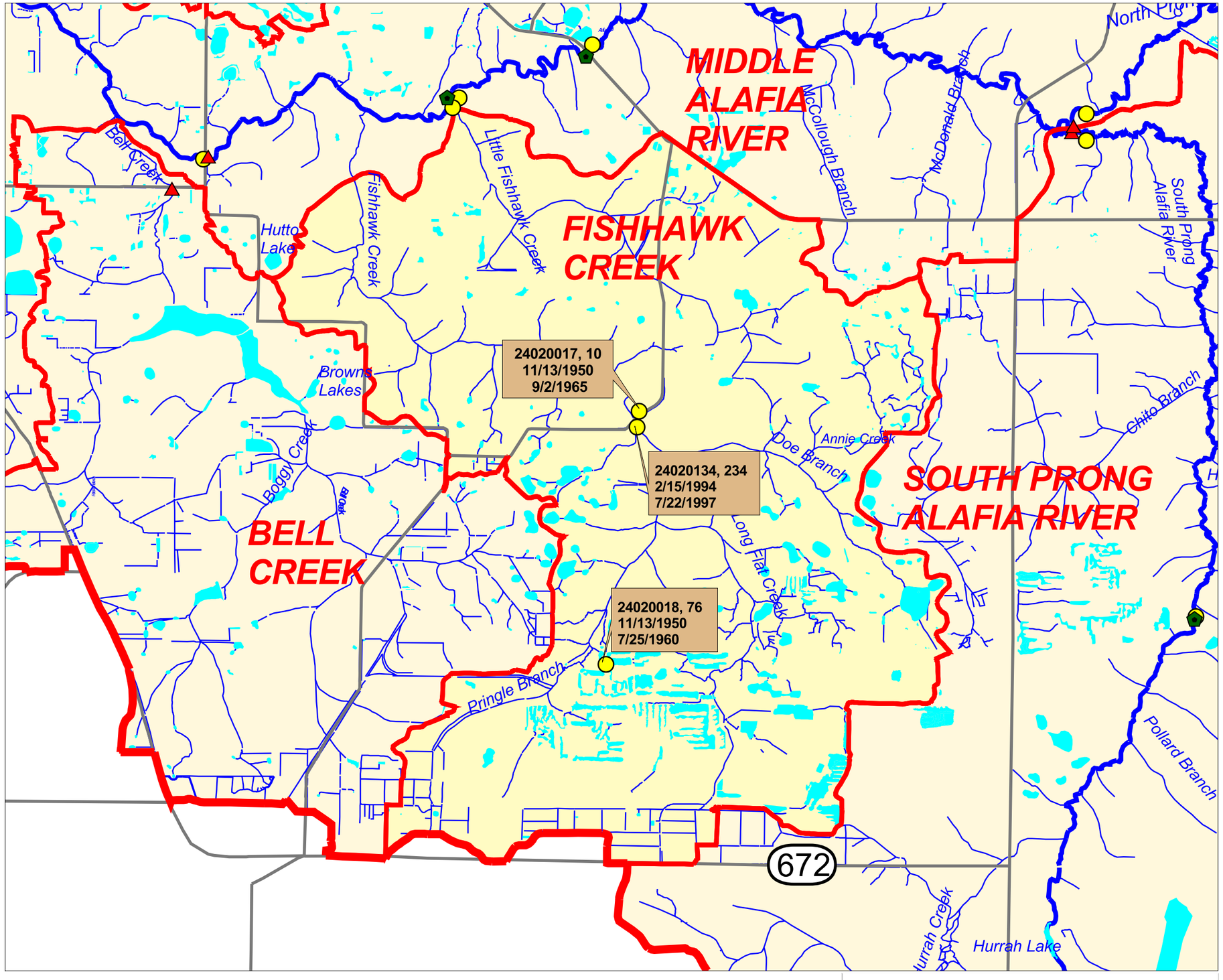

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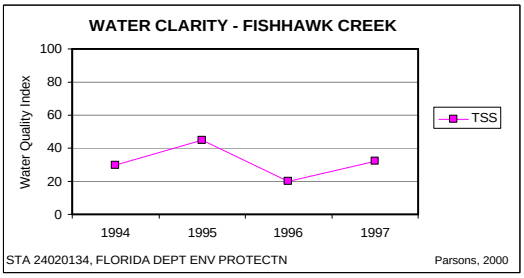
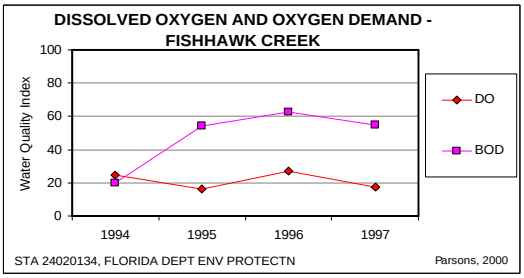
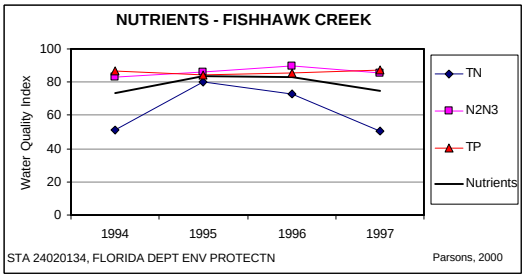
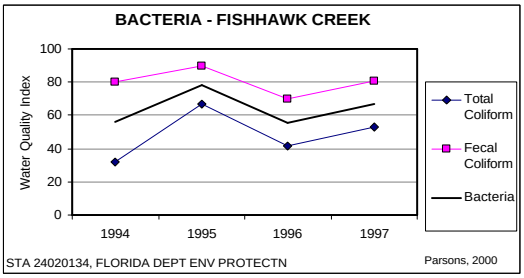
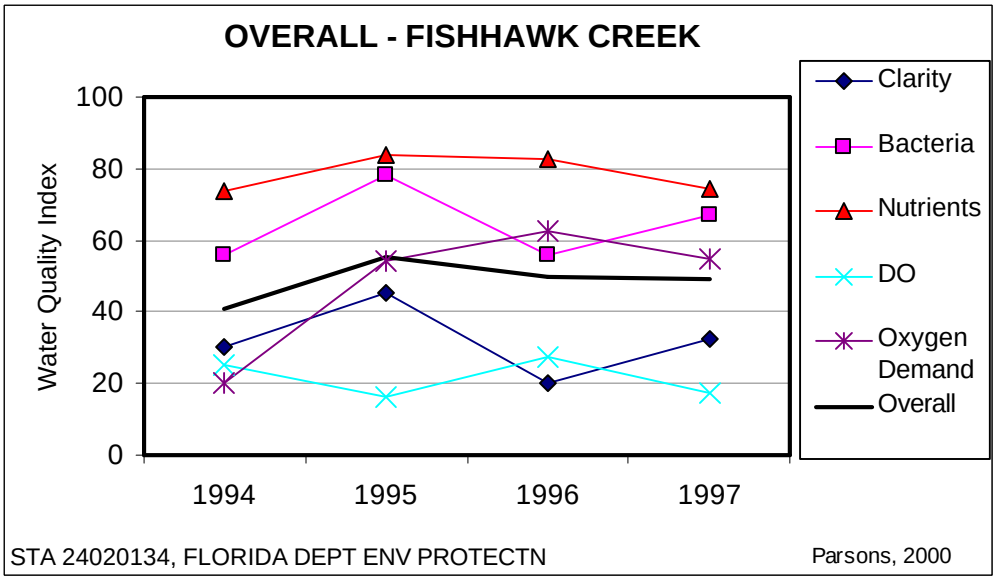
Fig 7.2-10 (11x 17 back)











Overall						
Year	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1994	30	56	74	25	20	41
1995	45	78	84	16	54	55
1996	20	56	83	27	63	50
1997	32	67	75	18	55	49

FIGURE 7.2-11: FISHHAWK CREEK SUBWATERSHED, STATION 24020134

discharged to the main channel segment. Within the last 50 years the majority of the land use within the watershed has been modified for agricultural and residential development, and the majority of the streams and drainage ways have been channelized or otherwise "improved" for drainage. Active and unreclaimed phosphate mine areas have significantly altered the topography and hydrology of the subwatershed.

Four separate stream segments in the North Prong Watershed have been assessed by the state as part of the 305(b) program – Lower North Prong Alafia, Upper North Prong Alafia, Poley Creek and Thirtymile Creek. Water quality in the Lower North Prong is good with respect to water chemistry, and the remaining three segments are impaired with respect to nutrients and coliforms. Turbidity is a problem in Poley Creek. Upper North Prong Alafia and Thirtymile Creek experience low dissolved oxygen levels. Each of these four segments is discussed separately below.

State 305(b) Assessment

Lower North Prong

Water quality in the Lower North Prong Alafia is fair. NO_x and phosphorous levels are high, but better water quality conditions exists with regards to the other water chemistry components; therefore, a rating of "good" has been assigned to this stream segment in regards to water chemistry (WQI=43). Exceedences for conventional pollutants as well as metals are the cause of this segment's rating as "fair". The North Prong in this location exhibits an improving trend in overall water quality. This trend toward improvement has been noted for total nitrogen, total phosphorous, and BOD. Other components of the WQI show a stable trend.

Lower North Prong Alafia WQI	
DO	22
BOD	31
TN	59
NO_2+NO_3	90
TP	90
TURB	53
TSS	37
COD	-
TOC	53
TCOLI	55
FCOLI	51
WQI	43

Upper North Prong Alafia WQI	
DO	66
BOD	20
TN	43
NO_2+NO_3	76
TP	90
TURB	30
TSS	30
COD	-
TOC	-
TCOLI	52
FCOLI	64
WQI	51

Upper North Prong

Water quality in the Upper North Prong Alafia is fair. NO_x and phosphorous levels are high as in the Lower North Prong; however, lower dissolved oxygen levels and higher coliforms counts at this location result in worse overall water chemistry at this location (WQI = 51). This segment's water chemistry in combination with exceedences for conventional pollutants have resulted in limitations in the beneficial use of the river in this segment. Metals data is not available.

Poley Creek

Excessive fecal coliform and nutrient concentrations as well as high turbidity are the primary water quality issues that have been identified by the FDEP in the watershed, and as such, water quality in Poley Creek is rated as "fair" by the state. The state's rating is based on ten samples collected in 1993 and 1994.

Poley Creek WQI	
DO	25
BOD	70
TN	41
NO_2+NO_3	47
TP	90
TURB	59
TSS	45
COD	-
TOC	70
TCOLI	-
FCOLI	72
WQI	55

Poley Creek partially supports its designated use with respect to the water chemistry (WQI=55) and water quality standards for conventional pollutants. Data for metals is not available. Data sufficient for a confidence level of "medium" was available. Phosphorous was found to be the nutrient of concern at this location. Oxygen demand, as measured by BOD, and fecal coliforms levels are high. Dissolved oxygen levels are high. Dissolved oxygen levels are high and oxygen demand, as measured by BOD5, was low; likewise, water clarity was very good as reflected in low concentrations of TSS and low turbidity.

Thirtymile Creek

Water quality in Thirtymile Creek is poor. High nutrient and fecal coliforms levels together with low dissolved oxygen concentrations exists in Thirtymile Creek. Water quality in Thirtymile Creek is arguably the worst of all the Alafia subwatersheds as this watershed is the only area in the Alafia to receive a priority rating of "high" for TMDL development. The state has determined that this creek does not support its designated use on an overall and water chemistry basis. Water quality standards exceedences for conventional parameters have occurred on a frequent basis.

Thirtymile Creek WQI	
DO	81
BOD	40
TN	82
NO_2+NO_3	90
TP	90
TURB	44
TSS	30
COD	-
TOC	40
TCOLI	-
FCOLI	72
WQI	62

Other Data

Extensive sampling programs have taken place in the North Prong Watershed. These programs date back to the 1950's and have included long-term ambient conditions programs as well as compliance monitoring. Key stations are shown on Figure 7.2-12. EPC has monitored the North Prong near its confluence with the Alafia since 1974. This location (Station 115, STORET Station 24020008) is sampled monthly and is presumably the data on which the state's assessment of the Lower North Prong is based. Water quality indices for the period of record at this station are shown on Figure 7.2-13. Metal are also periodically sampled at this station, and lead, mercury, and zinc levels have been detected at high levels.

The FDEP conducted a sampling program (Station 24020008) near the same location as the EPC station for the years 1973-1984. The parameters and results of the FDEP program are similar to the EPC program of the same period; however,

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FIGURE 7.2-12
NORTH PRONG ALAFIA RIVER SUBWATERSHED KEY SAMPLING STATIONS

Legend

Water Quality Stations

- EPA/ODW
- FL FISH & WILDLIFE CONS COMM.
- FLORIDA DEPT ENV PROTECTION
- HILLSBOROUGH COUNTY EPC
- POLK COUNTY WATER RESOURCE
- SWFWMD
- USEPA REGION 4
- USGS

Watershed Boundary

- Watershed
- Subwatershed

Conveyance Network

- Creek
- Main River Channel
- Storage

Major Roads

- Primary road with limited access
- Primary road
- Secondary and connecting road
- Subject Subwatershed
- County Boundary

Station Descriptions

Station number, sample count
Start Date
End Date

8000 0 8000 Feet

Scale: 1" = 8,000'

HILLSBOROUGH COUNTY
FLORIDA

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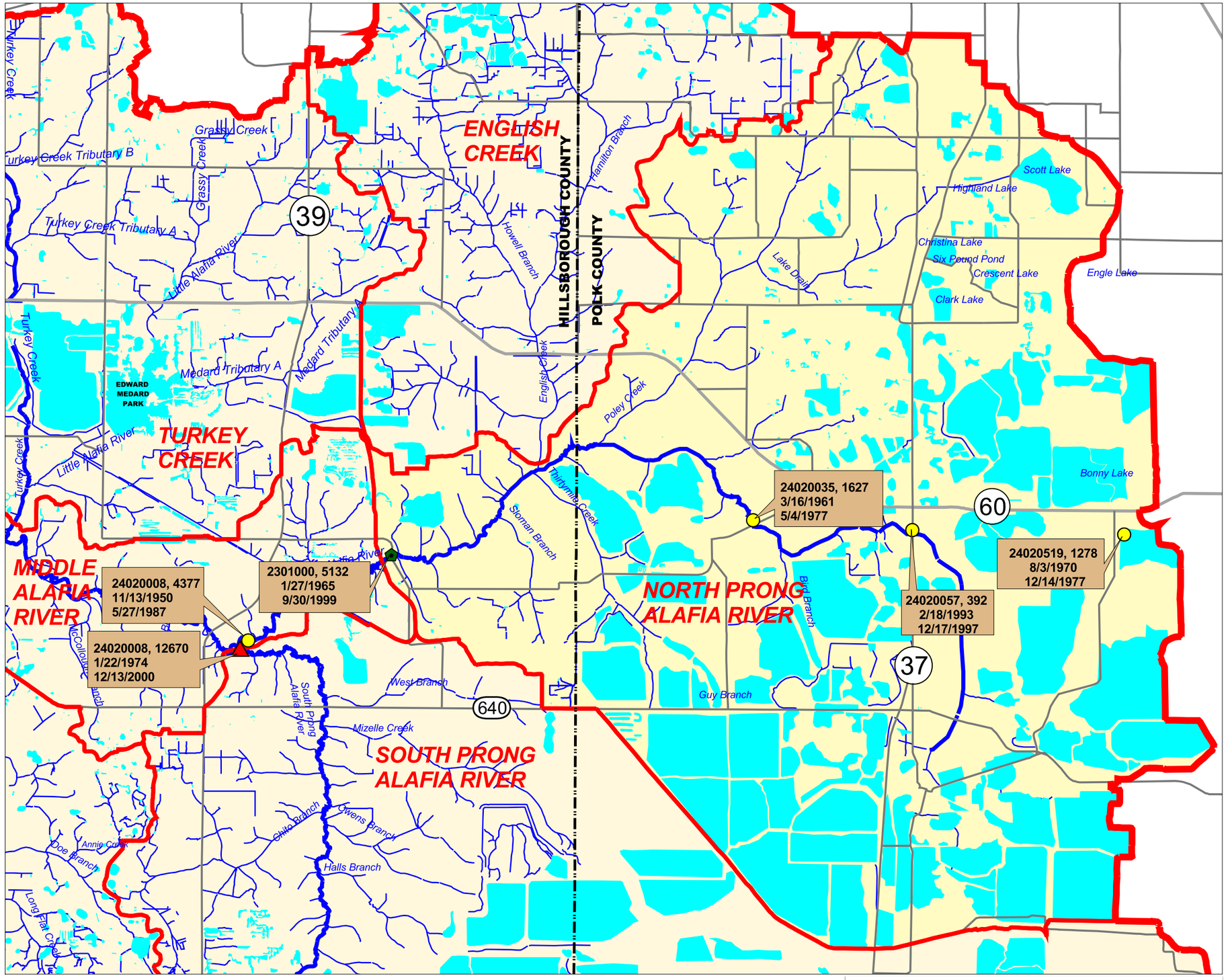

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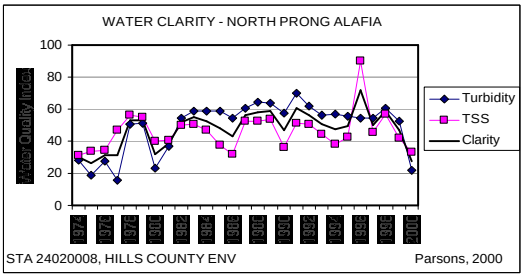
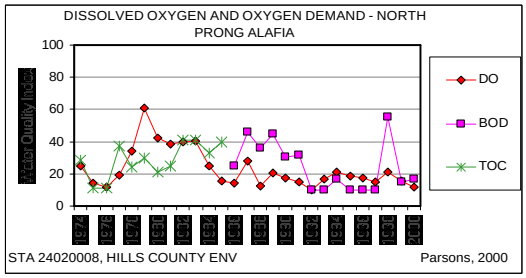
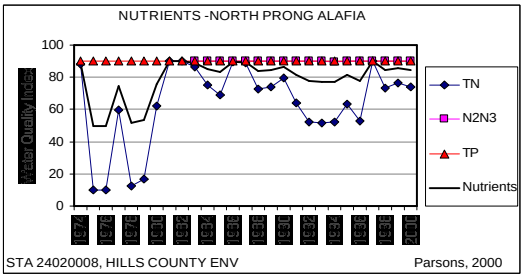
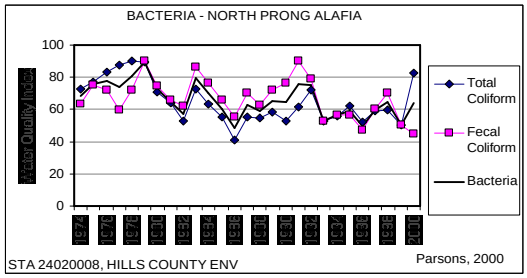
Figure 7.2-12 (11 x 17 back)









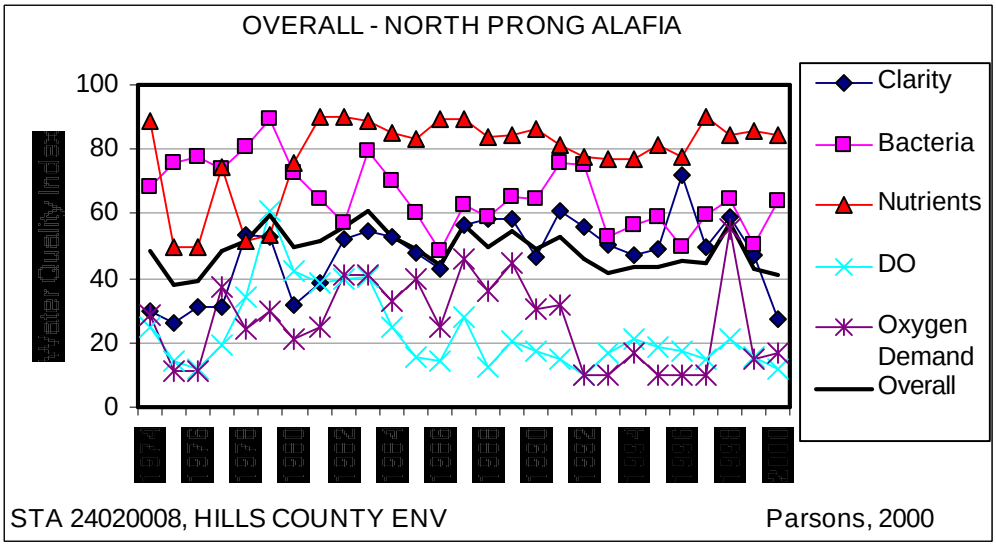


FIGURE 7.2-13A: NORTH PRONG ALAFIA RIVER, STATION 24020008
HEPC STA 115

Overall						
	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1974	30	68	89	25	29	48
1975	26	76	50	14	11	38
1976	31	78	50	12	11	39
1977	31	74	75	19	37	48
1978	53	81	51	34	24	51
1979	53	90	53	61	30	60
1980	32	73	76	43	21	50
1981	39	65	90	39	25	51
1982	52	57	90	40	41	56
1983	55	79	89	40	41	61
1984	53	70	85	25	33	53
1985	48	61	83	15	39	49
1986	43	48	90	14	25	44
1987	56	63	90	28	46	57
1988	58	59	84	12	36	50
1989	59	65	85	20	45	55
1990	47	65	87	17	30	49
1991	61	76	81	15	32	53
1992	56	75	77	10	10	46
1993	50	53	77	17	10	41
1994	47	56	77	21	17	44
1995	49	59	81	18	10	44
1996	72	50	78	17	10	45
1997	50	60	90	15	10	45
1998	59	65	84	21	55	57
1999	47	50	86	16	15	43
2000	27	64	85	12	17	41

FIGURE 7.2-13A: NORTH PRONG ALAFIA RIVER, STATION 24020008 HEPC STA 115

FDEP also conducted benthic sampling that showed an improving trend toward diversity at this location. In fact, WQIs at the beginning of this program would have rated "poor", but diversity showed steady improvement each year and was "good" at the time sampling was discontinued in 1981.

The USGS has maintained a station near the EPC station since 1965 (Station 2301000). Results overlapping the EPC program appear to be mostly similar. In the years preceding the EPC program (1965-1973) nutrient concentrations were high, as they are now- especially phosphorous.

Further upstream, at SR 676, the FDEP conducted a sampling program (Station 24020035, at SR 676), sporadically (no samples from 1973-1975), from 1961 to 1977. During this period nitrogen and phosphorous levels were very high - reaching an annual average peak of over 15 mg/l total nitrogen (1977) and over 12 mg/l total phosphorus (1963). This station overlapped, in time, with FDEP's Station 2402008. During these two years water quality at the upstream station was significantly worse than water quality at the downstream station.

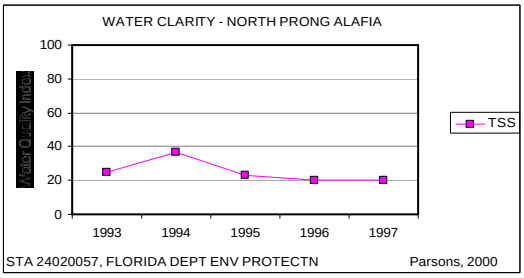
Still further upstream, the FDEP maintains a monitoring station just south of SR 60 (Station 24020057, Figure 7.2-13B). Data was available for this station for the years 1993-1997. During this period, overall water quality was not as good as at the more downstream EPC station due, primarily, to lower dissolved oxygen levels and higher oxygen demand.

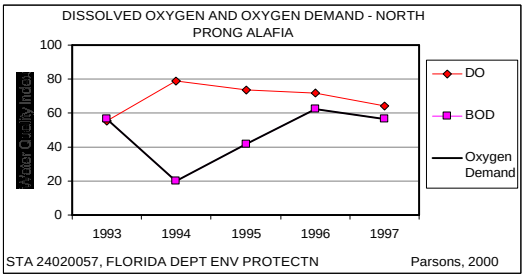
FDEP sampled the W.R. Grace discharge ditch from 1970 to 1977. Measurements were sporadic with respect to both parameters and sampling frequency. Ortho phosphate concentrations averaged 9.1 mg/l (for 17 samples) for a period from 1970-1972, and total Kjeldahl nitrogen concentrations averaged 7.62 mg/l (for 3 samples) for a period from 1975-1977.

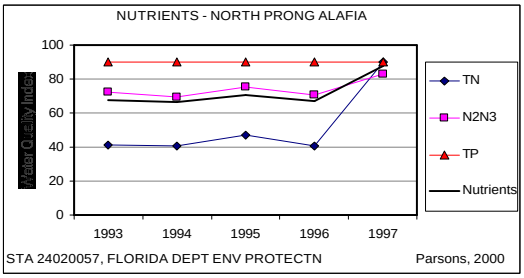
7.2.4.6 South Prong

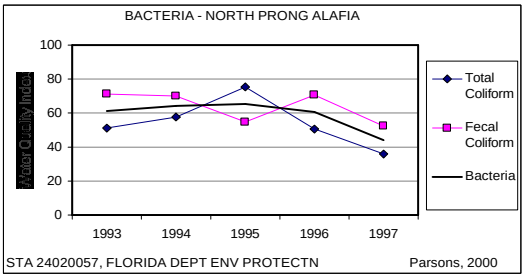
The South Prong Subwatershed drains approximately 124.2 square miles and is located within the southeast portion of Hillsborough County. Flow originates in the eastern and southern headwaters of the subwatershed and continues in a generally northwest direction toward the Alafia River approximately 0.5 miles upstream of the crossing at County Road 39.

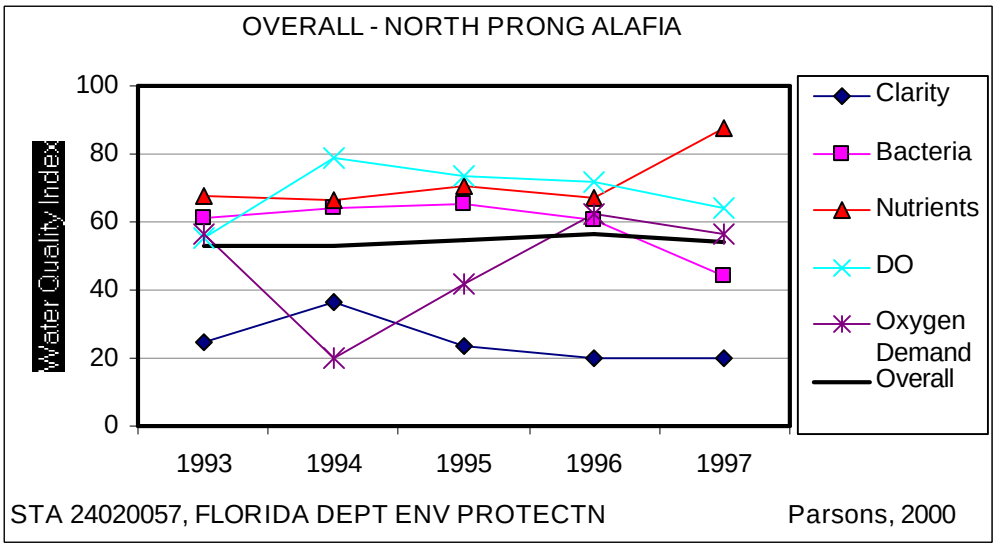
The majority of the land use within this subwatershed has been modified for phosphate mining and agricultural development. Historically, the headwaters consisted of isolated wetlands, swamps and high groundwater depressional areas that were hydraulically connected only during large storm events. Due to development in the watershed, many of these systems have either been channelized or mined.











Overall						
Year	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1993	25	61	68	56	56	53
1994	37	64	67	79	20	53
1995	23	65	71	73	42	55
1996	20	61	67	72	63	56
1997	20	44	88	64	56	54

FIGURE 7.2-13B: NORTH PRONG ALAFIA RIVER, STATION 24020057

Three separate stream segments in the South Prong Watershed have been assessed by the state as part of the 305(b) program – Lower South Prong Alafia, Mizelle Creek and Owens Branch. Water quality in Mizelle Creek is good, and the remaining two segments are impaired with respect to nutrients and coliforms. Each of these three segments is discussed separately below.

State 305(b) Assessment

Lower South Prong

Water quality in the Lower South Prong Alafia is good. NO_x and phosphorous levels are high, but better water quality conditions exists with regards to the other water chemistry components; therefore, a rating of "good" has been assigned to this stream segment in regards to water chemistry (WQI=40). Exceedences for conventional pollutants are the cause of this segment's failure to fully meet its overall designated use.

Lower South Prong Alafia WQI	
DO	27
BOD	10
TN	38
NO_2+NO_3	80
TP	90
TURB	30
TSS	30
COD	-
TOC	-
TCOLI	47
FCOLI	38
WQI	40

The South Prong in this location exhibits an improving trend in overall water quality. This trend toward improvement has been noted for total nitrogen, total phosphorous, and BOD. Other components of the WQI show a stable trend.

Mizelle Creek WQI	
DO	17
BOD	28
TN	37
NO_2+NO_3	79
TP	84
TURB	40
TSS	30
COD	-
TOC	50
TCOLI	51
FCOLI	74
WQI	37

Mizelle Creek

Water quality in the Mizelle Creek is good. NO_x, phosphorous and fecal coliform levels are high, but better water quality conditions exists with regards to the other water chemistry components; therefore, a rating of "good" has been assigned to this stream segment in regards to water chemistry (WQI=37) and for overall use support. Exceedences for conventional pollutants occur; however, this stream is deemed to fully meet its overall designated use.

Owens Branch WQI	
DO	35
BOD	20
TN	90
NO_2+NO_3	90
TP	77
TURB	20
TSS	10
COD	-
TOC	-
TCOLI	57
FCOLI	82
WQI	46

Owens Branch

Water quality in Owens Branch is fair. NO_x, phosphorous and fecal coliform levels are high, but better water quality conditions exists with regards to the other water chemistry components; therefore, a rating of "good" has been assigned to this stream segment in regards to water chemistry (WQI=37). Exceedences for conventional pollutants occur; however, this stream is deemed to fully meet its overall designated use.

Other Data

Several key sampling stations were identified in the South Prong subwatershed (Figure 7.2-14). The EPC has maintained a monitoring station near its confluence with the Alafia since 1974. This location (Station 116, STORET Station 24020019) is sampled monthly and is presumably the data on which the state's assessment of the Lower South Prong is based. Water quality indices for the period of record at this station are shown on Figure 7.2-15A. Recent water quality sampling at this location has indicated that water quality is "good" on an overall basis; however, bacteria and nutrient levels remain high- especially phosphorous and NO_x.

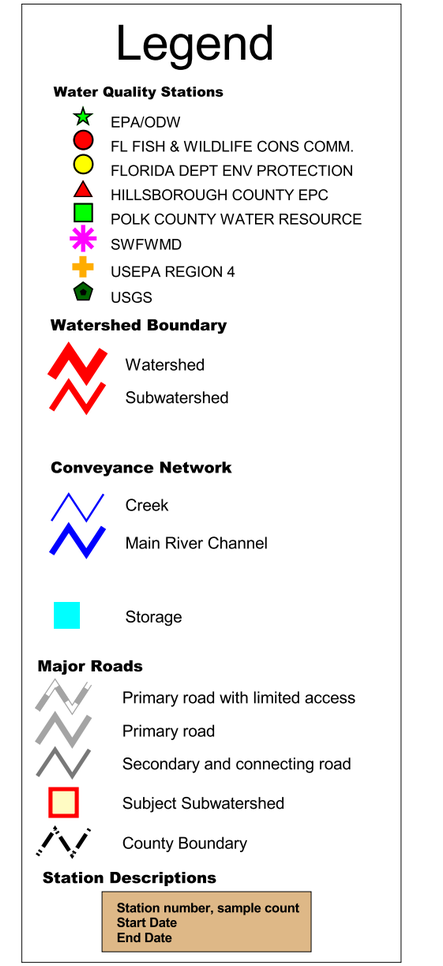
Metal are also periodically sampled at this station, and lead, mercury, and zinc levels have been detected at high levels in past times; however, metals sampling appears to have been very limited up until 1999 and recent testing for zinc and mercury were not noted. Testing for lead has occurred in the recent past; however, lead was not detected in recent sampling.

The FDEP conducted a sampling program (Station 24020019) near the same location as the EPC station for the years 1950-1987. Data collection at this site does not appear to have occurred with dependable frequency until 1973. Measurements prior to 1973 were for coliforms only and only during the years 1950, 1951, 1952. During this period coliform counts were significantly lower than current levels.

The FDEP maintains monitoring stations in Owens Branch (Station 24020906) and Mizelle Creek (Station 24020907). Since 1992 these stations have been monitored for the same parameters, and generally on the same days, providing a good opportunity for comparison. During this period both streams have exhibited consistently high dissolved oxygen levels, low oxygen demand, and good clarity. Phosphorous levels are elevated at both locations. Nitrogen levels are significantly higher at the Owens Branch station averaging 4.52-mg/l total nitrogen (1992 – 1997). Total nitrogen concentrations at Mizelle Creek average 0.93 mg/l (1992-1997). Ammonia nitrogen concentrations average twice the state standard at Mizelle Creek and three times the state standard at Owens Branch.

The USGS has maintained a monitoring station on the South Prong near Lithia since 1965 (Station 2301300). Parameter sets appear to have changed several times over the years; however, different phosphorus speciations have been monitored since the beginning of the program. Dissolved ortho phosphate averaged 35 mg/l during a period from 1965-1972 based on 58 individual measurements while total phosphorous averaged 2.1 mg/l (1971-1999) based on 161 samples. Nitrogen levels have generally been lower in the 1990's. During the ten-year period from 1974-1984 total nitrogen averaged 4 mg/l (based on 46 samples).

FIGURE 7.2-14
SOUTH PRONG ALAFIA RIVER SUBWATERSHED
KEY SAMPLING STATIONS



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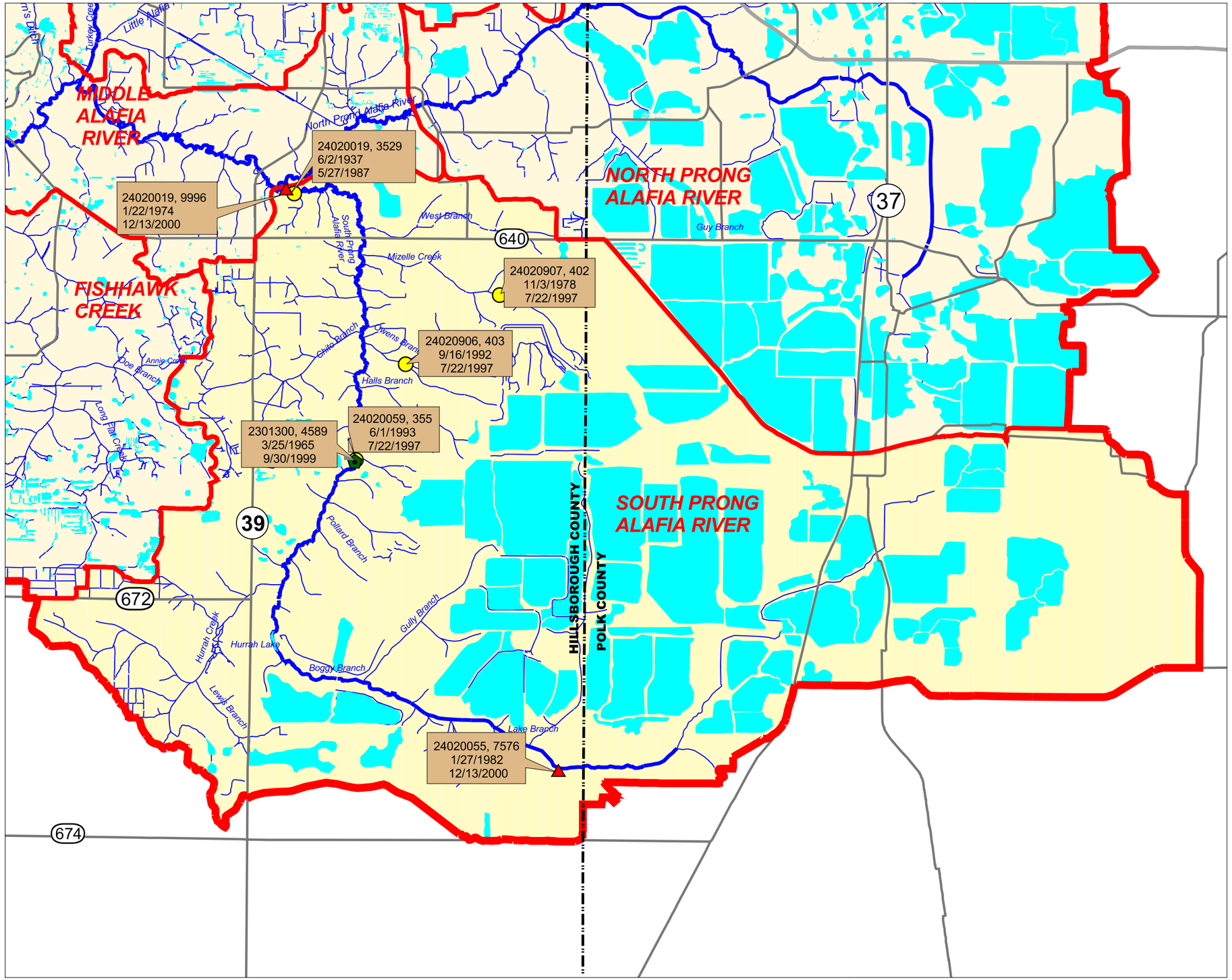
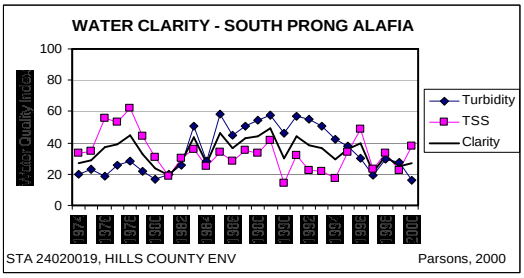
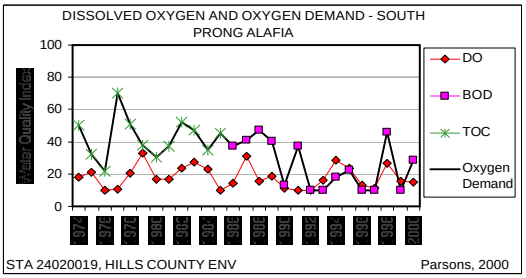
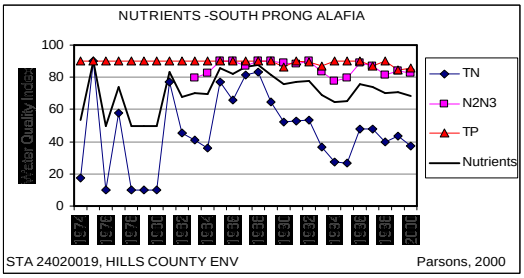


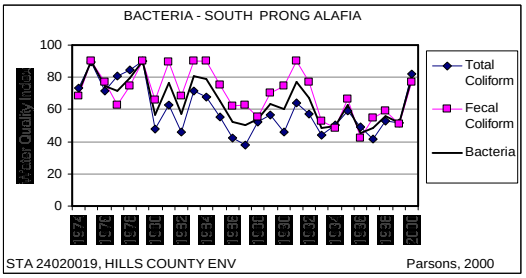
PARSONS ENGINEERING SCIENCE

Figure 7.2-14 (11 x 17 back)









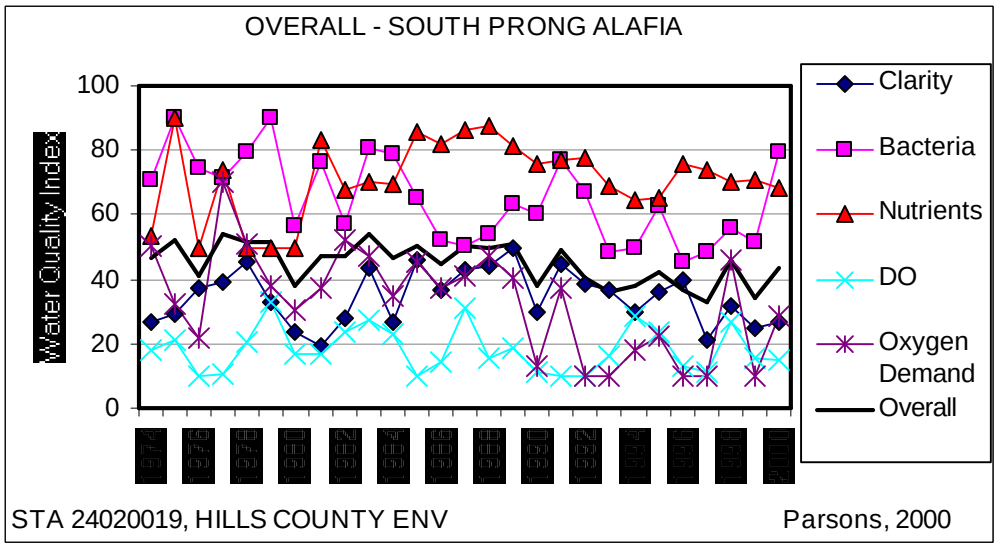


FIGURE 7.2-15A: SOUTH PRONG ALAFIA RIVER, STATION 24020019 HEPC STA 116

Overall						
Year	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1974	27	71	54	18	51	46
1975	29	90	90	21	32	52
1976	37	74	50	10	22	41
1977	39	72	74	11	70	54
1978	45	79	50	20	51	52
1979	33	90	50	33	38	51
1980	24	57	50	17	31	38
1981	19	76	83	17	37	47
1982	28	57	68	24	52	47
1983	43	81	70	28	47	54
1984	27	79	69	23	35	47
1985	46	65	86	10	45	50
1986	37	52	82	14	38	44
1987	43	50	86	31	41	50
1988	44	54	88	15	48	50
1989	50	63	82	19	40	51
1990	30	61	76	11	13	38
1991	45	77	77	10	38	49
1992	38	67	78	10	10	41
1993	36	48	69	16	10	36
1994	30	49	65	29	18	38
1995	36	63	65	23	23	42
1996	40	46	76	13	10	37
1997	21	48	74	11	10	33
1998	31	56	70	26	46	46
1999	25	51	71	15	10	34
2000	27	80	68	15	28	44

FIGURE 7.2-15A: SOUTH PRONG ALAFIA RIVER, STATION 24020019 HEPC STA 116

Mercury, lead, and zinc have also been measured at elevated levels. Flow at this location averages 83 cfs. Water quality indices for a portion of the period of record are shown on Figure 7.2-15B.

The FDEP maintains a station (Station 24020059) near the same location as the USGS station. Data was available for years 1993 to 1997. During this period water quality, overall, has been good due mainly to excellent clarity and acceptable dissolved oxygen levels. Overall nutrient levels have generally been "fair", but phosphorous and NO_x levels remain high.

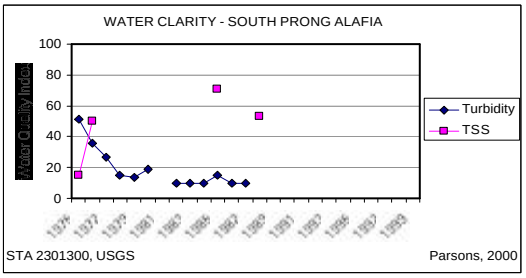
The EPC maintains another station on the South Prong further upstream. This station (Station 139, STORET Station 24020055) is located at Bethlehem Road and has been monitored since 1982. Water quality at this location is, and has historically been, "fair". A noticeable decline in water quality, for most parameters, occurred in 1987- 1989. The largest concern at this location is nutrients; however, conditions with respect to nutrients appear to be improving. Water quality indices for a portion of the period of record are shown on Figure 7.2-15C

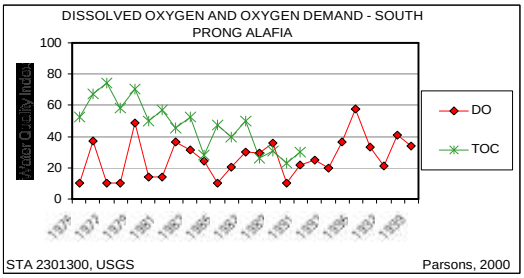
7.2.4.7 Turkey Creek

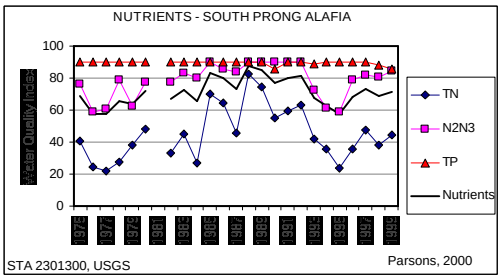
The Turkey Creek Subwatershed is located in the north-central portion of the Alafia River Watershed and is bordered by Plant City and Rev. Dr. Martin Luther King, Jr. Boulevard to the north, Henry George Road to the southeast, Keysville Road and the Alafia River to the south, and Dover Road to the west. Flow in Turkey Creek originates in the northern portion of the subwatershed and flows to the south to discharge into the Alafia River two miles upstream of the Lithia-Pinecrest Road Bridge. Flow in the Little Alafia River, the major tributary to Turkey Creek, originates in the northeast and flows in a southwesterly direction. This subwatershed drains approximately 43.7 square miles.

The natural hydrologic system in the Turkey Creek Subwatershed probably consisted of small lakes, depressions, and wetland systems flowing through sloughs and small creeks to Turkey Creek and the Little Alafia River. Anthropogenic land use changes from the natural condition to phosphate mining, agriculture, and mixed density residential significantly altered the hydrologic system in the basin.

Three separate stream segments plus Medard Reservoir are assessed by the state as part of the 305(b) program – Turkey Creek above the Little Alafia, Little Alafia above Medard Reservoir, and Little Alafia below Medard Reservoir. The state assessments of the Little Alafia and Medard Reservoir are based data from the 1980s. Each of these segments is discussed separately below.







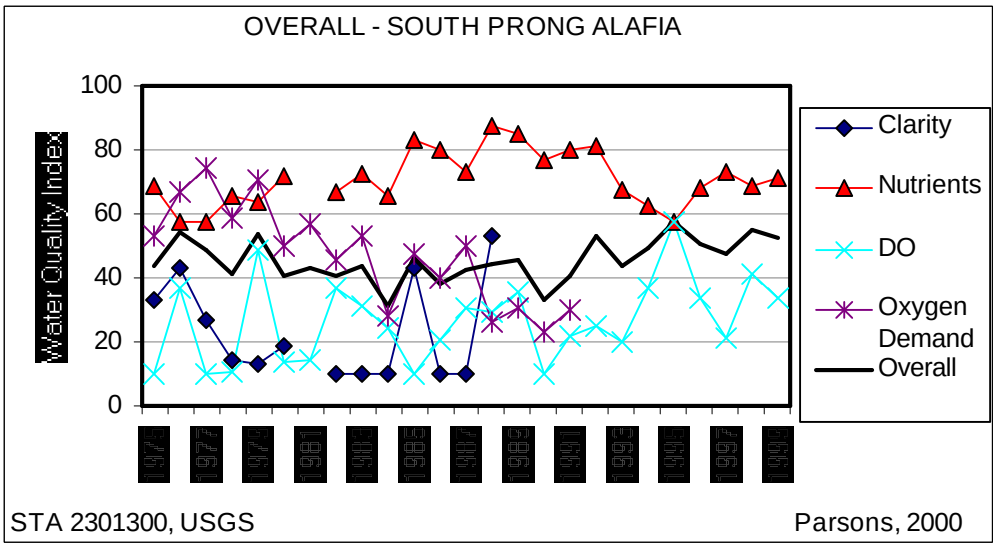
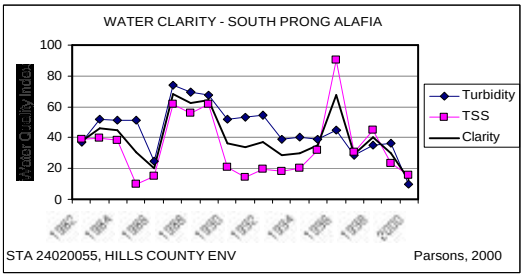
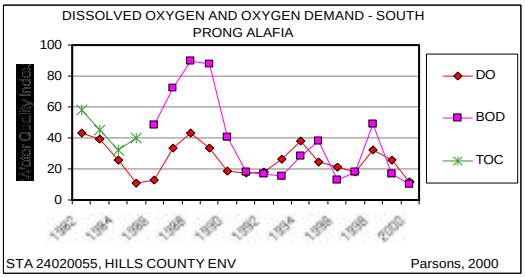


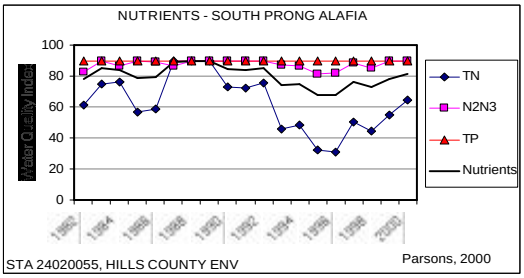
FIGURE 7.2-15B: SOUTH PRONG ALAFIA RIVER, STATION 2301300

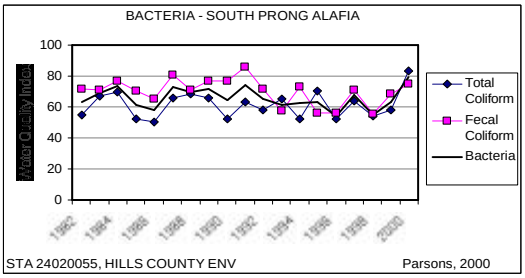
Overall						
1975	33	53	69	10	53	44
1976	43	67	58	37	67	54
1977	27	75	58	10	75	49
1978	15	59	65	10	59	42
1979	13	71	64	49	71	53
1980	19	50	72	14	50	41
1981		57		14	57	43
1982	10	46	67	37	46	41
1983	10	53	73	31	53	44
1984	10	28	66	24	28	31
1985	43	48	83	10	48	46
1986	10	40	80	21	40	38
1987	10	50	73	30	50	43
1988	53	26	88	29	26	45
1989		31	85	36	31	45
1990		23	77	10	23	33
1991		30	80	22	30	40
1992			81	25		53
1993			68	20		44
1994			62	37		50
1995			58	58		58
1996			68	34		51
1997			73	21		47
1998			69	41		55
1999			72	34		53

FIGURE 7.2-15B: SOUTH PRONG ALAFIA RIVER, STATION 2301300









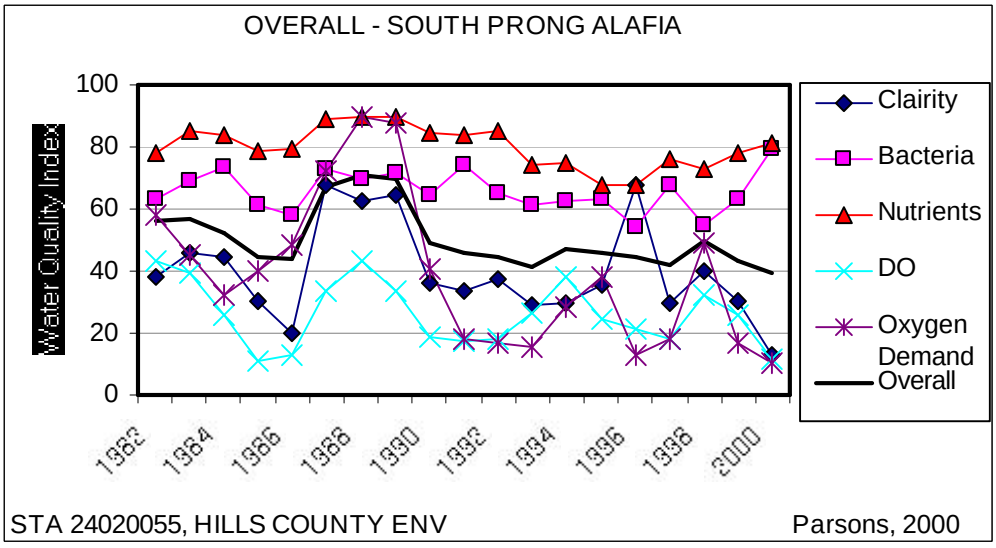


FIGURE 7.2-15C: SOUTH PRONG ALAFIA RIVER, STATION 24020055 HEPC STA 139

Overall						
Year	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1982	38	63	78	43	58	56
1983	46	69	85	39	45	57
1984	45	73	84	26	33	52
1985	31	61	79	11	40	44
1986	20	58	79	13	48	44
1987	68	73	89	33	72	67
1988	63	69	90	43	90	71
1989	64	71	90	33	88	69
1990	36	65	84	19	41	49
1991	34	74	84	17	18	46
1992	37	65	85	18	17	45
1993	29	61	74	26	15	41
1994	30	62	75	38	29	47
1995	35	63	68	24	38	46
1996	67	54	68	21	13	45
1997	29	68	76	18	18	42
1998	40	55	73	32	49	50
1999	30	63	78	26	17	43
2000	13	79	82	11	10	39

FIGURE 7.2-15C: SOUTH PRONG ALAFIA RIVER, STATION 24020055
HEPC STA 139

State 305(b) Assessment

Turkey Creek above the Little Alafia

Water quality in Turkey Creek above the Little Alafia is good. Total Nitrogen, NO_x, phosphorous and coliform levels are high, but better water quality conditions exists with regards to the other water chemistry components; therefore, a rating of "good" has been assigned to this stream segment in regards to water chemistry (WQI=42). Exceedences for conventional pollutants occur. Metals were not evaluated.

Turkey Creek above the Little Alafia WQI	
DO	19
BOD	20
TN	87
NO_2+NO_3	90
TP	86
TURB	36
TSS	-
COD	-
TOC	-
TCOLI	73
FCOLI	78
WQI	42

Water quality has exhibited an improving trend over the course of the evaluation period (1986-1995). This improving trend was observed for nutrients, clarity, oxygen demand, dissolved oxygen, and coliform bacteria.

Little Alafia above Medard Reservoir WQI	
WDO	10
WBOD	20
WTN	-
NO_2+NO_3	-
WTP	-
WTURB	-
WTSS	-
WCOD	-
WTOC	-
WTCOLI	-
WFCOLI	-
WQI	13

Little Alafia above Medard Reservoir

The state rates water quality in this segment as good- excellent with respect to water chemistry; however, this assessment is based on a very limited number of samples (7, 1980-1981) and the parameters which present problems to Turkey Creek above the Little Alafia were not available for evaluation.

Little Alafia below Medard Reservoir WQI	
WDO	10
WBOD	73
WTN	-
NO_2+NO_3	-
WTP	-
WTURB	-
WTSS	-
WCOD	-
WTOC	-
WTCOLI	-
WFCOLI	-
WQI	41

Little Alafia below Medard Reservoir

The state rates water quality in this segment as good. However, like the Little Alafia above the reservoir, this assessment is based on a very limited number of samples (6, 1980-1981) and the parameters which present problems to Turkey Creek above the Little Alafia were not available for evaluation.

Medard Reservoir

The state rates water quality in Medard Reservoir as fair. This assessment is based on a sampling program that took place in 1980 – 1986 in which 46 samples were collected. This program found NO_x concentrations to be very low- likely due to biological uptake in the reservoir. Chlorophyll was not tested, and the trophic state, based on nutrients, was 62 indicating fair water quality.

Medard Reservoir WQI	
DO	28
BOD	66
TN	46
NO_2+NO_3	10
TP	85
TURB	17
TSS	0
COD	0
TOC	45
TCOLI	0
FCOLI	0
WQI	52
TSI	62

Other Data

Several key stations were identified in the Turkey Creek subwatershed (Figure 7.2-16). EPC maintains two stations in Turkey Creek. One of these stations has been active since 1974. This long-term station (Station 111, STORET Station 24020006) is located at Highway 60. A second station (Station 151, STORET Station 24020005) was added further downstream at Durant Road in 1991. Water quality appears to be better at the more downstream station; however, high nutrient and coliform levels are problematic at both stations.

Water quality at the more upstream station (Station 111) has historically been poor but appears to be improving. Nutrient levels, especially phosphorous and NO_x are, and remain, high. Total coliform as well as fecal coliform counts are consistently high. Dissolved oxygen and oxygen demand are indicative of good water quality and appear to be improving. Water quality with respect to clarity is fair and also appears to be improving. Water quality indices for the period of record are shown on Figure 7.2-17A.

At the more downstream station (Station 151) water quality is fair. Like the upstream station, nutrient and coliform levels are high with phosphorous and NO_x being the primary nutrients of concern; however, nutrient and coliform levels at this station are lower than levels at Station 111- total nitrogen and bacteria levels are significantly lower. Oxygen demand, dissolved oxygen, and clarity are good at this location. Water quality indices the period of record are shown on Figure 7.2-17B

7.2.4.8 Alafia River.

The historic natural hydrologic system in the Alafia River Main Stem Subwatershed consisted of an aggregation of small lakes, natural depression, and wetland systems overflowing through numerous natural sloughs and small springs to the river. The north central portion of the subwatershed contains a number of natural depressions (sinkholes) with no defined drainage outlets.

State 305(b) Assessment

The Alafia River is divided into four segments in the state 305(b) report. These segments are, from upstream to downstream: Alafia River above Turkey Creek, Alafia River above Fishhawk Creek, Alafia River above Hillsborough Bay (freshwater), and Alafia River above Hillsborough Bay (estuary). Water quality in three of these segments is rated as good, and the estuarine portion is impaired with respect to nutrients, dissolved oxygen, and coliforms. Each of these four segments is discussed separately below.

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FIGURE 7.2-16
TURKEY CREEK SUBWATERSHED KEY SAMPLING STATIONS

Legend

Water Quality Stations

- EPA/ODW
- FL FISH & WILDLIFE CONS COMM.
- FLORIDA DEPT ENV PROTECTION
- HILLSBOROUGH COUNTY EPC
- POLK COUNTY WATER RESOURCE
- SWFWMD
- USEPA REGION 4
- USGS

Watershed Boundary

- Watershed
- Subwatershed

Conveyance Network

- Creek
- Main River Channel
- Storage

Major Roads

- Primary road with limited access
- Primary road
- Secondary and connecting road
- Subject Subwatershed
- County Boundary

Station Descriptions

Station number, sample count
Start Date
End Date

5000 0 5000 Feet

Scale: 1" = 5,000'

HILLSBOROUGH COUNTY
FLORIDA

N W E S

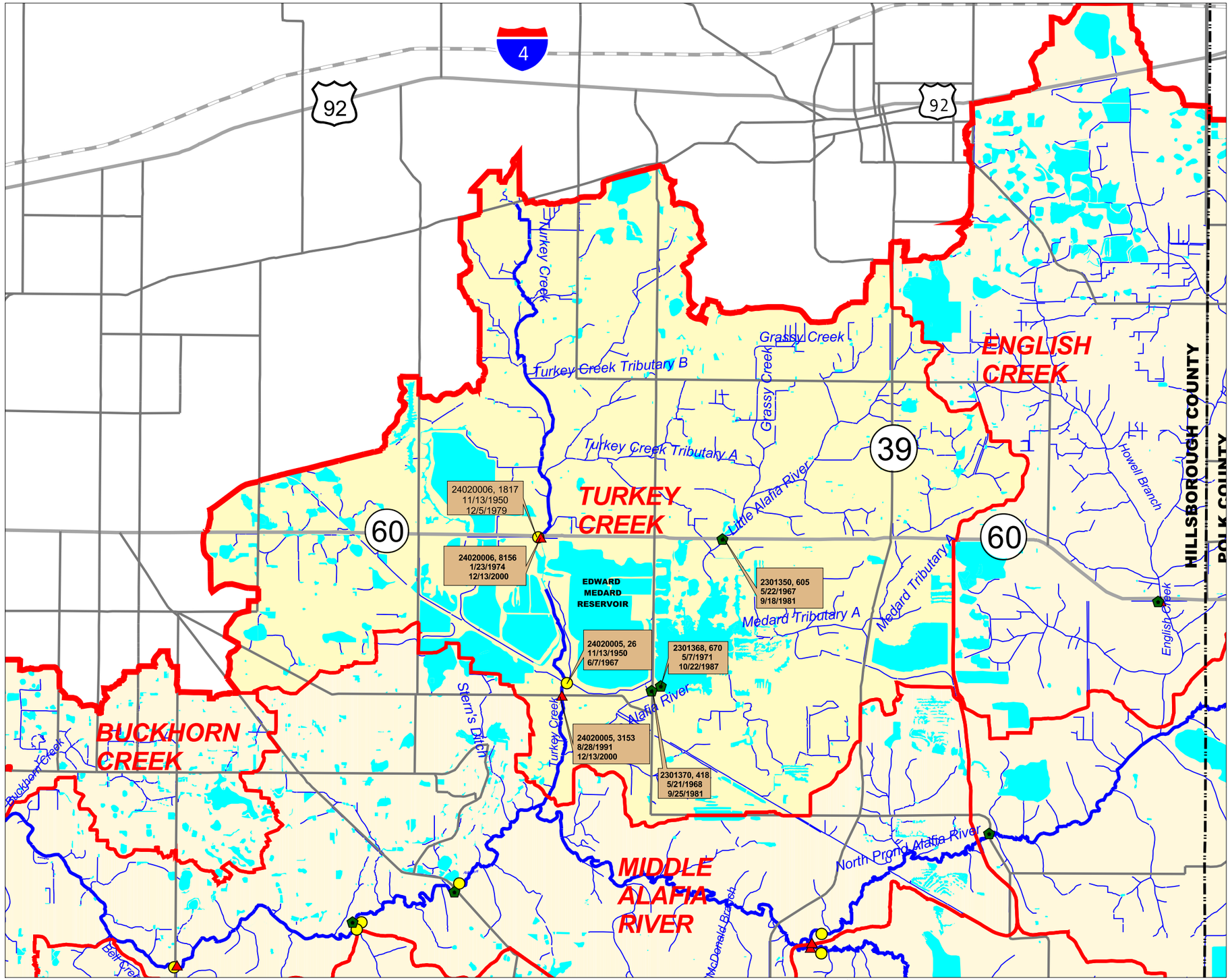

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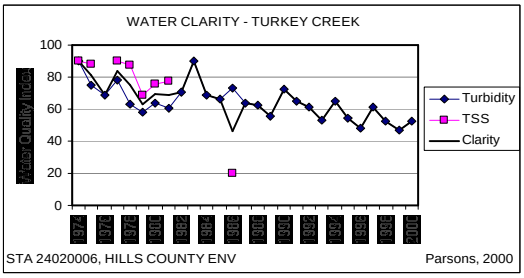
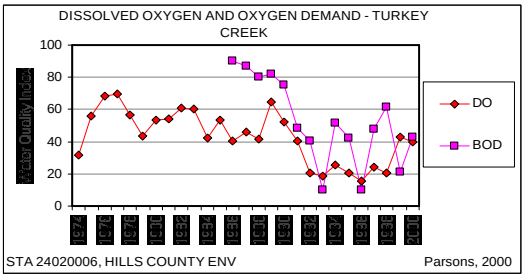
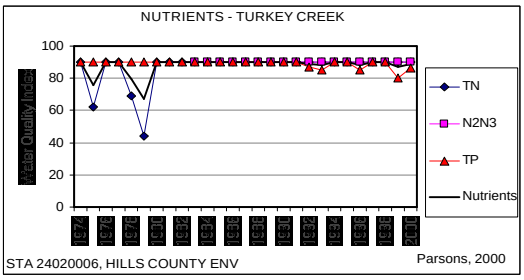
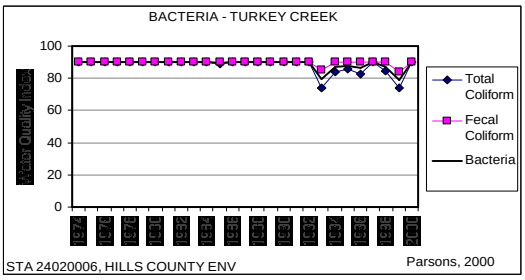
Figure 7.2-16 (11 X 17back)









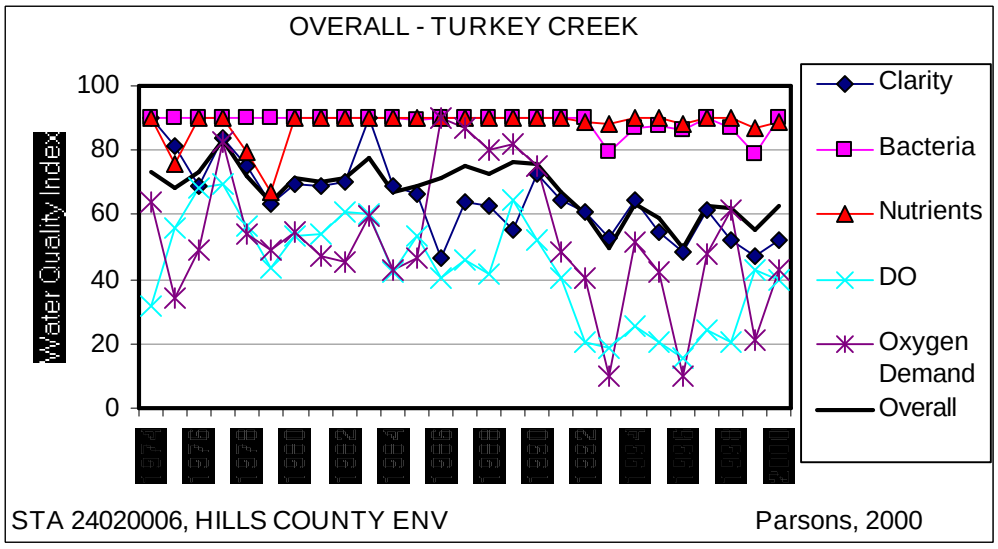
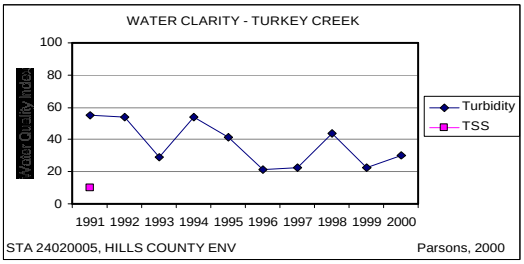
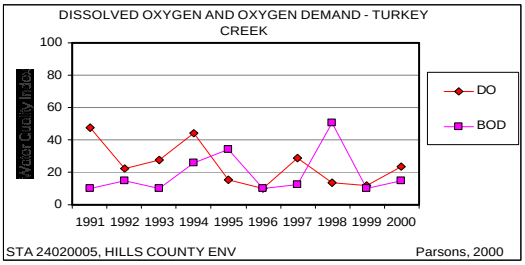


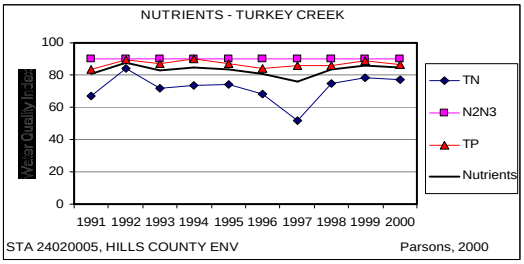
FIGURE 7.2-17A: TURKEY CREEK SUBWATERSHED, STATION 24020006, HEPC STA 111

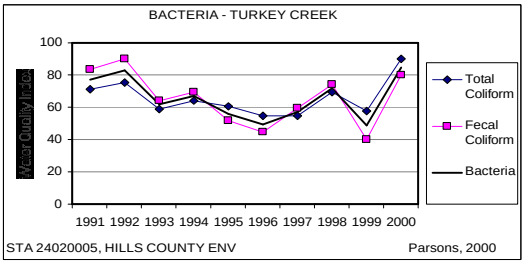
Overall						
Year	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1974	90	90	90	32	64	73
1975	82	90	76	56	34	68
1976	69	90	90	68	49	73
1977	84	90	90	70	83	83
1978	75	90	80	57	54	72
1979	63	90	67	44	49	64
1980	70	90	90	53	55	72
1981	69	90	90	54	47	70
1982	70	90	90	61	45	71
1983	90	90	90	60	59	78
1984	69	90	90	43	43	67
1985	66	89	90	54	47	69
1986	47	90	90	40	90	71
1987	64	90	90	46	87	75
1988	63	90	90	42	80	73
1989	56	90	90	65	82	76
1990	73	90	90	52	75	76
1991	65	90	90	41	49	67
1992	61	90	89	21	40	60
1993	53	79	88	19	10	50
1994	65	87	90	25	51	64
1995	54	88	90	21	42	59
1996	48	86	88	15	10	50
1997	61	90	90	24	48	63
1998	52	87	90	20	61	62
1999	47	79	87	43	21	55
2000	52	90	89	40	43	63

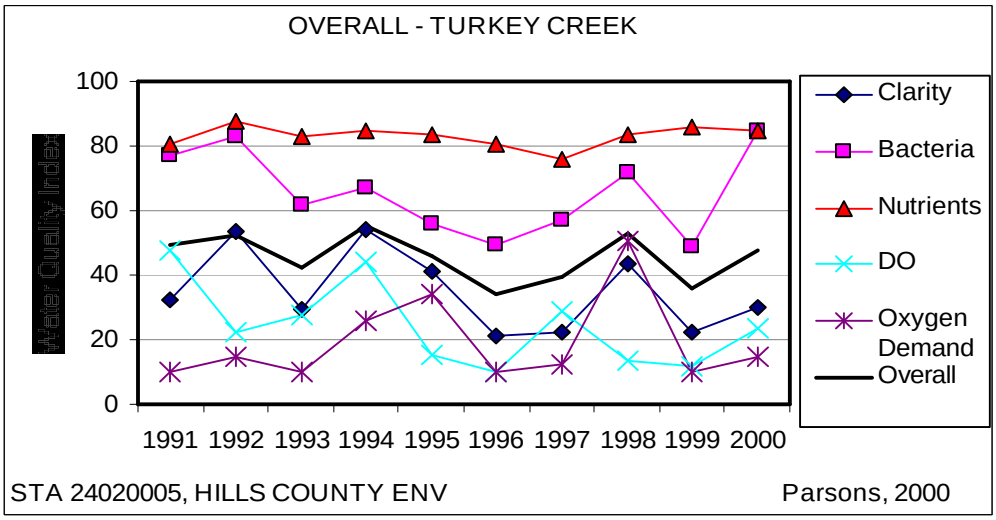
FIGURE 7.2-17A: TURKEY CREEK SUBWATERSHED, STATION 24020006, HEPC STA 111











Overall						
Year	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1991	33	77	80	48	10	50
1992	54	83	88	23	14	52
1993	29	61	83	28	10	42
1994	54	67	84	44	26	55
1995	41	56	84	15	34	46
1996	21	50	81	10	10	34
1997	23	57	76	29	12	39
1998	44	72	84	14	51	53
1999	23	49	86	12	10	36
2000	30	85	84	23	15	48

FIGURE 7.2-17B: TURKEY CREEK SUBWATERSHED, STATION 24020005, HEPC STA 151

Alafia River above Turkey Creek

Water quality in the Alafia River above Turkey Creek is rated as good. The river in this location fully supports its overall use as well as its use with respect to chemical indicators and water quality standards for conventional pollutants; nevertheless, phosphorous and NO_x concentrations are high. Fecal contamination is a concern. Water clarity is good and dissolved oxygen is very high.

Alafia River above Turkey Creek WQI	
DO	10
BOD	53
TN	57
NO_2+NO_3	88
TP	90
TURB	20
TSS	10
COD	-
TOC	53
TCOLI	-
FCOLI	62
WQI	42

Alafia River above Fishhawk Creek

Water quality in the Alafia River above Fishhawk Creek is rated as good. The river in this location fully supports its overall use as well as its use with respect to chemical indicators and water quality standards for conventional pollutants; however, like the upstream reach, phosphorous and NO_x concentrations are high. Again, like the upstream reach, water clarity is very good and dissolved oxygen is high.

Alafia River above Fishhawk Creek WQI	
DO	22
BOD	-
TN	56
NO_2+NO_3	84
TP	90
TURB	13
TSS	-
COD	-
TOC	-
TCOLI	-
FCOLI	43
WQI	44

Alafia River above Hillsborough Bay (Freshwater)

Water quality in the Alafia River above Hillsborough Bay is rated as good. The river in this location fully supports its overall use as well as its use with respect to chemical indicators and water quality standards for conventional pollutants; however, like the upstream reaches, phosphorous and NO_x concentrations are high. Total nitrogen at this location appears to be higher than at the upstream stations- water clarity and dissolved oxygen are good, but not as good as in the upstream reaches.

Alafia River above Hillsborough Bay (Freshwater WQI)	
DO	33
BOD	10
TN	63
NO_2+NO_3	90
TP	90
TURB	40
TSS	-
COD	-
TOC	-
TCOLI	44
FCOLI	43
WQI	42

Alafia River above Hillsborough Bay (Estuarine)

The estuarine portion of the Alafia River above Hillsborough Bay is rated as fair. The river in this location only partially supports its overall use as well as its use with respect to chemical indicators and water quality standards for conventional pollutants. Dissolved oxygen, nutrient, and fecal coliform levels are cause for concern. The trophic state index (TSI) for the estuary at this location is 55, with a chlorophyll TSI of 45. Nitrogen is the limiting nutrient. An improving trend has been noted at this station with respect to total phosphorus, chlorophyll, and BOD.

Alafia River above Hillsborough Bay (Estuarine)	
DO	70
BOD	50
TN	54
NO_2+NO_3	75
TP	89
TURB	52
TSS	-
COD	-
TOC	-
TCOLI	26
FCOLI	51
WQI	53
TSI	55

Other Data

Several key stations were identified along the Alafia River (Figure 7.2-18). EPC maintains three stations in the Alafia. Two of these stations have been active since 1974 – one in the estuarine portion of the river at US Highway 41 (Station 74, STORET Station 240200010 and one in the upper reaches of the main stem at Bell Shoals Road (Station 114, STORET Station 24020003). A third station was added at US 301 in 1999 (Station 153).

Water quality in the estuarine portion of the river (Station 74) is fair with respect to both chemistry and trophic state. Water quality and trophic state indices are provided on Figure 7.2-19A and show nutrients, dissolved oxygen, and oxygen demand to be the primary causes of impairment.

NO_x and phosphorus are the primary nutrients of concern. It is interesting to note the large percentage of total nitrogen existing as NO_x in the mid-to-late seventies. High phosphorous levels continue to plague this portion of the Alafia, but it appears that NO_x concentrations are decreasing.

Water clarity in this segment has traditionally been fair and has exhibited a fairly stable trend; however, water quality with respect to clarity was rated as “poor” during the year 2000. Bacteria levels have varied widely over the years but have generally been high.

Dissolved oxygen level have historically, and remain, low; likewise, oxygen demand is high. What appears to be a sudden increase in oxygen demand in 1986 is actually due to a change in measured parameters. Prior to 1986 EPC tested for TOC, which generally showed oxygen demand to be low. In 1986 EPC dropped TOC and began testing for BOD, which has shown oxygen demand in the “fair” to “poor” range.

The estuary at this location is nitrogen-limited and water quality appears to be improving with respect to the trophic state. The overall TSI during the nineties has generally been fair; however, the TSI edged upward to 60 (poor) for the year 2000. This follows consistent ratings of “poor” during the eighties. This improvement is due chiefly to lower levels of chlorophyll. During the mid-to-late seventies the TSI was generally fair reaching a record low of 41 in 1979. During this period chlorophyll levels were much the same as they were in eighties, but nitrogen levels were lower.

Further upstream, at US 301 (Station 153), water quality appears to be worse for the two years (1999 and 2000) that data is available. This decrease in water quality exists for all parameters that comprise the WQI resulting in a rating of poor for the year 2000 (WQI = 75). Four out of five indicators (bacteria, dissolved oxygen, oxygen demand, and nutrients) were rated as “poor” during the year 2000. Water quality indices for the period of record are shown on Figure 7.2-19B.

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FIGURE 7.2-18
ALAFIA RIVER MAIN STEM SUBWATERSHED KEY SAMPLING STATIONS

Legend

Water Quality Stations

- EPA/ODW
- FL FISH & WILDLIFE CONS COMM.
- FLORIDA DEPT ENV PROTECTION
- HILLSBOROUGH COUNTY EPC
- POLK COUNTY WATER RESOURCE
- SWFWMD
- USEPA REGION 4
- USGS

Watershed Boundary

- Watershed
- Subwatershed

Conveyance Network

- Creek
- Main River Channel
- Storage

Major Roads

- Primary road with limited access
- Primary road
- Secondary and connecting road
- Subject Subwatershed
- County Boundary

Station Descriptions

Station number, sample count
Start Date
End Date

9000 0 9000 Feet

Scale: 1" = 9,000'

HILLSBOROUGH COUNTY
FLORIDA

N W E S

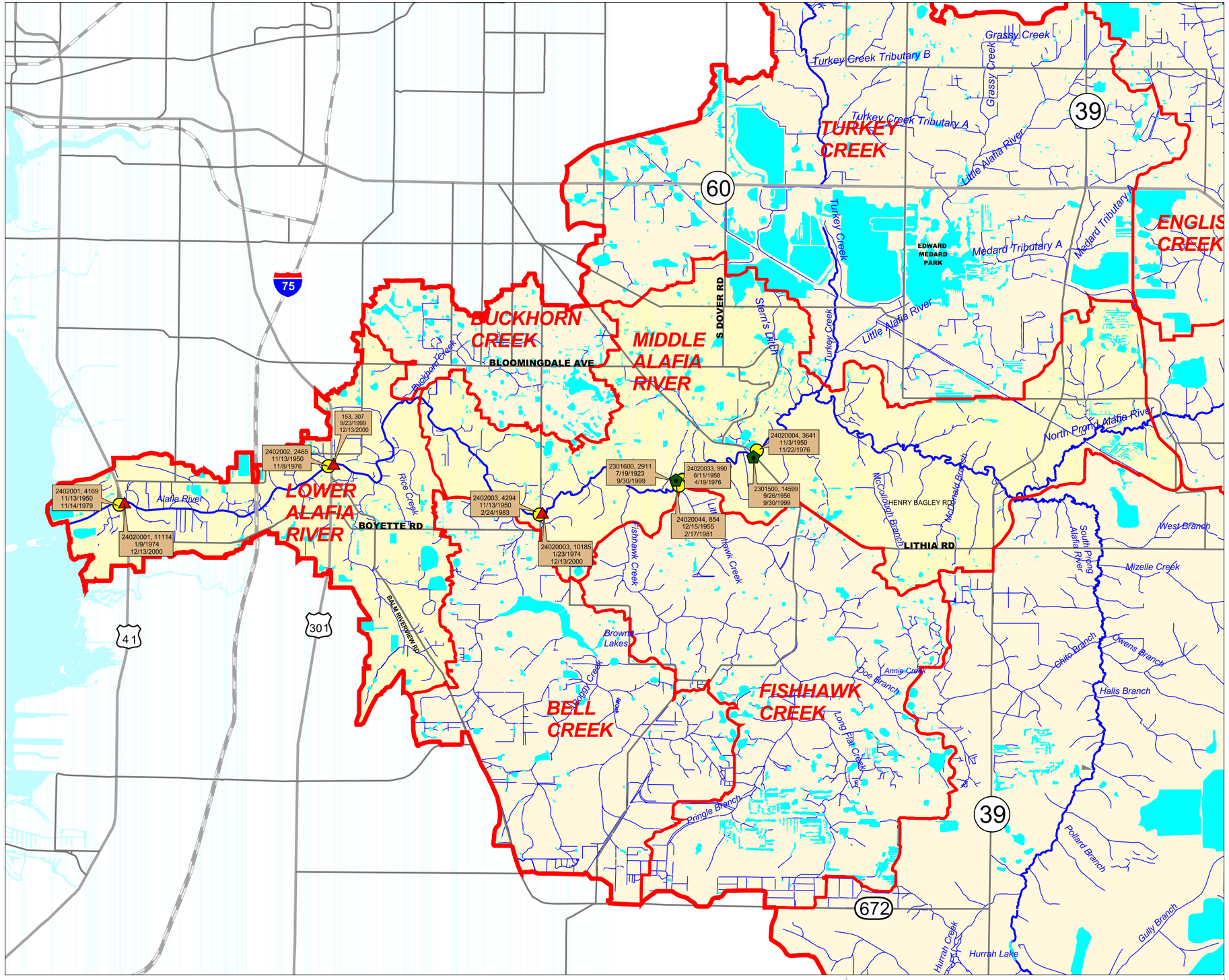

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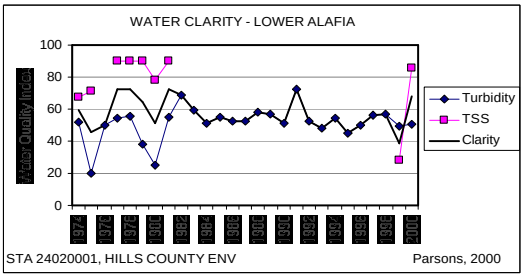
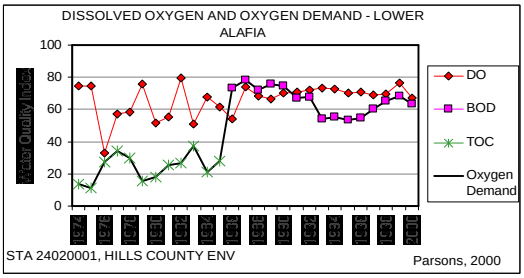
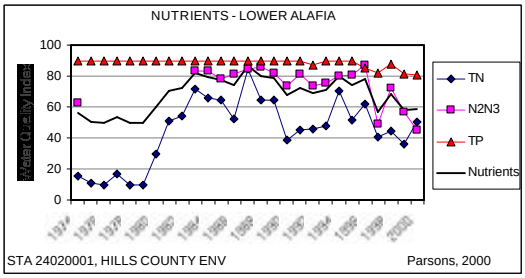
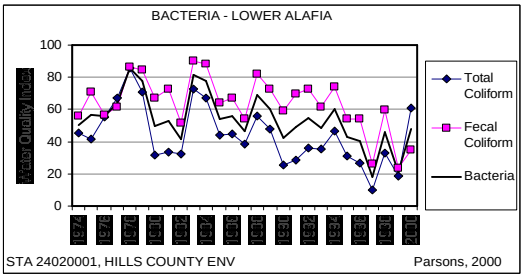
Figure 7.2-18 (11 x 17 front)









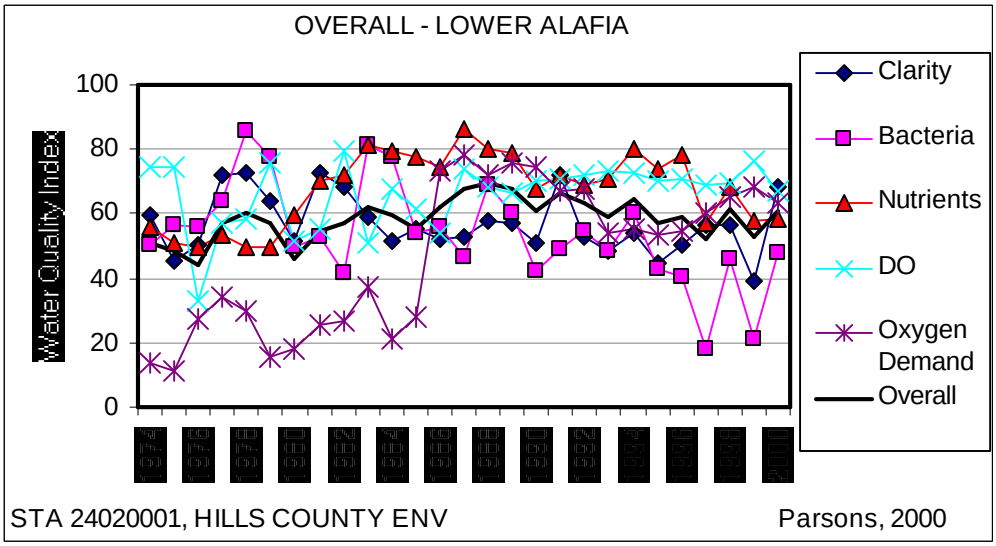


FIGURE 7.2-19A: ALAFIA RIVER, STATION 24020001
HEPC STA 74

Overall						
Year	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1974	60	51	56	75	14	51
1975	46	56	51	74	11	48
1976	50	56	50	33	27	44
1977	72	64	53	57	34	57
1978	73	86	50	58	30	60
1979	64	78	50	76	16	57
1980	52	50	60	52	18	46
1981	72	53	70	55	25	55
1982	69	42	72	80	27	57
1983	59	81	82	51	37	62
1984	52	78	80	68	21	60
1985	55	54	78	61	28	55
1986	52	56	75	54	74	62
1987	53	46	86	74	78	68
1988	58	69	80	68	72	69
1989	57	60	79	66	76	68
1990	51	42	67	70	75	61
1991	72	49	72	71	67	66
1992	53	54	69	72	68	63
1993	48	48	71	73	54	59
1994	54	60	80	72	55	64
1995	45	43	74	70	53	57
1996	50	40	78	71	55	59
1997	56	18	57	69	60	52
1998	57	46	68	70	65	61
1999	39	21	58	76	69	53
2000	68	48	59	67	63	61

FIGURE 7.2-19A: ALAFIA RIVER, STATION 24020001
HEPC STA 74

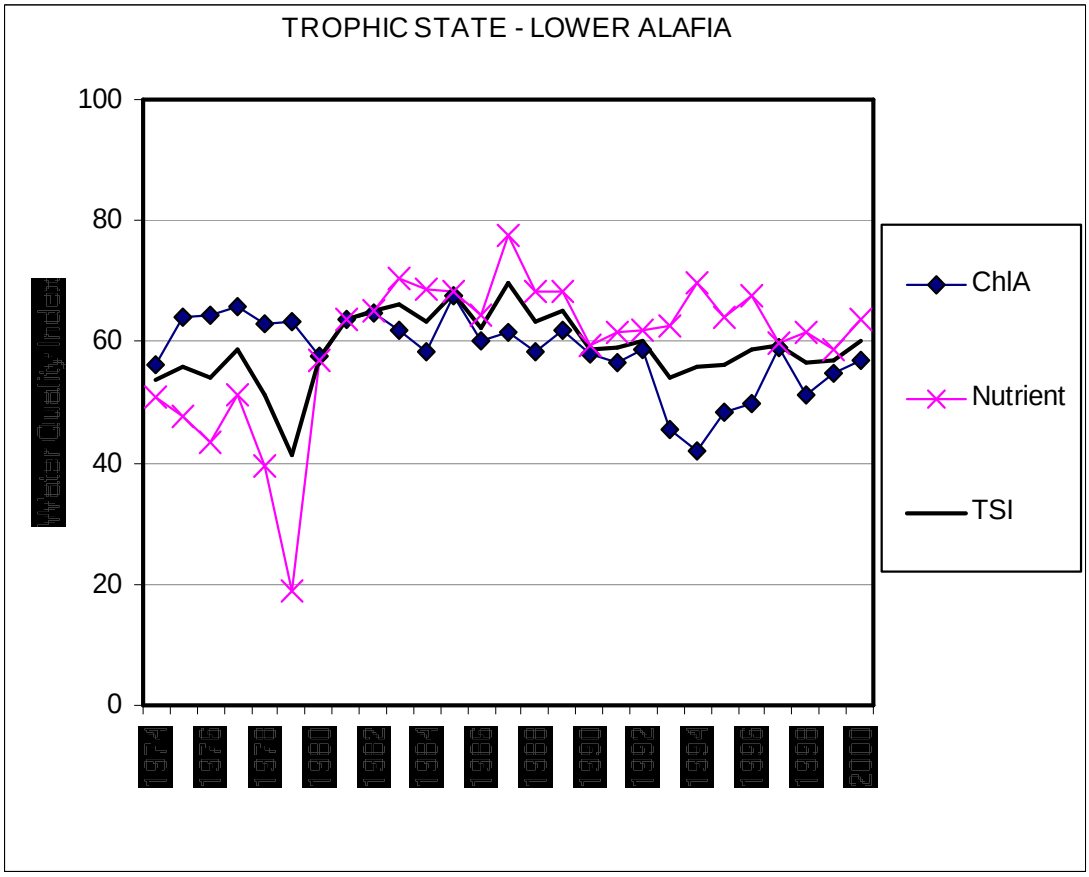
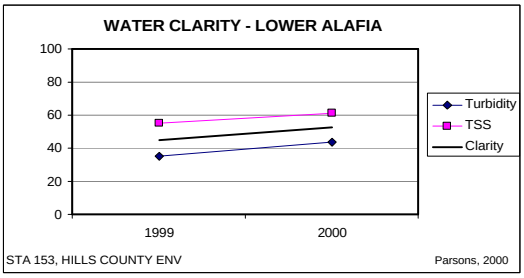
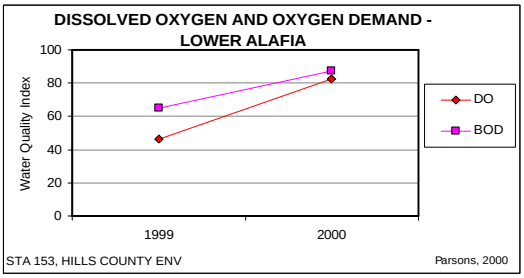


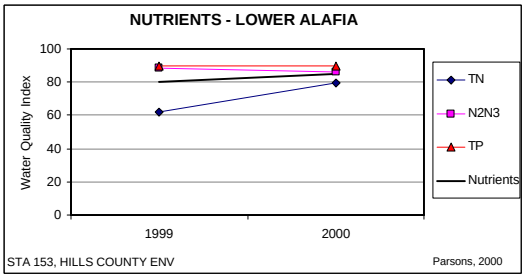
FIGURE 7.2-19A: ALAFIA RIVER, STATION 24020001
HEPC STA 74

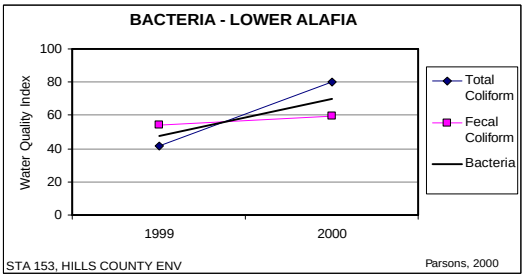
Year	ChlA	Nutrient	TSI
1974	56	51	54
1975	64	48	56
1976	64	43	54
1977	66	51	59
1978	63	39	51
1979	63	19	41
1980	58	57	57
1981	64	64	64
1982	65	65	65
1983	62	70	66
1984	58	69	64
1985	68	68	68
1986	60	64	62
1987	62	78	70
1988	58	68	63
1989	62	68	65
1990	58	59	59
1991	56	62	59
1992	59	62	60
1993	45	63	54
1994	42	70	56
1995	48	64	56
1996	50	68	59
1997	59	60	59
1998	51	62	56
1999	55	59	57
2000	57	64	60

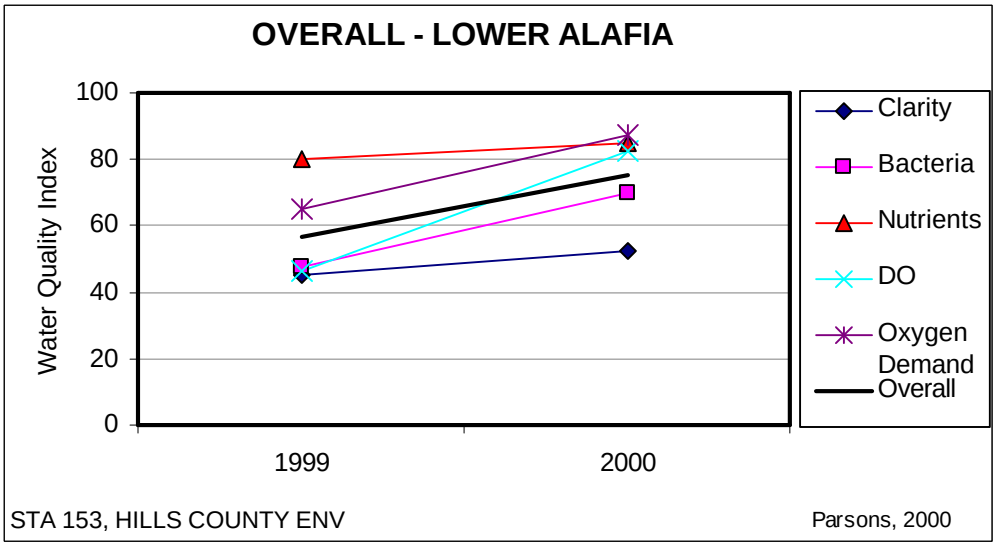
FIGURE 7.2-19A: ALAFIA RIVER, STATION 24020001
HEPC STA 74











Overall						
Year	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1999	45	48	80	47	65	57
2000	52	70	85	83	87	75

FIGURE 7.2-19B: ALAFIA RIVER, STATION 153

Further upstream at Bell Shoals Road (Station 114, STORET Station 24020003, Figure 7.2-19 C), overall water quality appears to be better than at Station 153 and Station 74 for the two years (1999 and 2000) that data is available for all three stations. This is due chiefly to water clarity as well as dissolved oxygen and oxygen demand. Water quality with respect to coliforms and nutrients are similar, but somewhat worse, at this location than at the more downstream Station 153. Historically water quality at this station has been better than at Station 74, on an overall basis, due mainly to higher dissolved oxygen, lower oxygen demand, and better clarity; however, nutrient and bacteria levels are higher at this location with phosphorous and NO_x presenting the largest concern with respect to nutrients.

7.2.4.9 Groundwater

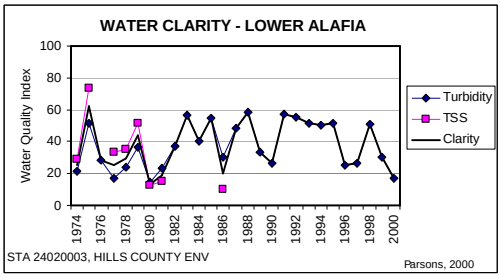
Groundwater quality is affected by the quality of recharge waters, the porous media through which it flows, and the duration of contact with the porous media. Due to this watershed's proximity to the bay and the estuarine nature of its lower reaches, groundwater quality is also affected by mixing with seawater or mineralized waters from lower depths (SWFWMD 2001).

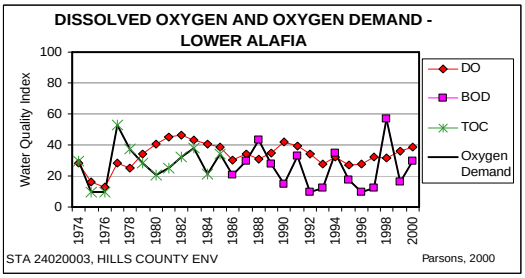
Water quality in the surficial aquifer can be impacted by precipitation, agricultural practices, septic systems, discharges from the Floridan aquifer, and the location of the freshwater/saltwater interface. Water quality in the surficial aquifer is generally good in the Alafia River Watershed, except in tidally influenced areas along the coast where high total dissolved solids (TDS) and sulfate levels are observed. In one of SWFWMD's surficial aquifer monitoring wells (Boyette – 275113 821626) nitrate levels are often higher than in the Upper Floridan, which could be indicative of excessive fertilizer use or sewage disposal practices. However, due to limited data, it is not possible to confirm such a conclusion (SWFWMD 2001).

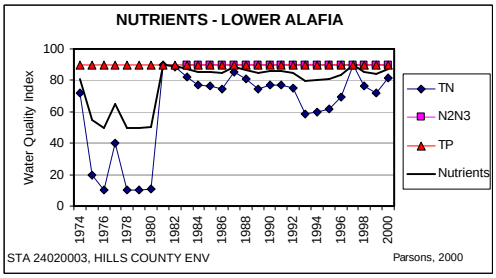
In the intermediate aquifer the water is potable throughout most of the watershed. However, high TDS levels are observed near the coast, likely due to seawater intrusion. TDS levels decline steadily inland from the bay and increase again in the southwest portion of the watershed. This increase is possibly due to breaches in the confining layer resulting from mining (SWFWMD, 2001). Water stored in the Upper Floridan aquifer is generally good with the exception of areas near the coast (SWFWMD, 2001).

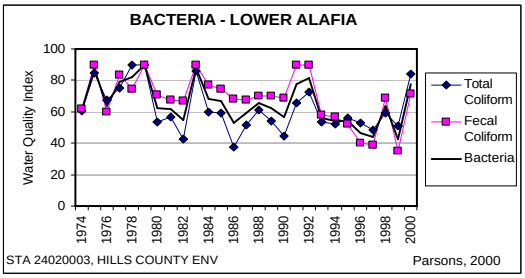
7.4.2.10 Superfund Sites

Figure 7.2 -20 shows the location of groundwater monitoring efforts associated with Superfund sites. The U.S. Environmental Protection Agency (EPA) is responsible for monitoring these sites under the Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA). The EPA database lists eight sites within the Alafia River watershed. Of these sites, seven are designated as sites where no further remedial action is planned. The EPA recognizes a possibility that hazardous substances will be released from the remaining site, the Sydney Mine









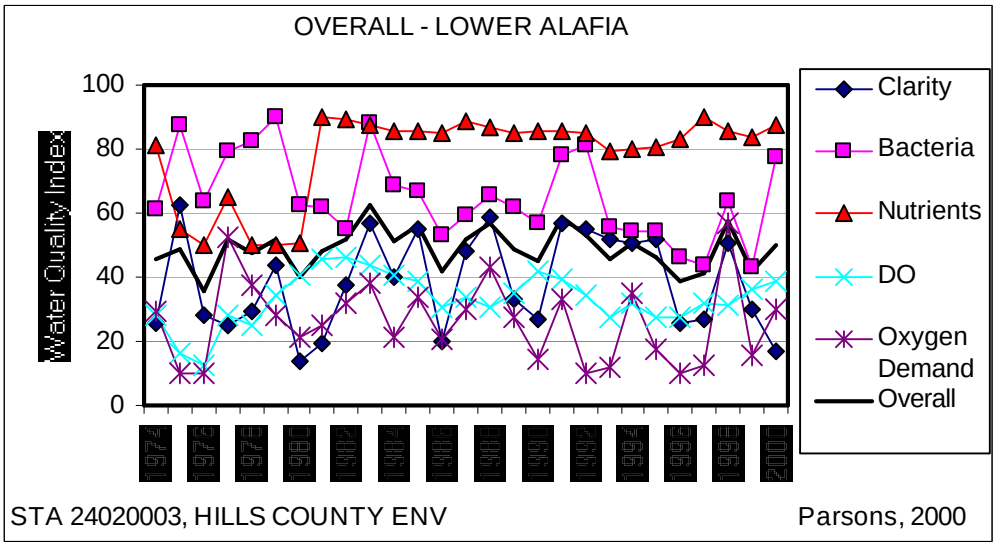
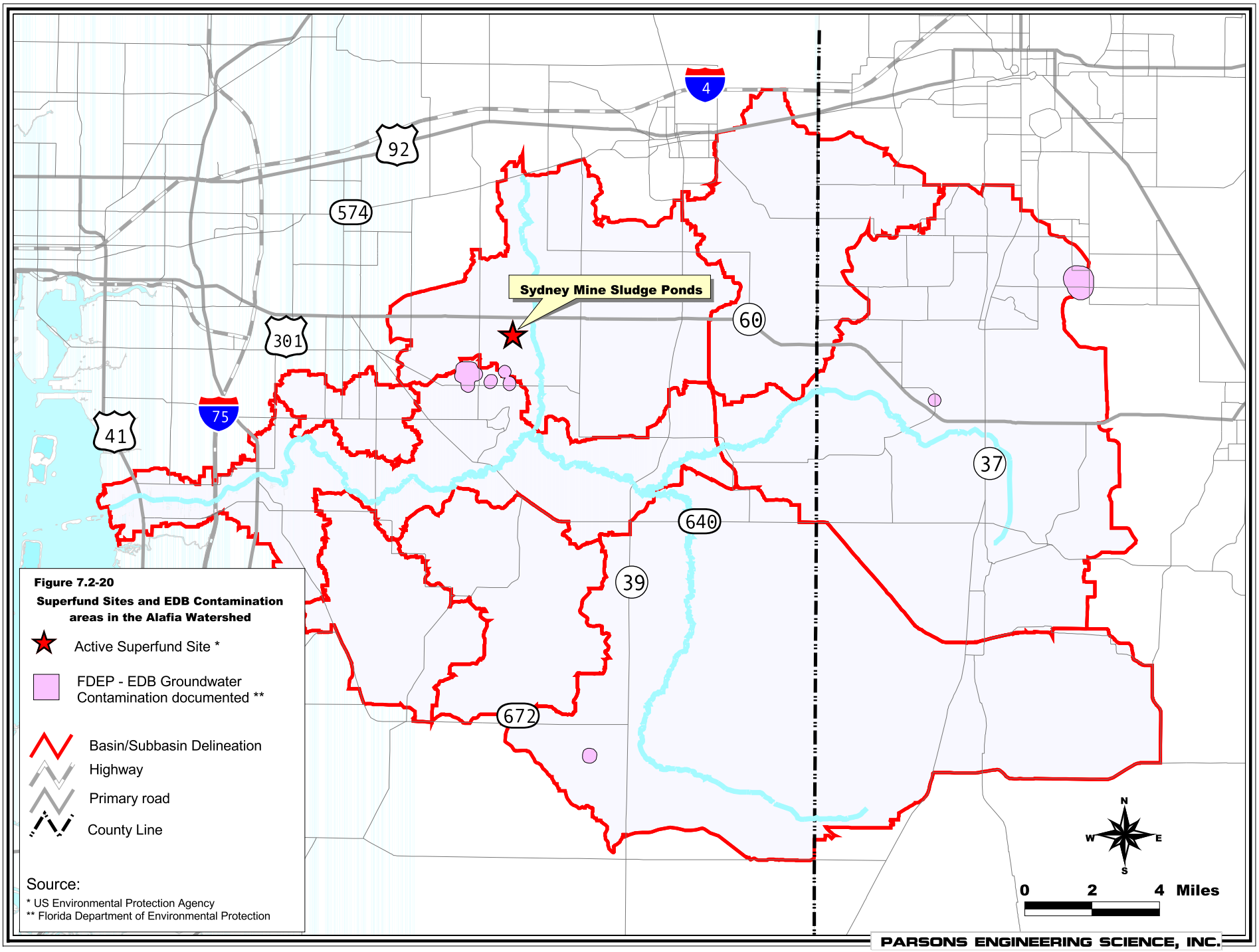


FIGURE 7.2-19C: ALAFIA RIVER, STATION 24020003
HEPC STA 114

Overall						
Year	Clarity	Bacteria	Nutrients	DO	Oxygen Demand	Overall
1974	25	61	81	28	29	46
1975	63	87	55	16	10	49
1976	28	64	50	13	10	36
1977	25	79	65	28	53	52
1978	30	82	50	25	37	48
1979	44	90	50	34	28	52
1980	13	62	50	41	21	40
1981	19	62	90	45	25	48
1982	37	55	89	46	32	52
1983	57	88	87	43	38	63
1984	40	68	86	41	22	51
1985	55	67	85	39	34	56
1986	20	53	85	31	21	42
1987	48	59	89	34	30	52
1988	59	66	87	31	43	57
1989	33	62	85	35	28	49
1990	27	57	86	42	15	45
1991	57	78	86	39	33	59
1992	55	81	85	34	10	53
1993	52	56	80	28	12	45
1994	50	54	80	32	35	50
1995	52	54	81	27	18	46
1996	25	47	83	28	10	39
1997	27	44	90	32	12	41
1998	51	64	86	31	57	58
1999	30	43	84	36	16	42
2000	17	78	87	39	30	50

FIGURE 7.2-19C: ALAFIA RIVER, STATION 24020003
HEPC STA 114


4
92
574
301
75
41
60
37
640
39
672
Sydney Mine Sludge Ponds
Figure 7.2-20
Superfund Sites and EDB Contamination areas in the Alafia Watershed
Active Superfund Site *
FDEP - EDB Groundwater Contamination documented **
Basin/Subbasin Delineation
Highway
Primary road
County Line
Source:
* US Environmental Protection Agency
** Florida Department of Environmental Protection
N
W
E
S
0 2 4 Miles
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sludge ponds. Several Superfund sites, where no further remedial action is planned, are located just outside the watershed.

Sydney Mine Sludge Ponds
The following is reprinted from the EPA's Superfund site database**.**

Site Background: The Sydney Mine Sludge Ponds Site is a 9*.5-acre* former liquid waste disposal site that was strip-mined for phosphate ore from the 1930s through the 1950s. Starting in late 1973, Hillsborough County leased a small portion of the tract and operated a liquid waste disposal facility until 1981. Approximately 16 million gallons of liquid waste, including sludge, grease trappings, cutting oil, etc. were hauled to and disposed of at the site. As a result of this disposal, contaminants, principally volatile organic compounds, have migrated vertically and laterally, and are being detected in the limestones of the Hawthorn aquifer, locally the principal potable water source of groundwater.

Cleanup Progress: Actual Construction Underway Twelve thousand cubic yards of contaminated soil from the sludge ponds were excavated and incinerated in the mid-1980s. Subsequent to this, the County constructed a slurry wall around the ponds, believing that this would prevent the migration of contaminants. In the late 1980s the County constructed a recovery and treatment system in order t*o* remediate the surficial aquifer. The ROD in 1989 directed that the aquifer be restored and working under a Unilateral Administrative Order in the early 1990s, the potentially responsible parties modified the surficial aquifer system, in an effort to improve the performance of the system. While this work was going on it became apparent that two additional water-bearing units had also become contaminated. At EPA's request additional recovery wells were installed in the intermediate aquifer. This system was put into operation in early 1995.

Late in 1996, the potentially responsible parties have submitted a plan to evaluate the effectiveness of intrinsic bioremediation, rather than active pumping and treating, as a way of ultimately achieving cleanup goals. Groundwater quality data over the years indicate that remediation through pumping and treating will take a very long time. EPA will evaluate this proposal, keeping in mind Tampa Bay's growth along the corridor that the site is located. The very same reason that attracted disposal of the liquid wastes in the clays of the former phosphate mine makes remediation of the groundwater to State of Florida standards very problematic.

In late 1997, the first round of data collection to determine whether intrinsic bioremediation is a viable option for the site's surficial and intermediate aquifers was conducted. The report on the second and final phase was submitted for EPA and FDEP review in mid-June 2000. Comments from FDEP have been received. Comments from EPA's Office of Research and Development are forthcoming during the week of September 25, 2000. Following this, EPA in consultation with

the FDEP may amend the 1989 ROD to rely on passive intrinsic bioremediation to conclude the groundwater clean-up, should the data being collect support this.

7.3 Water Quality Issues/Areas of Concern

Descriptions of various water quality issues and areas of concern related to the Alafia Watershed are provided in this section. These issues include regulated discharges as well as the Mulberry spill and various nonpoint sources.

7.3.1 Regulatory Issues / Regulated Discharges

From a regulatory perspective the Federal Water Pollution Control Act ("Clean Water Act"), as amended, provides the underlying legal framework for water quality management throughout the United States. The Clean Water Act requires that the chemical, physical and biological integrity of the Nation's waters be maintained at levels that provide "fishable and swimmable" conditions for all citizens. Regulations developed by the U.S. EPA and other agencies to implement the Act have therefore focused on maintaining water quality at levels necessary to support viable populations of fish and wildlife and protect human health.

Water quality standards—which include designated uses, numeric and narrative water quality criteria, and an anti-degradation policy—have been the primary tools used in the national management effort. Designated uses, such as potable water supply, shellfish harvesting, wildlife propagation and recreational contact, are identified by each state through its rulemaking process and are established for all waterbodies within a state's jurisdiction (e.g., Ch. 62-302.400, Florida Administrative Code [F.A.C.]). Water quality criteria, which describe the specific water quality conditions needed to achieve designated uses, are also established by rulemaking at the state level (e.g., Ch. 62-302.530, F.A.C.). Anti-degradation policy, which is implemented through the permitting process, holds that all existing uses of a waterbody (including those that may exceed the designated uses) should also be maintained. If existing water quality is higher than is strictly necessary to support designated uses, for example, regulatory agencies will seek to maintain that quality unless important economic and social goals require otherwise.

In order to prevent or correct water quality degradation caused by manmade nutrient discharges, state criteria typically include provisions intended to prevent excessive loads from anthropogenic sources (e.g., stormwater runoff; wastewater discharges from municipal, industrial, and agricultural facilities). State policies and programs also support the restoration of water bodies degraded by historical anthropogenic discharges. Like many states, however, Florida has not established numerical criteria for regulating nutrient loads and eutrophication, relying instead on a narrative guideline that states: "in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna" (Chap. 62-302.530, F.A.C.).

The Alafia Watershed contains numerous point source dischargers (Figure7.3-1). These dischargers include both industrial processes (mainly mine discharges) and domestic waste effluent. These dischargers are regulated by the FDEP and must submit monthly discharge monitoring reports (DMRs). An advisable future activity would be to review these reports. At present, only paper copies are available. Each report must be manually "pulled" from the file at FDEP's Tampa office. Future conversion to a digital format is expected.

Total Maximum Daily Loads (TMDLs)

Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or not supporting their designated uses. Ten stream segments in the Alafia are listed on the state's 1998 Section 303(d), Table 7.3-1.

Table 7.3-1

1998 303(d) List

Segment	Parameters of Concern	DEP Comments	Priority	Projected Year of TMDL Development
Alafia River Above Hillsborough Bay	Dissolved Oxygen, Nutrients, Coliforms		Low	2008
Bell Creek	Dissolved Oxygen, Nutrients, Coliforms		Low	2008
Buckhorn Spring	Nutrients	SWFWMD Suggested. High NOx levels and algal blooms downstream.	Low	2008
English Creek	Nutrients, Coliforms		Low	2008
North Prong	Dissolved Oxygen, Nutrients, Coliforms	This segment was nominated by the SW District. Alafia River Task Force developed a monitoring plan to evaluate facility BMPs.	Low	2008
Owens Branch	Nutrients, Coliforms		Low	2008
Poley Creek	Nutrients, Coliforms, Turbidity		Low	2008
South Prong	Nutrients, Coliforms		Low	2008
Thirtymile creek	Dissolved Oxygen, Nutrients, Coliforms	Included in Alafia River Task Force monitoring plan. Facility BMPs being implemented.	High	2003
Turkey Creek Above Little Alafia	Nutrients, Coliforms, Turbidity		Low	2008

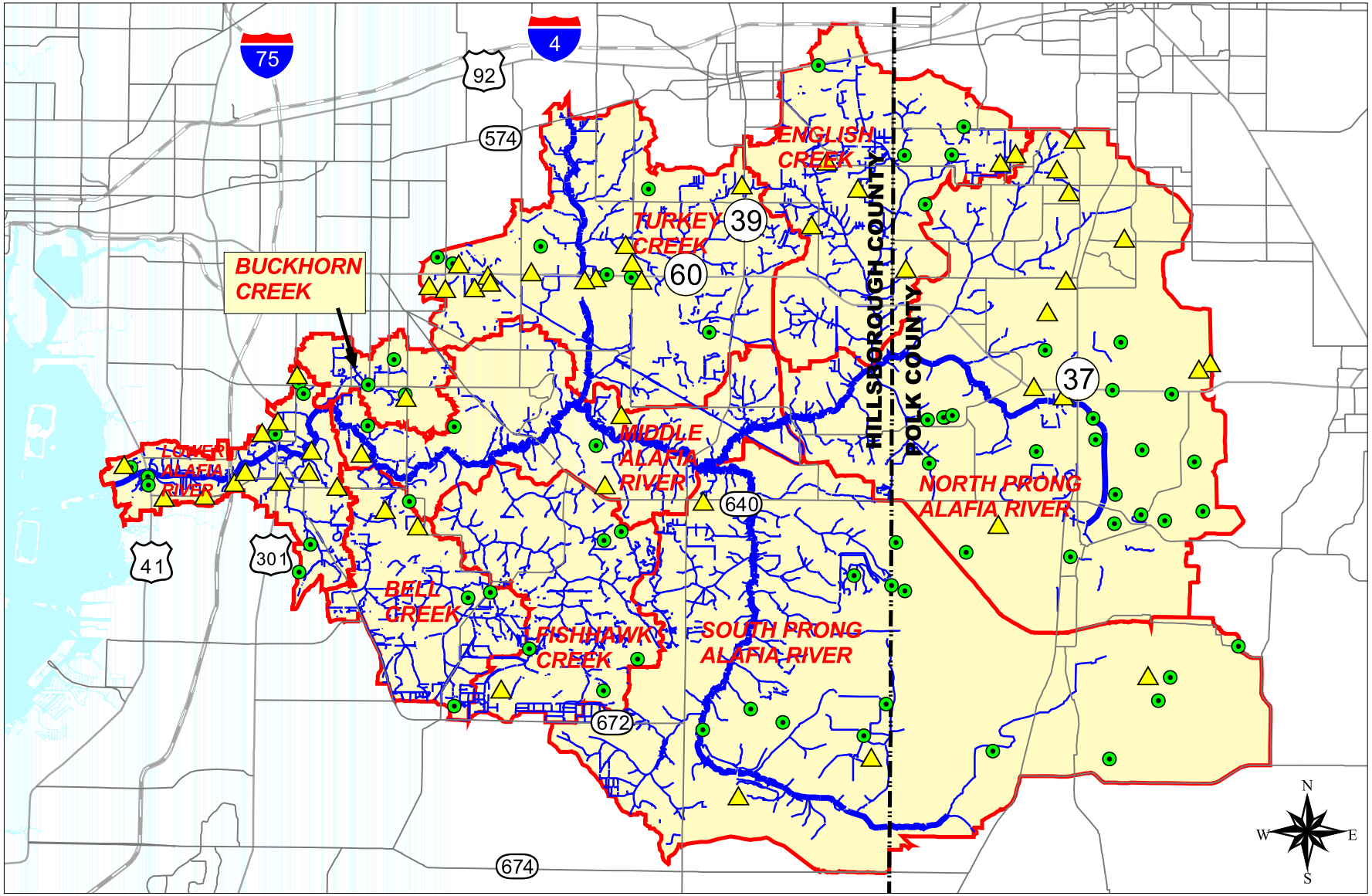

FIGURE 7.3-1
PERMITTED DISCHARGERS

HILLSBOROUGH COUNTY
FLORIDA

Domestic Discharge

Industrial Discharge

Primary road with limited access
Primary road
Secondary and connecting road

Alafia River Watershed

0 1 2 3 4 Miles

Scale: 1" = 4 Miles

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The 1998 list is the most current edition of the impaired waters list that has been approved by the EPA. The Florida Watershed Restoration Act outlines the process by which the list is refined through more detailed water quality assessments. Total TMDLs are required for the waters determined to be impaired based on these detailed assessments because technology-based effluent limitations, current effluent limitations required by state or local authority, or other pollution control requirements are not stringent enough to meet current water quality standards. TMDLs describe the amount of a pollutant that a water body can receive without violating standards.

The state is evaluating TMDLs by groups of basins on a five-year "basin rotation cycle" which began in 2000. The Alafia Watershed is lumped together with the Hillsborough and Manatee basin into Group 2. TMDL evaluation began for Group 2 in 2001 for high priority basins and will begin in 2006 for low priority basins. Actual TMDL development occurs in year three of the basin rotation cycle; therefore, TMDL development for the high-priority Alafia basin (Thirtymile Creek) is expected in 2003, and TMDL development for low-priority Alafia basins is expected in 2008.

Mulberry Acid Spill (December 1997)

The Mulberry acidic process water spill occurred as a result of a breach in the wall of a phosphogypsum stack located at the MPI phosphoric acid/fertilizer production facility in Mulberry, Polk County, Florida (Figure 7.3-2). Approximately 50-56 million gallons of acidic process water was released into the Alafia River via Skinned Sapling Creek. The released water had a pH of around 2 standard units and contained one or more hazardous (per CERCLA) substances, primarily phosphoric acid. (Cardinale, 1998)

Following the spill MPI, EPC, EPA, and FDEP acted quickly to collect samples and other information that would later be used to document the spill and assess its affect on natural resources. Through these investigations five types of natural resource losses and injuries were documented.

1. Approximately 377 acres of wetland vegetation experienced at least "some observable" die-off.
2. Instantaneous fish, crab, and shrimp kill along with associated loss of future production for affected species.
3. Injury to the physical and chemical quality of the Alafia River's surface waters – Reductions in pH in the river as well as increased nutrient concentrations that caused an imbalance in the natural populations of aquatic flora and fauna for several months.
4. Sediment sampling revealed a reduced abundance and diversity in benthic invertebrates compared to control and background stations.
5. A 30% mortality rate of the oyster and mussel population was documented after the spill.

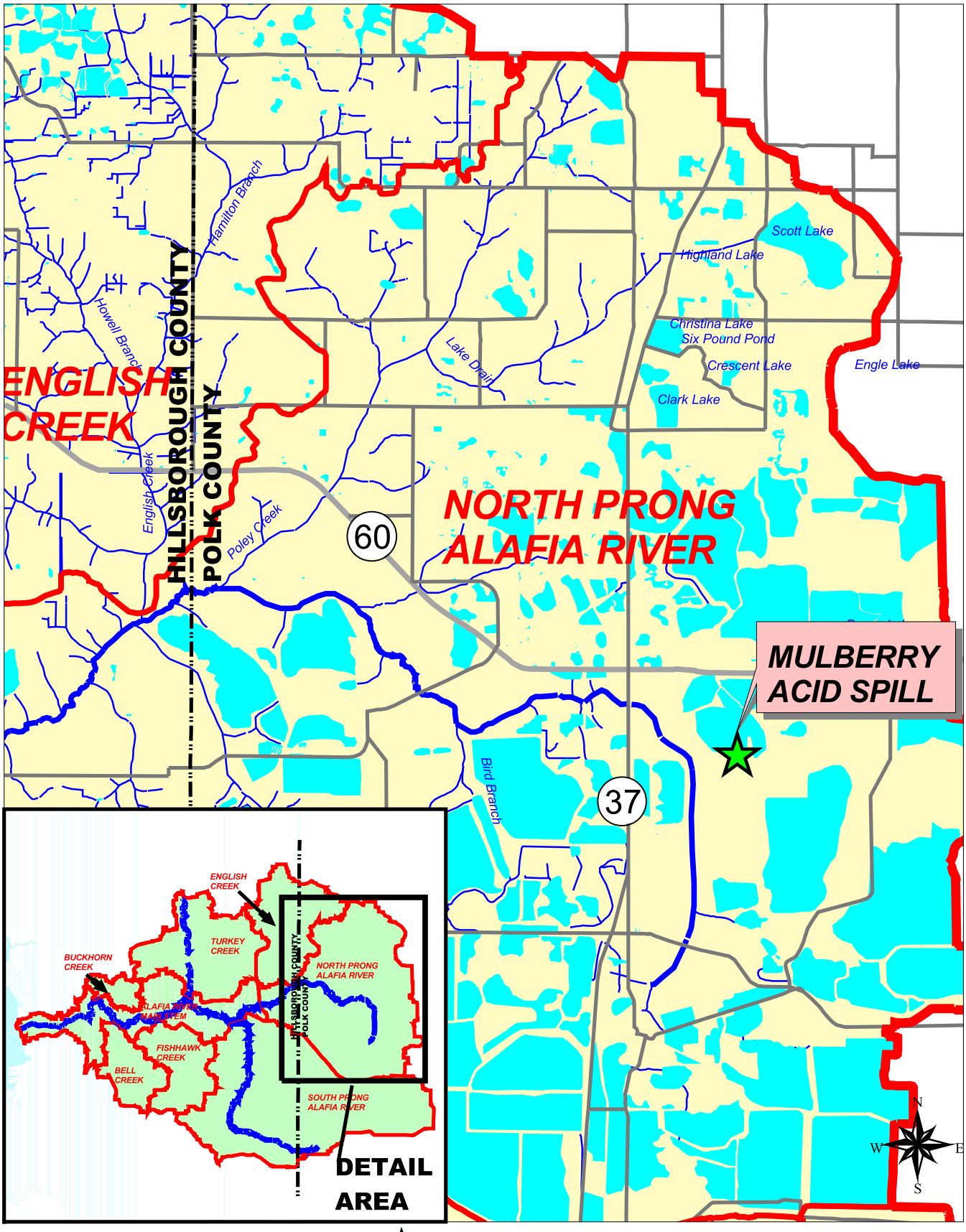

FIGURE 7.3-2
MULBERRY ACID SPILL

HILLSBOROUGH COUNTY
FLORIDA

Acid Spill Location
Alafia River Watershed
Main River Channel
Creek

Primary road with limited access
Primary road
Secondary and connecting road

0 4000 8000 Feet
Scale: 1" ~ 8,000'

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Other affects of the spill that could not be documented immediately but had a potential for injury included:

- Projected loss of bird species due to the loss of prey species (fish and shellfish). The loss of forage species will likely result in impacts to the future productivity and survival of the numerous birds that breed and forage in this area.
- The fish kill that resulted from the spill was substantial enough to indicate a potential for loss of recreational fishing activity.

A draft restoration plan was developed in 1999 and provided for public review. The plan described the strategy for restoration, formed a workgroup to identify potential restoration alternatives, and listed ten potential alternatives that were identified by the group. The alternatives were then screened to ensure that the relation of the benefits of the proposed alternative was appropriate to the effects of the spill. The screening process resulted in the selection of the five alternatives listed below:

1. Restore existing systems in the estuarine portions of the Alafia River.
2. Restore existing systems in the freshwater portions of the Alafia River.
3. Purchase environmentally sensitive lands for preservation.
4. Construct surface water improvement retrofit projects.
5. Create artificial reefs.

The first three alternatives were identified by the agencies involved in the study as the preferred alternatives.

7.3.2 Nonpoint Sources

Nonpoint sources, which have not been covered elsewhere in this report, include urbanization, atmospheric deposition, agriculture, and sewage disposal. These sources are discussed separately in the following subsections.

Urbanization

The negative impacts of urbanization on surface waters have been well documented in a number of sources, including the Nationwide Urban Runoff Program (NURP) and the state 305(b) reports. The practice of converting natural areas to land uses that have increased areas of impervious surfaces results in increased runoff volumes and pollutant loadings. As population density increases, there is a corresponding increase in pollutant loadings generated from human activities. Urban development in Hillsborough County in the Alafia Watershed (Figure 7.3-3) is concentrated in and adjacent to Brandon, Valrico, Riverview, and Plant City.

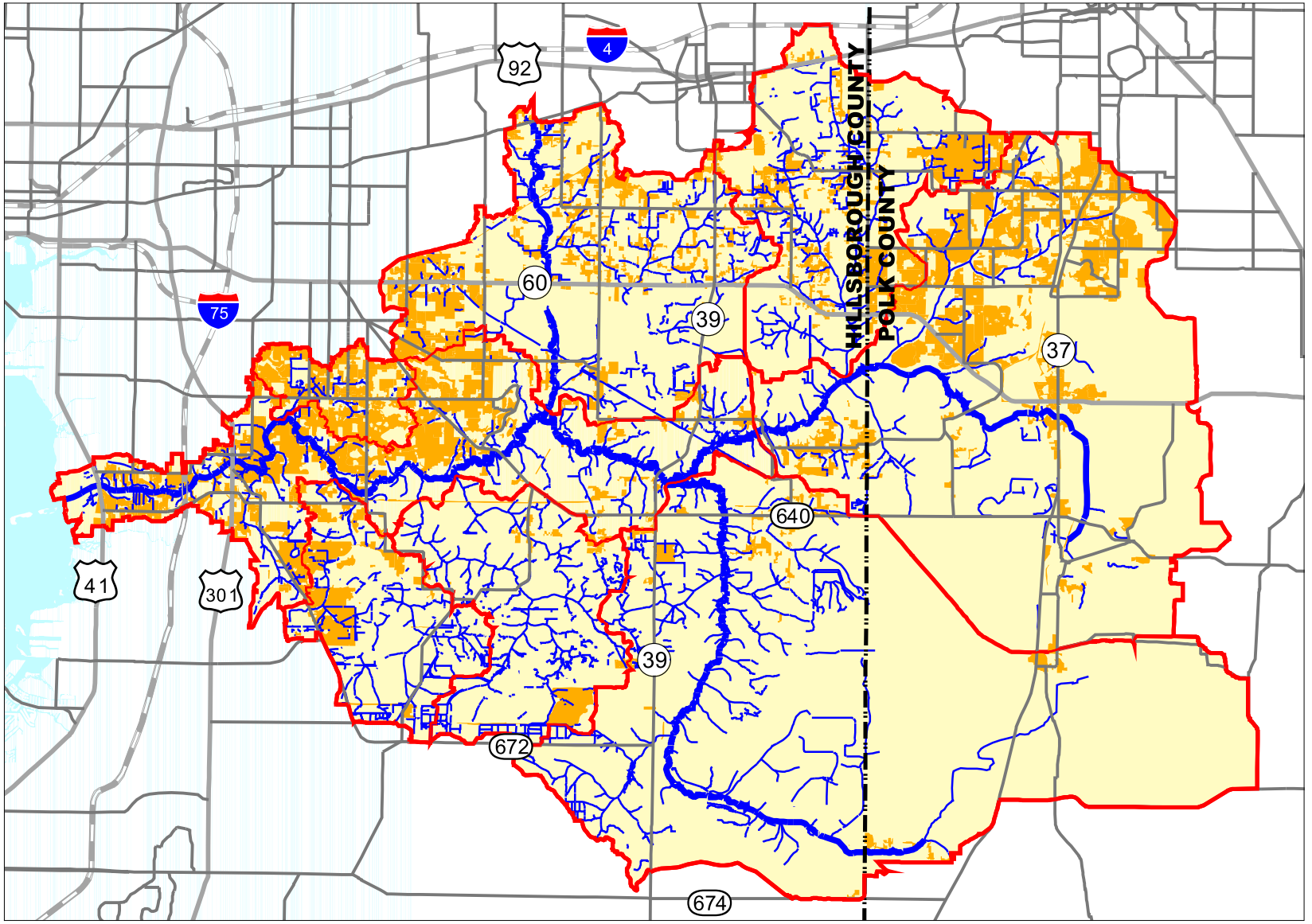

FIGURE 7.3-3
URBANIZATION

HILLSBOROUGH COUNTY
FLORIDA

Urban Land Use

Alafia River Watershed

Primary road with limited access

Primary road

Secondary and connecting road

Main River Channel

Creek

0 1 2 3 4 Miles

Scale: 1" = 4 Miles

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As urbanization progresses, changes to the natural hydrology of an area occur. Runoff volumes and pollutant loads increase and infiltration decreases. These increased flows require the construction of runoff conveyances or the modification of existing drainage systems to avoid flooding and erosion; likewise, increased velocities result in higher velocities that increase sediment loads and do not encourage settling of sediments and other contaminates.

Urban development also causes an increase in pollutants. The pollutants contained in urban runoff vary widely, from common organic material to highly toxic metals. Some of these pollutants, such as pesticides and fertilizers, are purposely placed on the ground surface to benefit the landowner's use or enjoyment of his property. Other pollutants, such as zinc and oil drippings from trucks and cars, are the indirect result of urban activities (USEPA, 1977).

Many researchers have linked urbanization to degradation of urban waterways (e.g., Klein, 1985, Livingston and McCarron, 1992, Schueler, 1987). The major pollutants found in runoff from urban areas include sediment, nutrients, oxygen-demanding substances, heavy metals, petroleum hydrocarbons, pathogenic bacteria, and viruses. Livingston and McCarron (1992) concluded that urban runoff was the major source of pollutants in pollutant loadings to Florida's lakes and streams. Table 7.3-2 lists common pollutants occurring from urban areas.

Table 7.3-2
Typical Sources of Common Pollutants

Source	Pollutants of Concern
Erosion	Sediment and attached soil nutrients, organic matter, and other adsorbed pollutants
Atmospheric deposition	Hydrocarbons emitted from automobiles, dust, aromatic hydrocarbons, metals, and other chemicals released from industrial and commercial activities
Construction materials	Metals from flashing and shingles, gutters and downspouts, galvanized pipes and metal plating, paint, and wood
Manufactured products	Heavy metals, halogenated aliphatics, phthalate esters, PAHs, other volatiles, and pesticides and phenols from automobile use, pesticide use, industrial use, and other uses
Plants and animals	Plant debris and animal excrement
Non-storm water connections	Inadvertent or deliberate discharges of sanitary sewage and industrial wastewater to storm drainage systems
Onsite disposal systems	Nutrients and pathogens from failing or improperly sited systems

(EPA, 1993)

The EPA prepared a very good description of the principal types of pollutants found in urban runoff and described their potential adverse effects. The following is reprinted from Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (EPA, 1993).

> ***Sediment.*** *Suspended sediments constitute the largest mass of pollutant loadings to surface waters. Sediment has both short- and long-term impacts*

on surface waters. Among the immediate adverse impacts of high concentrations of sediment are increased turbidity, reduced light penetration and decreases in submerged aquatic vegetation (SAV) (Chesapeake Implementation Committee, 1988), reduced prey capture for sight-feeding predators, impaired respiration of fish and aquatic invertebrates, reduced fecundity, and impairment of commercial and recreational fishing resources. Heavy sediment deposition in low-velocity surface waters may result in smothered benthic communities/reef systems (CRS, 1991), increased sedimentation of waterways, changes in the composition of bottom substrate, and degradation of aesthetic value. The primary cause of coral reef degradation in coastal areas is attributed to land disturbances and dredging activities due to urban development (Rogers, 1990). Additional chronic effects may occur where sediments rich in organic matter or clay are present. These enriched depositional sediments may present a continued risk to aquatic and benthic life, especially where the sediments are disturbed and resuspended.

***Nutrients**. The problems resulting from elevated levels of phosphorus and nitrogen are well known. Excessive nutrient loading to marine ecosystems can result in eutrophication and depressed dissolved oxygen (DO) levels due to elevated phytoplankton populations. Eutrophication-induced hypoxia and anoxia have resulted in fish kills and widespread destruction of benthic habitats (Harper and Gullient, 1989). Surface algal scum, water discoloration, and the release of toxins from sediment may also occur. Species composition and size structure for primary producers may be altered by increased nutrient levels (Hecky and Kilham, 1988; GESAMP, 1989; Thingstad and Sakshaug, 1990).*

Occurrences of eutrophication have been frequent in several coastal embayments along the northeast coast (Narragansett and Barnegat Bays), the Gulf Coast (Louisiana and Texas), and the West Coast (California and Washington) (NOAA, 1991). High nitrate concentrations have also been implicated in blooms of nuisance algae in Newport Bay, California (NRC, 1990b). Nutrient loadings in Louisiana coastal waters have decreased productivity, increased hypoxic events, and decreased fisheries yields (NOAA, 1991).

***Oxygen-Demanding Substances**. Proper levels of DO are critical to maintaining water quality and aquatic life. Decomposition of organic matter by microorganisms may deplete DO levels and result in the impairment of the waterbody. Data have shown that urban runoff with high concentrations of decaying organic matter can severely depress DO levels after storm events (USEPA, 1983). The NURP study found that oxygen-demanding substances could be present in urban runoff at concentrations similar to secondary treatment discharges.*

Pathogens. *Urban runoff typically contains elevated levels of pathogenic organisms. The presence of pathogens in runoff may result in waterbody impairments such as closed beaches, contaminated drinking water sources, and shellfish bed closings. OSDS-related pathogen contamination has been implicated in a number of shellfish bed closings.*

Hydrocarbons*. Petroleum hydrocarbons are derived from oil products, and the source of most such pollutants found in urban runoff is vehicles - auto and truck engines that drip oil. Many do-it-yourself auto mechanics dump used oil directly into storm drains (Klein, 1985). Concentrations of petroleum-based hydrocarbons are often high enough to cause mortalities in aquatic organisms.*

Oil and grease contain a wide variety of hydrocarbon compounds. Some polycyclic aromatic hydrocarbons (PAHs) are known to be toxic to aquatic life at low concentrations. Hydrocarbons have a high affinity for sediment, and they collect in bottom on benthic sediments where they may persist for long periods of time and result in adverse impacts communities. Lakes and estuaries are especially prone to this phenomenon.

Heavy Metals*. Heavy metals are typically found in urban runoff. For example, Klein (1985) reported on a study in the Chesapeake Bay that designated urban runoff as the source for 6 percent of the cadmium, 1 percent of the chromium, 1 percent of the copper, 19 percent of the lead, and 2 percent of the zinc.*

Heavy metals are of concern because of toxic effects on aquatic life and the potential for ground-water contamination. Copper, lead, and zinc are the most prevalent NPS pollutants found in urban runoff. High metal concentrations may bioaccumulate in fish and shellfish and impact beneficial uses of the affected waterbody.

Toxics*. Many different toxic compounds (priority pollutants) have been associated with urban runoff. NURP studies (USEPA, 1983) indicated that at least 10 percent of urban runoff samples contained toxic pollutants.*

Agriculture.

Approximately 30% of the land use in the Alafia River Watershed is agricultural (Figure 7.3-4), including cropland, pasture, tree crops, ornamental plant nurseries, fish farms, dairies, and horse farms. Croplands and pasture are the predominant land uses, especially in the eastern portion of the watershed. Nutrients, sediment, animal wastes, and pesticides are the primary concerns from agricultural runoff. Direct impacts to the habitat of aquatic species can also occur due to livestock,

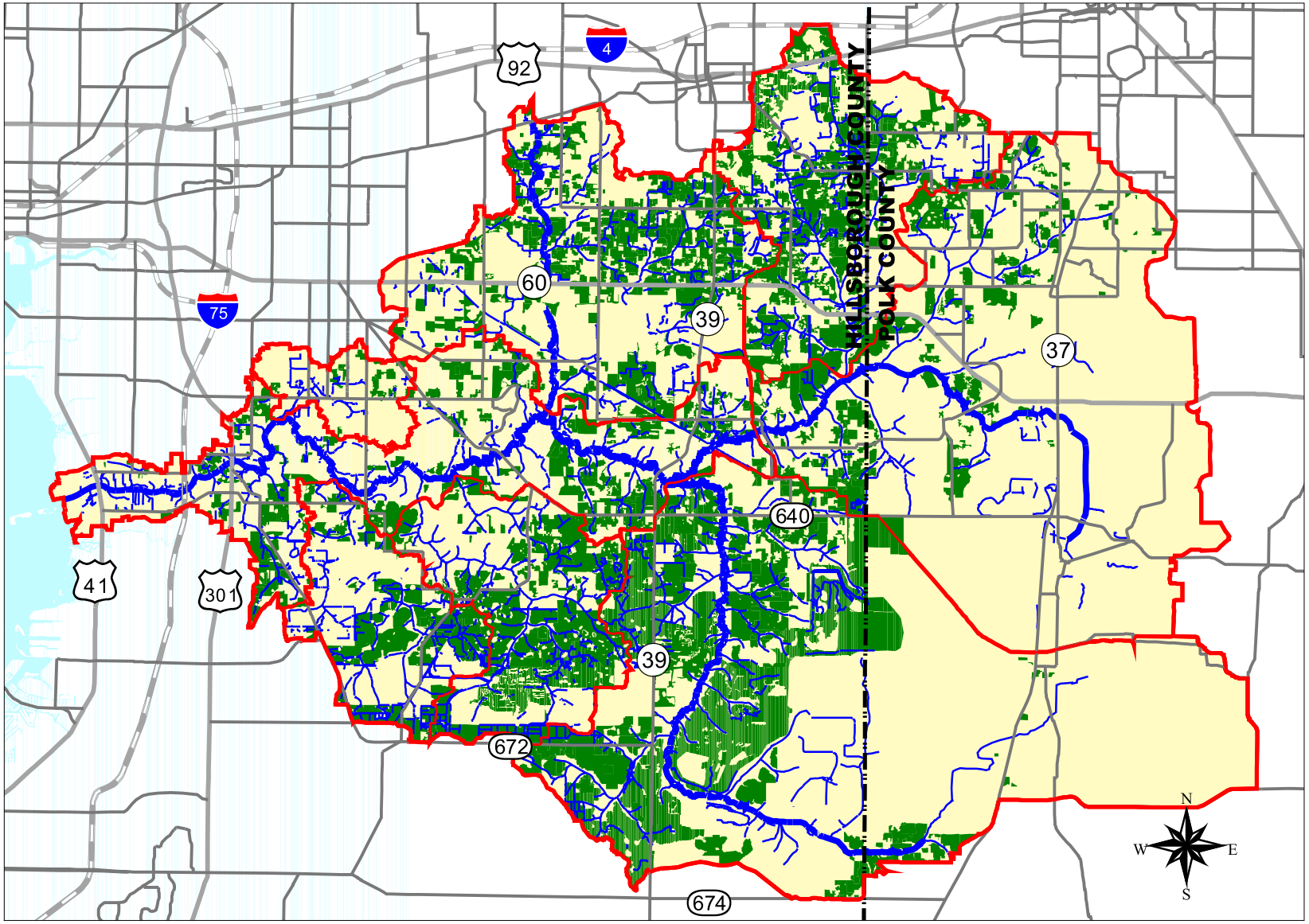

FIGURE 7.3-4
AGRICULTURE

HILLSBOROUGH COUNTY
FLORIDA

Agriculture Land Use

Alafia River Watershed

Primary road with limited access

Primary road

Secondary and connecting road

Main River Channel

Creek

0 1 2 3 4 Miles

Scale: 1" = 4 Miles

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equipment, or water management activities. The effects of these pollutants on water quality are discussed below.

Nitrogen and phosphorus are the two major nutrients from agricultural land that degrade water quality. Nutrients are applied to agricultural land generally either as commercial fertilizer in a dry or fluid form or manure. Increased nutrient loads can cause increased plant productivity. These plants eventually die depleting oxygen that reduces the quality of fish habitat. Additionally, increased algae production results in a corresponding increase in turbidity that interferes with feeding and reduces beneficial light penetration. Turbidity is also increased due to sediment load, and some pesticides and nutrients are transported with sediment.

Animal wastes contain oxygen-demanding substances, nutrients, and organic solids as well as bacteria, viruses, and other microorganisms. Fish kills may result from runoff and manure due to ammonia or dissolved oxygen depletion. Animal diseases can also be transmitted to humans through contact with animal feces.

Pesticides degrade water quality by eliminating or reducing populations of desirable organisms. This is caused by behavioral and structural changes in an organism that can occur due to pesticide exposure. For example, certain pesticides have been found to affect reproduction by inducing abortion. Herbicides in the aquatic environment can destroy the food source for higher organisms.

A major source of contamination from pesticide use is the result of normal application of pesticides. Other sources of pesticide contamination are atmospheric deposition, spray drift during the application process, misuse, and spills, leaks, and discharges that may be associated with pesticide storage, handling, and waste disposal. Pesticides can be transported to receiving waters either in dissolved form or attached to sediment.

Atmospheric Deposition

Atmospheric deposition is the fallout of nutrients and toxic materials in the atmosphere on to the earth's surface. Atmospheric pollutants may be deposited in dry or wet form. Dry deposition involves the settling of particulates over time with gravity. Wet deposition occurs when particulates and aerosols are removed from the atmosphere by a precipitation event. Wet deposition accounts for the majority of pollutants removed from the atmosphere (Paerl et al., 1990).

The nutrients and toxic materials are dispersed into the atmosphere from natural and anthropogenic sources, but the majority of the atmospheric pollution is the result of anthropogenic activity. The pollutants dispersed can remain in the local airshed or be distributed over thousands of miles, depending on atmospheric conditions. This makes determining the source of the pollution difficult. However, by monitoring the source or point of emission, many local contributors of the atmospheric pollutants can be identified.

Atmospheric nitrogen is also derived from many elusive, or non-point sources, many of which are not regulated under the Clean Air Act. Studies indicate that nitrogen levels in the atmosphere are increasing steadily and are largely responsible for the eutrophication of surface waters. Excessive nitrogen stimulates the growth of algae that can result in noxious odors, increased water turbidity and subsequent reduction in seagrass populations, and decreased dissolved oxygen concentrations to levels lethal to fish.

As much as 27 percent of the nitrogen and 31 percent of the phosphorus entering Tampa Bay is the result of atmospheric deposition (Zarbock et al., 1994). A study sponsored by the U.S. Environmental Protection Agency (EPA) for the Tampa Bay Estuary Program (TBEP, 1994) determined atmospheric deposition to be responsible for as much as 67 percent of the total nitrogen loading of Tampa Bay. The Alafia River Watershed contributes a significant amount of runoff to the bay, and includes within its boundaries some of the major sources of atmospheric pollution. These sources include power generation facilities, mass-burn incinerators and various other industrial operations.

In order to combat the effects of atmospheric deposition on Tampa Bay, the TBEP (June 2000) established a Nitrogen Management Consortium of local interested parties in 1996. The consortium consists of local governments, regulators, and representatives from the fertilizer production industry, agriculture, and utility. The consortium agreed to a plan that would reduce the nitrogen influx into the bay by 17 tons per year. The action plan involves the implementation of projects that will result in the reduction in numbers of septic systems and the construction of regional stormwater facilities (TBEP 1996). In order to address the source and magnitude of the atmospheric deposition input, and to develop appropriate management policies to reduce the input, the TBEP established a monitoring site near Gandy Bridge in Tampa. The monitoring stations measure wet and dry deposition of nitrogen and meteorological conditions and the data will be used to develop policies to reduce the levels of atmospheric pollutants.

Sewage Disposal

Sewage disposal activities in the watershed have the potential to impact surface water quality. These activities include septic tank usage, septage spreading, and sanitary sewer collection facilities and are described separately in the following subsections.

Septic Tanks

The use of septic tanks for sewage disposal is prevalent in the Alafia Watershed, and sewer service in not available in much of the watershed. Figure 7.3-5 shows the water and waste water (WWW) service boundaries within the watershed. The addresses for recent (1995-2000) septic tank permit applications were obtained from the Hillsborough County Health Department and plotted as shown on Figure 7.1-2. Information concerning the location of every septic tank in the watershed is

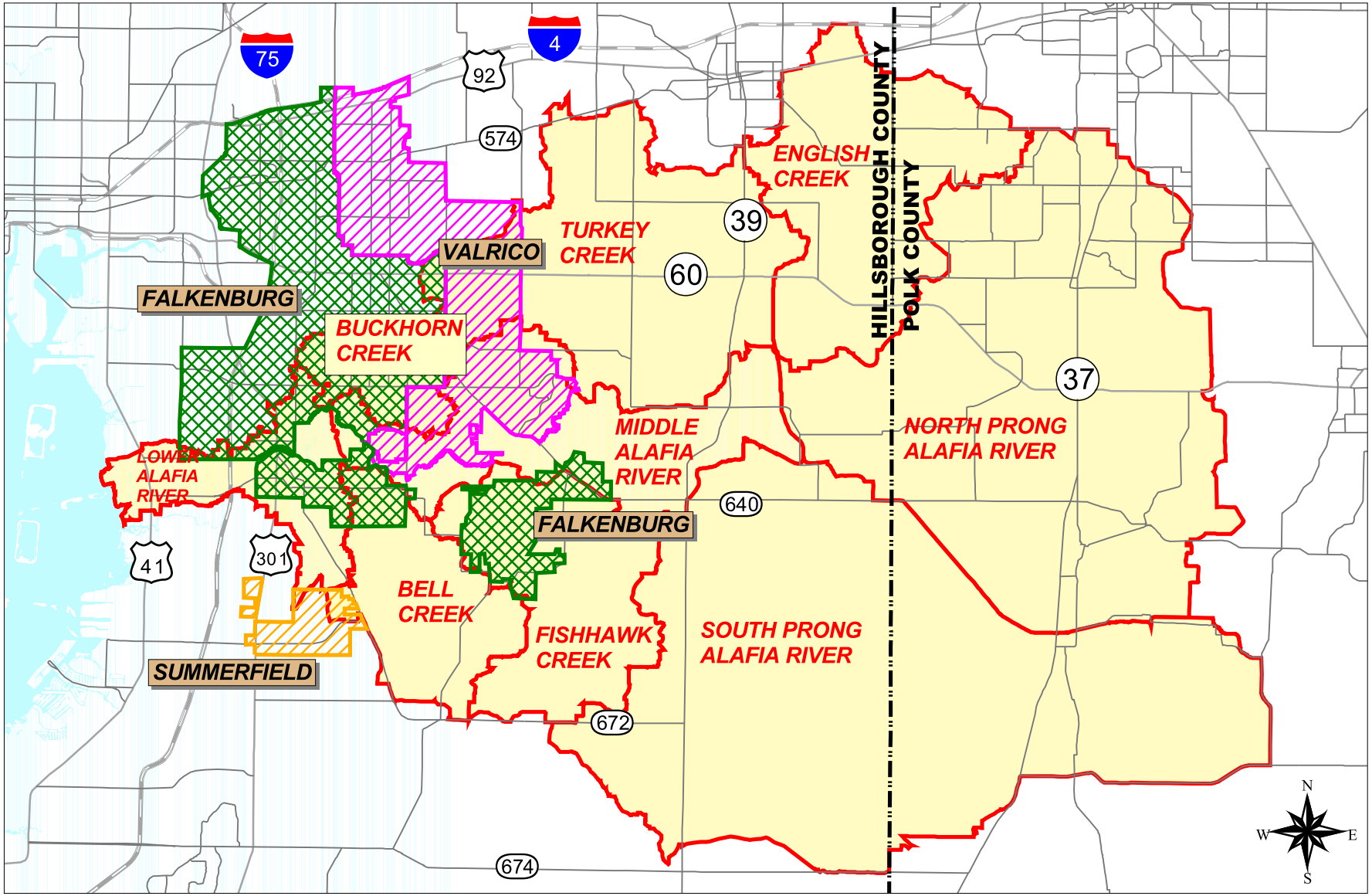

FIGURE 7.3-5
WWW SERVICE BOUNDARIES

HILLSBOROUGH COUNTY
FLORIDA

WWW Service Boundary
- FALKENBURG
- SUMMERFIELD
- VALRICO

- Primary road with limited access
- Primary road
- Secondary and connecting road
- Alafia River Watershed

0 1 2 3 4 Miles

Scale: 1" = 4 Miles

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not available; however, this figure shows the relative density of septic based on recent permits for either a new septic tank or a septic tank repair.

Septic tank effluent is a source of nitrogen, phosphorus, organic matter and bacterial and viral pathogens. Improper design or installation as well as neglectful operation compound the problem. In regards to system operation, as many as 75 percent of all system failures have been attributed to hydraulic overloading (Jarrett et al., 1985). Also, regular inspection and maintenance is necessary. and often does not occur. Also, septic systems are designed to operate over a specified period of time. At the end of the expected life span, replacement is necessary. Homeowners may be unaware of this issue or unable to afford a replacement.

Septage Spreading

The locations of septage spreading sites are shown on Figure 7.1-2. This practice is prevalent in the Fishhawk and Turkey Creek Watersheds and to a lesser degree in Bell Creek, South Prong, and the Middle Alafia. For the most part these sites are privately owned agricultural lands. The septage has value as a fertilizer; therefore, landowners either pay to have the waste delivered or simply grant permission to disposal companies to spread the waste on their land. This waste originates from pumped-out septic tanks.

This activity can impact surface water runoff quality as well as ground water due to high concentrations of nutrients, trace metals, and organic compounds. The primary controlling factor appears to be presence or lack of runoff controls in the case of impacted runoff, and the application rate in the case of potential groundwater contamination (Johnson, 1979).

Septage spreading is regulated by the Florida Department of Health. Pretreatment regulations are in force to reduce the potential for adverse impacts and setback requirements are in place to address the issue of stormwater runoff. Pretreatment involves screening for solids and stabilizing with lime. Setbacks are imposed on a sliding scale depending on site location and conditions ranging from 75 feet for drainage ditches to 3000 feet to Class I waters.

The Hillsborough County Water Department has investigated the feasibility of accepting 100 percent of the County's septage at wastewater treatment plants (WWTPs). The water department estimates that the capacity to dispose of 180,000 gallons of septage per day is needed to serve the needs of the entire county. The capital cost of WWTP improvements needed to accept the septage was estimated at $4.6 million. Operating costs are estimated at $80 per 1,000 gallons and three new employees would be needed. Public meetings were held in 1998 and the issue of discontinuing septage spreading in Hillsborough County is still under consideration.

Sanitary Sewer Collection Systems

Leaking sewers can be a source of nitrogen, phosphorus, organic matter and bacterial and viral pathogens. Leaks may be due to ill-fitting pipe joints, ruptures, or pipe failure caused by age or soil conditions. Whatever the pathway from the sewer line to the environment, surface water quality problems can result both from sewage leaking from the system or groundwater "leaking" to the system. Sewage leaks are problematic for obvious reasons, seepage, or flow, into the system can lead to sewage overflows due to pumping station capacity limitations or treatment plant bypass.

7.4. References

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Figure 7.1-2

WATER QUALITY

ALAFIA RIVER
WATERSHED MANAGEMENT PLAN

- Permitted Septic Tank - Hillsborough County Health Department
- Septage Spreading Site
- Environmental Protection Commission of Hillsborough County
- Hillsborough County Streamwatch
- Lake Monitoring Program
- Adop-a-Pond
- US Geological Survey Guaging Station

Permitted Point Source Discharge

Domestic

Domestic Wastewater is the liquid and water carried waste removed from residences, businesses, and institutions. Essentially, water is considered drinking water or potable water before it is used; after it has been used and discarded it becomes wastewater. Domestic Wastewater generally includes material disposed of through toilets, sinks, tubs and showers, washing machines and the like. Domestic Wastewater may also include partially treated Industrial Wastewater.

Industrial

Wastes from industrial sources contribute to water quality problems through out Hillsborough County. These industrial sources are issued discharge permits that authorize the discharge of properly treated wastewater to the land or surface water. Depending on the source, industrial wastewater discharges are highly variable in the volume and types of pollutants they contain.

Water Bodies

- Lake or Pond
- Wetland

Source:
Wetland and water features are from SWFWMD 1995 Land Use/Cover FLUCCS. These do not represent jurisdictional lines.

- Creek
- River
- Drainage Structure
- Basin/Watershed Boundary
- County Boundary
- Incorporated City
- Road
- Railroad

HILLSBOROUGH COUNTY
FLORIDA

N W E S

0 4500 9000 Feet

Scale: 1":4500'

PLANT CITY
LAKELAND
MULBERRY
HILLSBOROUGH COUNTY
POLK COUNTY

Valrico subregional WTP
Riverhills Country Club WTP
Rice Creek WTP
Boyette Springs Subdivision WTP
City of Lakeland WTP
City of Mulberry WTP

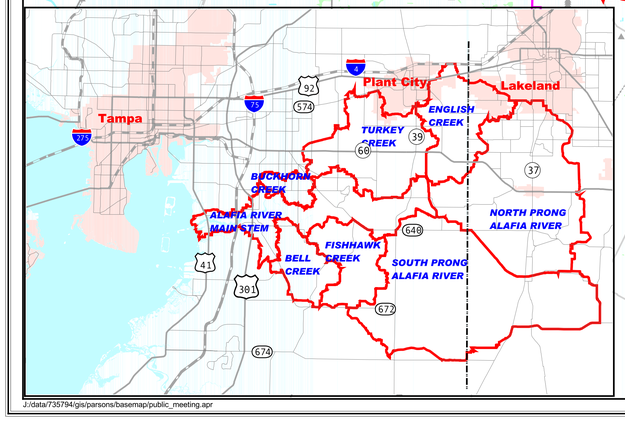
Cargill, Inc
Mobil Mining, Nichols Prep Plant
Mulberry Phosphates, Inc
Mobile Mining, Nichols Mine
Farmland Hydro L.P. - Green Bay Plant
Imc Fertilizer, Haynesworth Mine
Estech Silver City Mine
Mobile Mining, Big Four Mine

Carlton/Boyette Septage Site
McLean septage Site
Thompson Pasture Septage Site
Pruitt Ranch Septage Site
Mike Nelis Septage Site
Lacy Simmons Grove Septage Site
Lawton Grove Septage Site
Lightsey Grove Septage Site
Washington Road Septage Site

Turkey Creek
Turkey Creek Tributary A
Turkey Creek Tributary B
Grassy Creek
Little Alafia River
Railroad Ditch
Medard Tributary A
Medard Tributary B
MEDARD RESERVOIR
Sterrs Ditch
Buckhorn Creek
Archie Creek
Alafia River
Rice Creek
Bell Creek
Fishhawk Creek
Little Fishhawk Creek
McCollough Branch
McDonald Branch
Hutto Lake
Brown Lakes
Lake Grady
Boggy Creek
Pringle Branch
Long Fist Creek
Doe Branch
Annie Creek
Chito Branch
Owens Branch
Halls Branch
Mizelle Creek
West Branch
Guy Branch
South Prong Alafia River
North Prong Alafia River
Hurrah Creek
Hurrah Lake
Boggy Branch
Lewis Branch
Lake Branch
Howell Branch
Hamilton Branch
Lake Drain
English Creek
Poley Creek
Thirtymile Creek
Stoman Branch
Bird Branch
Little Bullfrog Creek
Bullfrog Creek
Scott Lake
Highland Lake
Christina Lake
Six Pound Pond
Crescent Lake
Clark Lake
Engle Lake
Bonny Lake

TRAPNELL RD
DURANT RD
E BLOOMINGDALE AVE
BOYETTE RD
EWELL RD
SHEPHERD RD
BAILEY RD
SMITH RYALS RD
COUNTY LINE RD
DOVER RD
TURKEY CREEK RD
S FORBES RD
MCINTOSH RD
BELL SHOALS RD
BAILEY RD
BAILEY RD
BOYETTE RD
STEPHEN J. WORTHAM PARK
WILLIAM OWEN PASS PARK
EDWARD MEDARD PARK
LITHIA SPRINGS PARK
ALDERMAN'S FORD PARK

111 112 114 115 116 129 130 132 139 144 149 150 151 153 154 201 202 203 204 205 206 208 209 210 211 212 214 217 2301000 2301300 2301500



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PARSONS ENGINEERING SCIENCE

Id	Stationnum	Org	Start	End
1	FL6290937	EPA/ODW	3/18/1986	3/18/1986
2	GFCSR0438	FL GAME AND FRESH WATER FISH	5/15/1984	5/15/1984
3	GFCSR0439	FL GAME AND FRESH WATER FISH	5/15/1984	5/15/1984
4	GFCSR0440	FL GAME AND FRESH WATER FISH	5/15/1984	5/15/1984
5	GFCSR0441	FL GAME AND FRESH WATER FISH	5/15/1984	5/15/1984
6	GFCSR0443	FL GAME AND FRESH WATER FISH	5/15/1984	5/15/1984
7	24010110	FLORIDA DEPT ENV PROTECTION	5/12/1976	1/10/1983
8	24020001	FLORIDA DEPT ENV PROTECTION	11/13/1950	11/14/1979
9	24020002	FLORIDA DEPT ENV PROTECTION	11/13/1950	11/8/1976
10	24020003	FLORIDA DEPT ENV PROTECTION	11/13/1950	2/24/1983
11	24020004	FLORIDA DEPT ENV PROTECTION	11/3/1950	11/22/1976
12	24020005	FLORIDA DEPT ENV PROTECTION	11/13/1950	6/7/1967
13	24020006	FLORIDA DEPT ENV PROTECTION	11/13/1950	12/5/1979
14	24020007	FLORIDA DEPT ENV PROTECTION	2/13/1951	11/13/1960
15	24020008	FLORIDA DEPT ENV PROTECTION	11/13/1950	5/27/1987
16	24020011	FLORIDA DEPT ENV PROTECTION	11/13/1950	12/16/1952
17	24020017	FLORIDA DEPT ENV PROTECTION	11/13/1950	9/2/1965
18	24020018	FLORIDA DEPT ENV PROTECTION	11/13/1950	7/25/1960
19	24020019	FLORIDA DEPT ENV PROTECTION	6/2/1937	5/27/1987
20	24020033	FLORIDA DEPT ENV PROTECTION	6/11/1958	4/19/1976
21	24020035	FLORIDA DEPT ENV PROTECTION	3/16/1961	5/4/1977
22	24020040	FLORIDA DEPT ENV PROTECTION	10/21/1953	5/4/1977
23	24020044	FLORIDA DEPT ENV PROTECTION	12/15/1955	2/17/1981
24	24020055	FLORIDA DEPT ENV PROTECTION	1/31/1984	7/22/1997
25	24020057	FLORIDA DEPT ENV PROTECTION	2/18/1993	12/17/1997
26	24020058	FLORIDA DEPT ENV PROTECTION	2/18/1993	12/18/1997
27	24020059	FLORIDA DEPT ENV PROTECTION	6/1/1993	7/22/1997
28	24020066	FLORIDA DEPT ENV PROTECTION	9/5/1995	9/5/1995
29	24020070	FLORIDA DEPT ENV PROTECTION	2/24/1997	2/24/1997
30	24020075	FLORIDA DEPT ENV PROTECTION	12/17/1997	12/17/1997
31	24020076	FLORIDA DEPT ENV PROTECTION	12/17/1997	12/17/1997
32	24020077	FLORIDA DEPT ENV PROTECTION	12/18/1997	12/18/1997
33	24020078	FLORIDA DEPT ENV PROTECTION	12/18/1997	12/18/1997
34	24020079	FLORIDA DEPT ENV PROTECTION	12/19/1997	12/19/1997
35	24020080	FLORIDA DEPT ENV PROTECTION	7/13/1997	7/13/1997
36	24020134	FLORIDA DEPT ENV PROTECTION	2/15/1994	7/22/1997
37	24020361	FLORIDA DEPT ENV PROTECTION	1/25/1984	9/16/1984
38	24020519	FLORIDA DEPT ENV PROTECTION	8/3/1970	12/14/1977
39	24020906	FLORIDA DEPT ENV PROTECTION	9/16/1992	7/22/1997
40	24020907	FLORIDA DEPT ENV PROTECTION	11/3/1978	7/22/1997
41	24022161	FLORIDA DEPT ENV PROTECTION	3/2/1976	2/22/1977
42	24024494	FLORIDA DEPT ENV PROTECTION	6/19/1978	6/19/1978
43	24025242	FLORIDA DEPT ENV PROTECTION	9/11/1973	6/26/1978
44	24029312	FLORIDA DEPT ENV PROTECTION	6/17/1975	7/21/1975
45	24029313	FLORIDA DEPT ENV PROTECTION	6/17/1975	6/17/1975
46	24029314	FLORIDA DEPT ENV PROTECTION	6/17/1975	6/17/1975
47	24040040	FLORIDA DEPT ENV PROTECTION	9/5/1995	9/5/1995
48	25021575	FLORIDA DEPT ENV PROTECTION	4/8/1976	5/6/1976
49	25021576	FLORIDA DEPT ENV PROTECTION	4/8/1976	5/6/1976
50	TEN MILE1	FLORIDA DEPT ENV PROTECTION	9/24/1995	12/15/1995
51	TEN MILE2	FLORIDA DEPT ENV PROTECTION	9/24/1995	12/15/1995
52	TEN MILE3	FLORIDA DEPT ENV PROTECTION	9/24/1995	12/15/1995
53	153	HILLSBOROUGH COUNTY EPC	9/23/1999	12/13/2000
54	154	HILLSBOROUGH COUNTY EPC	9/23/1999	12/13/2000
55	24020001	HILLSBOROUGH COUNTY EPC	1/9/1974	12/13/2000
56	24020002	HILLSBOROUGH COUNTY EPC	3/18/1975	3/18/1975
57	24020003	HILLSBOROUGH COUNTY EPC	1/23/1974	12/13/2000
58	24020005	HILLSBOROUGH COUNTY EPC	8/28/1991	12/13/2000
59	24020006	HILLSBOROUGH COUNTY EPC	1/23/1974	12/13/2000
60	24020008	HILLSBOROUGH COUNTY EPC	1/22/1974	12/13/2000
61	24020019	HILLSBOROUGH COUNTY EPC	1/22/1974	12/13/2000
62	24020035	HILLSBOROUGH COUNTY EPC	3/2/1977	5/4/1977
63	24020040	HILLSBOROUGH COUNTY EPC	3/2/1977	3/2/1977
64	24020055	HILLSBOROUGH COUNTY EPC	1/27/1982	12/13/2000
65	ALAFIA RIVER1	POLK COUNTY WATER RESOURCE	5/14/1994	12/4/1996
66	ALAFIA1N	POLK COUNTY WATER RESOURCE	6/4/1997	12/10/1998
67	ALAFIA2S	POLK COUNTY WATER RESOURCE	2/12/1997	12/10/1998
68	SCOTTS LK W6	POLK COUNTY WATER RESOURCE	4/14/1998	7/13/1998
69	FLO0001	SWFWMD	3/31/1992	8/18/1994
70	FLO0002	SWFWMD	3/31/1992	8/18/1994
71	FLO0003	SWFWMD	3/26/1992	12/1/1992
72	FLO0047	SWFWMD	12/1/1992	8/18/1994
73	FLO0048	SWFWMD	12/1/1992	8/23/1993
74	FLO0049	SWFWMD	12/1/1992	8/23/1993
75	FLO0050	SWFWMD	12/1/1992	8/17/1994
76	FLO0051	SWFWMD	12/1/1992	8/17/1994
77	STA0409	SWFWMD	7/20/1995	1/25/1996
78	110001	USEPA REGION 4	10/20/1966	4/17/1968
79	110002	USEPA REGION 4	10/20/1966	4/17/1968
80	110019	USEPA REGION 4	10/1/1966	6/2/1968
81	120067A	USEPA REGION 4	11/1/1979	11/1/1979
82	120072A	USEPA REGION 4	4/15/1980	4/17/1980
83	125015	USEPA REGION 4	2/11/1977	2/16/1977
84	125020	USEPA REGION 4	2/9/1977	2/16/1977
85	125025	USEPA REGION 4	2/11/1977	2/16/1977
86	1900-114	USEPA REGION 4	1/3/1979	3/27/1979
87	2300852	USGS	3/25/1956	7/12/1966
88	2300882	USGS	2/27/1968	6/9/1970
89	2300896	USGS	2/27/1968	2/27/1968
90	2300900	USGS	8/10/1965	1/30/1980
91	2300907	USGS	4/25/1956	4/26/1965
92	2300930	USGS	5/4/1965	6/9/1970
93	2300978	USGS	3/25/1965	6/9/1970
94	2301000	USGS	1/27/1965	9/30/1999
95	2301070	USGS	4/25/1956	5/2/1967
96	2301300	USGS	3/25/1965	9/30/1999
97	2301328	USGS	5/4/1965	6/9/1970
98	2301350	USGS	5/22/1967	9/18/1981
99	2301368	USGS	5/7/1971	10/22/1987
100	2301370	USGS	5/21/1968	9/25/1981
101	2301373	USGS	5/29/1969	6/15/1971
102	2301376	USGS	5/21/1968	9/21/1970
103	2301400	USGS	1/27/1965	7/12/1966
104	2301500	USGS	9/26/1956	9/30/1999
105	2301600	USGS	7/19/1923	9/30/1999
106	2301602	USGS	5/18/1967	12/5/1991
107	2301620	USGS	5/4/1965	5/3/1967
108	2301638	USGS	8/23/1951	1/17/1991
109	2301680	USGS	5/12/1966	5/12/1966
110	2301697	USGS	10/16/1972	8/15/1974
111	2301700	USGS	9/25/1956	12/1/1977
112	2301706	USGS	1/17/1991	1/17/1991
113	2301718	USGS	9/9/1933	6/9/1970
114	2301721	USGS	9/18/1990	4/22/1992
115	274517082034100	USGS	11/17/1982	8/25/1986
116	274601082065600	USGS	4/5/1935	5/25/1938
117	274813082022700	USGS	8/20/1984	9/4/1984
118	274916082033100	USGS	8/16/1984	8/16/1984
119	274922082025000	USGS	8/23/1984	9/4/1984
120	274948082145700	USGS	5/1/1974	5/1/1974
121	274950082151000	USGS	5/1/1974	5/1/1974
122	274959082025300	USGS	9/4/1984	9/4/1984
123	275002082154500	USGS	5/1/1974	5/1/1974
124	275004082024900	USGS	8/23/1984	9/4/1984
125	275007081544600	USGS	8/21/1984	1/16/1985
126	275009082070000	USGS	4/25/1956	4/25/1956
127	275103082243800	USGS	4/21/1978	1/26/1979
128	275110082235800	USGS	4/21/1978	1/26/1979
129	275114082234700	USGS	8/29/1990	8/30/1990
130	275118082160300	USGS	10/30/1991	10/30/1991
131	275118082233200	USGS	4/21/1978	1/26/1979
132	275121082210800	USGS	10/30/1991	4/22/1992
133	275122082233200	USGS	6/4/1971	10/22/1971
134	275123082223900	USGS	4/21/1978	3/6/1979
135	275125082213700	USGS	4/21/1978	3/6/1979
136	275126082220600	USGS	10/30/1991	4/22/1992
137	275126082243200	USGS	10/20/1971	10/20/1971
138	275127082210700	USGS	4/21/1978	3/6/1979
139	275129082220700	USGS	4/21/1978	3/6/1979
140	275130082163000	USGS	4/22/1992	4/22/1992
141	275130082230200	USGS	9/18/1990	8/28/1991
142	275131082230200	USGS	9/18/1990	3/5/1992
143	275131082230201	USGS	9/18/1990	3/5/1992
144	275132082230200	USGS	9/18/1990	3/5/1992
145	275132082230300	USGS	8/29/1990	8/30/1990
146	275132082230500	USGS	4/21/1978	3/6/1979
147	275133082204000	USGS	4/21/1978	3/6/1979
148	275134082230200	USGS	9/18/1990	3/5/1992
149	275134082230201	USGS	9/18/1990	9/19/1990
150	275143082164200	USGS	10/30/1991	10/30/1991
151	275146082170000	USGS	11/13/1978	11/13/1978
152	275147082200800	USGS	4/21/1978	3/6/1979
153	275147082201600	USGS	10/30/1991	4/22/1992
154	275152082185300	USGS	4/21/1978	3/6/1979
155	275155082170500	USGS	4/22/1992	4/22/1992
156	275200082170400	USGS	10/30/1991	4/22/1992
157	275201082191500	USGS	4/21/1978	3/6/1979
158	275203082135300	USGS	10/30/1991	4/22/1992
159	275205082184800	USGS	10/30/1991	4/22/1992
160	275206082192600	USGS	10/30/1991	4/22/1992
161	275207082193500	USGS	4/21/1978	3/6/1979
162	275216082171400	USGS	10/24/1978	11/13/1978
163	275238082173600	USGS	10/30/1991	4/22/1992
164	275242082175300	USGS	4/21/1978	1/12/1979
165	275242082184600	USGS	10/30/1991	4/22/1992
166	275253082183700	USGS	4/21/1978	3/6/1979
167	275301082055900	USGS	6/9/1970	6/9/1970
168	275305082182600	USGS	4/21/1978	1/12/1979
169	275306082180700	USGS	10/30/1991	4/22/1992
170	275307082182700	USGS	6/2/1966	6/2/1966
171	275310082183000	USGS	5/1/1946	5/1/1946
172	275314082182800	USGS	4/22/1992	4/22/1992
173	275320082181700	USGS	5/12/1966	6/5/1972
174	275320082182000	USGS	10/16/1972	8/15/1974
175	275325082180200	USGS	6/5/1972	6/5/1972
176	275340082175000	USGS	5/1/1946	5/1/1946
177	275353082171900	USGS	9/12/1978	9/12/1978
178	275405082141900	USGS	5/28/1992	3/15/1993
179	275411082173100	USGS	9/12/1978	9/12/1978
180	275422082145600	USGS	5/27/1992	3/10/1993
181	275709081580600	USGS	6/9/1970	6/9/1970
182	275747082134900	USGS	1/5/1994	3/14/1994

Figure 7.2-1
CURRENT AND HISTORIC
MONITORING STATION LOCATIONS

Water Quality Stations
- EPA/ODW
- FL FISH & WILDLIFE CONS. COMM.
- FLORIDA DEPT ENV PROTECTION
- HILLSBOROUGH COUNTY EPC
- POLK COUNTY WATER RESOURCE
- SWFWMD
- USEPA REGION 4
- USGS

1 0 1 Miles

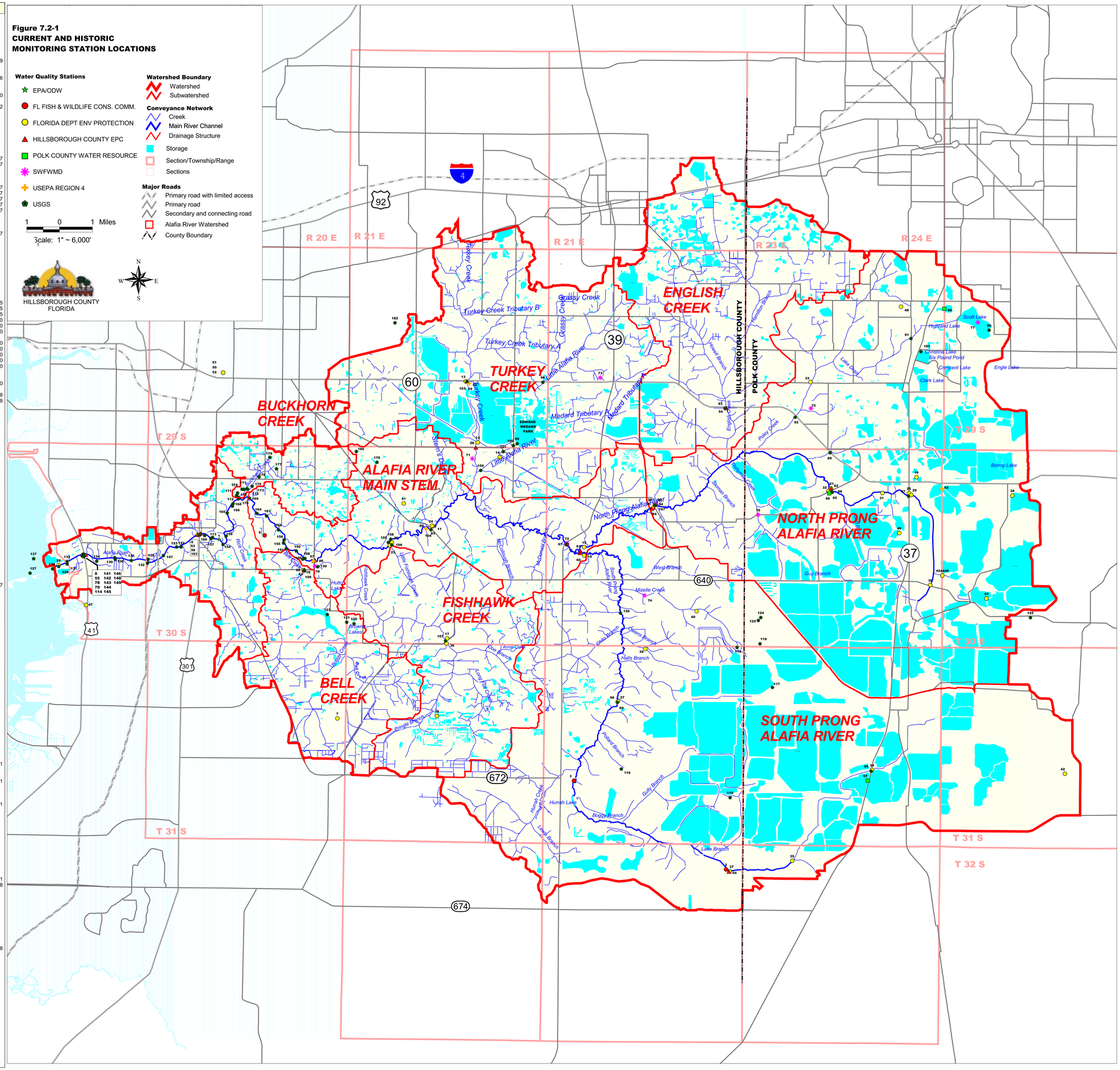
Scale: 1" ~ 6,000'

HILLSBOROUGH COUNTY
FLORIDA

Watershed Boundary
- Watershed
- Subwatershed

Conveyance Network
- Creek
- Main River Channel
- Drainage Structure
- Storage
- Section/Township/Range
- Sections

Major Roads
- Primary road with limited access
- Primary road
- Secondary and connecting road
- Alafia River Watershed
- County Boundary



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PARSONS ENGINEERING SCIENCE

CHAPTER 8

NATURAL SYSTEMS EXISTING CONDITIONS

8.1 Description Of The Natural Systems

8.1.1 Introduction

One objective of the Alafia River Watershed Management Plan is to determine what actions can be taken to improve and preserve the natural systems within the watershed. The natural systems are an essential part of the watershed in that they help prevent water quality degradation, aid in flood abatement, and provide habitat for wildlife. In order to determine what improvements are needed, the existing conditions of the natural systems within the watershed must be assessed, and the issues and problems affecting the systems must be addressed.

The Alafia River Watershed extends over portions of Hillsborough and Polk counties and encompasses approximately 418 square miles. For the purpose of this study, only the natural systems in the watershed within Hillsborough County will be discussed. The Alafia River is formed by the confluence of the North and South Prongs in the eastern part of Hillsborough County, and discharges into Hillsborough Bay in the northeastern region of Tampa Bay. The North Prong originates in a freshwater swamp near the city of Mulberry in Polk County. The headwaters of the South Prong originate in Hookers Prairie in western Polk County. The South Prong flows southwesterly before turning northward and joining the North Prong near Alderman's Ford Park near the county border. Other smaller creeks discharge into the river as it flows westward.

The land uses of the developed areas within the Alafia River watershed include residential, commercial, agricultural, and mining. Details of these various land uses are discussed in Volume I, Chapter 2.3. The majority of the residential land use is found in the western portion of the watershed, near the mouth of the river. The central portion of the watershed is predominantly agricultural and low density residential, with natural, undeveloped areas predominantly found along the river and its tributaries. The major land uses in the eastern portion of the watershed are past and current mining activities, and agriculture.

Natural, undeveloped areas are predominantly found along the river and its tributaries. These areas are typically forested systems that have formed over time on the alluvial sand deposits. The ridges and depressions formed by historic flooding in this area support a variety of vegetation, with hardwood dominated forests on the higher elevations and cypress or bay dominated forests in the depressions. The understory in these forests is usually dense and consists of saw palmetto, shrubs, ferns and vines. These areas are periodically flooded with little to no effect on the vegetation.

The Alafia River Watershed also contains some of the last remaining scrub habitat in the County. The sand pine scrub and xeric oak areas have been and are currently being cleared for residential development, phosphate mining, and agriculture. These areas support unique habitat for endangered wildlife and are important aquifer recharge areas.

For the purposes of this study, the natural areas within the watershed were identified and are described in this section. Using aerial photography and the Strategic Habitat Conservation Areas map prepared by the Florida Fish and Wildlife Conservation Commission, twenty specific natural systems areas were chosen as areas that would merit discussion in this document. The areas were chosen based on criteria such as their current ecological condition, available contiguous area, proximity to other natural areas, presence of protected species, and potential hydrological and water quality benefits. These twenty areas, the Strategic Habitat areas, and the uplands and wetlands within the Alafia River Watershed are depicted in Figure 8-1. The twenty areas are listed in the table below and individually discussed in Section 8.2.3.

Cargill West	Buckhorn Creek	Rhodine Scrub	Balm-Boyette Scrub Preserve
Williams Property	John Moore Road Site	Fishhawk Ranch	Alderman's Ford Addition East
Triple Creek	Bell Creek Preserve	Alafia Scrub Preserve	English Creek
Jameson Tract	Lithia Springs	River Crossings Estates	North Prong Alafia River
Alderman's Ford Addition West	Boy Scout Parcel	Fishhawk/Thomas Ranch	South Prong Alafia River

8.1.2 Land Cover Descriptions

This section describes the overall land cover types within the watershed, using the FLUCCS descriptions introduced in Volume i, Chapter 2, but providing more detail with respect to the natural land cover types. The following land cover types are based on the 1995 Existing Land Use Map provided by the SWFWMD, with some updating to the 1997 conditions performed by Parsons Engineering Science.

Herbaceous Rangeland (3100)
These areas are defined as treeless prairies found on the margins between marshes and upland forests. Within the watershed, this land cover description was used for relatively natural areas dominated by herbaceous species such as wiregrass (*Aristida stricta*), broom sedge (*Andropogon glomeratus*), rose natal grass (*Rhynchelytrum repens*), or other common grasses, forbs, and sedges. This land cover type represents approximately 0.1% of the watershed and can be found on the Cargill West and English Creek areas.

Figure 8-1

Natural Systems

Alafia River Watershed Management Plan

Natural Systems Area
(Included in WMP report)
Natural systems areas are those that were identified during the evaluation of the watershed as areas that benefit the wildlife habitat, water quality, or flood abatement conditions in the watershed. Twenty undeveloped areas were identified and described in detail in the Alafia River Watershed Management Plan.

Land Use/Cover

Lake or Pond
Wetlands, whether man-made or natural, with expanses of open water are indicated in this map as lakes or ponds. Lakes and ponds are important for stormwater storage, recreation, wildlife habitat, and in some cases, drinking water supply.

Wetland
Areas that support vegetation tolerant of temporary or permanent inundation are known as wetlands. These areas are essential to the watershed because they provide important wildlife habitat, they aid in flood abatement, and they help protect water quality.

Upland Forest
Forested areas, especially riparian forests, are important for watershed protection because they help filter runoff from upland areas and prevent particulate matter, trash, pollutants and other detrimental substances from being washed into the river. The forested areas included on this map include hardwood and conifer forests.

Strategic Habitat Conservation Area
GIS coverages produced by the Florida Fish and Wildlife Conservation Commission representing areas important to flora, fauna and natural communities based on known occurrences and evaluation of land uses from recent aerial photography

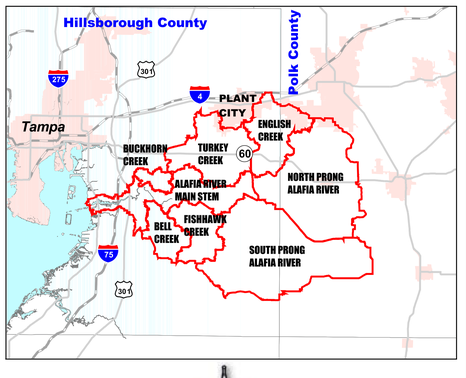
Source:
Wetland and water features are from SWFWMD 1995 Land Use/Cover FLUCCS.
These do not represent jurisdictional lines.

- Creek/River
- Subwatershed/Watershed Boundary
- County Boundary
- Road
- Railroad

N W E S

0 5000 10000 15000 Feet

Scale: 1" = 5000'



HILLSBOROUGH COUNTY
FLORIDA

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Figure 8-1 24 X36 insert

Shrub and Brushland (3200)
Shrub and brushland comprise approximately 2% of the total watershed and includes pine flatwoods where the trees have been clear-cut or lost to a catastrophic fire. Other areas of this land cover type are those areas that are reverting from improved pasture back to pine flatwoods after the cessation of grazing activity. The dominant species in this land cover form within the Alafia River Watershed is usually saw palmetto (*Serenoa repens*), with wax myrtle (*Myrica cerifera*), gallberry (*Ilex glabra*), saltbush (*Baccharis halmifolia*), and saplings of various oak and pine trees. Examples of this land cover type can be found on the ELAPP property north of Jameson Road along the South Prong. Additional large areas of this land cover are found on the Balm-Boyette Scrub Preserve and the Rhodine Scrub.

Upland Coniferous Forests (4100)
This land use description was used to define forests with canopies that were predominantly pine but had other canopy constituents present, such as native hardwood or nuisance exotic trees. Approximately 0.3% of the land cover within the watershed fits this classification. Large tracts of this land cover are found in the Cargill West site, the Balm-Boyette Scrub Preserve, and Fishhawk/Thomas Ranch.

Pine Flatwoods (4110)
In the Alafia River watershed, this land cover type is dominated by slash pine (*Pinus elliottii*), with an understory dominated by either saw palmetto or wiregrass. Approximately 1.4% of the watershed meets this classification, with the largest tracts found in the Alderman's Ford Addition West, Fishhawk South, Fishhawk/Thomas Ranch, Balm-Boyette Scrub Preserve, Rhodine Scrub, Bell Creek Preserve, and the Cargill West parcels.

Upland Hardwood Forests (4200)
This land cover type typically has a canopy dominated by hardwood species. In the Alafia River watershed, this classification provides 0.5% of the land cover and includes the xeric oak communities found on the Balm-Boyette Scrub Preserve, the Bell Creek Preserve, and the Rhodine Scrub. These communities support sand live oak (*Quercus geminata*), myrtle oak (*Quercus myrtifolia*), and Chapman oak (*Quercus chapmanii*) in the canopy and are important habitat for numerous protected species.

Hardwood – Conifer Mixed (4340)
This classification includes areas in which the canopy is mixed with hardwoods and pines with neither tree type dominant. The majority of the upland forests within the watershed fall into this category, which comprises 9% of the of the land cover entire watershed. These forests are usually dominated by laurel oak (*Quercus laurifolia*), water oak (*Quercus nigra*), slash pine, and cabbage palm (*Sabal palmetto*) in the canopy, and a variable understory. These forests provide important buffers along the river and tributaries.

Mangroves (6120)
Mangrove swamps comprise only 0.06% of the Alafia River Watershed, and are found near the mouth of the river. Species found within this habitat include red, black, and white mangroves (*Rhizophora mangle, Avicennia germinans*, and *Laguncularia racemosa*), as well as Brazilian pepper, black rush (*Juncus roemerianus*) and buttonwood (*Conocarpus erectus*). Nearly all the mangrove areas within the watershed have incurred some type of damage, such as competition from nuisance exotic vegetation, trimming, filling, and freezes. Mangroves provide important habitat for numerous species and are also beneficial for shoreline stabilization and water quality protection.

Bottomlands (6150)
Bottomlands or floodplains, comprise approximately 9% of the Alafia River Watershed and include the majority of the wetlands within the watershed. The forests are found along the river and main tributaries. These forests are highly diverse and include laurel oak, water oak, red maple (*Acer rubrum*), bald cypress (*Taxodium distichum*), bays, and other trees tolerant of occasional inundation. The understory can vary from a sparse cover of detritus and no vegetation to a dense cover of ferns, shrubs, and vines. This vegetation community provides vital water quality and flood protection benefits, as well as wildlife habitat.

Cypress (6210)
Cypress dominated forests are found in small pockets within the bottomland forests, such as in the Alderman's Ford Additions, and as depressions within what was historically pine flatwoods, as in the Fishhawk/Thomas Ranch site. This land cover type comprises only 0.2% of the total land cover within the watershed.

Mixed Forested Wetland (6300)
The mixed forested wetlands are those areas where the canopy is comprised of hardwoods and conifers, with neither tree achieving dominance. These areas are often wetlands in transition after some anthropogenic disturbances. Wetlands that have had impacts to their natural hydroperiods, or have been timbered and are regenerating their native canopy often fall into this category. Only 422 acres of this land cover type is found in the watershed, or 0.15% of the total land cover. A small area of this land cover type is located on the Fishhawk/Thomas Ranch site.

Vegetated Non-forested Wetlands (6400)
There are 479 acres, or 0.18% of the watershed that meet the criteria for this land cover classification. These areas are typically transitional areas that could not be further defined as supporting a dominant species due to the changes in their species composition. These changes are usually a result of development impacts, or an active nuisance species eradication program.

Freshwater Marshes (6410/6440)

This land cover type comprises 1.9% of the total land cover within the Alafia River Watershed and can be found throughout the undeveloped areas, rangeland, and in some improved pasture. This land cover description includes the Emergent Aquatic Vegetation land cover description because there is no distinction between these two categories in this watershed. Undisturbed freshwater marshes in central Florida can be easily identified by the concentric rings of vegetation that change with the hydrological gradient. Classic examples of these marshes will have an outer ring of cord grass (*Spartina bakeri*), and then a ring of soft rush (*Juncus effuses*) and/or saw grass (*Cladium jamaicensis*). Inner rings, depending on the water depth, may have pickerelweed (*Pontederia cordata*), arrowhead (*Sagittaria lancifolia*), spatterdock (*Nuphar lutea*), or water lily (*Nymphae odorata*). Impacted freshwater marshes may be monocultures of cattail (*Typha* sp.), primrose willow (*Ludwigia peruviana*), common reed (*Phragmites* sp.), or other nuisance species. These wetlands may be man-made in origin or may have been altered historically. Typical impacts include muck farming, draining or impounding, and dredging. Freshwater marshes are essential foraging and nesting habitat to numerous important species.

Salt Marsh (6420)

There are only 106 acres of the salt marsh land cover type found within the watershed, comprising only 0.04% of the total land cover. This land cover warrants discussion, however, because of it's importance to the fish and wildlife in the vicinity. Most of the salt marsh areas are located in depressions along the river shoreline, such as on the Alafia Scrub Preserve parcel, and in the excavated areas within the Florida Power electrical transmission corridor on the south side of the river. These areas are usually inundated and vegetated with emergent and submerged aquatic vegetation. These areas provide a source of nutrients for juvenile fish, and the salinity protects them from stenohaline predators. More than 90% of the important sport and commercial fish species are euryhaline, spending part of their lives in some form of estuarine habitat, such as salt marshes.

Wet Prairie (6430)

The wet prairie land cover type comprises approximately 757 acres, or 0.28% of the total watershed land area. Small areas of this land cover type are found on the Bell Creek Preserve, Balm-Boyette Scrub, Fishhawk/Thomas Ranch, Fishhawk South, Alderman's Ford Addition West, Alafia South Prong, and Alafia North Prong parcels. These areas may be natural depressions vegetated with common native grasses and sedges such as beak rushes (*Rhynchospora tracyi*), maidencane (*Panicum hemitomon*), St. John's wort (*Hypericum fasciculatum*), and others. These areas may also be remnants of former wetlands that have been filled to maximize grazing areas. Wet prairie communities are important to wildlife as foraging habitat.

8.2 Descriptions Of Specific Natural Systems Areas

8.2.1 Assessment Overview

The Alafia River Watershed encompasses some of the most valuable habitat remaining in Hillsborough County. Approximately 14% (23,106 acres) of the entire watershed within Hillsborough County is now in public ownership and another 7% (11,646 acres) is under negotiation for purchase and preservation, largely due to the efforts of the ELAPP program and interlocal agreements with the SWFWMD. The goals of the program are to preserve as much contiguous habitat as possible, with special emphasis on land adjacent to the Alafia River and its tributaries. The diverse natural communities within the watershed support a long list of flora and fauna, including numerous federal and state listed species. Table 8-1 provides a list of the protected species present or potentially present in the watershed. Appendix E provides a comprehensive list of all species observed in the watershed by Hillsborough County ecologists.

8.2.2 Assessment Methodology

For the purposes of this study, the Natural Systems within the Alafia River Watershed are defined as undeveloped areas that provide benefits to the water quality, wildlife habitat, flood protection, or aesthetics of the watershed. Each potential area has been identified and then assessed based on a set of criteria. These criteria include current ecological condition, available contiguous area, proximity to other natural areas, presence of protected species, and potential hydrologic benefits. The results of the assessment are presented in Section 8.3. Summary of the Assessment. The majority of the areas are relatively undisturbed, but in some cases, a prime location or another unique or important feature of a site resulted in the inclusion of agricultural lands in the assessment.

The assessment of these potential natural system areas included using existing information as much as possible. The Environmental Lands Acquisition and Protection Program (ELAPP) has conducted site assessments on numerous properties along the Alafia River corridor for consideration as potential acquisition sites. Management plans have been prepared for several of the acquired sites, which include detailed surveys of the flora and fauna. Several large tracts have been the subject of the Development of Regional Impact (DRI) process, such as the Fishhawk Ranch. The US Fish and Wildlife Service (USFWS), the Florida Fish and Wildlife Conservation Commission (FFWCC), and the National Audubon Society were consulted regarding the endangered and threatened species present or potentially present and about valuable habitat areas and biodiversity hotspots. The vegetation mapping was conducted using information from the Southwest Florida Water Management District (SWFWMD), and the National Wetland Inventory (NWI). This information provided a base from which the data gathering was expanded.

Table 8-1
Alafia River Watershed
Protected Species Expected (X) or Observed (O)

Species		Ranking *		Preferred Habitat										
Common Name	Scientific Name	Federal	State	Floodplain Forest	Freshwater Marsh	Wet Prairie	Pine Flatwoods	Sand Pine Scrub	Range Land	Longleaf Pine/Xeric Oak	Upland Hardwood Forests	Salt Marsh Estuary	Hardwood Swamp	Cypress
Birds														
Roseate spoonbill	*Ajaia ajaja*		SSC		O	O						O	O	O
Florida Scrub- Jay	*Aphelocoma coerulescens*	T	T							O				
Limpkin	*Aramus guarauna*		SSC	X									X	X
Florida burrowing owl	*Athene cunicularia floridana*		SSC						O					
Little blue heron	*Egretta caerulea*		SSC	O	O	O						O	O	O
Snowy egret	*Egretta thula*		SSC	O	O	O						O	O	O
Tricolored heron	*Egretta tricolor*		SSC	O	O	O						O	O	O
White ibis	*Eudocimus albus*		SSC	O	O	O						O	O	O
Florida sandhill crane	*Grus canadensis pratensis*		T		O	O			O			X	X	X

Table 8-1 (cont.)
Alafia River Watershed
Protected Species Expected (X) or Observed (O)

Species		Ranking*		Preferred Habitat										
Common Name	Scientific Name	Federal	State	Floodplain Forest	Freshwater Marsh	Wet Prairie	Pine Flatwoods	Sand Pine Scrub	Range Land	Longleaf Pine/Xeric Oak	Upland Hardwood Forests	Salt Marsh Estuary	Hardwood Swamp	Cypress
Birds (cont.)														
American kestrel Florida subspecies	*Falco sparverius paulus*		T						O					
Bald eagle	*Haliaeetus leucocephalus*	T	T	O			X		X		X	X	X	X
Wood stork	*Mycteria americana*	E	E	O	O	O						X	X	X
Mammals														
Florida mouse	*Podomys floridanus*		SSC							O	O			
Sherman's fox squirrel	*Sciurus niger shermani*		SSC							O	X			
Reptiles and Amphibians														
American alligator	*Alligator mississippiensis*	T(S/A)	SSC	O								X	X	X
Eastern indigo snake	*Drymarchon corais couperi*	T	T				X			O	O			
Florida pine snake	*Pituophis melanoleucus mugitus*		SSC					X		X				

Table 8-1 (cont.)
Alafia River Watershed
Protected Species Expected (X) or Observed (O)

Species		Ranking*		Preferred Habitat										
Common Name	Scientific Name	Federal	State	Floodplain Forest	Freshwater Marsh	Wet Prairie	Pine Flatwoods	Sand Pine Scrub	Range Land	Longleaf Pine/Xeric Oak	Upland Hardwood Forests	Salt Marsh Estuary	Hardwood Swamp	Cypress
Reptiles and Amphibians (cont.)														
Gopher frog	*Rana capito*		SSC				X	X	X	X	O			
Gopher tortoise	*Gopherus polyphemus*		SSC				O	O	O	O	O			
Short-tailed snake	*Stilosoma externuatum*		T					X		X				
Suwanee cooter	*Pseudemys concinna sueanniensis*		SSC	X									X	
Plants														
Curtiss' milkweed	*Asclepias curtissii*		E					X		X				
Florida bonamia	*Bonamia grandiflora*	T	E					X						
Grass Pink (unnamed)	*Calopogon barbatus*		T		X	X	X		X					
Grass Pink (unnamed)	*Calopogon multiflorus*		E		X	X	X		X					
Strap fern (unnamed)	*Campyloneurum phyllitidus*		E	X									X	
Pigeon-wing butterfly-pea	*Clitoria fragrans*	T	E					X		X				

Table 8-1 (cont.)
Alafia River Watershed
Protected Species Expected (X) or Observed (O)

Species		Ranking*		Preferred Habitat										
Common Name	Scientific Name	Federal	State	Floodplain Forest	Freshwater Marsh	Wet Prairie	Pine Flatwoods	Sand Pine Scrub	Range Land	Longleaf Pine/Xeric Oak	Upland Hardwood Forests	Salt Marsh Estuary	Hardwood Swamp	Cypress
Plants (cont.)														
Wild coco	*Eulophia alta*		T	X	X	X							X	X
Garberia	*Garberia heterophylla*		T					X		X				
Orchid (unnamed)	*Harrisella filiformis*		T	X									X	X
Nodding pinweed	*Lechea cernua*		T					X		X				
Catesby lily	*Lilium catesbaei*		T			X	X		O					
Florida spiny-pod	*Matela floridana*		E					X		X				
Hand fern	*Ophioglossum palmatum*		E	X			X						X	X
Blue butterwort	*Pinguicula caerulea*		T		X	X	X							
Yellow butterwort	*Pinguicula lutea*		T		X	X	X							
Large white fringed orchid	*Platanthera blephariglottis*		T		X	X								
Yellow fringed orchid	*Platanthera ciliaris*		T		X	X								

Table 8-1 (cont.)
Alafia River Watershed
Protected Species Expected (X) or Observed (O)

Species		Ranking*		Preferred Habitat											
Common Name	Scientific Name	Federal	State	Floodplain Forest	Freshwater Marsh	Wet Prairie	Pine Flatwoods	Sand Pine Scrub	Range Land	Longleaf Pine/Xeric Oak	Upland Hardwood Forests	Salt Marsh Estuary	Hardwood Swamp	Cypress
Plants (cont.)														
Yellow fringeless orchid	*Platanthera integra*		E		X	X								
Snowy orchid	*Platanthera nivea*		T		X									
Rose pogonia	*Pogonia ophiogloss-oides*		T		X	X								
Wild coco	*Pteroglossas-pis ecristata*		T					X		X				
Hooded pitcherplant	*Sarracenia minor*		T		X	X								
Scrub bluestem	*Schizach-ryium niveum*		E					X						
Ladies'-tresses (unnamed)	*Spiranthes longilabris*		T		X	X								
Wild pine	*Tillandsia balbisiana*		T	X		X	X		X	X				
Giant wild pine	*Tillandsia utriculata*		E	X							X			X

* Note: T = Threatened, E = Endangered, and SSC = Species of Special Concern

8.2.3 Descriptions of Specific Areas in the Watershed

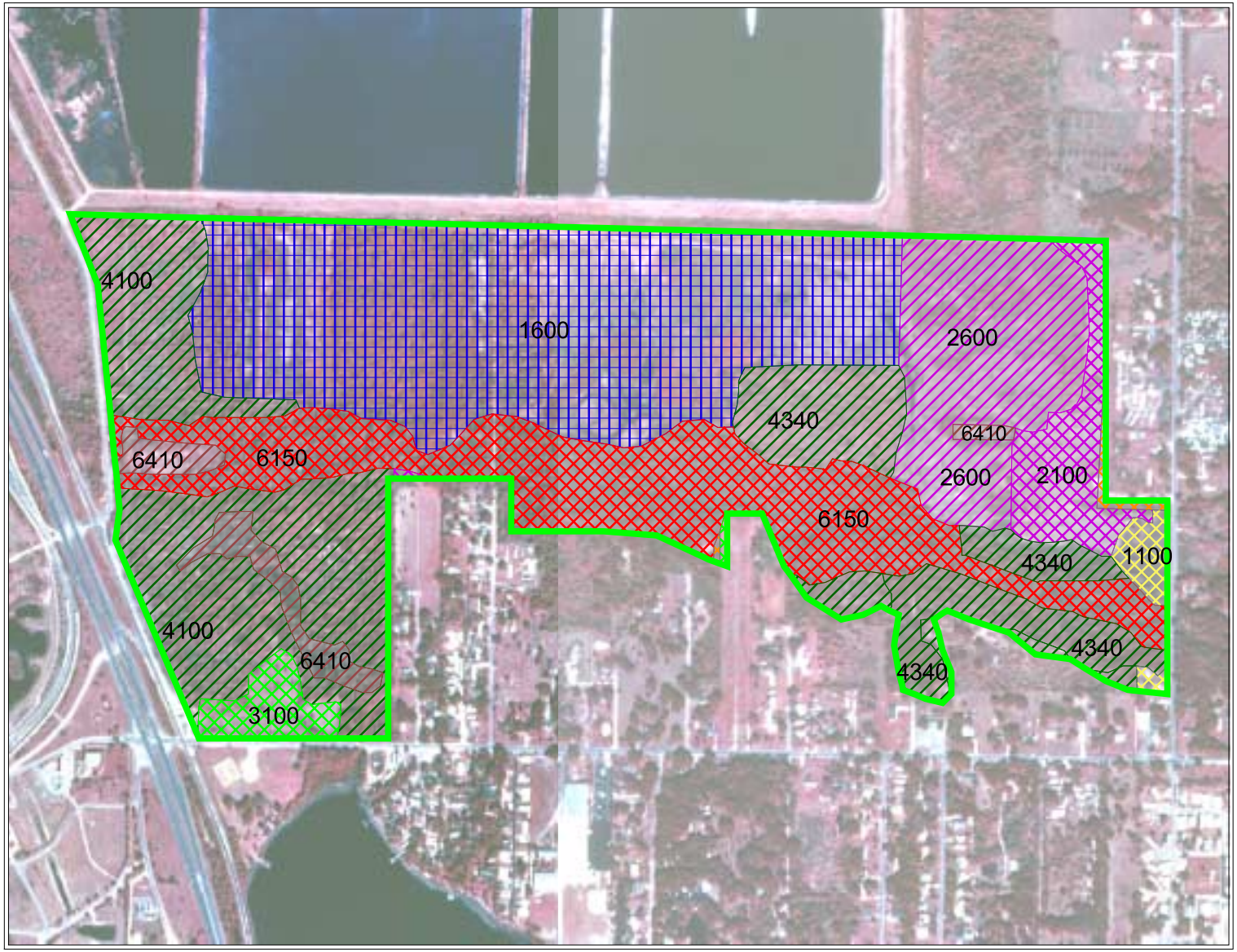
The following paragraphs describe the areas identified as the best remaining natural systems for wildlife habitat and natural resources within the Alafia River watershed. The twenty areas vary significantly in the types of benefits they provide or may potentially provide to the watershed as a whole. Each site is described as to the vegetation communities present, the benefits presented currently by the site, and the potential benefits that preservation and/or restoration of the site would offer.

Cargill West

Site Description. This site is located east of US 41, west of 78th Street and north of the Alafia River, in Section 14 of Township 30, Range 19. The parcel is approximately 235 acres, and is bordered on the north and west by active phosphate processing facilities, and on the south by residential areas. The property to the northeast of the site is under construction as a residential development. There are former fish farms in the northwest corner of the site.

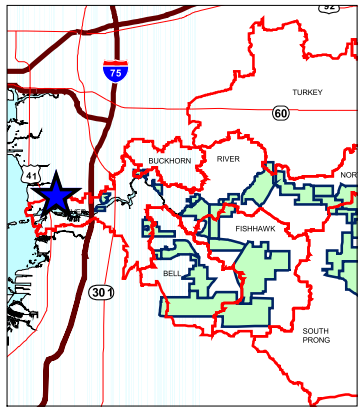
The natural features on this site have been disturbed by historic agricultural "improvements" and fish farming. Prior to the impacts, this site supported pine flatwoods vegetation, and some of this vegetation community has become re-established. The vegetation on the site is currently impacted by the presence of nuisance species such as Brazilian pepper (*Schinus terebinthifolius*), lead tree (*Leucaena leucocephala*) and air potato (*Dioscorea bulbifera*). A drainage ditch runs through the center of the property and discharges into the river near the U.S. 41 bridge. This drainage is lined with cabbage palms and oak trees and the flow is intermittent. The Natural Systems Map for the Cargill West site (Figure 8-2) shows the location of the site and the distribution of the vegetation communities.

The photograph to the left depicts the upland vegetation on the Cargill West site. The vegetation is predominantly second growth hardwood with cabbage palms and an open understory. There are a number of exotic, invasive plant species on the site.



1998 Land Use/Cover

- 1100 - RESIDENTIAL - LOW DENSITY
- 1600 - MINING
- 1900/3000-3999 - OPEN/RANGE/BARREN LAND
- 2100 - IMPROVED PASTURES
- 2600 - AGRICULTURE - OPEN LANDS
- 4000 - 4999 - UPLAND FORESTS
- 5000 - 5999 - WATER
- 6150 - WETLANDS - BOTTOMLANDS
- 6400 - 6499 - WETLANDS - NON FORESTED



HILLSBOROUGH COUNTY, FLORIDA

Figure 8-2
Alafia River Watershed Management Plan
Natural Systems - Cargill West

Boundaries are approximate

Source: 1994 USGS DOQQ
Modified SWFWMD 1995
Land Use/Cover

N
W E
S

400 0 400 800 Feet

Scale 1" = 800'

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No known wildlife surveys have been conducted on this site, but due to the small size of the site, the historic impacts, and the fragmented nature of the habitat, the fauna found on this site will likely be limited to generalist species. With restoration, this site would be good habitat for birds and small mammals, as well as numerous reptile and amphibian species.

In its current disturbed condition, it is unlikely that the site provides breeding habitat for many endangered species, but the foraging potential is always there. The following table lists the species potentially present on the Cargill West site.

Common Name	Scientific Name	Common Name	Scientific Name
Eastern indigo snake	*Drymarchon corais couperi*	Snowy egret	*Egretta thula*
American alligator	*Alligator mississippiensis*	Tricolored heron	*Egretta tricolor*
Florida sandhill crane	*Grus canadensis pratensis*	White ibis	*Eudocimus albus*
Roseate spoonbill	*Ajaia ajaja*	Little blue heron	*Egretta caerulea*
SE American kestrel	*Falco sparverius paulus*	Peregrine falcon	*Falco peregrinus tundrius*
Wood stork	*Mycteria americana*		

Status. This site is no longer available due to the Cargill gypsum stack relocation project.

Williams Property

Site Description. The Williams Property site is approximately 145 acres and is located on the north shore of the Alafia River, between I-75 and US 301 in Sections 17 and 18 of Township 30, Range 20. The site is currently used for cattle pasture. The surrounding land uses include residential, agricultural and some commercial uses.

This site formerly supported a pine flatwoods community with numerous shallow freshwater marshes surrounded by cypress swamps. The Natural Systems Map for the Williams Property (Figure 8-3) shows the location of the site and depicts the vegetation communities. The marshes have been drained and highly impacted by cattle grazing. The majority of the cypress has been cut and the flatwoods have been cleared to create pasture. The photograph below shows the pasture looking toward the shoreline of the river. In its current condition, the site does not provide significant natural resource benefits, but with its prime location and the potential for restoration, this site would be a valuable resource.

Status. This site is wholly owned by the William Williams, Jr. estate and the land has been in this family for many years. This area, with its proximity to the ibis breeding colonies, could provide significant foraging habitat if the existing wetlands were restored and a system of shallow wetlands were constructed in the existing pasture.

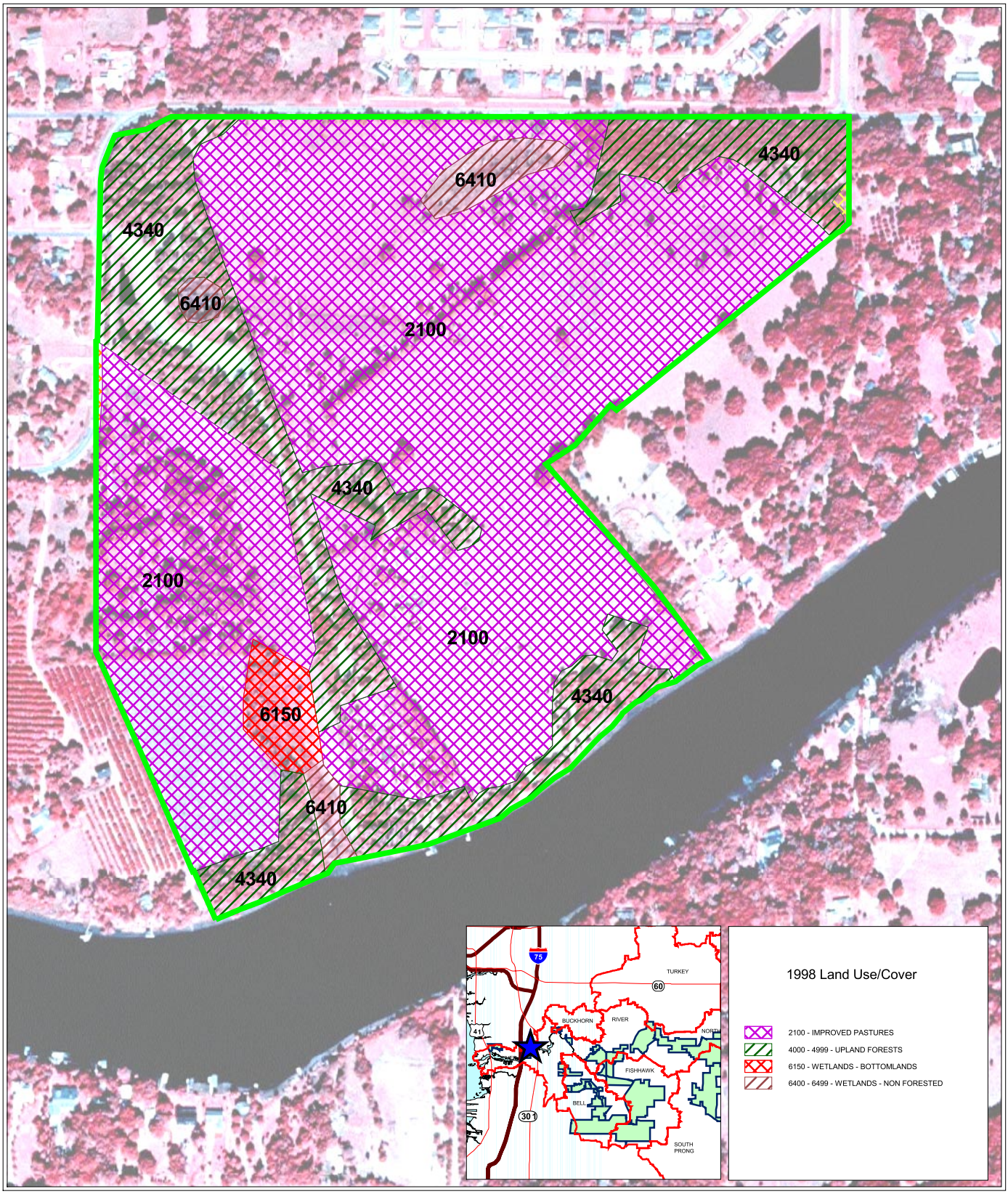

Figure 8-3
Alafia River Watershed Management Plan
Natural Systems - Williams Property

HILLSBOROUGH COUNTY, FLORIDA

Source: 1999 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

Boundaries are approximate

300 0 300 600 Feet

Scale 1" = 500'

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The Williams Property site formerly supported pine flatwoods and freshwater marshes. Restoration of this site would provide an excellent foraging area for the coastal nesting white ibis colony.

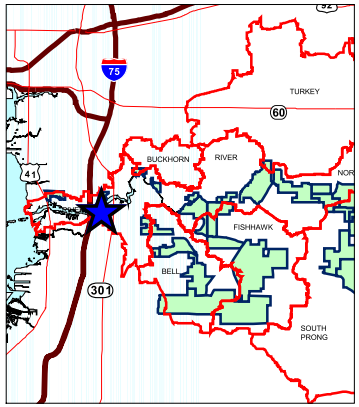
Alafia Scrub Preserve (Read Property)

Site Description. This property was purchased by the ELAPP program with 50% funding from the Florida Communities Trust. The 60-acre site is located on the southern shoreline of the Alafia River, east of the I-75 bridge, and west of Highway 301, in Section 19 of Township 30, Range 20. The 79-acre site is surrounded by undeveloped land and low-density residential land uses.

This site is dominated by a hardwood-conifer forest with a canopy of slash pine, laurel and live oak. The shrub layer is dominated by wax myrtle and saw palmetto where the canopy was thinner, and by cabbage palm and hardwood saplings in the shadier areas. The Natural Systems Map for the Alafia Scrub Preserve (Figure 8-4) indicates the location of the site and the distribution of the vegetation communities.

1998 Land Use/Cover

- 1100 - RESIDENTIAL - LOW DENSITY
- 4000 - 4999 - UPLAND FORESTS
- 6400 - 6499 - WETLANDS - NON FORESTED
- 8000 - 8399 - TRANS./COMM./UTIL



HILLSBOROUGH COUNTY, FLORIDA

Figure 8-4
Alafia River Watershed Management Plan
Natural Systems - Alafia Scrub Preserve

Boundaries are approximate

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

N
W E
S

225 0 225 450 Feet

Scale 1" = 450'

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The photograph below was taken at the northern edge of the Alafia Scrub Preserve.

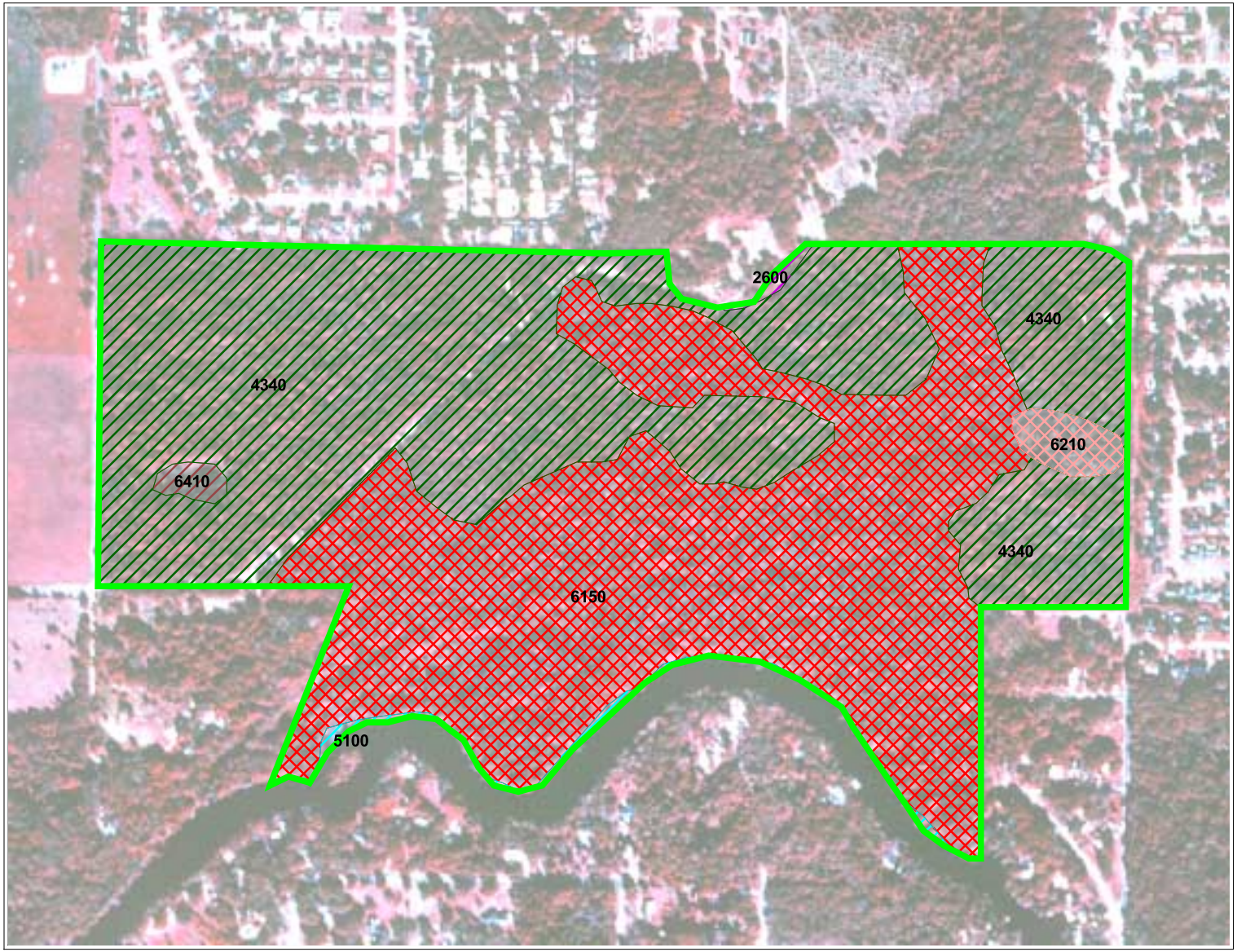
The photograph to the left was taken at the Alafia Scrub Preserve (Read Property). This site is heavily vegetated with upland hardwoods throughout. The shoreline is natural and includes some low areas with cypress and bays.

Status. This site was purchased by the county ELAPP program and the Florida Communities Trust as part of the effort to protect the Alafia River Watershed. No management plan has been prepared for this site to date, but protective fencing has been installed to prevent dumping and trespassing.

Buckhorn Springs and Creek

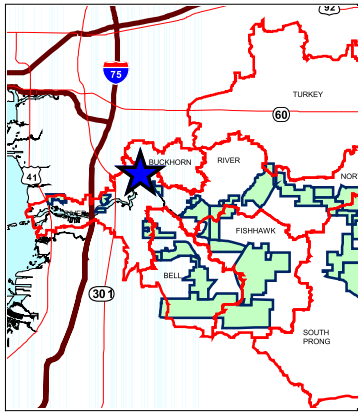
Site Description. This site is located on the northern shore of the Alafia River, south of Bloomingdale Avenue and between Kings Avenue and Providence Road, in Section 10 of Township 30, Range 20. This approximately 159-acre parcel is predominantly forested with a dense canopy of hardwoods and cypress, with an open understory. In the more mesic areas, the understory is carpeted with ferns, while in the areas on higher ground, the understory is dominated by cabbage palm seedlings, saplings of the canopy trees, and native grasses. The Natural Systems Map for Buckhorn Springs and Creek (Figure 8-5) shows the location of the site and the vegetation communities.

Status. This parcel is owned by Cargill, Inc. and has been approved for acquisition by ELAPP and the Southwest Florida Water Management District. Cargill, Inc. has indicated that they are not interested in selling it, but they may be persuaded to use it for mitigation some day in the future (Melody Russo, personal communication). Purchase and preservation of this site would definitely be beneficial to the protection of the natural resources and water quality in the watershed.



1998 Land Use/Cover

- 2600 - AGRICULTURE - OPEN LANDS
- 4000 - UPLAND FORESTS
- 5000 - WATER
- 6150 - WETLANDS - BOTTOMLANDS
- 6200/6300 - WETLANDS - FORESTED
- 6400 - WETLANDS - NON FORESTED



HILLSBOROUGH COUNTY, FLORIDA

Figure 8-5
Alafia River Watershed Management Plan
Natural Systems - Buckhorn Creek

Boundaries are approximate

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

N
W E
S

300 0 300 600 Feet

Scale 1" = 600'

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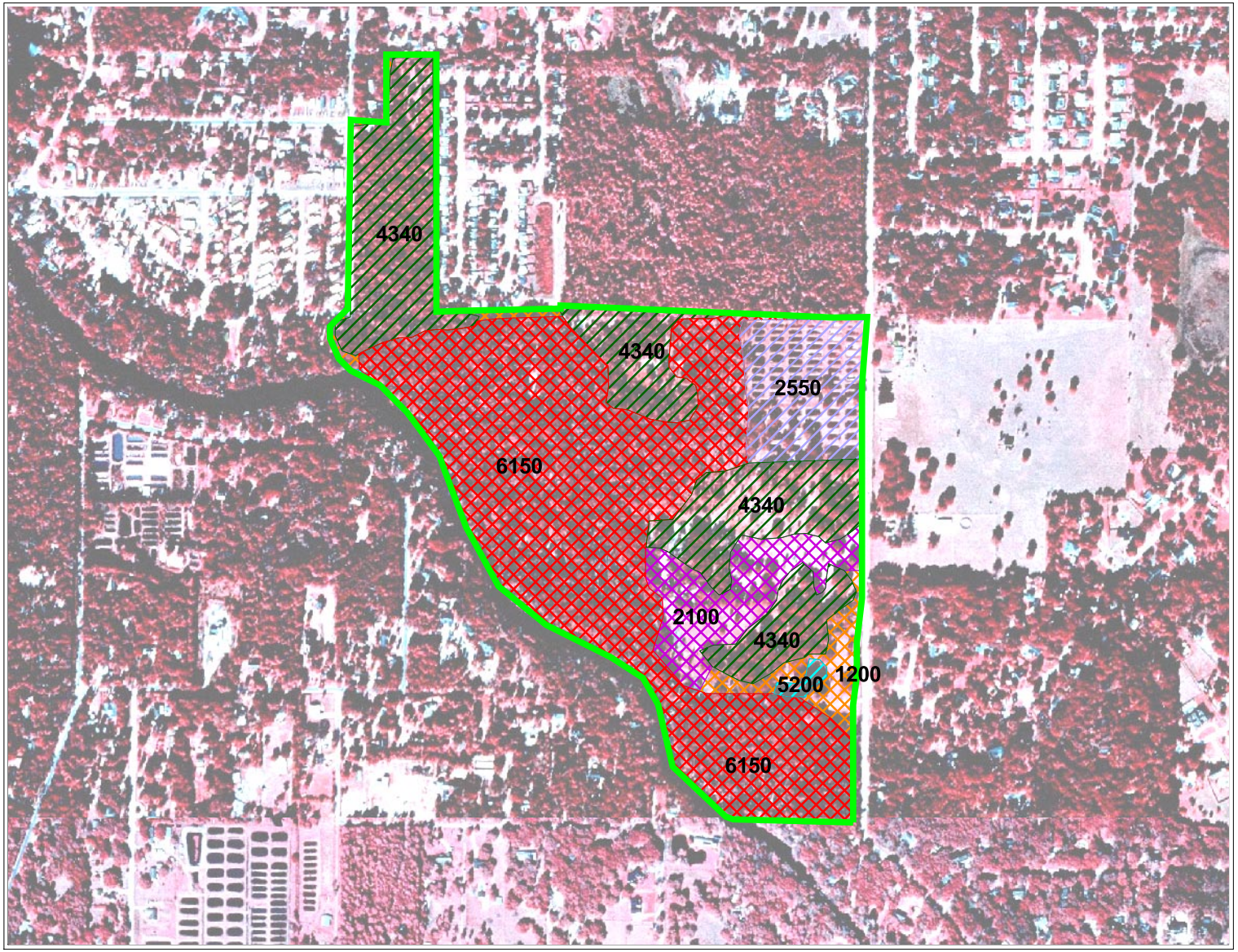
This photograph was taken in one of the more open areas on the site. The majority of the canopy trees were laurel oak and slash pine. The understory is vegetated with cabbage palm, saw palmetto, and grasses and forbs. Vines like cat briar, wild grape, and poison ivy are common.

John Moore Road Site

Site Description. This site is located east of the Buckhorn Creek parcel on the northern bank of the Alafia River, between Kings Road and John Moore Road, in Sections 10 and 15 of Township 30, Range 20. The site is approximately 130 acres and consists of hardwood-cypress forested floodplain and oak-pine forested uplands. The site is surrounded by low-density residential and agricultural land uses. The Natural Systems Map for the John Moore Road Site (Figure 8-6) shows the location of the site in the watershed and depicts the vegetation communities present. The photograph below was taken on the south side of the parcel near the river.

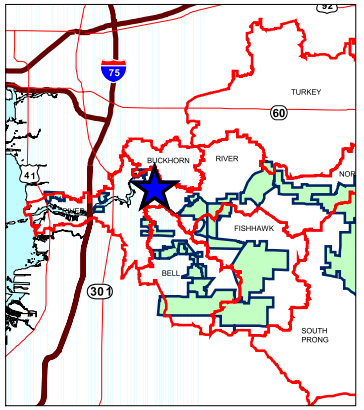
This photograph shows the vegetation in the southern portion of the parcel near the banks of the river. The banks were lower in this area and it appeared that the river overtopped the banks more frequently here than in other areas.

This site provides no unique or endangered habitat but is valuable because of its relative size and its strategic location along the riverbank. No known surveys for



1998 Land Use/Cover

- 1200 - RESIDENTIAL - MEDIUM DENSITY
- 2100 - IMPROVED PASTURES
- 2500 - 2599 - SPECIALTY FARMS/FISH
- 4000 - 4999 - UPLAND FORESTS
- 5000 - 5999 - WATER
- 6150 - WETLANDS - BOTTOMLANDS



HILLSBOROUGH COUNTY, FLORIDA

Figure 8-6
Alafia River Watershed Management Plan
Natural Systems - John Moore Road Site

Boundaries are approximate

Source: 1999 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

N
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400 0 400 800 Feet

Scale 1" = 800'

PARSONS ENGINEERING SCIENCE, INC

protected flora or fauna has been conducted, but the habitat is available for recruitment of these species.

Status. This site contains a significant amount of uplands and probably will be developed if it is not purchased for preservation. The majority of the parcel would be considered jurisdictional wetlands and would not be developed, but the preservation of the adjacent uplands would definitely enhance the value of the wetlands. This parcel was evaluated by ELAPP but was not approved for acquisition.

Bell Creek Preserve

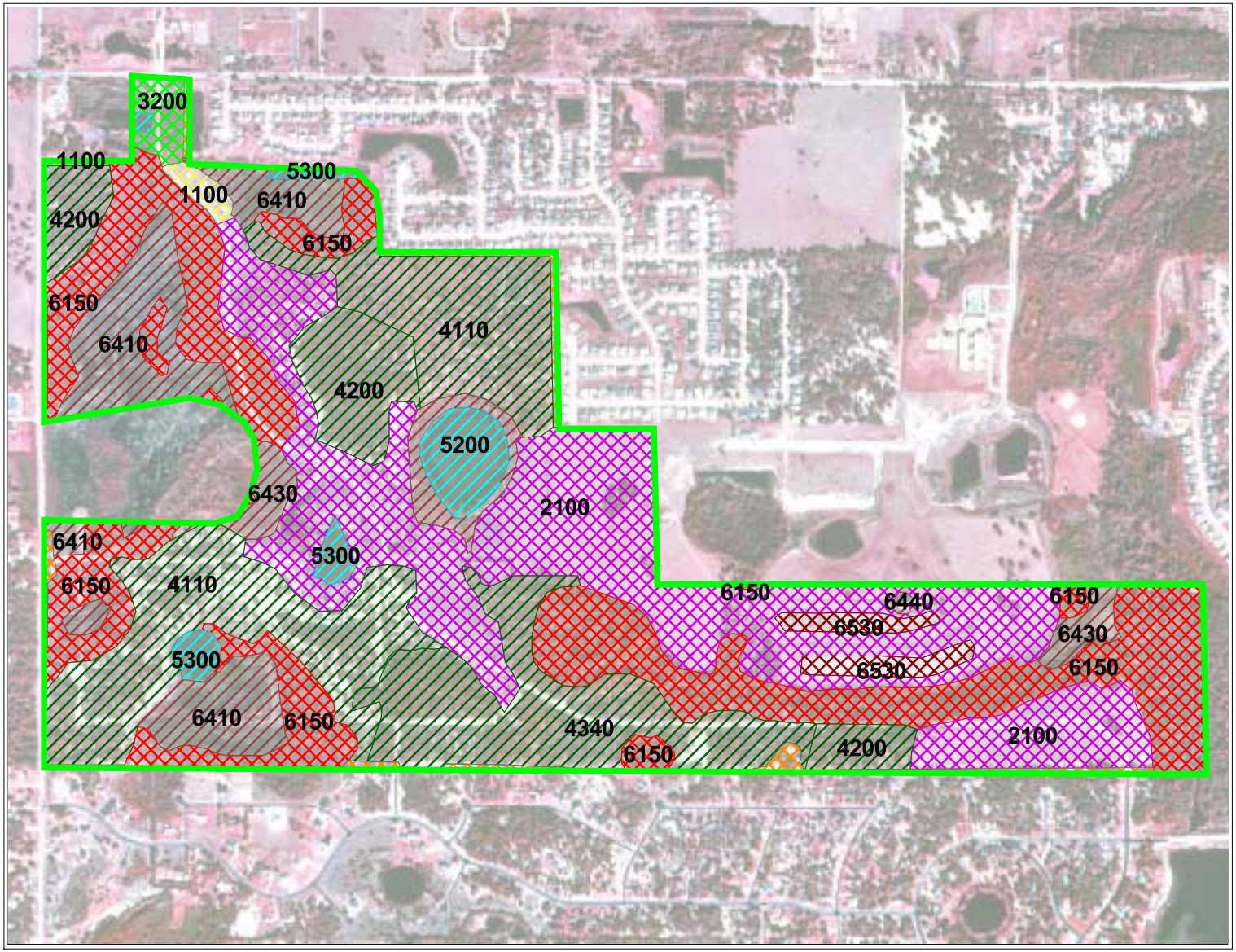
Site Description. The Bell Creek Preserve is located in Riverview, Florida, south of Boyette Road, and east of McMullen Road, in southern Hillsborough County, in Sections 26 and 27 of Township 30, Range 20. The site encompasses approximately 560 acres and lies in the lower Alafia and the Bell Creek watersheds. This area is owned by the County and managed by the Resource Management Team. A school is located on an out parcel of the preserve, along McMullen Road, and the Hillsborough County Natural Resources Natural Resources Management Team has an office and equipment area within the preserve.

The Bell Creek Preserve parcel encompasses seven distinct plant communities:

Sand pine scrub	Pine flatwoods	Old field
Xeric oak hammock	Freshwater marsh	Man-made lake
Mesic hammock		

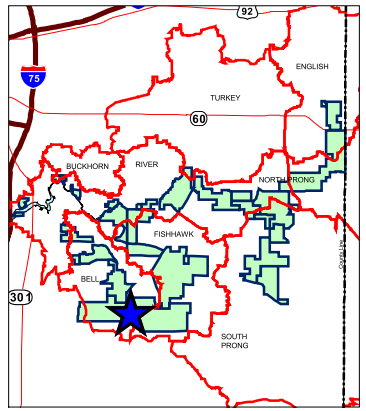
The Natural Systems Map for Bell Creek Preserve (Figure 8-7) shows the location and extent of the vegetation communities within the site. The mesic hammock provides the majority of the habitat on the parcel with approximately 120 acres. The old field areas are actually areas that were previously cleared for a residential subdivision and with 100 acres, comprise the second largest plant community. The County has left the asphalt roads intact, but is allowing the old field areas to convert to natural habitat.

The accessibility and popularity of the site has led to a fairly extent knowledge of the resources present. The County Natural Resource Management Team, based on known resources, sightings in the vicinity, and on-site surveys, has determined that 23 amphibian species, 53 reptile species, 158 bird species, and 41 mammal species are present or potentially present on the site.



1998 Land Use/Cover

- 1100 - RESIDENTIAL - LOW DENSITY
- 1900/3200/7400 - OPEN/RANGE/BARREN LAND
- 2100 - IMPROVED PASTURES
- 4000 - 4999 - UPLAND FORESTS
- 5000 - 5999 - WATER
- 6150 - WETLANDS - BOTTOMLANDS
- 6200 - 6399 - WETLANDS - FORESTED
- 6400 - 6499 - WETLANDS - NON FORESTED
- 6500 - 6599 - WETLANDS - NON VEGETATED



HILLSBOROUGH COUNTY, FLORIDA

Figure 8-7
Alafia River Watershed Management Plan
Natural Systems - Bell Creek Preserve

Boundaries are approximate

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

N
W E
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600 0 600 1200 Feet

Scale 1" = 1200'

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The photograph below shows the asphalt roads and the encroaching vegetation.

This photograph shows the old asphalt pavement that was lain when this area was planned for development. Most of the roads were left intact by the County to provide access through the site.
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A total of 34 federally- and/or state- listed species are present or potentially present on the Bell Creek Preserve site. Federally listed plants present or potentially present on the site include Florida golden aster, Florida bonamia, pygmy fringe tree, and chaffseed. Of these four species, only the Florida golden aster has been documented on site. Sixteen state-listed plant species are known to occur in the habitats present on this site. These species are:

Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Curtiss' milkweed	*Asclepias curtissii*	Auricled spleenwort	*Asplenium auritum*
Nodding pinweed	*Asplenium auritum*	Nodding caps	*Triphora latifolia*
Wild coco	*Eulophia alta*	Pine pinweed	*Lechea divaricata*
Rain lily	*Zephyranthes simpsonii*	Adders tongue	*Ophioglossum palmatum*
Tampa vervain	*Verbena tampensis*	Southern red lily	*Lilium catesbaei*
Swamp honeysuckle	*Rhododendron viscosum*	Nodding clubmoss	*Lycopodium cernuum*
Brittle maidenhair	*Adiantum tenerum*	Big yellow milkwort	*Polygala sp.*
Meadow spike moss	*Selaginella apoda*	Needle palm	*Rhapidophyllum hystrix*

Of these sixteen, those observed on the site are the southern red lily, nodding club moss and swamp honeysuckle have been documented on the site.

The eighteen listed faunal species listed below have been identified as present or potentially present on the Bell Creek Preserve site.

Gopher Tortoise	Roseate spoonbill	Bald eagle
Gopher frog	Snowy egret	SE American kestrel
Eastern indigo snake	Tricolored heron	Peregrine falcon
Florida pine snake	White ibis	Sherman's fox squirrel
American alligator	Burrowing owl	Little blue heron
Florida mouse	Wood stork	Florida sandhill crane

Status. A management plan was prepared for the Bell Creek Preserve site in 1997 that included goals and objectives for the management, enhancement, and protection of the site.

Rhodine Scrub

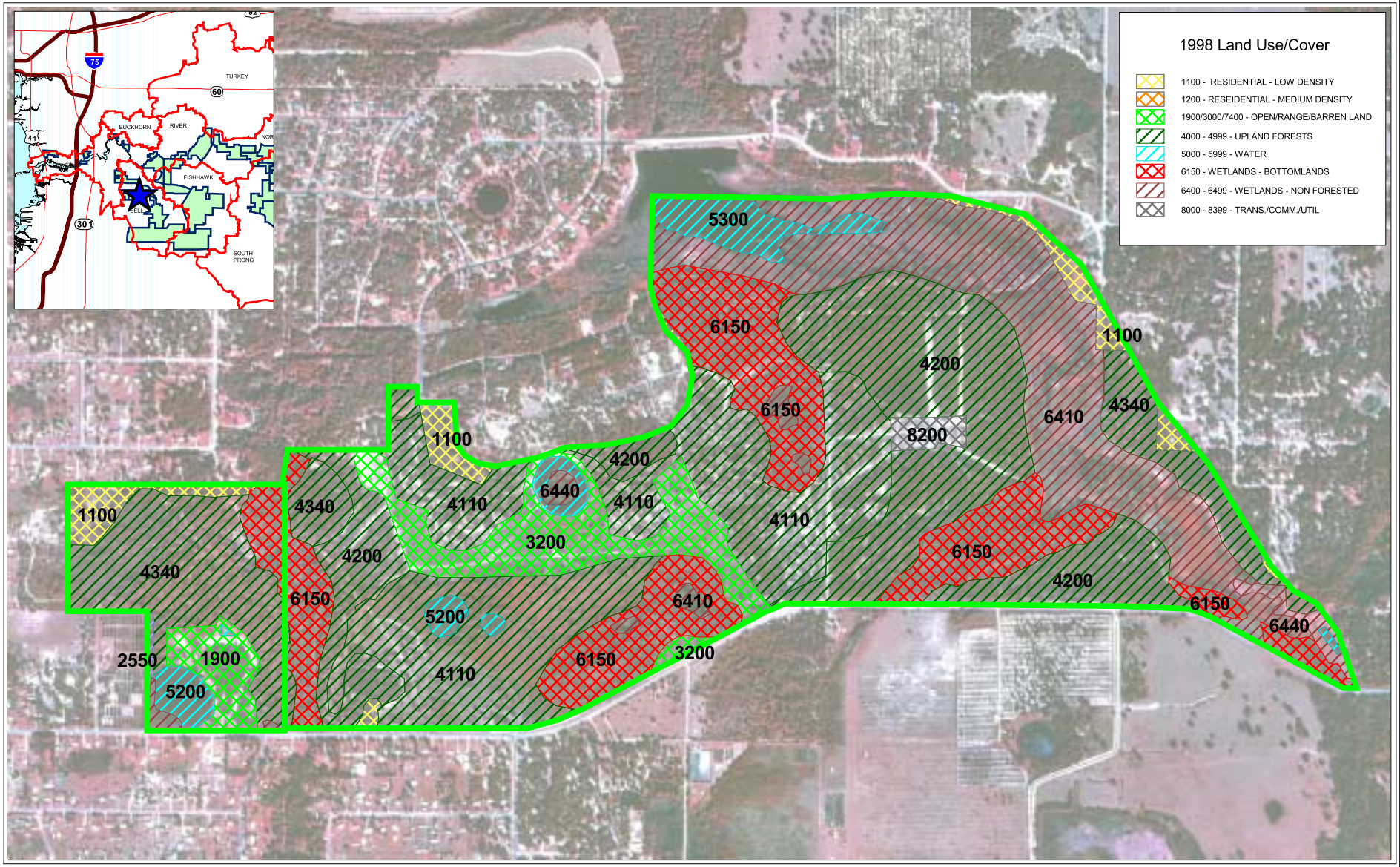
Site Description. The Rhodine Scrub site is located north of Rhodine Road approximately one mile east of Balm Riverview Road, south of the Alafia River in the Bell Creek Basin, in Sections 34, 35, and 36 of Township 30, Range 20. The site is approximately 803 acres and is surrounded by residential and agricultural land uses. Bell Creek traverses the east side of the site and Pellham Branch runs through the west side. The Rhodine Scrub Natural Systems Map (Figure 8-8) depicts the location within the watershed and the natural features on the site. The site includes a lake formed by the damming of Bell Creek, as well as forested uplands, forested wetlands, freshwater marshes, and some of the best scrub habitat in the County.

The federally listed Florida golden aster is present on this site, as are the state-protected gopher tortoise and Sherman's fox squirrel. The photograph below is the state-listed *Lilium catesbaei* that was photographed on this site.

The beautiful Catesby's lily is listed as threatened in the state of Florida and is usually found in pine flatwoods areas that are periodically burned. The lily is found throughout the state but is threatened because of habitat loss.

Status. Approximately 460 acres of this site has been purchased by the ELAPP program. An in-holding of 180 acres includes a communication tower and access roads. Purchase of the in-holding would significantly increase the value of this site by creating a more contiguous area of wildlife habitat.

After this site was purchased by ELAPP, it required a major effort to clean up trash and exclude the off-road vehicles that were tearing up the terrain. The site has been fenced and some habitat restoration efforts have been undertaken.



HILLSBOROUGH COUNTY, FLORIDA

Figure 8-8
Alafia River Watershed Management Plan
Natural Systems - Rhodine Scrub

Boundaries are approximate

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

N
W E
S

700 0 700 1400 Feet

Scale 1" = 1400'

PARSONS ENGINEERING SCIENCE, INC

Balm-Boyette Scrub

Site Description. The Balm-Boyette Scrub site is located in southeastern Hillsborough County, north of Balm-Picnic Road, between US Highway 301, and State Road 39, in Sections 12, 13, and 14 of Township 31, Range 20, and Sections 8, 15, 16, 17, 20, 21, and 22, of Township 31, Range 21. The 4,916-acre site lies in the upper reaches of the Bell Creek and Fishhawk Creek Basins within the Alafia River Watershed.

The majority of the site (3,716 acres) consists of a mosaic of plant communities in relative pristine condition. The Balm-Boyette Scrub Natural Systems Map (Figure 8-9) indicates the location of the site within the watershed and the various plant communities on the site. The eastern portion of the project, approximately 1,200 acres, was mined for phosphate in the 1950's and now consists of rolling topography, deep, narrow lakes, and improved pasture.

The photograph below depicts the dense scrub vegetation in the western portion of the site, near Balm-Riverview Road.

This photograph was taken on the western side of the property and shows the majestic old oaks and pines that comprise the canopy of this site. This site is one of the largest contiguous parcels under County ownership.

The site is a valuable resource in Hillsborough County because of the diversity of natural communities, its large expanse of available wildlife habitat, and its contiguity with other sites in the watershed. The twelve natural plant communities on the site include:

Hydric Hammock	Disturbed Flatwoods	Sand Pine Forest
Cypress Swamp	Mesic Hammock	Sand Pine Scrub
Hardwood Swamp	Mesic Old Field	Xeric Old Field
Freshwater Marsh	Scrubby Flatwoods	Pine Flatwoods

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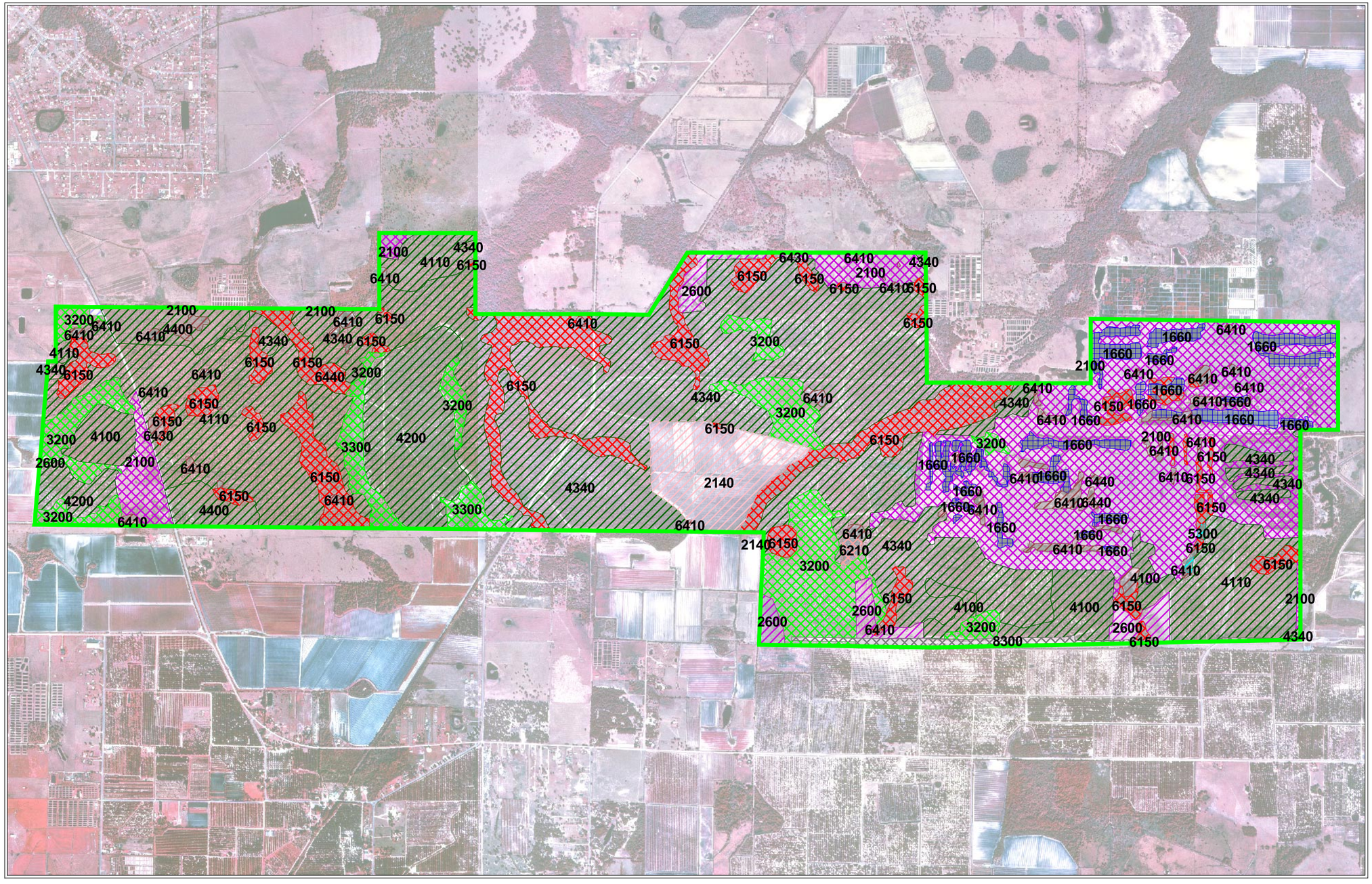

Figure 8-9
Alafia River Watershed Management Plan
Natural Systems - Balm-Boyette Scrub Preserve

HILLSBOROUGH COUNTY, FLORIDA

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

Boundaries are approximate

500 0 500 1000 1500 2000 2500 Feet
Scale 1" = 2500'

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Back of page (11x17)

Extensive surveys conducted by various groups over the last twenty-three years indicate that the site provides habitat or potentially provides habitat for 24 species of amphibians, 51 species of reptiles, 143 species of birds, and 39 species of mammals.

Four federally listed plant species potentially occur on the Balm-Boyette Scrub site. Of these four, only the Florida golden aster has been documented. Sixteen state-listed plant species may occur on the site, but only three of these, the nodding pinweed, Curtiss' milkweed, and wild coco, have been documented on the site.

Listed in the table below are nineteen federally- and/or state- listed wildlife species that occur or potentially occur on the site. The asterisk indicates that the species has been identified on the site.

Gopher Tortoise*	Roseate spoonbill	Bald eagle
Gopher frog	Snowy egret*	SE American kestrel
Eastern indigo snake*	Tricolored heron*	Florida Scrub-jay
Florida pine snake	White ibis*	Sherman's fox squirrel*
Florida mouse	Burrowing owl	Wood stork *
Florida sandhill crane	Short-tailed snake	Little blue heron*

Status. The site was purchased in 1992 through the County's ELAPP program and is now used as a wildlife preserve and passive recreation area. An evaluation of the site was conducted in 1999, and a Resource Management Plan has been prepared. The goals of the management plan are to preserve, restore, enhance, and maintain the site's natural plant communities to a condition suitable for maintaining viable populations of all species indigenous to the Preserve's habitat, plus introduce consistent and compatible public education and passive resource-related recreation. The County is accomplishing these goals by implementing a prescribed burn plan, restoring previously disturbed areas, implementing volunteer programs, and monitoring the results of these activities.

Fishhawk Creek /Thomas Ranch

Site Description. This 880-acre area lies along the southern banks of the Alafia River east of Bell Shoals Road, and extending approximately a mile and a half to the east, in Sections 13 and 24 of Township 30, Range 20, and Sections 18, 19, and 30 of Township 30, Range 21. A portion of the site extends approximately 7000 feet south of the new Fishhawk Road, along the eastern property boundary. The photograph below shows the expanses of open land and the mature trees on the site.

The photograph to the left was taken from the new Fishhawk Road that transects this parcel of land. Access to this site is not available and the owner is not interested in selling the land to the County. The site contains some unique habitat.

This area is comprised of a mosaic of vegetation communities including xeric oak, hickory, mesic hardwoods, pine flatwoods, and sand pine scrub. The Fishhawk/Thomas Ranch Natural Systems Map (Figure 8-10) depicts the vegetation communities on the site and shows the location of the site within the watershed. Fishhawk Creek flows through this site and discharges into the Alafia River near the eastern boundary.

The list below describes the endangered, threatened, and special concern plant and animal species observed and potentially present on the site. The utility easement and the recently constructed Fishhawk Road fragmented the habitat, but it still provides some of the best habitat in the County remaining in private ownership.

Gopher Tortoise	Roseate spoonbill	Bald eagle
Gopher frog	Snowy egret	SE American kestrel
Eastern indigo snake	Tricolored heron	Florida scrub jay
Florida pine snake	White ibis	Sherman's fox squirrel
Florida mouse	Burrowing owl	Wood stork
Florida sandhill crane	Short-tailed snake	Little blue heron
Wild coco	Auricled spleenwort	Southern red lily
Florida golden aster	Rain lily	Needle palm

Status. Efforts have been made by ELAPP to purchase this property for preservation but the owner does not appear to be interested in selling. In the meantime, the value of the property increases as urban sprawl encroaches from the eastern and western boundaries. Currently the site is being logged of ancient longleaf and sand pine in the northern portion of the property.

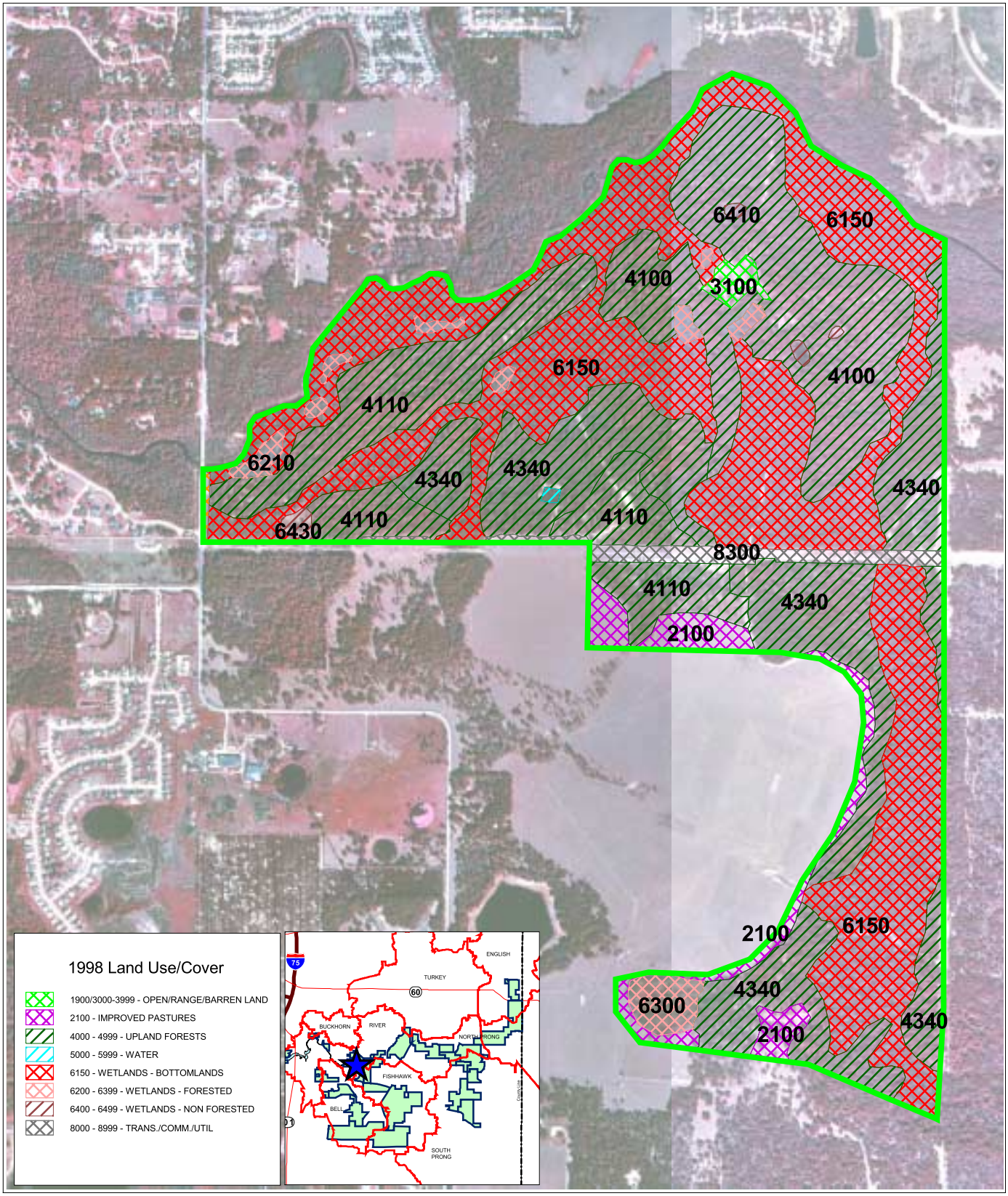


Figure 8-10
Alafia River Watershed Management Plan
Natural Systems - Fishhawk/Thomas Ranch

HILLSBOROUGH COUNTY, FLORIDA

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

Boundaries are approximate

N
W E
S

500 0 500 1000 1500 Feet

Scale 1" = 1500'

PARSONS ENGINEERING SCIENCE, INC

Fishhawk Ranch

Site Description. The Fishhawk Ranch property extends from the eastern boundary of the Fishhawk Creek/Thomas Ranch property to Lithia-Pinecrest Road, in Sections 19, 20, 29, 30, 31, 32, and 33 in Township 30, Range 21. This 1,600-acre property includes a significant amount of the Alafia River banks, as well as a large portion of the land adjacent to the Little Fishhawk Creek. Some of this land has been cleared for grazing and some has been developed as part of the Fishhawk Ranch subdivision, but many undisturbed portions remain. As with the Thomas/Fishhawk Ranch, this site has been fragmented by the power line easement and Fishhawk Road, but is still valuable habitat.

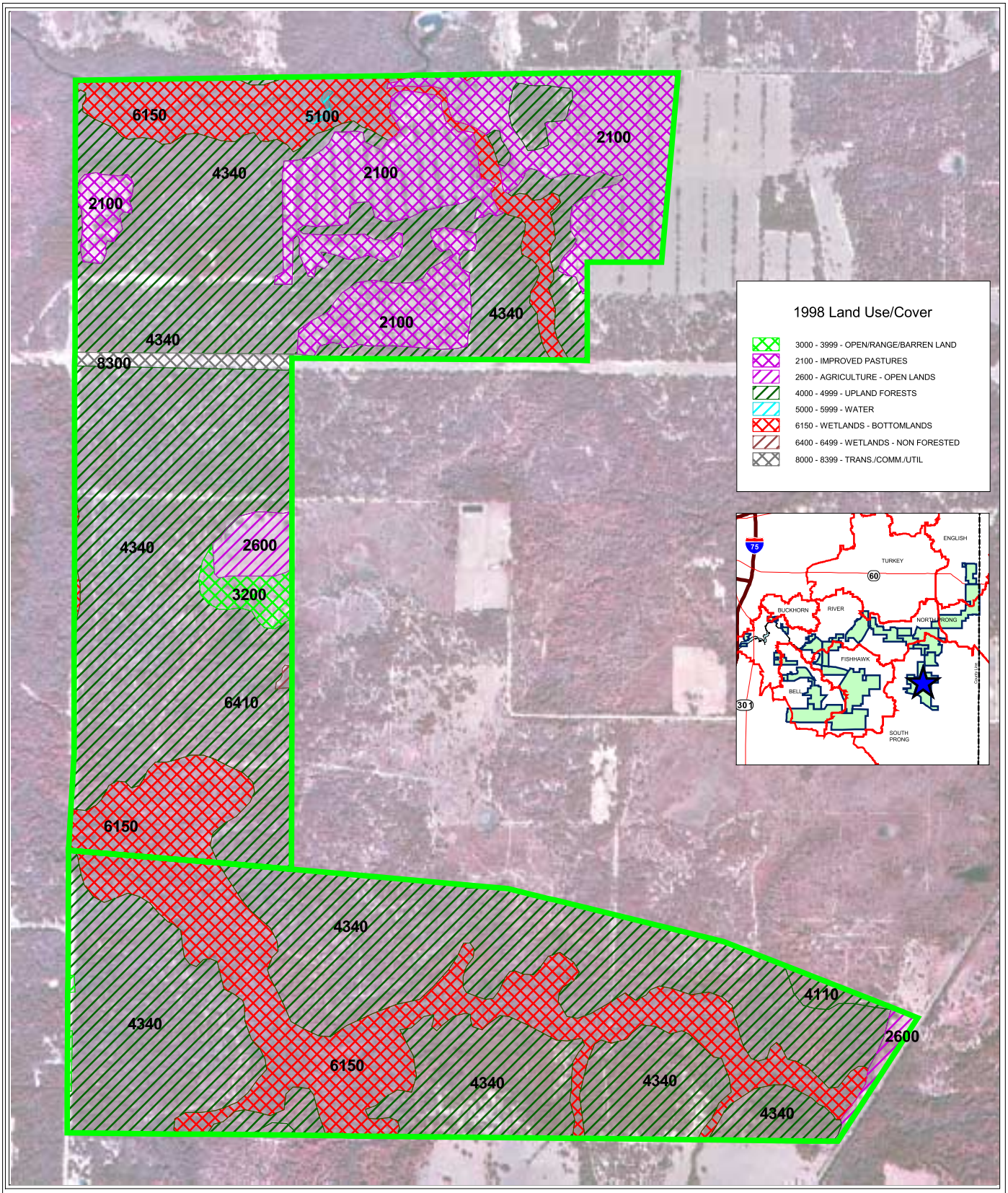
The photograph below shows the Little Fishhawk Creek as it crosses under the new Fishhawk Road. Since construction of the roadway, this area has been taken over by noxious vines and other exotic vegetation.

The photograph to the left shows Little Fishhawk Creek as it crosses under the Fishhawk Road bridge. This creek drains areas that are currently cattle ranches, but are rapidly being developed.

The Fishhawk Ranch Natural Systems Map (Figure 8-11) shows the different vegetation communities on the site and the location of the site within the watershed. The majority of the site includes xeric oak habitat that supports a large population of gopher tortoises. Also present are Sherman's fox squirrel, eastern indigo snake, and Florida mouse. The table below lists the state and federally listed species known to occur or expected to occur on the site.

*Gopher Tortoise	*Roseate spoonbill	*Bald eagle	*Wild coco
*Gopher frog	*Snowy egret	*SE American kestrel	*Florida golden aster
*Eastern indigo snake	*Tricolored heron	Florida scrub jay	Auricled spleenwort
Florida pine snake	*White ibis	*Sherman's fox squirrel	Rain lily
*Florida mouse	Burrowing owl	*Wood stork	*Catesbae's lily
*Florida sandhill crane	Short-tailed snake	*Little blue heron	Needle palm

* Indicates an observation.



HILLSBOROUGH COUNTY, FLORIDA

Figure 8-11
Alafia River Watershed Management Plan
Natural Systems - Fishhawk Ranch

N
W E
S

Boundaries are approximate

425 0 425 850 1275 1700 Feet

Scale 1" = 1700'

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

PARSONS ENGINEERING SCIENCE, INC

Status. Portions of this site are already under the ownership of Hillsborough County or preserved as green space under the DRI agreement. The County is negotiating for the purchase of land along the river and Little Fishhawk Creek for preservation.

Fishhawk South

Site Description. The acquisition of this site would link the Balm-Boyette site and the Fishhawk Ranch sites to create a contiguous corridor along Fishhawk Creek. This site is located in Sections 33, 34, and 35 of Township 30, Range 21, and Sections 2, 3, 4, 9, and 10, of Township 31 Range 21. The approximately 3,500-acre site includes xeric oak, pine flatwoods, freshwater marsh, floodplain forest, mixed pine/hardwood forest, and agricultural range and cropland. The Fishhawk South Natural Systems Map (Figure 8-12) indicates the vegetation communities present and their distribution on this site.

This photograph shows Fishhawk Creek in the northern portion of this parcel. The floodplain for this creek is predominantly second growth hardwoods with an understory of saplings and vines like catbriar and wild grape. Wild hog damage is prevalent.

Status. Purchase of this site would benefit water quality by limiting the range land near the creek, thereby limiting the cattle wastes and sediments that would be washing into the creek during storms. It would significantly improve the wildlife habitat in the vicinity by creating a contiguous wildlife corridor and preserving existing habitat. In addition, the agricultural lands within the site could be easily restored to the pine flatwoods and prairie lands that originally covered this area.

Lithia Springs

Site Description. This approximately 200-acre site is located along the Alafia River, west of Lithia Pinecrest Road, in Sections17 of Township 30, Range 21. It is currently being used as a recreational area with swimming, boating and picnicking activities. The majority of the site consists of the typical forested alluvial areas that

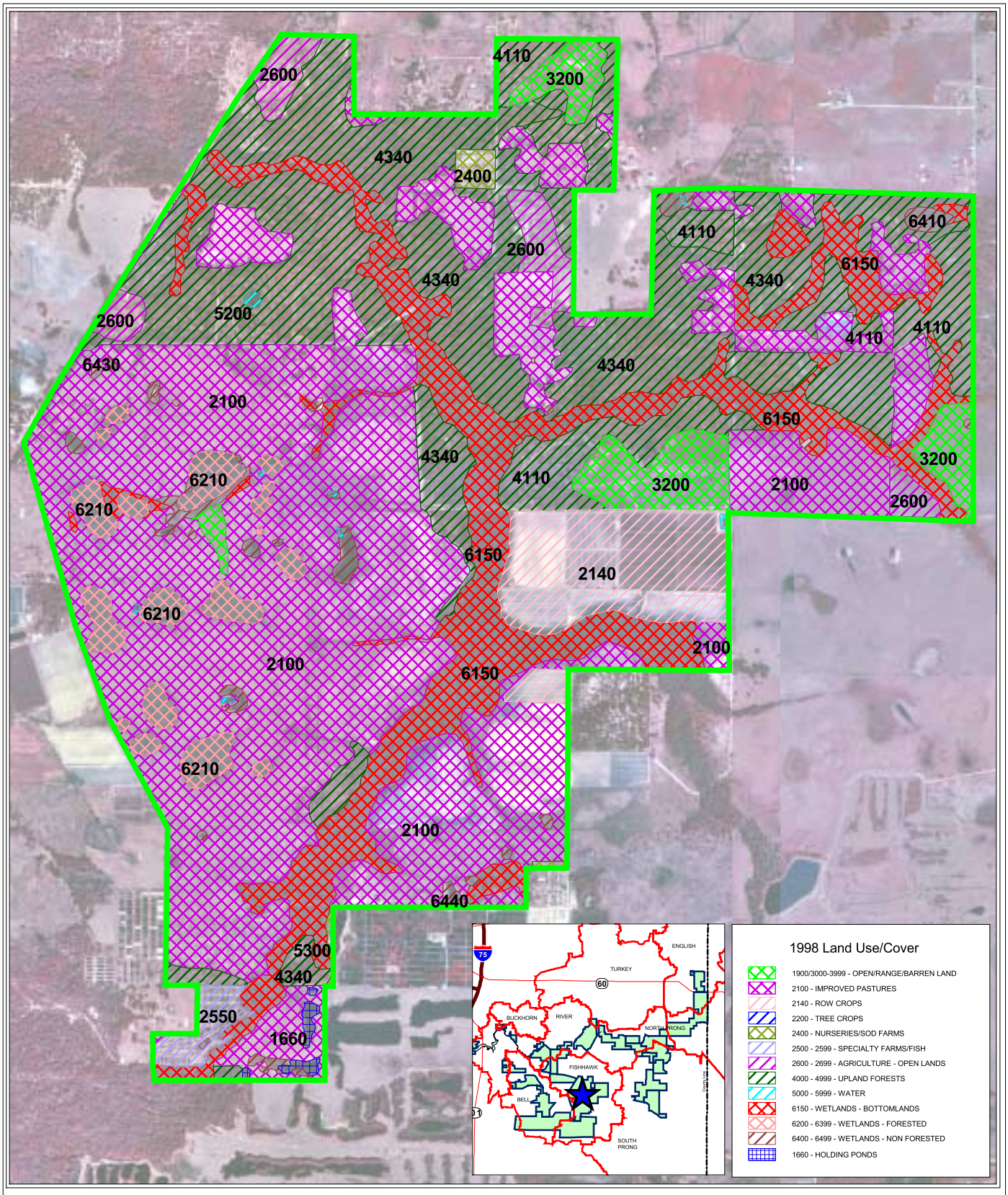


Figure 8-12
Alafia River Watershed Management Plan
Natural Systems - Fishhawk South

HILLSBOROUGH COUNTY, FLORIDA

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

Boundaries are approximate

575 0 575 1150 1725 2300 Feet

Scale 1" = 2300'

PARSONS ENGINEERING SCIENCE, INC

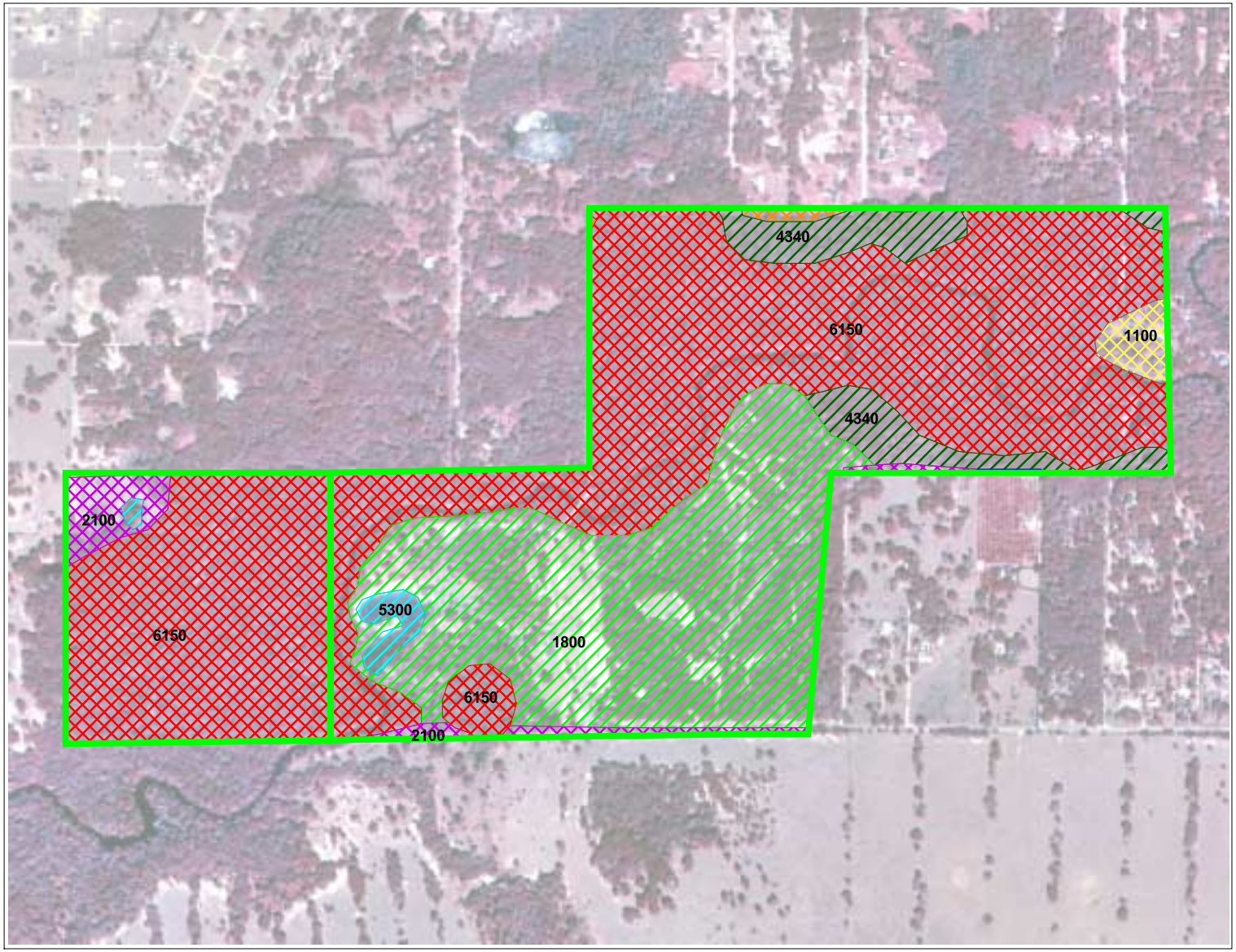
are found along the undisturbed floodplain of the Alafia River. These areas are typically vegetated with hardwoods, cypress, occasional pines, and a dense undergrowth of saw palmetto, vines, ferns, and shrubs. The Natural Systems Map for Lithia Springs (Figure 8-13) provides a depiction of the vegetative communities on the site.

Adjacent to the west side of the track owned by Cargill, Inc. is an approximately 40-acre site that has been purchased by the County. The southern portion of this site is predominantly Alafia River floodplain, but the northern portion contains a pond that was excavated at the base of the gradient to the floodplain. This pond, as seen in the photograph below, provides little habitat in its current condition, but is a candidate for a habitat restoration/stormwater treatment project.

This man-made pond was likely excavated to provide water for cattle and fill for the northern portion of the site. The cleared portion of the parcel is approximately 4 acres and is gently graded to the floodplain.

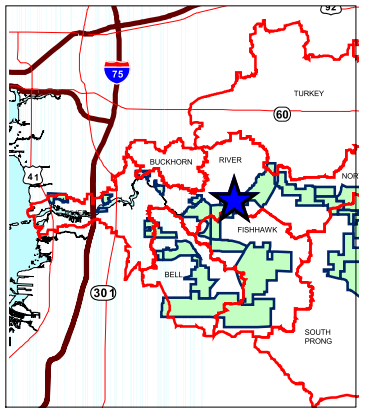
Status. The majority of the site is owned by Cargill, Inc. and they evidently have plans for the property. If the situation changes, the County will approach them again to attempt to purchase the site. Preservation of this property will contribute to the Alafia River Greenways/Corridor program.

The parcel owned by the County contains the small pond shown above. The pond currently provides little habitat and could be either enhanced with the creation of littoral shelves or graded and restored to floodplain. The land around the pond is overgrown with weeds but will likely be replanted with native vegetation by the County when funds and manpower are available.



1998 Land Use/Cover

- 1100 - RESIDENTIAL - LOW DENSITY
- 1800 - RECREATIONAL
- 2100 - IMPROVED PASTURES
- 4000 - 4999 - UPLAND FORESTS
- 6150 - WETLANDS - BOTTOMLANDS
- 5000 - 5999 - WATER



N
W E
S

400 0 400 800 Feet

Scale 1" = 800'

HILLSBOROUGH COUNTY, FLORIDA

Figure 8-13
Alafia River Watershed Management Plan
Natural Systems - Lithia Springs

Boundaries are approximate

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

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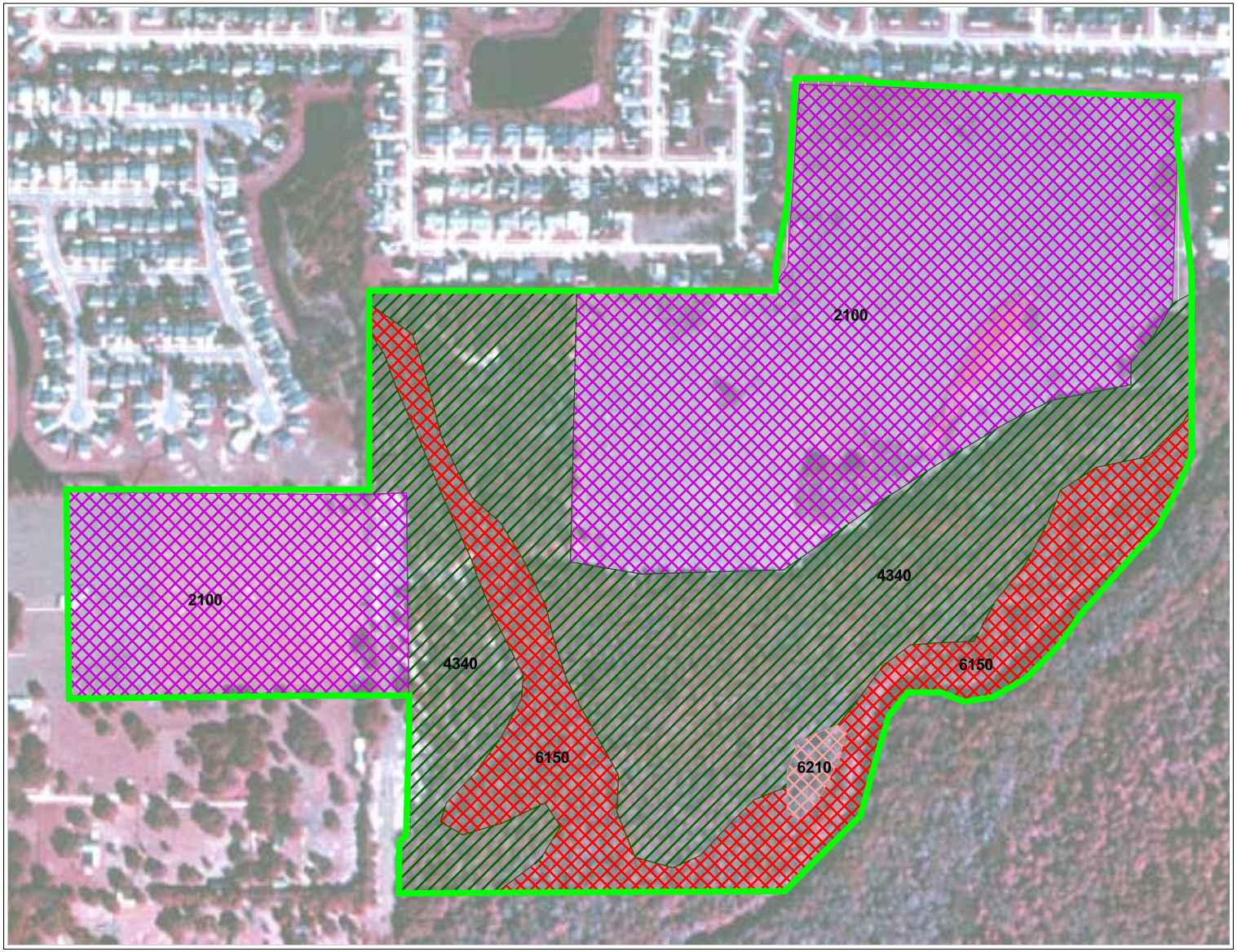
River Crossing Estates

Site Description. This approximately 150-acre parcel lies along the northern banks of the Alafia River within and surrounded by the Bloomingdale subdivision, in Section 13, Township 30, Range 20. The photograph below shows an example of the alluvial forests in the vicinity.

This photograph shows example of the alluvial forests along the banks of the Alafia River. These forests form on sand deposits from historic flooding events and are characterized by dense vegetation and rolling topography.

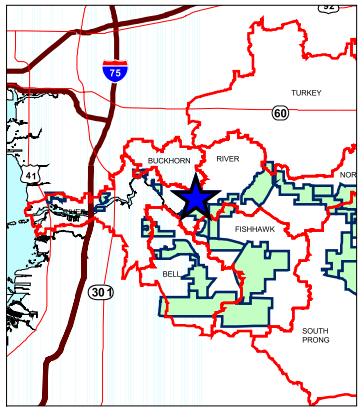
The majority of this parcel has been converted to pasture, but some relatively undisturbed upland remains. These uplands are characterized by a canopy dominated by oak and pine and an understory of saw palmetto and wiregrass. The forested area along the river is the typical alluvial zone vegetated by live and laurel oak, cypress, and a dense undergrowth of vines and shrubs. The River Crossing Estates Natural Systems Map (Figure 8-14) depicts the distribution of the vegetation types on the site.

Status. In 1992, the owner of this property was approached to sell it to the ELAPP program, but an agreement could not be reached regarding the selling price. The addition of this property to the land already in preservation along the northern banks of the Alafia River would be a significant benefit to the Alafia River Corridor program and would benefit water quality and wildlife habitat. The pastures could easily be restored to pine flatwoods and upland hardwoods.



1998 Land Use/Cover

- 2100 - IMPROVED PASTURES
- 4000 - 4999 - UPLAND FORESTS
- 6150 - WETLANDS - BOTTOMLANDS
- 6200-6399 - WETLANDS - FORESTED



HILLSBOROUGH COUNTY, FLORIDA

Figure 8-14
Alafia River Watershed Management Plan
Natural Systems - River Crossing Estates

Boundaries are approximate

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

N
W E
S

250 0 250 500 Feet

Scale 1" = 500'

PARSONS ENGINEERING SCIENCE, INC

Boy Scout Parcel

Site Description. This site includes land along the river on the west side of Lithia-Pinecrest Road and between Lithia-Pinecrest Road and the eastern section line of Sections 3, 9, 10, 15, and 16, in Township 30, Range 21. This large (approximately 1400 acres) parcel includes lands already under ownership by ELAPP, as well as lands protected by the River Hills Development of Regional Impact (DRI) open space agreements. ELAPP owns approximately 430 acres of the site in two parcels on the north and south side of the river. The majority of the remainder of the site belongs to the Boy Scouts who use the site for camping and meetings.

The photograph to the left shows the dense vegetation in the Alafia River floodplain within the Boy Scout Road parcel. Other portions of the floodplain have large trees and an understory of ferns.

The site is completely forested with the exception of a few small areas that were cleared within the Boy Scout camp for outdoor group meetings. The vegetation within the site is predominantly the typical dense hardwood forests that are found on the alluvial soils all along the undisturbed banks of the river. A few oxbow-like features are present, and these areas support bay trees and ferns. In addition, there are smaller areas of pine flatwoods, xeric oak, hardwood swamp, and sand pine scrub. The Boy Scout Road Parcel Natural Systems Map (Figure 8-15) illustrates the distribution of the vegetation associations on the site.

An eagle nest was observed on this site in 1987, and Sherman fox squirrels have been known to inhabit the oak forests.

Status. The parcels within this site are all either protected by DRI preservation agreements, wetland protection regulations, or preserved by ownership through the ELAPP program. If the status of the Boy Scout camp changes and a more invasive land use is proposed, the County may move to purchase the remainder of this site.

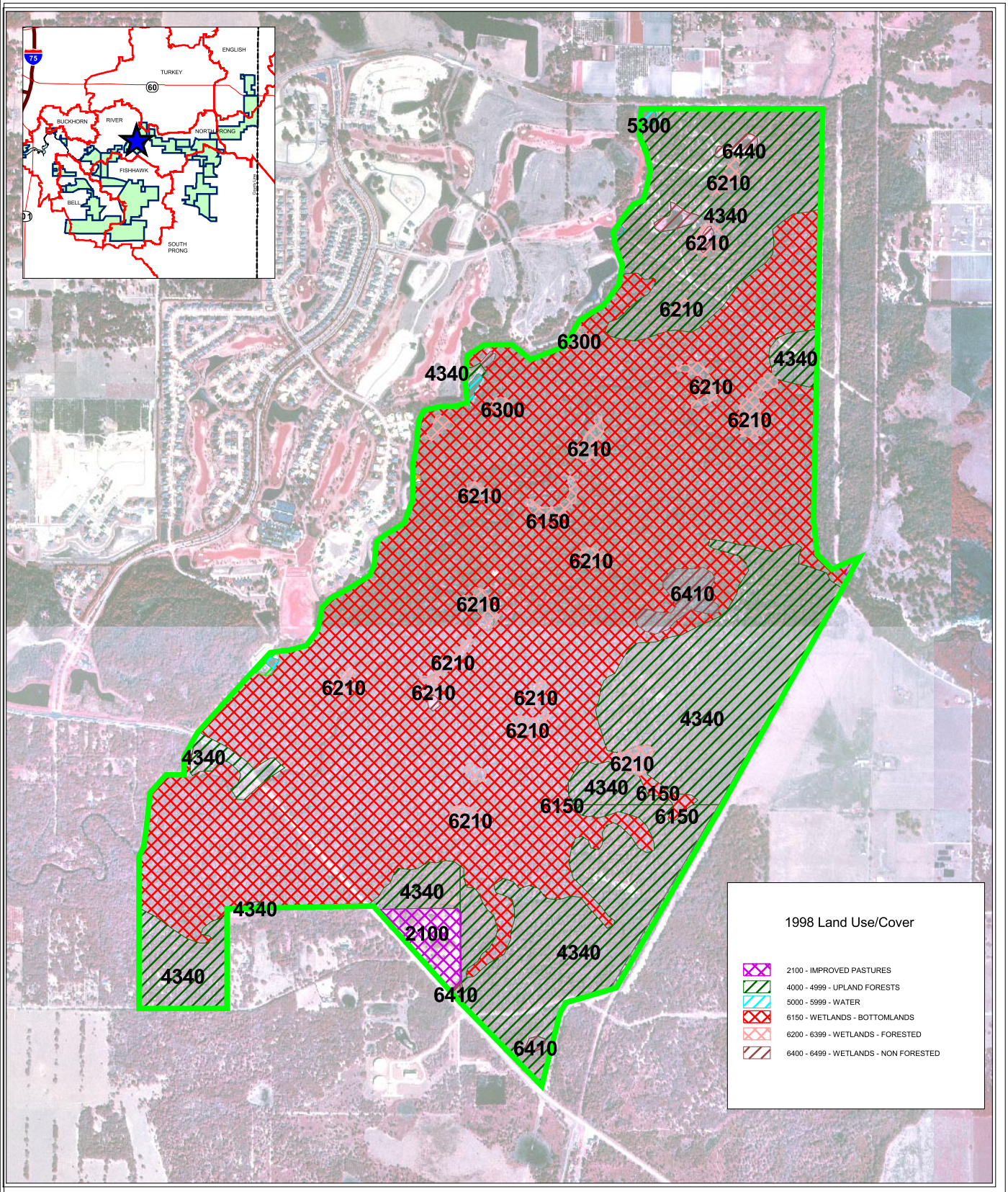


Figure 8-15
Alafia River Watershed Management Plan
Natural Systems - Boy Scout Parcel

HILLSBOROUGH COUNTY, FLORIDA

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

Boundaries are approximate

N
W E
S

600 0 600 1200 1800 Feet

Scale 1" = 1800'

PARSONS ENGINEERING SCIENCE, INC

Alderman's Ford Addition West

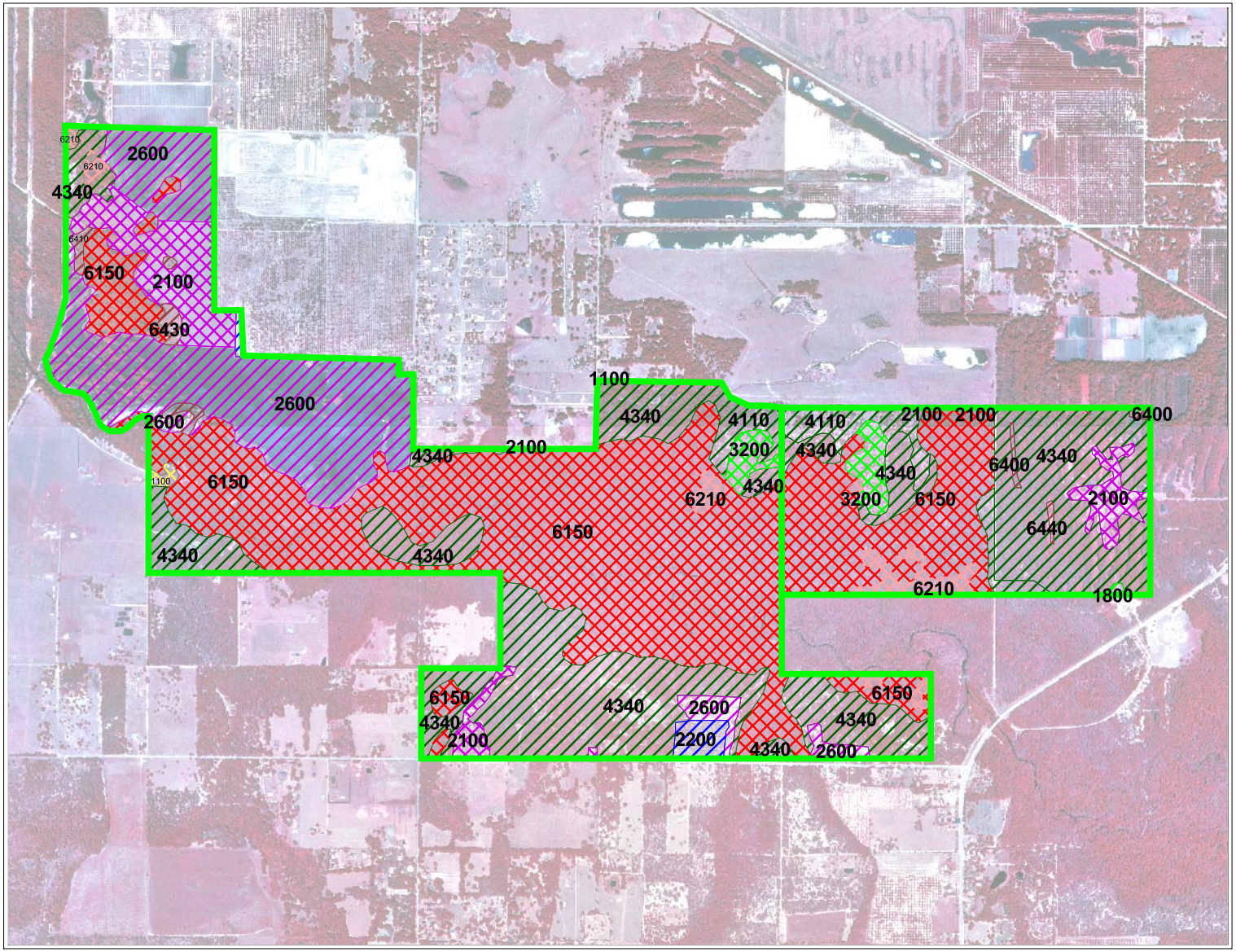
Site Description. The Alderman's Ford western addition includes lands along the river corridor from the western border of Section 10, Township 30, Range 21, to the northern half of Section 18, Township 30, Range 21. The Alderman's Ford Addition West Natural Systems Map (Figure 8-16) shows the location of the site and the distribution of the vegetation communities.

This approximately 1,500-acre site encompasses over two miles of the banks of the river and is predominantly vegetated by the typical dense hardwood forests on the alluvial soils along the river. The photograph below shows the dense forest along the river.

This photograph shows the dense forest that is typically found along the Alafia River. These forests have developed on the alluvial sand deposits that formed during flood events.

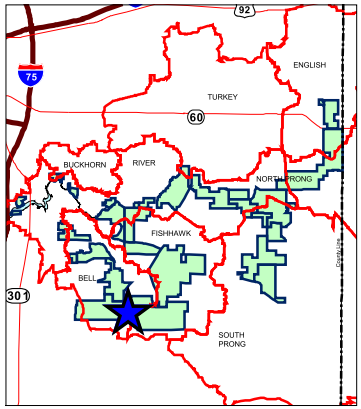
As the soils grade to uplands away from the influence of the river, the vegetation becomes more xeric and the mesic hardwoods are replaced by sand live oak, turkey oak, longleaf pines, and other constituents of xeric communities. The majority of Section 13 is owned by ELAPP and in purchasing the parcel, they acquired a former tree farm that has been invaded by nuisance vegetation. Other disturbances within the parcel include the eastern half of the northern half of Section 19 is land that was formerly mined.

Status. The majority of this site is already owned by the County under the ELAPP program and the preservation of this land and protection of the watershed is assured. There are two smaller parcels that ELAPP is negotiating for purchase that would also contribute to the preservation of this site. One parcel is the northern three-quarters of Section 14, Township 30, Range 21. This parcel is completely forested and includes approximately a mile of the Alafia River's southern bank and adjacent alluvial forests.



1998 Land Use/Cover

- 1100 - RESIDENTIAL - LOW DENSITY
- 1800 - RECREATIONAL
- 1900/3200/7400 - OPEN/RANGE/BARREN LAND
- 2100 - IMPROVED PASTURES
- 2200 - TREE CROPS
- 2600 - AGRICULTURE - OPEN LANDS
- 4000 - 4999 - UPLAND FORESTS
- 5000 - 5999 - WATER
- 6150 - WETLANDS - BOTTOMLANDS
- 6200 - 6399 - WETLANDS - FORESTED
- 6400 - 6499 - WETLANDS - NON FORESTED
- 6500 - 6599 - WETLANDS - NON VEGETATED



HILLSBOROUGH COUNTY, FLORIDA

Figure 8-16
Alafia River Watershed Management Plan
Natural Systems - Alderman's Ford Addition West

Boundaries are approximate

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

N
W E
S

1000 0 1000 2000 Feet

Scale 1" = 2300'

PARSONS ENGINEERING SCIENCE, INC

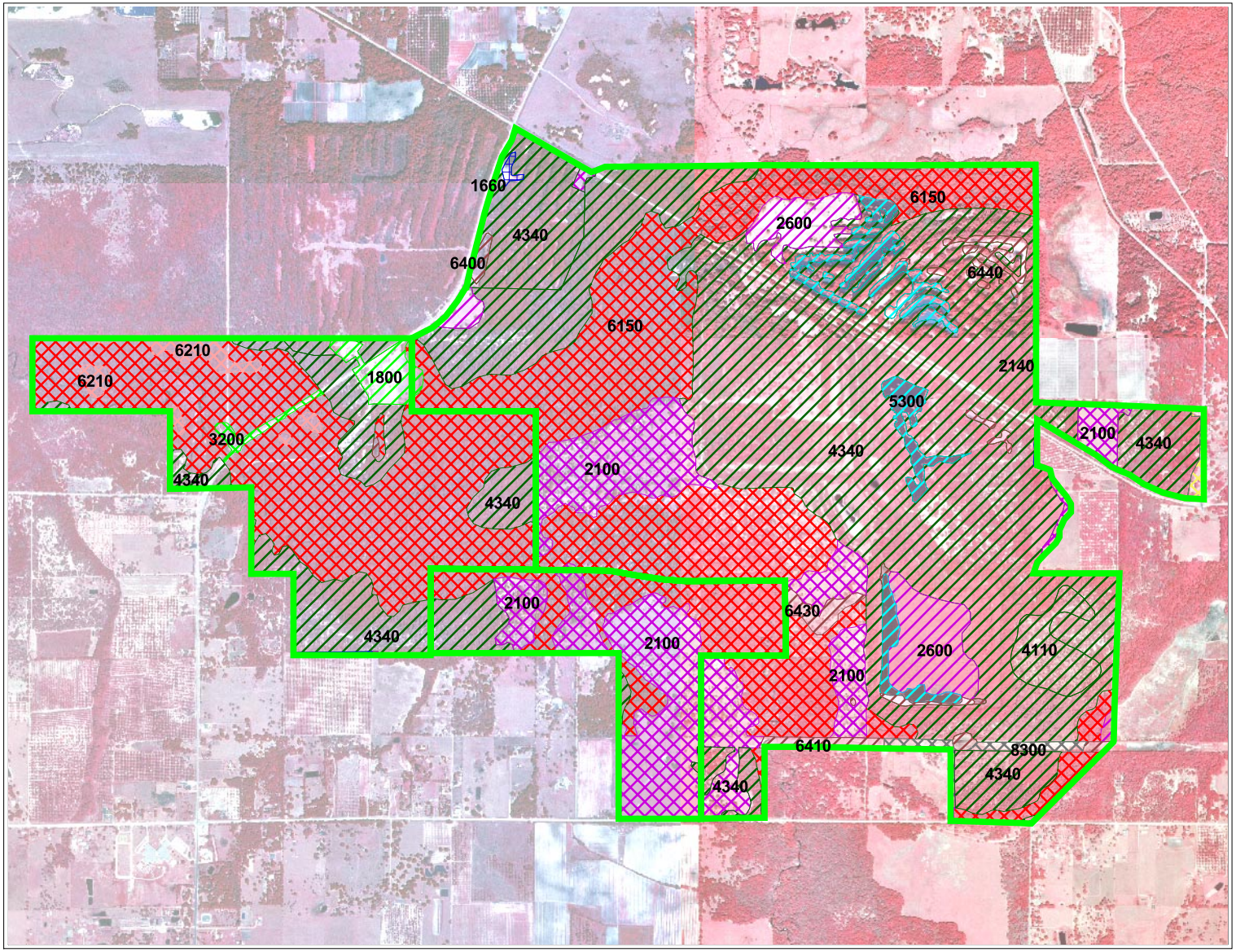
Alderman's Ford Addition East

Site Description. This site includes the existing Alderman's Ford County Park and land adjacent to the east side of the park, in Sections 16, 17, 18, 19, 20, 21, and part of 22, in Township 30, Range 22. The total land area is approximately 2,600 acres and includes previously mined lands and land that has been used for agriculture. Surrounding land uses include undeveloped and agricultural lands as well as active mining interests. The alluvial forests along the river are relatively undisturbed despite the historic mining activity. The photograph below was taken in the alluvial forest in this site.

This photograph shows a bridge across the South Prong of the Alafia and the dense forest that has formed on the alluvial sands. This area was mined right up to the edge of the waterway, but some areas of natural vegetation are intact.

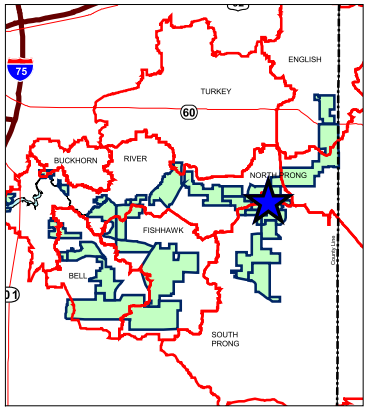
This site includes a large area of formerly mined land in Section 21 and the southwest corner of Section 16. These areas were mined in the 1940's and have never been reclaimed. There are still high, steep mounds of overburden, deep narrow lakes, and bermed up areas of spoil, but these areas are now covered with vegetation, and in most cases have established valuable habitat areas. Large trees have become established on the slopes and wetlands have formed in the depressions. The ELAPP staff is currently discussing restoration and enhancement projects and are interested in working with other departments within the County to develop a plan that would utilize this site to its full potential. The Alderman's Ford Addition East Natural Systems Map (Figure 8-17) shows the location of the site and the distribution of the vegetation communities.

Status. Hillsborough County and SWFWMD have purchased over 1400 acres in this site over the last few years and now only two small parcels remain to be purchased. Negotiations for the purchase of these parcels are underway.



1998 Land Use/Cover

- 1800 - RECREATIONAL
- 1900/3000/7400 - OPEN/RANGE/BARREN LAND
- 2100 - IMPROVED PASTURES
- 2600 - AGRICULTURE - OPEN LANDS
- 4000 - 4999 - UPLAND FORESTS
- 5000 - 5999 - WATER
- 6150 - WETLANDS - BOTTOMLANDS
- 6200/6300 - WETLANDS - FORESTED
- 6400 - 6499 - WETLANDS - NON FORESTED
- 6500 - 6599 - WETLANDS - NON VEGETATED
- 8000 - 8399 - TRANS./COMM./UTIL



HILLSBOROUGH COUNTY, FLORIDA

Figure 8-17
Alafia River Watershed Management Plan
Natural Systems - Alderman's Ford Addition East

Boundaries are approximate

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

N
W E
S

500 0 500 1000 1500 2000 2500 Feet

Scale 1" = 2500'

PARSONS ENGINEERING SCIENCE, INC

Alafia River South Prong

Site Description. This large tract of land (3,000+ acres) is located south of the Alderman's Ford Addition and north of the large tract of former phosphate mine that is now owned by the state of Florida. The tract includes all or part of Sections 28, 29, 31, 32, and 33, of Township 30, Range 22, and Sections 4, 5, 6, 8, and 9 of Township 31, Range 22. The site is east of SR 39, near the county line. The majority of the uplands in this tract have been converted to pasture, but some remnant pine flatwoods and pine/hardwoods uplands still remain. Wetlands on the site include the floodplain of the South Prong and several freshwater marshes and wet prairies. The photograph below is of a very high quality freshwater marsh on the ELAPP property.

This high quality freshwater marsh exhibits the typical concentric rings of vegetation that follow the natural hydrological gradient. This marsh is located on County land and will be preserved in perpetuity.

The floodplain of the South Prong and its tributaries is well protected by a broad band of forested floodplain with a canopy of hardwoods and an open understory. The Alafia River South Prong Natural Systems Map (Figure 8-18) provides the location of the site and the distribution of the vegetation communities.

Status. Preservation of this land would create a contiguous corridor of protected land along the southern tributary to the Alafia River. The County and SWFWMD have already purchased over 1,800 acres of this tract, and restoration plans are being developed. Negotiations for the remaining areas are underway.

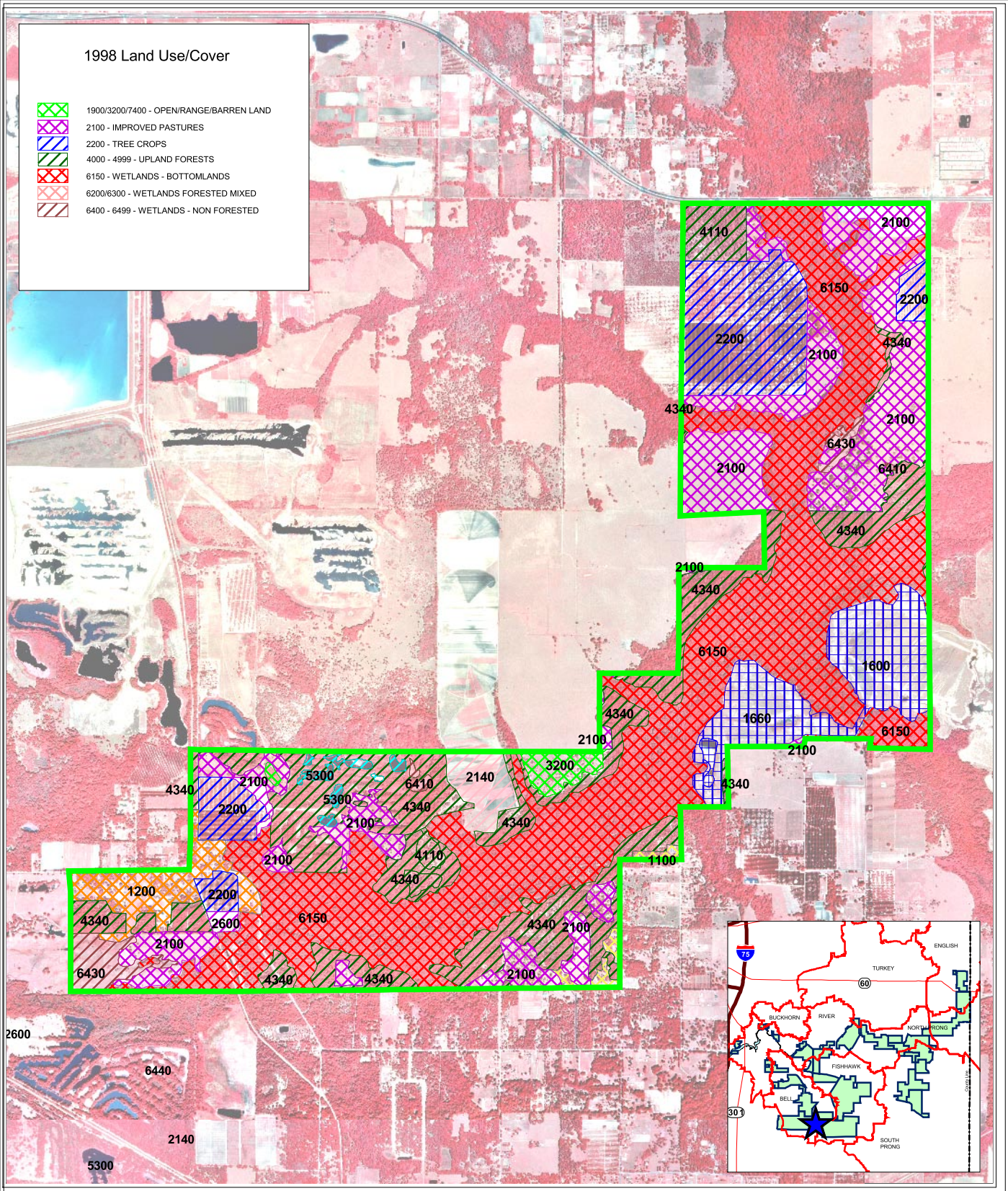


Figure 8-18
Alafia River Watershed Management Plan
Natural Systems - Alafia South Prong

HILLSBOROUGH COUNTY, FLORIDA

Boundaries are approximate

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

1000 0 1000 2000 3000 Feet

Scale 1" = 3000'

PARSONS ENGINEERING SCIENCE, INC

Triple Creek

Site Description. This site is located between the Balm Boyette Scrub Preserve and the Rhodine Scrub Preserve and includes the majority of Bell Creek between these two parcels. The site encompasses parts of Sections 36, Township 30, Range 20, Sections 1 and 12, of Township 31, Range 20, and Sections 6, and 7 of Township 31, Range 21. The site is surrounded by agricultural land uses, but subdivisions are encroaching from the west and east. The approximately 1100-acre site is currently used for cattle ranching, except for those areas near the creek. These areas are predominantly hardwood forests with some slash and longleaf pine. The Triple Creek Natural Systems Map (Figure 8-19) depicts the location of the site and the distribution of the vegetation communities on the site.

The photograph to the left was taken on the west side of the Triple Creek parcel facing east toward the creek. The land is predominantly pasture, but the hydrology of the creeks is intact and restoration will be easily accomplished.

Status. The County previously purchased two small properties within this parcel totaling 57 acres, and recently added approximately 800 acres. Purchase of the remaining 300+ acres would offer significant protection to the Bell Creek and Alafia River watershed. Restoration of the habitat adjacent to Bell Creek would provide significant improvements in water quality by removing the impacts resulting from the cattle ranching.

English Creek

Site Description. This parcel is located north of SR 60, in eastern Hillsborough County near the Polk County border in Sections 24 and 25 of Township 29, Range 22. The land uses on this approximately 660-acre parcel includes row crops, grazing land, and natural systems.

The majority of the English Creek parcel is composed of the forested floodplain of the creek, with a canopy of hardwoods such as red maple, hickory, water and laurel oak, and slash pine. Undeveloped uplands within this parcel are primarily forests of hardwoods such as laurel oak, live oak, holly and conifers, with an understory of saw palmetto and grasses. Portions of this site are overrun with exotic species,

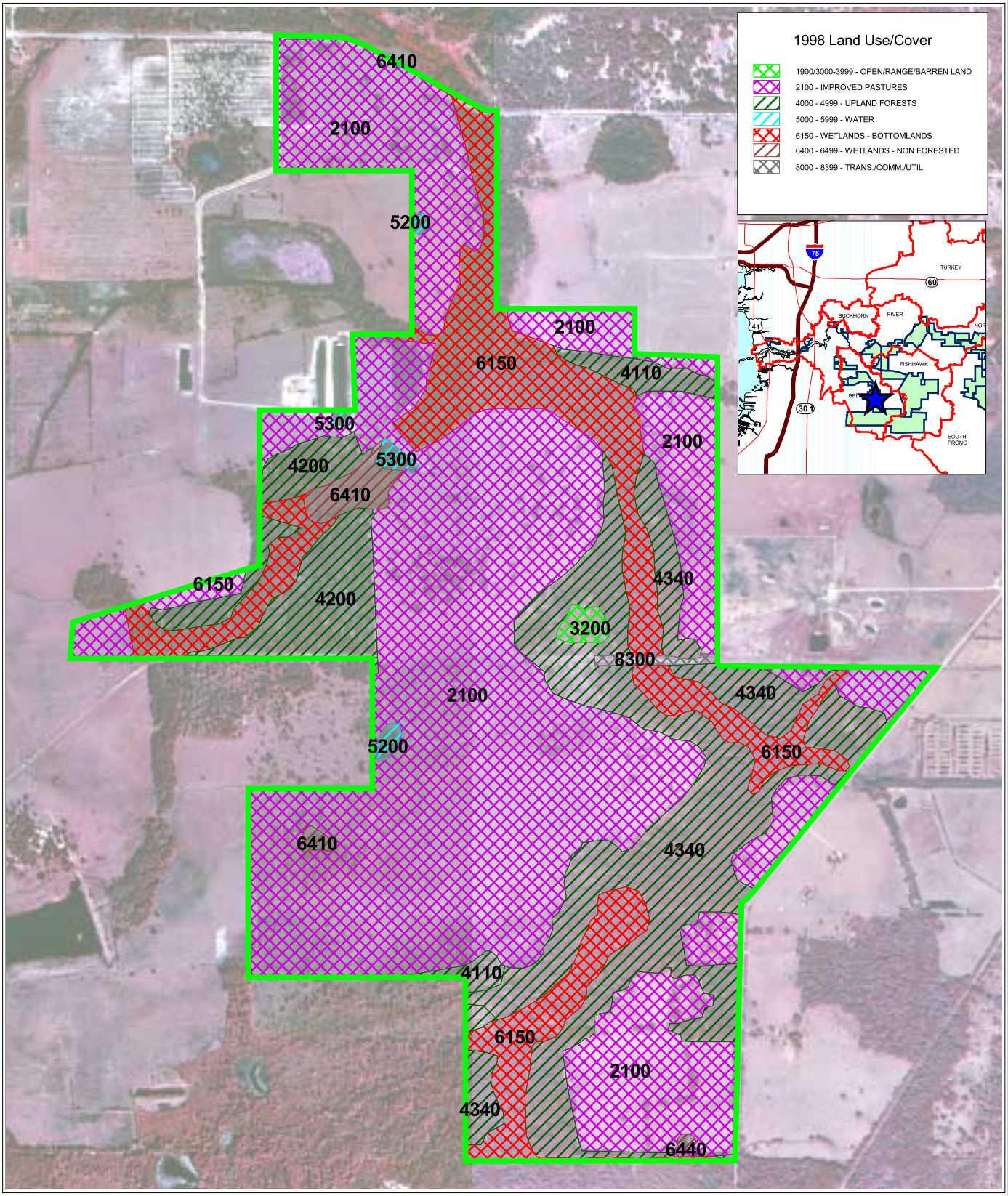


Figure 8-19
Alafia River Watershed Management Plan
Natural Systems - Triple Creek

HILLSBOROUGH COUNTY, FLORIDA

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

Boundaries are approximate

N
W E
S

500 0 500 1000 1500 Feet

Scale 1" = 1500'

PARSONS ENGINEERING SCIENCE, INC

especially in this southern extent near the highway. The English Creek Natural Systems Map (Figure 8-20) depicts the distribution of the vegetation communities and the location of the site within the watershed. The photograph below was taken near the creek in the southern portion of the site.

This photograph shows the typical vegetation along the floodplain forests that are along the lower reaches of English Creek. Impacts from cattle are still evident although they have been eliminated from the majority of the site.

Status. The County owns approximately 256 acres of this site, a portion of which is currently leased to Hillsborough Community College for environmental education. Negotiations are underway to purchase the remaining portion of the site north of Sam Hicks Road.

Alafia River – North Prong

Site Description. The site encompassing the North Prong of the Alafia River extends from the Alderman's Ford East site to the Polk County on the east, and north to English Creek in all or parts of Sections 28, 29, 31, 32, and 33 of Township 30, Range 22, and Sections 4, 5, 6, 8, and 9 of Township 31, Range 22.

This 2,800+-acre parcel includes range and cropland and land that was previously mined. The majority of the parcel is the alluvial forest along the banks of the river. Some forested areas of uplands are still standing and support a canopy of mixed pine and hardwoods. This site provides no special or unique characteristics except for its location and the preservation of the river floodplain. The Alafia River North Prong Natural Systems Map (Figure 8-21) depicts the location of the site and the distribution of the vegetation communities. There was no access to this property so no photograph is available.

Status. This site is owned by several different entities including a phosphate mining company. The County and the District have purchased approximately 1,000 acres of this site and are negotiating for the purchase of additional parcels.

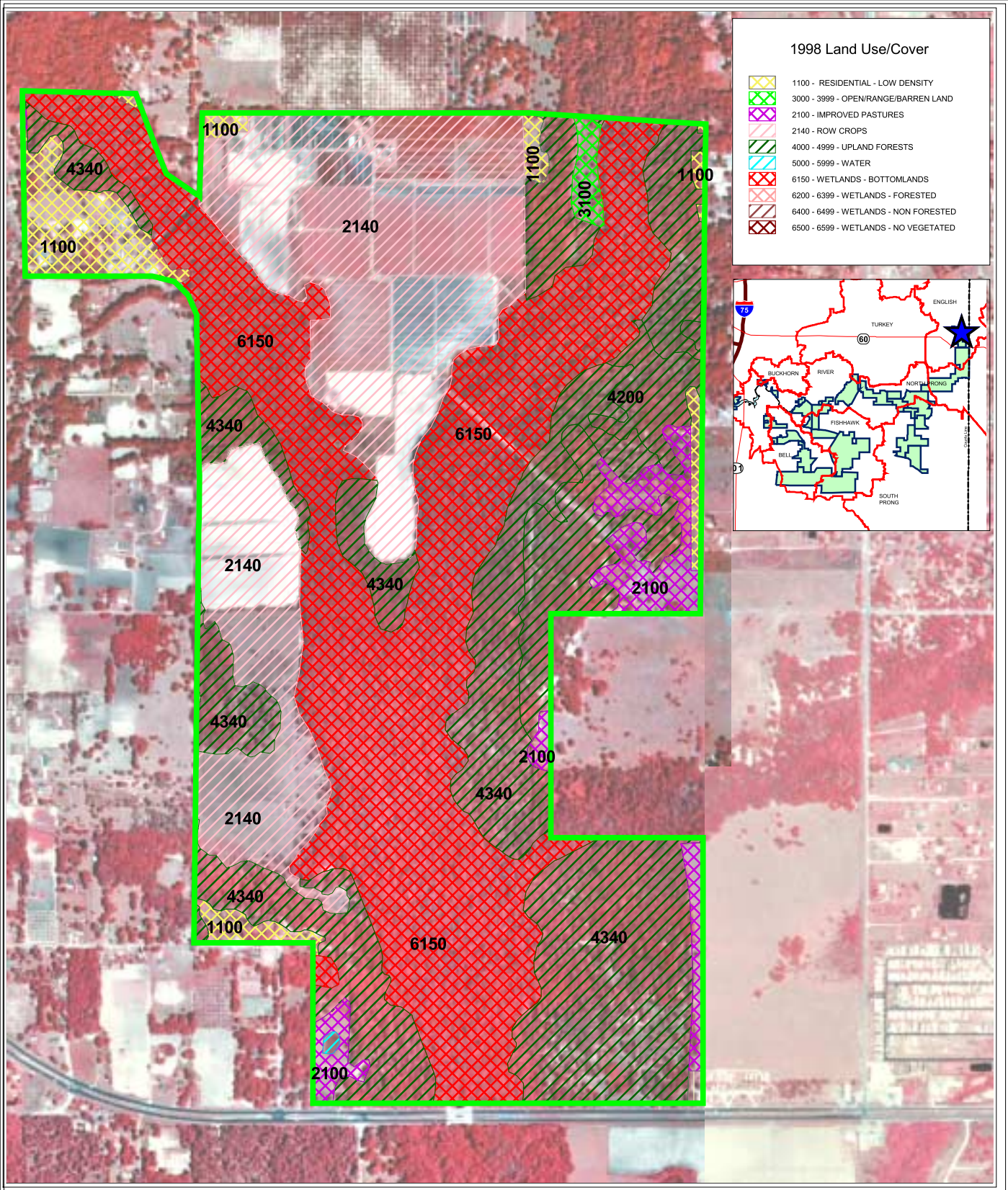


Figure 8-20
Alafia River Watershed Management Plan
Natural Systems - English Creek

HILLSBOROUGH COUNTY, FLORIDA

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

Boundaries are approximate

550 0 550 1100 Feet

Scale 1" = 1100'

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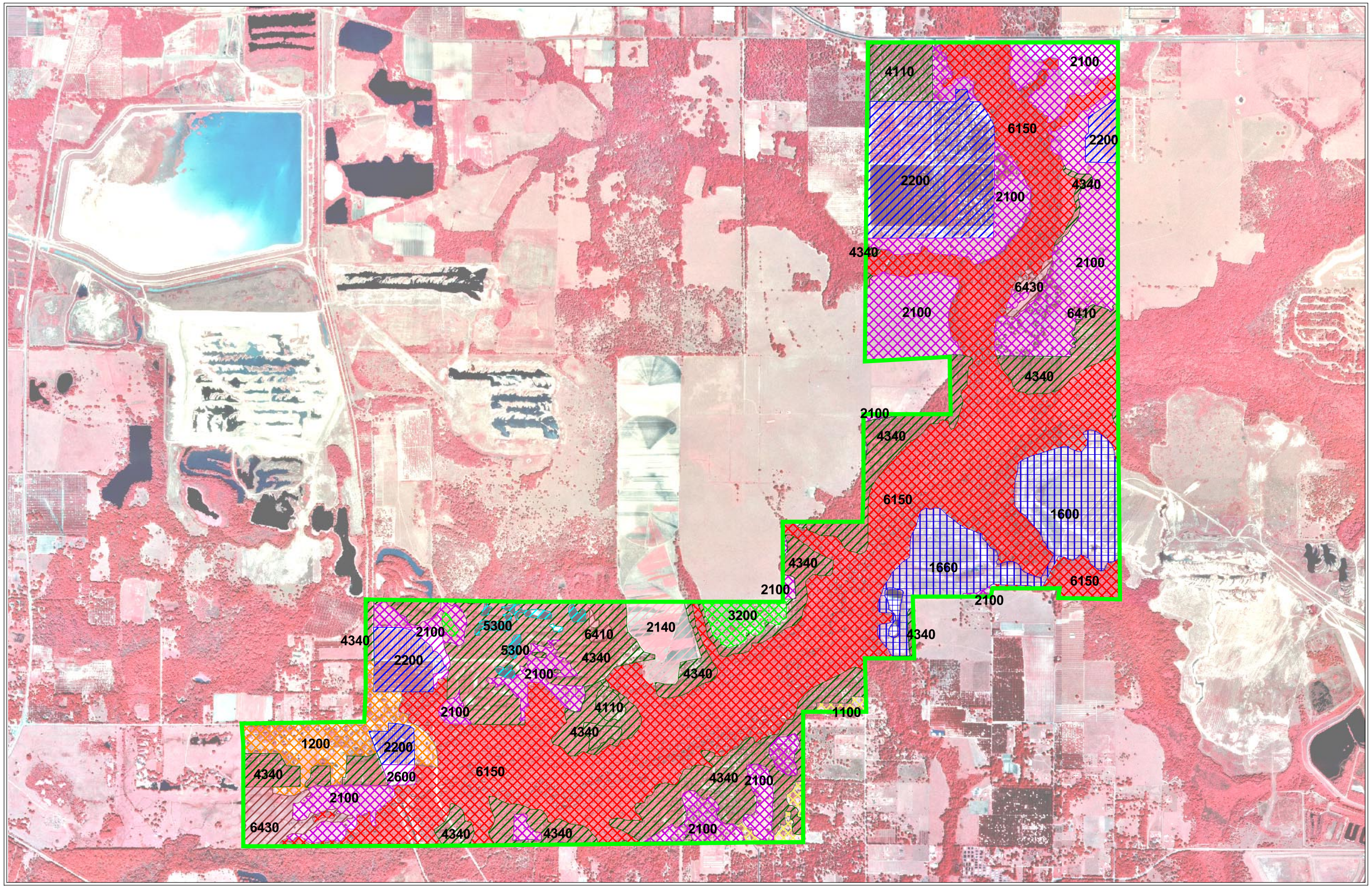
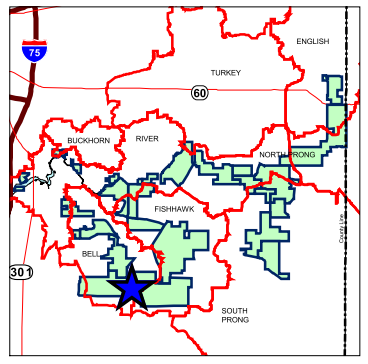


1998 Land Use/Cover

- 1100 - RESIDENTIAL - LOW DENSITY
- 1200 - RESEIDENTIAL - MEDIUM DENSITY
- 1600 - MINING
- 1900/3200/7400 - OPEN/RANGE/BARREN LAND
- 2100 - IMPROVED PASTURES
- 2140 - ROW CROPS
- 2200 - TREE CROPS
- 2600 - AGRICULTURE - OPEN LANDS
- 4000 - 4999 - UPLAND FORESTS
- 5000 - 5999 - WATER
- 6150 - WETLANDS - BOTTOMLANDS
- 6200 - 6399 - WETLANDS - FORESTED
- 6400 - 6499 - WETLANDS - NON FORESTED



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HILLSBOROUGH COUNTY, FLORIDA

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

Figure 8-21
Alafia River Watershed Management Plan
Natural Systems - Alafia North Prong

Boundaries are approximate

1100 0 1100 2200 Feet

Scale 1" = 2200'

PARSONS ENGINEERING SCIENCE, INC

Alafia River North Prong Natural Systems Map (8-21) **Insert 11x17**

Back of page

8.2.4 Summary of the Natural Systems Assessment

Due to the size of the Alafia River Watershed and the scope of this project, the descriptions of the twenty natural systems are necessarily brief. However, the following Table 8-2 provides a ranking of the natural systems within the watershed based on the selected criteria. As stated in the methodology section, assumptions were made regarding the condition of several of the natural systems because of access limitations.

The criteria used to determine the quality of each natural system included the current ecological condition, available contiguous area, proximity to other natural areas, presence of protected species, and potential hydrological and water quality benefits. The ranking was conducted on a scale of zero to ten, with 10 being the highest value. The ranking of existing conditions was fairly straightforward. For the first criteria, if native vegetation is the predominant cover, a site was scored high. If the site supports a vegetation community that is unique to this area and essential to certain endangered or threatened species, the site will be ranked higher. Sites in which the vegetation has been altered or which support a high percentage of non-native vegetation score low for this criteria.

For the second criteria, the ranking depends simply on the percent cover of the nuisance vegetation. Sites in which nuisance species comprise a high percentage of the vegetation cover receive a low score. Sites in which the nuisance species form broad areas of monocultures rank lower than areas in which the nuisance species are integrated into the native vegetation. Sites that are being treated for nuisance vegetation still rank low because although the exotic species are removed, it will likely take an extended period of time for the native vegetation to recover.

The third criterion is somewhat more difficult to determine. If the habitat has been subject to dredge and fill activities, channelization, impounding or excessive draining, it was ranked low. If the habitat has no obvious impacts from the activities listed above, it ranked high. For example, the hydrology within the east portion of the Balm-Boyette Scrub Preserve has been significantly impacted by the historic mining activities, and would rank low for this criterion.

The fourth criterion is self-explanatory. The twenty natural systems are assessed based on the numbers of protected species present, or if none are sighted, on the likelihood that listed species forage on or utilize the site in some manner.

Table 8-2
Natural Systems Ranking Within the Alafia River Watershed

Natural System	Ranking Criteria						
	Native Vegetation Present	Exotic Vegetation Absent	Soils and Hydrology Intact	Protected Species Present	Contiguous Habitat	Watershed Protection	Site Total
Cargill West	2	3	3	3	2	2	15
Williams Property	3	4	4	4	4	6	25
Alafia Scrub Preserve	7	7	8	6	4	5	37
Buckhorn Springs & Creek	6	4	4	6	4	9	33
John Moore Road Site	5	5	9	5	4	9	37
Bell Creek Preserve	7	4	7	8	3	9	38
Rhodine Scrub	8	5	6	8	7	7	41
Balm-Boyette Scrub	7	7	7	8	10	10	49
Fishhawk/Thomas Ranch	8	8	8	9	6	10	49
Fishhawk Ranch	10	9	9	10	10	10	58
Fishhawk South	4	5	9	5	8	8	39
Lithia Springs	5	5	8	5	8	9	40
River Crossing Estates	7	6	8	6	7	9	43
Boy Scout Parcel	9	8	9	8	9	9	52
Aldermans Ford Add. West	9	8	8	8	9	10	52
Aldermans Ford Add. East	6	3	3	7	9	9	37
Alafia River South Prong	5	5	9	5	9	9	42
Triple Creek	6	5	8	5	10	10	44
English Creek	4	8	7	5	7	7	38
Alafia River North Prong	4	7	8	5	9	10	43

The ranking for the fifth criterion is determined by the contiguity of the natural system to the Alafia River, its tributaries, and other natural systems within the watershed.

The sixth criterion estimates the value of the site in its existing condition to the preservation of the watershed as a whole. The larger sites that are directly on the Alafia River would score high for this criteria, although sites such as the Fishhawk/Thomas Ranch would score higher because it has undeveloped lands on both sides of the river, and also Fishhawk Creek, a major tributary within its boundaries.

The purpose of this ranking was to aid in the prioritization of potential projects for the Recommendations section of this management plan. Projects that can increase the ranking of a natural system while accomplishing water quality improvements and flood abatement will be considered more favorably than those that will show no natural resource improvements.

8.3 Habitat Loss, Degradation, and Fragmentation

The rate of development in this watershed has been a cause for concern for local and state environmental groups. Many of these groups have joined together to try to preserve as many of the remaining natural areas as possible. A description of these groups and the success of their efforts is provided in Section 8.4 of this chapter.

The following paragraphs describe the main issues identified by the environmental groups. Preservation of natural systems involves more than the purchase of land. Management plans that involve prescribed burning, restoration of historic hydrology and wildlife habitat, and maintenance of nuisance exotic species are also important to the preservation and restoration of the ecosystem.

8.3.1 Coastal-Nesting White Ibis Colonies

In the United States the white ibis (*Eudocimus albus*) inhabits a narrow swath of coastal waters, marshes and swamps on the southeastern coastal plain, extending from North Carolina to Texas. Outside the U.S. its range extends along the coasts of Mexico, Central America, and northern South America to the northern coast of Brazil (Bildstein 1993).

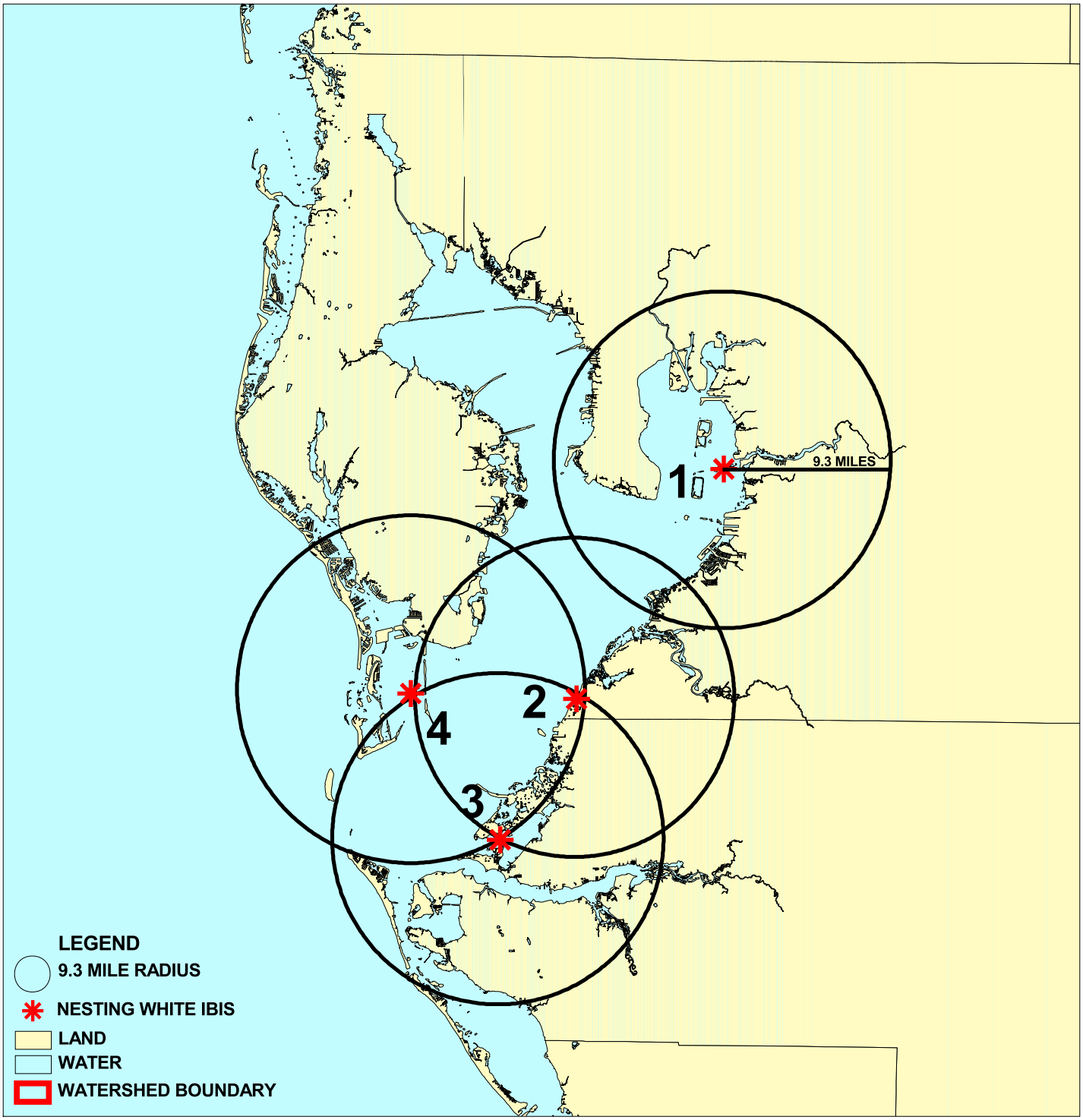
Although it remains one of Florida's most abundant wading birds, the statewide breeding population of the white ibis is estimated to have declined by about 50% between the mid 1970's and the early 1990's. In response to this decline, and earlier reductions in the breeding population that apparently occurred prior to the 1970's, the Florida Fish and Wildlife Conservation Commission has formally designated the white ibis a "species of special concern" (TBEP 1996).

Research done in South Carolina in the early 1990's demonstrated that, although adult white ibises can thrive on a diet of fiddler crabs and other saltwater prey, nestlings require a diet containing freshwater prey to avoid salt stress and allow survival and growth. Freshwater crayfish appear to be a particularly important component of the nestling's diet. As a result, for a brief but critical period each year, adults nesting in coastal colonies must fly inland and forage in freshwater wetlands to collect suitable food for their young (Bildstein 1993).

If freshwater wetlands containing appropriate prey items are not present in the vicinity of nesting colonies, adults will be forced to make longer foraging flights. As flight distances increase, the energetic demands on the adults also increase and reproductive success tends to decline. In some areas of the world—such as the island of Trinidad—ibises no longer breed successfully, apparently due to reduced availability of freshwater wetlands within reasonable flight distances of their former nesting sites (Bildstein 1993).

The number of white ibises nesting on Tampa Bay varies a great deal from year to year, due to fluctuations in the number of adults present in the region and their responses to a number of environmental factors. As a general rule of thumb the number of breeding pairs tends to decline during drought years and increase during years of above-average rainfall. Following the rainy El Niño winter of 1997-1998, for example, National Audubon Society staff counted more than 17,000 breeding pairs in the four Tampa Bay colonies, a value more than two times higher than the average number counted during the four preceding years (R. Paul and A. Schnapf, National Audubon Society, unpubl. data).

White ibises nest in four distinct colonies on Tampa Bay (Figure 8-22), returning to these sites year after year. One of these colonies is located on the Alafia Banks, immediately west of the Alafia River mouth (Figure 8-23). The circles centered on each colony in Figures 8-22 and 8-23 indicate an average foraging radius of 15 km (TBNEP 1996) for adult birds who are rearing nestlings. As noted above, freshwater wetlands within these circles appear to represent critical foraging areas for nesting adults. Land use data provided by SWFWMD suggests that, in 1995, only 950 acres of freshwater wetland habitat remained within the 15 km radius of the Alafia Banks colony (Figure 8-23). Of these wetlands, only about 740 acres are freshwater marsh and wet prairie – the white ibis' preferred foraging habitat. As can be seen in Figure 8-23, the majority of these habitats are found in the extreme eastern portion of the foraging circle, resulting in the necessity for the ibis to expend significant energy to forage during breeding. Efforts to protect the foraging habitat that remains in this area, and to restore additional acres of freshwater wetlands when cost-effective restoration opportunities arise within the area would help to ensure the long-term survival of this nesting colony.



0 4 8 Miles

1" = 8 miles

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W E
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HILLSBOROUGH COUNTY
FLORIDA

Source: Setting Priorities
For Tampa Bay
Habitat Protection
And Restoration

Figure 8-22

Freshwater Wetlands Locations Of The Four Colonies Of Coastal Nesting White Ibis On Tampa Bay

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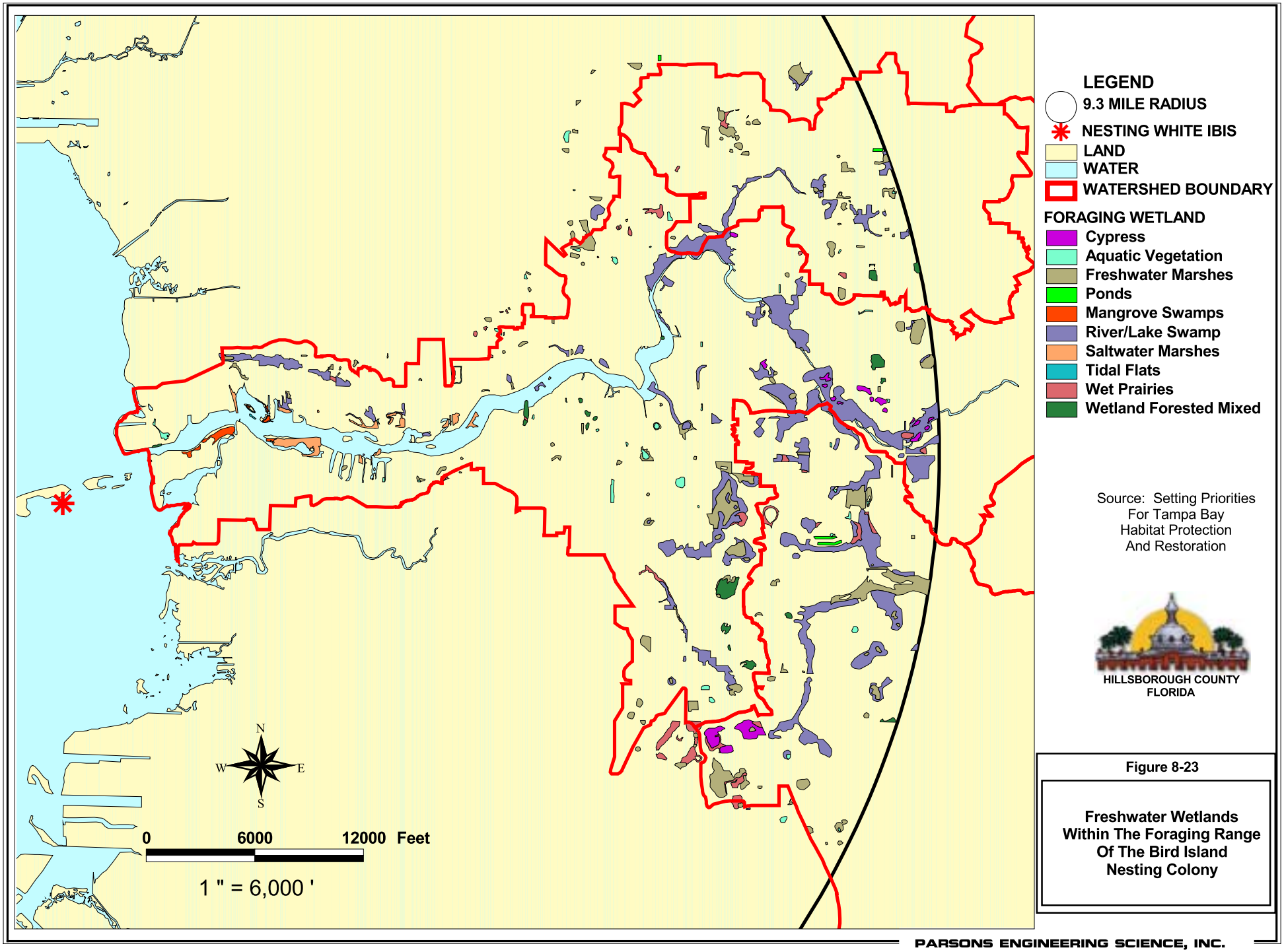

Source: Setting Priorities For Tampa Bay Habitat Protection And Restoration

HILLSBOROUGH COUNTY
FLORIDA

Figure 8-23

Freshwater Wetlands Within The Foraging Range Of The Bird Island Nesting Colony

8.3.2 Oligohaline Habitat

Low salinity or "oligohaline" marsh and mangrove areas (operationally defined by the Tampa Bay Estuary Program [1996] as areas in which salinity typically ranges between 0 and 10 ppt) were recognized as particularly important nursery habitats for the immature life stages of many of the Bay's estuarine-dependent fish and shellfish species. For this reason the TBEP identified the protection and restoration of low salinity estuarine habitats in the Bay and its tributaries as a priority environmental management issue.

The tidal reach of the Alafia River extends from Bell Shoals Road to the river mouth (Wolfe and Drew 1990). Monthly monitoring data provided by the EPC indicate that annual average mid-depth salinity in the vicinity of the U.S. Highway 41 bridge—the only EPC station located in the tidal reach of the Alafia River—fluctuated between 18 and 28 ppt (mean = 21 ppt) during the 10-year period 1990 – 1999. Although these values are well above the 0 to 10 ppt range established as a target for oligohaline habitats by the TBEP, salinities within the target range may occur in areas upstream from station 74. Appropriate salinities may also occur, or may be created by addition fresh water inflows, in small streams and creeks that discharge to the river's tidal reach.

Future stormwater management projects conducted in the Alafia River watershed could examine the feasibility and cost-effectiveness of providing targeted fresh water discharges to help maintain and enhance any oligohaline habitats that currently exist in the watershed. In the case of tidal creeks and other small tributaries it may also prove feasible to create low-salinity habitats in areas that currently experience salinities above the target range.

8.3.3 Wildlife Habitat Loss

Although the Alafia River Watershed has not been affected as significantly by the loss of wildlife habitat as other watersheds in the County, the changes have been dramatic. Figure 8-24 depicts the natural systems in 1938 compared to the natural systems in 1995. The historic land use information was prepared by the GIS Department at SWFWMD for Hillsborough County. The historical extent of the natural areas was estimated from black and white aerial photography flown in 1938. The historic vegetation community types were estimated using historic soil information. One anomaly noted in the maps is the disparity in the representation of the old mined areas. The historic land use shows some of the mined areas as non-vegetated areas, while the recent maps show these areas to be vegetated. The only plausible explanation is that these areas were being mined during the period that the aerials were flown and have since re-vegetated.

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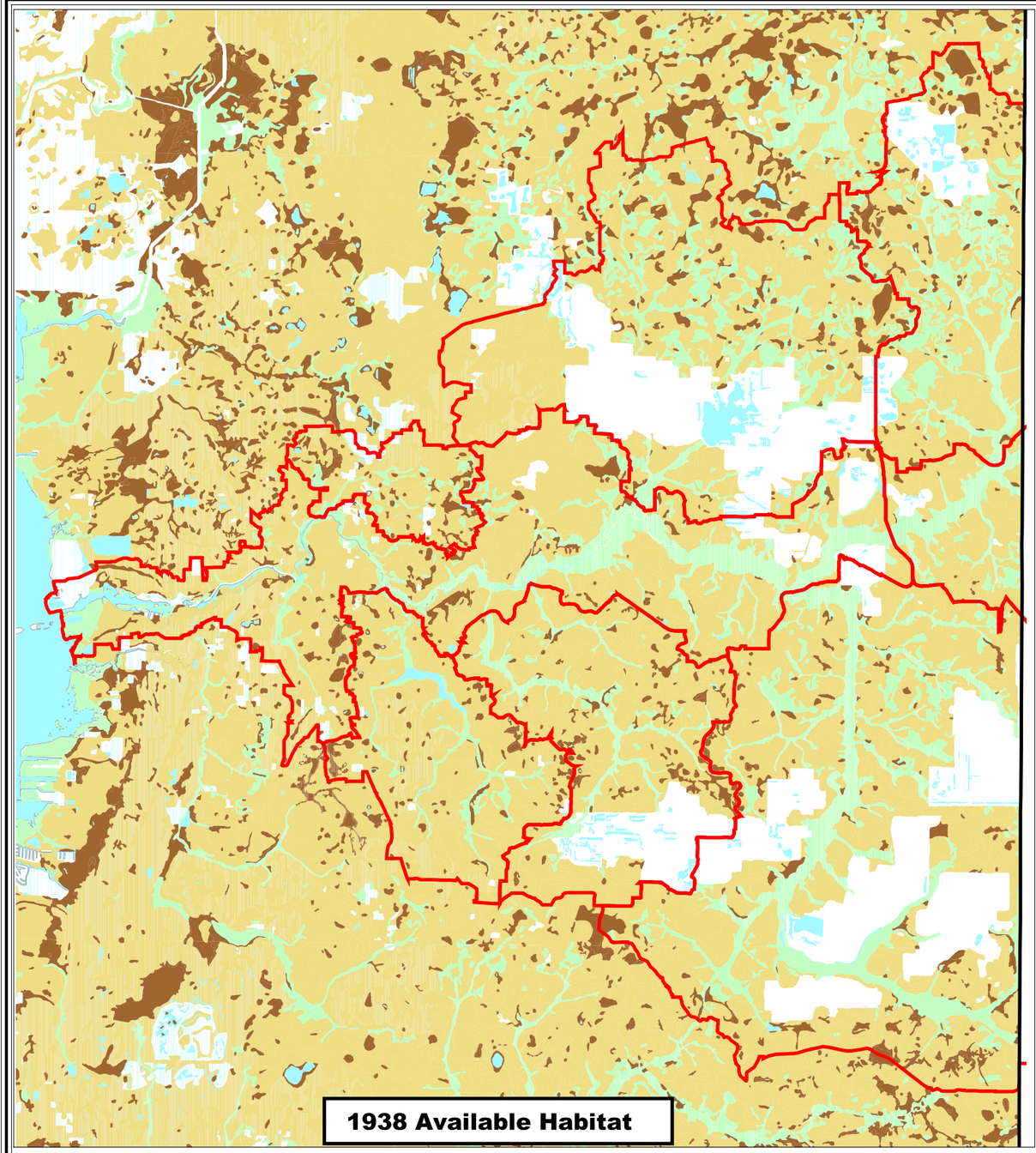
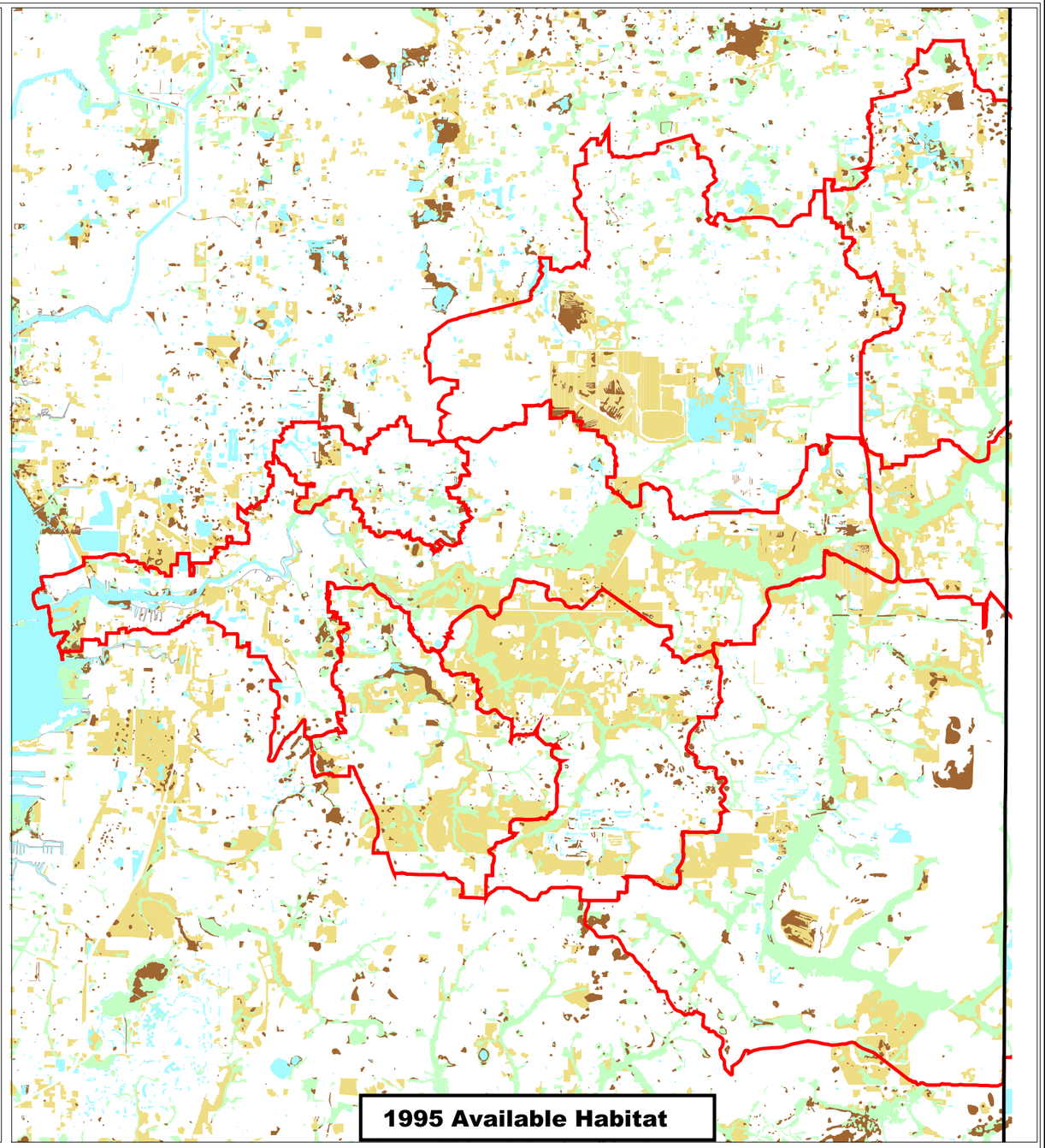




Source: SWFWMD
1938 Land Use/Cover

Land Use/Cover

- UPLAND FORESTS
- WATER
- WETLANDS - BOTTOMLANDS/FORESTED
- WETLANDS - NON FORESTED
- Alafia Basins
- Developed Areas

Alafia River Watershed
Habitat Loss, Fragmentation & Degradation

N
W E
S

5000 0 5000 10000 15000 Feet

1" = 15,000'

Source: 1994 USGS DOQQ
Modified SWFWMD
1995 Land Use/Cover

Figure 8-24

PARSONS ENGINEERING SCIENCE, INC

Figure 8-24 Habitat loss (11 x 17back)

The loss of upland habitat has been significant. The estimated loss of upland forests is approximately 73,000 acres or 73% of the forest uplands that were present in 1938. Most of this loss was due to clearing for agriculture and phosphate mining. Wetlands have also been significantly impacted. The forested bottomlands along the Alafia River were much more extensive in the late 1930s, with over 28,400 acres of habitat. This has been reduced by 37% to 18,000 acres, and is also mainly due to the agriculture and phosphate industries. Herbaceous wetlands have also declined by over 50%, from over 9,000 acres to slightly over 4,000 acres. These wetlands have been drained to create pasture or cropland, or have been excavated during phosphate mining operations and have not been reclaimed.

As significant to the outright loss of habitat is the fragmentation and isolation of habitat. The conservation of important habitat areas is essential to the preservation of species, but if these areas are isolated by development, they become "islands" because most wildlife can't reach other areas to breed and forage. Some species may decline over time, due to lack of genetic diversity. A solution to this is to link the conservation areas through corridors of natural communities. Corridors allow the larger mammals to move from preserve to preserve when one preserve would be too small. Corridors also allow gene flow, by allowing separate populations to intermingle and breed.

8.3.4 Growth Management

In September 2000, a group called Smart Growth America commissioned the opinion research firm of Belden, Russonello, & Stewart to conduct a geographically-balanced telephone poll to determine how Americans felt about certain quality of life issues. The results of the poll found that 78% support policies that will curb urban sprawl, preserve greenspace and wildlife habitat, and reduce pollution and traffic congestion. Over 80% of those polled think that the government should give priority over the redevelopment and maintenance of existing neighborhoods, rather than encouraging the development of new housing and commercial facilities, and new highways. Despite the strong public support for curbing sprawl, most regions of the country still enforce their market-driven, obsolete "growth management" policies that encourage flight from the city and were designed to make neighborhoods safe for cars and fire trucks. Efforts to implement smart growth practices are often thwarted.

The incentives to move to the suburbs are significant. There are more houses available and housing is often more affordable. Schools are usually better in the suburbs, and the crime rate is lower. Other quality of life benefits such as clean water and air are also more abundant outside the inner city. But as the sprawl expands, the problems of the inner city become those of the suburbs and circle of sprawl expands even more. This results in traffic congestion, air pollution, loss of agricultural lands and wildlife habitat, and the loss of those benefits the suburbs provided, and the solution is to move further and further from the city.

Smart Growth pilot projects are being successfully implemented in south Florida, in the communities of Boca Raton, West Palm and Fort Lauderdale. The projects encourage revitalizing inner city neighborhoods, increasing housing densities, maintaining greenspace, mixing affordable housing with upscale housing, improving aging infrastructure, and providing mass transit. By encouraging growth in the inner cities and reducing the incentives to move to the suburbs, undeveloped areas can be preserved. Building codes and zoning laws should be revised to allow higher densities of housing, while increasing the amount of greenspace required in new developments. Commercial development should be encouraged to use abandoned, previously developed properties, rather than clearing new lands. And more attention should be paid to providing reliable and affordable public transportation that to the development of new roads and highways.

8.3.5 Invasive Exotic Vegetation

Native plant communities evolve with a complex relationship of natural controls that keep them in balance. These natural controls may include environmental requirements, competing plant species, herbivores, and pathogens. When exotic plants are introduced to areas, they often have a competitive advantage over the native plants because natural controls of the exotic plants are not present. This competitive edge allows the exotics to displace the native species, creating monocultures that result in loss or degradation of wildlife habitat. In addition, exotic aquatic vegetation can contribute to water quality degradation resulting in fish kills, the loss of recreational and boating activities, water flow restrictions resulting in flooding, and the reduction of biological diversity.

Hillsborough County has a staff that specializes in the control of aquatic exotic vegetation in the watershed, but the control of those species that occur on uplands is usually the responsibility of the landowner. The most noxious and widespread upland exotic species in the watershed are Brazilian pepper, cogon grass, and Chinese tallow. Other exotic vegetation found in the Alafia River Watershed is listed in Appendix F.

Exotic vegetation usually occurs on or adjacent to previously disturbed lands, so mined lands and land in the vicinity are usually problem areas. Cogon grass, air potato, tropical soda apple, and napier grass are some of the species that usually show up on active or reclaimed mine land and then spread to natural areas. Stream crossings are also areas that are susceptible to exotic vegetation proliferation, especially primrose willow, cattail, air potato, and skunk vine. Figure 8-25 shows the worst areas of nuisance vegetation infestation.

Figure 8-25
ALAFIA RIVER WATERSHED
NUISANCE VEGETATION

Nuisance Vegetation Area
Areas where the vegetative cover is dominated by plants that have been identified as invasive nuisance species by the Florida Exotic Pest Plant Council, and the Florida Department of Agriculture and Consumer Services. Invasive plants are those that out-compete native species for space, light, and nutrients to become monocultures.

Creek/River

Subwatershed/Watershed Boundary

County Boundary

Road

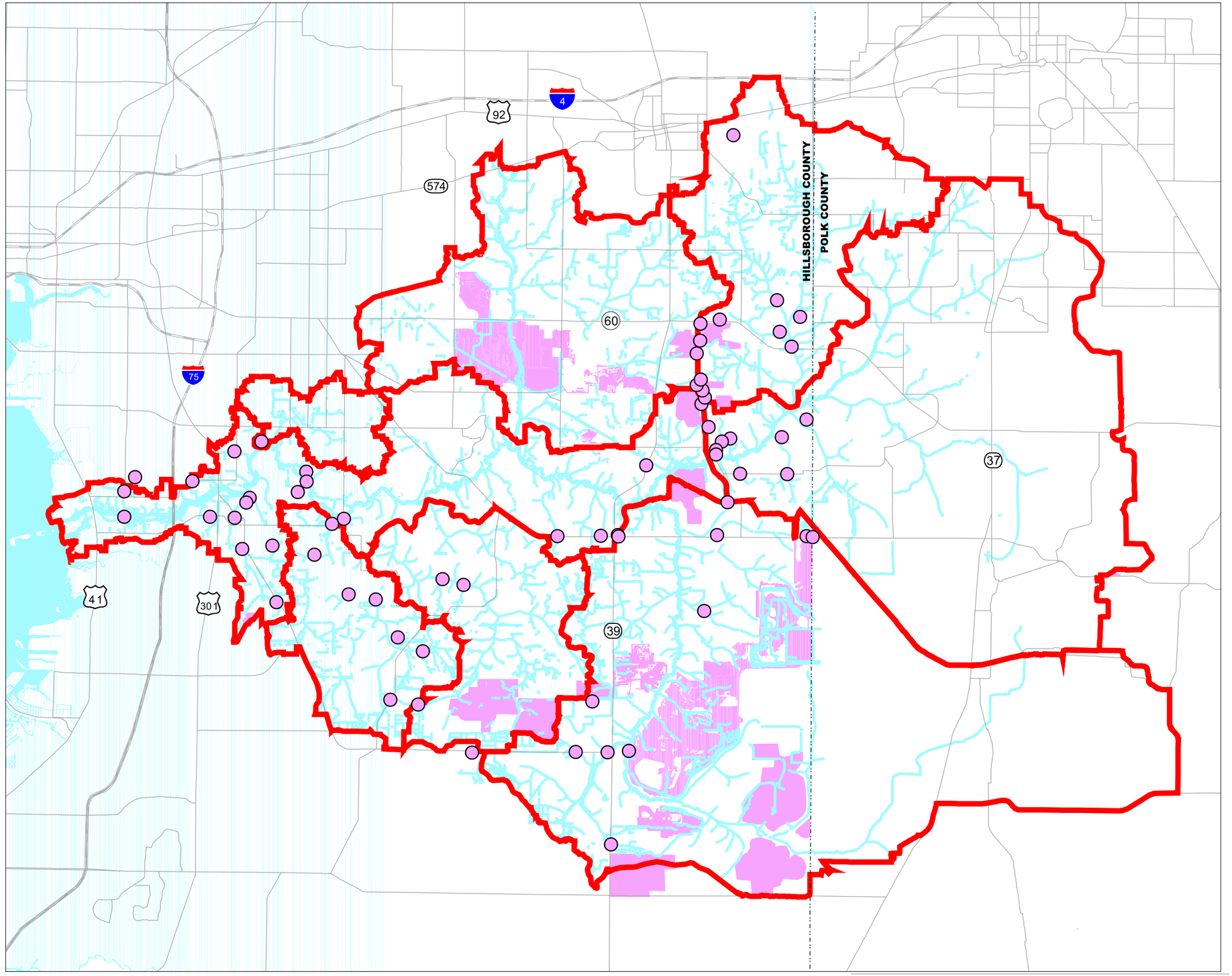
Railroad

0 3 6 Miles

Scale: 1:180,000

HILLSBOROUGH COUNTY
FLORIDA

N
W E
S



PARSONS ENGINEERING SCIENCE

Figure 8-25 nuisance vegetation 11 x 17 back

8.3.6 Phosphate Mine Impacts

Acid Spills
On December 7, 1997, approximately 60 million gallons of acidic process water spilled into Skinned Sapling Creek, a tributary to the Alafia River. The spill occurred at the Mulberry Phosphate Inc., facility in Mulberry, Polk County, Florida. The spilled water had a pH of approximately 1.8 to 2.0. By the next day, readings in the creek were as low as pH 2.24, and three days later, the pH readings in the Alafia River at the US 41 bridge had dropped from a normal of pH 7 to 8.5, to less than pH 4. The pH drop resulted in a massive fish kill that extended from the spill site to near the mouth of the river (FDEP/FIM 1998 draft).

The direct effect of the spill on the freshwater wetlands, vertebrate species, surface water quality, freshwater benthic invertebrates, and crustacean species was catastrophic. Over 10 million animals (fish, blue crabs, shrimp, etc.) were killed in the lower Alafia River (FDEP/FIM 1998 draft). The majority of these animals were schooling, planktivorous fish that are essential to the function of the ecosystem. Approximately 377 acres of freshwater wetlands in Polk County exhibited vegetation damaged from the spill (EPCHC, et al 1999 draft).

Some damages from the spill may not be realized for many years. The decline in fish and shellfish populations due to the spill will impact the productivity of piscivorous avian populations during the breeding season, and diminish future reproductive success and survival during the non-breeding season. There also were losses to recreational fishing opportunities over the two years due to the spill. These are subjective and difficult to measure, but with the decline in the large fish populations, a reduction in recreational fishing is assumed.

An environmental assessment (EPCHC, et al 1999 draft) was prepared to determine the optimal restoration alternative to offset the impacts from the spill. The three alternatives identified as the most appropriate were to restore riverine habitat, restore estuarine habitat, and to create artificial reefs.

Strip Mining.
The principal causes for the loss of species in present times are pollution and habitat destruction. Pollution, such as chemical spills, alters habitats so that they are uninhabitable for some species. Outright habitat destruction, such as clear-cutting, strip mining, and urbanization, alters habitats so that they are uninhabitable for virtually all species (Mushinsky et al 1996). The mining for phosphate that is occurring in the eastern portion of the watershed in Hillsborough County is an example of total habitat destruction. This type of strip mining completely alters the hydrology, soils, and vegetation of the habitat.

This photograph shows the habitat destruction caused by phosphate mining. Sand pine scrub habitat such as this has been nearly eliminated in this county by mining and agriculture.

Mandatory restoration laws led to the concept of "reclaimed" lands, but the reclamation has met with mixed success. Many experts, such as Dr. Henry Mushinsky of the University of South Florida, have conducted extensive studies on the effectiveness of mine restoration. Dr. Mushinsky's study (1997) compared the species diversity on mined and reclaimed land to lands that have never been mined. The study determined that even after 10 to 25 years, the mined and reclaimed lands support 50% fewer species than similar habitats that have never been mined.

New techniques are being developed in an effort to accelerate the natural processes of restoration. Some of these techniques have been very successful, such as the systematic segregation, stockpiling, and subsequent replacement of the soils removed during the mining process. Tim King of the Florida Fish and Wildlife Conservation Commission is aware of a sandpine scrub habitat that was successfully restored by the soil replacement process. Unfortunately this and other new techniques are not being used throughout the industry because of logistical problems and the prohibitive costs often associated.

Mr. King feels that the main problem with mine reclamation is that the agencies and mining companies don't look at the "big picture." Mining activity and the permitting for that activity is usually accomplished by small, arbitrary, legal land units, and these units are frequently restored without considering the impacts on the dynamics of the hydrology, and ecology of neighboring natural systems. Mr. King would like to see the restoration efforts incorporate more effective planning of natural systems, not of individual properties (personal communication, July 2000).

8.3.7 Crab Traps

A recent source of contention in the watershed near the mouth of the Alafia River, are the crab traps. Crabbing is an activity that has been popular since the first settlers arrived in Florida, when blue crabs were so plentiful they could be gathered

by the basketful. These days most crabs are trapped in baited wire baskets that are marked by buoys that float on the surface of the water and are attached to the traps by line. Each trap is marked with the owners' name, and these traps are protected by strong legislation. Interfering with a trap in any way can result in stiff penalties. There is no real limit to the number of crabs that can be taken, and although only crabs over 5 inches "from horn to horn" are supposed to be taken for food, smaller crabs can be taken for bait. According to local residents and boaters, this has resulted in a serious depletion of crabs in the area. With fewer crabs in the river the crabbers are catching less, so to compensate, they are putting in more traps. In addition, other areas have suffered from the depletion of blue crabs and the crabbers that trapped in these areas are moving into the Alafia River, and moving farther and farther upstream.

According to the recreational boaters, commercial crabbers place the traps in areas that are frequented by pleasure boaters and commercial fishermen. Many boaters have complained that channels are blocked and they can't reach their docks or access the main channel. The lines from the traps often get snared in boat propellers, nets, and fishing lines, creating problems for both the owners of the traps and the recreational boaters. Water skiing is difficult to impossible in the river without hitting one of the traps.

The crabbers argue that the boaters travel faster than they safely should in the river, and that while they are damaging their boats on the traps, they are also damaging the traps. When the lines get caught on the propellers, they are cut off and the expensive trap is lost. Many of the crabbers are former fishermen that were forced into the crabbing business because of the ban on cast netting. They claim that the recreationists are threatening their livelihood, just as the cast net ban did.

The issue is being discussed at the monthly meetings of the Agency on Bay Management (ABM). The ABM is the natural resources committee of the Tampa Bay Regional Planning Council, and is the primary community organization focusing on the protection and management of the Tampa Bay estuary. Ms. Suzanne Cooper chairs this association of representatives from the recreational, commercial fisheries, industrial, regulatory, academic and scientific sectors, local, regional, state and federal governments, and legislators. The agency was instituted in 1985 to address issues and opportunities affecting the Bay and its tributaries. The ABM has heard recommendations from all parties concerned with the issue, and some of those recommendations include:

- Enforcing the rules governing the length of the buoy line. The rule states that a four-foot line is sufficient to maintain a buoy floating on the water, but most of the crabbers in the area use longer lines, and that increases the risk of the lines getting snagged on propellers.
- Reducing the boating speed limit on the river and within the channel.

- Restricting the harvesting of crabs to males meeting the “5 inch horn-to-horn” size limit and not allowing the harvesting of smaller crabs for bait.
- Not allowing the trapping of crabs upstream of the US 41 bridge.
- Implementing a closed season in the fall during which all traps must be pulled and maintained. Those traps remaining in the river during the closed season will be pulled and destroyed.
- Conducting an inventory on the number of crabs in the river to substantiate the claims of the local residents and boaters that the crabs are being over-harvested.

An agreement was recently reached between the crabbers and the local residents. One of the more active residents that has been involved with the discussions has agreed to mark the areas where the crabbers may place the traps. The crabbers have agreed to this compromise and it appears that the issue has been resolved.

8.4 Funding Sources/Cooperating Agencies

8.4.1 Preservation 2000/Florida Forever

The alteration and development of Florida’s natural areas have contributed to the degradation of water resources, fragmentation and destruction of wildlife habitats, loss of recreational areas, and diminishment of wetlands and forests. In 1990, the Legislation found that imminent development of Florida’s natural areas and continuing increases in land values required an aggressive program to acquire public lands for environmental and recreational protection. As a result of this funding, the Legislature passed the Preservation 2000 Act, a ten-year program that funded the preservation of over one million acres of conservation land in sixty counties.

The P2000 program expired last year and has been replaced by the Florida Forever Program, which, like the P2000 program, provides $3 billion in funding for land preservation over the next ten years. The $300 million per year will be distributed as follows:

- $105 million to the Florida Department of Environmental Protection
- $105 million for the water management districts,
- $72 million to the Florida Communities Trust,
- $4.5 million to the Florida Greenways and Trails Program,
- $4.5 million to the Florida Fish and Wildlife Conservation Commission,
- $4.5 million to the Florida Division of Parks and Recreation, and
- $4.5 million to the Florida Division of Forestry

8.4.2 Florida Communities Trust

The Florida Communities Trust (FCT) was created in 1989 to help local governments in their effort to preserve green space, including parks, open space, and natural areas. The FCT provides grants and/or matching funds for the purchase and management of undeveloped areas for future parks, green space, or wildlife habitat. The trust is funded primarily through the Florida Forever program, which has more than doubled the $30 million per year allotment that was provided by the Preservation 2000 program. Between 1993 and 1999, the FCT and its local government partners have purchased over 27,000 acres of land, with the trust providing over half of the funds required for the purchase.

In the Alafia River Watershed, the FCT assisted in the purchase of the Sterling Downs Greenway, now referred to as the Bell Creek Preserve. Applications have been submitted for matching funds for the purchase of additional lands in the watershed.

8.4.3 Florida Greenways and Trails

The Office of Florida Greenways and Trails is a division of the FDEP that leads the implementation of the Statewide System of Greenways and Trails, provides technical assistance to communities, developers, and landowners, and administers the Greenways and Trails Land Acquisition Program under Florida Forever. The Office also provides information regarding recreational opportunities on greenways and trails and promotes public education about the benefits of these facilities. The activities of this Office are governed by Chapter 260 Florida Statutes and implemented by Chapter 62S-1, Florida Administrative Code. Figure 8-26 shows the proposed and existing designated greenways within the watershed.

8.4.4 Hillsborough County Greenways Program

In June 1995, the Board of County Commissioners endorsed the Hillsborough County Greenways Master Plan, a conceptual and strategic plan for creating and maintaining a countywide greenway system. The Master Plan proposes an interconnected system of greenways to protect natural resources and provide opportunities for recreation and non-motorized transportation. The BOCC established the Hillsborough County Greenways Program, which is administered by the Hillsborough County Planning and Growth Management Department. The department is also responsible for the planning functions related to greenway trail projects in the unincorporated portion of the county. The greenways proposed for the county coincide with those proposed by the state program.

8.4.5 Southwest Florida Water Management District

SWFWMD encompasses a wide variety of land and water ecosystems that require protection, and one way to protect whole ecosystems is through land acquisition. The District uses fee simple for the outright purchase of sensitive areas, and less-than-fee simple for the purchase of limited property rights. The less-than-fee simple plan allows the property owner to keep the land, while the natural resources on the land are protected at a lower cost.

SWFWMD uses the Water Management Lands Trust Fund (also know as the Save Our Rivers program) and the Florida Forever (previously P2000) program to guide the land acquisition. Through these two programs SWFWMD has purchased over 300,000 acres of public lands. The lands are identified for potential purchase in a Five-Year Plan. The Five-Year Plan identified over 600,000 acres throughout the state for potential purchase. Each site must be subjected to a series of reviews and then is either approved or rejected by the Governing Board or Basin Board. If the property is purchased, a management plan is prepared and implemented.

In 1998, the SWFWMD completed their five-year plan for the SOR/P2000 program. In this plan the District discussed the objectives of the program, the process of acquisition, the partnerships formed, and the management activities that are proposed for the acquired parcels. The plan also identified the acquisition plan for each of the watersheds within the District.

Within the Alafia River watershed, the District has identified over 32,000 acres for potential acquisition, and has already (as of 1998) purchased over 5000 acres. There are currently three land acquisition projects within the watershed. The largest project consists of a corridor of natural upland and wetlands along the main stem of the river, its headwaters, and its major tributaries. The purchase of this land will secure a riparian buffer that will protect the water quality, wildlife habitat, and floodplain of the river in perpetuity. In addition to those benefits, the corridor will connect to the Little Manatee River corridor acquisition project to the south, creating a “contiguous riverine greenway” for the two rivers. Other acquisition projects within the watershed include the Medard Reservoir a former mine site in the Turkey Creek subwatershed, and lands along the eastern shoreline of Tampa Bay, south of the river confluence

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- Inge Tonkin

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- Brandt Henningsen
- Forrest Turbeville
- Lisa Henningsen

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- Suzanne Cooper

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CHAPTER 9

WATER SUPPLY EXISTING CONDITIONS

9.1 Introduction

Water resource management may be the most important issue affecting Hillsborough County. Although water seems to be abundant in Florida, resources are not always readily available and there is often competition between water users and natural resource protection.

Tampa Bay Water's charge is to provide the region with potable water. Tampa Bay Water is a special state district created by an inter-local agreement among member governments -- Hillsborough County, Pasco County, Pinellas County, St. Petersburg, New Port Richey and Tampa. A nine-member Board of Directors made up of elected officials from these member governments establishes the policies that govern Tampa Bay Water.

The Hillsborough County Board of County Commissioners formed the Hillsborough County Water Resource Team in response to this regional initiative to seek an adequate water supply for the future, and to safeguard the environment as new water sources are developed. The team provides consensus recommendations to the county on water supply issues.

Currently, groundwater is the predominant developed potable water supply in the Alafia River Watershed. Tampa Bay Water proposes to develop a surface water supply in Eastern Hillsborough County, which will include the Alafia River. Section 9.2 briefly describes Tampa Bay Water's proposed surface water supply strategy in Eastern Hillsborough County. Section 9.3 outlines the hydrogeology of the Alafia River Watershed. Section 9.4 details groundwater-monitoring efforts within the Alafia River Watershed.

9.2 Water Supply Issues And Concerns

Nearly 100 million gallons per day (MGD) of water are withdrawn from the Alafia Watershed (SWFWMD, 2001). This estimate is based on the year 1998 and includes 92.7 MGD of groundwater withdrawals and 6.9 MGD of surface water withdrawals for a total of 99.6 MGD. Agricultural uses comprise the largest user group with 30 percent of the total and together with mining (28%) and public supply (25%) make up over 80 percent of the total. Fifteen (15) percent of the water is used by commercial and industrial facilities with the remaining two (2) percent devoted to recreation.

The single largest public supply withdrawal in the watershed is at the South Central Hillsborough Regional Wellfield (SCHRW), which is permitted to withdraw 24.1 MGD.

SCHRW is located near the confluence of the North Prong and South Prong of the Alafia River. Plant City is permitted to withdraw 6.09 MGD. New public supply withdraws are projected to begin operation in the near future. These new supplies include the Brandon Urban Dispersed Wellfield (BUDW) and a new surface water withdrawal from the Alafia River.

The BUDW is scheduled to begin operation in December 2001 and is permitted to withdraw 6.0 MGD. The BUDW is not wholly contained within the Alafia Watershed but occupies a portion of the watershed's northwest corner.

The new surface water supply is under construction and will withdraw water from the Alafia River at a withdrawal point located just upstream of the Bell Shoals Road crossing. Tampa Bay Water will withdraw 8 – 52 MGD at this location at times when the river flow exceeds 124 cubic feet per second (80 MGD). The SWFWMD is currently in the process of setting minimum flows for the Alafia River. Minimum flows are defined as "the limit at which further withdrawals would be significantly harmful to the water resources of ecology of the area." Once minimum flows are adopted this surface water permit will be reviewed and modified, if necessary.

Tampa Bay Water was required to assess the effect of groundwater withdrawals on the Alafia River flow as part of an evaluation of the SCHRW and again for permitting of the BUDW. No significant effect on flow in the main river was discovered. Likewise, lake and wetland monitoring has not shown impacts to these systems due to pumping. The greater thickness of the low-permeability confining layer underlying the surficial aquifer has been suggested as the reason for the absence of drawdown problems similar to those experienced in the northwest portion of Hillsborough County. Aquifer levels are on the decline, however. The Alafia River Watershed, like all coastal watersheds within the Southern Water Use Caution Area (SWUCA), have experienced a significant decline in the potentiometric surface of the Floridan Aquifer over the past 40 years. This decline has pushed the salt-water/fresh-water transition zone inland.

Aquifer Storage and Recovery (ASR) could be a viable water source alternative in the Alafia River Watershed pending the experiences of two nearby, proposed ASR projects. One of these ASR projects is under evaluation at the nearby Florida Power Corporation's Hines Energy Complex southwest of Bartow and the other is located in the Big Bend area. The Hines Energy ASR will store up to one MGD of cooling water. The feasibility of the Big Bend ASR project has already been confirmed, and following the successful completion of the Hillsborough County South Central ASR Test Well, a storage capacity of over one billion gallons is expected utilizing a seven-well network to store reclaimed water.

9.3 Hydrogeology

(Section 9.3 is a reprint of Chapters 1 through 4 of the report entitled "Alafia River Watershed Hydrogeology and Groundwater Use," prepared by SDI Environmental Services, Inc. of Tampa, Florida, dated September 19, 2000. Figures and tables from the SDI report are also reprinted. References from the SDI report are incorporated into the reference section at the end of Chapter 9. Parsons Engineering Science and Hillsborough County made no content changes to SDI text, figures, or tables.)

9.3.1 Hydrogeology Introduction

Hillsborough County, Florida is developing an Alafia River Watershed Management Plan for stormwater management. SDI Environmental Services, Inc. (SDI) was selected as a subconsultant to Parsons Engineering Science, Inc. (Parsons ES) to describe the hydrogeology and groundwater use of the Alafia River watershed. The purpose of this assignment was to provide information that would be useful for addressing the hydrogeologic and water use issues associated with the management plan. A principal issue was the potential influence on the groundwater resource of proposed stormwater management structural projects. The Alafia River watershed and basins within the watershed are shown in Figure 9-1.

This report focuses on the hydrogeology and groundwater use in the Alafia River watershed. The objectives of the report are to describe both the hydrogeologic framework and water use activities in the Alafia River watershed using readily available and interpretable data. The sources of data were the Southwest Florida Water Management District, Tampa Bay Water, U.S. Geological Survey, and selected consulting firm reports.

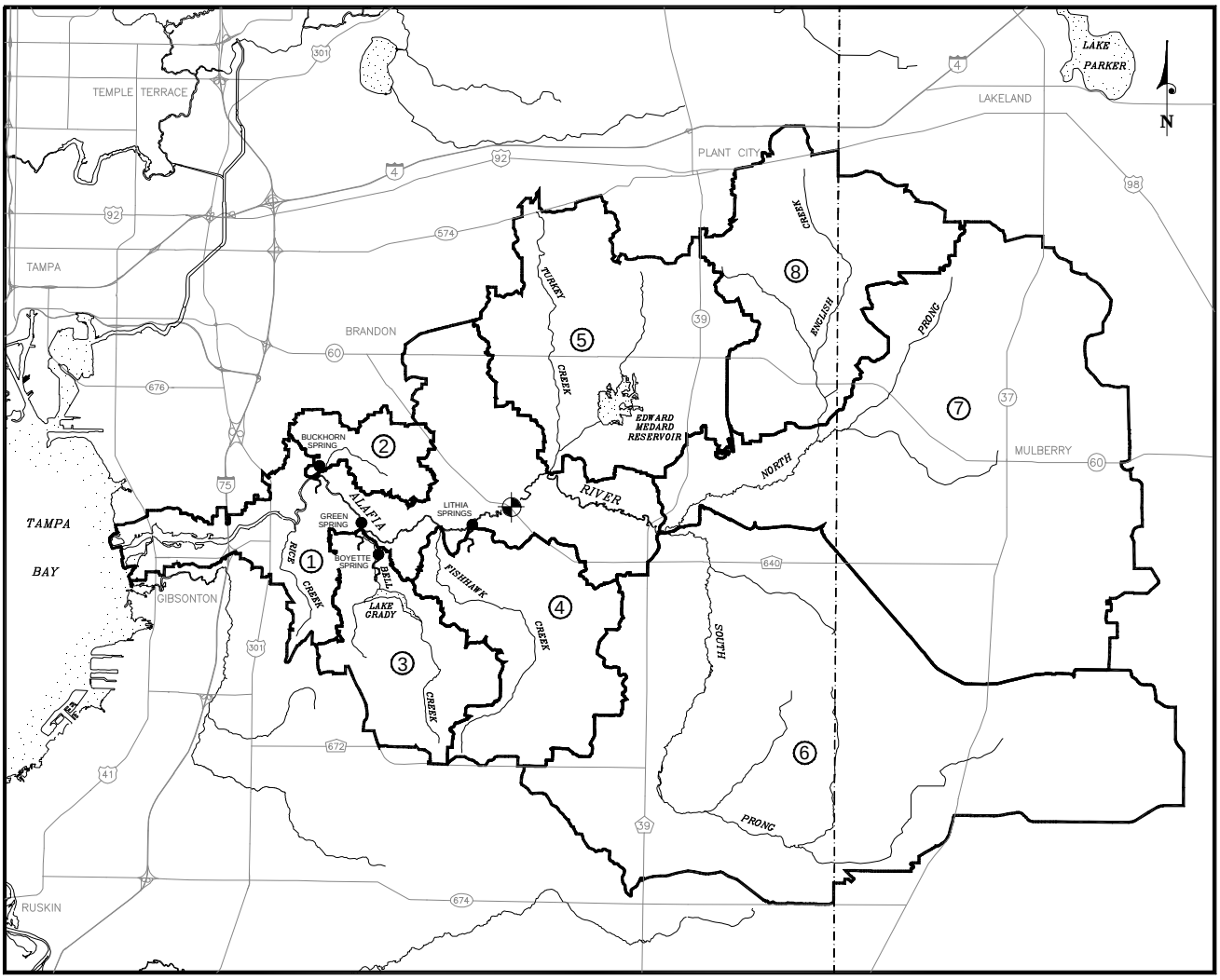


Figure 9-1. Surface Water Basins Within the Alafia River Watershed.

9.3.2 Hydrogeology Of The Alafia River Watershed

The Alafia River watershed (Figure 9-1) is underlain by a sequence of sedimentary rocks whose lithology, structure, and geologic history control the occurrence and movement of fresh and saline groundwater. Fresh groundwater occurs inland from the coastal margin of Tampa Bay, whereas saline groundwater occurs in the vicinity of the coastal margin of Tampa Bay (SWFWMD, 1995).

Available data for describing the hydrogeology of the Alafia River watershed are sparse. Because of this, the hydrogeologic descriptions in this report are approximate. However, they should be sufficient for qualitative assessments of the potential influence of proposed stormwater management structural projects.

Geologic And Hydrogeologic Units

Table 9-1 shows the generalized geologic and hydrogeologic units underlying the Alafia River watershed. Geologic units are also known as stratigraphic units. For the purpose of this report, the Alafia River watershed is considered to be underlain by three sequences of rocks. They are from uppermost to lowermost: 1) a sequence of undifferentiated clastic rocks (predominantly sands and clays); 2) a sequence of Miocene carbonate (limestone and dolomite) and clastic rocks; and 3) a sequence of Eocene and Oligocene carbonate rocks. The correlations between the geologic and hydrogeologic units in the vicinity of the Alafia River watershed in this investigation are shown in Table 9-1.

The hydrogeologic unit nomenclature used in Table 9-1 follows the Southeastern Geological Society (1986) and Miller (1986). The Floridan aquifer system (FAS) consists of the upper and lower Floridan aquifer systems separated by a middle confining unit. The middle confining unit and lower Floridan aquifer generally contain highly mineralized water in west-central Florida (Hickey, 1990). The upper Floridan aquifer system (UFAS) is defined as the stratigraphic interval in the FAS that, with permeable limestone and dolomite rocks, contain fresh groundwater. The UFAS is a commonly used hydrogeologic refinement for conceptualizing the major component of groundwater flow in the carbonate rocks in west-central Florida. Duer, et al. (1988) reported that the UFAS supplied more than ten times the amount of water than either the SAS or the IAS in the area of their investigation which included the Alafia River watershed.

Depending upon the geographic location within the Alafia River watershed, the hydrogeologic unit that immediately overlies the UFAS may be either the SAS, ICU, or IAS (Table 9-1). As mentioned in the text that follows, either the SAS or ICU overlay the UFAS in the western and northwest parts of the watershed where the Miocene rocks of the IAS transitions to the ICU. The IAS overlies the UFAS in approximately 90 percent of the watershed. The SAS is present throughout the

Table 9-1. Generalized Geologic and Hydrogeologic Units of the Alafia River Basin.

SERIES	GEOLOGIC UNIT	GENERAL LITHOLOGY	HYDROGEOLOGIC UNIT
UNDIFFERENTIATED	UNDIFFERENTIATED SAND AND CLAY	PREDOMINANTLY SAND WITH SOME INTERBEDDED CLAY, SHELL	SURFICIAL AQUIFER SYSTEM
			INTERMEDIATE CONFINING UNIT
MIOCENE	HAWTHORN GROUP PEACE RIVER FORMATION	INTERBEDDED SAND, CLAY, AND CARBONATE, ALL OF WHICH ARE VARIABLY PHOSPHATIC	INTERMEDIATE AQUIFER SYSTEM
	ARCADIA FORMATION	SANDY AND CLAYEY LIMESTONE AND DOLOMITE WITH BEDS OF SAND AND CLAY, ALL OF WHICH ARE VARIABLY PHOSPHATIC	
	TAMPA MEMBER	SIMILAR TO ARCADIA FORMATION BUT WITH LESS DOLOMITE, SAND, CLAY AND PHOSPHATE	
OLIGOCENE	SUWANNEE LIMESTONE	LIMESTONE; SANDY LIMESTONE; FOSSILIFEROUS	FLORIDAN AQUIFER SYSTEM
EOCENE	OCALA LIMESTONE	CHALKY, FORAMINIFERAL LIMESTONE; DOLOMITIC NEAR BOTTOM	UPPER FLORIDAN AQUIFER SYSTEM
	AVON PARK FORMATION	LIMESTONE AND CRYSTALLINE BROWN DOLOMITE; GYPSUM NODULES IN LOWER PART	
			MIDDLE CONFINING UNIT

MODIFIED FROM RYDER, 1985
AND CAMBELL & ARTHUR, 1993

watershed, except possibly in some segments of the Alafia River channel where the sand has been eroded. The SAS overlies the UFAS in the area where clay is absent (see Figure 9-6).

The locations of three hydrogeologic sections through the Alafia River watershed are shown in Figure 9-2. Cross-sections A-A´ (Figure 9-3) and B-B´ (Figure 9-4) are approximately oriented south to north and cross-section C-C´ (Figure 9-5) is approximately oriented west to east. The sources of the lithologic data are the Florida Geological Survey lithologic data file and Geraghty and Miller (1988a; 1988b). The SAS and UFAS occur in all three of the cross-sections. Whereas, as seen in cross-section A-A´ (Figure 9-3) and in cross-section C-C´ (Figure 9-5), the ICU and IAS are absent in parts of both sections. The approximate area within the Alafia River basin where clay of the ICU is absent is shown in Figure 9-6. As seen in Figure 9-6, ICU clay may be absent in parts of the Buckhorn Creek and the lower Alafia River basins. Identifying where the clay of the ICU may be absent is important for qualitative assessments about the potential influence of proposed stormwater management structural projects on the groundwater resource. Also shown in Figure 9-6 are the approximate areas where the ICU and IAS are present within the Alafia River watershed. The boundary between the ICU and IAS in the western part of the watershed is consistent with SDI (1998).

The lithologic logs illustrated in Figures 9-3 (A-A´), 9-4 (B-B´), and 9-5 (C-C´) show that the rocks which comprise the IAS are mainly clayey limestones and clay. Carr and Alverson (1959), Miller (1986), and Scott (1988) have described these Miocene age rocks. Because clayey limestone and clay are the predominant rocks that comprise the IAS, the transmissivity of the IAS are expected to be relatively low in comparison to the transmissivity of the UFAS.

Transmissivity is a measure of the ability of rocks to transmit groundwater. Geraghty & Miller, Inc. (1988a) report aquifer transmissivities determined from the results of five aquifer test performed on the IAS. The reported values vary from 350 feet squared per day (ft^2/d) to 1700 ft^2/d and are shown in Figure 9-7 at the location of the aquifer tests. These transmissivity values are hydrologically reasonable for clayey limestones.

Geraghty & Miller, Inc. (1988a) also report aquifer transmissivities determined from the results of 28 aquifer tests performed on the UFAS. The reported values vary from 16,000 ft^2/d to 250,000 ft^2/d and are shown in Figure 9-8 at the locations of the aquifer tests. These transmissivities are hydrologically reasonable for the UFAS and are comparable to reported UFAS transmissivities from other parts of west-central Florida (Ryder, 1985; SWFWMD, 1994). As would be expected, the transmissivities of the UFAS are much larger than the transmissivities of the IAS.

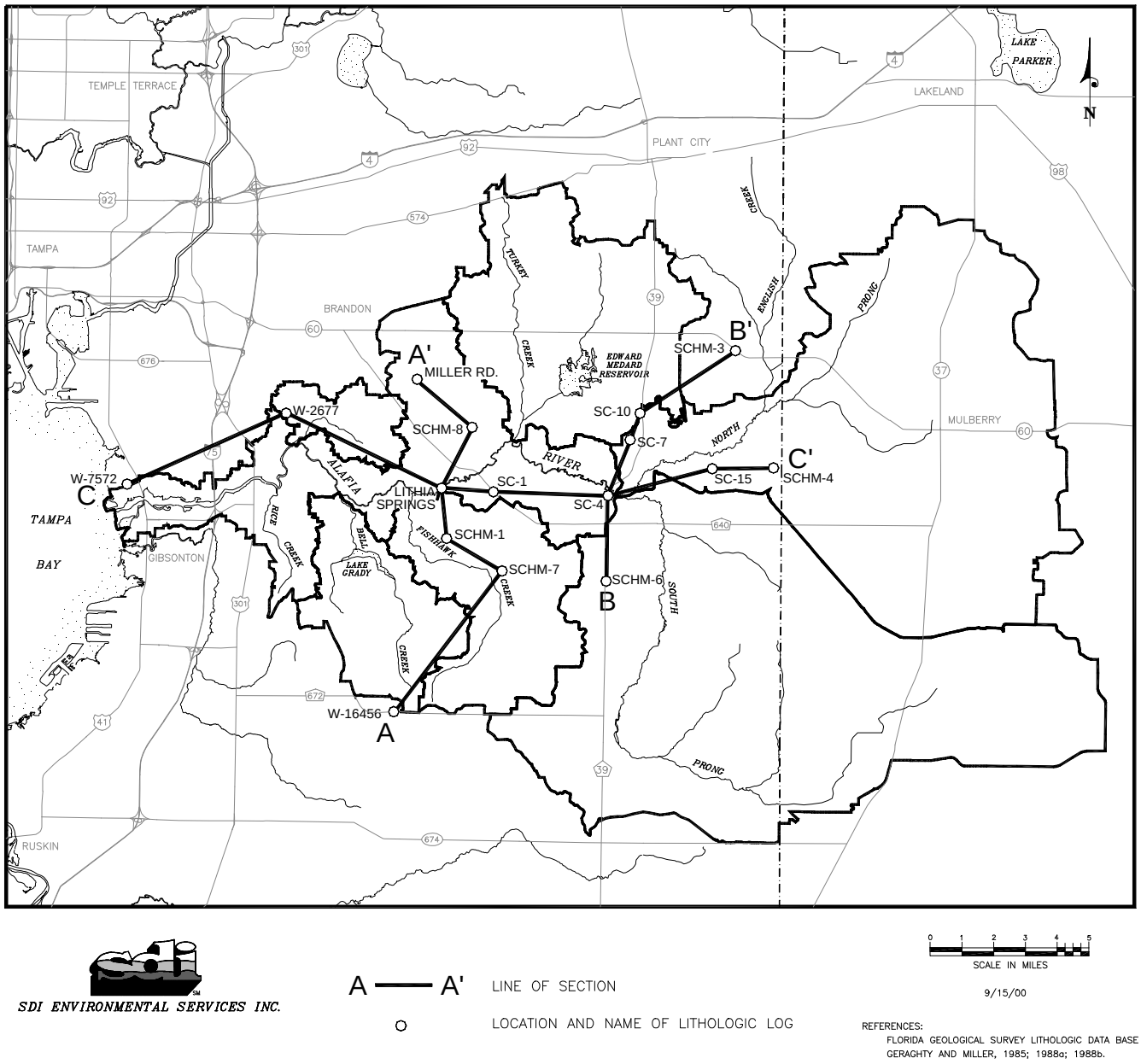
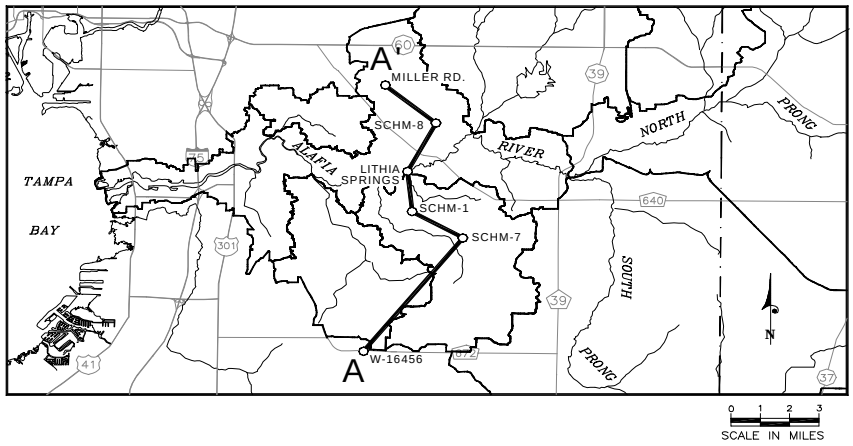


Figure 9-2. Location of Hydrogeologic Cross Sections Through the Alafia River Watershed.



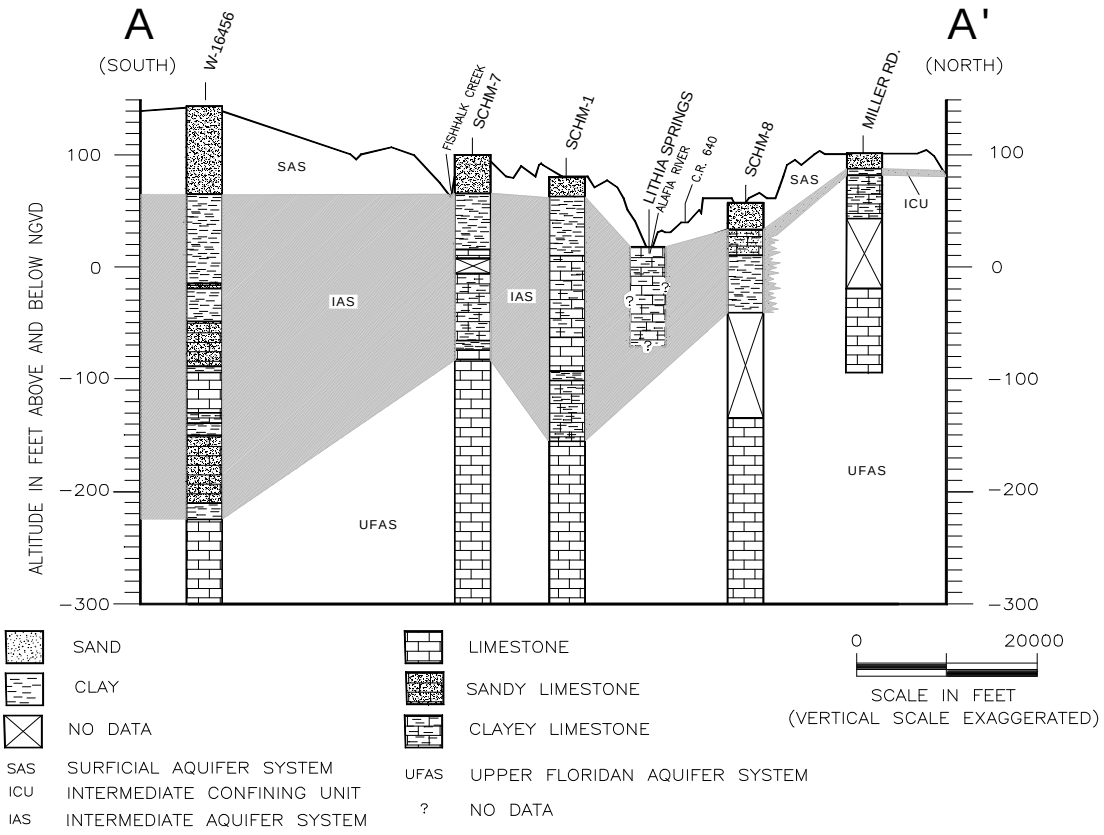


Figure 9-3. Hydrogeologic Cross Section A-A´.

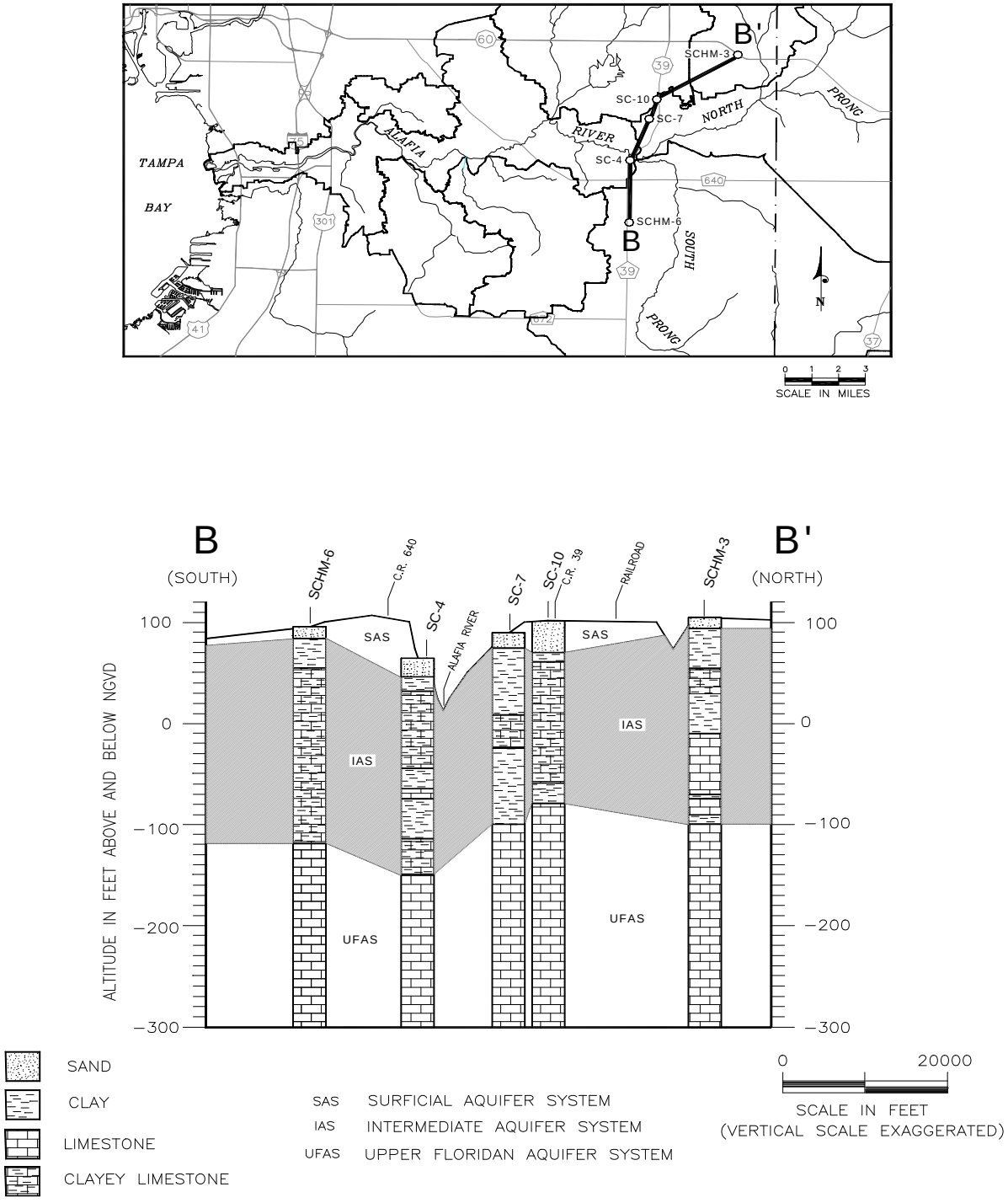
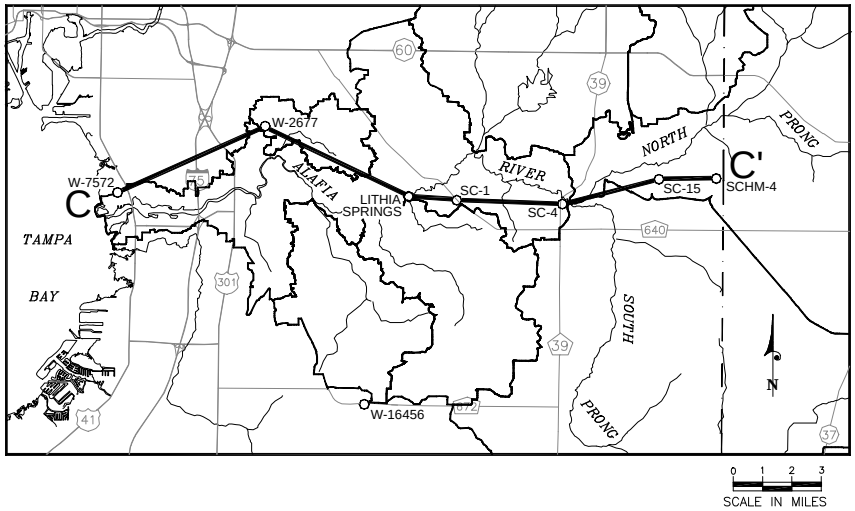


Figure 9-4. Hydrogeologic Cross Section B-B´.



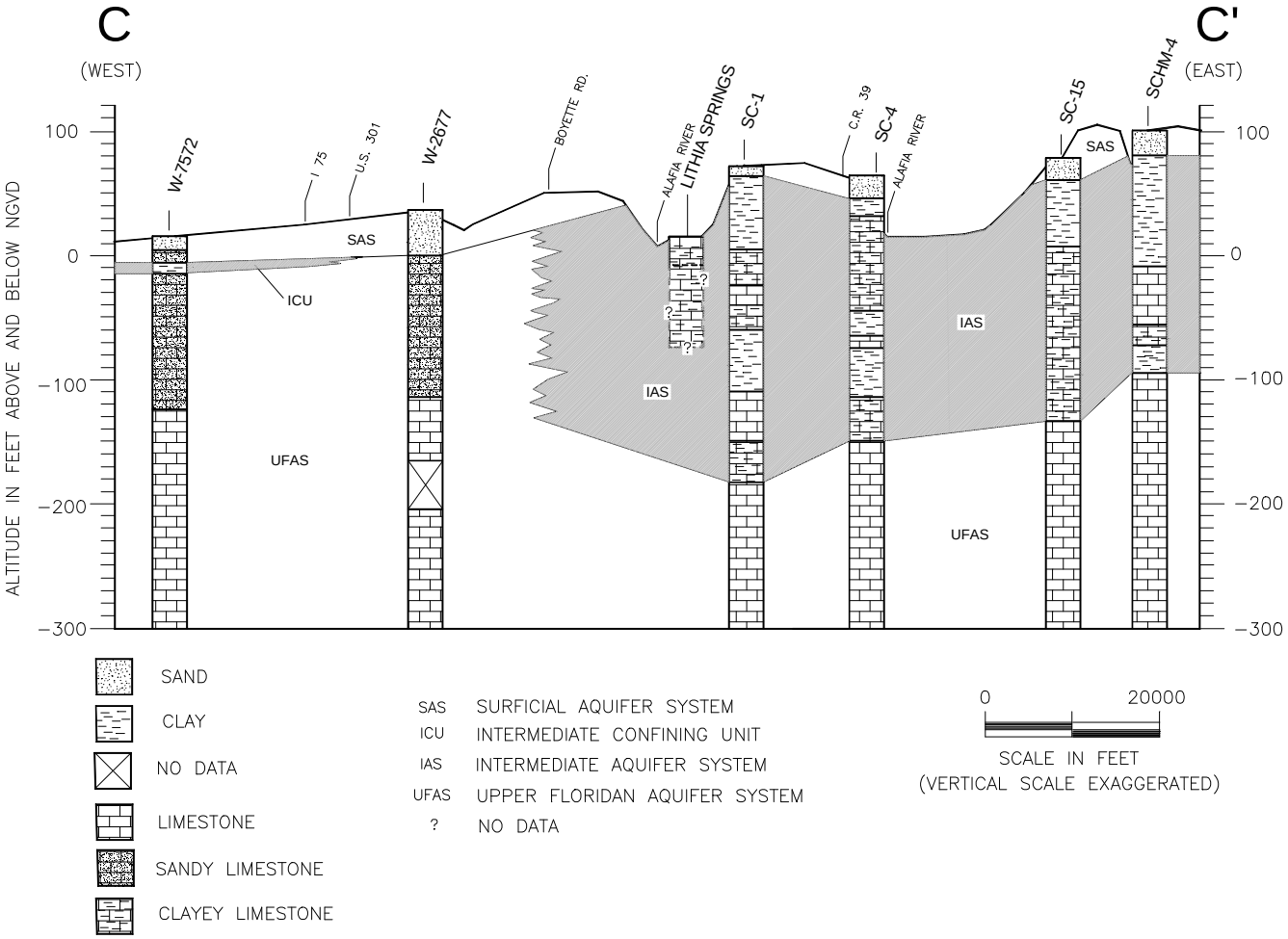


Figure 9-5. Hydrogeologic Cross Section C-C´.

Figure 9-6. Approximate Areas within the Alafia River Watershed Where the Intermediate Confining Unit may be Absent and Where the Intermediate Confining Unit and the Intermediate Aquifer System are Present.

Sas, Ias, And Ufas Water Levels

Figures 9-9 through 9-11 shows SAS, IAS, and UFAS water levels at three sites, SC-1, SCHM-4, and SCHM-6. The locations of these sites are shown in Figure 9-2. The pattern of water level relationships between the SAS, IAS, and UFAS water levels shown in Figures 9-9 through 9-11 are representative of what would be expected throughout most of the Alafia River Basin where the IAS is present. As seen in Figures 9-9 through 9-11, SAS water levels are higher than IAS water levels and IAS water levels are higher than UFAS water levels. These water level differences indicate downward flow or recharge from the SAS to the IAS and then downward flow or recharge from the IAS to the UFAS. The water level differences between the SAS and IAS and between the IAS and UFAS are consistent with the presence of clay between these hydrogeologic units. The presence or absence of clay would be an important consideration for qualitative assessments about the potential influence of proposed stormwater management projects upon the groundwater resource.

Figure 9-12 compares Edward Medard Reservoir water levels with SCHM-9 UFAS water levels. The reservoir water levels are higher than the SCHM-9 UFAS water levels suggesting that clays of the IAS are present between the reservoir and the UFAS. The reservoir provides recharge to the IAS and then to the UFAS.

Recharge estimates from model simulation results (SWFWMD, 1993 Draft) show that simulated downward recharge to the UFAS varies from 0 to 2 inches per year (in/yr) in the western part of the Alafia watershed and varies from 2 to 6 in/yr in the eastern part of the watershed. Ryder (1985) reports similar recharge estimates. The SWFWMD model simulation results also show that simulated upward discharge from the UFAS to the SAS, as would be hydrogeologically expected, occurs in the vicinity of the coastal margin of Tampa Bay along the western edge of the Alafia River watershed.

Figure 9-13 shows the part of the IAS potentiometric map for September 1998 in west-central Florida (Torres, et al., 1999a) that includes the Alafia River watershed. Figure 9-14 shows the part of the UFAS potentiometric map for September 1998 in west-central Florida (Torres, et al., 1999b) that includes the Alafia River watershed. The U.S. Geological Survey (USGS) during May and September of each year since 1985 has prepared IAS potentiometric maps and since 1975 has prepared UFAS potentiometric maps. Both the IAS and UFAS maps are based upon water level measurements made in selected monitor wells which are open to different depths in west-central Florida.

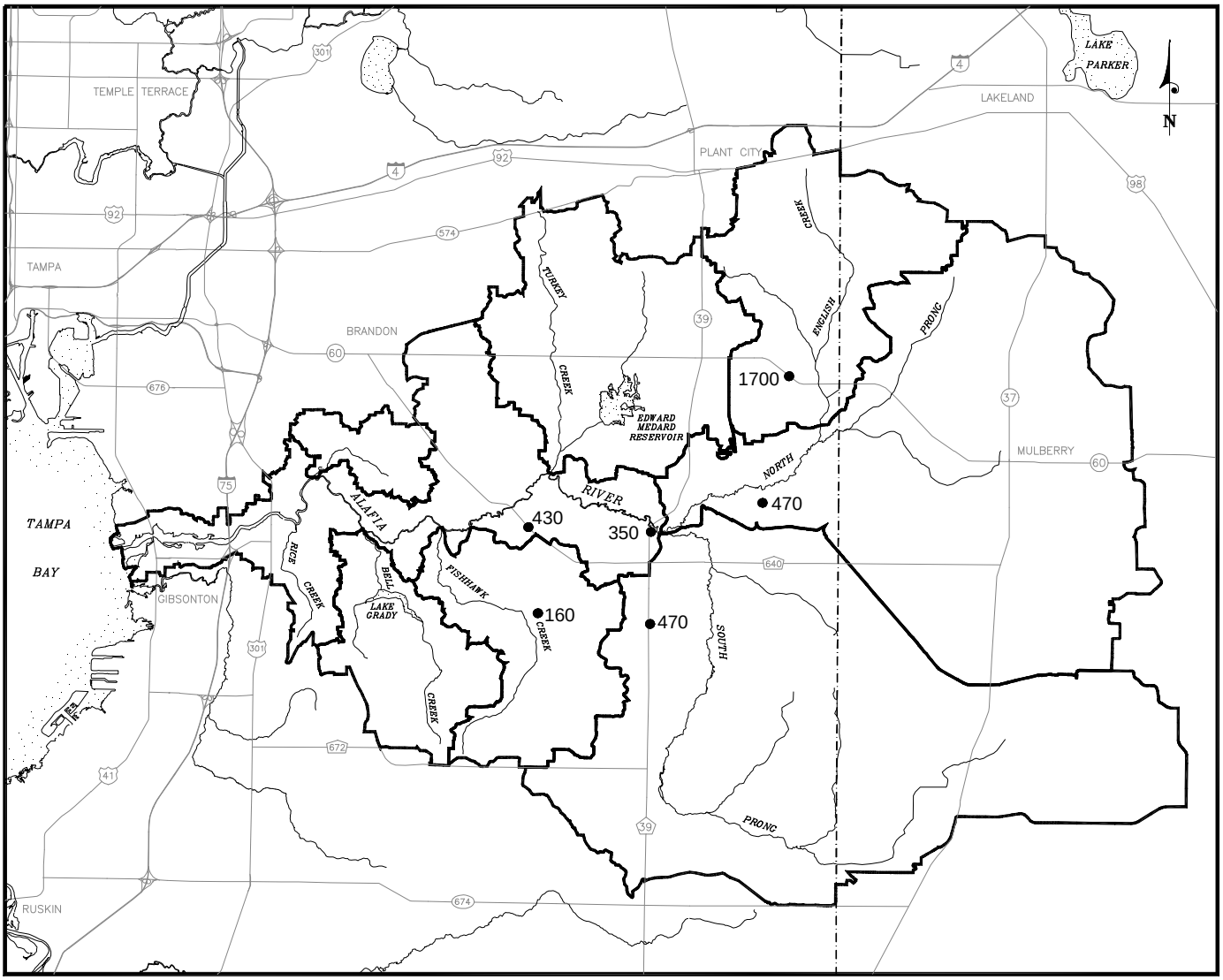


Figure 9-7. Transmissivities Reported for the Intermediate Aquifer System.

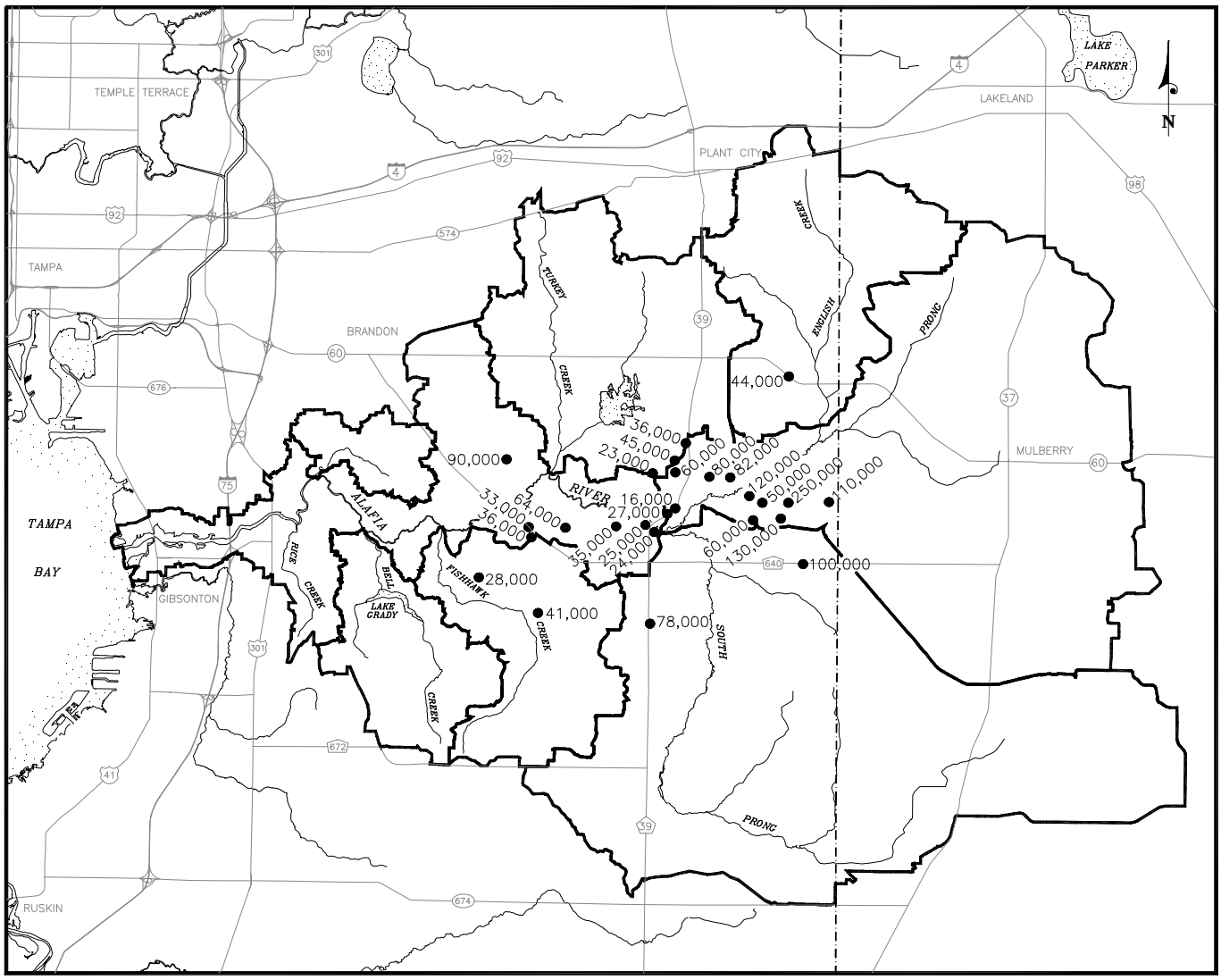
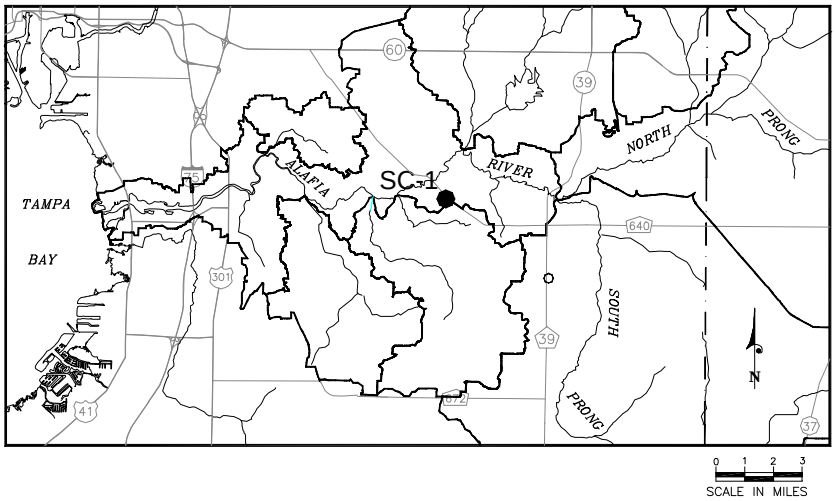


Figure 9-8. Transmissivities Reported for the Upper Floridan Aquifer System.



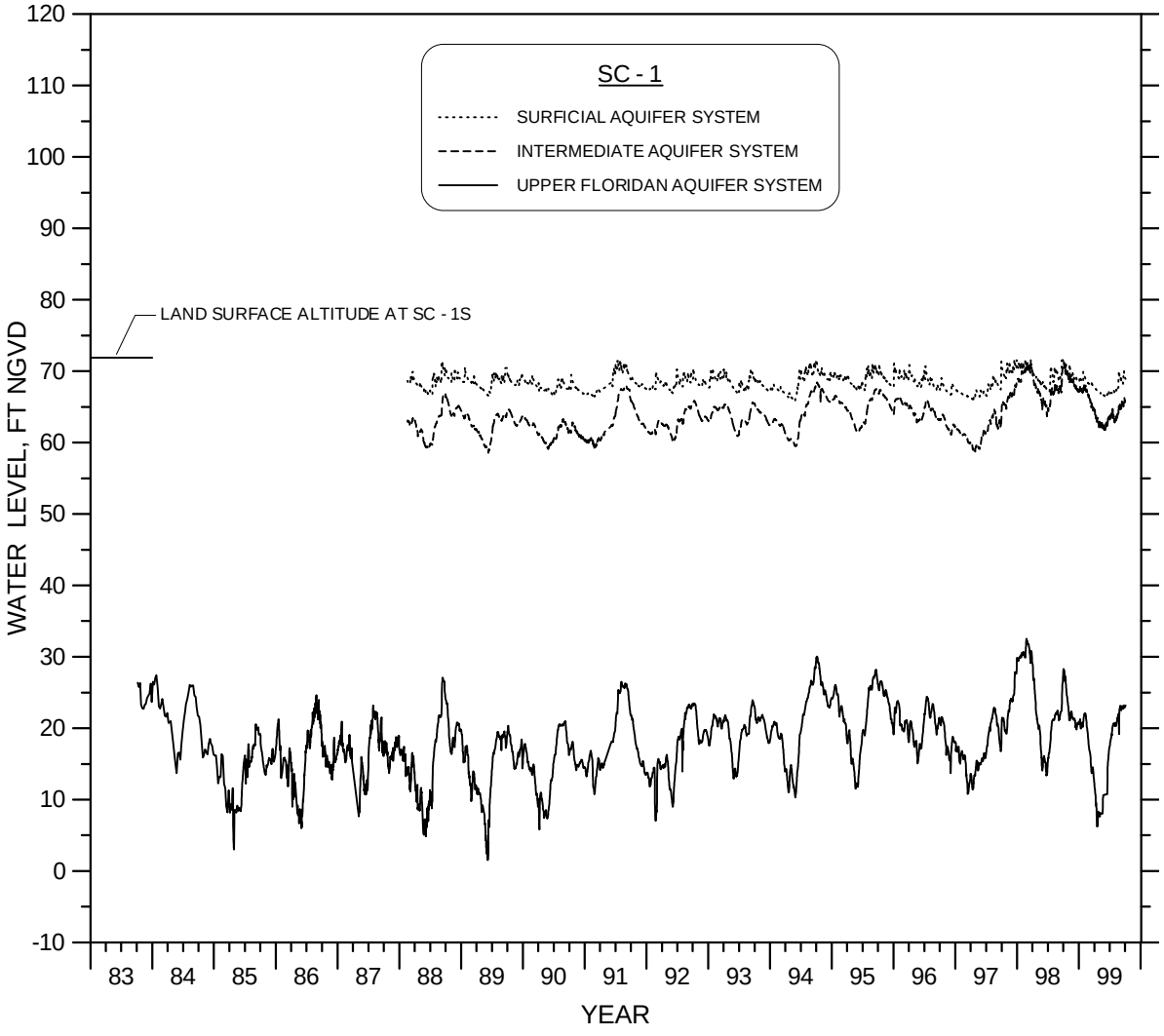
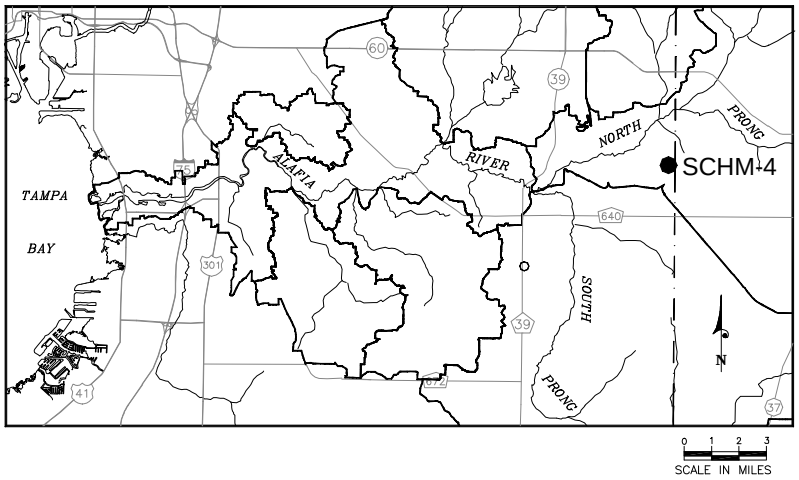


Figure 9-9. SAS, IAS, and UFAS Water Levels at the SC-1 Site.



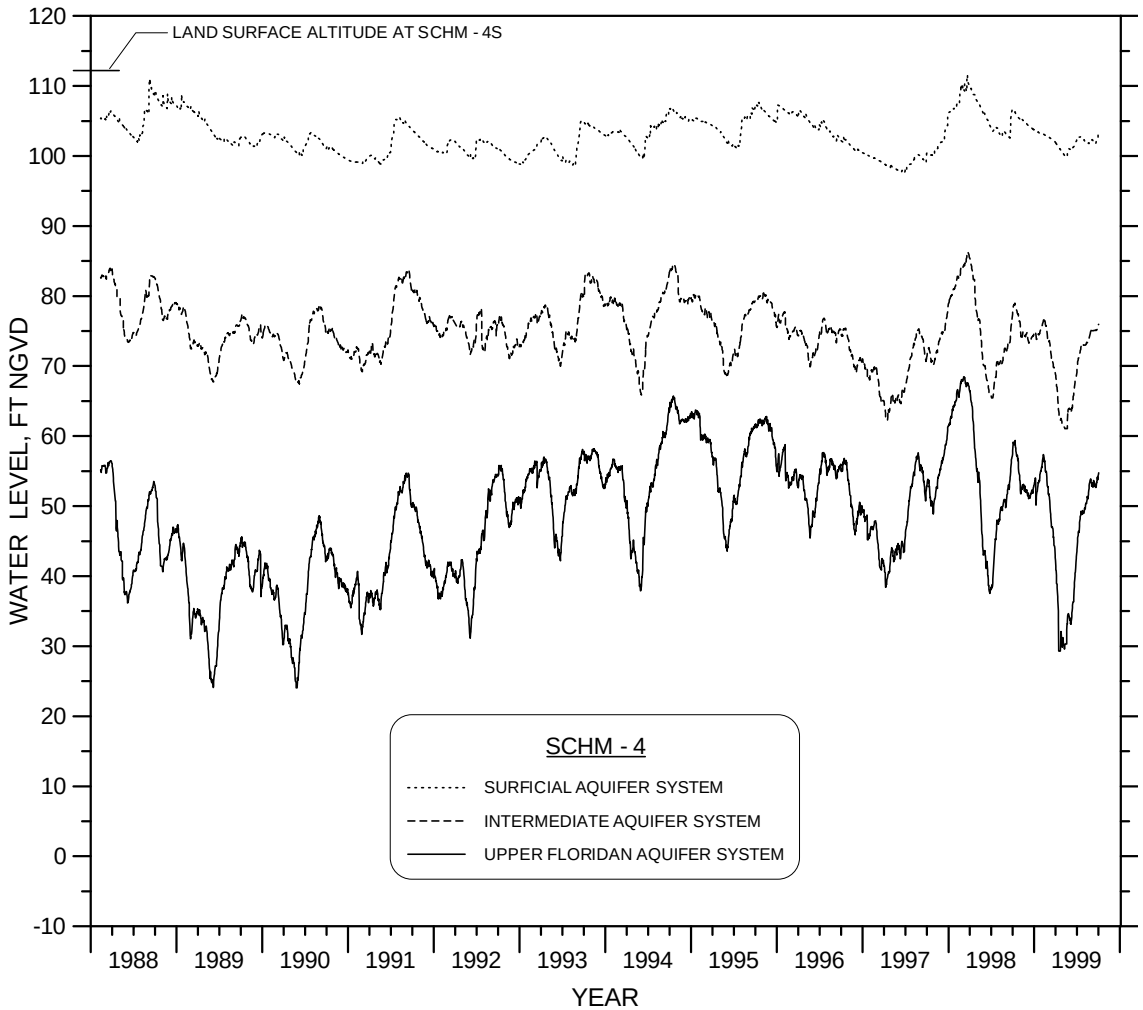


Figure 9-10. SAS, IAS, and UFAS Water Levels at the SCHM-4 Site.

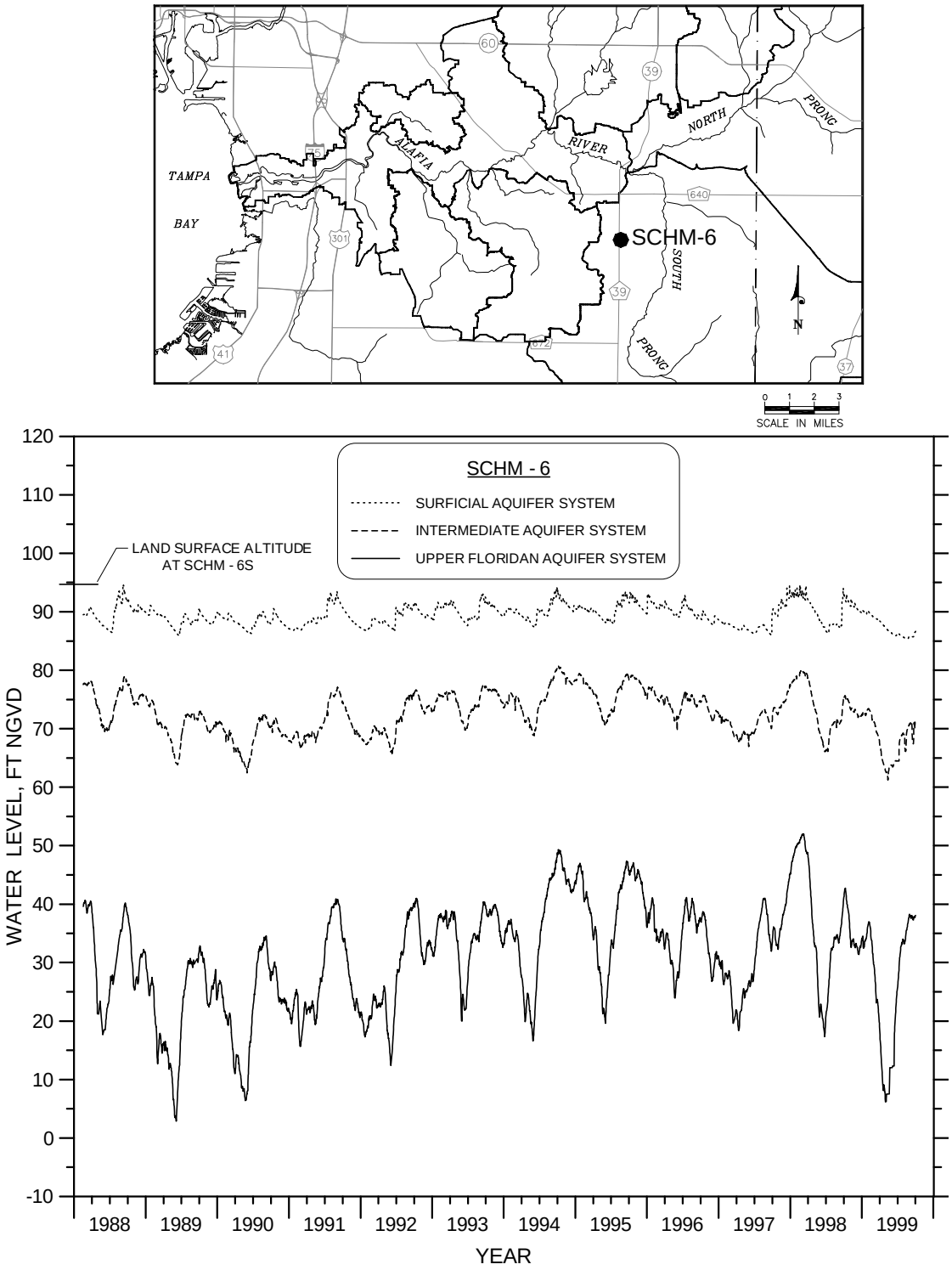
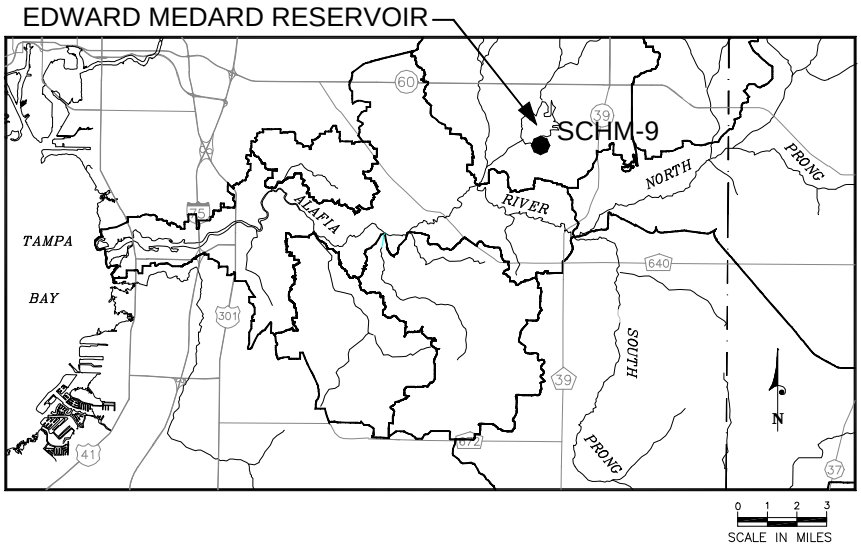


Figure 9-11. SAS, IAS, and UFAS Water Levels at the SCHM-6 Site.



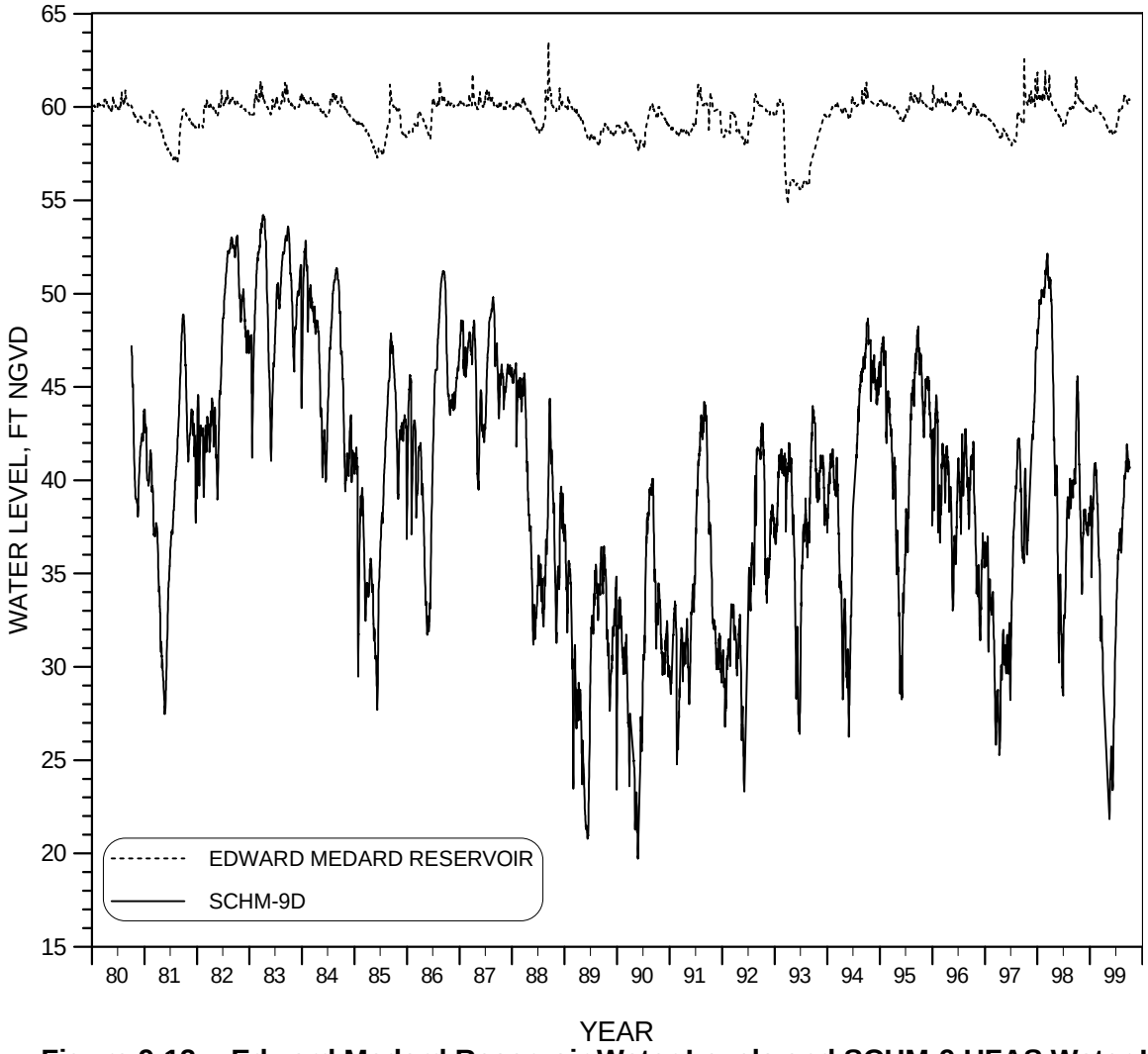


Figure 9-12. Edward Medard Reservoir Water Levels and SCHM-9 UFAS Water Levels.

The contour lines, which compose the IAS and UFAS potentiometric maps, connect points of equal water level elevations. The configuration of the IAS and UFAS contour lines is dependent upon a number of hydrogeologic factors including the distribution of aquifer pumpage, distribution of aquifer recharge, distribution of aquifer transmissivity, and depth of monitor wells. The depth of monitor wells is an important factor because both the IAS and UFAS could have water levels that vary as a function of depth.

Potentiometric surface maps are constructed for two principal purposes. One is to assess the spatial variations in groundwater levels, which is the purpose for this report, and the other is to assess groundwater flow directions. Caution has to be exercised when using potentiometric maps for the latter purpose of assessing flow directions. The reason for this caution is that a potentiometric surface map is a two-dimensional representation of the water level or hydraulic head distribution within an aquifer which may actually have a three-dimensional distribution. Only for very special circumstances, such as horizontal flow in an aquifer with constant transmissivity would a potentiometric map yield unqualified interpretations about flow directions.

The IAS potentiometric surface map for September 1998 (Figure 9-13) shows that the highest IAS water levels (greater than 110 ft NGVD) occur in the southeastern part of the Alafia River watershed in the South Prong basin. The lowest IAS water levels (less than 20 ft NGVD) occur in the western part of the watershed. The contour lines of equal IAS water level elevations show the distinct pattern of a reentrant with contours curving east-northeast and then recurving west-northwest in the vicinity of the main stem of the Alafia River and the North Prong of the Alafia River. The configuration of IAS contour lines suggests that groundwater as baseflow may flow into the main stem and North Prong of the Alafia River. This interpretation is hydrogeologically consistent with a geological map of Hillsborough County prepared by the Florida Geological Survey. Campbell, et al. (1993) show that the Tampa member of the Arcadia Formation, which is part of the IAS (see Table 9-1), outcrops in the bottom of the main stem of the Alafia River, in the bottom of the North Prong of the Alafia River, and in the bottom of the North Prong tributary, English Creek.

The UFAS potentiometric surface map for September 1998 (Figure 9-14) shows that the highest UFAS water levels (greater than 80 ft NGVD) occur in the northeastern part of the Alafia River watershed in the English Creek basin. The lowest UFAS water levels (less than 10 ft NGVD) occur in the lower Alafia River basin in the western part of the Alafia River watershed near Tampa Bay. The shape of the contour lines of equal UFAS water level elevations reflects a number of hydrogeologic factors, including, as mentioned above, the distribution of groundwater pumpage, the distribution of aquifer recharge, and the distribution of aquifer transmissivity.

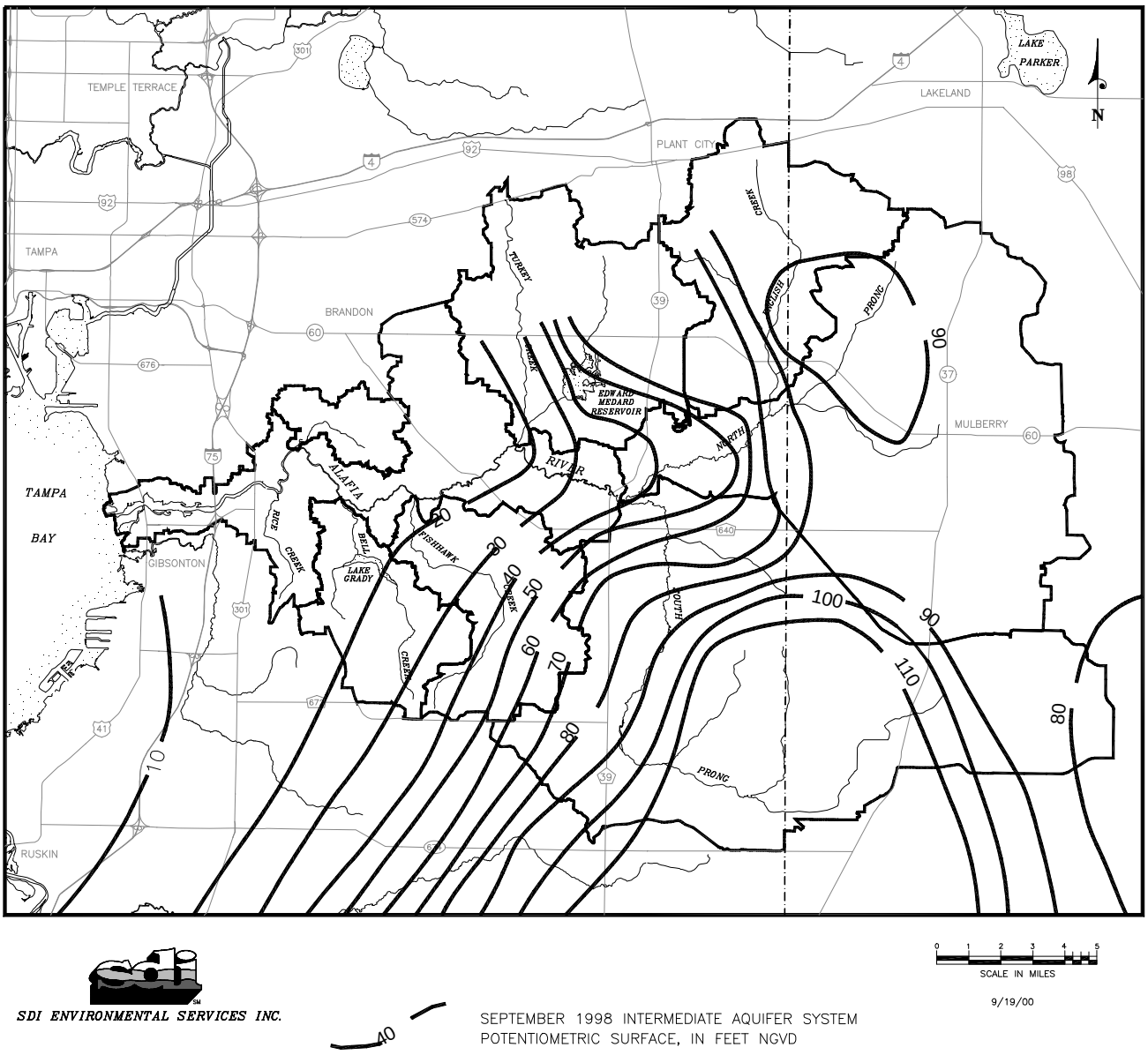


Figure 9-13. Potentiometric Surface of the Intermediate Aquifer System in the Alafia River Watershed September 1998 (modified from Torres, et al., 1999a).

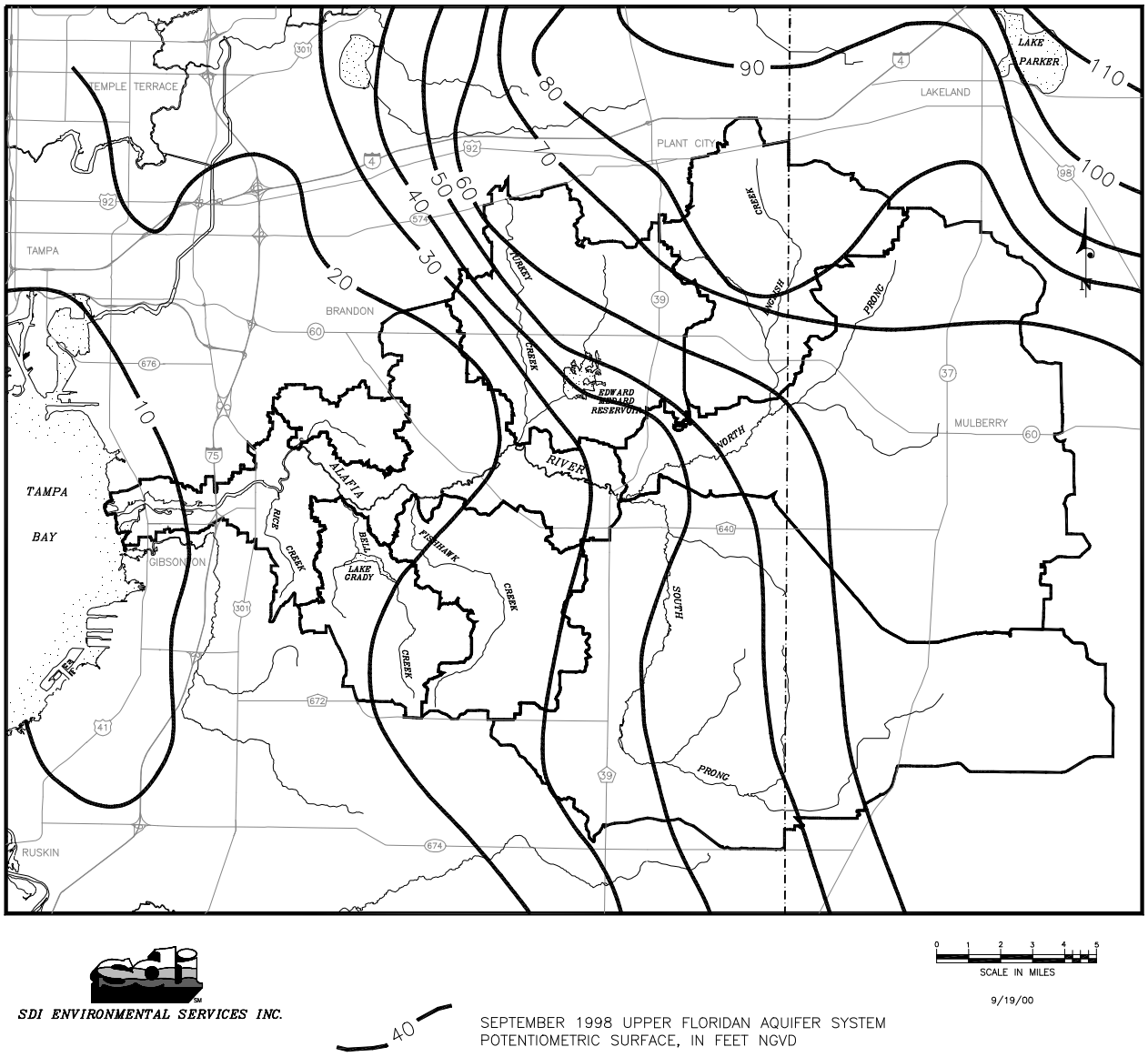


Figure 9-14. Potentiometric Surface of the Upper Floridan Aquifer System in the Alafia River Watershed September 1998 (from Torres, et al., 1999b).

Comparing Figures 9-13 and 9-14 in the Alafia River watershed shows that the location of the highest IAS water levels is south of the location of the highest UFAS water levels. This difference in location of high water levels probably reflects the thickening of IAS clays toward the south. The location of the lowest IAS water levels is similar to the location of the lowest UFAS water levels. The IAS and UFAS water levels appear to converge toward common values in the western part of the Alafia River watershed. This would be consistent with clayey limestones of the IAS transitioning into sandy limestones (without clay) of the UFAS in the western part of the watershed (Figure 9-5).

Minimum Seven-Day Average Discharge Per Year At The Alafia River At Lithia Gaging Station

The minimum seven-day average discharge for each year of the period-of-record discharge at the Alafia River at Lithia gaging station is shown in Figure 9-15. The location of the Alafia River at Lithia gaging station is shown in Figure 9-1. The minimum seven-day average discharge in each year was determined by calculating a seven-day running average of the daily discharge data. Then, the minimum or smallest seven-day running average value in the year was identified. The minimum seven-day average discharge is a measure of the lowest amount of stream flow that occurred each year. Low flow in the Alafia River may contain two flow components: 1) groundwater as baseflow; and 2) anthropogenic discharges (Zarbock, et al., 1995). During extended wet periods, surface water runoff and drainage from wetlands also could be part of the minimum seven-day average discharge in a year.

The minimum seven-day average discharges (Figure 9-15) show an abrupt and persistent increase in the middle 1950's and early 1960's. This increase may be due to anthropogenic discharges into the Alafia River. Mining and municipal wastewater discharges into the Alafia River were identified by Zarbock, et al. (1995). Complete records of anthropogenic discharges into the Alafia River, however, are not readily available (Hans Zarbock, CH2M-Hill, personal communication, 5/17/00).

A visual examination of Figure 9-15 and a Mann-Kendall trend analysis (Gilbert, 1987) indicate a trend of decreasing minimum seven-day average discharge in the period from 1954 through 1999 at the Alafia River at Lithia gaging station. This trend suggests that there is a long-term decline in anthropogenic discharge into the Alafia River. Stoker, et al. (1996) also identified the trend of decreasing minimum seven-day average discharges.

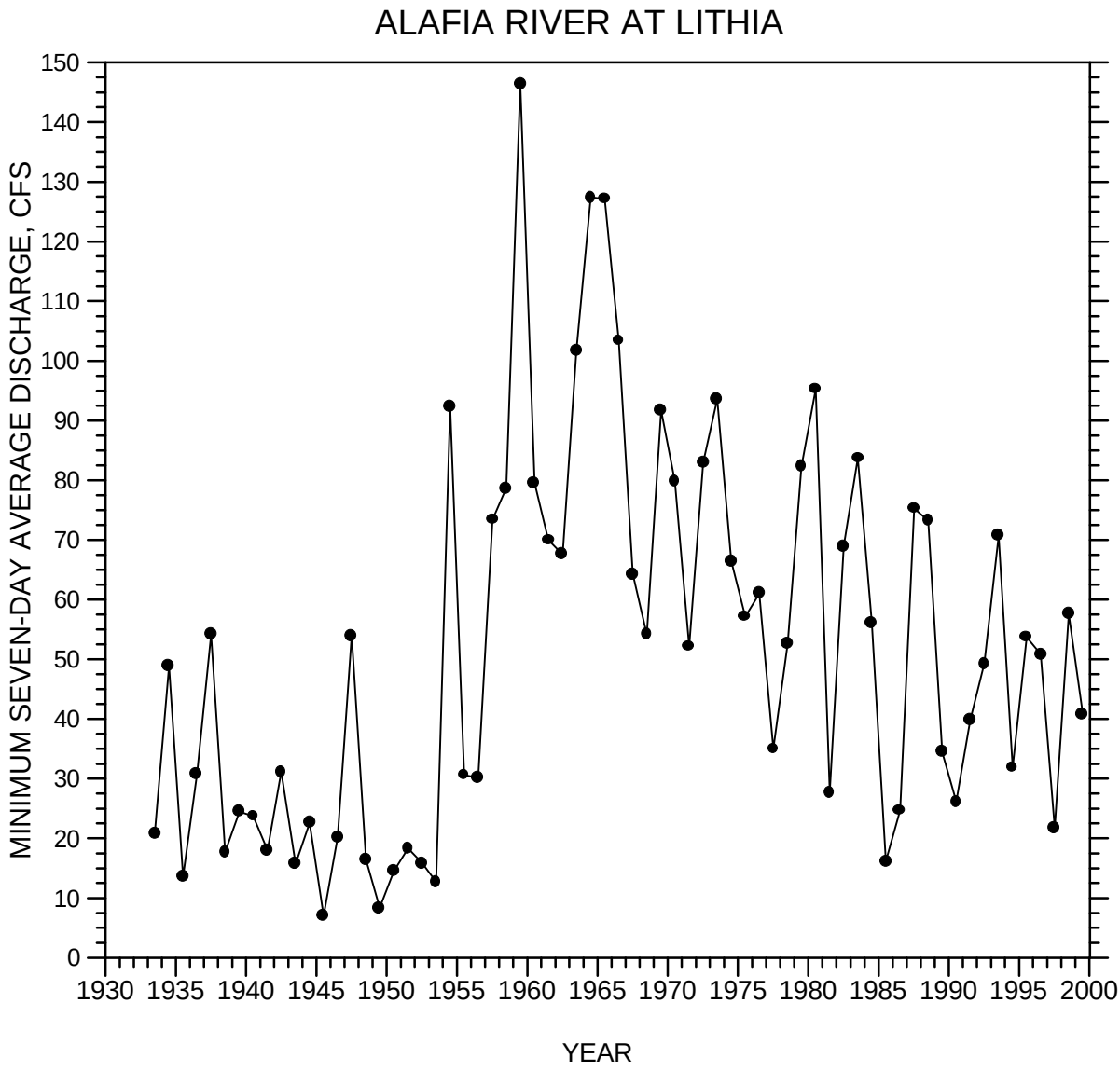


Figure 9-15. Minimum Seven-Day Average Low Discharge per Year at the Alafia River at Lithia Gaging Station.

A comparison between the minimum seven-day average discharges in the 1934-1953 period, which should contain little, if any, anthropogenic discharges, and in the 1980-1999 period suggests that at the present time anthropogenic discharges are probably the dominant component of low flow in the Alafia River. Baseflow, even though occurring, as mentioned above in Section 2.2, cannot be reliably determined from the observed stream discharge because records of anthropogenic discharge into the Alafia River are not readily available.

Springs

A spring is a place where water discharges from an aquifer through a natural rock opening and flows at land surface or into a body of water. Springs can be classified according to the type of aquifer - water table or artesian - from which they derive their water. In Florida, the discharges from water table springs are normally smaller than the discharges from artesian springs (Rosenau, et al., 1977). Because of this difference in discharge, artesian springs are more readily observed and identified within a landscape than are water table springs.

Two water table springs - Boyette Springs and Green Springs (Figure 9-1) - were identified by SWFWMD (1993) with estimated discharges, respectively, of 0.1 ft^3/sec and 0.5 ft^3/sec. Because surficial sands overly near surface clays over a large part of the Alafia River watershed (Figures 9-3, 9-4, and 9-5), other water table springs would be anticipated to occur within the watershed. While unimportant as sources of water supply, water table springs may have local ecological importance. Because of this, their presence should be determined prior to undertaking proposed stormwater management structural projects.

In the Alafia River watershed, there are two identified groups of artesian springs - Buckhorn Springs and Lithia Springs (Figure 9-1). SWFWMD (1993) mentions that *" . . . it is highly probable that subaqueous springs are located beneath the surface of the Alafia River. However, none were located during a reconnaissance of the river."* Rosenau, et al., 1977 and SWFWMD (1993) provide detailed descriptions of Buckhorn Springs and Lithia Springs. Buckhorn Springs is composed of four principal spring vents and many smaller vents near Buckhorn Creek (SWFWMD, 1993). The four principal vents are identified as Buckhorn Springs Main, Buckhorn Springs East, Buckhorn Springs West, and Buckhorn Springs South. Lithia Springs is composed of two spring vents - Lithia Major Spring and Lithia Minor Spring.

Cargill, Inc. is permitted by SWFWMD to divert water from both Buckhorn Springs and Lithia Springs for industrial use. SWFWMD (1993) reported that approximately 14 percent of the combined flow of both springs was diverted to the Cargill, Inc. chemical manufacturing complex at the mouth of the Alafia River.

Locations of the source areas for Buckhorn Springs and Lithia Springs discharge were identified by SWFWMD (1993) to likely be north of both springs in the Brandon area. Because of this, sites for proposed stormwater management projects north of

the springs should be studied in sufficient detail to assess the possibility of potential impact to spring flow.

Tampa Bay Water measured the discharge each week from Buckhorn Springs (Buckhorn Springs Main and Buckhorn Springs East) from about the middle of 1987 through the latter part of 1996. The average of these Buckhorn Springs discharge measurements was 12 ft^3/sec (CCI and SDI, 1997). The USGS has measured flow from Lithia Major Spring and Lithia Minor Spring several times each year since 1969 and has reported the flow of water withdrawn and measured by Cargill, Inc. for industrial use at the time of their measurements. Tampa Bay Water has measured the flow each week from the Lithia Major Spring from about the middle of 1984 to date. The total discharge from Lithia Springs near Lithia based upon USGS and Cargill measurements in the period from June, 1969 through August 1999 is shown in Figure 9-16. The average of these Lithia Springs discharge measurements is 46 cfs (29 mgd). As seen in Figure 9-16, there is a downward trend in total discharge from Lithia Springs from the beginning of the record to near the latter part of 1990. This is followed by a period with an upward trend in total Lithia Springs discharge from the latter part of 1990 through August 1999.

Double-mass curves are useful for qualitatively and quantitatively assessing the ratio of average discharge at two stations (Searcy and Hardison, 1960). The change in the ratio of average discharges for two stations is seen as a change in the slope of a double-mass curve between two sequential periods which can be used to estimate the change in average flow at one of the stations. VHB and SDI (2000) discuss a double-mass curve analysis of Lithia Springs discharge versus Silver Springs discharge located near Ocala, FL. Figure 9-17 shows this double-mass curve. As seen in Figure 9-17, the double-mass curve shows an increase in slope in 1990 indicating an increase in average Lithia Springs flow. The increase in slope in Figure 9-17 is consistent with the upward trend in Figure 9-16 and indicates that average Lithia Springs discharge increased by about 9 ft^3/sec (5.8 mgd) in the period from 1990 through 1999. This increase in average spring flow may be due in part to a regional decline in agricultural water use (VHB and SDI, 2000) and to the decline in the industrial or commercial water use within the Alafia River watershed discussed in the following section.

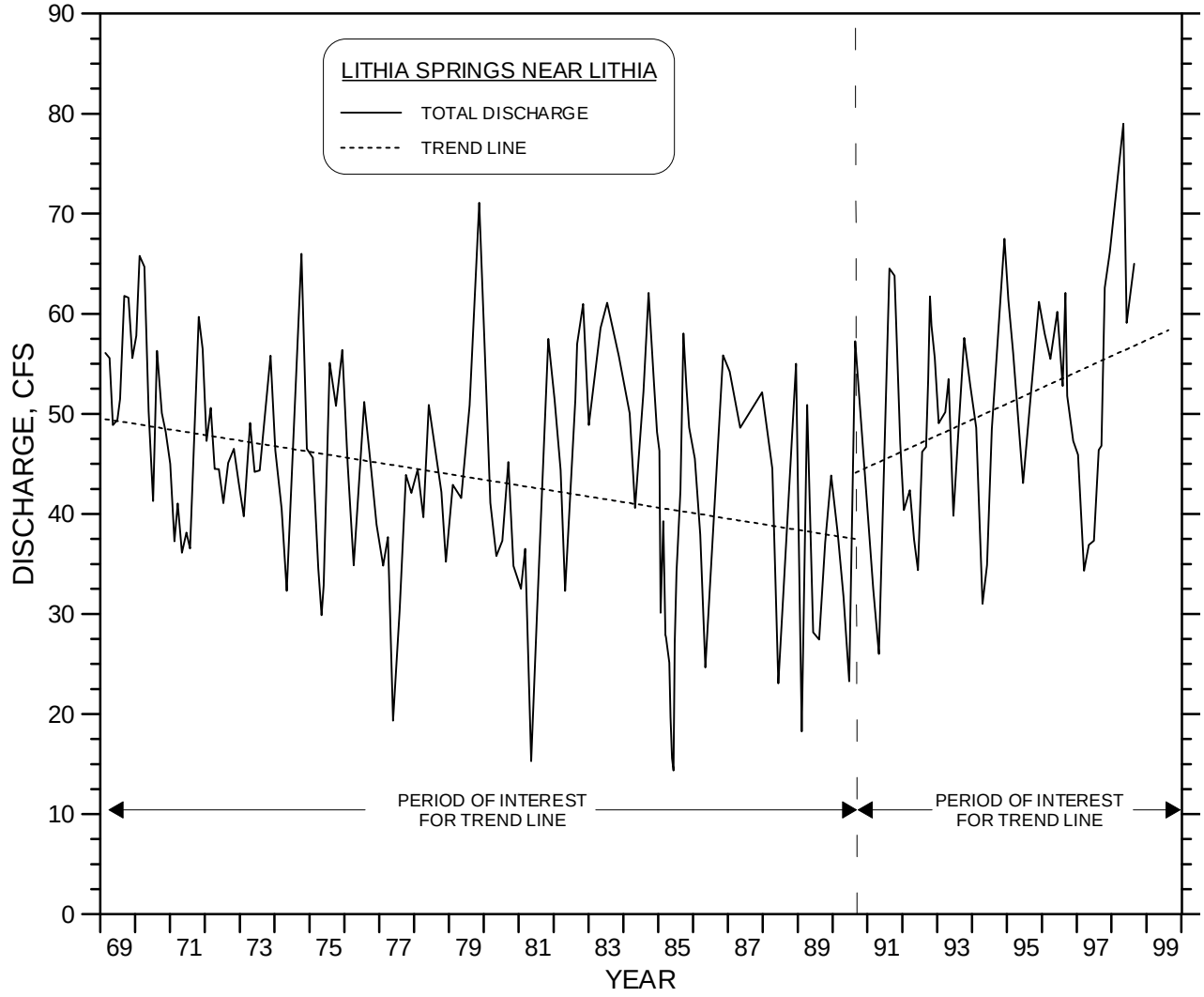


Figure 9-16. Lithia Springs Discharge (modified from VHB and SDI, 2000).

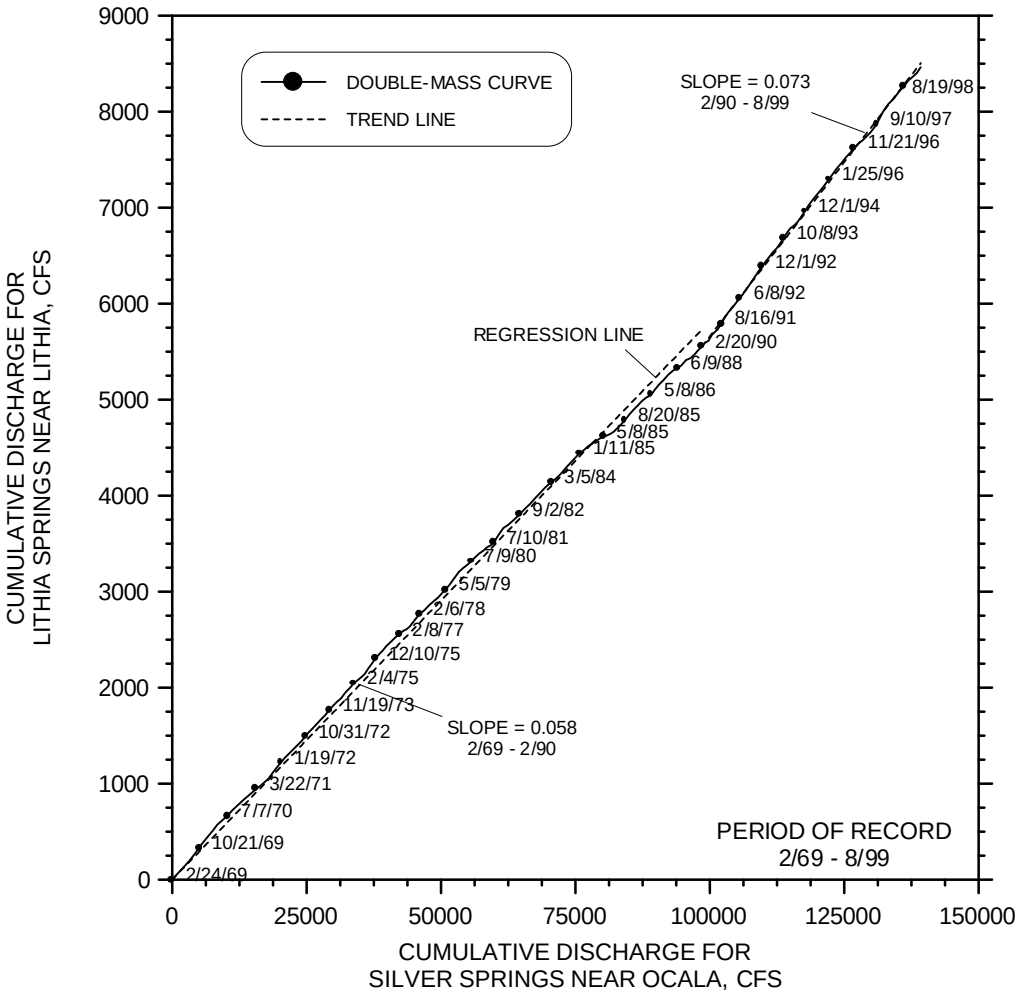


Figure 9-17. Double Mass Curve of Lithia Springs near Lithia Discharge Versus Silver Spring near Ocala Discharge (modified from VHB and SDI, 2000).

9.3.3 Groundwater Use In The Alafia River Watershed

SWFWMD (1993, Draft) estimated for 1989 that greater than 99 percent of groundwater use in Hillsborough County was supplied by the upper Floridan aquifer system (UFAS) and less than 1 percent was supplied by the intermediate aquifer system (IAS). Water use from the surficial aquifer is limited (Duer, et al., 1988). Based upon these observations, it would be reasonable to assume, except for mining or dewatering water use, that the UFAS supplies groundwater for most water uses in the Alafia River watershed. The mining or dewatering water use relies upon water from excavated mining pits whose source of water are surficial deposits.

The SWFWMD identifies five categories of water use for which permits are issued. They are: 1) public supply; 2) agricultural; 3) mining or dewatering; 4) industrial or commercial; and 5) recreation or aesthetic (see SWFWMD, 1997 for definitions of these terms). Since the 1991-1992 period, SWFWMD has started to do more detailed estimates of groundwater use (SWFWMD, 1997). A large portion of groundwater use throughout the Southwest Florida Water Management District is agricultural pumpage. Agricultural pumpage had historically not been reported for Water Use Permits (WUPs). But, beginning in the early 1990's, SWFWMD began a program of using metered pumpage from selected agricultural wells to guide the estimation of unmetered agricultural pumpage. As a result of the improved estimation procedures, water use estimates are more complete and reliable since 1992 than are estimates before that time. These improved estimates of agricultural pumpage reduced a major limitation identified by SWFWMD (1993, Draft) with regard to understanding the hydrogeological behavior of the UFAS in west-central Florida.

Figure 9-18 shows the location of groundwater sites with a WUP in 1998 within the Alafia River watershed. The source of this data was the SWFWMD regulatory database. The most up-to-date information in electronic format is for 1998. There are a total of 850 sites shown in Figure 9-18 with a WUP in 1998. Sites with a WUP are distributed throughout the watershed with the northern part containing the largest number. Table 9-2 lists the number and water use category of groundwater sites with a WUP in 1998 within each of the Alafia River Basins. The Turkey Creek Basin contained the largest number of sites with a WUP and Buckhorn Creek Basin contained the least number of sites with a WUP. The majority of the WUPs in the Turkey Creek Basin are agricultural.

Average daily water use estimates per month by permit category in the 1992-1998 period for the Alafia River watershed are shown in Figure 9-19. The decrease in industrial or commercial water use in 1996 (Figure 9-19) indicates a decline in the amount of water pumped from the UFAS. This, along with the increase in the mining or dewatering water use in 1996, reflects changes in water use practices by the mining industry. Average daily water use in the 1992-1998 period for the five water use categories in the Alafia River Basins is shown in Table 9-3. The average total water use in the Alafia River watershed for the 1992-1998 period was estimated to be 79.25 mgd. The North Prong Basin had the largest amount of average water use (37.27 mgd) in the 1992-1998 period and the Buckhorn Creek Basin had the least amount of average water use (0.16 mgd). The industrial or commercial category had the largest average water use in the 1992-1998 period (24.53 mgd) and was closely followed by the public supply category (22.27 mgd) and the agricultural category (18.19 mgd).

9.3.4 Conclusions

The data available for describing the hydrogeology of the Alafia River watershed are sparse, as a result, the hydrogeologic interpretations in this report are approximate. But there were enough available and interpretable data to provide reasonable hydrological assurance that the hydrogeologic framework presented in this report can be used to provide the basis for qualitative assessments of the potential influence upon the groundwater resource of proposed stormwater management structural projects. Also, the available water use data, particularly the locations of sites with WUPs, can be used for qualitative assessments of the potential effects at sites with valid water use permits.

Prior to construction of stormwater management structures, the results of qualitative assessments should be confirmed. Site specific hydrogeologic data, including continuous standard penetration tests and laboratory permeability analysis of clay cores, should be collected and analyzed for a quantitative assessment of the potential effects upon the groundwater resource.

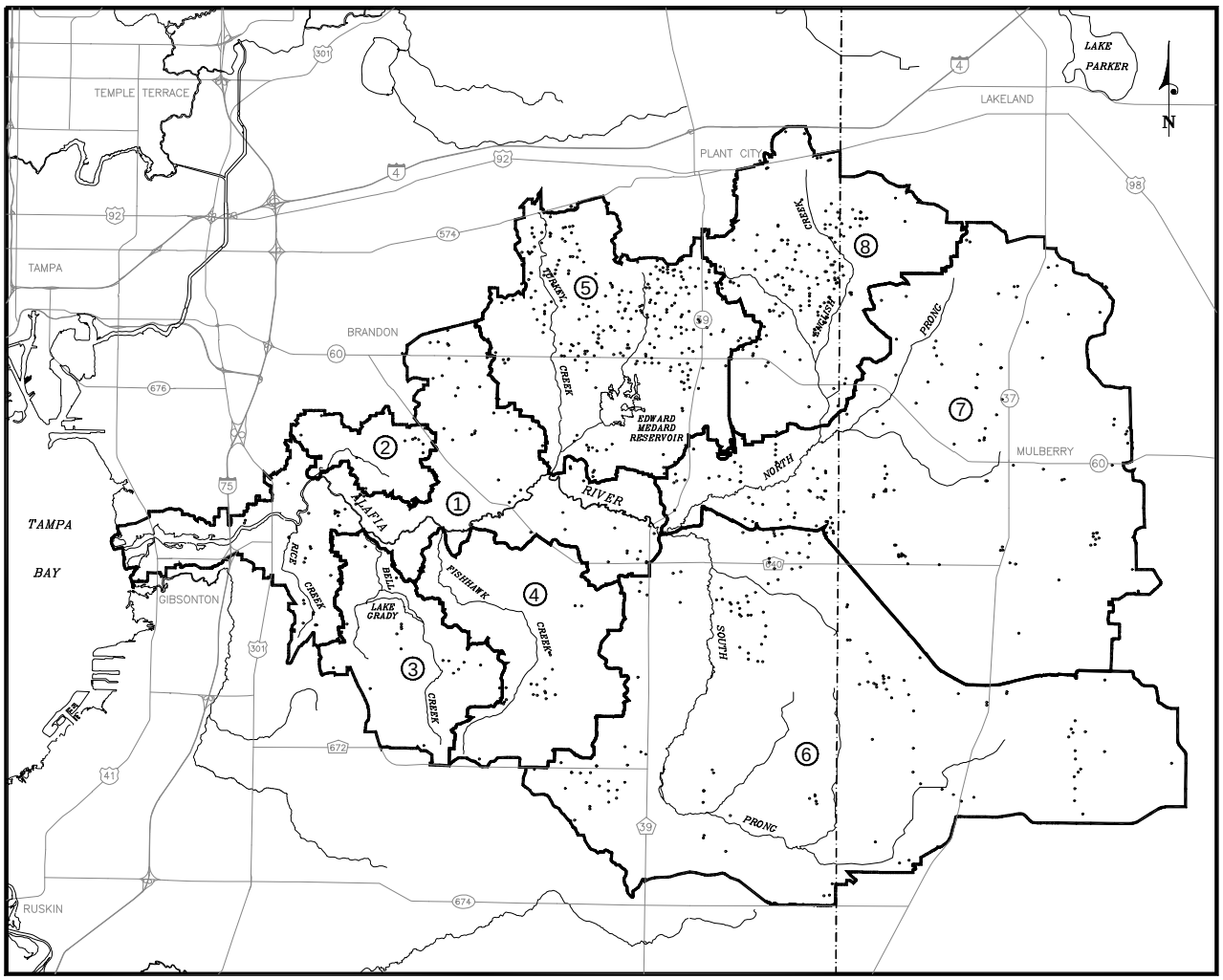


Figure 9-18. Location of Groundwater Sites with a WUP in 1998 Within the Alafia River Watershed.

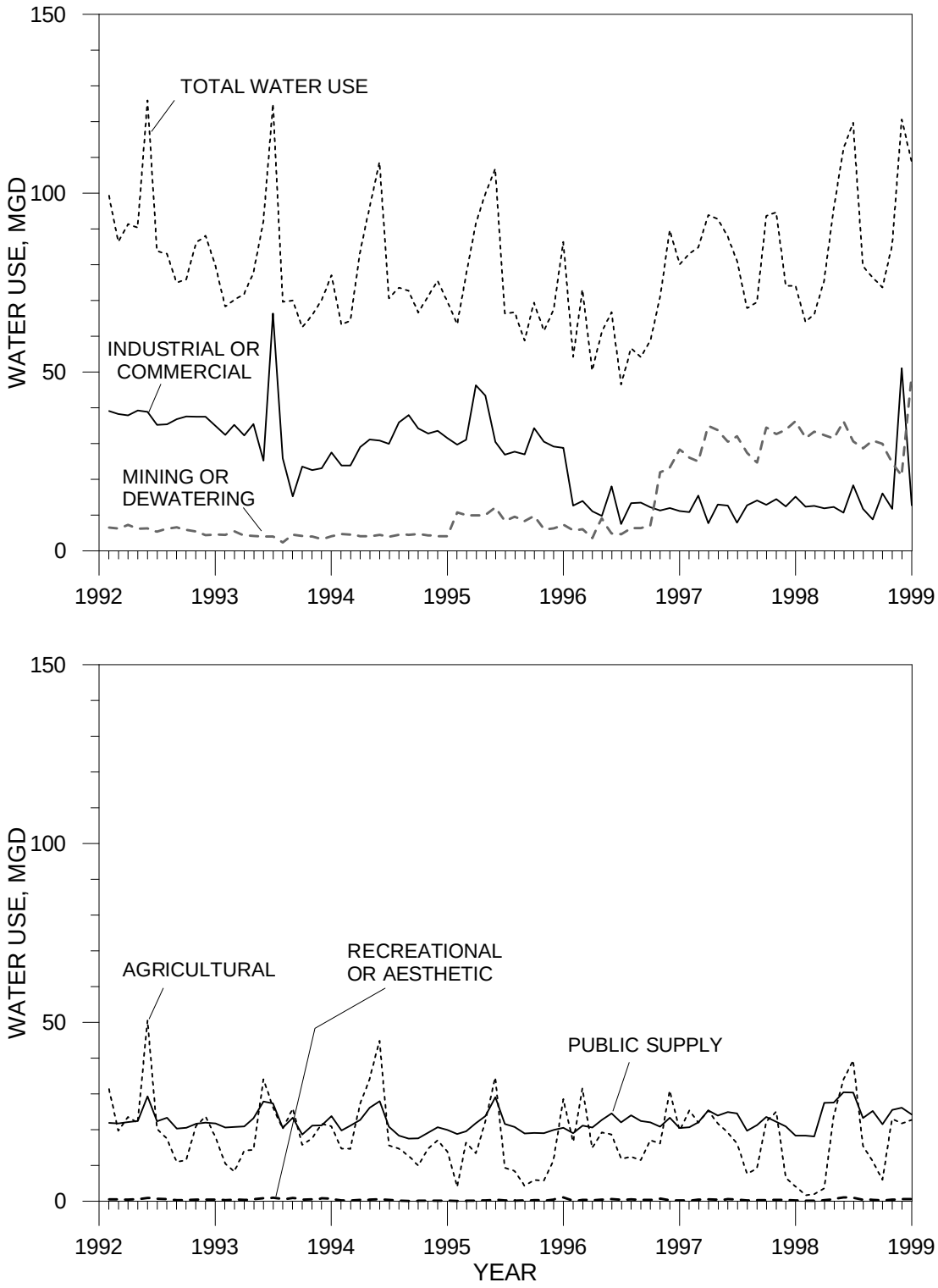


Figure 9-19. Monthly Water Use Estimates by Permit Category in the 1992-1998 Period for the Alafia River Watershed.

Table 9-2. Water Use Category and Number of Groundwater Sites with a WUP Within Alafia River Basins in 1998.

Alafia River Basin	Basin Number in Figure 9-18	Water Use Category					Basin Total
		Public Supply	Agricul-tural	Mining or De-watering	Industrial or Com-mercial	Recrea-tion or Aesthetic	
Lower Alafia River	1	11	60	0	0	13	84
Buckhorn Creek	2	1	5	0	0	6	12
Bell Creek	3	1	16	1	0	3	21
Fishhawk Creek	4	0	23	0	0	0	23
Turkey Creek	5	10	243	2	0	2	257
South Prong Alafia River	6	4	86	58	0	0	148
North Prong Alafia River	7	22	67	21	31	10	151
English Creek	8	6	137	0	9	2	154
Water Use Category Total		55	637	82	40	36	850

Table 9-3. Average Daily Groundwater Use Within Alafia River Basins for the Period 1992-1998.

Alafia River Basin	Basin Number in Figure 9-18	Water Use Category					Basin Average (mgd)
		Public Supply (mgd)	Agricul-tural (mgd)	Mining or De-watering (mgd)	Industrial or Com-mercial (mgd)	Recrea-tion or Aesthetic (mgd)	
Lower Alafia River	1	2.67	1.28	0.01	0.00	0.11	4.07
Buckhorn Creek	2	0.00	0.09	0.00	0.00	0.07	0.16
Bell Creek	3	0.00	0.65	0.00	0.00	0.03	0.68
Fishhawk Creek	4	0.00	0.78	0.00	0.00	0.00	0.78
Turkey Creek	5	2.35	5.58	0.78	0.00	0.02	8.73
South Prong Alafia River	6	0.07	4.92	9.95	8.52	0.00	23.46
North Prong Alafia River	7	17.08	1.56	3.09	15.51	0.03	37.27
English Creek	8	0.12	3.33	0.00	0.50	0.15	4.10
1992-1998 Average Water Use		22.29	18.19	13.83	24.53	0.41	79.25

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CHAPTER 10

PUBLIC MEETING NUMBER 1

Public input is a critical component in the development of the Alafia River Watershed Management Plan. The residents within the watershed are often the best source of information regarding the area. In order to prepare a plan that addresses the needs of these residents, the County has solicited comments via an internet web site, and in public meetings. This chapter describes the format of the first meeting and addresses the comments collected at that meeting.

Public Meeting Format

The first public meeting was held on October 19, 2000 at the Riverview Civic Center. The format of the meeting was to provide a brief introduction to the project and some basic background information on stormwater runoff and the problems that can be incurred if stormwater runoff is not managed properly. Mr. Duncan Rose of Parsons presented a slide show that introduced the project, showed the type of flooding and water quality problems that the area has been experiencing, and provided graphics that explained why these problems are occurring.

After the introductory slide show, the attendees were requested to meet with the Parsons and County staff members present at the meeting, review the exhibits provided and submit questions or comments to the staff. The staff members present represented the three main elements of the Alafia River Watershed Management Plan; Flood Control, Water Quality, and Natural Systems. Stations were set up with exhibits specific to each of these three elements and personnel from the county and their contractors were present to answer questions. In addition, a Geographic Information System (GIS) station was set up so that the attendees could locate their property and easily identify problems areas. Forms were prepared to facilitate the preparation of comments, with example comments provided to indicate the type of problems that would be within the scope of the project. Each comment was numbered and the general location of the problem was mapped. Abbreviated forms of the comments submitted from the public during this first phase of the project are summarized in Table 10.1, with a response from the County.

TABLE 10-1
ALAFIA RIVER WATERSHED PUBLIC MEETING NUMBER 1 COMMENTS

NUMBER	PROBLEM TYPE	COMMENTOR	COMMENT	RESPONSE
39	Flood Hazard	Sheryl Bowman 10940 McMullen Road Riverview FL 33569	During El Niño (1998) the County staff flooded the Bell Creek Nature Preserve making areas of the site impassible. Flooding was caused by activities conducted by the County in the Creek.	Better coordination between the County engineers and biologists in different departments is needed.
24	Flood Hazard	Catherine Hussey 10918 Park Dr. Riverview, FL	Canal floods houses and yards when waters rise in Alafia. Flooding has occurred five times in last 20 years. Thinks connecting to canal across the street would alleviate problem by equalization.	Will evaluate during second phase of the project.
	Flood Hazard	Jim Martinez 4505 Squirrel Run Way Valrico FL	Frequent flooding in road and in yard – to four feet and lasting about one or two weeks.	Will evaluate during second phase of the project.
5	Flood Hazard	Bob Minthorn 8613 Magnolia St. Gibsonton, FL 33534	Magnolia St. floods during storm events	Will evaluate during second phase of the project.
7	Natural Systems	Bob Minthorn 8613 Magnolia St. Gibsonton, FL 33534	Vacant lots on Magnolia Street are overrun with Australian pine and Brazilian pepper.	Unfortunately the County cannot be responsible for the maintenance of private property
9	Flood Hazard	Betty & Cliff Waters 4506 Squirrel Run Way Valrico, FL 33594	Flooding in the vicinity of Squirrel Run Way and River Drive. In 1988 with 8 feet of water in the house. Flooding occurred in the house 5 times in 1997, and in September 1998. Four feet of standing water in yard during almost every summer.	Will evaluate and plan corrections during second phase of the project.
10	Flood Hazard	Karen & Darryl Wagner 4510 Squirrel Run Way Valrico, FL 33594	Flooding in the vicinity of Squirrel Run Way and River Drive. Floodwaters remained through December 1998. Flooding to 4 feet in the road, 3-4 feet in the yard, occurring year-round.	Will evaluate and plan corrections during second phase of the project.

TABLE 10-1 (Cont.)
ALAFIA RIVER WATERSHED PUBLIC MEETING NUMBER 1 COMMENTS

NUMBER	PROBLEM TYPE	COMMENTOR	COMMENT	RESPONSE
11	Natural Systems	Bill Prudente 4701 John Moore Road Brandon FL 33511	River West Vicinity Erosion. Heavy rain and high water elevations cause massive erosion on banks. Proposes planting on banks or installation of fabric mats to prevent erosion.	Will evaluate problem during next phase of project.
17	Flood Hazard	Janet D. Kovach 8214 Revels Rd. Riverview, FL 33569	Drainage ditches are not being maintained on a regular basis, causing roadway flooding. Alafia Ridge and parts of Revels Rd. turn into lakes during heavy rainfall events. Water is 8 to 12 inches deep, 6 to 8 times annually.	Will evaluate problem during next phase of project.
18	Flood Hazard	Mary Eisenmenger 10442 Nightingale Dr. Riverview FL 33569	Flooding at Boyette Springs Park in playing fields and lower Sedgebrook Road. Stormwater not draining into Bell Creek. Asphalt eroding from flooding	Will evaluate problem during next phase of project.
21	Water Quality	Carole Dann 8312 Bevels Road Riverview FL 33569	Ms. Dann is a participant in the Streamwater Watch program and has noted that water samples taken 0.25 miles upstream from her dock are significantly clearer, and wonders if the two small tributaries downstream from the sampling location may be responsible for the difference in water clarity.	Will evaluate the problem during the next phase of the project.
22	Flood Hazard	Robert Arrington, Jr. 8219 Valrie Lane Riverview, FL 33569	Valerie Lane between McMullen to Cummins becomes a river during heavy storm events. The standing water can be 6” to 1’ deep, and is thought to be runoff from the River Glen Subdivision.	Will evaluate the problem during the next phase of the project.
23	Flood Hazard	Tony Russo 4540 Oak River Circle Valrico, Fl	The property floods during heavy rain events, and has for the last four years. Mr. Russo thinks that it is caused by County’s lack of maintenance of drainage easements.	Will evaluate the problem during the next phase of the project.
31		Bill Prudente 4701 John Moore Road Brandon FL 33511	Mr. Prudente is concerned about salt-water intrusion in the river due to proposed Tampa Bay Water pumping of 52 mgd.	Not related to this project. Please contact Gary Kuhl at 301-7206.

TABLE 10-1 (Cont.)
ALAFIA RIVER WATERSHED PUBLIC MEETING NUMBER 1 COMMENTS

NUMBER	PROBLEM TYPE	COMMENTOR	COMMENT	RESPONSE
201	Flood Hazard	Mel Pace 2405 E Bloomingdale Valrico, FL 33594	Flooding of Stearns Creek in the vicinity of Hillgrove and Stearns Rd., south of Bloomingdale and Lithia-Pinecrest. Inadequate drainage causes roads and yards to flood after significant rainfall events, 2 to 4 inches on roads and yards, occasionally into garages.	Will evaluate the problem during the next phase of the project.
217	Natural Systems	Robert Arrington, Jr. 8219 Valrie Lane Riverview, FL 33569	River Glen Subdivision has destroyed a cypress head on McMullen Road. The retention ponds on each side of the wetland remain full but are not draining into the wetland and have intercepted drainage into the wetland. Discharge ditch from wetland is not flowing, and other local flooding may be due to this problem area.	Will evaluate the problem during the next phase of the project.
213	Natural Systems	Merrick Endres 8609 Stoner Rd. Riverview FL 33569	Resident has a complaint about Brazilian pepper and air potato in neighborhood along the river.	Will evaluate the problem during the next phase of the project.
213	Flood Hazard	Merrick Endres 8609 Stoner Rd. Riverview FL 33569	River overtops banks and floods banks, once in 1993, during no-name storm and once in the hurricane of September 2000, and floods yard.	Will evaluate the problem during the next phase of the project.
202	Flood Hazard	Darryl Wagner 4510 Squirrel Run Way Valrico, FL 33594	Chronic flooding problems in the vicinity of River Drive and Squirrel Run Way. The water stands approximately 6 feet deep on the roads, 3 feet of water under their stilt home and 4 feet of water in the yard. Five or more floods occurred during the El Niño year.	Will evaluate the problem during the next phase of the project.
204	Flood Hazard	Robert Arrington, Jr. 8219 Valrie Lane Riverview, FL 33569	Cummins Road vicinity flooding due to inadequate culvert size and clogged streambed. Water stands about 6” deep in Cummins Road and 3’ deep in the pasture south of the road. Flooding occurs about once a month.	Will evaluate the problem during the next phase of the project.
212	Flood Hazard	Bill Prudente 4701 John Moore Rd. Brandon FL 33511	Flooding during heavy rainfall events in street, 2 to 3 feet deep in the yard, and 6 to 12 inches in the home. Caused by runoff from adjacent built up subdivisions.	Will evaluate the problem during the next phase of the project.

CHAPTER 11

POLLUTANT LOADING MODEL

A nonpoint source loading model was prepared to estimate stormwater runoff quality from the Alafia River Watershed. This model uses the EPA Simple Method, which is an event mean concentration (EMC) approach. In this approach, mass loads are calculated as the product of the EMC and the stormwater runoff volume. The stormwater runoff volume is estimated as the fraction of rainfall appearing as runoff multiplied by the rainfall depth and basin area. The EMC is constant; thus, this method is also referred to as the "constant concentration" method.

The results of this loading model are intended to serve as an estimate. The water quality estimating procedures used for this project are very simple and approximate, yet water quality estimations by any means are not precise. Dr. Wayne Huber in the EPA SWMM User's Manual expressed this fact very well in the following.

> *Simulation of urban runoff quality is a very inexact science if it can even be called such. Very large uncertainties arise both in the representation of the physical, chemical and biological processes and in the acquisition of data and parameters for model algorithms.*

Nevertheless, the loading estimates for the Alafia River Watershed presented herein represent a reasonable estimate that can be used to guide management actions.

The basin delineations developed for the flood control model (Chapter 3) were used along with soils and land use information to develop basin properties that were applied to the runoff coefficients and EMCs to estimate loads. Additional details concerning the individual elements of the analysis are contained in the following subsections.

11.1 Overall Methodology

Pollutant loads were calculated using the EPA Simple Method (USEPA 1992). Runoff estimates were used with EMC values for particular land uses to calculate gross pollutant loads; subsequently, this information was used in combination with the results of an existing stormwater treatment evaluation to determine net loads and loading rates.

According to the Simple Method, non-point source pollutant loads are calculated using the following formula:

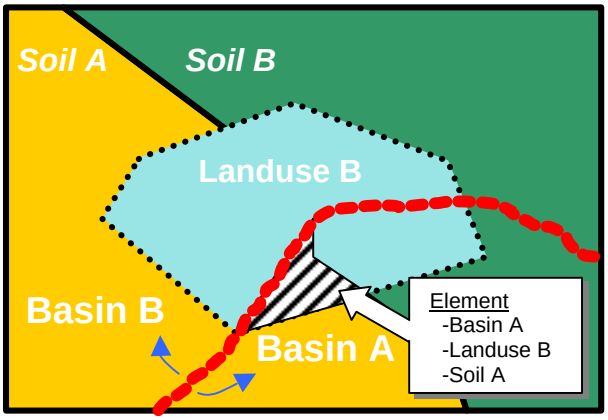
$L_N = (0.227)(P)(CF)(RC_N)(C_N)(A_N)$

Where:

L_N	=	Pollutant load (lb/period)
P	=	Precipitation (in/ period)
RC_N	=	Weighted average runoff coefficient based on impervious area and hydrologic soil classification
C_N	=	Event mean concentration of pollutant (mg/L)
A_N	=	Catchment area contributing to outfall (acres)
CF	=	Correction factor for storms that do not produce runoff

The Hillsborough County Nonpoint Source (NPS) ArcView© Avenue™ extension (Parsons, 1999) was used to perform pollutant loading and removal calculations. Within the extension, GIS themes of soils and land use are used together with drainage basin delineations to produce a new theme that is the intersection of the soils, land use, and basins. Each unique combination of basin, soils, and land use, hereafter referred to as an element (refer to Figure 11.1-1), has the following minimum attributes:

Figure 11.1-1
Calculation Element



Parsons, 2001

- Hydrologic Soil Group
- Land use – land uses aggregated according to groupings provided by Hillsborough County.
- Element Shape – used to calculate area
- Basin Identification – Multiple fields, as needed, to fully characterize the shape from the smallest delineated basin division (i. e. subbasin 780101) to the largest division for which loads are to be summarized (i. e. , Hillsborough County).

In the model, the average annual runoff expected from each specific basin/land use/soils polygon is calculated as the product of the rainfall amount times the corresponding runoff coefficient. Correction factors (CF), to account for the numerous small rainfall events that do not result in any runoff, are “built-in” to the

runoff coefficients (refer to Section 11.3.2); therefore, the CF is equal to one (1). The total volume of runoff for a sub-basin is then determined by summing the calculated runoff for each element within that basin. Pollutant loads are calculated in much the same way- that is, each element is assigned an EMC based on land use which is used in combination with the polygon element's runoff volume to produce mass loads. The mass loads for each element contained within a feature of interest (i. e., basin) are summed to produce mass loads for that particular feature.

The Hillsborough County Nonpoint Source (NPS) ArcView© Avenue™ extension divides mass loads into three parts: gross load, removed load, and net load. These three types of loads are described as follows:

- Gross Load - - The mass washed off, or mass generated.
- Removed Load - The mass removed by BMPs.
- Net Load - Gross load minus removed load.

The loads are further divided into annual average dry season loads, annual average wet season loads, and total annual average loads. The average annual rainfall in the Tampa Bay area, which amounts to 51. 4 inches, was split 58-42 as requested by Hillsborough County staff - 58% (30.39 inches) of the annual rainfall was used for the wet season calculations and 42% (22.01 inches) was used for the dry season calculations.

11.2 Watershed Characteristics

Basin delineations, land use themes, and soils themes were used to develop subbasin properties that were used along with EMCs to calculate pollutant loads. The following subsections describe the basin delineations and the land use and soil characteristics of the watershed.

11.2.1 Basin Delineations

Stormwater runoff quality calculations were performed for each subbasin. A summary of subwatershed areas and number of subbasins is provided in Table 11-2.1. These subbasins, developed for the flood control model (Chapter 3), range in size from less than one acre to more than 15,000 acres, depending on basin characteristics and configuration of the stormwater system network. The average basin size is 128 acres, and

Table 11-2.1
Summary of Watershed Areas and Number of Subbasins

Subwatershed	Area (acres)	Count
Bell Creek	12,631	140
Buckhorn Creek	4,776	213
English Creek	24,571	217
Fishhawk Creek	17,447	191
North Prong Alafia River	65,660	215
Alafia River - Main Stem	31,922	511
South Prong Alafia River	79,199	203
Turkey Creek	31,719	399

Parsons, 2001

the median is around 60 acres. Subbasins may be aggregated to an intermediate, or subwatershed, level to evaluate particular areas or reaches of interest within the watershed.

11.2.2 Land Use

The land use composition determines the extent of impervious areas and the expected runoff pollutant concentrations (EMCs), which in turn influence the volume and quality of runoff. In general, developed areas are associated with larger pollution loads than undeveloped land uses. The 1995 land use themes prepared by the SWFWMD were used herein to evaluate land use in each watershed. SWFWMD land use coverages are based on the Florida Land Use and Cover Classification System (FLUCCS). For pollutant loading estimates, land use categories were aggregated to correspond with the Hillsborough County NPDES permit. Major non-natural land use categories evaluated for pollutant loading include:

- Low/Medium Density Residential
- High Density Residential
- Light Industrial
- Agricultural
- Commercial
- Institutional
- Highway/Utility
- Recreational
- Open Land
- Extractive (Mining)/Disturbed

For purposes of this analysis, natural areas are assumed to contribute no load. A listing of land use categories from the source data verses the reclassified land uses is provided on Table 11.2-2 and the extent of each land uses' occurrence in each of each of the major subwatersheds is provided on Table 11.2-3.

Overall watershed land use is split relatively evenly between agricultural (28%), mining (27%), and natural areas (24%). Agriculture is most prevalent in the Fishhawk (49%), English (43%), Bell (39%), and Turkey (36%) Creek subwatershed with the majority of mining concentrated in the North (49%) and South (46%) Prong Alafia subwatersheds. Buckhorn Creek is, by far, the most urban of the watersheds (65%). The aggregated land use distribution is shown on Figures 11.2-1 and 11.2-2.

Table 11.2-2
Land Use Aggregation

FLUCCS	LAND USE	Aggregate LAND USE
1100	Residential low density < 2 dwelling units	Low/Medium Density
1200	Residential med density 2->5 dwelling unit	Low/Medium Density
1300	Residential high density	High Density Residential
1400	Commercial and services	Commercial
1480	Cemeteries	Commercial
1500	Industrial	Light Industrial
1600	Extractive	Extractive
1700	Institutional	Institutional
1800	Recreational	Recreational
1900	Open land	Open Land
2100	Cropland and pastureland	Agricultural
2140	Row crops	Agricultural
2200	Tree crops	Agricultural
2300	Feeding operations	Agricultural
2400	Nurseries and vineyards	Agricultural
2420	Sod farms	Agricultural
2500	Specialty farms	Agricultural
2540	Aquaculture	Agricultural
2550	Tropical fish farms	Agricultural
2600	Other open lands <rural>	Agricultural
3100	Herbaceous	Open Land
3200	Shrub and brushland	Open Land
3300	Mixed rangeland	Open Land
4100	Upland coniferous forest	Upland Forest
4110	Pine flatwoods	Upland Forest
4120	Longleaf pine - xeric oak	Upland Forest
4200	Upland hardwood forests - part 1	Upland Forest
4340	Hardwood conifer mixed	Upland Forest
5100	Streams and waterways	Water
5230	Lakes > 10 acres (4 hectares) < 100 acres	Water
5240	Lakes < 10 acres (4 hectares) dominant features	Water
5310	Reservoirs > 500 acres (202 hectares)	Water
5320	Reservoirs > 100 acres (40 hectares) & < 500 acres	Water
5330	Reservoirs > 10 acres(4 hectares) & < 100 acres	Water
5340	Reservoirs < 10 acres(4 hectares) w/dominant featu	Water
5400	Bays and estuaries	Water
6110	Bay swamps	Wetland Forest
6120	Mangrove swamps	Wetland Forest
6150	Stream and lake swamps (bottomland)	Wetland Forest
6200	Wetland coniferous forests	Wetland Forest
6210	Cypress	Wetland Forest
6300	Wetland forested mixed	Wetland Forest
6410	Freshwater marshes	Wetland Non-Forested
6420	Saltwater marshes	Wetland Non-Forested
6430	Wet prairies	Wetland Non-Forested
6440	Emergent aquatic vegetation	Wetland Non-Forested
6450	Submergent aquatic vegetation	Wetland Non-Forested
6510	Tidal flats/submerged shallow platform	Wetland Non-Forested
6530	Intermittent ponds	Wetland Non-Forested
7400	Disturbed land	Extractive
8100	Transportation	Highway/Utility
8200	Communications	Highway/Utility
8300	Utilities	Highway/Utility

Table 11.2-3
Watershed Land Use

Landuse	Bell Creek	Buckhorn Creek	English Creek	Fishhawk Creek	North Prong Alafia River	Alafia River - Main Stem	South Prong Alafia River	Turkey Creek
Agricultural	39%	9%	43%	49%	11%	24%	30%	36%
Commercial	0%	3%	2%	0%	1%	2%	0%	1%
Extractive (Mining)/Disturbed	0%	0%	3%	1%	49%	3%	46%	4%
High Density Residential	0%	15%	0%	0%	1%	4%	0%	2%
Highway/Utility	1%	0%	5%	4%	1%	1%	0%	1%
Institutional	0%	3%	0%	0%	0%	0%	0%	0%
Light Industrial	0%	0%	1%	0%	1%	0%	0%	1%
Low/Medium Density Residential	17%	45%	14%	3%	15%	27%	2%	16%
Open Land	3%	3%	6%	4%	3%	2%	2%	12%
Recreational	0%	4%	1%	0%	0%	1%	0%	0%
Upland Forest	25%	5%	12%	27%	6%	16%	7%	14%
Water	1%	4%	2%	0%	2%	4%	0%	3%
Wetland Forest	10%	6%	8%	8%	8%	14%	11%	5%
Wetland Non-Forested	4%	3%	3%	2%	2%	2%	3%	2%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Figure 11.2-1
Overall and Subwatershed Land Use

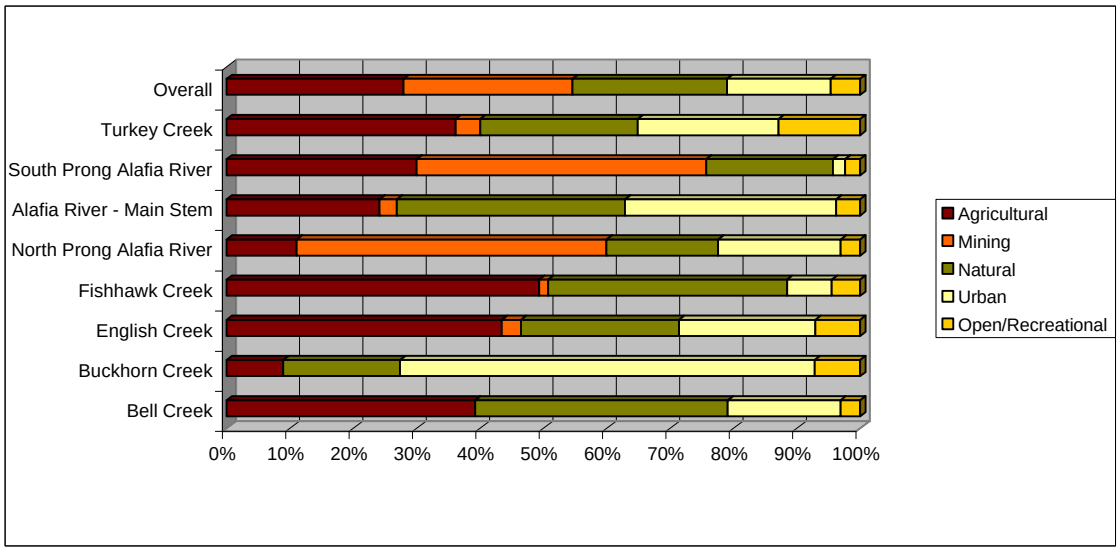
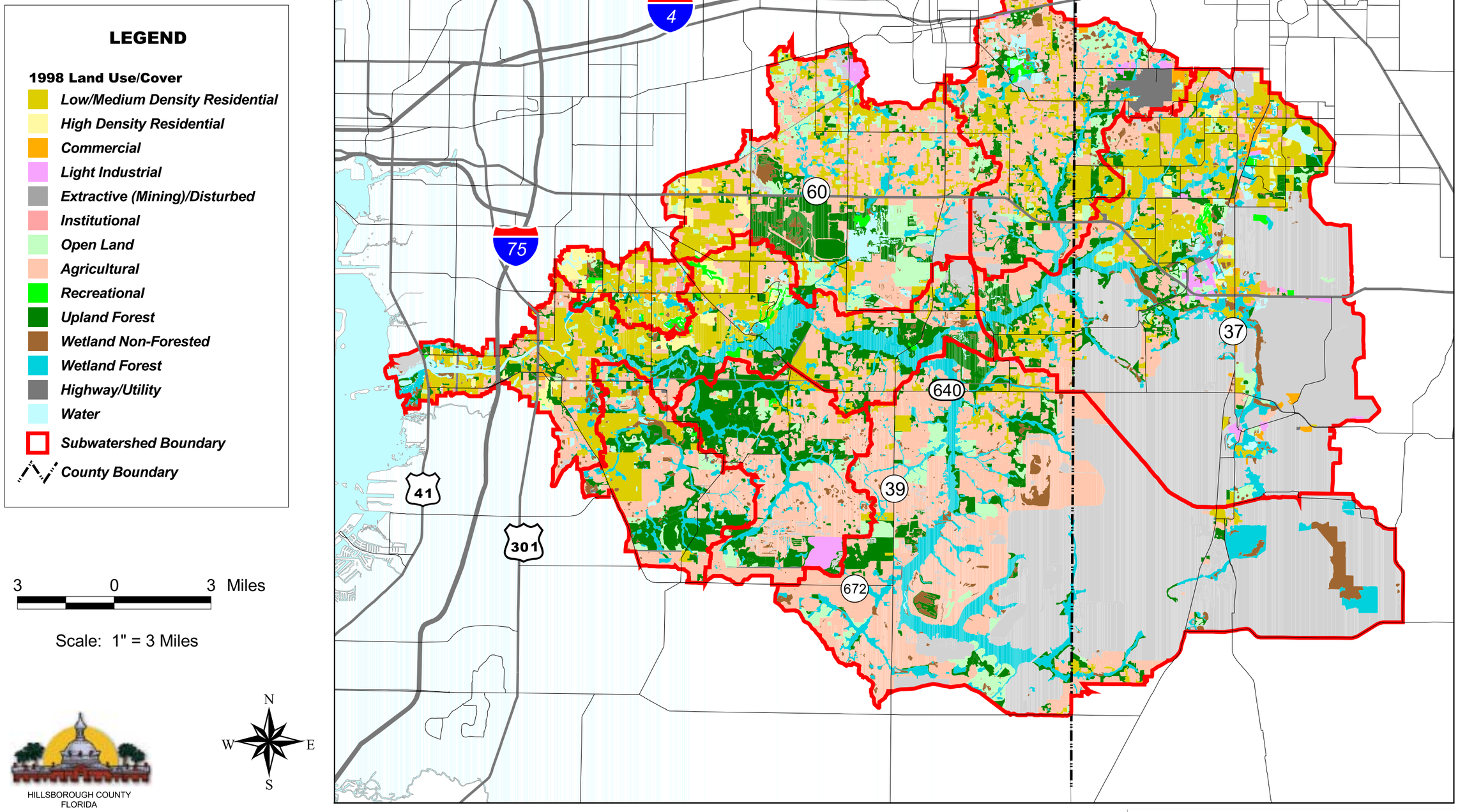


FIGURE 11.2-2
ALAFIA RIVER WATERSHED
LOADING MODEL LAND USE



LEGEND

1998 Land Use/Cover

- *Low/Medium Density Residential*
- *High Density Residential*
- *Commercial*
- *Light Industrial*
- *Extractive (Mining)/Disturbed*
- *Institutional*
- *Open Land*
- *Agricultural*
- *Recreational*
- *Upland Forest*
- *Wetland Non-Forested*
- *Wetland Forest*
- *Highway/Utility*
- *Water*
- *Subwatershed Boundary*
- *County Boundary*

3 0 3 Miles

Scale: 1" = 3 Miles

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Figure 11.2-2 Loading Model Land Use 11x17 – back

11.2.3 Soil Hydrologic Characteristics

For hydrologic analyses, a standard method of soils classification is the hydrologic soils group. Soils are grouped into four hydrologic soil groups A through D, which are commonly used to estimate infiltration rates and soil moisture capacities. Descriptions of these soil groups are:

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

In many cases in Florida, dual hydrologic soil group classifications (A/D or B/D) are assigned to soils that, during the wet season, are saturated throughout much of the soil column due to a high surficial water table. Thus, during this time of year, infiltration is impeded and soils type A or B act as a D soil. However, during the rest of the year, when the water table is lower, the soil acts as an A or B soil. Due to the prevalence of B/D soils in the area, soil types that were not classified were considered to be B/D for runoff volume estimates.

11.3 Runoff Coefficients

Runoff coefficients are based on soils and landuse and represent the fraction of rainfall appearing as runoff. The relationship between rainfall and runoff is, however, not truly linear; thus, each unique rainfall event will have a different runoff coefficient for a given basin. During the dry season less runoff occurs because more water is required to wet the ground surface, and infiltration occurs at a faster rate due to lower soil moisture. Runoff will occur on a pervious surface only if the rainfall rate exceeds the soil infiltration rate. Infiltration rates are lower when the ground is wet and become near to zero when the ground is saturated.

Three sets of runoff coefficients were developed for the Alafia River Watershed – dry season, wet season, and annual. Each set of runoff coefficients include a separate coefficient for each unique soil-land use combination that occurs in the watershed. These runoff coefficients are intended to represent the fraction of rainfall appearing as runoff during an average year.

The vast majority of published runoff coefficients are intended for use in the Rational Formula for peak discharge rate estimation as opposed to runoff volume estimation. While, by definition, there is no difference between these two types of runoff coefficients (peak rate or flow volume), runoff coefficients used in the Rational

formula generally include design factors of safety. For this reason, the runoff coefficients developed for the Alafia River Watershed are generally lower than published runoff coefficients.

11.3.1 Methodology

The EPA Stormwater Management Model (SWMM) Runoff Block was used to simulate runoff. A continuous simulation was conducted based on an "average" year. Hydrologic parameters were estimated for each unique soil/land use combination and an "average" rainfall-year was applied. The seasonal runoff totals divided by the seasonal rainfall totals are the runoff coefficients. This methodology is expected to produce more accurate results and eliminates the subjectiveness of estimating the coefficients directly; instead, the factors that influence runoff are estimated and the actual coefficient itself is calculated. SWMM Runoff Block concepts and equations used in the modeling effort are described in the subsection below. These equations and concepts include Horton Infiltration, handling of pervious and impervious areas, and the non-linear "reservoir" concept for flow routing.

Horton Infiltration

The Horton Infiltration equation is used to simulate infiltration. The general form of the Horton equation is as follows:

$$f_p = f_c + (f_o - f_c) \bullet e^{-kt}$$

where:

f_p	=	Infiltration capacity ,(ft. /sec)
f_c	=	Minimum or ultimate infiltration capacity,(ft. /sec)
f_o	=	Maximum or initial infiltration capacity,(ft. /sec)
t	=	Time from beginning of storm, sec.
k	=	Decay coefficient, sec^{-1}

Using this equation, infiltration capacity is regenerated during dry weather. This methodology is preferred over a runoff coefficient or curve number approach for continuous simulations since the actual amount of infiltration is greatly influenced by the moisture condition in the surface soil zone at the time rainfall occurs. Inputs to the model include f_o, f_c, and k. The most sensitive of these parameters with respect to outflow volume is f_o which depends primarily on soil type and vegetation.

Handling Of Pervious And Impervious Areas

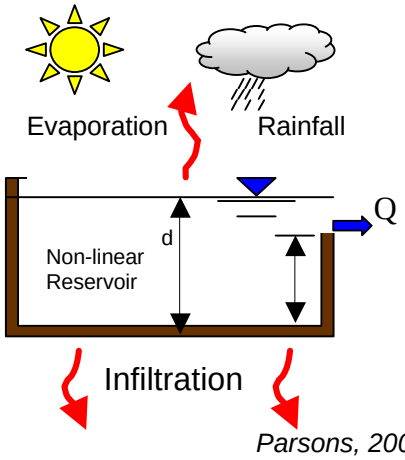
Impervious area is typically the most sensitive parameter. Flow from a subbasin is

calculated separately for three components and then summed. These three components are pervious areas (which can contain depression storage), impervious areas with depression storage, and impervious areas without depression storage (immediate) runoff.

Non-Linear Reservoir Concept For Flow Routing

The non linear "reservoir" traces inflow to and outflows from the subbasin and ensures that continuity is preserved – what goes in equals what goes out plus what is stored. The driving force is rainfall. Losses include evaporation, outflow (Q), and infiltration. A conceptual drawing of the non-linear concept is shown in Figure 11.3-1, and the flow routing equation is presented below.

Figure 11.3-1
EPA SWMM Surface Runoff



Parsons, 2001

$$Q = \frac{1.486}{n} \bullet W \bullet (d - d_s)^{5/3} \bullet S^{1/2}$$

Where,

Q = surface runoff,
W= width of the watershed,
S = average slope of the watershed,
d = depth in the non-linear reservoir,
n = Manning's roughness coefficient,
d_s = depression storage depth

Since the goal of this analysis is to estimate volumes rather than peak flows, the importance of slope, width, and roughness is somewhat diminished. These three input parameters do, however, influence the amount of time that water is "stored" and, therefore, available for infiltration.

Tampa International Airport (TIA) is the nearest rainfall recording station for which long-term, hourly rainfall data is available. Hourly rainfall has been recorded at TIA since 1970. The average year selected was 1995. During the 1995 year 52.41 inches of rainfall were received which agrees well with the annual average of 52.4 inches used in the loading model. The simulation period was December 1, 1994 (to establish soil moisture conditions) to December 31, 1995.

Input parameters that are independent of soil and landuse conditions (i. e., basin width) as well as parameters less important for volume calculation (i. e., pervious area roughness) were held constant. The basin shapes were assumed as square which fixed the subbasin width at 660 feet. The slope is the watershed-wide average developed for the flood control model. These fixed parameters are provided in Table 11.3-1.

Input parameters that are dependent on soils and land use conditions were estimated for each unique soil/land use combination. Percent impervious (Table 11.3-2) was estimated for each land use and depression storage was included for land uses expected to contain significant storage – specifically, mining 0.6 inches), forests (0.2 inches), and wetlands (0.3 inches). Percent imperviousness ranges from zero for agricultural, mining, open and natural land uses to 55% for commercial land use. These impervious areas represent only the percentage that is directly connected.

Table 11.3-1
Fixed Parameters for All Basins

Parameter	Value
Area	10 acres
Width	660 feet
Slope	0. 013 ft/ft
Impervious Area Roughness	0. 014
Pervious Areas Roughness	0. 03

Minimum infiltration rates were assigned based on soil type (Table 11.3-3), and maximum infiltration rates were assigned based on land use (vegetative cover) and soil type (Table 11.3-4). The maximum infiltration rate ranges from 0.6 inches per hour for wetlands with "D" soils to five (5) inches per hour for forests with Type "A" soils.

Table 11.3-3
Minimum Infiltration Rate

Hydrologic Soil Group	Minimum Infiltration Rate (in/hour)
A	0. 3
B	0. 15
B/D	0. 04
C	0. 1
D	0. 04

Table 11.3-2
Directly Connected Impervious Area

Land use	DCIA (%)
Agricultural	0
Commercial	55
Extractive (Mining)/Disturbed	0
High Density Residential	45
Highway/Utility	35
Institutional	20
Light Industrial	50
Low/Medium Density Residential	15
Open Land	0
Recreational	5
Upland Forest	0
Wetland Forest	0

11.3.2 Wet, Dry, and Annual Runoff Coefficients (Model Results)

The overall runoff coefficients for the watershed range from 0.05 for Upland Forest underlain by Type "A" soil to 0.73 for commercial land use with Type "D" soil (Table 11.3-5). During the dry season (October through May) several land uses are predicted to produce no runoff. The variation between seasons in runoff coefficient for an individual land use is greater for land uses that are more pervious.

Table 11.3-4
Maximum Infiltration Rate

Landuse	Soil Type	Maximum Infiltration Rate (in/hour)
Agricultural	A	3. 75
Agricultural	B	3
Agricultural	B/D	3
Agricultural	C	2. 25
Agricultural	D	1
Commercial	A	2. 5
Commercial	B	2
Commercial	B/D	2
Commercial	C	1. 5
Commercial	D	0. 75
Extractive (Mining)/Disturbed	A	2. 5
Extractive (Mining)/Disturbed	B	2
Extractive (Mining)/Disturbed	B/D	2
Extractive (Mining)/Disturbed	C	1. 5
Extractive (Mining)/Disturbed	D	0. 75
High Density Residential	A	2. 5
High Density Residential	B	2
High Density Residential	B/D	2
High Density Residential	C	1. 5
High Density Residential	D	0. 75
Highway/Utility	A	2. 5
Highway/Utility	B	2
Highway/Utility	B/D	2
Highway/Utility	C	1. 5
Highway/Utility	D	0. 75
Institutional	A	2. 5
Institutional	B	2
Institutional	B/D	2
Institutional	C	1. 5
Institutional	D	0. 75

Landuse	Soil Type	Maximum Infiltration Rate (in/hour)
Light Industrial	A	2. 5
Light Industrial	B	2
Light Industrial	B/D	2
Light Industrial	C	1. 5
Light Industrial	D	0. 75
Low/Medium Density Residential	A	2. 5
Low/Medium Density Residential	B	2
Low/Medium Density Residential	B/D	2
Low/Medium Density Residential	C	1. 5
Low/Medium Density Residential	D	0. 75
Open Land	A	3. 12
Open Land	B	2. 5
Open Land	B/D	2. 5
Open Land	C	1. 62
Open Land	D	0. 85
Recreational	A	3. 12
Recreational	B	2. 5
Recreational	B/D	2. 5
Recreational	C	1. 62
Recreational	D	0. 85
Upland Forest	A	5
Upland Forest	B	4
Upland Forest	B/D	4
Upland Forest	C	3
Upland Forest	D	1. 25
Wetland Forest	A	3. 7
Wetland Forest	B	3
Wetland Forest	B/D	3
Wetland Forest	C	2. 25
Wetland Forest	D	1
Wetland Non-Forested	A	1. 6
Wetland Non-Forested	B	1. 34
Wetland Non-Forested	B/D	1. 34
Wetland Non-Forested	C	1
Wetland Non-Forested	D	0. 6

Subwatershed composite runoff coefficients are provided on Figure 11.3-2. Composite runoff coefficients are shown for the dry, wet, and annual conditions. These coefficients range from a dry season low of 0.08 in the South Prong Alafia River Watershed to a wet season high of 0.44 in the urbanized Buckhorn Creek Watershed. Seasonal runoff coefficients for each subbasin are illustrated on Figures 11.3-3 through 11.3-5

Table 11.3-5
Runoff Coefficients

Land Use	Soil	Wet	Dry	Year
Agricultural	A	0. 115	0. 001	0. 079
Agricultural	B	0. 213	0. 033	0. 156
Agricultural	B/D	0. 323	0. 074	0. 243
Agricultural	C	0. 307	0. 088	0. 237
Agricultural	D	0. 526	0. 310	0. 457
Commercial	A	0. 583	0. 486	0. 552
Commercial	B	0. 640	0. 516	0. 600
Commercial	B/D	0. 702	0. 556	0. 655
Commercial	C	0. 687	0. 552	0. 644
Commercial	D	0. 774	0. 648	0. 734
Extractive (Mining)/Disturbed	A	0. 070	0. 000	0. 048
Extractive (Mining)/Disturbed	B	0. 123	0. 000	0. 084
Extractive (Mining)/Disturbed	B/D	0. 227	0. 004	0. 155
Extractive (Mining)/Disturbed	C	0. 176	0. 000	0. 119
Extractive (Mining)/Disturbed	D	0. 289	0. 065	0. 217
High Density Residential	A	0. 508	0. 404	0. 474
High Density Residential	B	0. 578	0. 440	0. 533
High Density Residential	B/D	0. 653	0. 489	0. 600
High Density Residential	C	0. 635	0. 482	0. 586
High Density Residential	D	0. 739	0. 599	0. 694
Highway/Utility	A	0. 432	0. 321	0. 396
Highway/Utility	B	0. 513	0. 362	0. 465
Highway/Utility	B/D	0. 602	0. 420	0. 544
Highway/Utility	C	0. 580	0. 412	0. 526
Highway/Utility	D	0. 703	0. 549	0. 653
Institutional	A	0. 315	0. 194	0. 276
Institutional	B	0. 415	0. 243	0. 360
Institutional	B/D	0. 523	0. 314	0. 456
Institutional	C	0. 496	0. 302	0. 434
Institutional	D	0. 645	0. 469	0. 589

Land Use	Soil	Wet	Dry	Year
Light Industrial	A	0. 545	0. 445	0. 513
Light Industrial	B	0. 609	0. 478	0. 567
Light Industrial	B/D	0. 677	0. 523	0. 628
Light Industrial	C	0. 661	0. 517	0. 615
Light Industrial	D	0. 757	0. 624	0. 714
Low/Medium Density Residential	A	0. 275	0. 151	0. 235
Low/Medium Density Residential	B	0. 381	0. 202	0. 323
Low/Medium Density Residential	B/D	0. 496	0. 277	0. 426
Low/Medium Density Residential	C	0. 467	0. 263	0. 401
Low/Medium Density Residential	D	0. 625	0. 442	0. 566
Open Land	A	0. 132	0. 005	0. 091
Open Land	B	0. 240	0. 051	0. 180
Open Land	B/D	0. 364	0. 116	0. 284
Open Land	C	0. 364	0. 132	0. 290
Open Land	D	0. 546	0. 335	0. 478
Recreational	A	0. 174	0. 052	0. 135
Recreational	B	0. 277	0. 096	0. 219
Recreational	B/D	0. 394	0. 158	0. 318
Recreational	C	0. 396	0. 174	0. 324
Recreational	D	0. 569	0. 367	0. 504
Upland Forest	A	0. 080	0. 000	0. 054
Upland Forest	B	0. 134	0. 000	0. 091
Upland Forest	B/D	0. 215	0. 001	0. 146
Upland Forest	C	0. 197	0. 011	0. 137
Upland Forest	D	0. 387	0. 151	0. 311
Wetland Forest	A	0. 081	0. 000	0. 055
Wetland Forest	B	0. 143	0. 000	0. 097
Wetland Forest	B/D	0. 236	0. 012	0. 165
Wetland Forest	C	0. 205	0. 016	0. 145
Wetland Forest	D	0. 367	0. 133	0. 292
Wetland Non-Forested	A	0. 112	0. 000	0. 076
Wetland Non-Forested	B	0. 205	0. 017	0. 145
Wetland Non-Forested	B/D	0. 339	0. 097	0. 261
Wetland Non-Forested	C	0. 276	0. 065	0. 208
Wetland Non-Forested	D	0. 405	0. 180	0. 333

FIGURE 11.3-2
ALAFIA RIVER WATERSHED
SUBWATERSHED RUNOFF COEFFICIENTS

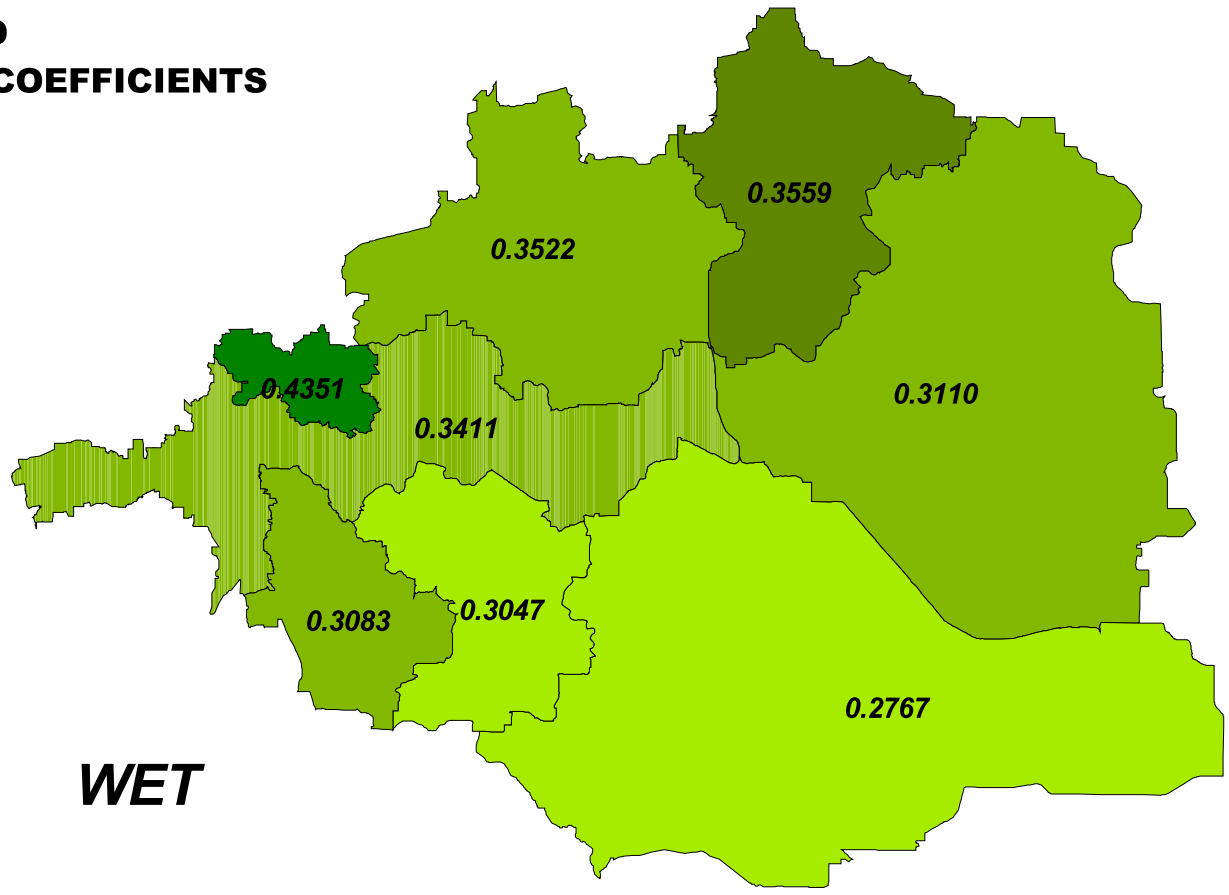
RUNOFF COEFFICIENT

- 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.25
- 0.25 - 0.3
- 0.3 - 0.35
- 0.35 - 0.4
- 0.4 - 0.45

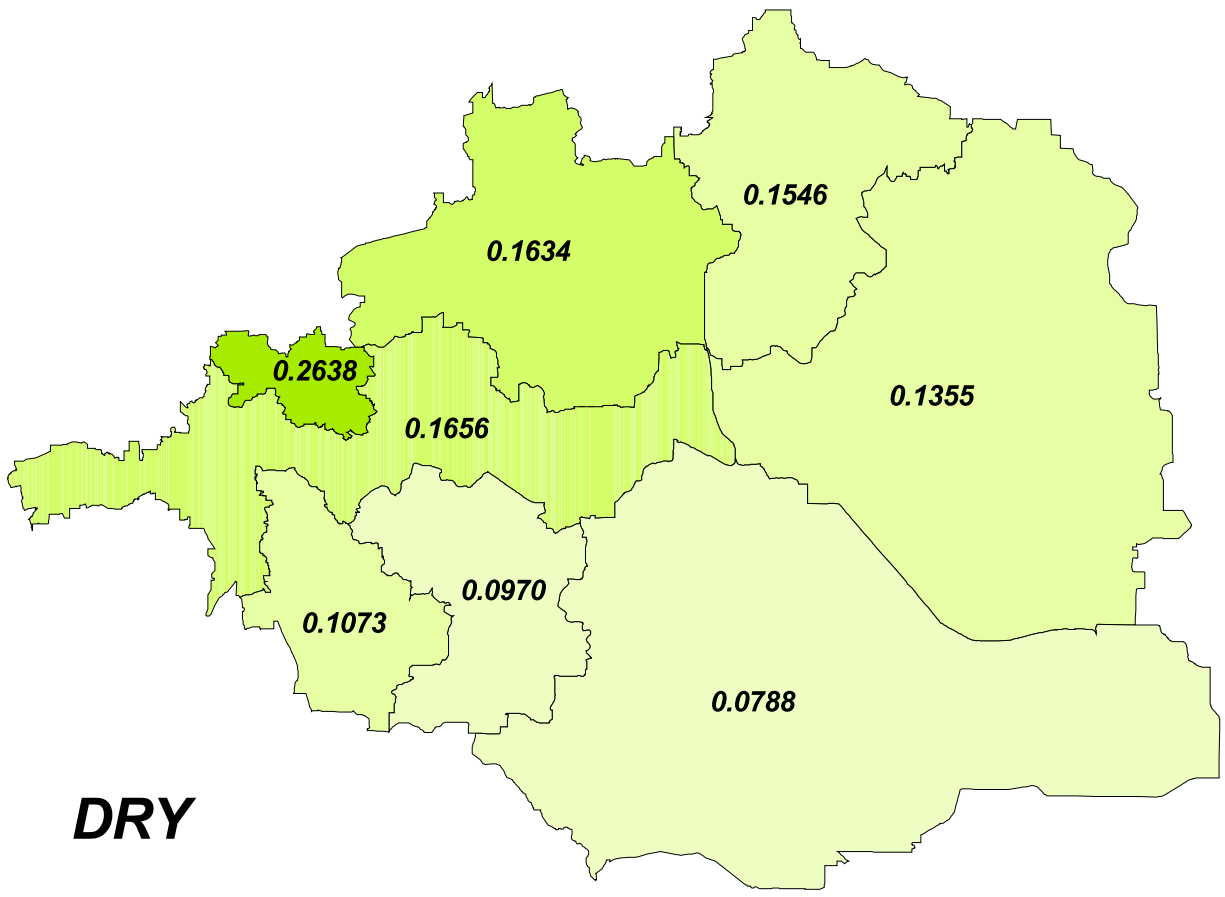
5 0 5 Miles

Scale: 1" = 5 Miles

N W E S



WET



DRY

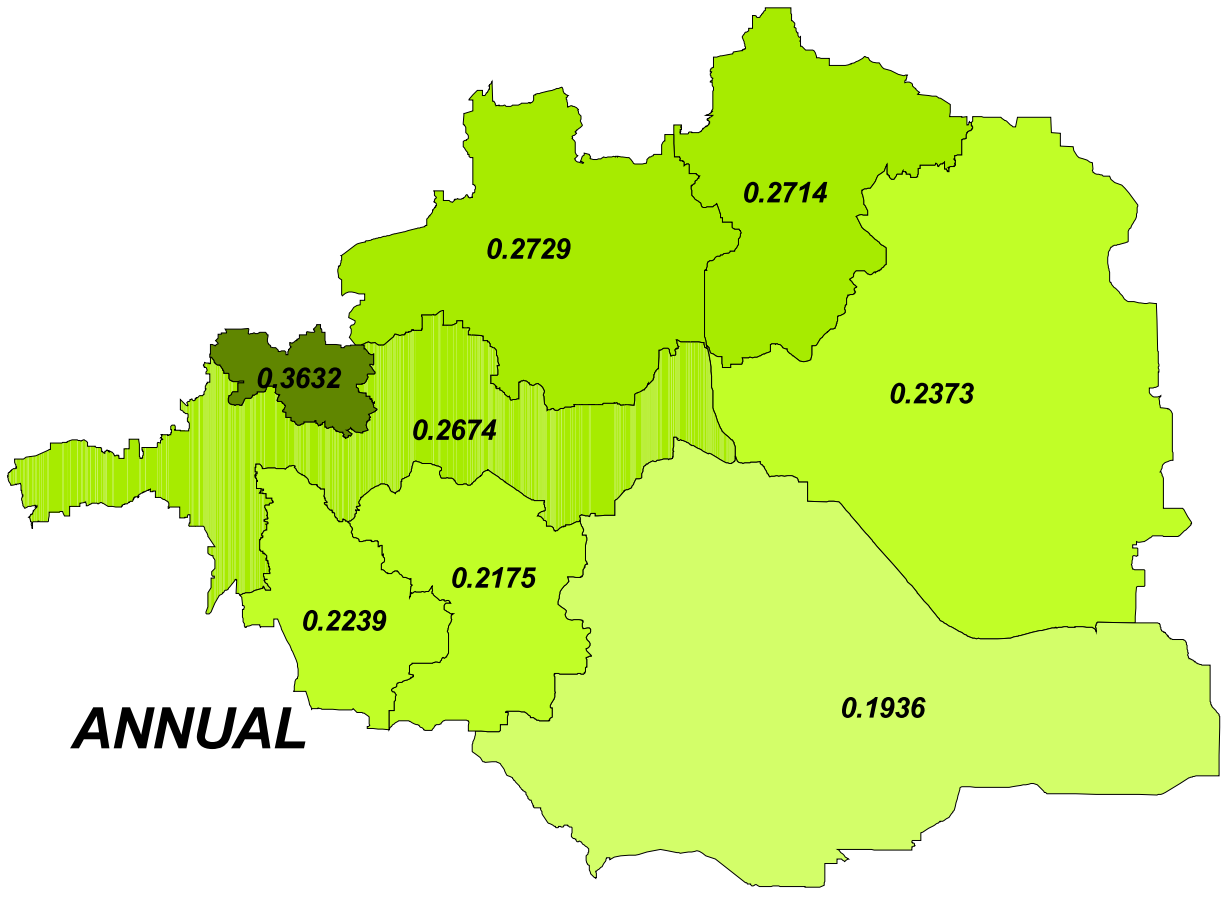


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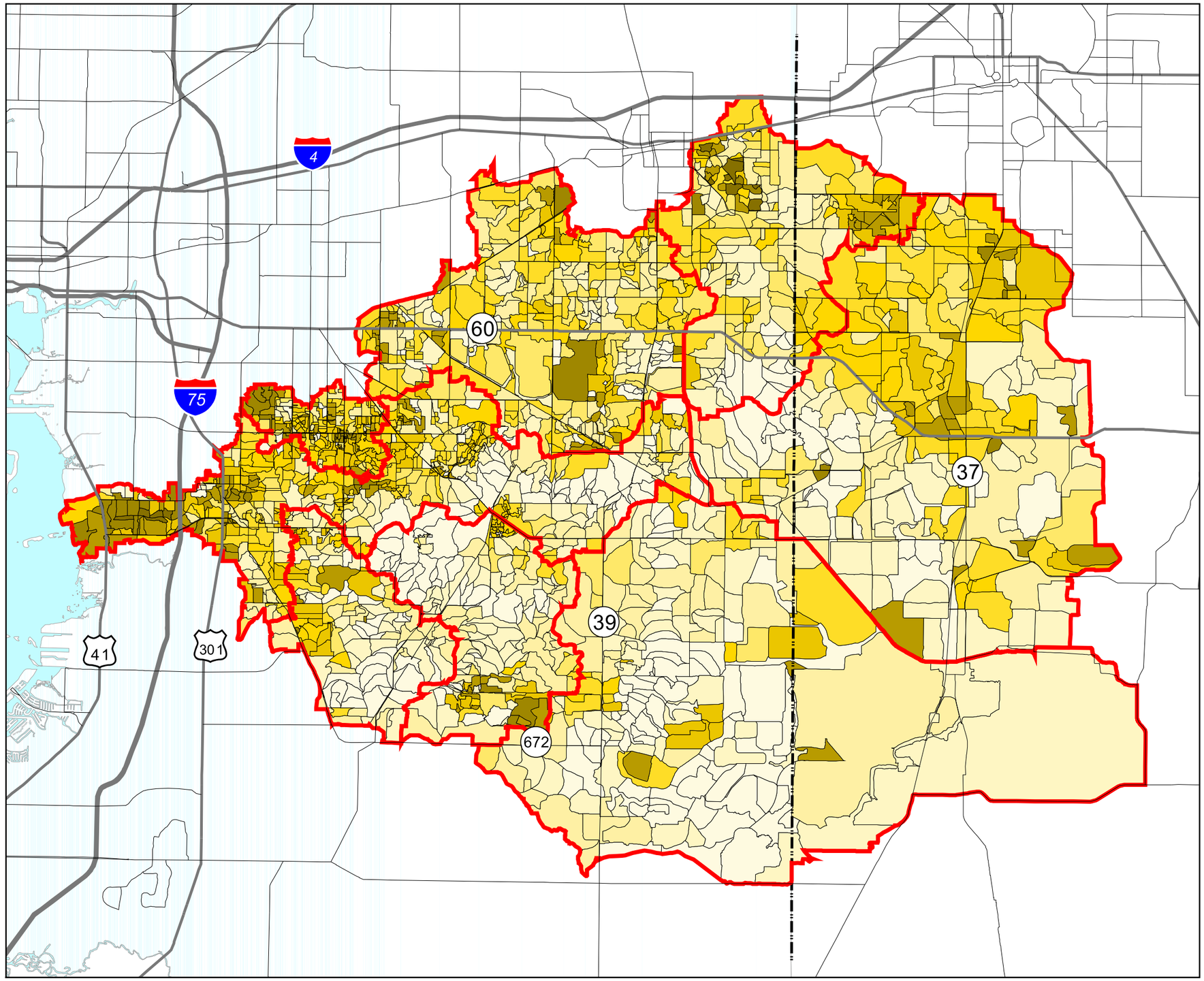
Figure 11.3-2 Subwatershed Runoff Coefficients Figure – back

FIGURE 11.3-3
ALAFIA RIVER WATERSHED
SUBBASIN RUNOFF COEFFICIENTS
DRY SEASON



RUNOFF COEFFICIENT

- *0 - 0.04*
- *0.04 - 0.07*
- *0.07 - 0.11*
- *0.11 - 0.14*
- *0.14 - 0.19*
- *0.19 - 0.25*
- *0.25 - 0.34*
- *0.34 - 0.46*
- *0.46 - 0.62*
- *0.62 - 0.99*
- *Subwatershed Boundary*
- *County Boundary*

3 0 3 Miles

Scale: 1" = 3 Miles

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Figure 11.3-3 Basin Runoff Coefficients –Dry Season – back

FIGURE 11.3-4
ALAFIA RIVER WATERSHED
SUBBASIN RUNOFF COEFFICIENTS
WET SEASON

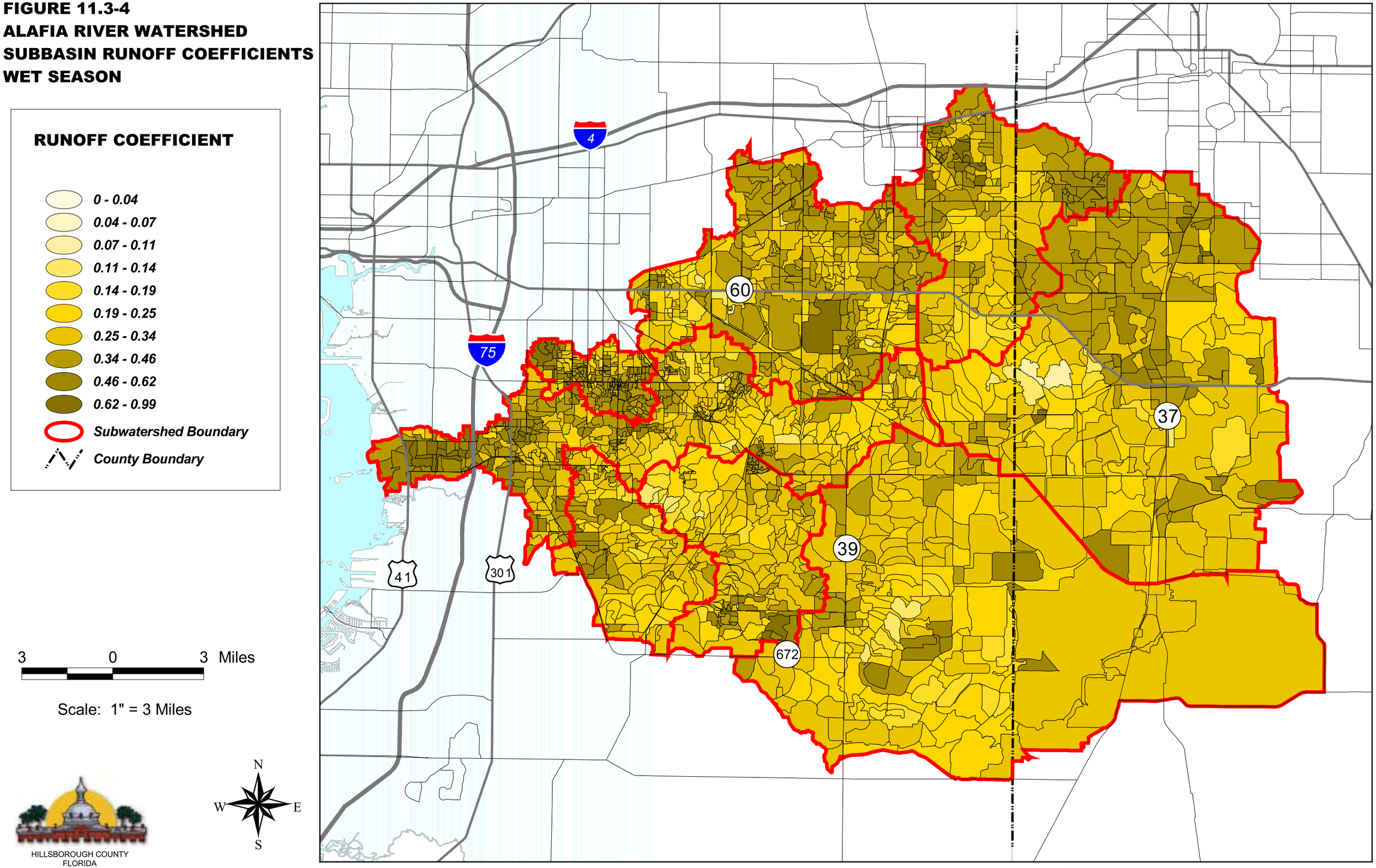
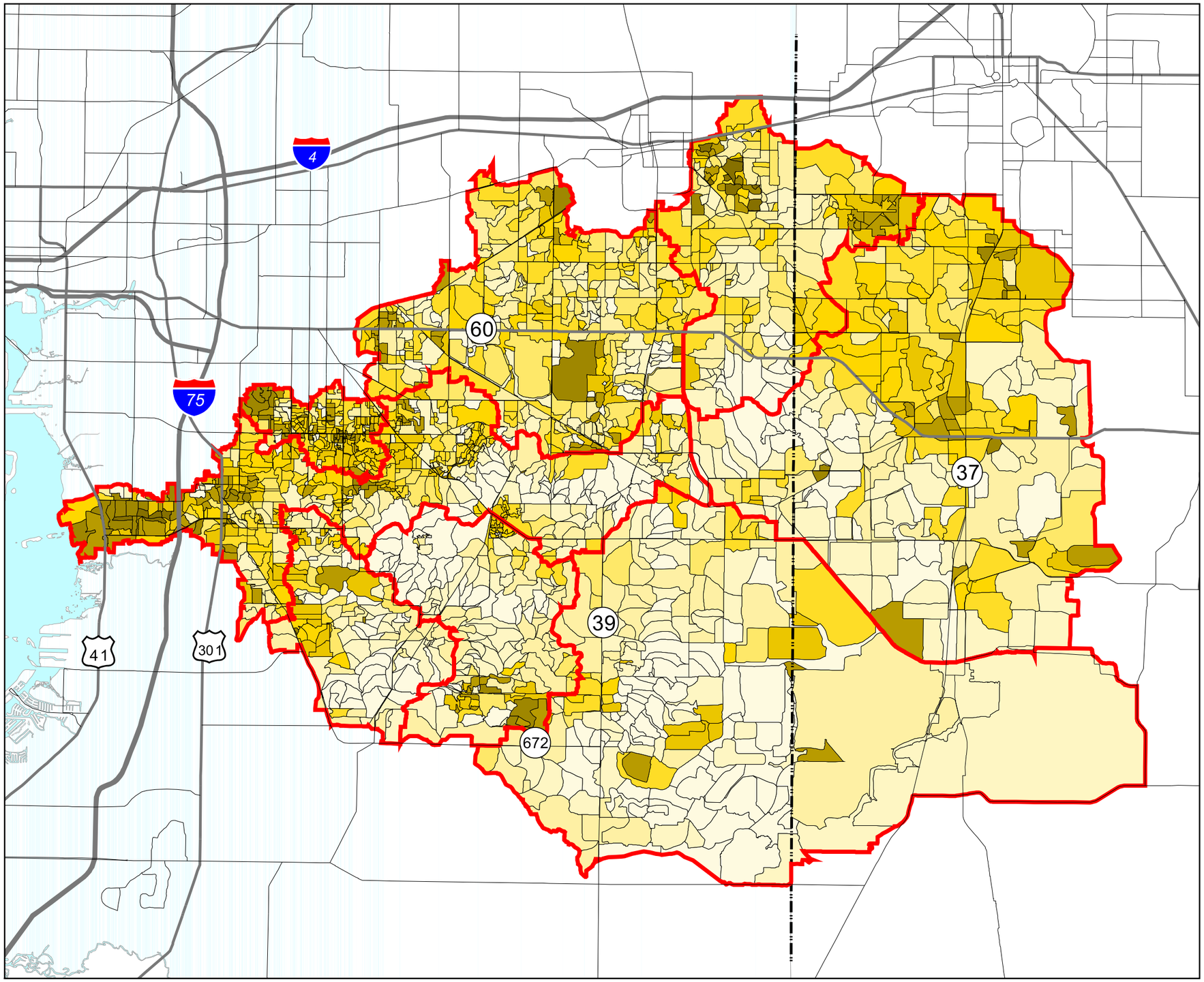


Figure 11.3-4 Basin Runoff Coefficients –Wet Season -back

FIGURE 11.3-5
ALAFIA RIVER WATERSHED
SUBBASIN RUNOFF COEFFICIENTS
ANNUAL



RUNOFF COEFFICIENT

- *0 - 0.04*
- *0.04 - 0.07*
- *0.07 - 0.11*
- *0.11 - 0.14*
- *0.14 - 0.19*
- *0.19 - 0.25*
- *0.25 - 0.34*
- *0.34 - 0.46*
- *0.46 - 0.62*
- *0.62 - 0.99*
- *Subwatershed Boundary*
- *County Boundary*

3 0 3 Miles

Scale: 1" = 3 Miles

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Figure 11.3-5 Basin Runoff Coefficients –Annual –back

11.4 Event Mean Concentrations

An EMC is the concentration that has a 50% probability of being exceeded during a storm event; thus, over the course of time, half of the storms will produce concentrations higher than the EMC and half of the storms will produce concentrations lower than the EMC. EMC values used in the loading model (Table 11.4-1) were provided by Hillsborough County in an effort to standardize nonpoint source water quality calculation county-wide. The Hillsborough County EMCs are based on sampling results from stormwater characterization studies done for the County's NPDES permit, where available. For land use categories or parameters not reported by Hillsborough County, EMC data from other studies in Florida are used.

Table 11.4-1
Event Mean Concentrations (EMCs)

Land Use	BOD_5	TSS	TKN	NO_3+ NO_2	TN	TP	TDP	O&G	CD	CU	PB	ZN
Low/Medium Density Residential	1. 00	19. 00	1. 082	0. 281	1. 363	0. 401	0. 282	1. 080	0. 001	0. 013	0. 008	0. 022
High Density Residential	2. 60	29. 00	1. 368	0. 679	2. 047	1. 337	0. 552	1. 073	0. 001	0. 047	0. 006	0. 058
Light Industrial	2. 87	18. 20	2. 088	0. 187	2. 275	0. 332	0. 187	3. 663	0. 001	0. 024	0. 006	0. 096
Agricultural	18. 30	12. 70	2. 167	0. 803	2. 970	2. 349	1. 223	0. 500	0. 013	0. 041	0. 003	0. 017
Commercial	2. 67	22. 92	1. 645	0. 387	2. 032	0. 279	0. 157	0. 650	0. 001	0. 018	0. 004	0. 026
Institutional	2. 67	22. 92	1. 645	0. 387	2. 032	0. 279	0. 157	0. 650	0. 001	0. 018	0. 004	0. 026
Highway/Utility	24. 00	261. 00	2. 990	1. 140	4. 130	0. 120	0. 300	0. 400	0. 040	0. 103	0. 960	0. 410
Recreational	3. 80	11. 10	2. 090	0. 508	2. 598	0. 050	0. 130	0. 900	0. 007	0. 041	0. 006	0. 004
Open Land	3. 80	11. 10	2. 090	0. 508	2. 598	0. 050	0. 130	0. 900	0. 001	0. 001	0. 001	0. 006
Extractive (Mining)/Disturbed	28. 94	13. 20	3. 500	0. 030	3. 530	0. 194	0. 134	0. 900	0. 001	0. 001	0. 001	0. 006
Upland Forest	0. 00	0. 00	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000
Wetland Forest	0. 00	0. 00	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000
Wetland Non-Forested	0. 00	0. 00	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000
Water	0. 00	0. 00	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000

Key: Note: All Units mg/l

BOD_5	=	Biochemical Oxygen Demand (5 Day)	TN	=	Total Nitrogen	Cd	=	Cadmium
TSS	=	Total Suspended Solids	TP	=	Total Phosphorus	Cu	=	Copper
TKN	=	Total Kjeldahl Nitrogen	TDP	=	Total Dissolved Phosphorus	Pb	=	Lead
NO_3+NO_2	=	Nitrate + Nitrite	O&G	=	Oil and Grease	Zn	=	Zinc

EMC values were available for many land uses for numerous pollutants including five-day biochemical 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 (O&G), cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn). A comparison of these values to other Florida and national studies is 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 EMCs for agricultural land use tend to be much higher than those reported elsewhere in Florida. For most parameters, these elevated EMCs impact estimated load calculations significantly where agricultural land use is present.

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 agriculture land use are 74 and 586 percent higher 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 of EMS 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. Additional primary sources of TSS include vehicle emissions and atmospheric deposition. Relatively low TSS data for Hillsborough County may reflect regulations requiring turbidity control at construction sites, although the coarse grain nature of soils present on many land uses in Hillsborough County is a more likely explanation. 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. This may reflect decreased emissions due to use of unleaded

gasoline or fate and transport of lead particles in the particular systems sampled. 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. Copper is also a common component of 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 transportation-related activities, atmospheric deposition and fertilizers. Relatively low zinc concentrations may reflect fate and transport characteristics of the particular systems sampled.

11.5 Existing Stormwater Runoff Treatment

The type and coverage of best management practices (BMPs) providing pollutant removal was estimated for each basin. BMP type and coverage data were developed based on interpretation of aerial photos. For this analysis, BMP types include strictly wet ponds and percolation ponds; no attempt was made to estimate removal from other BMP types (e. g., swales) that may provide some treatment, as their identification would require extensive field identification and verification. That level of detail can be developed as more data become available.

For each land use type present within each sub-basin, a percent coverage of the area draining to the BMP was estimated. Removal was then calculated based on the following removal efficiencies (see Table 11.5-1). Areas treated, or partially treated, by a BMP are shown on Figure 11.5-1.

Table 11.5-1
Estimated BMP Removal Efficiencies for Existing Treatment

BMP Description	BOD_5	TSS	TKN	NO_3+NO_2	TN	TP	TDP	O&G	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%[1]	80%[1]	80%[1]	80%[1]	80%[1]	80%[1]

Notes

1. Harper, H. H. 1995. "Pollutant removal efficiencies for typical stormwater management systems in Florida. " Stormwater Research Conference 1995.
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.

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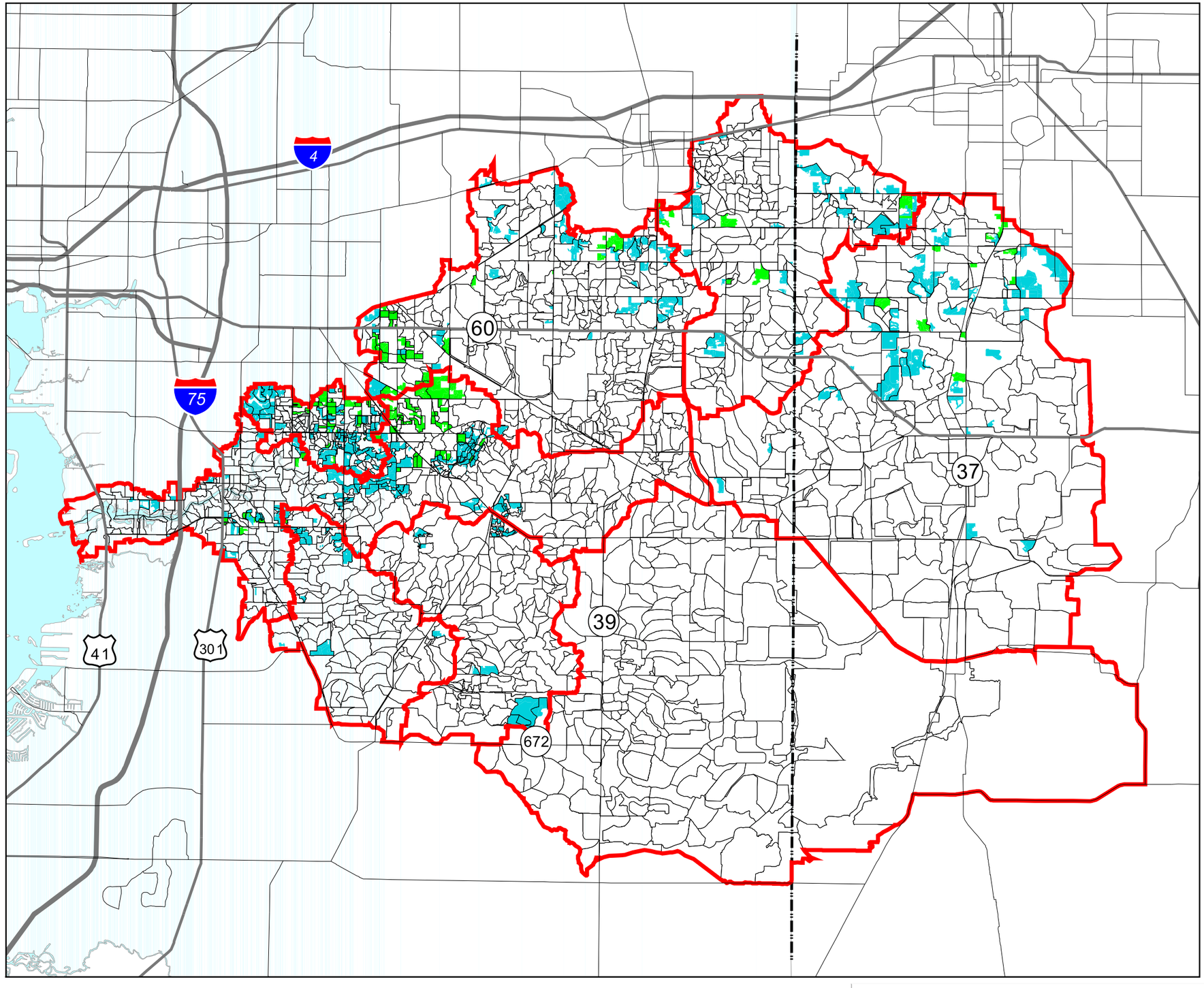
FIGURE 11.5-1
ALAFIA RIVER WATERSHED
SUBBASIN TREATMENT
EVALUATION

LEGEND

- *Dry BMP*
- *Wet BMP*
- *Subbasin Boundary*
- *Subwatershed Boundary*
- *County Boundary*



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Scale: 1" = 3 Miles

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Figure 11.5-1 Basin Treatment Evaluation –back

11.6 Results

According to the loading model, wash-off loads to the Alafia River total around 14 million pounds of suspended solids, one and one-half million pounds of nitrogen, and one-half million pounds of phosphorous per year, on average. Existing treatment areas remove a portion of the load; however, the net loads are not reduced significantly due to the relatively small percentage of the watershed that receives treatment and, in the case of nitrogen, due to low removal efficiencies for existing BMPs. Since the inorganic fraction of nitrogen is higher in the Alafia River than in other typical surface waters, the nitrogen removal efficiency may be underestimated by the literature values that were used (Table 11.5-1). Nevertheless, the results of this analysis demonstrate the need for water quality retrofits, watershed-wide.

Table 11.6-1
Mass Load Summary

Subwatershed	COUNTY	Gross Load (#/average year)			Removed Load (#/average year)			Net Load (#/average year)		
		TN	TP	TSS	TN	TP	TSS	TN	TP	TSS
Alafia River	Hillsborough	137,659	61,769	1,704,060	9,524	6,133	273,184	128,135	55,636	1,430,875
Bell Creek	Hillsborough	52,986	31,526	483,777	931	654	37,381	52,055	30,872	446,395
Buckhorn Creek	Hillsborough	30,054	12,091	362,726	6,145	4,891	185,455	23,909	7,201	177,271
English Creek	Hillsborough	92,246	52,364	781,803	2,979	2,052	90,528	89,267	50,313	691,276
	Polk	68,241	16,741	2,038,908	5,360	1,104	453,167	62,881	15,637	1,585,741
	Total	160,487	69,105	2,820,711	8,339	3,156	543,695	152,148	65,950	2,270,017
Fishhawk Creek	Hillsborough	103,085	54,799	1,564,140	4,339	766	708,650	98,746	54,032	855,490
North Prong Alafia River	Hillsborough	19,927	12,245	131,815	73	61	2,537	19,854	12,185	129,278
	Polk	390,306	62,283	3,089,304	8,662	5,275	252,133	381,644	57,008	2,837,171
	Total	410,233	74,528	3,221,119	8,735	5,336	254,669	401,498	69,193	2,966,449
South Prong Alafia River	Hillsborough	232,184	132,589	1,101,803	-	-	-	232,184	132,589	1,101,800
	Polk	241,062	27,127	966,152	-	-	-	241,062	27,127	966,152
	Total	473,246	159,716	2,067,955	-	-	-	473,246	159,716	2,067,955
Turkey Creek	Hillsborough	177,172	78,361	1,655,933	9,799	8,299	166,443	167,373	70,062	1,489,490
Subtotals										
Hillsborough		845,313	435,744	7,786,057	33,790	22,856	1,464,178	811,523	412,890	6,321,875
Polk		699,609	106,151	6,094,364	14,022	6,379	705,300	685,587	99,772	5,389,064
Total		1,544,922	541,895	13,880,421	47,812	29,234	2,169,478	1,497,100	512,662	11,710,939
Percent of Total										
Hillsborough		55%	80%	56%	71%	78%	67%	61%	81%	54%
Polk		45%	20%	44%	29%	22%	33%	39%	19%	46%

Gross, removed, and net loads per county by subwatershed are provided in Table 11.6-1. Gross, removed, and net loads of TN, TP, TSS, and BOD_5 per county for each subbasin are provided in Appendix G, and annual average loads for additional parameters are provided in Appendix H. In general, the larger subwatersheds produced the largest loads, as expected. Loads for Turkey Creek, the South Prong Alafia, and the North Prong Alafia were increased somewhat by the prevalence of low-permeability soils in these subwatersheds; however, this increase was tempered by higher-than-average storage, thus less runoff, in the mine-heavy North and South Prong Alafia River Watersheds. This also could explain the disparity which exists between area and load on a county basis. Polk County makes-up 22 percent of the total watershed area (Table 11.6-2), yet 42 percent of the TSS load and 39 percent of the TN load was generated in Polk County. The North Prong Alafia Watershed is the largest contributor of TSS and TN, out-producing the largest watershed, the South Prong Alafia, for these two parameters. The South Prong Alafia Watershed is predicted to produce the largest mass of phosphorous of all the subwatersheds due primarily to the large percentage in agricultural land use.

Table 11.6-2
Subwatershed Areas by County

Subwatershed	Hillsborough		Polk		Watershed	
	Area (sq. miles)	%	Area (sq. miles)	%	Area (sq. miles)	%
Alafia River	49. 9	100%	0. 0	0%	49. 9	12%
Bell Creek	19. 7	100%	0. 0	0%	19.7	5%
Buckhorn Creek	7. 5	100%	0. 0	0%	7.5	2%
English Creek	26. 1	68%	12. 3	32%	38. 4	9%
Fishhawk Creek	27. 3	100%	0. 0	0%	27. 3	7%
North Prong Alafia River	9. 0	9%	93. 6	91%	102. 6	24%
South Prong Alafia River	71. 1	57%	52. 6	43%	123. 7	29%
Turkey Creek	49. 5	100%	0. 0	0%	49. 5	12%
Totals	260. 1	62%	158. 5	38%	418. 6	100%

Loading rates were calculated for each subbasin and subwatershed. These rates, presented in pounds per acre, are beneficial in identifying areas with high loading potential since the rates are not skewed by area as are the mass loads. These subwatershed loading rates, Table 11.6-3 and Figure 11.6-1, show the South Prong Alafia Watershed to have the highest loading rates for TN and BOD_5– this is due to the dominance of agriculture and mining in this subwatershed. The prominence of agriculture in the Fishhawk Creek

Table 11.6-3
Loading Rates
(pounds/acre/year)

Subwatershed	TN	TP	TSS	BOD_5
Alafia River	3.4	1.5	38.4	12.1
Bell Creek	4.2	2.5	36.2	19.4
Buckhorn Creek	3.2	1.0	23.4	4.4
English Creek	5.2	2.3	78.2	24.1
Fishhawk Creek	6.0	3.3	51.6	33.1
North Prong Alafia River	5.9	1.0	43.6	36.8
South Prong Alafia River	7.1	2.4	30.9	49.9
Turkey Creek	4.4	1.9	39.4	17.5

Units = pounds/annual average year

subwatershed causes this subwatershed to have the highest loading rate for TP, and the prevalence of urban areas in combination with relatively high runoff rates cause the English Creek Subwatershed to rate highest for TSS. Annual average loading rates for each basin are shown on Figures 11.6-2 through 11.6-5 and detailed in Appendix I.

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FIGURE 11.6-1
ALAFIA RIVER WATERSHED
SUBWATERSHED ANNUAL
AVERAGE LOADING RATES

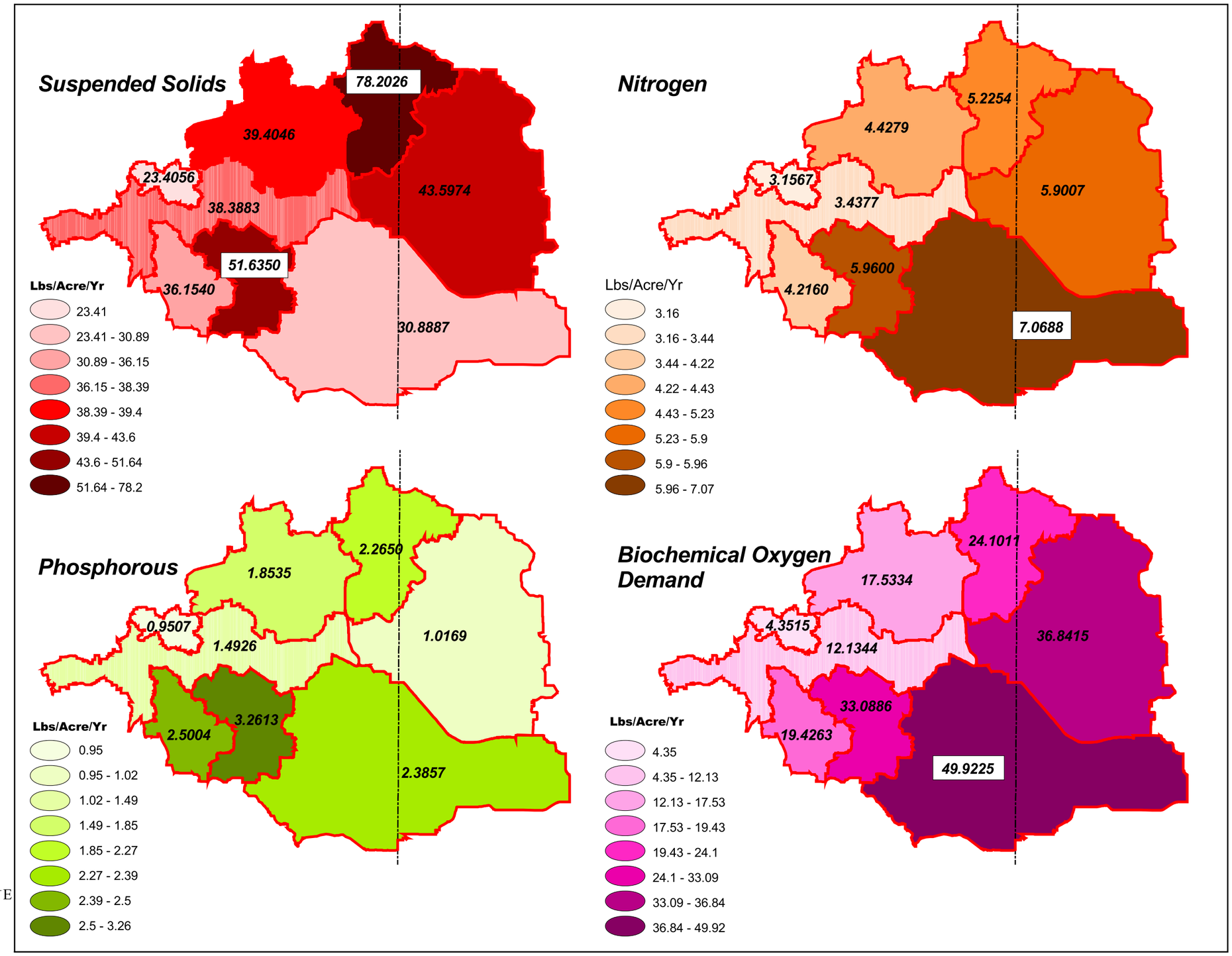

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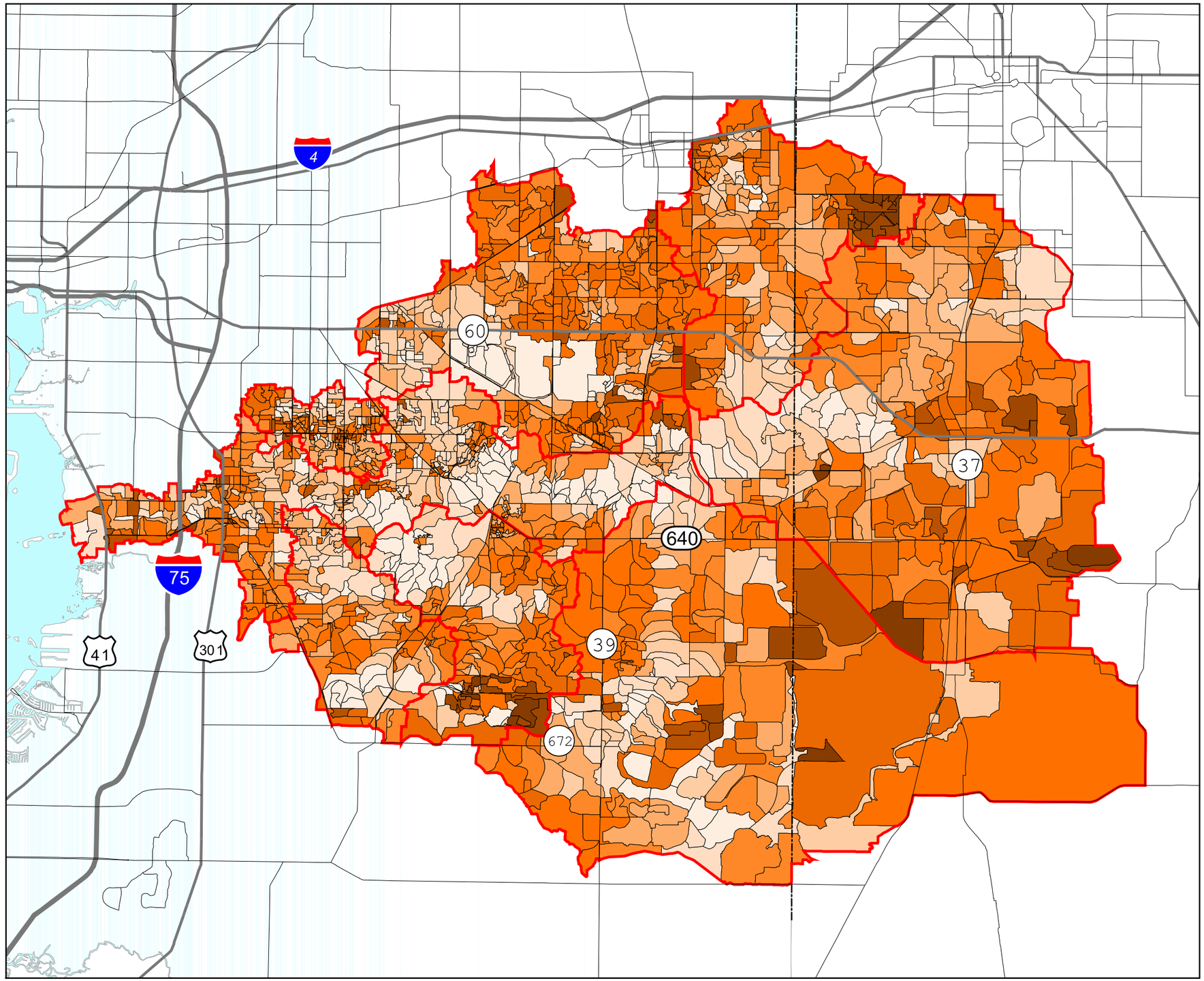
Figure 11.6-1 Subwatershed Annual Average Loading Rates-back

FIGURE 11.6-2
ALAFIA RIVER WATERSHED
SUBBASIN ANNUAL AVERAGE
LOADING RATES - NITROGEN



Lbs/Acre/Yr

- *0 - 1.34*
- *1.34 - 2.64*
- *2.64 - 3.77*
- *3.77 - 4.9*
- *4.9 - 6.09*
- *6.09 - 7.4*
- *7.4 - 9.49*
- *9.49 - 13.31*
- *13.31 - 19.16*
- *19.16 - 29.35*
- *Subwatershed Boundary*
- *County Boundary*

3 0 3 Miles

Scale: 1" = 3 Miles

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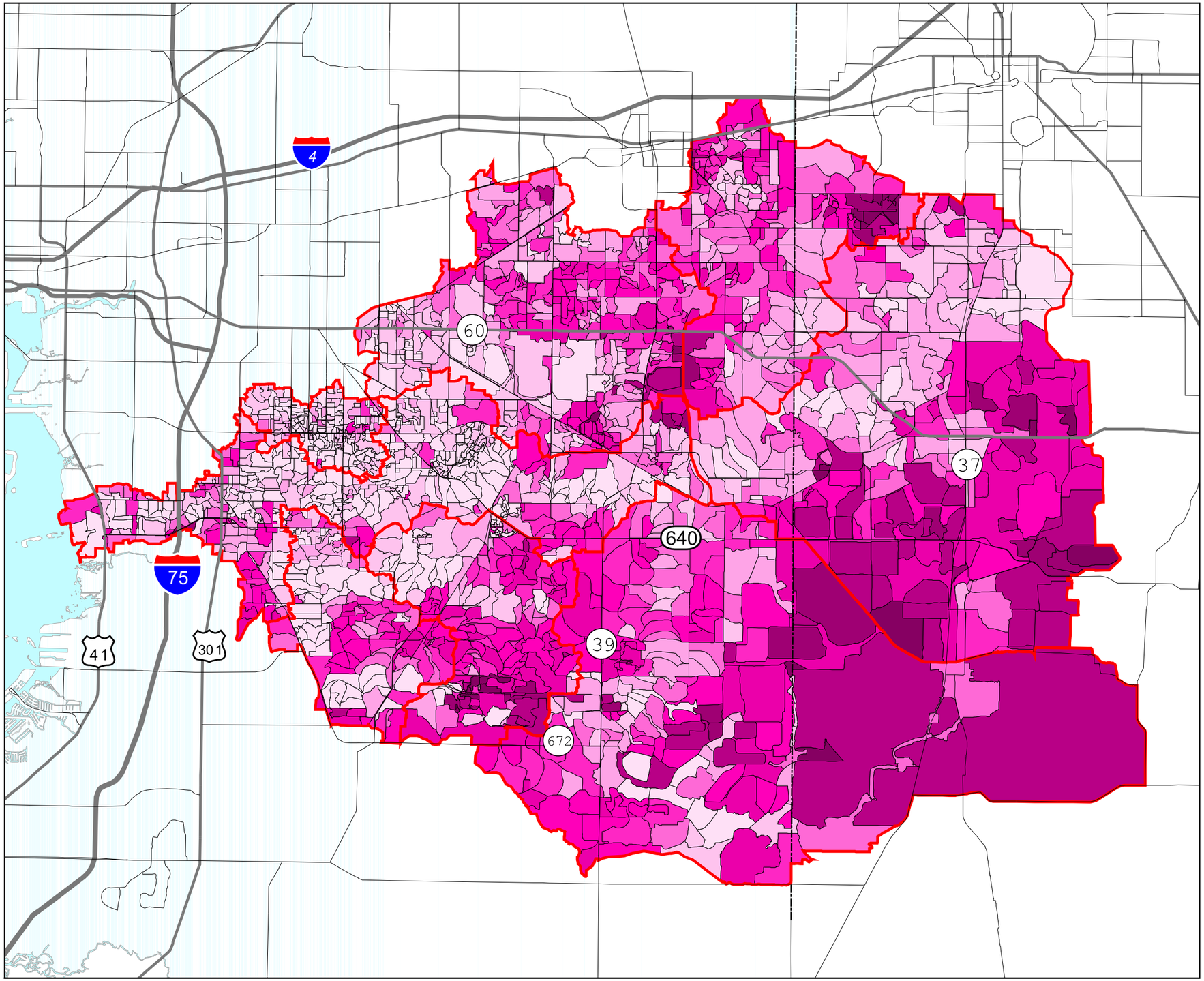
Figure 11.6-2 Basin Annual Average Loading Rate – Suspended Solids - back

FIGURE 11.6-3
ALAFIA RIVER WATERSHED SUBBASIN ANNUAL AVERAGE LOADING RATES - BIOCHEMICAL OXYGEN DEMAND



Lbs/Acre/Yr

- *0 - 5.28*
- *5.28 - 11.23*
- *11.23 - 17.72*
- *17.72 - 24.9*
- *24.9 - 33.02*
- *33.02 - 41.81*
- *41.81 - 55.38*
- *55.38 - 79.81*
- *79.81 - 119.69*
- *119.69 - 229.2*
- *Subwatershed Boundary*
- *County Boundary*

3 0 3 Miles

Scale: 1" = 3 Miles

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Figure 11.6-3 Basin Annual Average Loading Rate – Nitrogen – back

FIGURE 11.6-4
ALAFIA RIVER WATERSHED SUBBASIN ANNUAL AVERAGE LOADING RATES - SUSPENDED SOLIDS

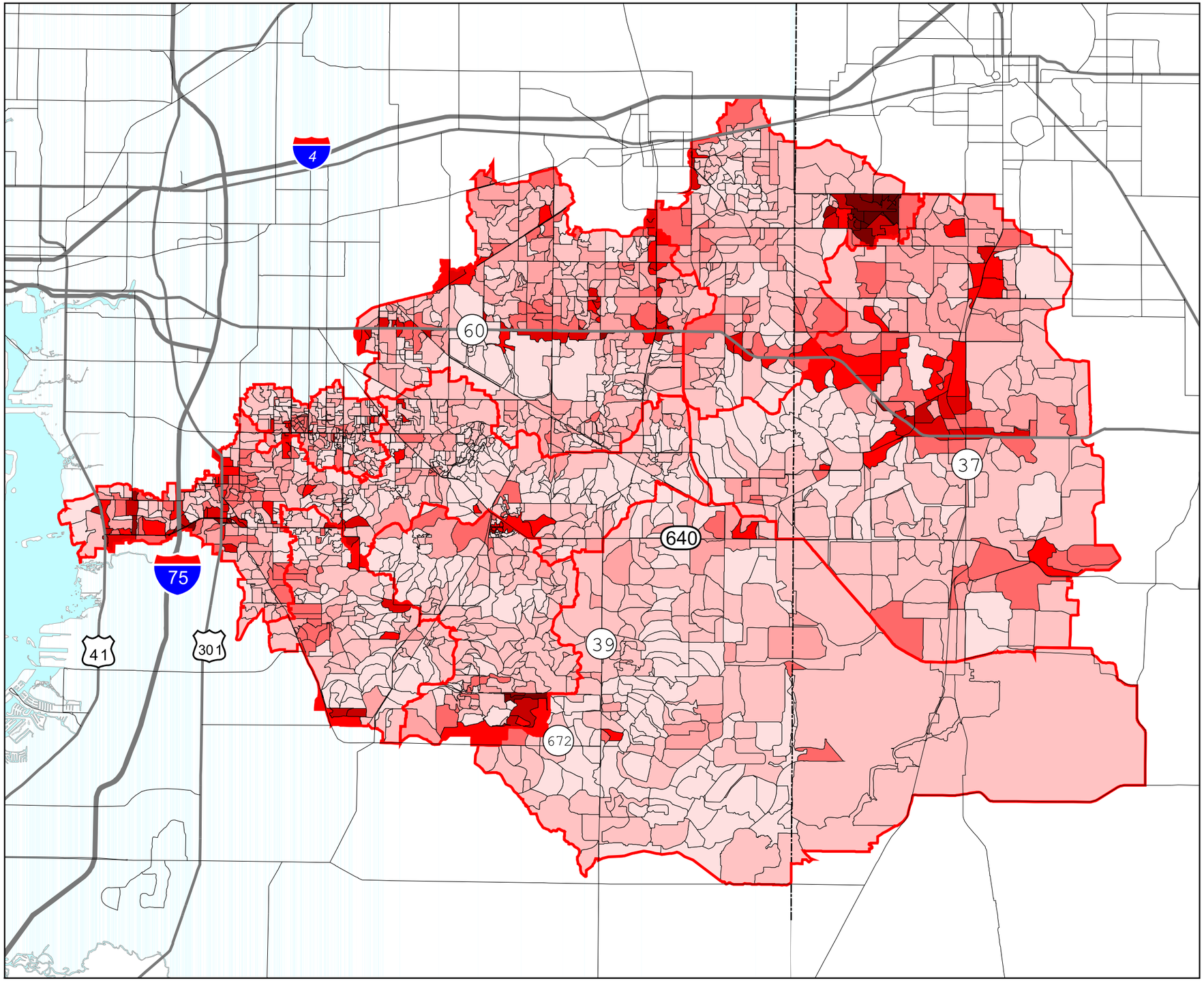

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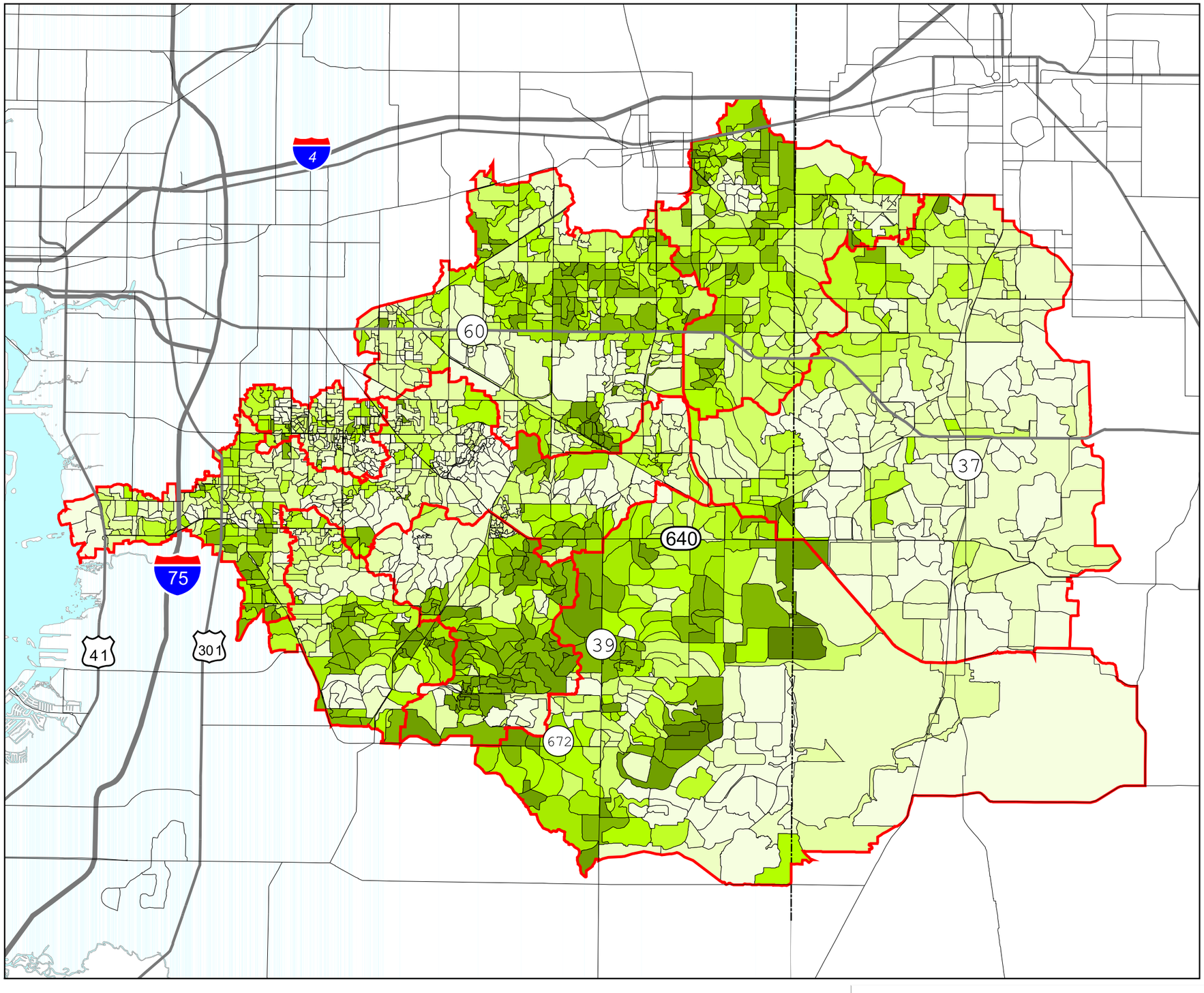
Figure 11.6-4 Basin Annual Average Loading Rate – Phosphorous – back

FIGURE 11.6-5
ALAFIA RIVER WATERSHED
SUBBASIN ANNUAL AVERAGE
LOADING RATES - PHOSPHOROUS



Lbs/Acre/Yr

- *0 - 0.42*
- *0.42 - 0.96*
- *0.96 - 1.57*
- *1.57 - 2.19*
- *2.19 - 2.88*
- *2.88 - 3.61*
- *3.61 - 4.41*
- *4.41 - 5.35*
- *5.35 - 7.55*
- *7.55 - 12.17*
- *Subwatershed Boundary*
- *County Boundary*

3 0 3 Miles

Scale: 1" = 3 Miles

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Figure 11.6-5 Basin Annual Average Loading Rate – Biochemical Oxygen Demand – back

CHAPTER 12

WATER QUALITY LEVELS-OF-SERVICE

In order to effectively manage stormwater pollution in Hillsborough County, the County has established levels-of-service (LOS) criteria to allow comparison of existing or proposed conditions to pollutant loading goals. Pollutant loads based on runoff from single-family (low to medium density) residential land use were selected by Hillsborough County 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.

12.1. Methodology

The procedure applied to determine LOS consists of the following steps:

1. Calculate the net pollutant load for each chemical of interest based on actual land use composition
2. Calculate the gross pollutant load for that same chemical, assuming that 100 percent of the area is developed for low/medium residential land uses
3. Calculate the ratio of step 1/ step 2
4. Apply the criteria described below to determine the LOS.

LOS criteria A through F were defined based on the following ranges:

LOS A requires a net load equivalent to 20% or less of untreated single-family residential load. A LOS equal to A for a sub-basin would indicate the presence of undisturbed natural systems, or areas supplied with treatment systems capable of removing pollution levels to those representing natural systems. An A LOS would also represent the case of areas of typical land uses (residential) receiving stormwater treatment levels above the minimum required per 62-40.432(5) F.A.C.

LOS B requires a net load equivalent to 20 to 40% of untreated single-family residential load. A LOS equal to B would indicate the presence of treatment systems showing removal efficiencies consistent with those representing adequately designed and maintained conditions.

LOS C requires a net load equivalent to 40 to 70% of untreated single-family residential load. A LOS equal to C would indicate the presence of treatment systems showing removal efficiencies consistent with those representing average to poorly maintained conditions.

LOS D requires a net load equivalent to 70 to 100% of untreated single-family

residential load. A LOS equal to D would indicate minimal treatment of sub-basin discharges.

LOS F requires a net load equal to or greater than 100% of untreated single-family residential load. 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.

This LOS grading scheme is numerated in Table 12.2-1.

Table 12.2-1
LOS Criteria

LOS	Ratio Upper Range	Ratio Lower Range
A	0.2	0
B	0.4	0.2
C	0.7	0.4
D	1	0.7
F	-	1

12.2. RESULTS

As discussed above, Hillsborough County has established levels of service (LOS) based on the ratio of net existing to single-family residential pollutant loads. Subwatershed levels-of-service are illustrated on Figure 12.2-1. The explanation for these levels-of-service begins with an examination of the EMCs (Table 11.2-3) and the runoff coefficients (Table 11.3-5). More specifically, land uses with EMCs higher than the single-family EMC will tend to exhibit poorer water quality as will land uses that have a runoff potential that is higher than the single-family runoff potential. Figure 12.2-2 shows the percent change in runoff from the actual verses the single-family condition and is used in the following discussion, along with the EMC table to explain the subwatershed levels-of-service. Subbasin levels-of-service are provided in Appendix J and illustrated in Figures 12.2-3 through 12.3-6.

The single-family EMC for BOD_5 is the lowest, at 1 mg/l, of all non-natural land uses; in fact, the single-family EMC for $BOD_5$is less than half of next lowest EMC, high-density residential (2.6 mg/l). The stark difference in BOD_5 between single-family and the other land uses is the reason that all subwatersheds rate an F for BOD_5. Individual basins (Figure 12.2-6) achieved higher levels-of-service for BOD_5 due mainly to lower runoff volume and, to a lesser degree, existing treatment.

The greatest phosphorous EMC used was for agricultural land use; therefore, subwatersheds with a large percentage of area in agricultural land use received low levels-of-service. All four watersheds where agriculture is the dominate land use - Bell Creek, English Creek, Fishhawk Creek, and Turkey Creek - received an LOS of F. Agriculture was also likely responsible for decreased phosphorus levels-of-service in the main stem and the South Prong Alafia River. Many of the land uses in Buckhorn Creek produce higher flows than the single-family condition – this, along with high-density residential land use, caused Buckhorn Creek to rate a D with respect to phosphorous.

Like BOD_5, the total nitrogen (TN) EMC for single-family residential was the lowest of all TN EMCs which resulted in low ratings for TN throughout the watershed. The variation in TN between the different land uses is less (than BOD_5) drastic; therefore, most subwatersheds rated a D rather than an F as in the case of BOD_5. The main stem and Bell Creek rated a C for TN likely due to the prevalence of natural areas in these subwatersheds.

The single-family TSS EMC is higher than the EMC for many of the watershed's most dominate land uses (agriculture and mining); therefore, most subwatersheds received an LOS of C. Plant City Municipal Airport, a large transportation land use with an assumed TSS EMC of 261 mg/l, caused Turkey Creek to receive an LOS of F.

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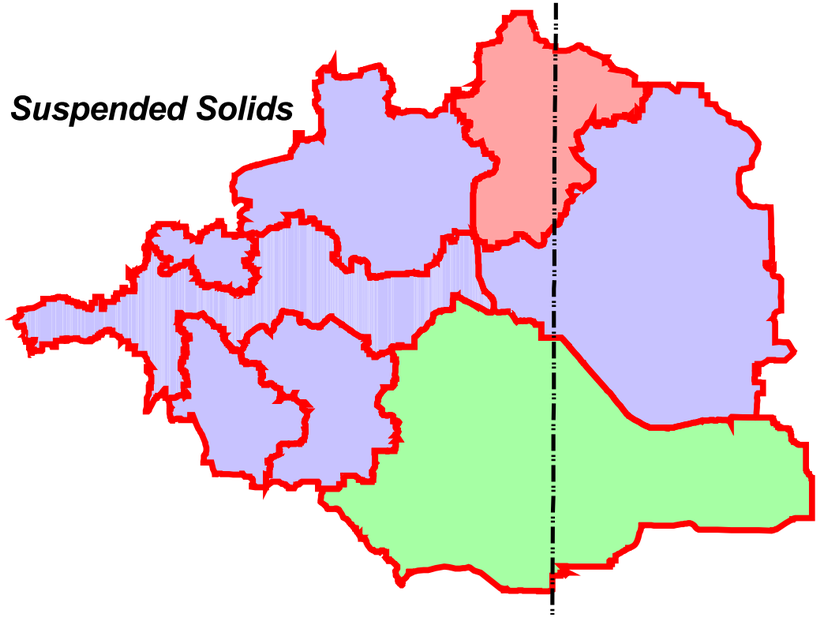
FIGURE 12.2-1
ALAFIA RIVER WATERSHED SUBWATERSHED LEVEL-OF-SERVICE

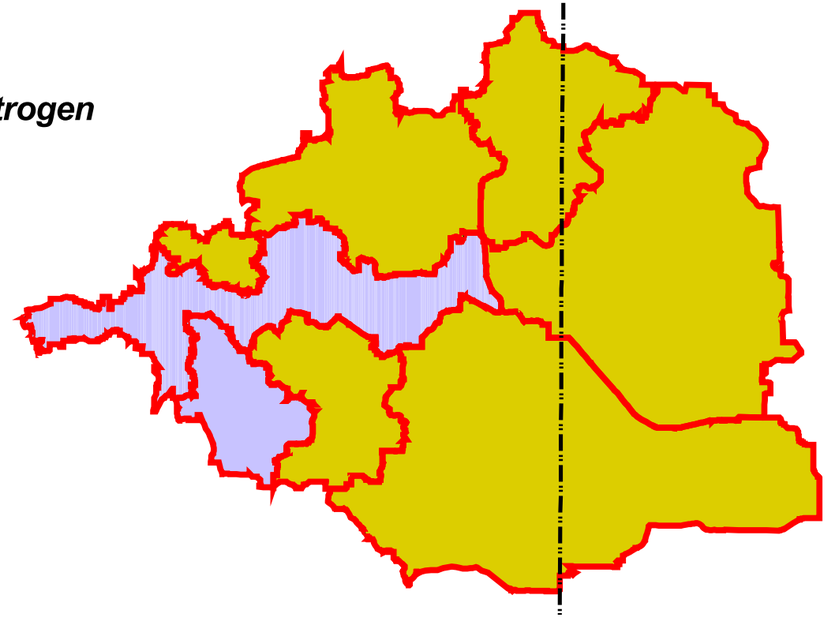
LEVEL-OF-SERVICE

- *A*
- *B*
- *C*
- *D*
- *F*
- *Subwatershed Boundary*
- *County Boundary*

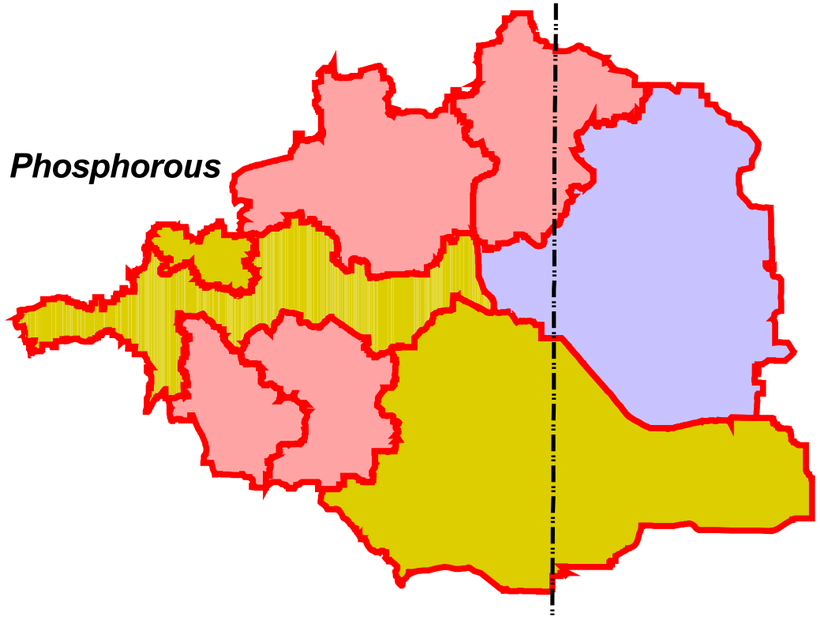
Suspended Solids



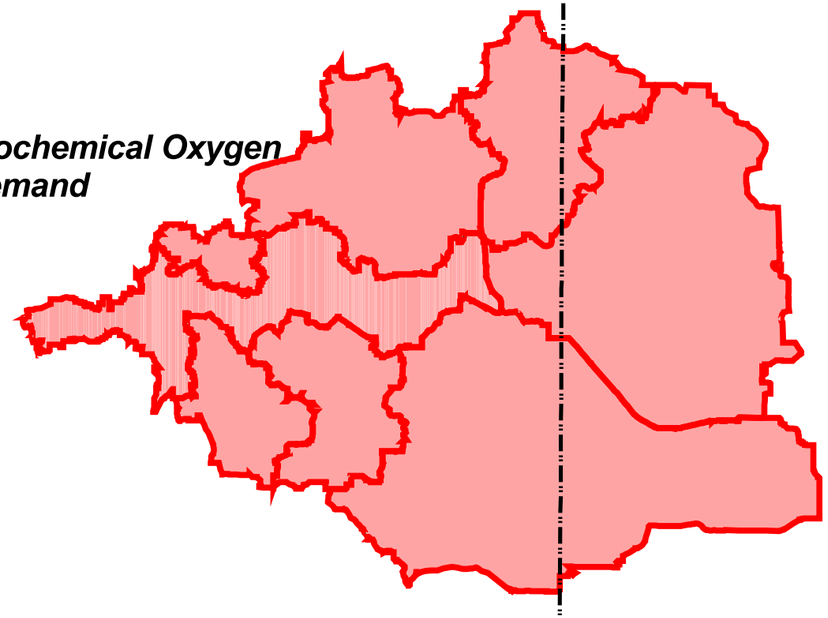
Nitrogen



Phosphorous



Biochemical Oxygen Demand



6 0 6 Miles

Scale: 1" = 6 Miles

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FIGURE 12.2-2
ALAFIA RIVER WATERSHED
FLOW VOLUME VARIATIONS
BETWEEN EXISTING CONDITIONS
AND SINGLE FAMILY COMPARISON
CONDITIONS

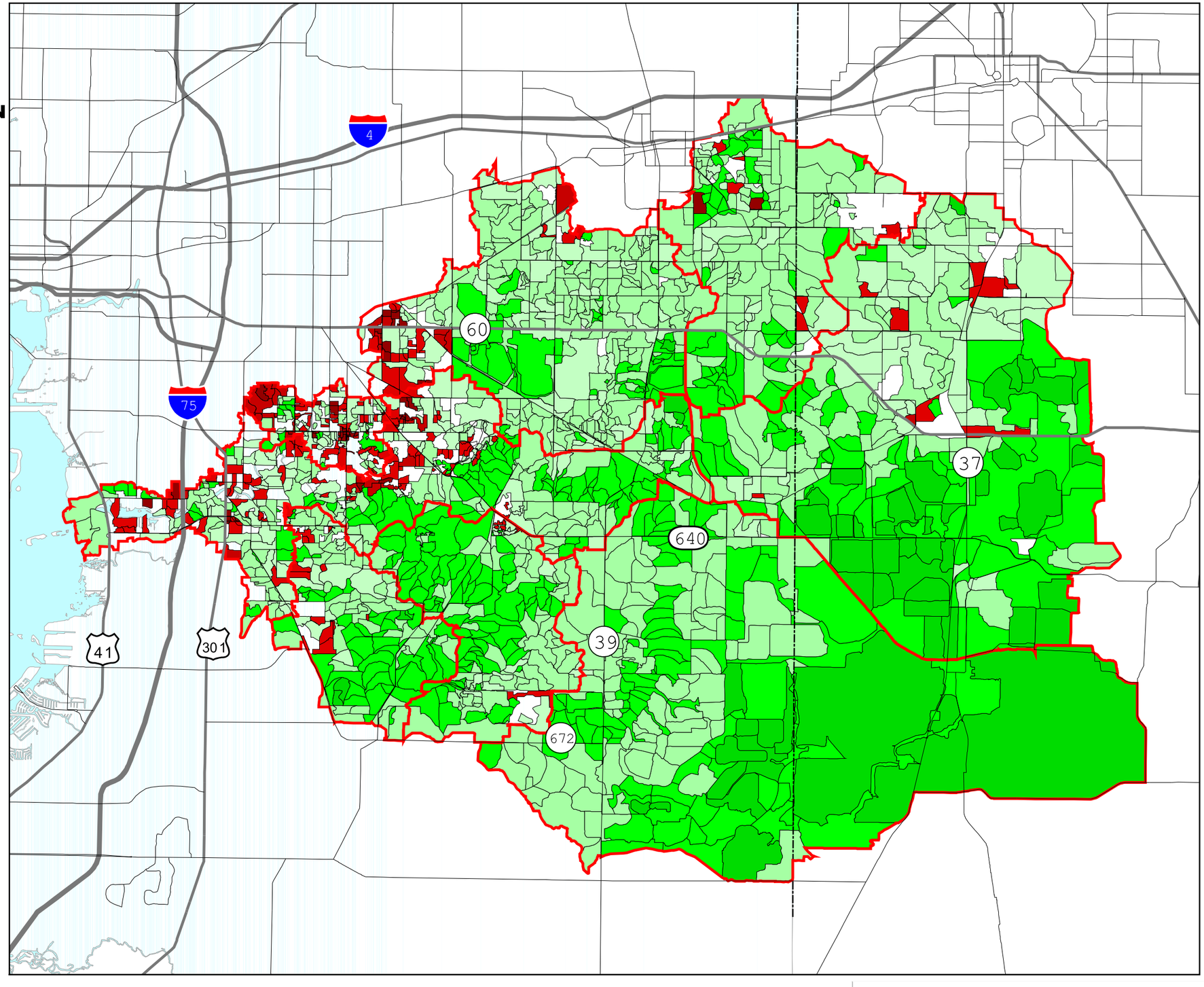
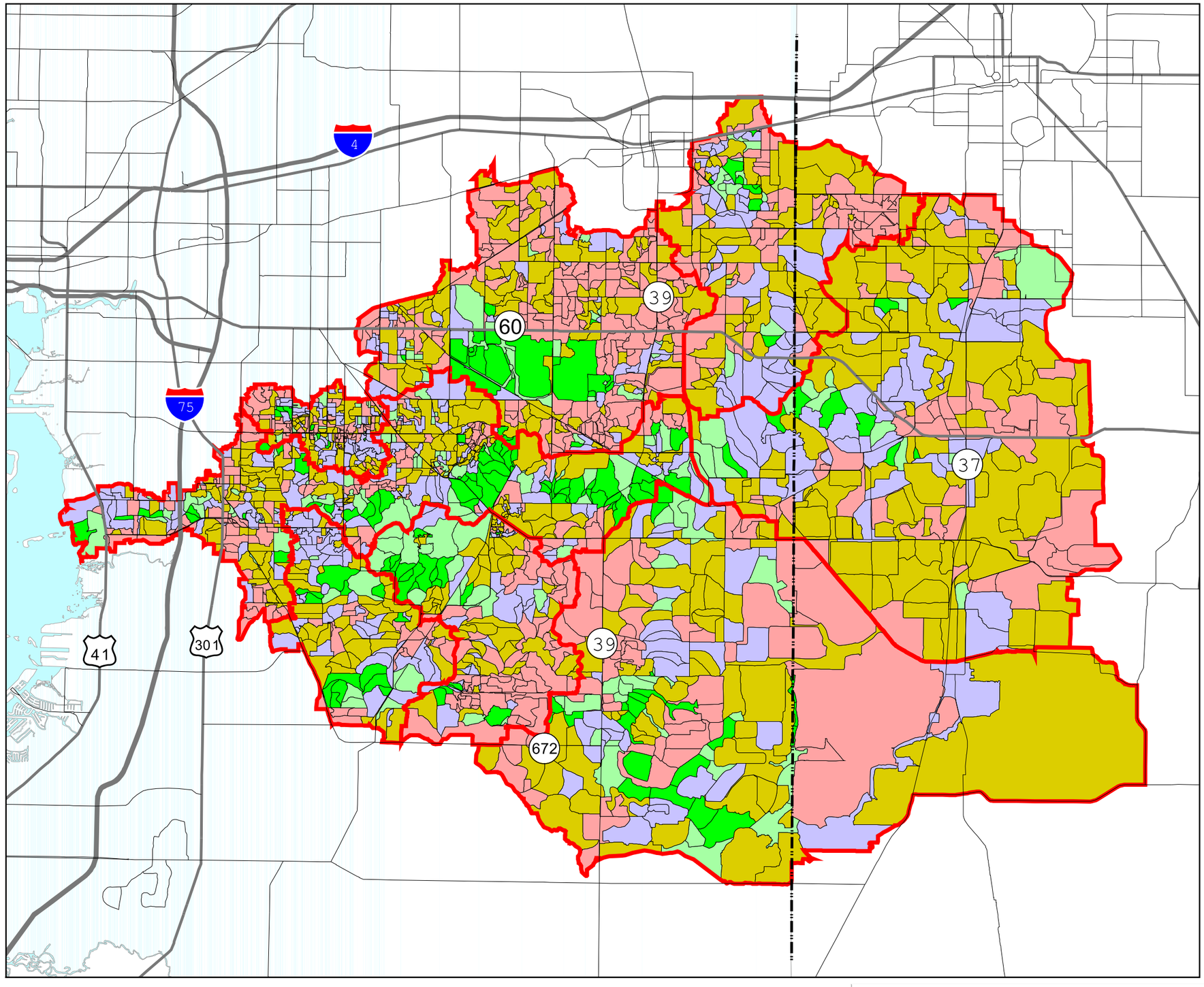


FIGURE 12.2-3
ALAFIA RIVER WATERSHED
SUBBASIN LEVEL-OF-SERVICE
NITROGEN



LEVEL-OF-SERVICE

- *A*
- *B*
- *C*
- *D*
- *F*
- *Subwatershed Boundary*
- *County Boundary*

3 0 3 Miles

Scale: 1" = 3 Miles

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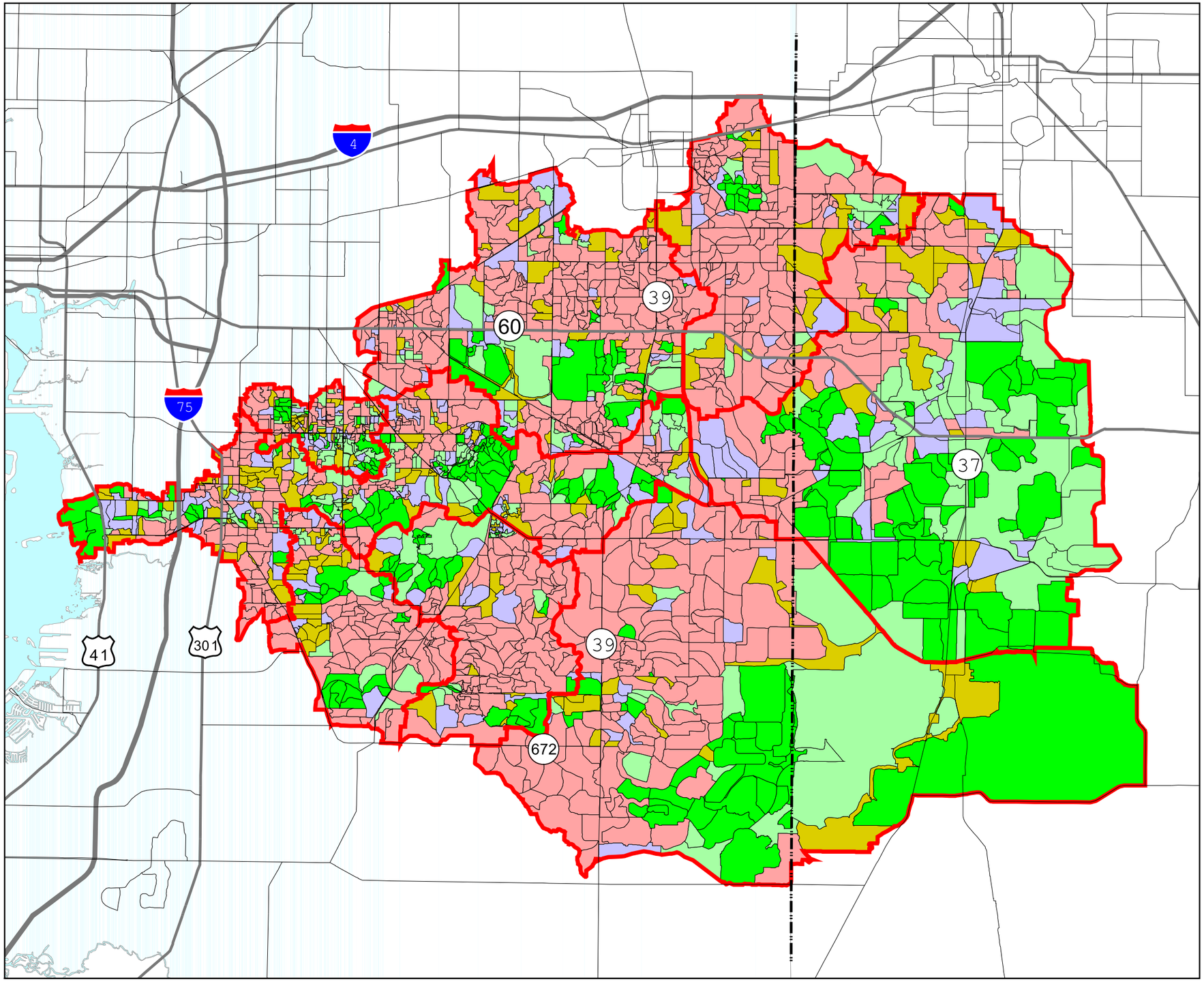
FIGURE 12.2-4
ALAFIA RIVER WATERSHED
SUBBASIN LEVEL-OF-SERVICE
PHOSPHOROUS



LEVEL-OF-SERVICE

- *A*
- *B*
- *C*
- *D*
- *F*
- *Subwatershed Boundary*
- *County Boundary*

3 0 3 Miles

Scale: 1" = 3 Miles

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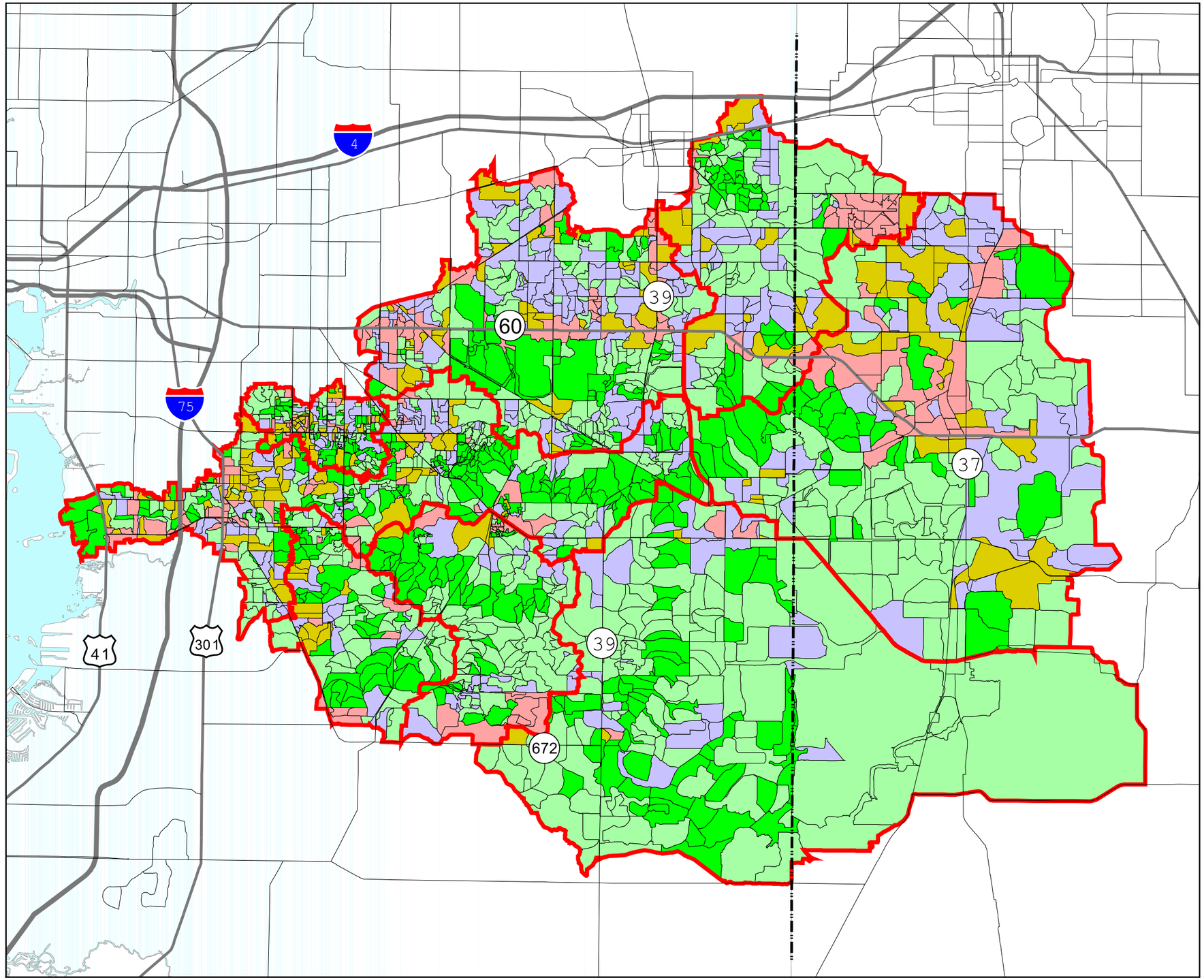
FIGURE 12.2-5
ALAFIA RIVER WATERSHED
SUBBASIN LEVEL-OF-SERVICE
SUSPENDED SOLIDS



LEVEL-OF-SERVICE

- *A*
- *B*
- *C*
- *D*
- *F*
- *Subwatershed Boundary*
- *County Boundary*

3 0 3 Miles

Scale: 1" = 3 Miles

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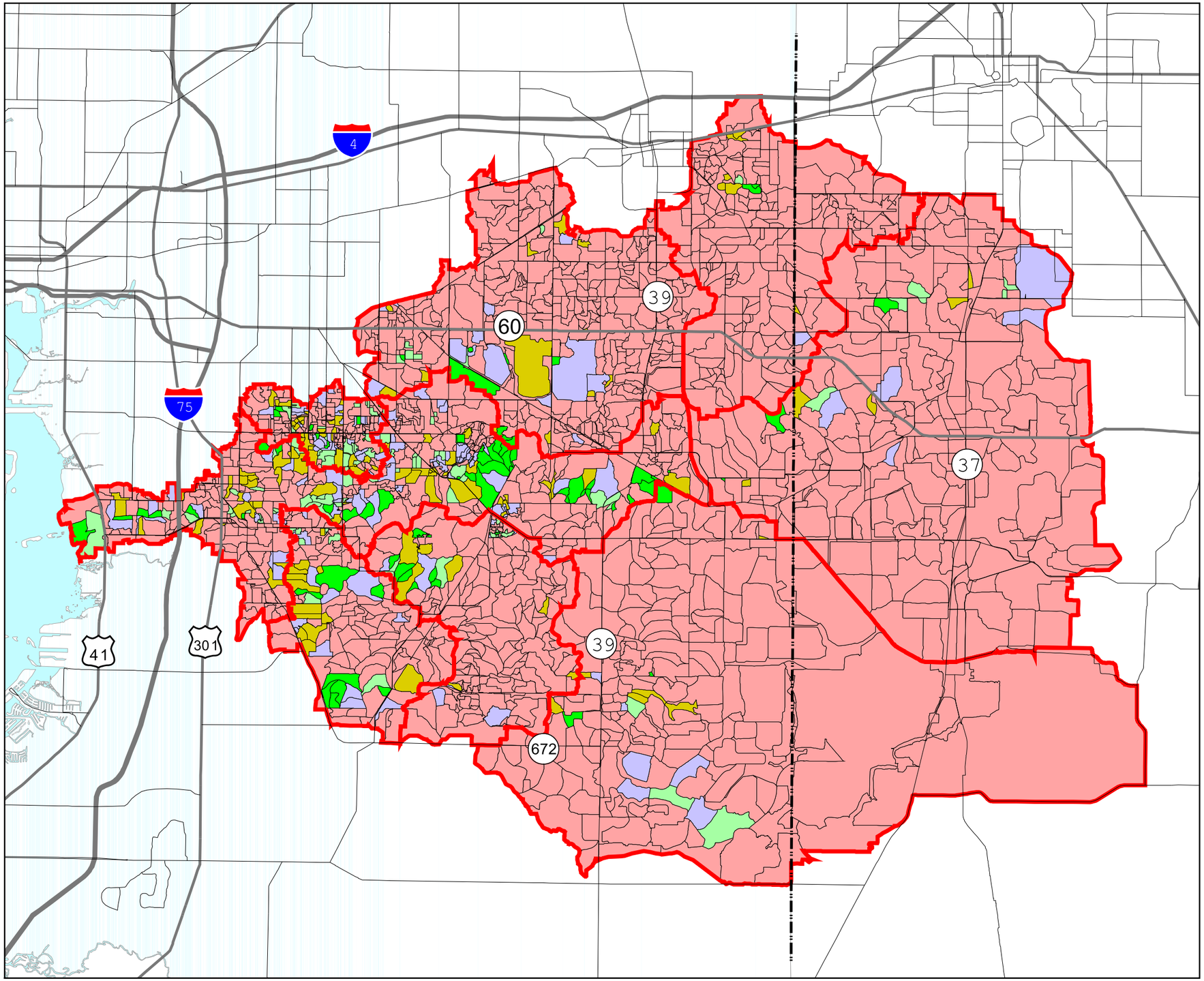
FIGURE 12.2-6
ALAFIA RIVER WATERSHED
SUBBASIN LEVEL-OF-SERVICE
BIOCHEMICAL OXYGEN DEMAND



LEVEL-OF-SERVICE

- *A*
- *B*
- *C*
- *D*
- *F*
- *Subwatershed Boundary*
- *County Boundary*

3 0 3 Miles

Scale: 1" = 3 Miles

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