FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration

NORTHEAST DISTRICT • LOWER ST. JOHNS BASIN

Final TMDL Report

Fecal Coliform TMDL for Sherman Creek, WBID 2227

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Florida Department of Environmental Protection, Bureau of Watershed Management

Total Maximum Daily Load (TMDL) Program
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Identification of Impaired Surface Waters Rule
http://www.dep.state.fl.us/legal/Rules/shared/62-303/62-303.pdf

STORET Program
http://www.dep.state.fl.us/water/storet/index.htm

2008 305(b) Report
http://www.dep.state.fl.us/water/docs/2008_Integrated_Report.pdf

Criteria for Surface Water Quality Classifications
http://www.dep.state.fl.us/water/wqssp/classes.htm

Basin Status Reports for the Lower St. Johns Basin
http://www.dep.state.fl.us/water/basin411/sj_lower/status.htm

Water Quality Assessment Reports for the Lower St. Johns Basin
http://www.dep.state.fl.us/water/basin411/sj_lower/assessment.htm

U.S. Environmental Protection Agency

Region 4: Total Maximum Daily Loads in Florida
http://www.epa.gov/region4/water/tmdl/florida/

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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal coliform for Sherman Creek in the Intracoastal Waterway Planning Unit of the Lower St. Johns River Basin. The creek was verified as impaired for fecal coliform, and was included on the Verified List of impaired waters for the Lower St. Johns River Basin that was adopted by Secretarial Order in May 2004. This TMDL establishes the allowable loadings to Sherman Creek that would restore the waterbody so that it meets its applicable water quality criterion for fecal coliform.

1.2 Identification of Waterbody

Sherman Creek, located in Duval County in northeast Florida, drains an area of about 6.54 square miles (mi^2). The creek flows directly into Pablo Creek, which serves as the Intracoastal Waterway (**Figures 1.1** and **1.2**). The WBID also contains Puckett Creek, a large tributary to Sherman Creek, and is tidally influenced. Sherman Creek is approximately 4.6 miles long and is a second-order stream.

The Sherman Creek watershed is centrally located in the extreme eastern part of Duval County, on the coast near the central edge of the City of Jacksonville, with Manhattan Beach, Atlantic Beach, and Mayport nearby. The Atlantic Ocean is located to the east of the watershed and the Intracoastal Waterway to the west. Additional information about the creek's hydrology and geology are available in the Basin Status Report for the Lower St. Johns Basin (Florida Department of Environmental Protection [Department], 2002).

For assessment purposes, the Department has divided the Lower St. Johns Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Sherman Creek consists of one segment, WBID 2227, which this TMDL addresses (**Figure 1.2**).

Sherman Creek is part of the Intracoastal Waterway Planning Unit. Planning units are groups of smaller watersheds (WBIDs) that are part of a larger basin unit, in this case the Lower St. Johns Basin. The Intracoastal Waterway Planning Unit consists of 20 WBIDs. **Figure 1.3** shows Sherman Creek's location in the planning unit and the boundaries of the other WBIDs in the planning unit.

Figure 1.1. Locations of Sherman Creek Watershed and Major Geopolitical Features in the Lower St. Johns Basin

Figure 1.2. Overview of the Sherman Creek Watershed, WBID 2227

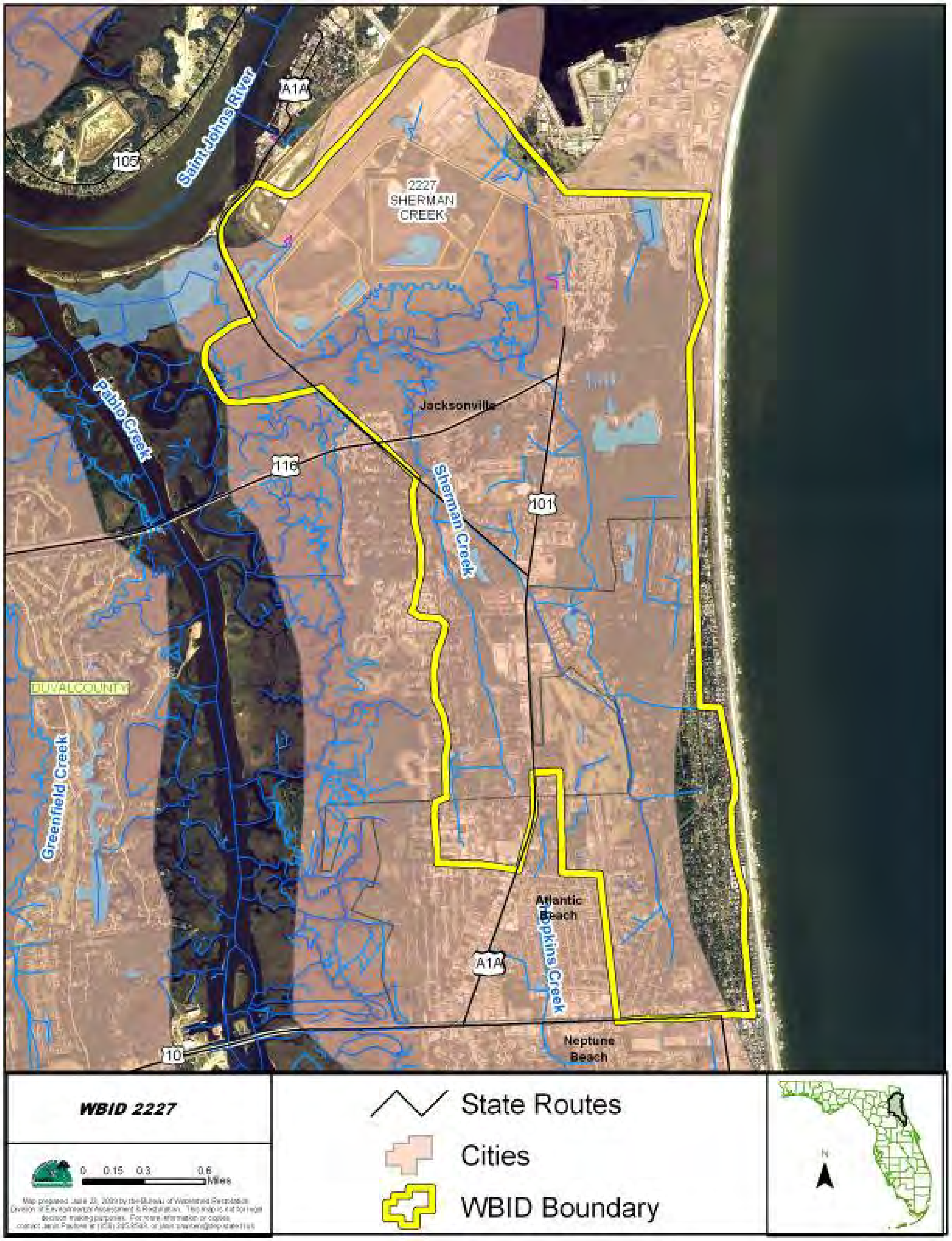
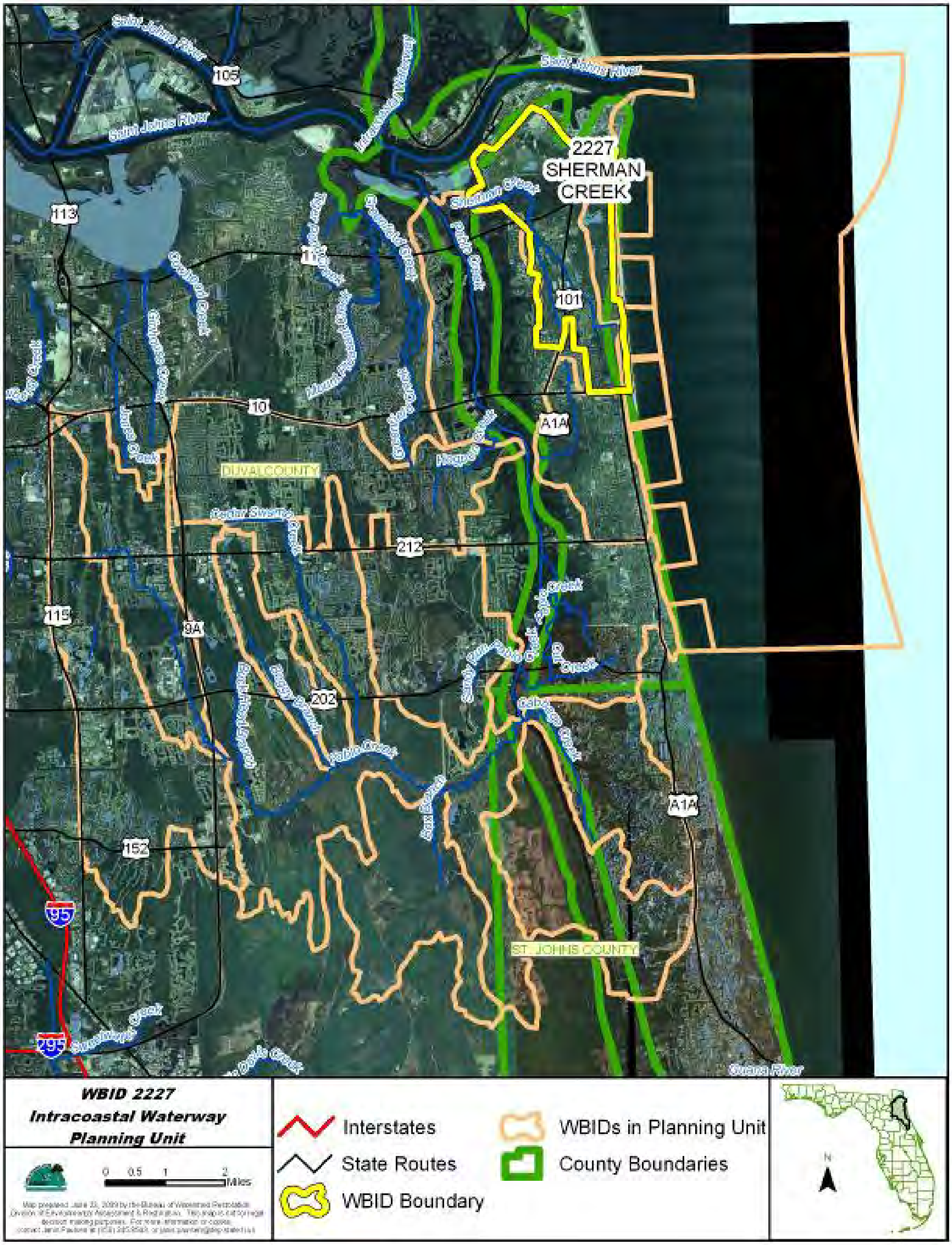


Figure 1.3. WBIDs in the Intracoastal Waterway Planning Unit



1.3 Background

This report was developed as part of the Department's watershed management approach for restoring and protecting state waters and addressing TMDL Program requirements. The watershed approach, which is implemented using a cyclical management process that rotates through the state's 52 river basins over a 5-year cycle, provides a framework for implementing the TMDL Program–related requirements of the 1972 federal Clean Water Act and the 1999 Florida Watershed Restoration Act (FWRA) (Chapter 99-223, Laws of Florida).

A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still meet water quality standards, including its applicable water quality criteria and its designated uses. TMDLs are developed for waterbodies that are verified as not meeting their water quality standards. They provide important water quality restoration goals that will guide restoration activities.

This TMDL Report will be followed by the development and implementation of a Basin Management Action Plan, or BMAP, to reduce the amount of fecal coliform that caused the verified impairment of the Sherman Creek. These activities will depend heavily on the active participation of the St. Johns River Water Management District (SJRWMD), the City of Jacksonville, Jacksonville Electric Authority (JEA), local businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for impaired waterbodies.

Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act requires states to submit to the U.S. Environmental Protection Agency (EPA) a list of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment of these waters on a schedule. The Department has developed such lists, commonly referred to as 303(d) lists, since 1992. The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4], Florida Statutes [F.S.]), and the state's 303(d) list is amended annually to include basin updates.

Florida's 1998 303(d) list included 55 waterbodies and 277 parameters in the Lower St. Johns Basin. However, the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rule-making process, the Environmental Regulation Commission adopted the new methodology as Rule 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001; the rule was amended in 2006 and again in 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Sherman Creek and has verified that the creek is impaired for fecal coliform based on data in the Department's IWR database. **Tables 2.1** through **2.3** provide summary results for fecal coliform data for the verification period (which for Group 2 waters was January 1, 1996, to June 30, 2003), by month, season, and year, respectively.

There is a 41.6 percent overall exceedance rate for fecal coliform in Sherman Creek. Exceedances occur in all months except March and July, with 100 percent exceedances in August (**Table 2.1**). Sample size for each month is small, with all months having fewer than 10 samples; 6 have fewer than 5 samples. There is a total of 60 samples, ranging from 4 to 42,000 counts per 100 milliliters (counts/100

mL).

When aggregating data by season, the lowest percentage of exceedances occurs in the winter and fall, and the highest in summer, indicating that perhaps concentrations are influenced by warmer weather. There is at least a 33.33 percent exceedance rate across each season (**Table 2.2**).

By year, there appears to be a general downward trend in exceedances from 1996 to 2002, except for 2000. However, there is only one sample from 1996; all other years have at least nine samples (**Table 2.3**).

There are 5 sites with historical data. Two sites only have 1 sample; the other 3 have at least 19 samples. **Section 5.1** discusses sampling stations further.

Table 2.1. Summary of Fecal Coliform Data by Month for the Verified Period (January 1, 1996–June 30, 2003)

NOTES:
Coliform counts are #/100mL.
Exceedances represent values above 400 counts/100mL.
Mean precipitation is for Jacksonville International Airport (JIA) in inches; means are monthly means based on data from 1955 to 2008.

Month	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances	Mean Precipitation
January	3	230	800	500	510	2	66.67%	2.39
February	6	110	5,000	265	1,180	2	33.33%	3.14
March	3	52	204	184	147	0	0.00%	3.95
April	3	20	3,000	2,200	1,740	2	66.67%	2.80
May	6	4	1,700	74	399	2	33.33%	1.61
June	6	20	5,000	270	1,767	2	33.33%	7.40
July	3	12	232	208	151	0	0.00%	6.72
August	3	700	800	800	767	3	100.00%	6.72
September	9	20	42,000	500	8,604	5	55.56%	9.94
October	8	10	5,800	110	799	1	12.50%	3.39
November	4	40	1,700	765	818	2	50.00%	1.81
December	6	20	4,100	850	1,357	4	66.67%	3.12

Table 2.2. Summary of Fecal Coliform Data by Season for the Verified Period (January 1, 1996–June 30, 2003)

NOTES:
Winter is January–March; spring is April–June; summer is July–September; fall is October–December.
Coliform counts are #/100mL.
Exceedances represent values above 400 counts/100mL.
Mean precipitation is for JIA in inches. Means are based on the three months that constitute each season from 1955 to 2008.

Season	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances	Mean Total Precipitation
Winter	12	52	5,000	230	754	4	33.33%	10.72
Spring	15	4	5,000	210	1.214	6	40.00%	12.41
Summer	15	12	42,000	500	5,346	8	53.33%	21.15
Fall	18	10	5,800	225	989	7	38.89%	8.34

Table 2.3. Summary of Fecal Coliform Data by Year for the Verified Period (January 1, 1996–June 30, 2003)

NOTES:
Coliform counts are #/100mL.
Exceedances represent values above 400 counts/100mL.
Precipitation is for JIA in inches, and represents the total precipitation for the year shown.

Year	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances	Total Precipitation
1996	1	1,300	1,300	1,300	1,300	1	100.00%	60.63
1998	9	20	5,000	700	1,069	5	55.56%	56.72
1999	12	20	1,700	225	390	5	41.67%	42.44
2000	12	20	42,000	2,600	7,754	8	66.67%	39.77
2001	12	20	5,000	285	793	5	41.67%	49.14
2002	14	4	5,800	97	506	1	7.14%	54.72

Chapter 3: DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criteria Applicable to the TMDL

Florida's surface waters are protected for five designated use classifications, as follows:

Class I	**Potable water supplies**
Class II	**Shellfish propagation or harvesting**
Class III	**Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife**
Class IV	**Agricultural water supplies**
Class V	**Navigation, utility, and industrial use (there are no state waters currently in this class)**

Sherman Creek is a Class III fresh waterbody, with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to the impairment addressed by this TMDL is for fecal coliform.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

3.2.1 Fecal Coliform Criterion

Numeric criteria for bacterial quality are expressed in terms of fecal coliform bacteria concentrations. The water quality criterion for the protection of Class III waters, as established by Rule 62-302, F.A.C., states the following:

> ***Fecal Coliform Bacteria**:*
> *The most probable number (MPN) or membrane filter (MF) counts per 100 mL of fecal coliform bacteria shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day.*

The criterion states that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. However, there were insufficient data (fewer than 10 samples in a given month) available to evaluate the geometric mean criterion for fecal coliform bacteria. Therefore, the criterion selected for the TMDs was not to exceed 400.

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of pollutants in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either "point sources" or "nonpoint sources." Historically, the term "point source" has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term "nonpoint sources" was used to describe intermittent, rainfall-driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from failing septic systems; and atmospheric deposition.

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA's National Pollutant Discharge Elimination System (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, such as those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with Clean Water Act definitions, the term "point source" will be used to describe traditional point sources (such as domestic and industrial wastewater discharges) **AND** stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 6.1**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

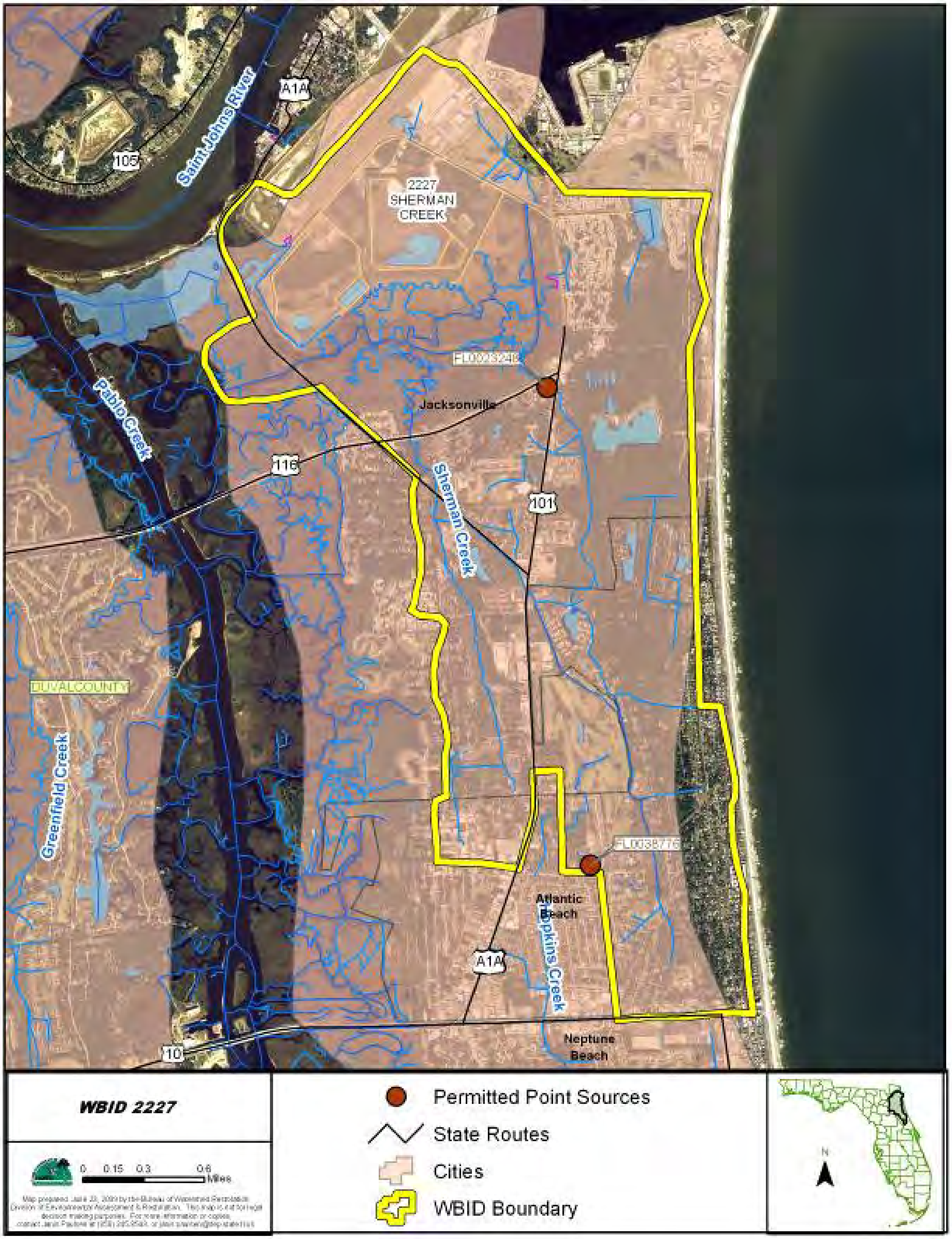
4.2 Potential Sources of Coliform in the Sherman Creek Watershed

4.2.1 Point Sources

There are two domestic wastewater facilities located in the watershed: Buccaneer WWTF (Permit #FL0023248) and Atlantic Beach WWTF (Permit #FL0038776) (**Figure 4.1**). The Atlantic Beach facility is the primary WWTF; the Buccaneer facility is a secondary facility that also services the Atlantic Beach area.

The Atlantic Beach facility has two permitted outfalls that discharge into the St Johns River east of the confluence with the Intracoastal Waterway. The Buccaneer facility also discharges into the St. Johns River. Although both facilities are physically located in the Sherman Creek watershed, neither is permitted to discharge into Sherman Creek or any tributaries to Sherman Creek; therefore, there should be no impacts in the watershed from either of these facilities. The facilities discharge into the main stem of the Lower St Johns River.

Figure 4.1. Permitted Discharges in the Sherman Creek Watershed



Municipal Separate Storm Sewer System Permittees

The City of Jacksonville and the Florida Department of Transportation (FDOT) District 2 are co-permittees for a Phase I NPDES municipal separate storm sewer system (MS4) permit (Permit #FLS000012) that covers the Sherman Creek watershed. FDOT and the Cities of Jacksonville, Neptune Beach, and Atlantic Beach share responsibility for the permit.

Figure 4.2 shows the stormwater infrastructure of the watershed. Outfalls represent points where a stormwater conveyance discharges into a separate stormwater system through a channelized or natural waterway. Inlets are a component of the stormwater system located along the curbed edge of paved surfaces or at the low point of an area to provide for the collection of stormwater runoff, access for inspection and maintenance, pipe junctions, sediment traps, or conflicts with other utilities (K. Grable, personal communication, October 16, 2008). In the Sherman Creek watershed, there are 15 outfalls and 175 inlets.

4.2.2 Land Uses and Nonpoint Sources

Additional coliform loadings to Sherman Creek are generated from nonpoint sources in the watershed. Potential nonpoint sources of coliform include loadings from surface runoff, wildlife, pets, leaking or overflowing sewer lines, and leaking septic tanks.

Land Uses

The spatial distribution and acreage of different land use categories were identified using the 2004 land use coverage contained in the Department's Geographic Information System (GIS) library, initially provided by the SJRWMD. Land use categories and acreages in the watershed were aggregated using the Level 2 codes tabulated in **Table 4.1. Figure 4.3** shows the principal land uses in the watershed.

The Sherman Creek watershed is a small, urbanized area. As **Table 4.1** shows, a large percentage of the land is high-density residential (20.1 percent); medium-density residential areas occupy another 15 percent of the watershed. Because the watershed is located near estuarine areas, another 16 percent contains wetlands. There are no agricultural areas. A portion of the Mayport Naval Base is located in the watershed. Natural areas occupy approximately 33 percent (1,396.1 acres) of the land in the watershed, and non-natural areas about 67 percent (2,789 acres).

Figure 4.2. Stormwater Infrastructure in the Sherman Creek Watershed

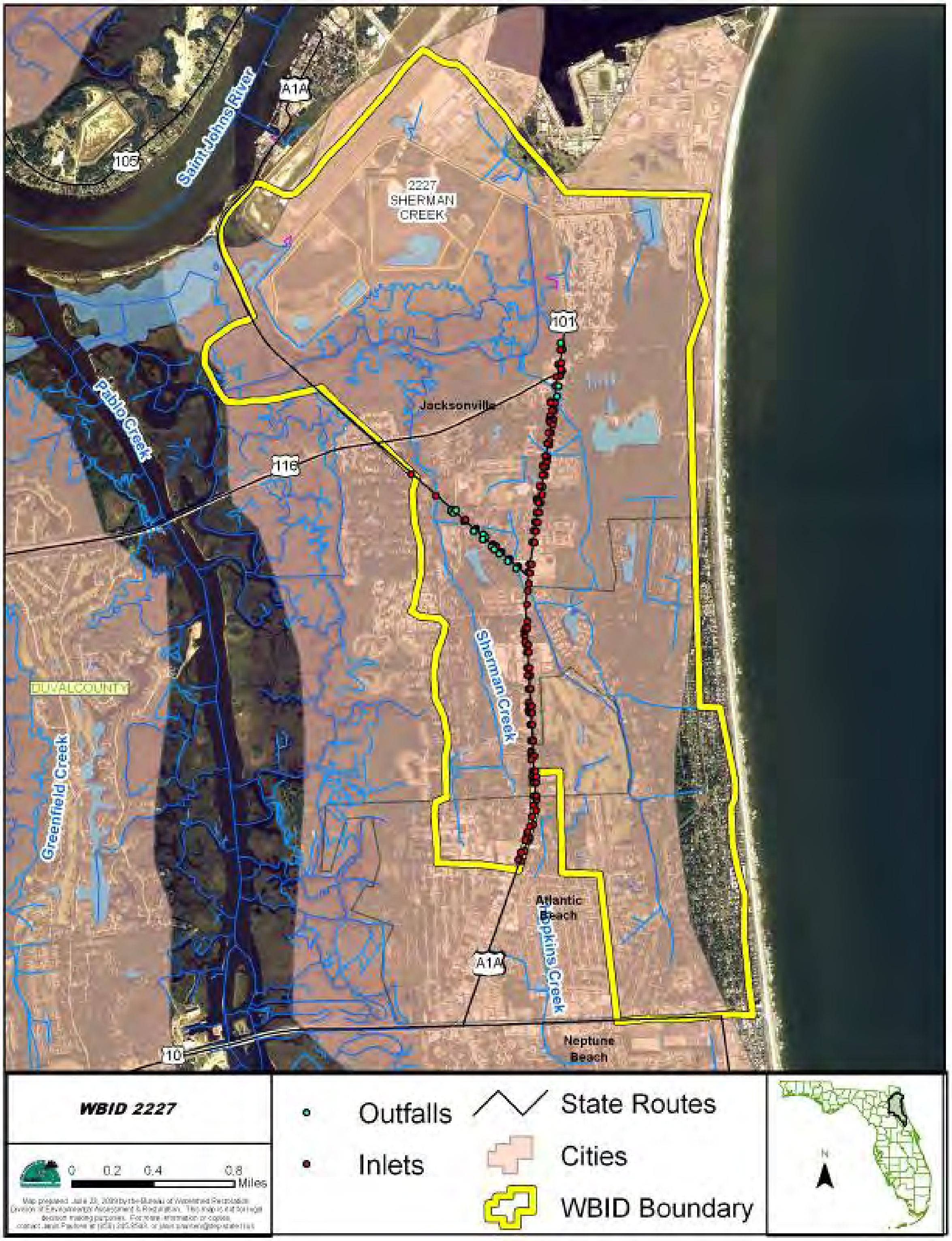


Figure 4.3. Principal Land Uses in the Sherman Creek Watershed

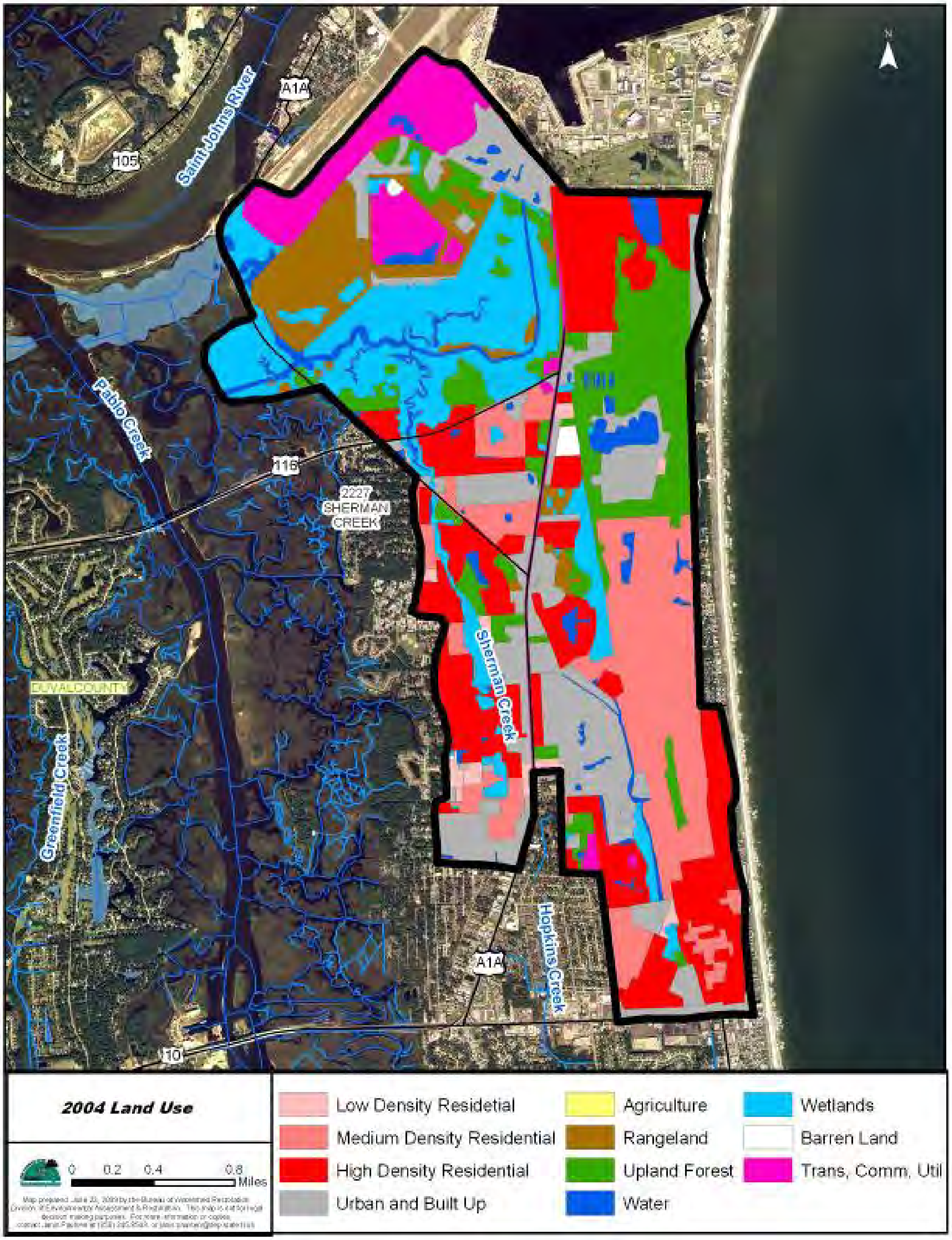


Table 4.1. Level 2 Land Use Categories in the Sherman Creek Watershed

2004 Land Use	Acres	% of Total
Residential, high density – 6 or more dwelling units/acre	841.68	20.11%
Residential, medium density – 2 to 5 dwelling units/acre	630.15	15.05%
Vegetated nonforested wetlands	551.2	13.17%
Upland hardwood forests	441.19	10.54%
Recreational	339.08	8.10%
Transportation	242.6	5.80%
Commercial and services	148.64	3.55%
Shrub and brushland (wax myrtle or saw palmetto, occasionally scrub)	135.95	3.25%
Institutional	133.43	3.19%
Wetland hardwood forests	116.8	2.79%
Reservoirs – pits, retention ponds, dams	95.46	2.28%
Herbaceous upland nonforested	88.29	2.11%
Utilities	81.71	1.95%
Streams and waterways	78.55	1.88%
Industrial	51.78	1.24%
Upland hardwood forests	45.72	1.09%
Residential, low density – less than 2 dwelling units/acre	44.07	1.05%
Mixed upland nonforested	36.71	0.88%
Upland coniferous forests	33.14	0.79%
Lakes	19.86	0.47%
Disturbed land	13.1	0.31%
Bays and estuaries	11.1	0.27%
Wetland forested mixed	3.11	0.07%
Open land	2.04	0.05%
Sand other than beaches	0.3	0.01%
Total:	**4,185.66**	**100.00%**

Population

Population and housing unit information from the 2000 census at the block level was obtained from the U.S Census Bureau. GIS was used to estimate the fraction of each block in the Sherman Creek watershed and then applied to the block information to estimate the population and number of housing units. Based on **Table 4.2**, the population in the watershed is estimated at 1,756 people living in 611 households. According to the U.S. Census Bureau, census block population densities in the Sherman Creek watershed in the year 2000 ranged from 0 to 19,588 persons per square mile, with an average of 2,804 people/mi^2 in the watershed **(Figure 4.4)**. For all of Duval County, the Census Bureau reported a housing density of 426 houses per square mile. This places Duval County seventh in housing densities and population in Florida (U.S. Census Bureau Website, 2005). The estimated average housing density in Sherman Creek is 983 houses per square mile. This is twice that of Duval County, but much of Duval County is rural. In contrast, high housing densities would be expected in the Sherman Creek watershed because it is near the coast, which often attracts large numbers of people.

Figure 4.4. Population Density in the Sherman Creek Watershed in 2000

Septic Tanks

Approximately 78 percent of Duval County residences are connected to a wastewater treatment plant, while the rest use septic tanks (PBS&J, 2007; Florida Department of Health [FDOH] Website, 2006a. FDOH reports that as of fiscal year 2003–04, there were 88,834 permitted septic tanks in Duval County and for fiscal years 1993–2004, 5,479 permits for repairs were issued, or an average of approximately 457 repairs annually countywide.

As noted previously, there is an average of about 2,804 people/mi^2, or 18,336 people, in the watershed. The average household in the Sherman Creek watershed has 2.85 people (see **Table 4.2**). The Department obtained the FDOH 2008 coverage of septic tank repair permit data from 1990 to 2006 (**Figure 4.5** presents this information in map form). JEA also provided data for its service area, which includes the Sherman Creek watershed. The data include septic tank repair permit records issued from 1990 to 2006, areas serviced by a WWTF, and areas where large numbers of failing septic tanks are present. The data show there were 21 permits for repairs issued during this time in the watershed. For calculation purposes, an average of 2 permits issued per year was assumed. With 2 septic tank failures, 2.85 people per household, and using an estimate of 70 gallons/day/person (EPA, 2001), a potential loading of 1.51 x 10^{10} fecal colonies/day is derived. **Table 4.3** shows this estimation.

There are no septic tank phase-out areas (areas with the highest priority to be sewered to eliminate septic tanks due to high failure rates) in the Sherman Creek watershed; most of the area is serviced by either the Buccaneer WWTF or the Atlantic Beach WWTF.

Table 4.2. Estimation of Average Household Size in the Sherman Creek Watershed Area

NOTES: Data from U.S. Census Bureau Website, 2000, based on Duval County blocks present in the Sherman Creek watershed.
\- = Empty cell

Tract	Population	Housing Units
138	3,425	382
139.01	1,882	691
139.02	289	100
139.03	7,955	3,498
139.04	4,785	1,759
Total:	**18,336**	**6,430**
-	**AVERAGE HOUSEHOLD SIZE:**	**2.85**

Table 4.3. Estimation of Annual Fecal Coliform Loading from Failed Septic Tanks in the Sherman Creek Watershed

NOTES:
[1] Based on septic tank repair permits issued in the watershed from March 1990 to April 2004 (FDOH and JEA information); see text.
[2] From U.S Census Bureau; see **Table 4.2** for more information on this estimate.
[3] EPA, 2001.

Estimated Number of Tank Failures[1]	Estimated Number of Persons per Household[2]	Gallons/ Person/Day[3]	Estimated Load from Failed Tanks[3]	Estimated Daily Load (counts/day)	Estimated Annual Load (counts/year)
2	2.85	70	1.00 x 10^4/mL	1.51 x 10^{10}	5.51 x 10^{12}

Figure 4.5. Septic Tank Overflows in the Sherman Creek Watershed

4.2.3 Other Potential Sources

Pets

It is possible that pets, especially dogs, are having an impact on the waterbody. The Department has been unable to obtain data on the number of dogs in the area; however, estimates can be made using literature-based values of dog ownership rates (**Table 4.4**). For example, using household-to-dog ratio estimates from the American Veterinary Medical Association (AVMA), the approximate loading is 1.16 x 10^{12} organisms/day.

Table 4.4. Estimated Loading from Dogs in the Sherman Creek Watershed

NOTES:
[1] From the AVMA Website, 2006, which states the original source to be the *U.S Pet Ownership and Demographics Sourcebook,* 2002.
[2] EPA, 2001.

Estimated Number of Households	Estimated Household:Dog Ratio[1]	Estimated Dog Population in Watershed	Estimated Number of Dogs with Impact to Creek	Estimated Counts/ Dog/Day[2]	Estimated Daily Load (counts/day)	Estimated Annual Load (counts/year)
4,327	0.361	2,321	232	5 x 10^{9}	1.16 x 10^{12}	4.23 X 10^{14}

Leaking or Overflowing Wastewater Collection Systems

As noted previously, about 78 percent of households in Duval County are connected to a wastewater facility. Assuming 6,430 homes in the watershed, with 2.85 people per home, and a 70-gallon-per-person-per-day discharge, and also assuming that the countywide average of 78 percent of households connected to a WWTF applies in the Sherman Creek watershed, a daily flow of approximately 2.29 x 10^{6} liters (L) is transported through the collection system. The EPA (Davis, 2002) suggests that a 5 percent leakage rate from collection systems is a realistic estimate. Based on this rate and EPA values for fecal coliform in raw sewage, the potential loadings of fecal coliform from leaking sewer lines are 9.47 x 10^{13} counts/day (**Table 4.5**).

Table 4.5. Estimated Loading from Wastewater Collection Systems in the Sherman Creek Watershed

Estimated Homes on Central Sewer	Estimated Daily Flow (L)	Daily Leakage (L)	Raw Sewage (counts/100mL)	Estimated Daily Load (counts/day)	Estimated Annual Load (counts/year)
5,015	3.79 x 10^{6}	1.89 x 10^{5}	5 x 10^{6}	9.47 x 10^{12}	3.45 X 10^{15}

4.3 Source Summary

Table 4.6 summarizes the estimates from various sources. It is important to note that this is not a complete list and represents estimates of potential loadings. In addition, proximity to the waterbody, temperature, site-specific soil characteristics, and rainfall frequency and magnitude are just a few of the factors that could influence and determine the actual loadings from these sources that reach Sherman Creek. In addition, the types of best management practices (BMPs), both structural and nonstructural, that have been implemented for specific land uses in the watershed could reduce the actual fecal loads delivered to Sherman Creek. Finally, the age and condition of the septic systems and drainage characteristics in the watershed could affect assumptions about the assimilation and/or retention of coliform.

Table 4.6. Summary of Estimated Potential Coliform Loading from Various Sources in the Sherman Creek Watershed

NOTE: N/A – Not applicable

Source	Fecal Coliform Estimated Daily Load (counts/day)	Fecal Coliform Estimated Annual Load (counts/year)
Permitted Facilities	N/A	N/A
Septic Tanks	1.51×10^{10}	5.51×10^{12}
Pets	9.47×10^{12}	$3.45 \text{ X } 10^{15}$

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The methodology used for this TMDL was the "percent reduction" methodology. The Department generally prefers to use the load duration curve or "Kansas" method for coliform TMDLs, but this method could not be used because there are no stream gauging stations on Sherman Creek. To determine the TMDL, the percent reduction that would be required for each of the exceedances to meet the applicable criterion was determined, and the median value of all of these reductions for fecal coliform determined the overall required reduction, and is therefore the TMDL.

5.1.1 Data Used in the Determination of the TMDL

There are five sampling stations on Sherman Creek with historical coliform observations (**Figure 5.1**). The primary collector of historical data is the City of Jacksonville, which maintained routine (quarterly) sampling sites at Wonderwood Drive on both Sherman Creek (STORET ID: SC3) and Puckett Creek (STORET ID: SC1), and Sherman Creek at the A1A Bridge (STORET ID: IWW2). The Department sampled two sites once in 2002: Sherman Creek at Bridge and Sherman Creek Tributary at Wonderwood Drive. **Table 5.1** shows data collection information for each of the stations, and **Figure 5.1** shows the locations of the sample sites. **Table 5.2** summarizes observed historical data, and **Appendix B** contains all the fecal coliform observations for the entire period of record from the sites for the planning and verified periods for the Lower St. Johns Basin. **Figure 5.2** shows the historical observations visually over time.

All 3 sites sampled by the City of Jacksonville have exceedances. The highest percentage of exceedances occurred on Puckett Creek at Wonderwood Drive (69 percent), followed by Sherman Creek at Wonderwood Drive (58 percent), and Sherman Creek at A1A Bridge (18 percent). All data were considered in the development of the TMDL.

Table 5.1. Sampling Station Summary for the Sherman Creek Watershed, 1996–2008 (excluding 1997)

NOTE:
- = Empty cell/no data

Station	STORET ID	Station Owner	1996	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
21FLA 20030736	Sherman Cr Trib at Wonderwood Dr.	Department	-	-	-	-	-	1	-	-	-	-	6	2
21FLA 27010002	Sherman Cr at Bridge	Department	-	-	-	-	-	1	-	-	-	-	6	2
21FLJXWQIWW2	Sherman Creek at A1A Bridge	City of Jacksonville	2	6	8	8	8	4	4	3	4	4	6	-
21FLJXWQSC1	Puckett Creek at Wonderwood Dr	City of Jacksonville	-	6	8	8	8	4	4	2	4	4	6	-
21FLJXWQSC3	Sherman Creek at Wonderwood Dr	City of Jacksonville	-	6	8	8	8	4	4	3	4	4	6	-
-	-	**N**	**2**	**18**	**24**	**24**	**24**	**14**	**12**	**8**	**12**	**12**	**30**	**4**
-	-	**Total**	**184**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table 5.2. Statistical Summary of Historical Data for Sherman Creek

NOTE:
Coliform concentrations are counts/100mL.

Station	N	Max	Min	Median	Number of Exceedances	% Exceedances
21FLA 20030736	9	2,200	105	267	3	33%
21FLA 27010002	9	167	6	30	0	0%
21FLJXWQIWW2	57	3,000	4	40	10	18%
21FLJXWQSC1	54	31,000	84	680	37	69%
21FLJXWQSC3	55	42,000	20	500	32	58%

Figure 5.1. Historical Sample Sites in the Sherman Creek Watershed

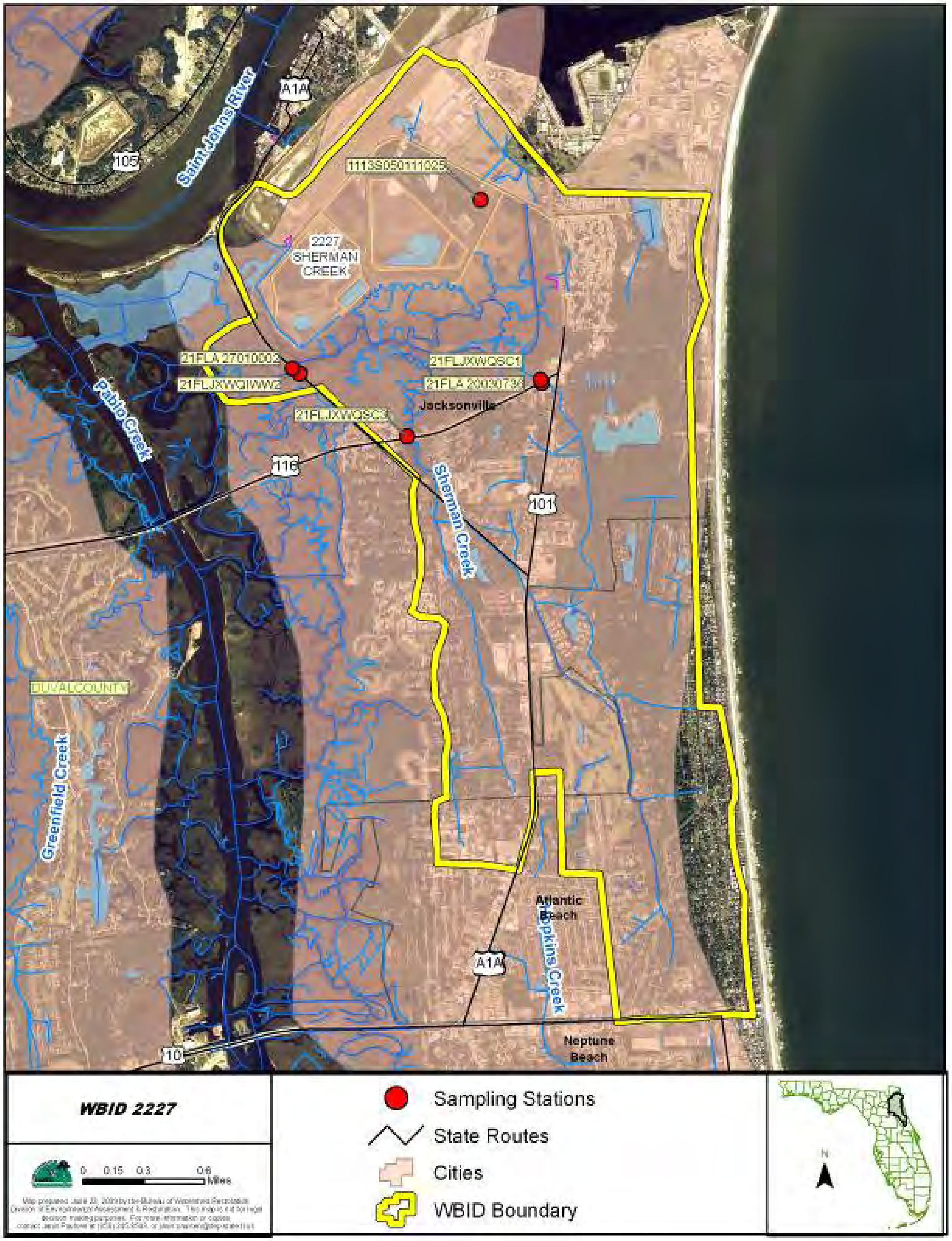
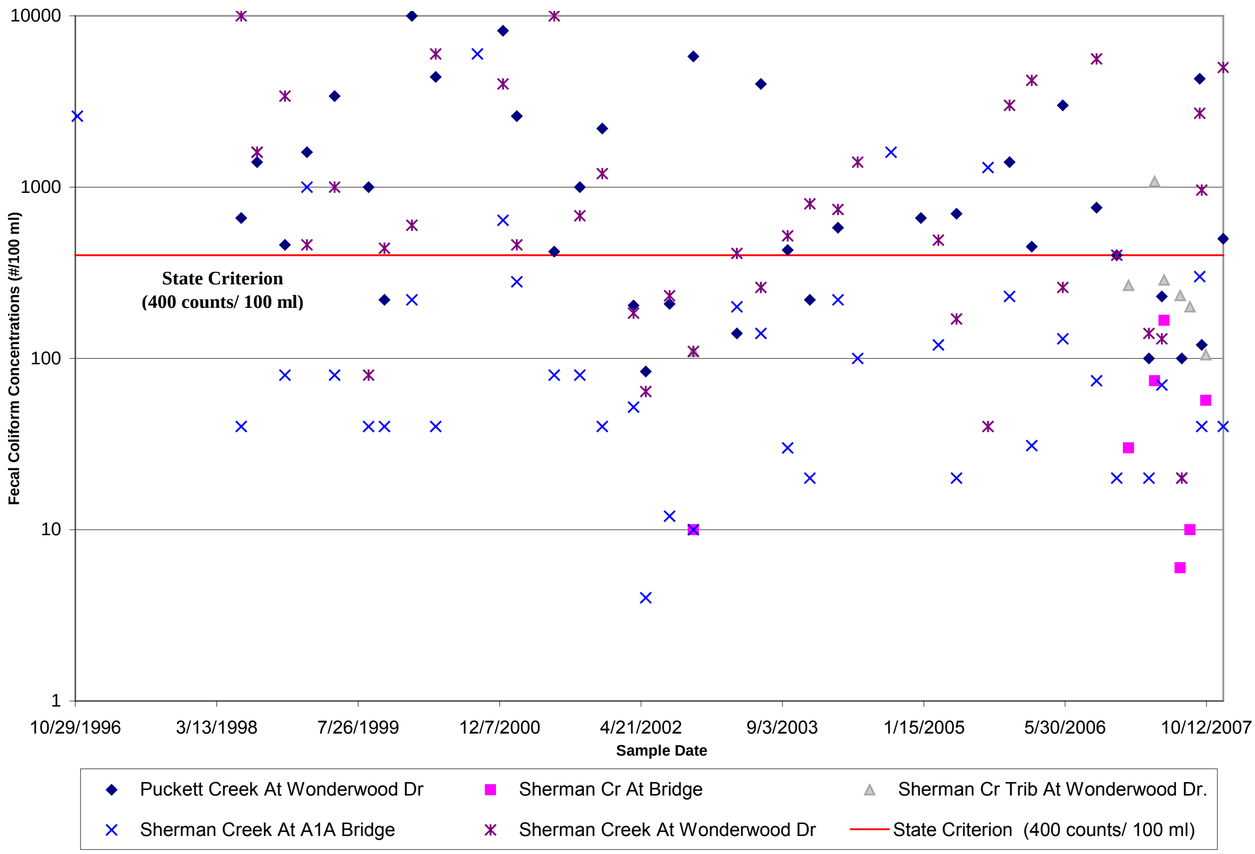


Figure 5.2. Historical Fecal Coliform Observations in Sherman Creek



5.1.2 TMDL Development Process

Due to the lack of supporting flow information, a simple calculation was performed to determine the needed reduction. Exceedances of the state criterion were compared with the criterion of 400 counts/100mL. For each individual exceedance, an individual required reduction was calculated using the following:

$$\frac{[(\text{observed value}) - (\text{state criterion})] \times 100}{(\text{observed value})}$$

After the individual results were calculated, the median of the individual values was calculated, which is 71 percent in Sherman Creek. This means that in order to meet the state criterion of 400 counts/100mL in Sherman Creek, a 71 percent reduction in current loading is necessary and is therefore the TMDL for Sherman Creek. **Table 5.3** show the individual exceedances used in calculating the TMDL for Sherman Creek.

Table 5.3. Calculations To Determine the Fecal Coliform TMDL for Sherman Creek

Sample Date	Location	Observed Exceedance (#/100mL)	Required % Reduction
11/5/1996	Sherman Creek at A1A Bridge	2,600	85%
6/8/1998	Puckett Creek at Wonderwood Dr	660	39%
6/8/1998	Sherman Creek at Wonderwood Dr	10,000	96%
8/3/1998	Puckett Creek at Wonderwood Dr	1,400	71%
8/3/1998	Sherman Creek at A1A Bridge	1,600	75%
8/3/1998	Sherman Creek at Wonderwood Dr	1,600	75%
11/9/1998	Puckett Creek at Wonderwood Dr	460	13%
11/9/1998	Sherman Creek at Wonderwood Dr	3,400	88%
1/26/1999	Puckett Creek at Wonderwood Dr	1,600	75%
1/26/1999	Sherman Creek at A1A Bridge	1,000	60%
1/26/1999	Sherman Creek at Wonderwood Dr	460	13%
5/4/1999	Puckett Creek at Wonderwood Dr	3,400	88%
5/4/1999	Sherman Creek at Wonderwood Dr	1,000	60%
9/1/1999	Puckett Creek at Wonderwood Dr	1,000	60%
10/27/1999	Sherman Creek at Wonderwood Dr	440	9%
2/1/2000	Puckett Creek at Wonderwood Dr	10,000	96%
2/1/2000	Sherman Creek at Wonderwood Dr	600	33%
4/25/2000	Puckett Creek at Wonderwood Dr	4,400	91%
4/25/2000	Sherman Creek at Wonderwood Dr	6,000	93%
9/20/2000	Puckett Creek at Wonderwood Dr	62,000	99%
9/20/2000	Sherman Creek at A1A Bridge	6,000	93%
9/20/2000	Sherman Creek at Wonderwood Dr	84,000	100%
12/19/2000	Puckett Creek at Wonderwood Dr	8,200	95%
12/19/2000	Sherman Creek at A1A Bridge	640	38%
12/19/2000	Sherman Creek at Wonderwood Dr	4,000	90%
2/6/2001	Puckett Creek at Wonderwood Dr	2,600	85%
2/6/2001	Sherman Creek at Wonderwood Dr	460	13%
6/18/2001	Puckett Creek at Wonderwood Dr	420	5%
6/18/2001	Sherman Creek at Wonderwood Dr	10,000	96%
9/17/2001	Puckett Creek at Wonderwood Dr	1,000	60%
9/17/2001	Sherman Creek at Wonderwood Dr	680	41%
12/5/2001	Puckett Creek at Wonderwood Dr	2,200	82%
12/5/2001	Sherman Creek at Wonderwood Dr	1,200	67%
10/23/2002	Puckett Creek at Wonderwood Dr	5,800	93%
3/26/2003	Sherman Creek at Wonderwood Dr	410	2%
6/19/2003	Puckett Creek at Wonderwood Dr	4,000	90%
9/22/2003	Puckett Creek at Wonderwood Dr	430	7%
9/22/2003	Sherman Creek at Wonderwood Dr	520	23%
12/9/2003	Sherman Creek at Wonderwood Dr	800	50%
3/18/2004	Puckett Creek at Wonderwood Dr	580	31%
3/18/2004	Sherman Creek at Wonderwood Dr	740	46%
5/26/2004	Sherman Creek at Wonderwood Dr	1,400	71%
9/21/2004	Puckett Creek at Wonderwood Dr	12,000	97%
9/21/2004	Sherman Creek at A1A Bridge	1,600	75%

Sample Date	Location	Observed Exceedance (#/100mL)	Required % Reduction
9/21/2004	Sherman Creek at Wonderwood Dr	13,500	97%
1/5/2005	Puckett Creek at Wonderwood Dr	660	39%
3/8/2005	Sherman Creek at Wonderwood Dr	490	18%
5/11/2005	Puckett Creek at Wonderwood Dr	700	43%
8/30/2005	Puckett Creek at Wonderwood Dr	11,000	96%
8/30/2005	Sherman Creek at A1A Bridge	1,300	69%
11/14/2005	Puckett Creek at Wonderwood Dr	1,400	71%
11/14/2005	Sherman Creek at Wonderwood Dr	3,000	87%
2/1/2006	Puckett Creek at Wonderwood Dr	450	11%
2/1/2006	Sherman Creek at Wonderwood Dr	4,200	90%
5/22/2006	Puckett Creek at Wonderwood Dr	3,000	87%
9/18/2006	Puckett Creek at Wonderwood Dr	760	47%
9/18/2006	Sherman Creek at Wonderwood Dr	5,600	93%
11/28/2006	Puckett Creek at Wonderwood Dr	400	0%
11/28/2006	Sherman Creek at Wonderwood Dr	400	0%
4/11/2007	Sherman Cr Trib at Wonderwood Dr.	1,080	63%
9/18/2007	Puckett Creek at Wonderwood Dr	4,300	91%
9/18/2007	Sherman Creek at Wonderwood Dr	2,700	85%
9/25/2007	Sherman Creek at Wonderwood Dr	9,60	58%
12/10/2007	Puckett Creek at Wonderwood Dr	500	20%
12/10/2007	Sherman Creek at Wonderwood Dr	5,000	92%
4/23/2008	Sherman Cr Trib at Wonderwood Dr.	600	33%
5/19/2008	Sherman Cr Trib at Wonderwood Dr.	2,200	82%
	Median:	**1,400**	**71%**

5.1.3 Critical Conditions/Seasonality

Appendix B provides historical fecal coliform observations collected in Sherman Creek. Coliform data are presented by month, season, and year to determine whether certain patterns are evident in the dataset.

A nonparametric test (Kruskal-Wallis) was applied to the fecal coliform dataset to determine whether there were significant differences among months or seasons. At an alpha (α) level of 0.05, there are no significant differences among seasons (**Appendix C**). Grouping observations by season increased sample sizes for statistical comparison, as seen in **Table 2.2**. The highest percentage of exceedances occurred in the fall (October–December) and summer (June–August). **Appendix D** presents comparisons of stations and seasons.

Rainfall records for JIA (**Appendix E** illustrates rainfall from 1990 to 2008) were used to determine rainfall amounts associated with individual sampling dates. Rainfall recorded on the day of sampling (1D), the cumulative total for the day of and the previous 2 days (3D), the cumulative total for the day of and the previous 6 days (7D), and the cumulative total for the day of and the previous 30 days (30D) were all paired with the respective coliform observation. A Spearman correlation matrix was generated that summarized the simple correlation coefficients between rainfall and coliform values (**Appendix F**). The simple correlations (r values in the Spearman correlation table) between both fecal coliform and the various rainfall totals were positive, suggesting that as rainfall (and possible runoff) increased, so did the number of coliform.

Simple linear regressions were performed between coliform observations and rainfall totals to determine whether any of the relationships were significant at an α level of 0.05. The r^2 values between fecal coliform and the precipitation regimes showed no significance (**Appendix G**). A table of historical monthly average rainfall (**Appendix H**) indicates that monthly rainfall totals increase in June, peak in September, and by October return to levels observed in February and March. The highest percentage of exceedances occurred in the fall (October to December; see **Table 2.2**). **Appendix I** contains a table of annual rainfall from 1955 to 2008 at JIA; the long-term average was 52.47 inches over this period. There does not appear to be an obvious correlation between total annual precipitation and percent exceedance of fecal coliform.

Assessment of Hydrologic Conditions

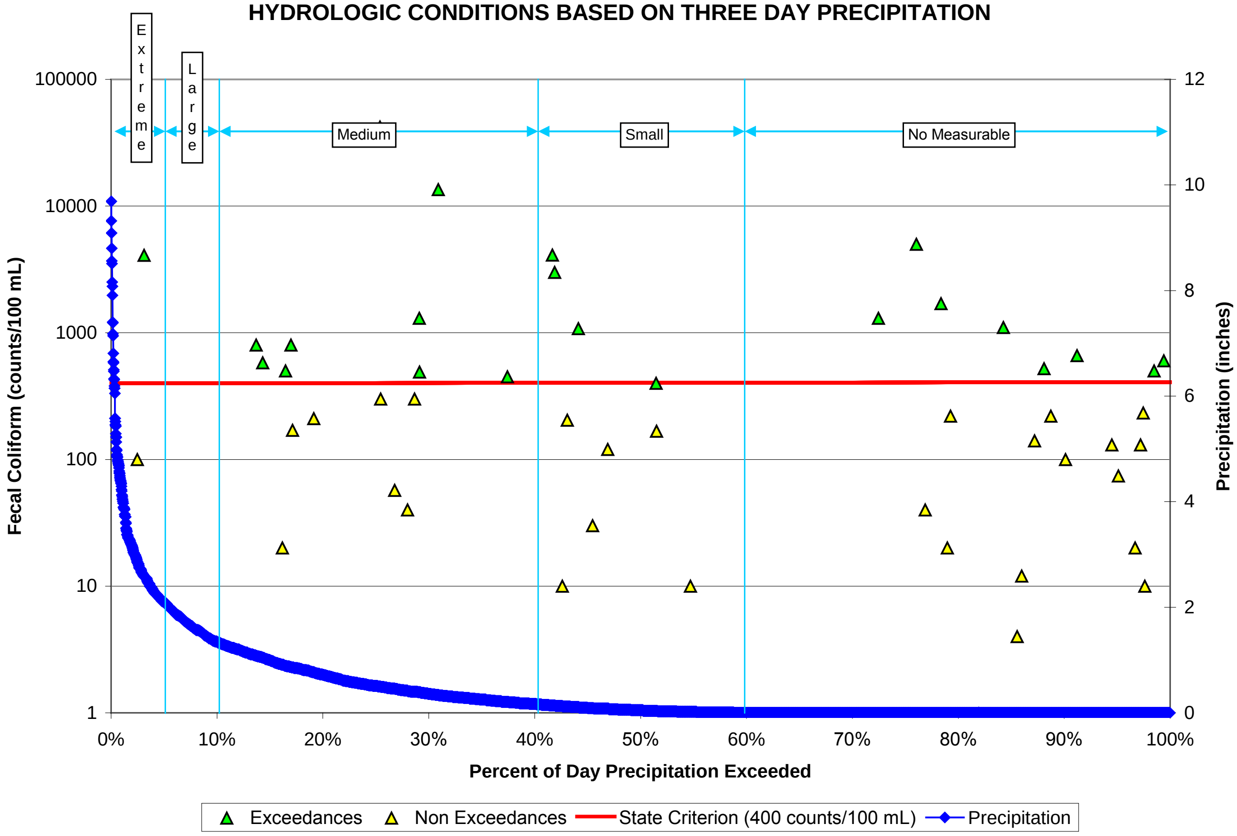
As no flow data were available, hydrologic conditions were analyzed using rainfall. A loading curve–type chart that would normally be applied to flow events was created using precipitation data from JIA from 1990 to 2004 instead. The chart was divided as if flow were being analyzed, where extreme precipitation events represent the upper percentiles (0–5th percentile), followed by large precipitation events (5th–10th percentile), medium precipitation events (10th–40th percentile), small precipitation events (40th–60th percentile), and no recordable precipitation events (60th–100th percentile). Three-day (the day of and 2 days prior to sampling) precipitation accumulations were used in the analysis.

Data show that fecal coliform exceedances occurred over all hydrologic conditions for which data exist, and all have at least a 50 percent exceedance rate. However, the lowest percentage of exceedances (50 percent) occurred after medium precipitation events (0.18 to 1.33 inches). There were no data collected within 3 days of an extreme precipitation event. The highest percentage of exceedances (100 percent) occurred after large precipitation events. If a high percentage of exceedances occurs during no measurable precipitation days, point sources are suspected to be contributing. Likewise, if a high percentage of exceedances occurs after large and extreme precipitation events, this may indicate that exceedances are nonpoint source driven, perhaps from stormwater conveyance systems or various land uses. It is difficult to draw conclusions without data from extreme event ranges; however, with exceedances spread throughout the ranges in which data exist, it is most likely that the exceedances stem from a variety of both point and nonpoint sources. **Table 5.4** summarizes data and hydrologic conditions, and **Figure 5.3** shows the same data visually.

Table 5.4. Summary of Fecal Coliform Data by Hydrologic Condition

Precipitation Event	Event Range (inches)	Total Samples	Number of Exceedances	% Exceedance	Number of Nonexceedances	% Nonexceedance
Extreme	>2.1"	2	1	50.00%	1	50.00%
Large	1.33" - 2.1"	0	0	0%	0	0%
Medium	0.18" - 1.33"	16	9	56.25%	7	43.75%
Small	0.01" - 0.18"	10	4	40.00%	6	60.00%
None/ Not Measurable	<0.01"	22	8	36.36%	14	63.64%

Figure 5.3. Fecal Coliform by Hydrologic Flow Condition for Sherman Creek



Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

The objective of a TMDL is to provide a basis for allocating acceptable loads among all of the known pollutant sources in a watershed so that appropriate control measures can be implemented and water quality standards achieved. A TMDL is expressed as the sum of all point source loads (wasteload allocations, or WLAs), nonpoint source loads (load allocations, or LAs), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\textbf{TMDL} = \sum \textbf{WLAs} + \sum \textbf{LAs} + \textbf{MOS}$$

As discussed earlier, the WLA is broken out into separate subcategories for wastewater discharges and stormwater discharges regulated under the NPDES Program:

$$\textbf{TMDL} \cong \sum \textbf{WLAs}_{\textbf{wastewater}} + \sum \textbf{WLAs}_{\textbf{NPDES Stormwater}} + \sum \textbf{LAs} + \textbf{MOS}$$

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (a) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for within the LA, and (b) TMDL components can be expressed in different terms (for example, the WLA for stormwater is typically expressed as a percent reduction, and the WLA for wastewater is typically expressed as mass per day).

WLAs for stormwater discharges are typically expressed as “percent reduction” because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges also differs from the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities, and instead are required to meet a performance standard of providing treatment to the “maximum extent practical” through the implementation of BMPs.

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. The TMDL for Sherman Creek is expressed in terms of both counts/100mL and percent reduction, and represents the maximum daily fecal coliform load the creek can assimilate and maintain the fecal coliform criterion (**Table 6.1**). Since the TMDL is a percent reduction, the reduction can be applied on a daily basis.

Table 6.1. TMDL Components for Sherman Creek

NOTE:
N/A – Not applicable

WBID	Parameter	TMDL (counts/100mL)	WLA for Wastewater (counts/day)	WLA for NPDES Stormwater (%)	LA (% Reduction)	MOS
2227	Fecal Coliform	400	N/A	71%	71%	Implicit

6.2 Load Allocation

A fecal coliform reduction of 71 percent is required in WBID 2227 from nonpoint sources. It should be noted that the load allocation includes loading from stormwater discharges that are not part of the NPDES Stormwater Program.

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

While there are currently no permitted facilities in the Sherman Creek watershed that require fecal coliform monitoring, any future facilities seeking an NPDES permit to discharge to Sherman Creek will be required to meet the limits set forth in their prospective permit. For fecal coliform, discharge concentrations will not exceed 200 counts/100mL as a monthly average, 400 counts/100mL in more than 10 percent of the samples, or 800 counts/100mL at any given time. Permitted limits will meet TMDL requirements and will therefore protect water quality.

6.3.2 NPDES Stormwater Discharges

The WLA for the City of Jacksonville and FDOT's MS4 permit is a 71 percent reduction in WBID 2227 in current anthropogenic fecal coliform loading. It should be noted that any MS4 permittee is only responsible for reducing the loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

While the LA and WLA for fecal coliform are expressed as the percent reductions needed to attain the applicable Class III criterion, it is the combined reductions from both anthropogenic point and nonpoint sources that will result in the required reduction of in-stream fecal and total coliform concentrations. However, it is not the intent of this TMDL to abate natural background conditions.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Department, 2001), an implicit MOS was assumed in the development of this TMDL by not allowing any exceedances of the state criterion, even though the actual criterion allows for 10 percent exceedances over the fecal coliform criterion of 400 counts/100mL.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Basin Management Action Plan

Following the adoption of this TMDL by rule, the next step in the TMDL process is to develop an implementation plan, or BMAP, for the TMDL. The first BMAP for the tributaries to the Lower St. Johns River will address the 10 worst-case impairments in the 55 tributaries impaired for fecal coliform. Any future BMAPs will address additional subsets of the tributaries listed for fecal coliform.

In addition to addressing failing septic tanks, the BMAP may include some sort of public education program about pet waste cleanup. As **Table 4.4** shows, potential impacts from dogs in the watershed could be significant. If pet owners are educated on the potential impacts their pets are having on Sherman Creek, and they are inclined to take action, this could potentially decrease a source load. When considering the significance of seven-day rainfall, this could be a potentially significant load to the stream.

Through the implementation of projects, activities, and additional source assessments in the BMAP, stakeholders expect the following outcomes:

- *Improved water quality trends in the tributaries of the Lower St. Johns River, which will also help improve water quality in the main stem of the river;*
- *Decreased loading of the target pollutant (fecal coliform);*
- *Enhanced public awareness of pollutant sources, pollutant impacts on water quality, and corresponding corrective actions;*
- *Enhanced understanding of basin hydrology, water quality, and pollutant sources; and*
- *The ability to evaluate management actions, estimate their benefits, and identify additional pollutant sources.*

7.1.1 Determination of Worst-Case WBIDs

The initial determination of the worst-case WBIDs uses a ranking method that establishes the severity of bacterial contamination based on the number of exceedances of fecal coliform colony counts—i.e., the number of total fecal coliform samples in a waterbody during the period of record to indicate how many samples are over 800, 5,000, and 10,000 colony counts. A combined rank is then created based on the number of exceedances in each category. The WBIDs are sorted from worst to best to provide a guideline for assessment priorities, with the worst-case waterbody ranked first. Future BMAPs will continue to address the worst-case waters first, using the ranking method.

7.1.2 Identification of Probable Sources

Tributary Pollutant Assessment Project

Initial sampling for the study on the six initial WBIDs of highest concern began on July 26, 2005, and was completed on February 1, 2006. The final deliverable (the *Tributary Pollutant Assessment Project Manual*) was submitted to JEA on June 1, 2006, and became available for public review and comment on June 16, 2006. Four types of fecal indicators (fecal coliform, *E. coli*., *Enterococci*, and coliphages) were studied. *Enterococcus faecalis* was also studied in an attempt to further identify potential sources of sewage, and samples were checked for human/ruminant primers.

The executive summary submitted to the Department by JEA and PBS&J is attached as **Appendix K**. The results of the study will be used to help guide the identification of restoration projects during BMAP development.

Technical Reports

In an effort to address the known impairments in the Lower St. Johns tributaries, the Department contracted with PBS&J to develop technical reports that describe and interpret the water quality, spatial, and geographic data from the Department, Duval County Health Department, City of Jacksonville, and JEA. The reports analyze the available data to identify the most probable sources of fecal coliform, which fall into five main categories, as follows: (1) stormwater, (2) onsite sewage treatment and disposal systems (OSTDS), (3) sewer infrastructure, (4) nonpoint sources such as pet waste, and (5) natural background such as wildlife. These reports were peer reviewed by technical stakeholders in the basin, who also provided additional input based on their knowledge of the tributaries.

7.1.3 Issues To Be Addressed in Future Watershed Management Cycles

The BMAP process identified the following items that should be addressed in future watershed management cycles to ensure that future BMAPs use the most accurate information:

- ***Source Identification****—Sources of fecal coliform impairment are particularly difficult to trace. For this reason, the BMAP includes source identification studies as management actions.*
- ***Septic Tanks****—The Department is implementing a study,* Evaluation of Septic Tank Influences on Nutrient Loading to the Lower St. Johns River Basin and Its Tributaries, *to better understand the nutrient and bacteria loading from septic tanks via ground water by monitoring conditions at representative sites. The study seeks to answer questions on potential OSTDS impacts and the attenuation of nitrogen, phosphorus, and bacteria (fecal coliform) by soil, under the range of conditions that represent typical OSTDS sites near impaired surface waters. It will also document the nutrients and bacteria in the receiving Lower St. Johns tributaries at each site. The results will provide information about the relative contribution of fecal coliform from septic tanks located near the impaired tributaries.*
- ***GIS Information****—During the BMAP process, the available GIS data, which provide a basis for some of the source analyses, have improved. As more information becomes available, the updated GIS database for the tributaries will*

be used to aid in source identification. This information will include determining the spatial locations for private wastewater systems and infrastructure, collecting jurisdictional or systemwide programs and activities on a WBID scale for future reporting and assessment, and systematically updating all GIS information databases used to compile the BMAP.

7.1.4 BMAP Implementation

The BMAP requires that all stakeholders implement their projects to achieve reductions as soon as practicable. However, the full implementation of the BMAP will be a long-term process. Some of the projects and activities in the BMAP are recently completed or currently ongoing, but several projects will require more time to design, secure funding, and construct. While funding the projects could be an issue, funding limitations do not affect the requirement that every entity must implement the activities listed in the BMAP.

Since BMAP implementation is a long-term process, the TMDL targets established for the Lower St. Johns Basin will not be achieved in the next five years. It may take even longer for the tributaries to respond to reduced loadings and fully meet applicable water quality standards. Regular follow-up and continued coordination and communication among the stakeholders will be essential to ensure the implementation of management strategies and the assessment of their incremental effects. Any additional management actions required to achieve TMDLs, if necessary, will be developed as part of BMAP follow-up.

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C. In 1994, the Department's stormwater treatment requirements were integrated with the stormwater flood control requirements of the state's water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations

Chapter 62-40, F.A.C., also requires the water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES stormwater permitting program to designate certain stormwater discharges as "point sources" of pollution. The EPA promulgated regulations and began implementing the Phase I NPDES Stormwater Program in 1990. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific standard industrial classification (SIC) codes, construction sites disturbing 5 or more acres of land, and master drainage systems of local governments with a population above 100,000, which are better known as MS4s. However, because the master drainage systems of most local governments in Florida are interconnected, the EPA has implemented Phase 1 of the MS4 permitting program on a countywide basis, which brings in all cities (incorporated areas), Chapter 298 urban water control districts, and FDOT throughout the 15 counties meeting the population criteria. The EPA authorized the Department to implement the NPDES Stormwater Program (except for tribal lands) in October 2000.

An important difference between the federal and state stormwater/environmental resource permitting programs is that the NPDES Program covers both new and existing discharges, while the state's program focuses on new discharges only. Additionally, Phase II of the NPDES Program, implemented in 2003, expands the need for these permits to construction sites between 1 and 5 acres, and to local governments with as few as 10,000 people. The revised rules require that these additional activities obtain permits by 2003. While these urban stormwater discharges are now technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution, such as domestic and industrial wastewater discharges. It should be noted that all MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Appendix B: Historical Fecal Coliform Observations in Sherman Creek

NOTES:
Underlined numbers/shaded cells represent values that exceed 400 counts/100mL.

***Remark Codes:**
A = Value reported is the mean of two or more determinations.
B = Results based upon colony counts outside the acceptable range.
K = Off-scale low. Actual value not known, but known to be less than value shown.
L = Off-scale high. Actual value not known, but known to be greater than value shown.
P = Too numerous to count.
Q = Sample held beyond normal holding time.
U = Material was analyzed for, but not detected. Value stored is the limit of detection for the process in use. In the case of species, undetermined sex.
- = No remark code for this sampling event

Sample Date	Station	Location	Value (#/100mL)	Remark Code*
11/5/1996	21FLJXWQIWW2	Sherman Creek at A1A Bridge	<u>1,300</u>	-
11/5/1996	21FLJXWQIWW2	Sherman Creek at A1A Bridge	<u>1,300</u>	-
6/8/1998	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	<u>5,000</u>	-
6/8/1998	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	<u>5,000</u>	-
6/8/1998	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	330	-
6/8/1998	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	-
6/8/1998	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	-
6/8/1998	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	330	-
8/3/1998	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	800	-
8/3/1998	21FLJXWQIWW2	Sherman Creek at A1A Bridge	800	-
8/3/1998	21FLJXWQIWW2	Sherman Creek at A1A Bridge	800	-
8/3/1998	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	800	-
8/3/1998	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	700	-
8/3/1998	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	700	-
11/9/1998	21FLJXWQIWW2	Sherman Creek at A1A Bridge	40	-
11/9/1998	21FLJXWQIWW2	Sherman Creek at A1A Bridge	40	-
11/9/1998	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	<u>1,700</u>	-
11/9/1998	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	<u>1,700</u>	-
11/9/1998	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	230	-
11/9/1998	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	230	-
1/26/1999	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	800	-
1/26/1999	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	800	-
1/26/1999	21FLJXWQIWW2	Sherman Creek at A1A Bridge	500	-
1/26/1999	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	230	-
1/26/1999	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	230	-
1/26/1999	21FLJXWQIWW2	Sherman Creek at A1A Bridge	500	-
5/4/1999	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	<u>1,700</u>	-
5/4/1999	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	<u>1,700</u>	-
5/4/1999	21FLJXWQIWW2	Sherman Creek at A1A Bridge	40	-
5/4/1999	21FLJXWQIWW2	Sherman Creek at A1A Bridge	40	-
5/4/1999	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	500	-
5/4/1999	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	500	-
9/1/1999	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	K
9/1/1999	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	500	-
9/1/1999	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	U

Sample Date	Station	Location	Value (#/100mL)	Remark Code*
9/1/1999	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	40	-
9/1/1999	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	500	-
9/1/1999	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	40	-
10/27/1999	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	220	-
10/27/1999	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	K
10/27/1999	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	U
10/27/1999	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	220	-
10/27/1999	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	110	-
10/27/1999	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	110	-
2/1/2000	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	300	-
2/1/2000	21FLJXWQIWW2	Sherman Creek at A1A Bridge	110	-
2/1/2000	21FLJXWQIWW2	Sherman Creek at A1A Bridge	110	-
2/1/2000	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	300	-
2/1/2000	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	5,000	-
2/1/2000	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	5,000	-
4/25/2000	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	-
4/25/2000	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	-
4/25/2000	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	3,000	-
4/25/2000	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	3,000	-
4/25/2000	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	2,200	-
4/25/2000	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	2,200	-
9/20/2000	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	42,000	-
9/20/2000	21FLJXWQIWW2	Sherman Creek at A1A Bridge	3,000	-
9/20/2000	21FLJXWQIWW2	Sherman Creek at A1A Bridge	3,000	-
9/20/2000	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	42,000	-
9/20/2000	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	31,000	-
9/20/2000	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	31,000	-
12/19/2000	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	4,100	-
12/19/2000	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	4,100	-
12/19/2000	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	2,000	-
12/19/2000	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	2,000	-
12/19/2000	21FLJXWQIWW2	Sherman Creek at A1A Bridge	320	-
12/19/2000	21FLJXWQIWW2	Sherman Creek at A1A Bridge	320	-
2/6/2001	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	1,300	-
2/6/2001	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	1,300	-
2/6/2001	21FLJXWQIWW2	Sherman Creek at A1A Bridge	140	-
2/6/2001	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	230	-
2/6/2001	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	230	-
2/6/2001	21FLJXWQIWW2	Sherman Creek at A1A Bridge	140	-
6/18/2001	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	210	-
6/18/2001	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	5,000	-
6/18/2001	21FLJXWQIWW2	Sherman Creek at A1A Bridge	40	P
6/18/2001	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	210	P
6/18/2001	21FLJXWQIWW2	Sherman Creek at A1A Bridge	40	-
6/18/2001	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	5,000	P
9/17/2001	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	500	-

Sample Date	Station	Location	Value (#/100mL)	Remark Code*
9/17/2001	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	500	-
9/17/2001	21FLJXWQIWW2	Sherman Creek at A1A Bridge	40	-
9/17/2001	21FLJXWQIWW2	Sherman Creek at A1A Bridge	40	-
9/17/2001	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	340	-
9/17/2001	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	340	-
12/5/2001	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	1,100	-
12/5/2001	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	-
12/5/2001	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	-
12/5/2001	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	1,100	-
12/5/2001	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	600	-
12/5/2001	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	600	-
3/26/2002	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	204	-
3/26/2002	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	184	-
3/26/2002	21FLJXWQIWW2	Sherman Creek at A1A Bridge	52	-
5/8/2002	21FLJXWQIWW2	Sherman Creek at A1A Bridge	4	-
5/8/2002	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	84	-
5/8/2002	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	64	-
7/31/2002	21FLJXWQIWW2	Sherman Creek at A1A Bridge	12	-
7/31/2002	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	208	-
7/31/2002	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	232	-
10/23/2002	21FLJXWQIWW2	Sherman Creek at A1A Bridge	10	-
10/23/2002	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	110	-
10/23/2002	21FLA 27010002	Sherman Cr at Bridge	10	B
10/23/2002	21FLA 20030736	Sherman Cr Trib at Wonderwood Dr.	110	B
10/23/2002	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	5,800	-
3/26/2003	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	140	-
3/26/2003	21FLJXWQIWW2	Sherman Creek at A1A Bridge	200	-
3/26/2003	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	410	-
6/19/2003	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	4,000	B
6/19/2003	21FLJXWQIWW2	Sherman Creek at A1A Bridge	140	B
6/19/2003	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	260	-
9/22/2003	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	520	-
9/22/2003	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	430	-
9/22/2003	21FLJXWQIWW2	Sherman Creek at A1A Bridge	30	-
12/9/2003	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	220	-
12/9/2003	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	800	-
12/9/2003	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	K
3/18/2004	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	580	-
3/18/2004	21FLJXWQIWW2	Sherman Creek at A1A Bridge	220	-
3/18/2004	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	740	-
5/26/2004	21FLJXWQIWW2	Sherman Creek at A1A Bridge	100	-
5/26/2004	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	1,400	-
9/21/2004	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	13,500	-
9/21/2004	21FLJXWQIWW2	Sherman Creek at A1A Bridge	1,600	-
9/21/2004	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	12,000	-
1/5/2005	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	660	-

Sample Date	Station	Location	Value (#/100mL)	Remark Code*
3/8/2005	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	490	-
3/8/2005	21FLJXWQIWW2	Sherman Creek at A1A Bridge	120	-
5/11/2005	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	170	-
5/11/2005	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	700	-
5/11/2005	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	K
8/30/2005	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	40	-
8/30/2005	21FLJXWQIWW2	Sherman Creek at A1A Bridge	1,300	-
8/30/2005	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	11,000	-
11/14/2005	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	3,000	-
11/14/2005	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	1,400	-
11/14/2005	21FLJXWQIWW2	Sherman Creek at A1A Bridge	230	-
2/1/2006	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	450	-
2/1/2006	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	4,200	-
2/1/2006	21FLJXWQIWW2	Sherman Creek at A1A Bridge	31	B
5/22/2006	21FLJXWQIWW2	Sherman Creek at A1A Bridge	130	-
5/22/2006	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	3,000	-
5/22/2006	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	260	-
9/18/2006	21FLJXWQIWW2	Sherman Creek at A1A Bridge	74	-
9/18/2006	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	5,600	-
9/18/2006	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	760	-
11/28/2006	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	400	-
11/28/2006	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	K
11/28/2006	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	400	-
1/9/2007	21FLA 27010002	Sherman Cr at Bridge	30	B
1/9/2007	21FLA 20030736	Sherman Cr Trib at Wonderwood Dr.	267	B
3/22/2007	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	U
3/22/2007	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	140	-
3/22/2007	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	100	-
4/11/2007	21FLA 20030736	Sherman Cr Trib at Wonderwood Dr.	1,080	-
4/11/2007	21FLA 27010002	Sherman Cr at Bridge	74	A
5/7/2007	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	130	-
5/7/2007	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	230	-
5/7/2007	21FLJXWQIWW2	Sherman Creek at A1A Bridge	70	-
5/15/2007	21FLA 27010002	Sherman Cr at Bridge	167	-
5/15/2007	21FLA 20030736	Sherman Cr Trib at Wonderwood Dr.	287	-
7/11/2007	21FLA 20030736	Sherman Cr Trib at Wonderwood Dr.	233	-
7/11/2007	21FLA 27010002	Sherman Cr at Bridge	6	A
7/16/2007	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	100	-
7/16/2007	21FLJXWQIWW2	Sherman Creek at A1A Bridge	20	U
7/16/2007	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	20	U
8/14/2007	21FLA 27010002	Sherman Cr at Bridge	10	U
8/14/2007	21FLA 20030736	Sherman Cr Trib at Wonderwood Dr.	200	B
9/18/2007	21FLJXWQIWW2	Sherman Creek at A1A Bridge	300	B
9/18/2007	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	2,700	-
9/18/2007	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	4,300	-
9/25/2007	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	120	B

Sample Date	Station	Location	Value (#/100mL)	Remark Code*
9/25/2007	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	960	-
9/25/2007	21FLJXWQIWW2	Sherman Creek at A1A Bridge	40	B
10/9/2007	21FLA 27010002	Sherman Cr at Bridge	57	A
10/9/2007	21FLA 20030736	Sherman Cr Trib at Wonderwood Dr.	105	A
12/10/2007	21FLJXWQSC1	Puckett Creek at Wonderwood Dr	500	Q
12/10/2007	21FLJXWQSC3	Sherman Creek at Wonderwood Dr	5,000	Q
12/10/2007	21FLJXWQIWW2	Sherman Creek at A1A Bridge	40	Q
4/23/2008	21FLA 20030736	Sherman Cr Trib at Wonderwood Dr.	600	-
4/23/2008	21FLA 27010002	Sherman Cr at Bridge	40	-
5/19/2008	21FLA 27010002	Sherman Cr at Bridge	10	B
5/19/2008	21FLA 20030736	Sherman Cr Trib at Wonderwood Dr.	2,200	-

Appendix C: Kruskal–Wallis Analysis of Fecal Coliform Observations versus Season and Month

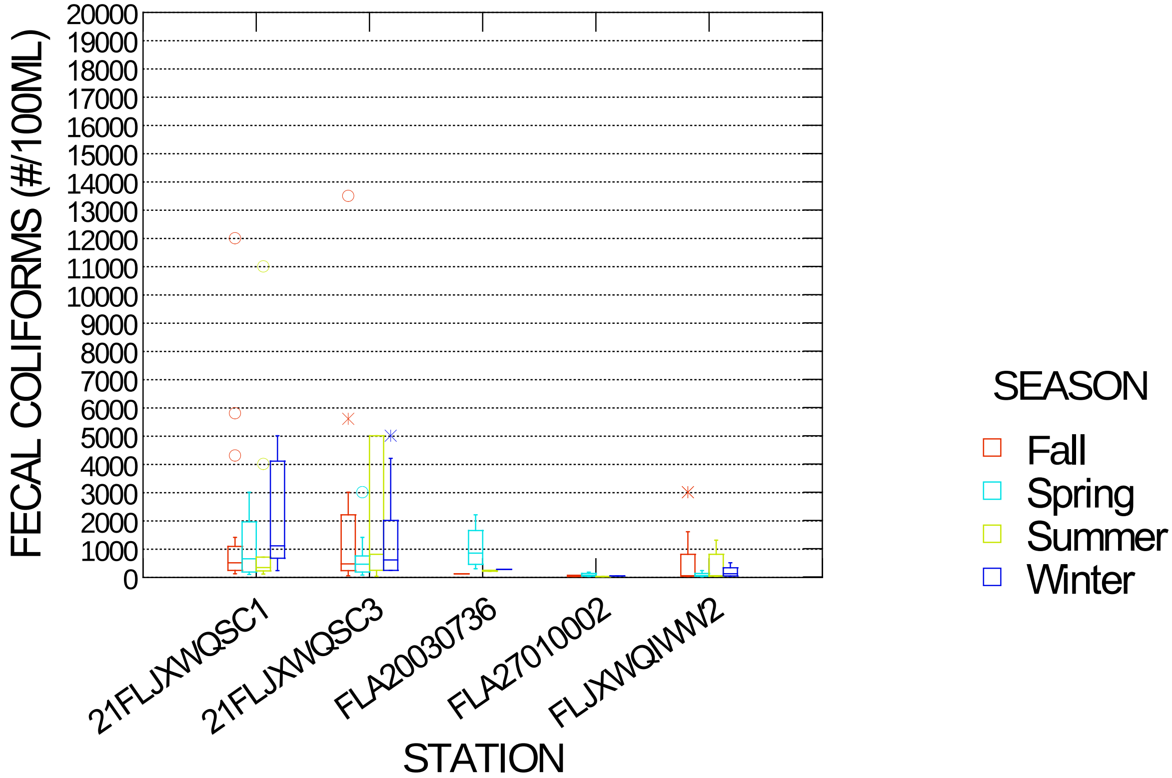
Group	Count	Rank Sum
Fall	60	5735
Spring	48	3944
Summer	34	2998
Winter	42	4343

Kruskal-Wallis Test Statistic = 3.999
Probability is 0.262 assuming Chi-square distribution with 3 df

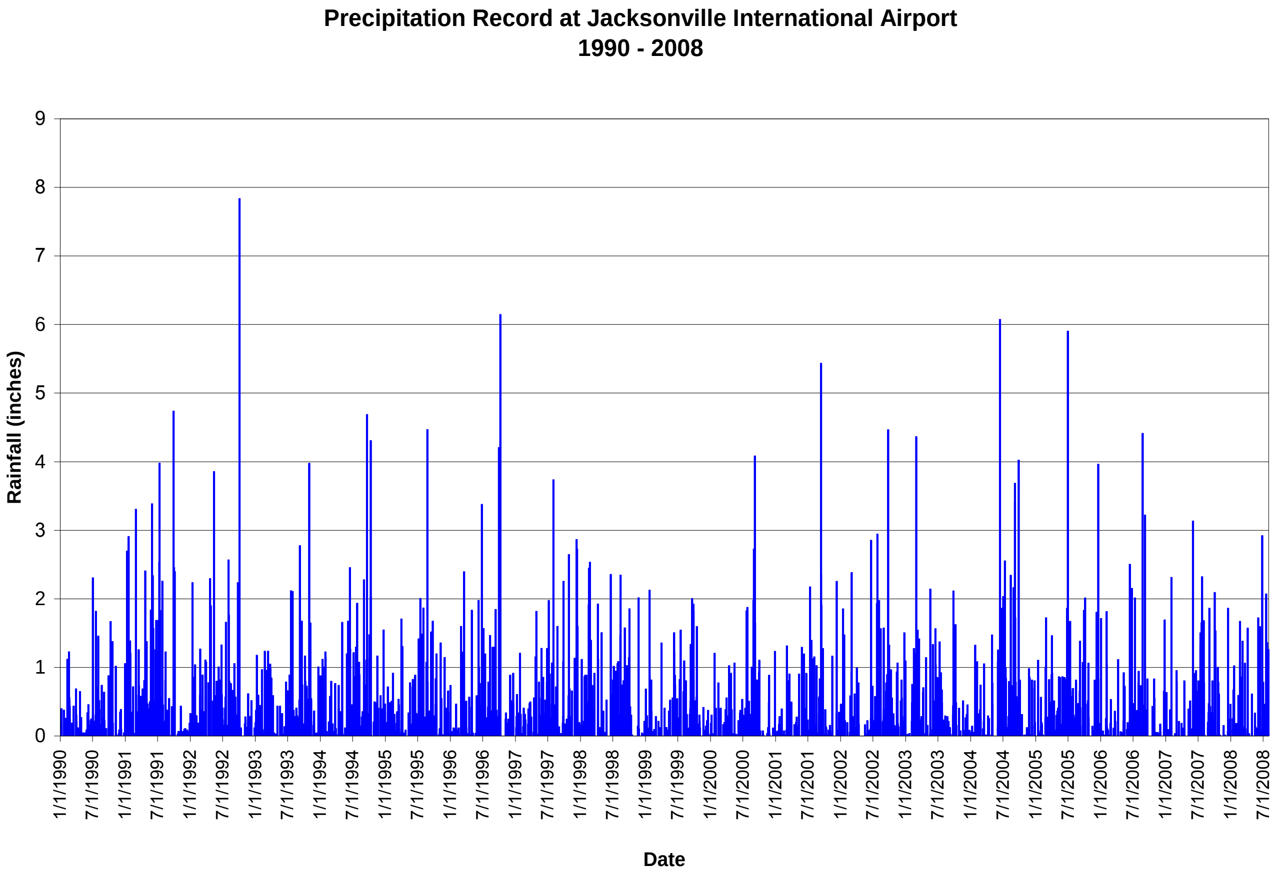
Group	Count	Rank Sum
January	9	896.5
February	15	1522
March	14	1040
April	10	999
May	24	1905
June	15	1452.5
July	8	339
August	11	1206.5
September	33	3623
October	13	683
November	14	1429
December	18	1924.5

Kruskal-Wallis Test Statistic = 24.809
Probability is 0.010 assuming Chi-square distribution with 11 df

Appendix D: Chart of Fecal Coliform Observations by Season and Station in Sherman Creek



Appendix E: Chart of Rainfall for JIA, 1990–2008



Appendix F: Spearman Correlation Matrix Analysis for Precipitation and Fecal Coliform in Sherman Creek

NOTE:
- = Not applicable

-	Year	Month	Fecals	V1DayPrecip	V3Dayprecip	V7Dayprecip	CumulativeT
Year	1	-	-	-	-	-	-
Month	-0.109	1	-	-	-	-	-
Fecals	-0.162	0.053	1	-	-	-	-
V1DayPrecip	0.16	0.18	0.206	1	-	-	-
V3DayPrecip	-0.029	-0.269	0.23	0.355	1	-	-
V7DayPrecip	-0.059	-0.268	0.096	0.284	0.826	1	-
CumulativeT	-0.103	0.164	0.055	0.245	0.315	0.489	-1

Appendix G: Analysis of Fecal Coliform Observations and Precipitation in Sherman Creek

FECAL COLIFORM DATA VERSUS DAY OF SAMPLING PRECIPITATION

Multiple R: 0.435   Squared multiple R: 0.189
Adjusted squared multiple R: 0.185   Standard error of estimate: 5057.230

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	883.63	399.672	0	.	2.211	0.028
V1DAYPRECIP	15356.2	2355.42	0.435	1	6.52	0

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.09E+09	1	1.09E+09	42.504	0.000
Residual	4.65E+09	182	2.56E+07		

Durbin-Watson D Statistic 1.276
First Order Autocorrelation 0.362

FECAL COLIFORM DATA VERSUS DAY OF SAMPLING AND 2 DAYS PRIOR PRECIPITATION

Multiple R: 0.044 Squared multiple R: 0.002
Adjusted squared multiple R: 0.000 Standard error of estimate: 5611.455

NOTE:
- = Not applicable

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	1666.646	491.103	0	-.	3.394	0.001
V3DAYPRECIP	435.435	739.32	0.044	1	0.589	0.557

Analysis of Variance

NOTE:
- = Not applicable

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.09E+07	1	1.09E+07	0.347	0.557
Residual	5.73E+09	182	3.15E+07	-	-

Durbin-Watson D Statistic 1.159
First Order Autocorrelation 0.420

FECAL COLIFORM DATA VERSUS DAY OF SAMPLING AND 6 DAYS PRIOR PRECIPITATION

Multiple R: 0.006 Squared multiple R: 0.000
Adjusted squared multiple R: 0.000 Standard error of estimate: 5616.710

NOTE:
- = Not applicable

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	1805.977	467.233	0	-.	3.865	0.000
V7DAYPRECIP	14.906	194.948	0.006	1	0.076	0.939

Analysis of Variance

NOTE:
- = Not applicable

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	184434.25	1	184434.248	0.006	0.939
Residual	5.74E+09	182	3.15E+07	-	-

Durbin-Watson D Statistic 1.158
First Order Autocorrelation 0.421

FECAL COLIFORM DATA VERSUS DAY OF SAMPLING AND 30 DAYS PRIOR PRECIPITATION

Multiple R: 0.273   Squared multiple R: 0.075
Adjusted squared multiple R: 0.070   Standard error of estimate: 5403.049

NOTE:
- = Not applicable

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	133.369	594.098	0	.	0.224	0.823
CUMULATIVET	360.944	94.189	0.273	1	3.832	0

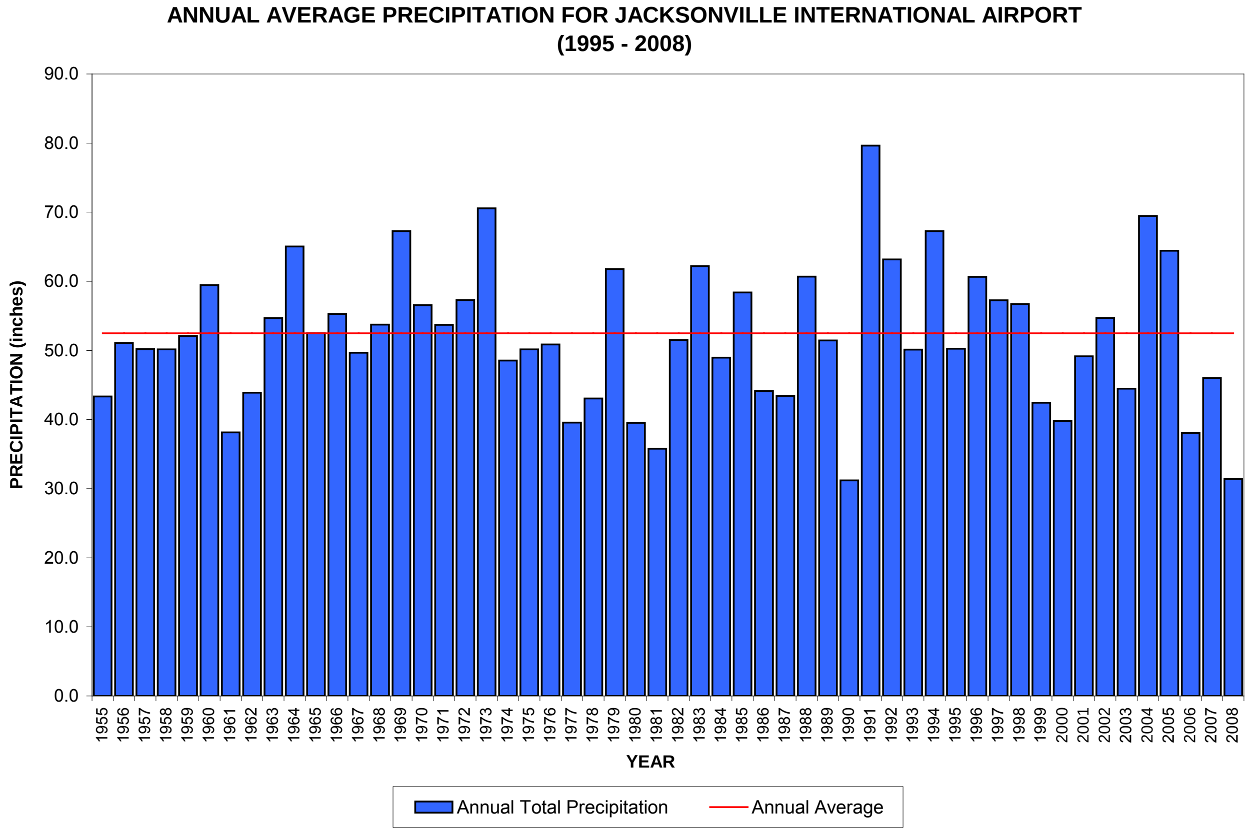
Analysis of Variance

NOTE:
- = Not applicable

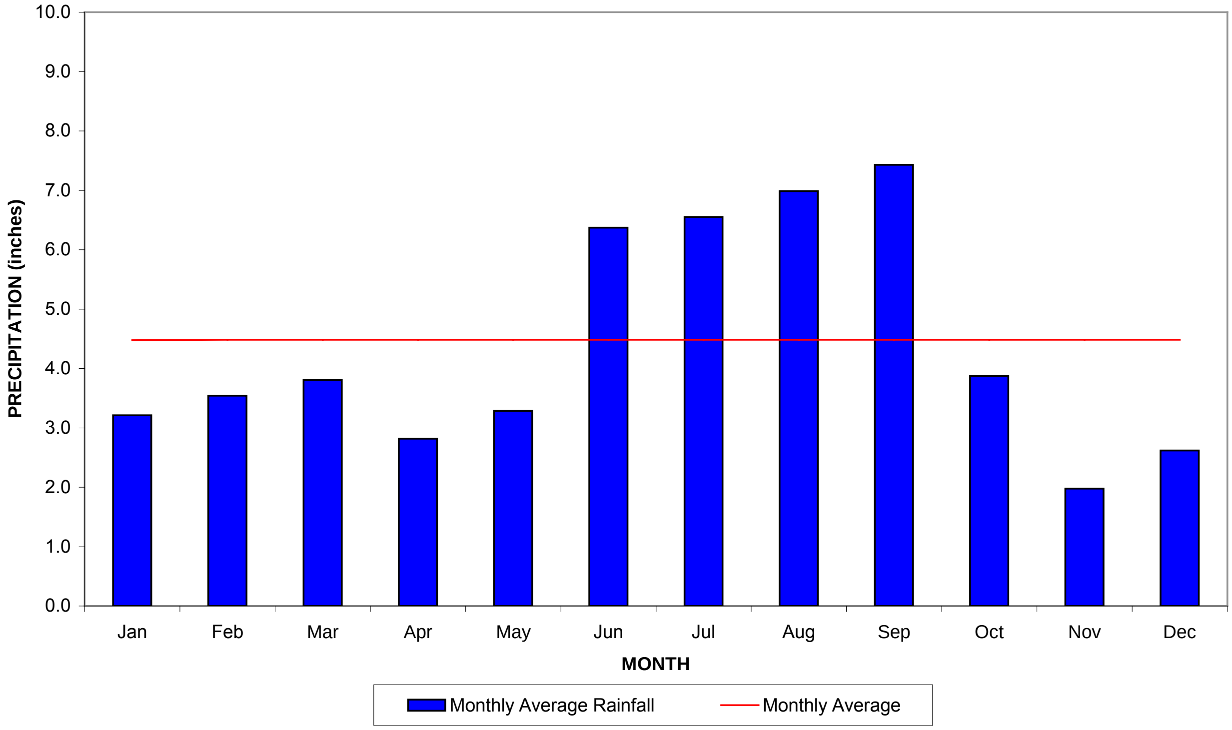
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	4.29E+08	1	4.29E+08	14.685	0
Residual	5.31E+09	182	2.92E+07		

Durbin-Watson D Statistic 1.173
First Order Autocorrelation 0.413

Appendix H: Annual and Monthly Average Precipitation at JIA



MONTHLY AVERAGE PRECIPITATION FOR JACKSONVILLE INTERNATIONAL AIRPORT (1955 - 2008)



Appendix I: Monthly and Annual Precipitation from JIA, 1955–2008

NOTES:
Rainfall is in inches, and represents data from JIA.
- = No data

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1955	3.1	2.46	1.66	1.5	4.51	2.7	5.53	3.85	10.6	5.36	1.9	0.2	**43.33**
1956	2.9	2.94	0.81	2.33	3.98	7.87	8.25	5.24	2.89	13.4	0.4	0	**51.08**
1957	0.3	1.69	3.87	1.61	5.25	7.1	12.3	3.3	8.33	3.5	1.6	1.3	**50.18**
1958	3.4	3.74	3.38	8.24	3.79	3.96	4.37	4.67	4.75	5.07	2	2.8	**50.14**
1959	3	5.22	9.75	2.65	9.2	2.94	4.51	2.86	5.67	3.12	2.2	1	**52.08**
1960	2.1	5.17	6.94	3.54	1.18	4.7	16.2	6.5	8.57	2.95	0.1	1.5	**59.45**
1961	2.9	4.85	1.17	4.16	3.06	5.27	3.48	10.6	1.02	0.27	0.9	0.5	**38.15**
1962	2.2	0.52	3.1	2.36	1.12	8.22	6.31	10.1	4.37	1.13	2.1	2.5	**43.9**
1963	5.4	6.93	2.23	1.75	1.74	12.5	6.47	4.95	4.88	1.53	2.7	3.6	**54.66**
1964	7.3	6.55	1.76	4.65	4.8	4.67	6.12	5.63	10.3	5.09	3.3	4.8	**65.03**
1965	0.7	5.5	3.91	0.95	0.94	9.79	2.71	9.58	11	1.75	1.9	3.8	**52.47**
1966	4.6	5.97	0.71	2.25	10.4	7.74	11.1	3.88	5.94	1.38	0.2	1.1	**55.3**
1967	3.1	4.35	0.81	2	1.18	12.9	5.22	12.3	1.8	1.13	0.2	4.7	**49.68**
1968	0.8	3.05	1.2	0.99	2.17	12.3	6.84	16.2	2.68	5.09	1.3	1.1	**53.72**
1969	0.8	3.39	4.23	0.34	3.78	5.12	5.89	15.1	10.3	9.81	4.6	3.9	**67.26**
1970	4.2	8.85	9.98	1.77	1.84	2.65	7.6	11	3.2	3.95	0	1.6	**56.55**
1971	2	2.55	2.41	4.07	1.9	5.52	5.07	12.8	4.17	6.46	0.8	5.9	**53.69**
1972	5.8	3.48	4.43	2.98	8.26	6.75	3.15	9.76	2.6	4.46	4.2	1.4	**57.29**
1973	4.6	5.07	10.2	11.6	5.33	4.1	5.45	7.49	7.86	4.08	0.4	4.3	**70.57**
1974	0.3	1.28	3.47	1.53	4.14	5.53	9.83	11.2	8.13	0.34	1	1.7	**48.52**
1975	3.5	2.58	2.46	5.78	7	5.21	6.36	6.23	5.24	3.63	0.4	1.8	**50.15**
1976	2.3	1.05	3.41	0.63	10	4.26	5.41	6.37	8.56	1.63	2.4	4.8	**50.87**
1977	3	3.24	1.03	1.76	3.07	2.65	1.97	7.26	7.45	1.68	3.1	3.4	**39.56**
1978	4.6	4.17	2.83	2.24	9.18	2.62	6.67	2.39	4.4	1.26	0.8	1.8	**43.04**
1979	6.3	3.75	1	4.18	7.54	5.91	4.67	4.78	17.8	0.25	3.6	2	**61.76**
1980	2.6	1.06	6.83	3.91	3.02	4.59	5.29	3.97	3.03	2.69	2.3	0.2	**39.53**
1981	0.9	4.53	5.41	0.32	1.48	3.31	2.46	6.47	1.22	1.35	4.9	3.4	**35.77**
1982	3	1.67	4.26	3.6	3.55	8.06	3.81	6.93	9.32	3.37	1.9	2	**51.52**
1983	7.2	4.27	8.46	4.65	1.38	6.86	6.11	4.63	4.61	4.29	3.3	6.4	**62.19**
1984	2.1	4.67	5.77	3.14	1.46	4.76	6.01	3.78	12.3	1.53	3.3	0.1	**48.96**
1985	1.1	1.45	1.26	2.76	2.08	3.71	6.33	8.93	16.8	8.34	2.1	3.6	**58.39**
1986	4.2	4.72	5.44	0.93	2.13	2.53	3.27	9.6	1.99	1.8	2.9	4.7	**44.1**
1987	4.1	6.47	6.27	0.14	0.75	4.18	4.4	4.48	7.13	0.3	5	0.2	**43.39**
1988	6.4	6.08	2.65	3.44	1.35	3.71	4.5	8.48	16.4	2.35	4.3	1.1	**60.68**
1989	1.7	1.77	2.14	2.79	1.55	3.66	8.98	9.16	14.4	1.39	0.5	3.4	**51.45**
1990	1.8	4.07	1.59	1.34	0.18	1.59	6.53	3.81	2.6	4.54	1.2	1.9	**31.2**
1991	10	1.52	7.33	6.31	9.35	11.7	15.9	3.48	6.2	6.36	0.7	0.6	**79.63**
1992	5.8	2.64	4.09	5.33	5.97	7.04	3.32	10.8	7.33	8.34	1.9	0.7	**63.18**
1993	3.9	2.89	5.98	0.85	1.6	2.52	7.54	2.96	7.6	8.84	3.6	1.9	**50.12**
1994	6.6	0.92	2.14	1.51	3.15	14	8.26	3.29	9.79	10.2	3.5	3.9	**67.26**
1995	1.9	2.07	3.67	1.77	1.77	5.35	9.45	9.93	5.41	3.53	3.2	2.2	**50.25**
1996	1.1	1.11	6.83	2.85	0.72	11.4	4.2	7.83	8.49	11.5	1.4	3.2	**60.63**
1997	2.9	1.28	1.84	4.56	3.43	6.33	7.69	8.24	3.97	4.84	2.4	9.8	**57.27**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1998	3.5	11.1	2.64	4.71	0.96	2.95	7.29	10.1	7.65	3.01	2.4	0.4	**56.72**
1999	4.6	1.7	0.4	1.92	1.02	7.75	3.56	3.51	13	3.24	0.8	0.9	**42.44**
2000	2.8	1.17	1.79	2.6	1.15	2.43	5.69	7.38	11.6	0.23	1.6	1.4	**39.77**
2001	0.9	0.68	5.48	0.62	2.56	5.59	8.31	3.58	16	0.81	1.4	3.1	**49.14**
2002	4.5	0.82	4.38	2.41	0.47	6.24	7.8	8.14	9.31	2.58	2.7	5.4	**54.72**
2003	0.1	4.66	10.7	2.63	2.54	6.75	7.33	1.83	3.04	2.98	0.7	1.2	**44.47**
2004	1.6	4.47	1.36	2.02	1.24	17.2	8.6	9.85	16.3	1.32	2.9	2.7	**69.47**
2005	1.9	3.56	3.67	4.53	3.51	14.8	7.37	4.43	5.76	6.49	1.1	7.4	**64.44**
2006	2.30	3.91	0.68	1.22	2.01	7.25	3.97	7.08	4.55	1.81	0.39	2.90	**38.07**
2007	2.29	2.40	2.22	1.02	1.12	6.68	9.48	3.57	5.44	8.85	0.17	2.74	**45.98**
2008	2.63	5.22	3.50	2.34	0.66	8.21	8.83	-	-	-	-	-	**31.39**
AVG	**3.21**	**3.54**	**3.81**	**2.82**	**3.29**	**6.37**	**6.55**	**6.99**	**7.43**	**3.87**	**1.98**	**2.62**	**52.47**

Appendix J: Comments Received on Draft TMDL

From: Carper, Rick [mailto:rcarper@coab.us]
Sent: Tuesday, March 10, 2009 10:30 AM
To: Tracy, Amy
Cc: Abendroth, John; Victor, Patrick
Subject: RE: Request for additional information Sherman Creek WBID boundary Modification

Amy, attached mxd contains all basins as shown in our original 1995 Stormwater Master Plan. The map provided with my last email is from the 2002 Stormwater Master Plan Update, but I do not have GIS layers for that. Sherman Creek, as you are using it, would include all of the Selva Marina Canal basins, Puckett Creek, FDOT, Stewart Ditch, Core City North and South and Sherman Creek. Our Selva 3 and Sherman Creek boundaries go farther east than your maps because we have no stormwater flow from west of the initial dune routed to the beach.

The Hopkins Creek basin was the primary focus of the 2002 SWMP update (done by CDM, Patrick Victor, Project Manager), attached pictures are excerpts of the study showing additional info on Hopkins Creek modeling and development. As shown on the original and overlay pictures, the Skate Road ditch is (was) Hopkins Creek. Hopefully, these pictures, along with the map previously provided showing the stormwater conveyance systems, will suffice for explanation of why the boundaries are incorrect.

Rick

From: Tracy, Amy [mailto:Amy.Tracy@dep.state.fl.us]
Sent: Tuesday, March 10, 2009 9:36 AM
To: Carper, Rick
Cc: Abendroth, John
Subject: Request for additional information Sherman Creek WBID boundary Modification

Good morning Rick,

Do you happen to have a shapefile for the proposed Sherman Creek basin boundary that you could send; it would help us to define the boundary.

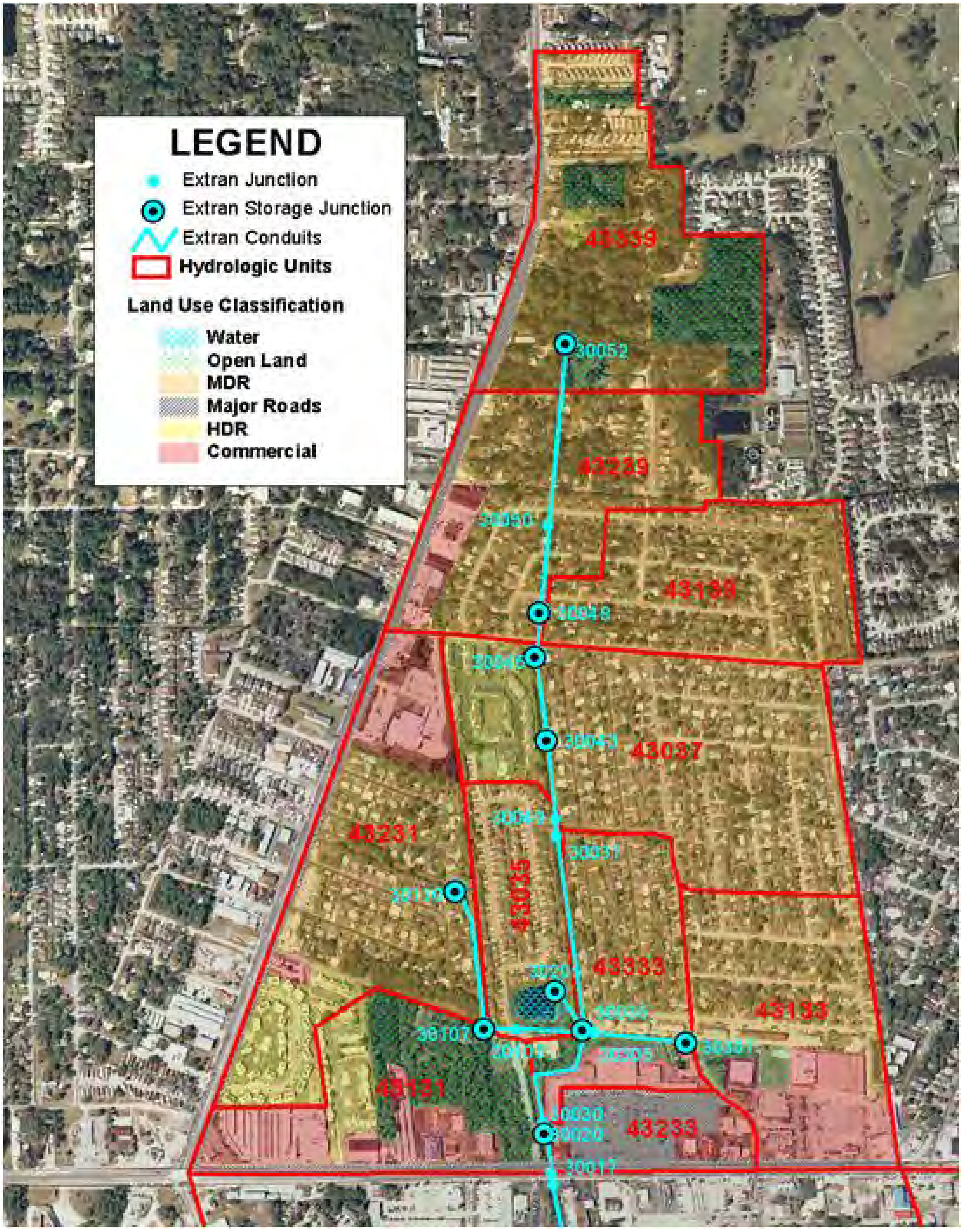
In addition, can you please provide a short text explanation about why the boundary is incorrect, please forgive me but I cannot quite follow the explanation below. My understanding is due to the stormwater infrastructure the hydrology of the Sherman Creek does not match the current WBID boundary. Due to the stormwater conveyance system the Sherman Creek boundary should not include the Skate Road Ditch, which should be included in the Hopkins Creek boundary.

Could you please provide the explanation in a little more detail than provided below? Please accept my apologies for the additional request but we will need something more formal and explaining the reasons for the boundary modification. Please feel free to contact me if you have any questions or concerns.

Best regards,

Amy L Tracy
Environmental Consultant
Watershed Planning & Coordination Section, FDEP
Bureau of Watershed Restoration
Phone: 850-245-8506
Amy.Tracy@dep.state.fl.us

Aerial photo showing Hopkins Creek drainage basin in 1940 (from 2002 Stormwater Management Plan Update,Camp Dresser & McKee [CDM])



Aerial photo showing stormwater infrastructure in Hopkins Creek drainage basin (from 2002 Stormwater Management Plan Update, CDM)

Aerial photo showing current Hopkins Creek drainage basin (from 2002 Stormwater Management Plan Update, CDM)

From: Carper, Rick [mailto:rcarper@coab.us]
Sent: Wednesday, February 11, 2009 5:04 PM
To: Tracy, Amy; Mandrup-Poulsen, Jan
Cc: TLBusby@wildwoodconsulting.net
Subject: RE: Department Announces Proposed TMDLs for the LSJR Tributaries

Amy, attached drainage basin map is from our 2002 Stormwater Master Plan Update and shows graphically where the basin boundaries are and the associated conveyance systems. The Royal Palms Subdvision was built in the early sixties with storm sewer systems piped to carry all runoff from east to west to the Skate Road ditch (which is effectively Hopkins Creek north of Cavalla Road). North of Donner Road, drainage is by means of open ditch from Church (now Dutton Island) Road south. Dutton Island Road is the boundary between Atlantic Beach and Jacksonville, but the Hopkins Creek basin extends a short distance into Jacksonville also, as shown on the drainage map.

Please let me know if additional information is required.

Rick

Ricky L. Carper, P.E.
Public Works Director/City Engineer, City of Atlantic Beach
1200 Sandpiper Lane
Atlantic Beach, FL 32233
rcarper@coab.us
Ph: (904) 247-5834; Fax: (904) 247-5843

From: Tracy, Amy [mailto:Amy.Tracy@dep.state.fl.us]
Sent: Monday, February 09, 2009 8:46 AM
To: Carper, Rick; Mandrup-Poulsen, Jan
Cc: TLBusby@wildwoodconsulting.net
Subject: FW: Department Announces Proposed TMDLs for the LSJR Tributaries

Good morning Rick,

Thank you for contacting Wildwood Consulting with your concerns regarding the Sherman Creek basin boundary, Marcy forwarded to me to help you. The Department's Watershed Assessment Section is processing comments regarding the Sherman Creek TMDL. Thank you for the attached map, can you also please provide to the Department a couple of paragraphs explaining where the boundary should be and why the current boundary is incorrect? Any supporting information you may also have is greatly appreciated.

I have also included Jan Mandrup-Paulsen, the Administrator for the Watershed Assessment Section in this email. Please provide the information to him, and of course, if you have any questions please feel free to contact him.

Sincerely,
Amy L Tracy
Environmental Consultant
Watershed Planning & Coordination Section, FDEP
Bureau of Watershed Restoration
Phone: 850-245-8506
Amy.Tracy@dep.state.fl.us

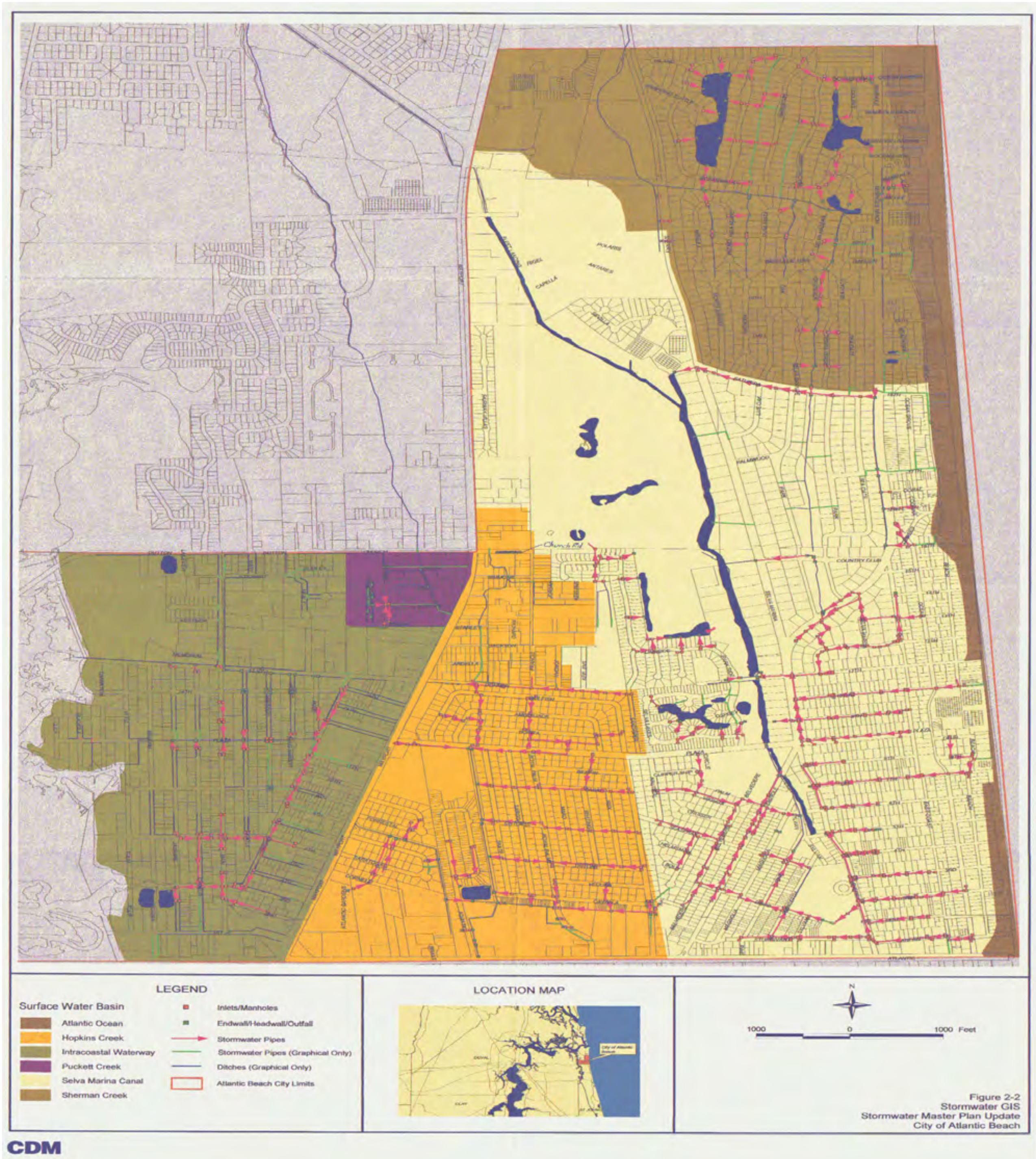
From: Marcy Policastro [mailto:mpolicastro@wildwoodconsulting.net]
Sent: Friday, February 06, 2009 3:53 PM
To: Tracy, Amy
Cc: TLBusby@wildwoodconsulting.net
Subject: FW: Department Announces Proposed TMDLs for the LSJR Tributaries

Amy –
Rick Carper with the City of Atlantic Beach provided the email below and attached map. He says that the WBID boundary for Sherman Creek is incorrect. What is the best way to address this issue?
Thanks!
-Marcy

From: Carper, Rick [mailto:rcarper@coab.us]
Sent: Friday, February 06, 2009 3:25 PM
To: mpolicastro@wildwoodconsulting.net; Tiffany Busby
Cc: Kaluzniak, Donna
Subject: RE: Department Announces Proposed TMDLs for the LSJR Tributaries

Tiffany and/or Marcy, the boundaries show for the Sherman Creek basin are incorrect (see my marked up scan) in that a big chunk of the area shown in Atlantic Beach is actually in the Hopkins Creek basin. Is this significant? If yes, who at FDEP should I contact?

Thanks,
Rick



Response: Based on the information provided, the boundaries for the Sherman Creek watershed were revised (see graphic above). Figures and tables were revised in the final document as necessary to reflect changes in the boundaries.

Appendix K: Executive Summary, Tributary Pollution Assessment Project

Note: *This appendix contains the executive summary of the Tributary Pollution Assessment Project (TPAP) submitted to the Department by JEA and PBS&J. The six phases detailed in the methodology development and evaluation section have already been completed as of the date of this TMDL. In place of the public workshop mentioned in the section describing Phase 6, the* Tributary Pollution Assessment Manual *was presented to the Jacksonville Waterways Commission on February 1, 2007.*

The Tributary Pollution Assessment Project involves developing and evaluating a methodology for conducting tributary pollution assessments for listed water bodies in the Duval County area, as referenced in the Reasonable Assurance (RA) Plan. Duval County has approximately 100 tributary Water Body IDs (WBIDs), i.e. small to large tributaries of the St. Johns River, identified by the State. The RA Plan provides reasonable assurance that the fecal coliform levels of the 51 top-ranked WBIDs will be reduced sufficiently to restore them to their designated use for recreation. The 51 WBIDs are grouped into four priority groups in the RA Plan.

PBS&J was contracted by JEA to develop a methodology for conducting tributary pollution assessments for sources of fecal coliform contamination in the listed tributaries. This methodology will be field-verified by conducting sanitary surveys of selected tributary water body segments, and revised based on lessons learned from this process. The final product of this endeavor will be a *Tributary Pollution Assessment Manual* that can be used as a blueprint for conducting sanitary surveys.

The Tributary Pollution Assessment Project is a continuation of the effort started under the RA Plan. The RA Plan participants have been brought together to form the Tributary Assessment Team (TAT). The TAT will serve as an advisory committee to the PBS&J Project Team throughout the development of the *Tributary Pollution Assessment Manual*. The TAT is composed of representatives from:

- *JEA*
- *City of Jacksonville Environmental Quality Division*
- *City of Jacksonville Public Works Department*
- *Duval County Health Department*
- *Florida Department of Environmental Protection*
- *St. Johns Riverkeeper*
- *Water and Sewer Expansion Authority*
- *U.S. Army Corps of Engineers*

Other representatives (from these and additional entities) may be included in the TAT activities in varying roles, as relevant.

Our approach for developing and evaluating a methodology for conducting tributary pollution assessments is divided into six major phases including:

1) Pre-planning;
2) Planning;
3) Development of Tributary Pollution Assessment Manual;
4) Evaluation of Methodology/Manual by Conducting Sanitary Surveys;
5) Summary Report; and

6) Public Workshop.

The Pre-Planning phase (Phase I) entailed four main goals:

1) to obtain and review all documents included in the RA Plan;
2) to develop categories for tributary classification and categorize the 51 priority WBIDs;
3) to overlay each WBID onto land use, infrastructure, and historical sampling maps to begin assessing probable sources and migration pathways; and
4) to develop the *Draft Work Plan*.

The Planning phase (Phase II) begins with the organization and initial meeting of the Tributary Assessment Team (TAT) with the ultimate goal of finalizing the *Work Plan*.

The Development of the *Tributary Pollution Assessment Manual* phase (Phase III) primarily involves the formulation of the assessment methodology for each tributary category described in the Pre-Planning phase, the use of a decision tree to determine which assessment methodology corresponds to each of the highest-ranked WBIDs, and the establishment of a model monitoring plan for each tributary category. This phase will be completed upon submitting the *Manual* to the TAT for review.

The next phase, Evaluation of Methodology/Manual by Conducting Sanitary Surveys (Phase IV), entails field-verification of the methodology described in the *Draft Tributary Pollution Assessment Manual* for the highest ranked water bodies for each category (or as determined to ensure adequate geographical representation of the study area) and applying the results to recommend generic corrective actions and revise the methodology, if necessary. The outcome of this phase would be the *Tributary Pollution Assessment Manual.*

The final two phases, Summary Report (Phase V) and Public Workshop (Phase VI), would entail providing a summary of the results of the tributary pollution assessments, including a discussion of lessons learned and site-specific corrective actions, to JEA and presenting the results from the *Tributary Pollution Assessment Manual* to the public. The final phase would also include a written summary of public input received at the workshop.

For additional information, please contact: Don Deis, PBS&J Project Manager, at (904) 363–8442 or drdeis@pbsj.com.

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Division of Water Resource Management
Bureau of Watershed Management
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