FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

NORTHEAST DISTRICT • LOWER ST. JOHNS RIVER BASIN

TMDL Report

Fecal Coliform and Total Coliform TMDL for Williamson Creek (WBID 2316)

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Florida Department of Environmental Protection

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Web sites

Florida Department of Environmental Protection, Bureau of Watershed Management

TMDL Program

http://www.dep.state.fl.us/water/tmdl/index.htm

Identification of Impaired Surface Waters Rule

http://www.dep.state.fl.us/water/tmdl/docs/AmendedIWR.pdf

STORET Program

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

2004 305(b) Report

http://www.dep.state.fl.us/water/docs/2004_Integrated_Report.pdf

Criteria for Surface Water Quality Classifications

http://www.dep.state.fl.us/legal/rules/shared/62-302.pdf

Basin Status Report for the Lower St. Johns River Basin

http://www.dep.state.fl.us/water/tmdl/stat_rep.htm

Water Quality Assessment Report for the Lower St. Johns River Basin

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Allocation Technical Advisory Committee (ATAC) Report

http://www.dep.state.fl.us/water/tmdl/docs/Allocation.pdf

U.S. Environmental Protection Agency, National STORET Program

http://www.epa.gov/storet/

Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal and total coliforms for the Williamson Creek watershed in the Ortega River Planning Unit of the Lower St. Johns River Basin. The creek was verified impaired for fecal and total 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. The TMDL establishes the allowable loadings to Williamson Creek that would restore the waterbody so that it meets its applicable water quality criteria for coliform.

1.2 Identification of Waterbody

Williamson Creek is located in Duval County, in northeast Florida, with an approximate 1.45 square-mile (mi^2) drainage area that flows directly into the Cedar River, which flows into the Ortega River and then into the St. Johns River (**Figures 1.1 and 1.2**). The creek is approximately 1.8 miles long and is a second order stream. The Williamson Creek watershed is located on the western edge of the City of Jacksonville and, as a result, is highly urban. Additional information about the stream's hydrology and geology are available in the Basin Status Report for the Lower St. Johns River Basin (Florida Department of Environmental Protection [FDEP], 2004).

For assessment purposes, the Department has divided the St. Johns River Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Williamson Creek lies within one WBID, 2316, as shown in **Figure 1.2**, which this TMDL addresses.

Williamson Creek is part of the Ortega River Planning Unit (PU). Planning units are groups of WBIDs, and are in turn part of a larger basin, in this case the Lower St. Johns River Basin. The Ortega River planning unit consists of 30 WBIDs. **Figure 1.3** shows the location of these WBIDs, Williamson Creek's location in the planning unit, and a list of other WBIDs in the PU.

Figure 1.1. Location of Williamson Creek and Major Geopolitical Features in the St. Johns River Basin

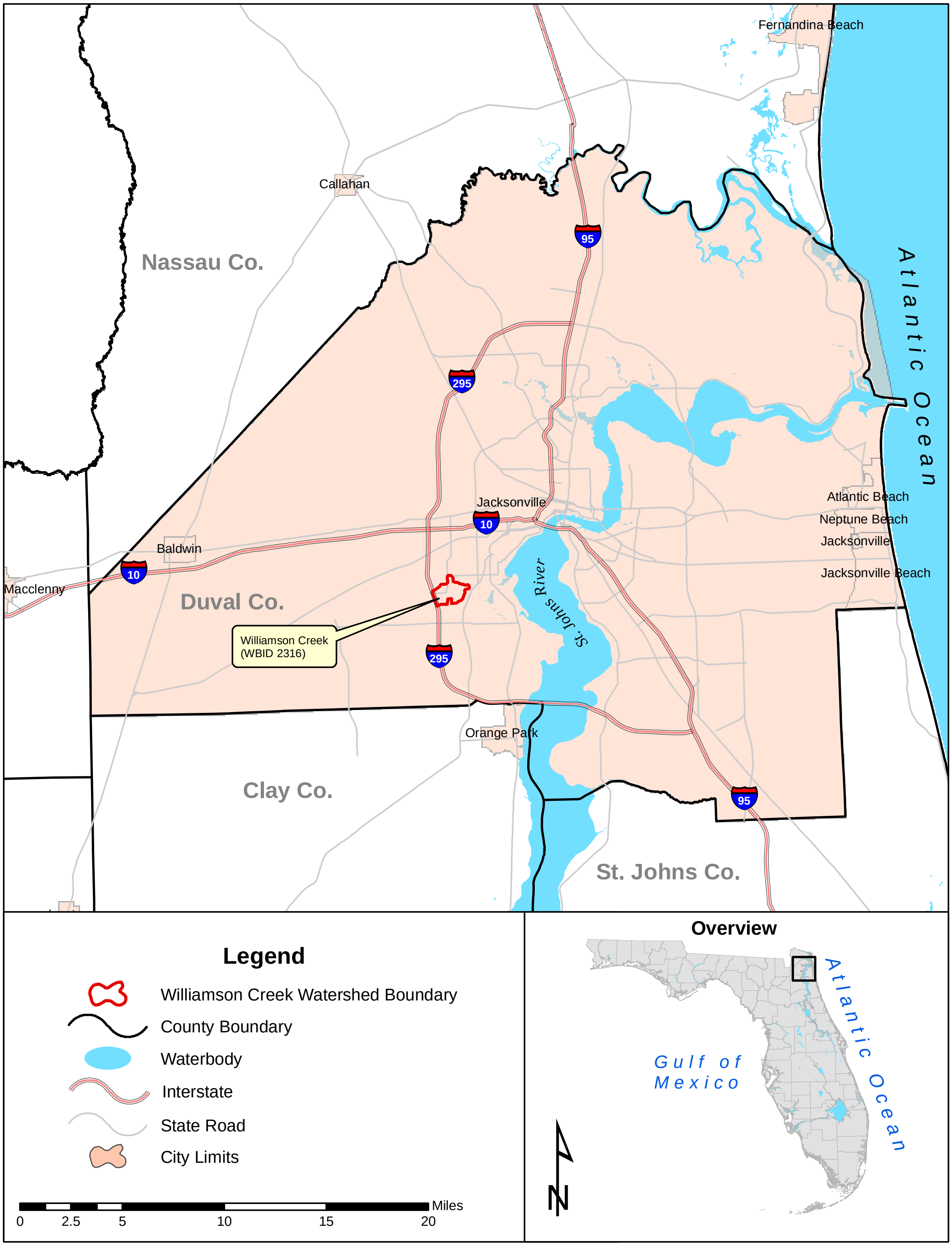


Figure 1.2. Overview of Williamson Creek Watershed

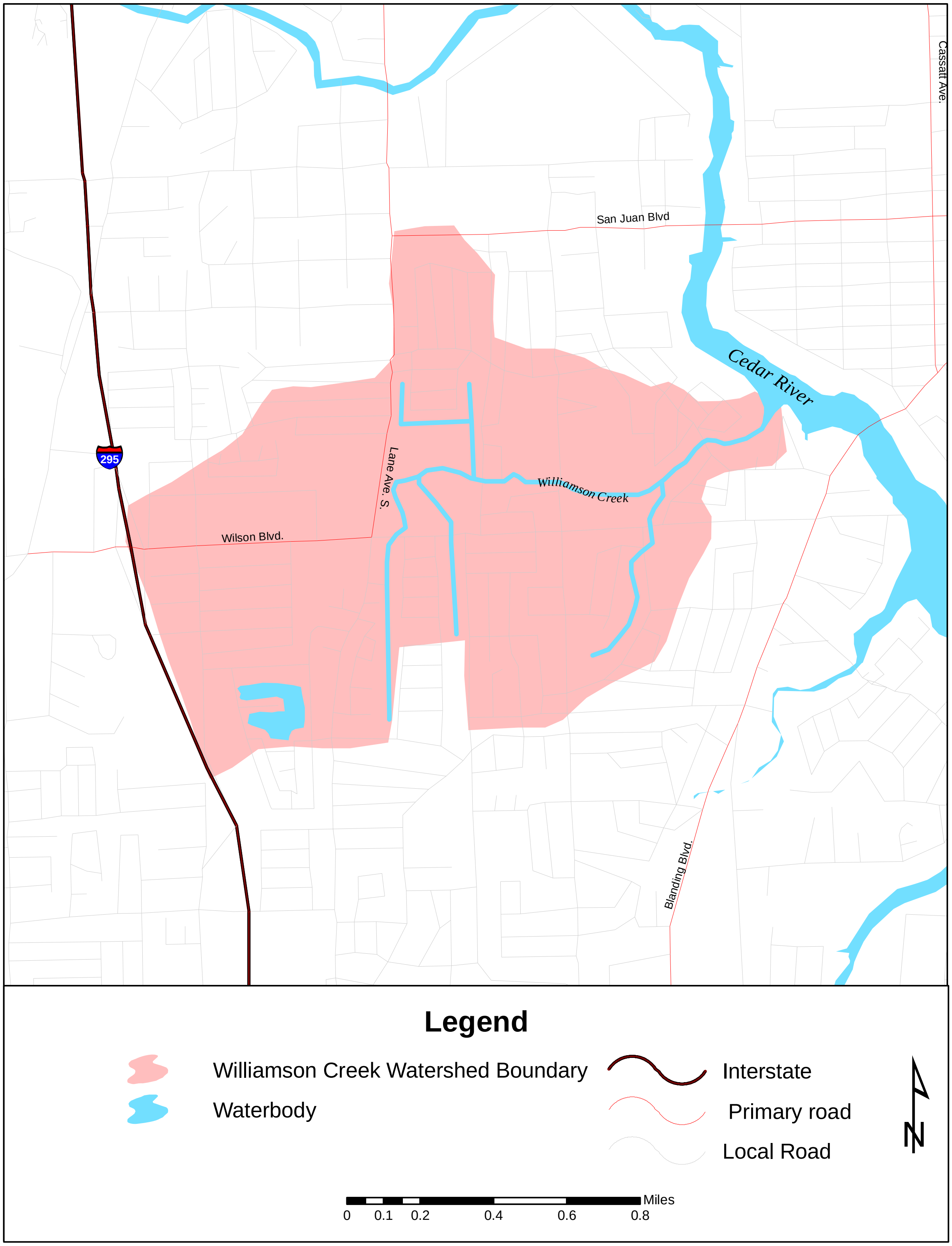
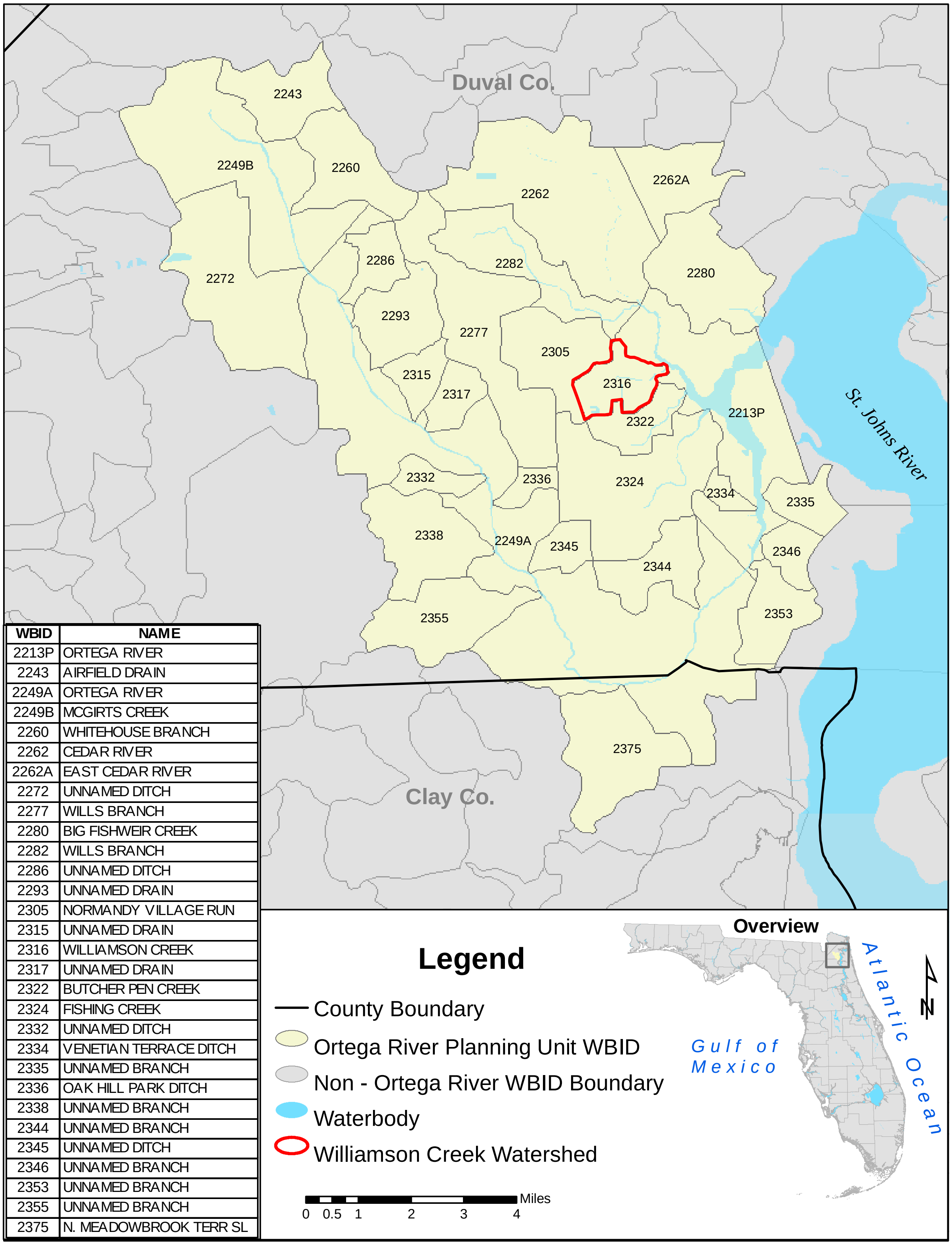


Figure 1.3. WBIDs in the Ortega River Planning Unit



WBID	NAME
2213P	ORTEGA RIVER
2243	AIRFIELD DRAIN
2249A	ORTEGA RIVER
2249B	MCGIRTS CREEK
2260	WHITEHOUSE BRANCH
2262	CEDAR RIVER
2262A	EAST CEDAR RIVER
2272	UNNAMED DITCH
2277	WILLS BRANCH
2280	BIG FISHWEIR CREEK
2282	WILLS BRANCH
2286	UNNAMED DITCH
2293	UNNAMED DRAIN
2305	NORMANDY VILLAGE RUN
2315	UNNAMED DRAIN
2316	WILLIAMSON CREEK
2317	UNNAMED DRAIN
2322	BUTCHER PEN CREEK
2324	FISHING CREEK
2332	UNNAMED DITCH
2334	VENETIAN TERRACE DITCH
2335	UNNAMED BRANCH
2336	OAK HILL PARK DITCH
2338	UNNAMED BRANCH
2344	UNNAMED BRANCH
2345	UNNAMED DITCH
2346	UNNAMED BRANCH
2353	UNNAMED BRANCH
2355	UNNAMED BRANCH
2375	N. MEADOWBROOK TERR SL

1.3 Background

This report was developed as part of the Florida Department of Environmental Protection's (Department) 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 five-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. TMDLs 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 and total coliforms that caused the verified impairment of Williamson Creek. These activities will depend heavily on the active participation of the St. Johns River Water Management District, 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 EPA a list of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant source in each of these impaired 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 River Basin, however, the Florida Watershed Restoration Act (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 Chapter 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Williamson Creek and has verified the impairments for fecal and total coliforms based on information in the Department's IWR data base. **Tables 2.1** through **2.3** provide summary results for fecal and total coliform for the verification period, which for Group 2 waters was January 1, 1996 – June 30, 2003, by month, season, and year, respectively.

There is a 75.56 percent overall exceedance rate for fecal coliforms and an 80.0 percent overall exceedance rate for total coliforms. The greatest percent of exceedances occurred during the months of February, July, October, November, and December (all 100 percent exceedance); the least in March, but there is only one sample collected in March (**Table 2.1**). The highest count occurred during November (160,000 counts/100 mL). February was the only month for which data exist and no exceedances occurred. There is no data from June. Fecal coliform exceedances occur in all seasons, however, as shown in **Table 2.2**, a greater number occur in the fall (October - December), and the least amount occur in the spring (April - June).

Total coliform exhibit a 100 percent exceedance rate for the months of April, May, August, October, and December. As with fecal coliforms, total coliform exceedances occurred across all seasons. The highest percentage of exceedances occurred in the spring season (100 percent).

With respect to sampling stations, many stations do not have but a few samples, which make it difficult to analyze trends between stations. For fecal coliforms, there is only one station which has more than four samples. When considering fecal coliforms and using all the data, coliform values seem to decrease going downstream. There are two stations where total coliform data have been collected and have more than eight samples. When considering these two stations, data indicate that exceedances and coliform concentrations increase from upstream to downstream. Sampling stations are discussed further in **Section 5.1**.

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

FECAL COLIFORMS[1]								
Month	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**No. of Exceedances**	**% Exceedance**	**Mean Precipitation**
January	2	220	700	460	460	1	50.00%	2.39
February	1	3,000	3,000	3,000	3,000	1	100.00%	3.14
March	1	120	120	120	120	0	0.00%	3.95
April	3	110	1,100	300	503	1	33.33%	2.8
May	2	300	530	415	415	1	50.00%	1.61
June	0	---	---	---	---	---	---	7.40
July	1	90,000	90,000	90,000	90,000	1	100.00%	6.72
August	3	140	13,000	3,233	5,458	2	66.67%	6.72
September	3	38	500	280	273	1	33.33%	9.94
October	2	1,400	22,000	11,700	11,700	2	100.00%	3.39
November	1	160,000	160,000	160,000	160,000	1	100.00%	1.81
December	3	1,560	21,000	1,633	8,064	3	100.00%	3.12
TOTAL COLIFORMS[2]								
Month	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**No. of Exceedances**	**% Exceedance**	**Mean Precipitation**
January	0	---	---	---	---	---	---	2.39
February	0	---	---	---	---	---	---	3.14
March	2	1,467	1,900	1,684	1,684	0	0.00%	3.95
April	2	5,800	6,400	6,100	6,100	2	100.00%	2.8
May	3	3,700	12,200	4,400	6,767	3	100.00%	1.61
June	0	---	---	---	---	---	---	7.40
July	2	1,833	4,400	3,117	3,117	1	50.00%	6.72
August	3	10,000	29,000	23,600	20,867	3	100.00%	6.72
September	3	122	3,200	1,117	1,480	1	33.33%	9.94
October	1	5,200	5,200	5,200	5,200	1	100.00%	3.39
November	2	1,219	8,000	4,610	4,610	1	50.00%	1.81
December	3	4,800	15,800	8,400	9,667	3	100.00%	3.12

Coliform counts are #/100 mL
[1]Exceedances represent values above 400 counts/100 mL
[2]Exceedances represent values above 2,400 counts/100 mL
Mean precipitation is from Jacksonville International Airport (JIA) in inches. Mean precipitation is the long term (1955 – 2004) mean for the stated month

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

FECAL COLIFORMS[1]								
Season[2]	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Number of Exceedances**	**% Exceedance**	**Mean Precipitation**
Winter	4	120	3,000	460	1,010	2	50.00%	10.72
Spring	5	110	1,100	300	468	2	40.00%	12.41
Summer	7	38	90,000	500	15,313	4	57.14%	21.15
Fall	6	1,400	160,000	11,317	34,599	6	100.00%	8.34
TOTAL COLIFORMS[3]								
Season[2]	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Number of Exceedances**	**% Exceedance**	**Mean Precipitation**
Winter	3	1,467	5,800	1,900	3,056	1	33.33%	10.72
Spring	4	3,700	12,200	5,400	6,675	4	100.00%	12.41
Summer	8	122	29,000	3,800	9,159	5	62.50%	21.15
Fall	6	1,219	15,800	6,600	7,237	5	83.33%	8.34

Coliform counts are #/100 mL
[1]Exceedances represent values above 400 counts/100 mL
[2]Winter = January – March; spring = April – June; summer = July – September; fall = October - December
[3]Exceedances represent values above 2,400 counts/100 mL
Mean precipitation is from Jacksonville International Airport (JIA) in inches, and is the long term mean (1955 – 2004) for all three months of the season

Table 2.3. Annual Summaries of Fecal and Total Coliform Data for Verified Period (January 1, 1996 – June 30, 2003)

FECAL COLIFORMS[1]								
Year	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Number of Exceedances**	**% Exceedance**	**Total Precipitation**
1996	1	160,000	160,000	160,000	160,000	1	100.00%	60.63
1998	3	300	90,000	22,000	37,433	2	66.67%	56.72
1999	5	140	13,000	1,100	3,268	4	80.00%	42.44
2000	4	220	21,000	400	5,505	2	50.00%	39.77
2001	4	38	3,000	835	1,177	2	50.00%	49.14
2002	5	120	3,233	530	1,159	3	60.00%	54.72
TOTAL COLIFORMS[2]								
Year	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Number of Exceedances**	**% Exceedance**	**Total Precipitation**
1999	1	2,900	2,900	2,900	2,900	1	100.00%	42.44
2002	20	122	23,600	4,600	6,178	14	70.00%	54.72

Coliform counts are #/100 mL
[1]Exceedances represent values above 400 counts/100 mL
[2]Exceedances represent values above 2,400 counts/100 mL – data were only reported for 1999 and 2002
Precipitation is for Jacksonville International Airport (JIA) in inches, and represents the total precipitation for the year indicated

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)**

Williamson 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 criteria applicable to the impairment addressed by this TMDL are fecal and total coliforms.

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 coliform bacteria concentrations. The water quality criteria for protection of Class III waters, as established by Chapter 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.*
>
> ***Total Coliform Bacteria:***
> *The MPN per 100 ml shall be less than or equal to 1,000 as a monthly average nor exceed 1,000 in more than 20 percent of the samples examined during any month; and less than or equal to 2,400 at any time.*

The criteria state that monthly averages shall be expressed as geometric means based on a minimum of ten samples taken over a thirty-day period. However, there were insufficient data (less than 10 samples in a given month) available to evaluate the geometric mean criterion for fecal coliform bacteria. Therefore, the criterion selected for the TMDLs was not to exceed 400 counts per 100 ml for fecal coliforms, nor exceed 2,400 counts per 100 ml for total coliforms.

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 sources 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 Program (NPDES). These nonpoint sources included certain urban stormwater discharges, including 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 Coliforms in Williamson Creek Watershed

4.2.1 Point Sources

There are no permitted wastewater treatment facilities or industrial wastewater facilities that discharge into the Williamson Creek or any of its tributaries.

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 (FLS000012) that covers the Williamson Creek watershed. Responsibility for the permit is shared among FDOT, and the Cities of Jacksonville, Neptune Beach, and Atlantic Beach. Of these, the City of Jacksonville is the only City with land in the Williamson Creek watershed.

4.2.2 Land Uses and Nonpoint Sources

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

Land Uses

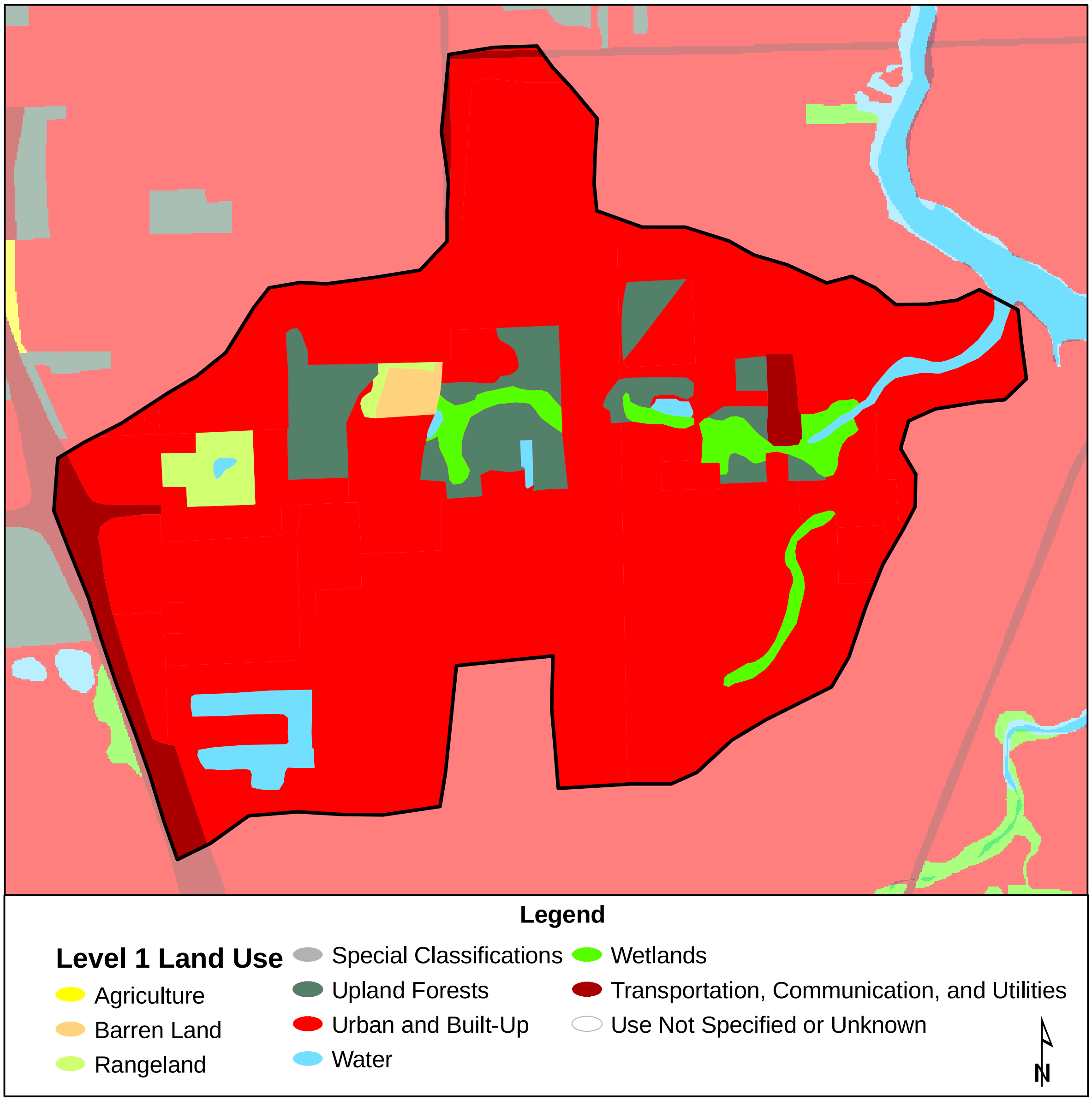
The spatial distribution and acreage of different land use categories were identified using the 2000 land use coverage contained in the Department's Geographic Information System (GIS) library, initially provided by the SJRWMD. Land use categories and acreages in the watershed were aggregated using the Level 3 codes tabulated in **Table 4.1. Figure 4.1** shows the principle land uses in the watershed.

The Williamson Creek watershed is a fairly small area which is highly urban, occupying approximately 930 acres (1.45 mi^2). As shown in **Table 4.1**, the majority of the land is high density residential (61.85 percent), followed by low density residential (6.67 percent). Non-natural land uses, including residential areas (high, medium, and low), institutional uses, commercial services, golf courses, etc., comprise 85.4 percent of the watershed area or 740 acres. Natural land use types, such as pine flatwoods, upland mixed coniferous/hardwoods, streams, mixed scrub-shrub wetlands, etc., comprise 14.6 percent, or 135.5 acres. According to the land use, there are no livestock agriculture land use types.

Table 4.1. Classification of Land Use Categories in the Williamson Creek Watershed

Level 3 Land Use Code	Attribute	Acres	Percent of Total Area
1300	Residential, high density - 6 or more dwelling units/acre	574.76	61.85%
1100	Residential, low density - less than 2 dwelling units/acre	62.01	6.67%
4340	Upland mixed coniferous/hardwood	61.74	6.64%
1400	Commercial and services	52.05	5.60%
1200	Residential, medium density - 2-5 dwelling units/acre	51.49	5.54%
6170	Mixed wetland hardwoods	28.58	3.08%
8140	Roads and highways (divided 4-lanes with medians)	28.03	3.02%
1700	Institutional	19.24	2.07%
5300	Reservoirs - pits, retention ponds, dams	18.66	2.01%
3200	Shrub and brushland	13.89	1.49%
5100	Streams and waterways	6.51	0.70%
8340	Sewage treatment	6.21	0.67%
7410	Rural land in transition	6.16	0.66%
	Total:	**929.33**	**100.00%**

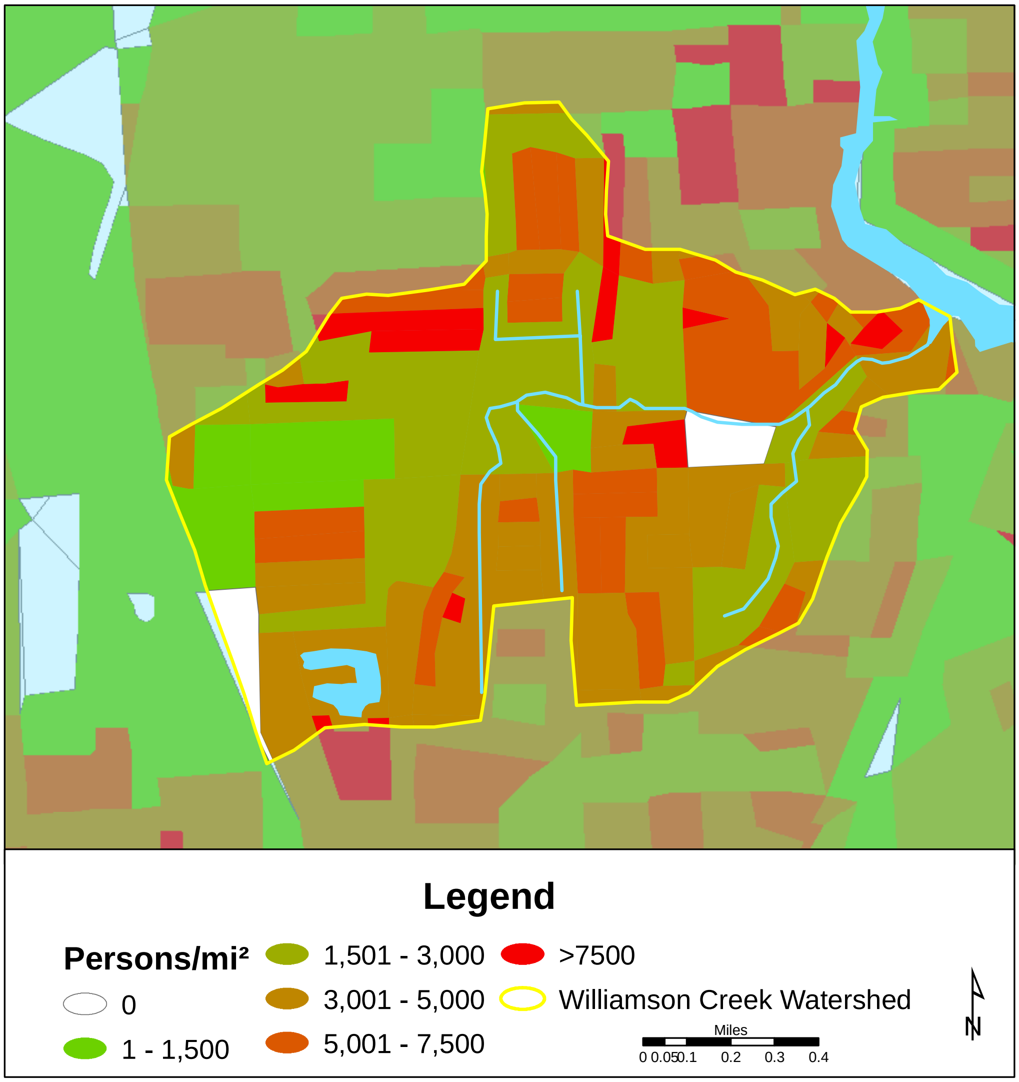
Figure 4.1. Principle Level 1 Land Uses in the Williamson Creek Watershed



Population

According to the U.S Census Bureau, census block population densities in the Williamson Creek watershed in the year 2000 ranged from 0 – 11,970 persons per square mile, with an average of 3,188 persons per square mile in the watershed **(Figure 4.2).** The Census Bureau reports that for all of Duval County, the total population for 2000 was approximately 780,000, with 329,778 housing units and an average occupancy rate of 92.1 percent (303,747 units). For all of Duval County, the 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 Web site, 2005). The housing density in Williamson Creek is approximately 1,173 units/mi^2, which is considerably higher than the average for the rest of the county.

Figure 4.2. Population Density in the Williamson Creek Watershed



Septic Tanks

Using data supplied by the Department of Revenue and Department of Health (DoH), it is estimated that approximately 57 percent of residences within Duval County are connected to a wastewater treatment plant, with the rest utilizing septic tanks (Department of Revenue cadastral data, 2003, and DoH Website, 2005a). The DoH reports that as of fiscal year 2003-2004, there were 88,834 permitted septic tanks in Duval County (DoH Website, 2005b). From fiscal years 1994–2004, 4,954 permits for repairs were issued, or an average of approximately 450 repairs annually (DoH Website, 2005c) countywide.

As noted previously, there are an estimated 3,182 persons/mi^2 in the WBID, or 4,622 persons in the watershed area. The average household in the Williamson Creek watershed has 2.72 persons (see **Table 4.2**). According to the DoH, there is an annual average of 450 repairs (fiscal years 1994 –

2004) in Duval County. Based on this, there is an average of less than one (0.8) failure in the Williamson Creek watershed annually.

To focus on the Williamson Creek watershed, the Department obtained septic tank repair permit data from JEA for their service area, which includes the Moncrief Creek watershed. The data include septic tank repair permit records issued from March 1990 – April 2004, areas serviced by a wastewater treatment facility (WWTF), and areas where high numbers of failing septic tanks are present. This information is presented in **Figure 4.3** in map form. The data show there were 29 permits for repairs issued during this time in the watershed, or an average of 2.1 repairs per year. This estimate is more than twice the estimate based on DoH countywide data. None of the areas in the watershed are in septic tank phase out areas, or areas that have the highest priority to be sewered to eliminate septic tanks due to high failure rates.

Based on this data provided by JEA, which is more watershed specific than that of the countywide DoH data, there was an average of 2.1 permits issued in the watershed for septic tank repairs. If this estimate is rounded up to three (to allow for those septic tanks where failures may not be known or have not been repaired), and using 70 gallons/day/person (U.S. Environmental Protection Agency [USEPA], 2001), a loading of 2.16×10^{10} colonies/day is derived for fecal coliforms, and an estimated 2.16×10^{15} colonies/day for total coliforms. These estimations are shown in **Table 4.3.**

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

Household Size	No. of Households	Percentage of Total	Number of People
1-person household	372	21.86%	372
2-person household	536	31.49%	1,071
3-person household	325	19.10%	974
4-person household	251	14.73%	1,002
5-person household	135	7.96%	677
6-person household	53	3.10%	317
7-or-more-person household	30	1.76%	209
TOTAL:	**1,701**	**100.00%**	**4,622**
		AVERAGE HOUSEHOLD SIZE:	**2.72**

Data from U.S. Census Bureau web site, 2005, based on Duval County tracts which are present in the Williamson Creek watershed

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

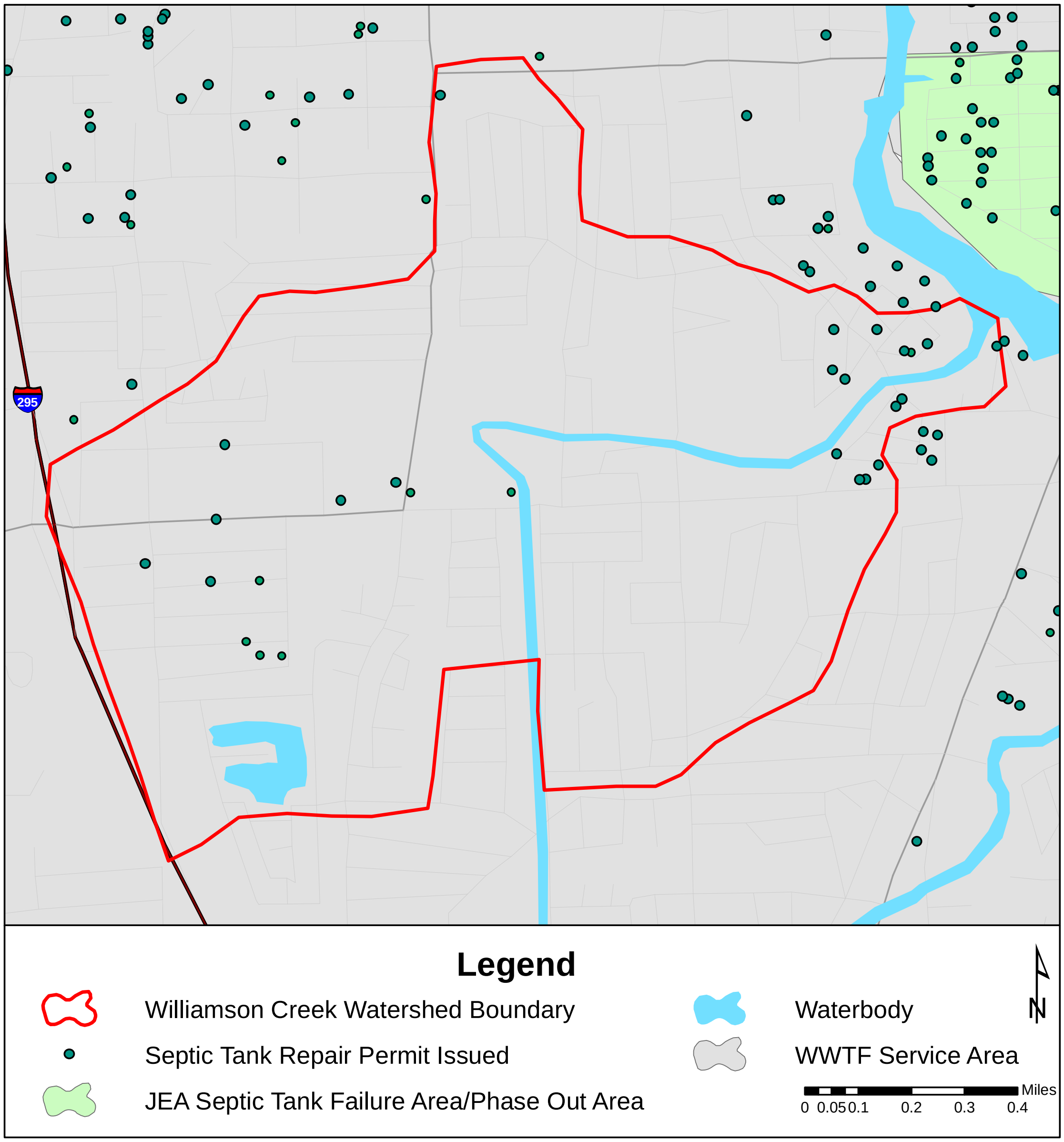
Coliform Type	Estimated Population in Watershed	Estimated Number of Tank Failures[1]	Estimated Load From Failed Tanks[2]	Gallons/ Person/ Day[2]	Estimated Number Persons Per Household[3]	Estimated Load from Failing Tanks (counts/day)	Estimated Load from Failing Tanks (counts/year)
Fecal	4,622	3	1.00×10^{4}/mL	70	2.72	2.16×10^{10}	7.89×10^{12}
Total	4,622	3	1.00×10^{9}/mL	70	2.72	2.16×10^{15}	7.89×10^{17}

[1] Based on septic tank repair permits issued in the watershed from March 1990 – April 2004 (Fl. DoH and JEA information) – see text

[2] Fecal coliform concentration from EPA document "Protocol for Developing Pathogen TMDLs;" total coliform concentration from EPA manual, "Onsite Wastewater Treatment Systems Manual."

[3] From U.S Census Bureau, see Table 4.2 for more information on this estimate.

Figure 4.3. Septic Tank Repair Permits Issued March 1990 – April 2004 for Williamson Creek Area



Agricultural Sources

According to Level 3 land use, there are no agricultural type land uses in the Williamson Creek watershed. As noted in **Section 4.2.2**, the majority of the land use (85.4 percent) consists of residential and commercial and services, and other non-natural categories.

Pets

While it is doubtful that agriculture has very little, if any, influence on the basin, it is very possible that pets, especially dogs, are having an impact on the waterbody. The Department has been unable to obtain numbers 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), and assuming that coliforms from10 percent of dogs reach the waterbody and are viable upon reaching it, the approximate loading would be 3.07 x 10^{11} organisms/day. Estimates of total coliforms concentrations from pet waste are not known, but concentrations are assumed to be greater than that of fecal coliforms. These are estimates, as the actual loading from dogs is not known.

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

Coliform Type	Estimated Number of Households	Estimated Household:Dog Ratio[1]	Estimated Total Dog Population in Watershed	Estimated Loading of Total	Estimated Number of Dogs with Impact to Creek	Estimated Counts/Pet/Day[2]	Estimated Daily Load from Dogs (counts/day)	Estimated Daily Load from Dogs (counts/year)
Fecal	1,701	0.361	614	10%	61	5 x 10^9	3.07 X 10^{11}	1.12 X 10^{14}
Total	1,701	0.361	614	10%	61	5 x 10^9	>3.07 X 10^{11}	>1.12 X 10^{14}

[1]From the American Veterinary Medical Association website, which states the original source to be the "U.S Pet Ownership and Demographics Sourcebook," 2002.
[2] From EPA document, "Protocol for Developing Pathogen TMDLs," 2001.

Leaking or Overflowing Wastewater Collection Systems

As noted previously, it has been estimated that 57 percent of households in Duval County are connected to wastewater facilities. Assuming 1,701 homes in the watershed, with 2.72 people per home, and a 70 gallon per person per day discharge, and also assuming that the countywide average of 57 percent are connected to a WWTF applies in Williamson Creek, a daily flow of approximately 6.99 x 10^5 L (0.184 MGD) is transported through the collection system. The EPA Protocol for Developing Pathogen TMDLs (EPA, 2001) suggests that a 5% leakage rate from collection systems is realistic. Based on this and EPA values for fecal and total coliforms in raw sewage, the potential daily loadings of fecal and total coliforms from leaking sewer lines are 1.75 x 10^{12} and 3.50 x 10^{14} counts/day, respectively (**Table 4.5**).

Table 4.5. Estimated Loading from the Wastewater Collection Systems

Coliform Type	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/day)
Fecals	970	6.99 x 10^5	3.50 x 10^4	5 x 10^6	1.75 X 10^{12}	6.38 X 10^{14}
Totals	970	6.99 x 10^5	3.50 x 10^4	1 x 10^9	3.50 X 10^{14}	1.28 X 10^{17}

4.4 Source Summary

4.4.1 Summary of Fecal Coliform Loadings into Williamson Creek from the Various Sources

Table 4.6 summarizes estimates from the various sources. It is important to note that this is not a complete list (wildlife, for example, is missing) and represents estimates of potential loadings. Proximity to the waterbody, rainfall frequency and magnitude, and temperature are just a few of the factors that could influence and determine the actual loadings from these sources that reach Williamson Creek. For some estimates total coliform concentrations were not available. However, fecal coliform is a component of total coliform, so total coliform loading would be expected to be greater than that of fecal coliforms.

Table 4.6. Summary of Estimated Potential Coliform Loading From Various Sources the Williamson Creek Watershed

Source	Fecal Coliforms		Total Coliforms	
	Estimated Daily Load (counts/day)	Estimated Annual Load (counts/year)	Estimated Daily Load (counts/day)	Estimated Annual Load (counts/year)
Permitted Discharges	N/A*	N/A*	N/A*	N/A*
Septic Tanks	2.16×10^{10}	7.89×10^{12}	2.16×10^{10}	7.89×10^{12}
Dogs	3.07×10^{11}	1.12×10^{14}	$>3.07 \times 10^{11}$	$>1.12 \times 10^{14}$
Collection Systems	1.75×10^{12}	6.38×10^{14}	3.50×10^{14}	1.28×10^{17}

* There are currently no permitted discharges within the Williamson Creek watershed

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 Williamson Creek. To determine the TMDL, the percent reduction that would be required for each of the exceedances to meet applicable criteria was determined, and the median value of all of these reductions for both fecal and total coliforms determined the overall required reduction, and therefore the TMDL.

5.1.1 Data Used in the Determination of the TMDL

There are six sampling stations in Williamson Creek that have historical coliform observations. The primary data collector of historical data is the City of Jacksonville, which maintains a routine (quarterly) sampling site at Hyde Park Road (STORET ID: CR84). Additional data was collected by the Department in 1999 and 2002, and the SJRWMD in 1992 and 1993. Fecal coliform and total coliform data collected from these sites between January 1991 and December 2002 were used to determine the TMDL. **Table 5.1** shows summaries, by station, of the Department’s data inventory for Williamson Creek. **Figure 5.1** shows the location of the sample sites, and **Table 5.2** provides a brief overview data from each site. **Figures 5.2** and **5.3** are charts showing the observed historical data over time, and **Appendices B** and **C** contain all historical observations for fecal and total coliforms from all sites. **Table 2.3** shows average coliform counts by year.

Table 5.1. Sampling Station Summary for the Williamson Creek Watershed

FECAL COLIFORMS				
Station	**STORET ID**	**Station Owner[1]**	**Year(s) with Data**	**N**
WILLIAMSON CREEK AT HUGH EDWARDS	21FLA 20030429	FDEP	2002	2
WILLIAMSON CREEK AT JAMMES ROAD	21FLA 20030618	FDEP	1999	1
WILLIAMSON CREEK AT HYDE PARK ROAD	21FLJXWQCR84	COJ	1991 - 1996; 1998 - 2002	38
WILLIAMSON CREEK 100 M UPSTREAM OF MOUTH	21FLSJWMLSJ911	SJRWMD	1992 - 1993	4
TOTAL COLIFORMS				
Station	**STORET ID**	**Station Owner[1]**	**Year(s) with Data**	**N**
WILLIAMSON CR UP FR STA 20.4.7	21FLA 20030084	FDEP	2002	8
WILLIAMSON CREEK AT HUGH EDWARDS	21FLA 20030429	FDEP	2002	12
WILLIAMSON CREEK AT HYDE PARK ROAD	21FLJXWQCR84	COJ	1991 - 1995	19
WILLIAMSON CREEK AT JAMMES ROAD, JACKSONVILLE	21FLA 20030618	FDEP	1999	1

[1] FDEP = Fl. Dept. of Env. Prot.; COJ = City of Jacksonville; SJRWMD = St. Johns River Water Management District

Figure 5.1. Sampling Sites with Historical Data in Williamson Creek Watershed

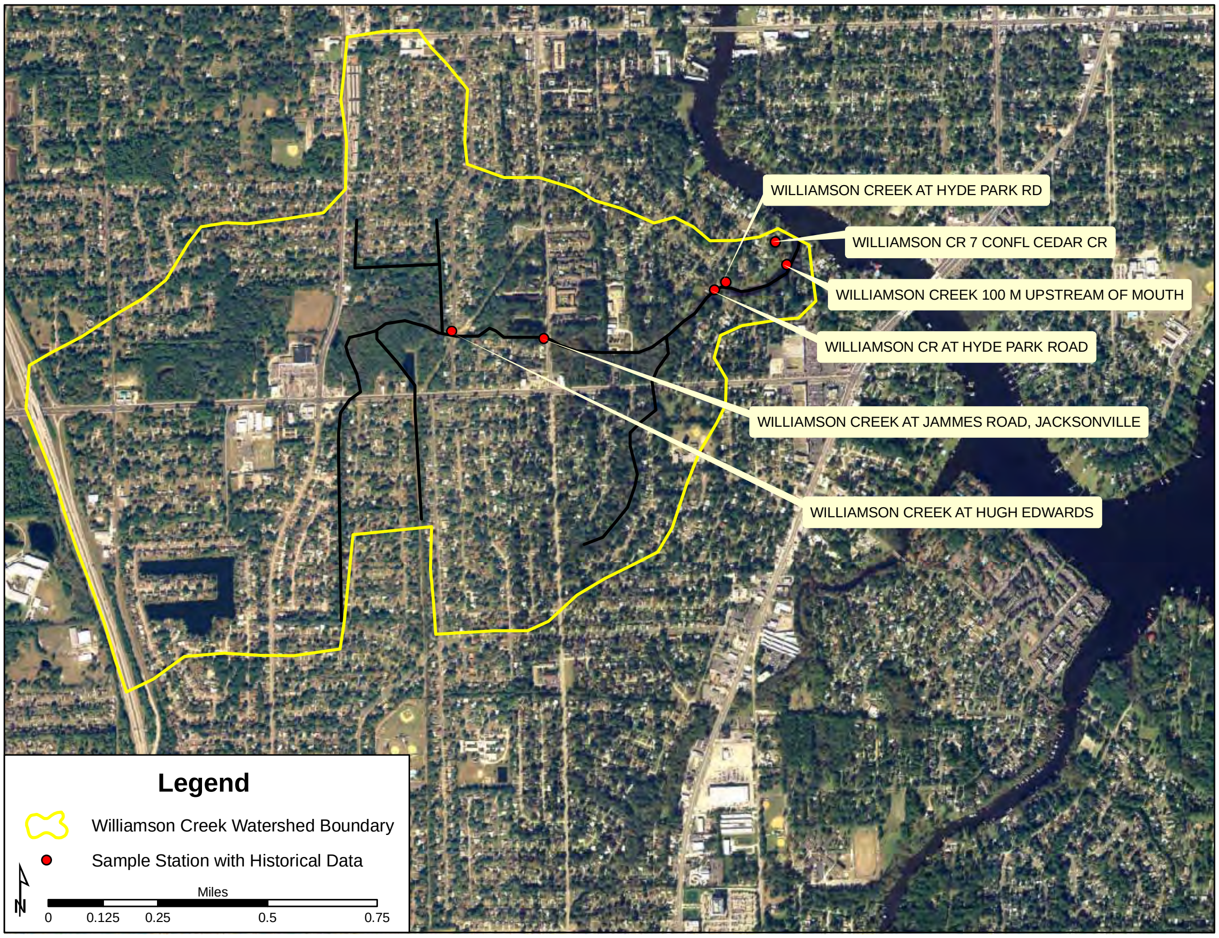


Table 5.2. Statistical Table of Observed Historical Coliform Data for Williamson Creek

FECAL COLIFORMS							
Station	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Exceedances**	**% Exceedances**
WILLIAMSON CREEK AT HUGH EDWARDS	2	1,633	3,233	2,433	2,433	2	100.00%
WILLIAMSON CREEK AT JAMMES ROAD	1	13,000	13,000	13,000	13,000	1	100.00%
WILLIAMSON CREEK AT HYDE PARK ROAD	38	38	160,000	1,350	9,454	29	76.32%
WILLIAMSON CREEK 100 M UPSTREAM OF MOUTH	4	2	730	340	353	2	50.00%
TOTAL COLIFORMS							
Station	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Exceedances**	**% Exceedances**
WILLIAMSON CREEK AT HUGH EDWARDS	12	122	15,800	4,600	5,451	9	75.00%
WILLIAMSON CREEK AT JAMMES ROAD, JACKSONVILLE	1	29,000	29,000	29,000	29,000	1	100.00%
WILLIAMSON CREEK AT HYDE PARK ROAD	19	1,300	24,000	5,000	8,353	17	89.47%
WILLIAMSON CR UP FR STA 20.4.7	8	1,219	23,600	4,500	7,269	5	62.50%

Coliform concentrations are #/100 mL

Figure 5.2. Historical Fecal Coliform Observations for Williamson Creek

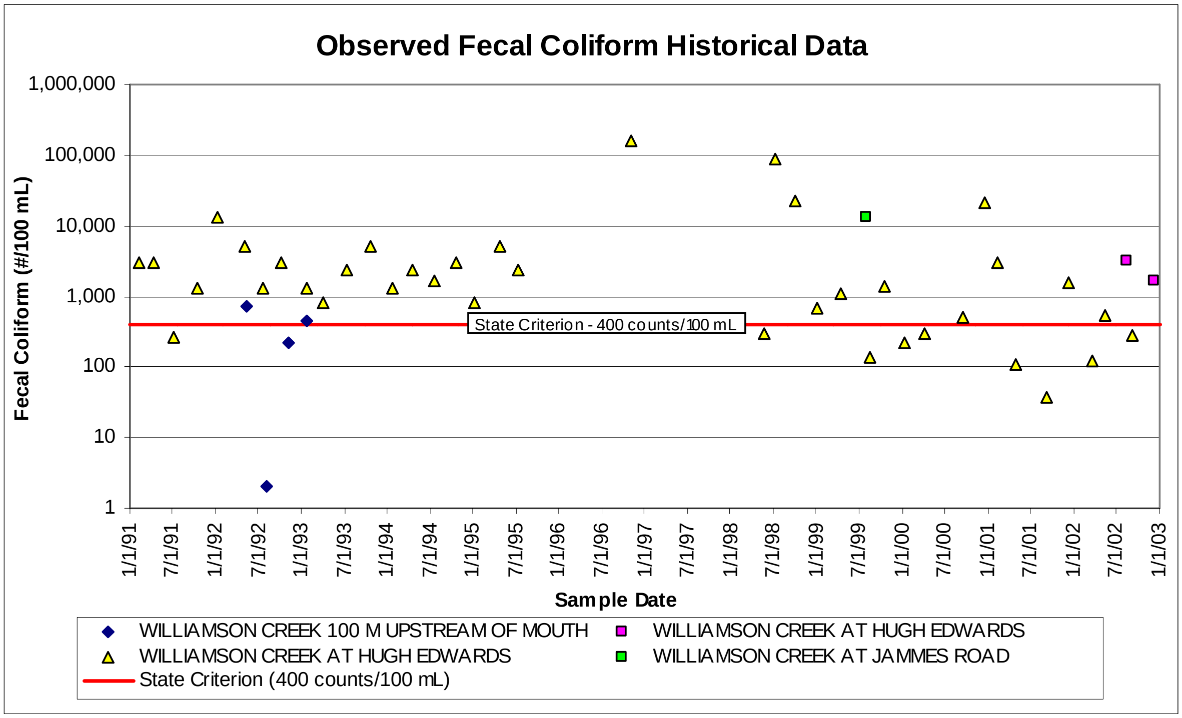
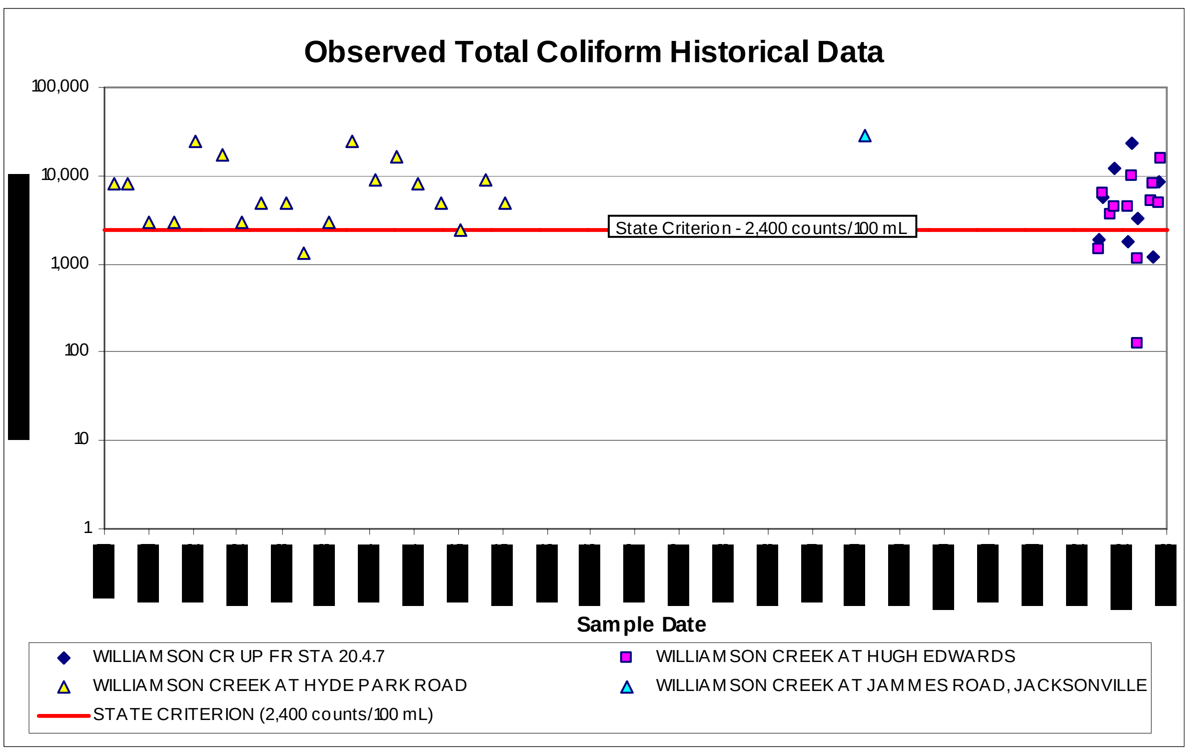


Figure 5.3. Historical Observations Total Coliforms for Williamson Creek



5.1.2 TMDL Development Process

Due to the lack of supporting flow data, a simple calculation was performed to determine the needed reductions. Exceedances of the state criterion for fecal coliforms were compared to the criterion of 400 counts/100mL; exceedances of the total coliform criterion were compared to 2,400 counts/100 mL. For each exceedance, the 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 all the individual values was calculated, which is 83 percent for fecal coliforms and 66 percent for total coliforms. This means that in order to meet the state criterion of 400 counts/100mL, an 83 percent reduction in current loading for fecal coliforms, and 66 percent reduction for total coliforms is necessary, and are therefore the TMDLs for Williamson Creek. **Tables 5.3** shows the individual reduction calculations for fecal coliform, and **Table 5.4** shows total coliform for Williamson Creek.

Table 5.3. Calculation of Reductions for the Fecal Coliform TMDL for Williamson Creek

DATE	LOCATION	VALUE	REQUIRED REDUCTION
2/12/1991	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	86.67%
4/10/1991	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	86.67%
10/14/1991	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	69.23%
1/7/1992	WILLIAMSON CREEK AT HYDE PARK ROAD	13,000	96.92%
5/4/1992	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	92.00%
5/11/1992	WILLIAMSON CREEK 100 M UPSTREAM OF MOUTH	730	45.21%
7/22/1992	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	69.23%
10/7/1992	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	86.67%
1/19/1993	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	69.23%
1/20/1993	WILLIAMSON CREEK 100 M UPSTREAM OF MOUTH	460	13.04%
4/5/1993	WILLIAMSON CREEK AT HYDE PARK ROAD	800	50.00%
7/14/1993	WILLIAMSON CREEK AT HYDE PARK ROAD	2,400	83.33%
10/18/1993	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	92.00%
1/25/1994	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	69.23%
4/18/1994	WILLIAMSON CREEK AT HYDE PARK ROAD	2,400	83.33%
7/20/1994	WILLIAMSON CREEK AT HYDE PARK ROAD	1,700	76.47%
10/24/1994	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	86.67%
1/9/1995	WILLIAMSON CREEK AT HYDE PARK ROAD	800	50.00%
4/25/1995	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	92.00%
7/11/1995	WILLIAMSON CREEK AT HYDE PARK ROAD	2,400	83.33%
11/6/1996	WILLIAMSON CREEK AT HYDE PARK ROAD	160,000	99.75%
7/13/1998	WILLIAMSON CREEK AT HYDE PARK ROAD	90,000	99.56%
10/7/1998	WILLIAMSON CREEK AT HYDE PARK ROAD	22,000	98.18%
1/5/1999	WILLIAMSON CREEK AT HYDE PARK ROAD	700	42.86%
4/14/1999	WILLIAMSON CREEK AT HYDE PARK ROAD	1,100	63.64%
8/3/1999	WILLIAMSON CREEK AT JAMMES ROAD	13,000	96.92%
10/20/1999	WILLIAMSON CREEK AT HYDE PARK ROAD	1,400	71.43%
9/19/2000	WILLIAMSON CREEK AT HYDE PARK ROAD	500	20.00%
12/18/2000	WILLIAMSON CREEK AT HYDE PARK ROAD	21,000	98.10%
2/8/2001	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	86.67%
12/11/2001	WILLIAMSON CREEK AT HYDE PARK ROAD	1,560	74.36%
5/16/2002	WILLIAMSON CREEK AT HYDE PARK ROAD	530	24.53%
8/14/2002	WILLIAMSON CREEK AT HUGH EDWARDS	3,233	87.63%
12/10/2002	WILLIAMSON CREEK AT HUGH EDWARDS	1,633	75.51%
	MEDIAN:	**2,400**	**83.33%**

Table 5.4. Calculation of Reductions for the Total Coliform TMDL for Williamson Creek

DATE	LOCATION	VALUE	REQUIRED REDUCTION
2/12/1991	WILLIAMSON CREEK AT HYDE PARK ROAD	8,000	70.00%
4/10/1991	WILLIAMSON CREEK AT HYDE PARK ROAD	8,000	70.00%
7/2/1991	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	20.00%
10/14/1991	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	20.00%
1/7/1992	WILLIAMSON CREEK AT HYDE PARK ROAD	24,000	90.00%
5/4/1992	WILLIAMSON CREEK AT HYDE PARK ROAD	17,000	85.88%
7/22/1992	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	20.00%
10/7/1992	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	52.00%
1/19/1993	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	52.00%
7/14/1993	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	20.00%
10/18/1993	WILLIAMSON CREEK AT HYDE PARK ROAD	24,000	90.00%
1/25/1994	WILLIAMSON CREEK AT HYDE PARK ROAD	9,000	73.33%
4/18/1994	WILLIAMSON CREEK AT HYDE PARK ROAD	16,000	85.00%
7/20/1994	WILLIAMSON CREEK AT HYDE PARK ROAD	8,000	70.00%
10/24/1994	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	52.00%
4/25/1995	WILLIAMSON CREEK AT HYDE PARK ROAD	9,000	73.33%
7/11/1995	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	52.00%
8/3/1999	WILLIAMSON CREEK AT JAMMES ROAD, JACKSONVILLE	29,000	91.72%
4/18/2002	WILLIAMSON CR UP FR STA 20.4.7	5,800	58.62%
4/18/2002	WILLIAMSON CREEK AT HUGH EDWARDS	6,400	62.50%
5/16/2002	WILLIAMSON CREEK AT HUGH EDWARDS	3,700	35.14%
5/30/2002	WILLIAMSON CR UP FR STA 20.4.7	12,200	80.33%
5/30/2002	WILLIAMSON CREEK AT HUGH EDWARDS	4,400	45.45%
7/24/2002	WILLIAMSON CREEK AT HUGH EDWARDS	4,400	45.45%
8/14/2002	WILLIAMSON CR UP FR STA 20.4.7	23,600	89.83%
8/14/2002	WILLIAMSON CREEK AT HUGH EDWARDS	10,000	76.00%
9/3/2002	WILLIAMSON CR UP FR STA 20.4.7	3,200	25.00%
10/28/2002	WILLIAMSON CREEK AT HUGH EDWARDS	5,200	53.85%
11/7/2002	WILLIAMSON CREEK AT HUGH EDWARDS	8,000	70.00%
12/3/2002	WILLIAMSON CREEK AT HUGH EDWARDS	4,800	50.00%
12/3/2002	WILLIAMSON CR UP FR STA 20.4.7	8,400	71.43%
12/10/2002	WILLIAMSON CREEK AT HUGH EDWARDS	15,800	84.81%
	MEDIAN:	**7,200**	**66.25%**

5.1.3 Critical Conditions/Seasonality

Exceedances in Williamson Creek cannot be associated with flows, as no flow data within the basin have been reported. Therefore, the effects of flow under various conditions cannot be determined or be considered as a critical condition.

Historical fecal and total coliform observations in Williamson Creek are provided in **Appendices B** and **C**. Coliform data have been presented by month, season, and year to determine whether certain patterns are evident in the data set.

A non-parametric test (Kruskal-Wallis) was applied to both the fecal and total coliform datasets to determine whether there were significant differences among months or seasons. At an alpha (α) level of 0.05, both fecal and total coliforms had significant differences among months. Fecal coliform showed significant differences between seasons while total coliform did not (**Appendices D, E, F,** and **G**). It is very difficult to evaluate possible patterns among months due to the small sample sizes. For example, the range in monthly observations for fecal coliform varies from 1 to 13 in a given month, with seven months having less than eight observations. The sample sizes for total coliform were even smaller, with sample size ranging from 0 to 12, and only two months having more than ten samples. Grouping observations by season increased sample sizes for statistical comparison and, as seen in **Table 2.3**, for fecal coliform the fall (October - December) season had the highest exceedance rate (100 percent). For total coliform, the highest exceedance rate occurred in spring (April - June), with a 100 percent exceedance rate. A likely factor that could contribute to these monthly or seasonal differences would be the pattern of rainfall.

Rainfall records for the Jacksonville International Airport (**Appendix H** illustrates rainfall from 1990 – 2004) 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 two days (3D), the cumulative total for the day of and the previous six days (7D) were all paired with the respective coliform observation. A Spearman Correlation matrix was generated that summarized the simple correlation coefficients between the various rainfall and coliform measures (**Appendices I** and **J**). The simple correlations (r values in the Spearman Correlation table) between both fecal and total coliform and the various rainfall totals were mostly negative, suggesting that as rainfall (and possible runoff) increased, the number of coliforms decreased (inverse relationship).

Simple linear regressions were performed between the coliform observation and rainfall total to determine whether any of the relationships were significant at an α level of 0.05. Although the r^2 values were low, the correlations between fecal and total coliform to any of the precipitation regimes showed no significance (**Appendices K** and **L**). As noted in the previously, the highest percentage of exceedances of fecal coliform occurred in February, July, October, November, and December. For total coliform, the greatest percentage of exceedances occurred in April, May, August, October, and December. A table of monthly historical average rainfall (**Appendix M**) indicates that monthly rainfall totals increase in June and peak in September and by October return to levels observed in February and March. **Appendix N** includes a graph of annual rainfall over the 1955 – 2004 period versus the long-term average (52.27 inches) over this period. The years of 1996 – 1998 represented above average rainfall years while the years 1999 – 2001 were below average and 2002 was again above average. Higher percentages of fecal coliform exceedances occurred in 1996, but there was only one data point for this year, while 1999 and 2000 had the lowest percentage of exceedances (both 50 percent). There is not an obvious trend which correlates with precipitation, which may indicate exceedances are most likely due to a combination of factors from both point and nonpoint sources. There are fewer total coliform samples, and data from only two years – 1999 - 2002; therefore it is more difficult to determine a trend with precipitation with respect to year.

Hydrologic conditions were analyzed using rainfall, since no flow data was available. A loading curve type chart, that would normally be applied to flow events, was created using precipitation data from JIA from 1990 – 2004 instead. The chart was divided in the same manner as if flow was being analyzed, where extreme precipitation events represent the upper percentiles (0-5th percentile), followed by large precipitation events (5th – 15th percentile), medium precipitation events (15th – 40th percentile), small precipitation events (40th – 60th percentile), and no recordable precipitation events

(60th – 100th percentile). Three day (day of and two days prior to sample collection date) precipitation accumulations were used in the analysis.

Data show that fecal coliform exceedances occurred over all hydrologic conditions; however, the least percentage of exceedances (45.45 percent) occurred under what would be considered small precipitation events. The greatest percentage of exceedances (100 percent) occurred within large precipitation events. If a large percentage of exceedances occur during no measurable precipitation days, it is suspected that point sources are contributing. Likewise, if a large percentage of exceedances are found to be occurring after large and extreme precipitation events, this may indicate that exceedances are more nonpoint source driven; perhaps from stormwater conveyance systems or various land uses. With respect to fecal coliforms in Williamson Creek, there is no downward trend in exceedances with decreasing precipitation. This most likely indicates that exceedances are being influenced by both point and nonpoint sources.

Total coliform had a high number of exceedances in both the large event and no measurable precipitation ranges. There are no ranges without exceedances. Such a pattern may indicate that there is a combination of point and nonpoint sources affecting exceedances. **Tables 5.5** and **5.6** summarize the coliform data for each hydrologic condition. **Figures 5.4** and **5.5** shows the same data visually.

Table 5.5. Summary of Fecal Coliform Data by Hydrological Condition

Precipitation Event	Event Range	Total Values	Number of Exceedances	Percent Exceedance	Number of Non-Excedances	Percent Non-Exceedance
Extreme	>2.1"	2	1	50.00%	1	50.00%
Large	1.33" - 2.1"	5	5	100.00%	0	0.00%
Medium	0.18" - 1.33"	8	6	75.00%	2	25.00%
Small	0.01" - 0.18"	11	5	45.45%	6	54.55%
None/Not Measurable	<0.01"	19	17	89.47%	2	10.53%

Table 5.6. Summary of Total Coliform Data by Hydrological Condition

Precipitation Event	Event Range	Total Values	Number of Exceedances	Percent Exceedance	Number of Non-Excedances	Percent Non-Exceedance
Extreme	>2.1"	2	1	50.00%	1	50.00%
Large	1.33" - 2.1"	5	5	100.00%	0	0.00%
Medium	0.18" - 1.33"	6	3	50.00%	3	50.00%
Small	0.01" - 0.18"	8	4	50.00%	4	50.00%
None/Not Measurable	<0.01"	19	19	100.00%	0	0.00%

Figure 5.4 Fecal Coliform Data by Hydrological Condition Based on Rainfall

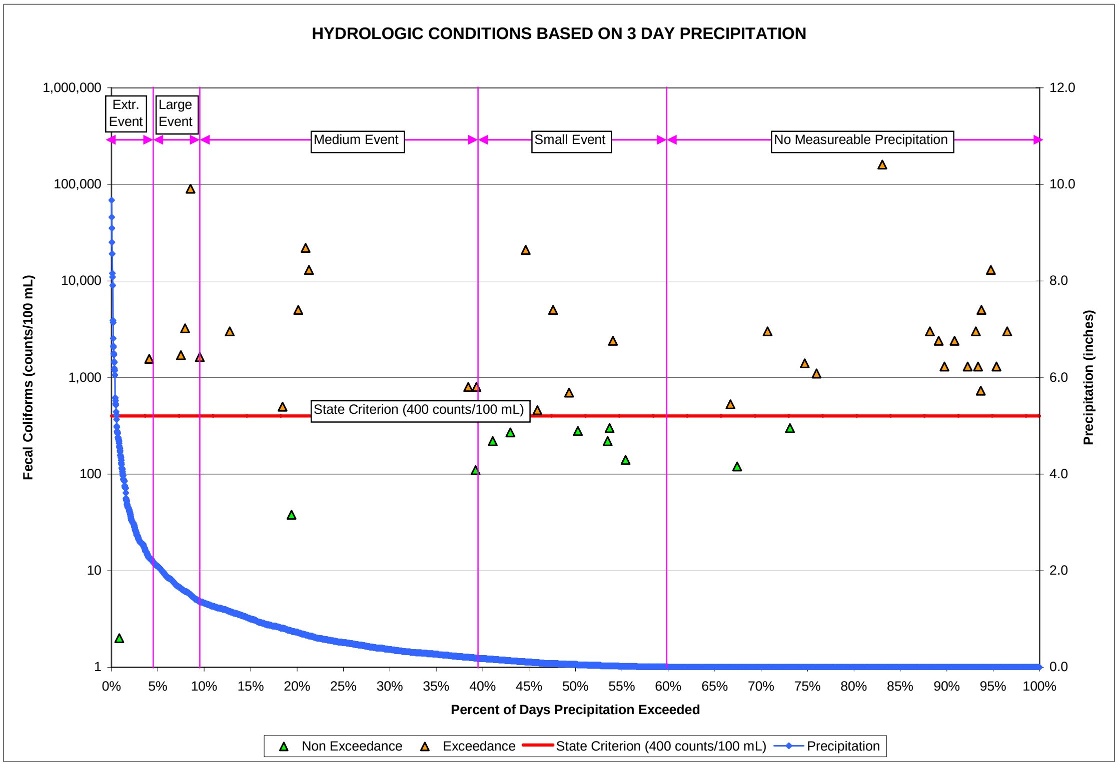
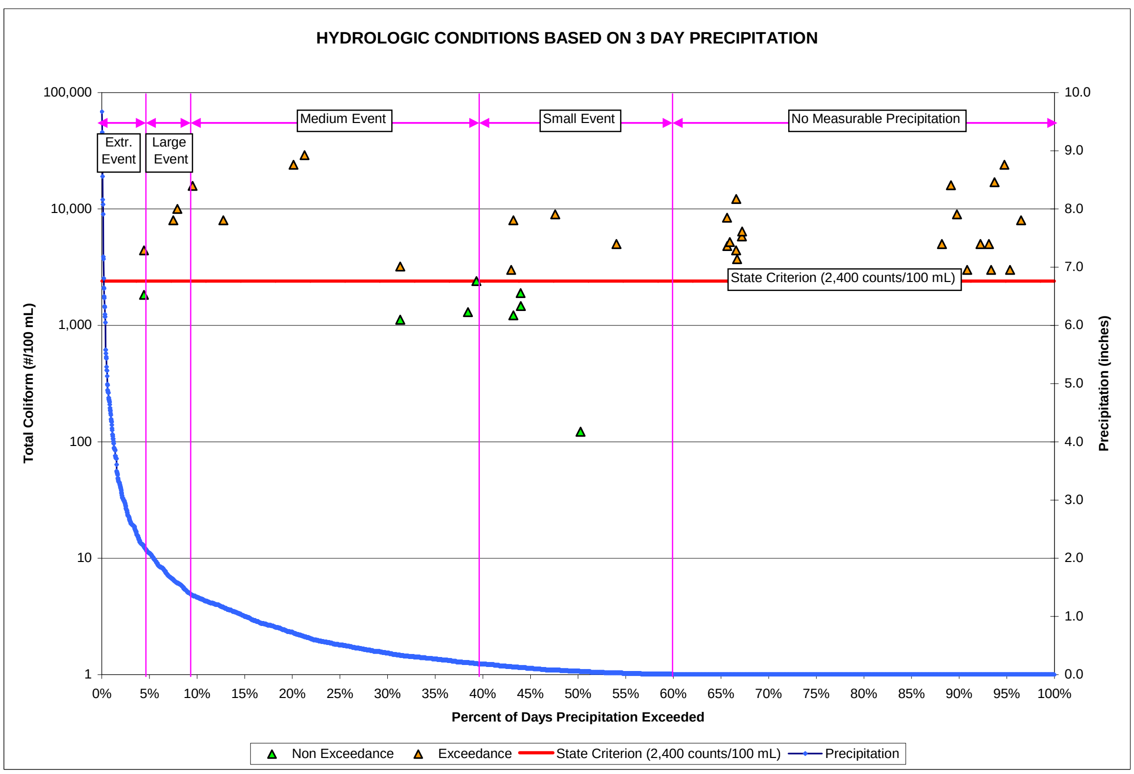


Figure 5.5 Total Coliform Data by Hydrological Condition Based on Rainfall



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 (Waste Load 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**. TMDLs for Williamson Creek are expressed in terms of counts per 100 mL and percent reduction, and represent the maximum fecal and total coliform load the creek can assimilate and maintain the applicable coliform criterion **(Table 6.1).**

Table 6.1. TMDL Components for Williamson Creek

WBID	Parameter	TMDL (counts/100 mL)	WLA		LA (Percent Reduction)	MOS
			Wastewater (counts/day)	NPDES Stormwater		
2316	Fecal Coliform	400	N/A	83%	83%	Implicit
2316	Total Coliform	2,400	N/A	66%	66%	Implicit

6.2 Load Allocation (LA)

A fecal coliform reduction of 83 percent and a total coliform reduction of 66 percent are required 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 (WLA)

6.3.1 NPDES Wastewater Discharges

There are currently no permitted NPDES wastewater discharges in this basin. However, as part of this TMDL, any future wastewater discharge permits issued within the Williamson Creek basin will be required to meet state Class III criteria for fecal coliforms as well as the TMDL value, and therefore will not be allowed to exceed as fecal coliform counts of 200 counts/100 mL as a monthly average or 400 counts/100 mL. Similarly, total coliform values will not be allowed to exceed 1,000 counts/100mL as a monthly average or exceed 1,000 counts/100 mL in 20 percent of the samples examined during any month, or exceed 2,400 counts/100 mL at any time.

6.3.2 NPDES Stormwater Discharges

The WLA for the City of Jacksonville and FDOT’s Municipal Separate Storm Sewer System (MS4) permit is an 83 percent reduction in current anthropogenic fecal coliform and a 66 percent reduction in current anthropogenic total coliform loading from the MS4. It should be noted that any MS4 permittee will only be responsible for reducing the loads associated with stormwater outfalls for which it owns or otherwise has responsible control, and is not responsible for reducing other nonpoint source loads within its jurisdiction.

6.4 Margin of Safety (MOS)

Consistent with the recommendations of the Allocation Technical Advisory Committee (FDEP, February 2001), an implicit margin of safety (MOS) was used in the development of this TMDL. A MOS was included in the TMDL by not allowing any exceedances of the state criterion, even though intermittent natural exceedances of the criterion would be expected and would be taken into account when determining impairment. Additionally, the TMDL calculated for fecal coliforms was based on meeting the water quality criterion of 400 counts/100 mL and 2,400 counts/100 mL for total coliforms without any exceedances, while the actual fecal coliform criterion allows for 10 percent exceedances over the criterion.

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 for the TMDL, which will be a component of the Basin Management Action Plan (BMAP) for Williamson Creek. This document will be developed over the next year in cooperation with local stakeholders and will attempt to reach consensus on more detailed allocations and on how load reductions will be accomplished. The BMAP will include the following:

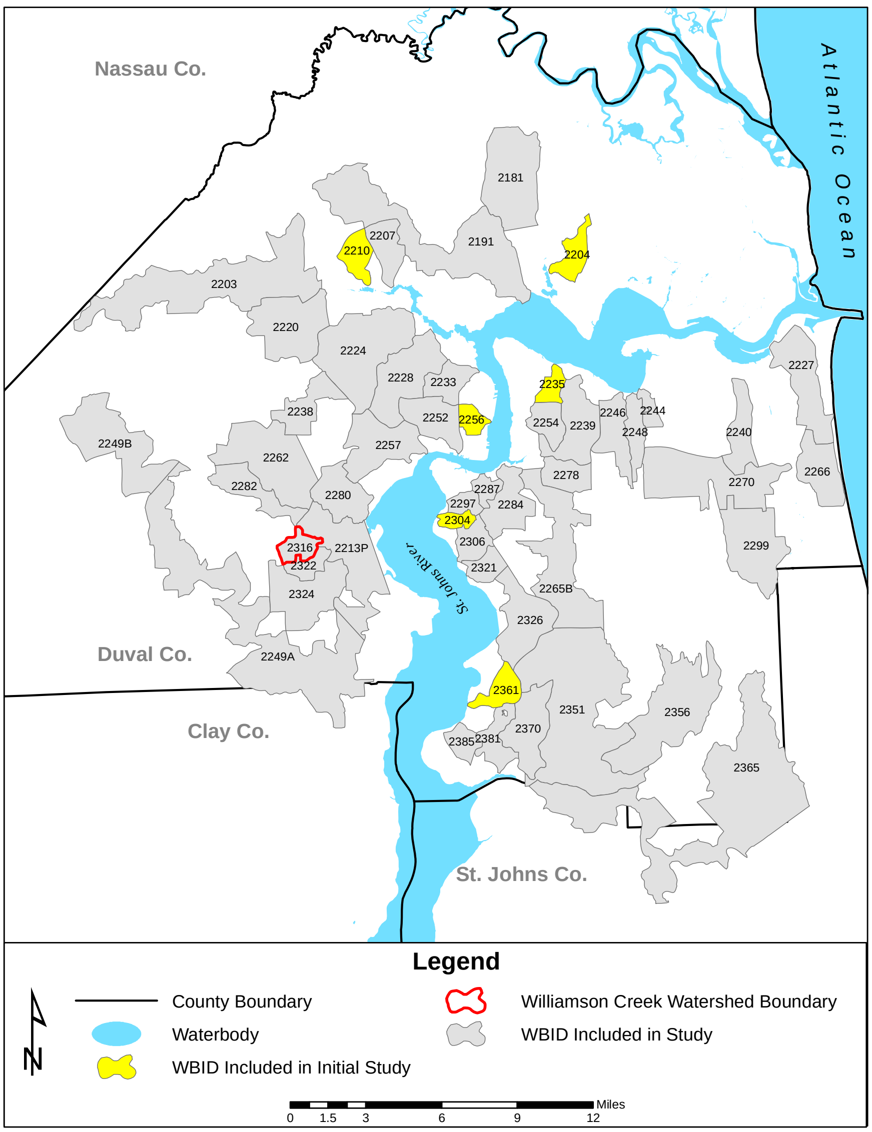
- Appropriate allocations among the affected parties,
- A description of the load reduction activities to be undertaken,
- Timetables for project implementation and completion,
- Funding mechanisms that may be utilized,
- Any applicable signed agreement,
- Local ordinances defining actions to be taken or prohibited,
- Local water quality standards, permits, or load limitation agreements, and
- Monitoring and follow-up measures.

The BMAP for Williamson Creek will include the results of a project funded by JEA that will consider 51 drainage basins in the general area of the City of Jacksonville, which includes Williamson Creek. The project, known as the Tributary Pollution Assessment Project (TPAP), is directed by a Tributary Assessment Team (TAT) consisting of representatives from JEA, the Department, City of Jacksonville, Duval County Health Department, Water and Sewer Expansion Authority, U.S. Army Corps of Engineers, St. Johns River Keepers, and PBS & J, who is the primary contractor for the project.

The goal of the TPAP is to devise a standard manual that can be used for tributary sanitary surveys in the Duval County area. The manual will be developed by studying 6 of the 51 watersheds deemed to be of the highest priority by JEA and the contractors, along with a control watershed. After the manual has been developed, it will be applied to the remaining 45 watersheds, and may then be expanded to other watersheds in the Duval County area. The manual will be used to help better determine the health of these watersheds and to determine potential sources of contamination, especially with respect to fecal coliforms. This will help JEA, who is the sewer utility provider in the area, concentrate repair efforts and to identify those areas where failing septic tanks may be playing a role in contamination. The drainage basins included in this initial study are shown in **Figure 7.1**, and include:

- Big Davis Creek (2356)
- Big Fishwier Creek (2280)
- Blockhouse Creek (2207)
- Broward River (2191)
- Butcher Pen Creek (2322)
- Cedar River (2262)
- Christopher Branch (2321)
- Cormorant Branch (2381)
- Cow Head Creek (2244)
- Craig Creek (2297)
- Deep Bottom Creek (2361)
- Deer Creek (2256)
- Dunn Creek (2181)
- Durbin Creek (2365)
- Fishing Creek (2324)
- Gin House Creek (2248)
- Goodbys (2326)
- Greenfield Creek (2240)
- Hogan Creek (2252)
- Hogpen Creek (2270)
- Hopkins Creek (2266)
- Jones Creek (2246)
- Julington Creek (2351)
- Little Potsburg Creek (2284)
- Little Sixmile Creek (2238)
- Long Branch (2233)
- Mandarin Drain (2385)
- McCoy Creek (2257)
- McGirts Creek (2249B)
- Miller Creek (2287)
- Miramar Creek (2304)
- Moncrief Creek (2228)
- New Castle Creek (2235)
- New Rose Creek (2306)
- Nine Mile Creek (2220)
- Oldfield Creek (2370)
- Open Creek (2299)
- Ortega River (2213P)
- Ortega River (2249A)
- Potsburg Creek (2265B)
- Red Bay Branch (2254)
- Ribault River (2224)
- Sherman Creek (2227)
- Silversmith Creek (2278)
- Sixmile Reach (2232)
- Strawberry Creek (2239)
- Terrapin Creek (2204)
- Trout River (2203)
- West Branch (2210)
- Williamson Creek (2316)
- Wills Branch (2282)

Figure 7.1. Map of WBIDs included in the TPAP study



The WBIDs included in this study have been categorized based on the primary land use (SJRWMD 2000 data) in the WBID – urban, suburban, or rural. Further efforts were made to identify potential sources of fecal coliform contamination based on land uses, JEA information, and survey data. The WBIDs were then prioritized based on this, as well as existing data. Six WBIDs of highest concern were selected for the initial study (3 urban, 2 suburban, and 1 rural). At the time this document was compiled, a control waterbody had yet to be selected.

Initial sampling for the study is set to begin on the six initial WBIDs on July 26, 2005 and end on February 1, 2006. The final deliverable (manual) will be submitted to JEA on June 1, 2006, and will be available for public review and comment on June 16, 2006. Four types of fecal indicators (fecal coliforms, *E. coli*., *Enterococci*, and coliphages) will be studied. *Enterococcus faecalis* will be studied in an attempt to further identify potential sources of sewage, and samples will be checked for human/ruminant primers. In addition, optical brighteners (using fluorometric techniques) will be included to bolster potential sewage sources input identification.

The executive summary submitted to the Department by JEA and PBS & J is attached as **Appendix O**. It is expected that the results of this study will be used to help guide identification of restoration projects during BMAP development. In addition to addressing failing septic tanks, BMAP plans may include some sort of public education in picking up after dogs. As **Table 4.4** shows, potential impacts from dogs and cats could be significant. It pet owners are educated on the potential impacts their pets are having on Williamson Creek, and they are inclined to take action, this could potentially decrease a source load.

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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.

The rule requires the state's water management districts (WMDs) to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a SWIM plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka. No PLRG has been developed for Newnans Lake at the time this study was conducted.

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. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific Standard Industrial Classification (SIC) codes, construction sites disturbing five or more acres of land, and master drainage systems of local governments with a population above 100,000, which are better known as municipal separate storm sewer systems (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 the Florida Department of Transportation throughout the fifteen counties meeting the population criteria.

An important difference between the federal and state stormwater permitting programs is that the federal program covers both new and existing discharges, while the state program focuses on new discharges. Additionally, Phase 2 of the NPDES Program will expand the need for these permits to construction sites between one and five acres, and to local governments with as few as 10,000 people. These 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 similar to other point sources of pollution, such as domestic and industrial wastewater discharges. The Department recently accepted delegation from the EPA for the stormwater part of the NPDES Program. It should be noted that most MS4 permits issued in Florida include a re-opener clause that allows permit revisions to implement TMDLs once they are formally adopted by rule.

Appendix B: Historical Fecal Coliform Observations in Williamson Creek

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
WILLIAMSON CREEK	2316	2/12/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	2/12/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	4/10/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	4/10/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	7/2/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	270	
WILLIAMSON CREEK	2316	7/2/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	270	
WILLIAMSON CREEK	2316	10/14/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	
WILLIAMSON CREEK	2316	10/14/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	
WILLIAMSON CREEK	2316	1/7/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	13,000	
WILLIAMSON CREEK	2316	1/7/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	13,000	
WILLIAMSON CREEK	2316	5/4/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	5/4/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	5/11/1992	21FLSJWMLSJ911	WILLIAMSON CREEK 100 M UPSTREAM OF MOUTH	730	B
WILLIAMSON CREEK	2316	7/22/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	
WILLIAMSON CREEK	2316	7/22/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	
WILLIAMSON CREEK	2316	8/4/1992	21FLSJWMLSJ911	WILLIAMSON CREEK 100 M UPSTREAM OF MOUTH	2	K
WILLIAMSON CREEK	2316	10/7/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	10/7/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	11/4/1992	21FLSJWMLSJ911	WILLIAMSON CREEK 100 M UPSTREAM OF MOUTH	220	
WILLIAMSON CREEK	2316	1/19/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	
WILLIAMSON CREEK	2316	1/19/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	
WILLIAMSON CREEK	2316	1/20/1993	21FLSJWMLSJ911	WILLIAMSON CREEK 100 M UPSTREAM OF MOUTH	460	
WILLIAMSON CREEK	2316	4/5/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	800	
WILLIAMSON CREEK	2316	4/5/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	800	
WILLIAMSON CREEK	2316	7/14/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	2,400	
WILLIAMSON CREEK	2316	7/14/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	2,400	
WILLIAMSON CREEK	2316	10/18/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	10/18/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	1/25/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	
WILLIAMSON CREEK	2316	1/25/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	
WILLIAMSON CREEK	2316	4/18/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	2,400	
WILLIAMSON CREEK	2316	4/18/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	2,400	
WILLIAMSON CREEK	2316	7/20/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,700	
WILLIAMSON CREEK	2316	7/20/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,700	
WILLIAMSON CREEK	2316	10/24/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	10/24/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	1/9/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	800	
WILLIAMSON CREEK	2316	1/9/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	800	
WILLIAMSON CREEK	2316	4/25/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	4/25/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	7/11/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	2,400	

Appendix B: Historical Fecal Coliform Observations in Williamson Creek (Continued)

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
WILLIAMSON CREEK	2316	7/11/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	2,400	
WILLIAMSON CREEK	2316	11/6/1996	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	160,000	L
WILLIAMSON CREEK	2316	11/6/1996	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	160,000	L
WILLIAMSON CREEK	2316	5/26/1998	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	300	
WILLIAMSON CREEK	2316	5/26/1998	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	300	
WILLIAMSON CREEK	2316	7/13/1998	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	90,000	
WILLIAMSON CREEK	2316	7/13/1998	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	90,000	
WILLIAMSON CREEK	2316	10/7/1998	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	22,000	
WILLIAMSON CREEK	2316	10/7/1998	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	22,000	
WILLIAMSON CREEK	2316	1/5/1999	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	700	
WILLIAMSON CREEK	2316	1/5/1999	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	700	
WILLIAMSON CREEK	2316	4/14/1999	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,100	
WILLIAMSON CREEK	2316	4/14/1999	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,100	
WILLIAMSON CREEK	2316	8/3/1999	21FLA 20030618	WILLIAMSON CREEK AT JAMMES ROAD	13,000	
WILLIAMSON CREEK	2316	8/18/1999	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	140	
WILLIAMSON CREEK	2316	8/18/1999	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	140	
WILLIAMSON CREEK	2316	10/20/1999	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,400	
WILLIAMSON CREEK	2316	10/20/1999	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,400	
WILLIAMSON CREEK	2316	1/10/2000	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	220	
WILLIAMSON CREEK	2316	1/10/2000	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	220	
WILLIAMSON CREEK	2316	4/3/2000	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	300	
WILLIAMSON CREEK	2316	4/3/2000	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	300	
WILLIAMSON CREEK	2316	9/19/2000	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	500	
WILLIAMSON CREEK	2316	9/19/2000	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	500	
WILLIAMSON CREEK	2316	12/18/2000	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	21,000	
WILLIAMSON CREEK	2316	12/18/2000	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	21,000	
WILLIAMSON CREEK	2316	2/8/2001	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	2/8/2001	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	4/26/2001	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	110	
WILLIAMSON CREEK	2316	4/26/2001	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	110	
WILLIAMSON CREEK	2316	9/5/2001	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	38	
WILLIAMSON CREEK	2316	9/5/2001	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	38	
WILLIAMSON CREEK	2316	12/11/2001	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,560	
WILLIAMSON CREEK	2316	12/11/2001	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,560	
WILLIAMSON CREEK	2316	3/20/2002	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	120	
WILLIAMSON CREEK	2316	5/16/2002	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	530	
WILLIAMSON CREEK	2316	8/14/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	3,233	
WILLIAMSON CREEK	2316	9/9/2002	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	280	
WILLIAMSON CREEK	2316	12/10/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	1,633	
WILLIAMSON CREEK	2316	12/10/2002	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,633	

Shaded cells are values which exceed the state criterion of 400 counts/100 mL
Remark Codes: B – Results based on colony counts outside the acceptable range
L – Off scale high. Actual value not known, but known to be greater than value shown
K – Off scale low. Actual value not known, but known to be less than value shown

NOTE: Some samples were seen as duplicates (i.e. same date and location) and were averaged, per the IWR, for TMDL determination. Appendix B includes all data contained in the IWR database. For this reason, some discrepancies may exist between Appendix B and tables contained in the text.

Appendix C: Historical Total Coliform Observations in Williamson Creek

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
WILLIAMSON CREEK	2316	2/12/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	8,000	
WILLIAMSON CREEK	2316	2/12/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	8,000	
WILLIAMSON CREEK	2316	4/10/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	8,000	
WILLIAMSON CREEK	2316	4/10/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	8,000	
WILLIAMSON CREEK	2316	7/2/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	7/2/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	10/14/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	10/14/1991	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	1/7/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	24,000	
WILLIAMSON CREEK	2316	1/7/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	24,000	
WILLIAMSON CREEK	2316	5/4/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	17,000	
WILLIAMSON CREEK	2316	5/4/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	17,000	
WILLIAMSON CREEK	2316	7/22/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	7/22/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	10/7/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	10/7/1992	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	1/19/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	1/19/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	4/5/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	
WILLIAMSON CREEK	2316	4/5/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	1,300	
WILLIAMSON CREEK	2316	7/14/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	7/14/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	3,000	
WILLIAMSON CREEK	2316	10/18/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	24,000	
WILLIAMSON CREEK	2316	10/18/1993	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	24,000	
WILLIAMSON CREEK	2316	1/25/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	9,000	
WILLIAMSON CREEK	2316	1/25/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	9,000	
WILLIAMSON CREEK	2316	4/18/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	16,000	
WILLIAMSON CREEK	2316	4/18/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	16,000	
WILLIAMSON CREEK	2316	7/20/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	8,000	
WILLIAMSON CREEK	2316	7/20/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	8,000	
WILLIAMSON CREEK	2316	10/24/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	10/24/1994	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	1/9/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	2,400	
WILLIAMSON CREEK	2316	1/9/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	2,400	
WILLIAMSON CREEK	2316	4/25/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	9,000	
WILLIAMSON CREEK	2316	4/25/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	9,000	
WILLIAMSON CREEK	2316	7/11/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	7/11/1995	21FLJXWQCR84	WILLIAMSON CREEK AT HYDE PARK ROAD	5,000	
WILLIAMSON CREEK	2316	8/3/1999	21FLA 20030618	WILLIAMSON CREEK AT JAMMES ROAD	29,000	
WILLIAMSON CREEK	2316	3/26/2002	21FLA 20030084	WILLIAMSON CR UP FR STA 20.4.7	1,900	
WILLIAMSON CREEK	2316	3/26/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	1,467	
WILLIAMSON CREEK	2316	4/18/2002	21FLA 20030084	WILLIAMSON CR UP FR STA 20.4.7	5,800	
WILLIAMSON CREEK	2316	4/18/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	6,400	
WILLIAMSON CREEK	2316	5/16/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	3,700	
WILLIAMSON CREEK	2316	5/30/2002	21FLA 20030084	WILLIAMSON CR UP FR STA 20.4.7	12,200	
WILLIAMSON CREEK	2316	5/30/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	4,400	
WILLIAMSON CREEK	2316	7/24/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	4,400	

Appendix C: Historical Total Coliform Observations in Williamson Creek (Continued)

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
WILLIAMSON CREEK	2316	7/24/2002	21FLA 20030084	WILLIAMSON CR UP FR STA 20.4.7	1,833	
WILLIAMSON CREEK	2316	8/14/2002	21FLA 20030084	WILLIAMSON CR UP FR STA 20.4.7	23,600	
WILLIAMSON CREEK	2316	8/14/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	10,000	
WILLIAMSON CREEK	2316	9/3/2002	21FLA 20030084	WILLIAMSON CR UP FR STA 20.4.7	3,200	
WILLIAMSON CREEK	2316	9/3/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	1,117	
WILLIAMSON CREEK	2316	9/9/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	122	
WILLIAMSON CREEK	2316	10/28/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	5,200	
WILLIAMSON CREEK	2316	11/7/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	8,000	
WILLIAMSON CREEK	2316	11/7/2002	21FLA 20030084	WILLIAMSON CR UP FR STA 20.4.7	1,219	
WILLIAMSON CREEK	2316	12/3/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	4,800	
WILLIAMSON CREEK	2316	12/3/2002	21FLA 20030084	WILLIAMSON CR UP FR STA 20.4.7	8,400	
WILLIAMSON CREEK	2316	12/10/2002	21FLA 20030429	WILLIAMSON CREEK AT HUGH EDWARDS	15,800	

Shaded cells are values which exceed the state criterion of 2,400 counts/100 mL

Remark Codes: No remark codes were reported for this data

NOTE: Some samples were seen as duplicates (i.e. same date and location) and were averaged, per the IWR, for TMDL determination. Appendix C includes all data contained in the IWR database. For this reason, some discrepancies may exist between Appendix C and tables contained in the text.

Appendix D: Kruskall – Wallis Analysis of Fecal Coliform Observations versus Season in Williamson Creek

The following results are for:
WBID$ = 2316

Categorical values encountered during processing are:
SEASON2 (4 levels)
1, 2, 3, 4

Kruskal-Wallis One-Way Analysis of Variance for 81 cases
Dependent variable is VALUE
Grouping variable is SEASON2

Group	Count	Rank Sum
1	18	667.000
2	20	726.000
3	22	760.000
4	21	1168.000

Kruskal-Wallis Test Statistic = 11.114
Probability is 0.011 assuming Chi-square distribution with 3 df

Appendix E: Kruskall – Wallis Analysis of Total Coliform Observations versus Season in Williamson Creek

The following results are for:
WBID$ = 2316

Categorical values encountered during processing are:
SEASON (4 levels)
1, 2, 3, 4

Kruskal-Wallis One-Way Analysis of Variance for 59 cases
Dependent variable is VALUE
Grouping variable is SEASON

Group	Count	Rank Sum
1	12	366.000
2	15	536.500
3	18	428.500
4	14	439.000

Kruskal-Wallis Test Statistic = 4.160
Probability is 0.245 assuming Chi-square distribution with 3 df

Appendix F: Kruskall – Wallis Analysis of Fecal Coliform Observations versus Month in Williamson Creek

The following results are for:
WBID$ = 2316
Categorical values encountered during processing are:
MONTH (11 levels)
1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12

Kruskal-Wallis One-Way Analysis of Variance for 81 cases
Dependent variable is VALUE
Grouping variable is MONTH

Group	Count	Rank Sum
1	13	427.000
2	4	234.000
3	1	6.000
4	14	511.000
5	6	215.000
7	12	548.000
8	5	152.000
9	5	60.000
10	12	674.000
11	3	171.000
12	6	323.000

Kruskal-Wallis Test Statistic = 24.132
Probability is 0.007 assuming Chi-square distribution with 10 df

Appendix G: Kruskall – Wallis Analysis of Total Coliform Observations versus Month in Williamson Creek

The following results are for:
WBID$ = 2316

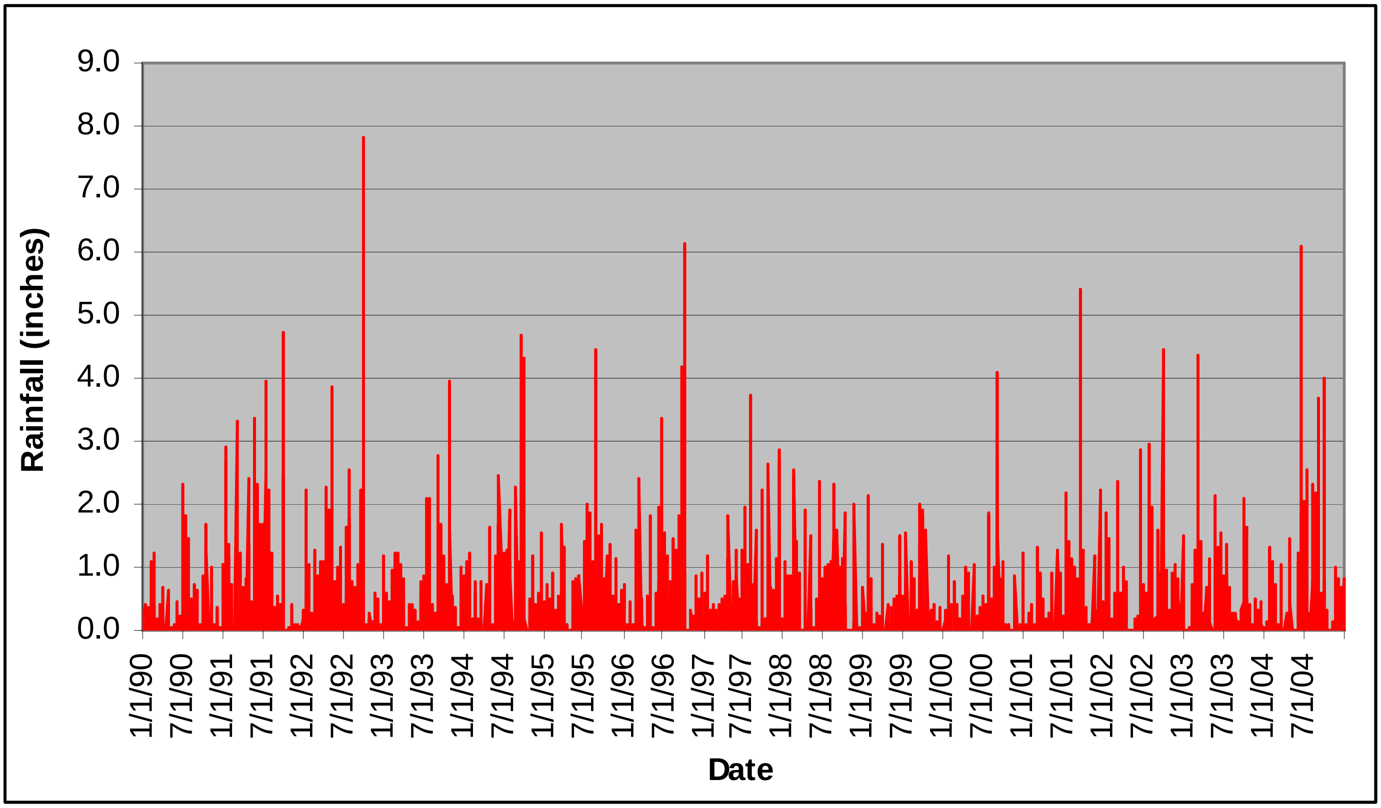
Categorical values encountered during processing are:
MONTH (11 levels)
1, 2, 3, 4, 5, 7, 8,
9, 10, 11, 12

Kruskal-Wallis One-Way Analysis of Variance for 59 cases
Dependent variable is VALUE
Grouping variable is MONTH

Group	Count	Rank Sum
1	8	276.000
2	2	76.000
3	2	14.000
4	10	342.000
5	5	194.500
7	12	246.500
8	3	160.000
9	3	22.000
10	9	284.000
11	2	41.000
12	3	114.000

Kruskal-Wallis Test Statistic = 22.410
Probability is 0.013 assuming Chi-square distribution with 10 df

Appendix H: Chart of Rainfall for Jacksonville International Airport (JIA) from 1990 – 2004

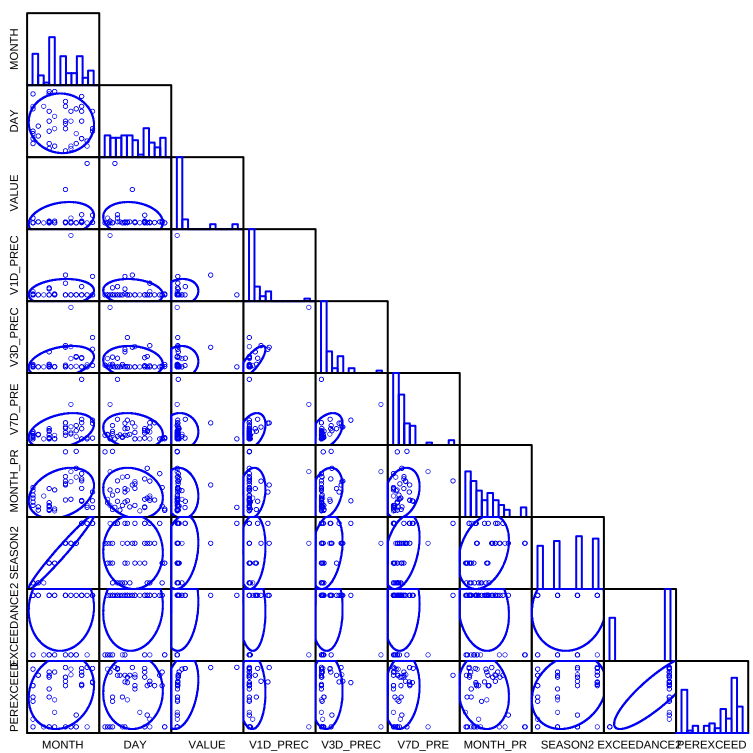


Appendix I: Spearman Correlation Matrix Analysis for Precipitation and Fecal Coliforms in Williamson Creek

The following results are for:
WBID$ = 2316
Spearman correlation matrix

	MONTH	DAY	VALUE	V1D_PREC	V3D_PREC
MONTH	1.000				
DAY	-0.038	1.000			
VALUE	0.228	-0.029	1.000		
V1D_PREC	0.057	-0.146	-0.011	1.000	
V3D_PREC	0.287	-0.112	-0.064	0.602	1.000
V7D_PRE	0.299	-0.127	0.089	0.399	0.468
MONTH_PR	0.271	-0.103	-0.023	0.073	0.218
SEASON2	0.976	-0.013	0.267	0.060	0.264
EXCEEDANCE2	0.047	0.129	0.722	-0.106	-0.107
PEREXCEED	0.237	-0.026	0.995	-0.001	-0.041

	V7D_PRE	MONTH_PR	SEASON2	EXCEEDANCE2	PEREXCEED
V7D_PRE	1.000				
MONTH_PR	0.305	1.000			
SEASON2	0.339	0.310	1.000		
EXCEEDANCE2	0.145	0.006	0.094	1.000	
PEREXCEED	0.111	-0.005	0.275	0.726	1.000



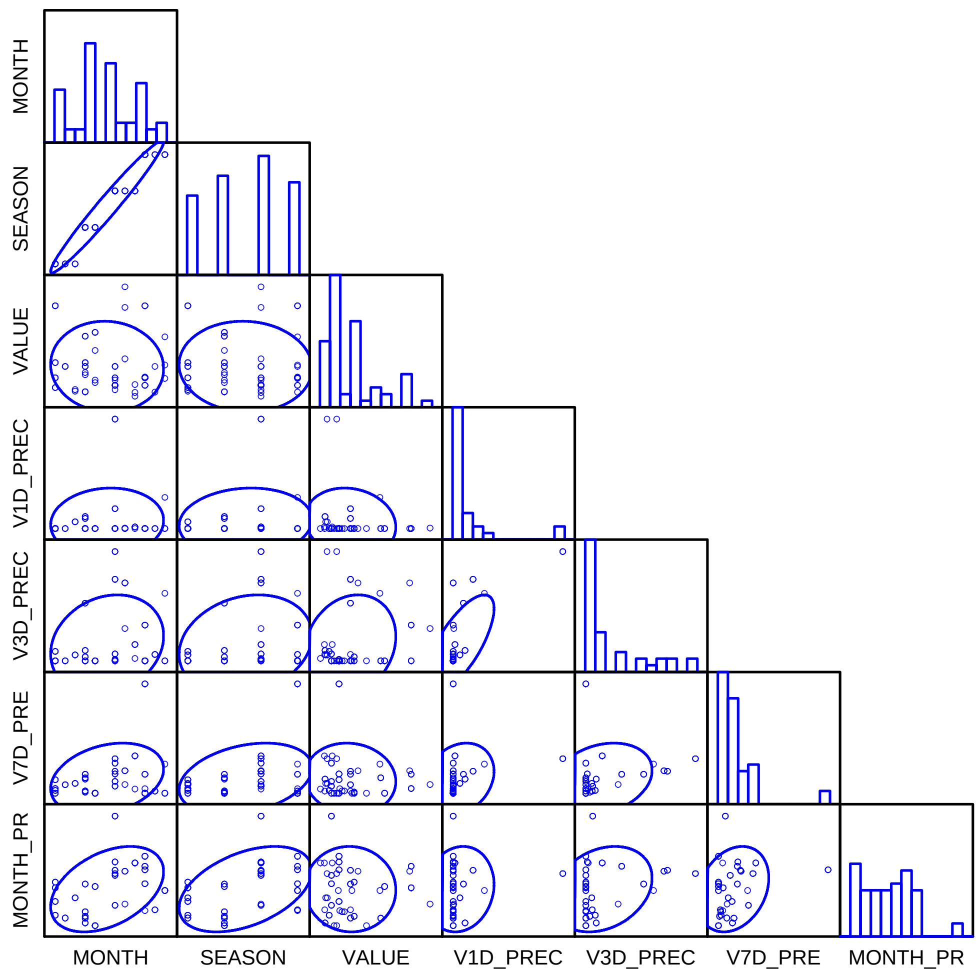
Appendix J: Spearman Correlation Matrix Analysis for Precipitation and Fecal Coliforms in Williamson Creek

The following results are for:
WBID$ = 2316

Spearman correlation matrix

	MONTH	SEASON	VALUE	V1D_PREC	V3D_PREC
MONTH	1.000				
SEASON	0.976	1.000			
VALUE	-0.074	-0.079	1.000		
V1D_PREC	-0.007	-0.025	-0.201	1.000	
V3D_PREC	0.160	0.151	-0.068	0.690	1.000
V7D_PRE	0.123	0.162	-0.084	0.484	0.517
MONTH_PR	0.454	0.492	-0.050	0.074	0.281

	V7D_PRE	MONTH_PR
V7D_PRE	1.000	
MONTH_PR	0.314	1.000



Appendix K: Analysis of Fecal Coliform Observations versus Precipitation in Williamson Creek

Analysis of sample day precipitation (1 day)

The following results are for:
WBID$ = 2316

Dep Var: VALUE N: 81 Multiple R: 0.122 Squared multiple R: 0.015

Adjusted squared multiple R: 0.002 Standard error of estimate: 28107.214

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	7993.052	3288.912	0.000	.	2.430	0.017
V1D_PREC	14526.276	13323.565	0.122	1.000	1.090	0.279

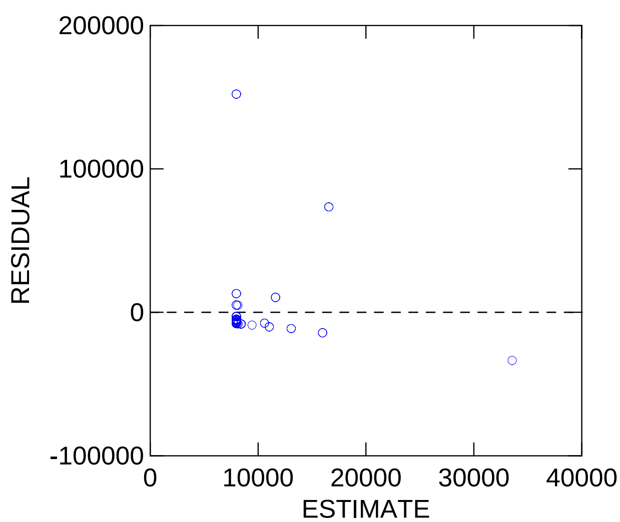
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	9.39082E+08	1	9.39082E+08	1.189	0.279
Residual	6.24112E+10	79	7.90015E+08		

*** WARNING ***
Case 5842 has large leverage (Leverage = 0.649)
Case 5869 is an outlier (Studentized Residual = 6.846)
Case 5870 is an outlier (Studentized Residual = 6.846)

Durbin-Watson D Statistic 1.033
First Order Autocorrelation 0.482

Plot of residuals against predicted values



Analysis of sample day and two days prior precipitation (3 day)

The following results are for:
WBID$ = 2316

Dep Var: VALUE N: 81 Multiple R: 0.042 Squared multiple R: 0.002

Adjusted squared multiple R: 0.000 Standard error of estimate: 28292.353

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	8494.324	3550.288	0.000	.	2.393	0.019
V3D_PREC	1625.136	4302.850	0.042	1.000	0.378	0.707

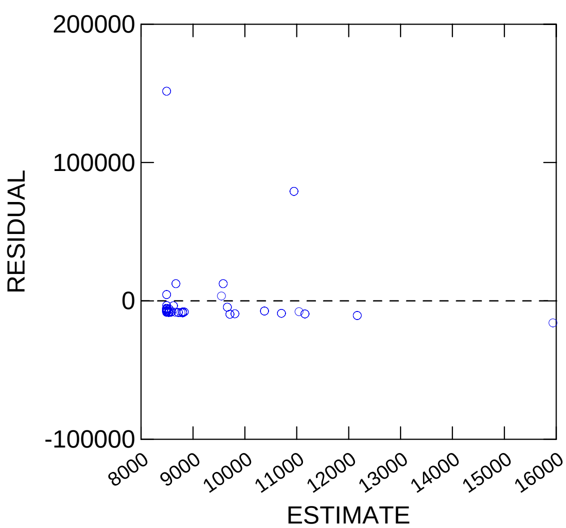
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.14184E+08	1	1.14184E+08	0.143	0.707
Residual	6.32361E+10	79	8.00457E+08		

*** WARNING ***
Case 5842 has large leverage (Leverage = 0.420)
Case 5869 is an outlier (Studentized Residual = 6.751)
Case 5870 is an outlier (Studentized Residual = 6.751)

Durbin-Watson D Statistic 1.019
First Order Autocorrelation 0.490

Plot of residuals against predicted values



Analysis of sample day and six days prior precipitation (7 day)

The following results are for:
WBID$ = 2316

Dep Var: VALUE N: 81 Multiple R: 0.043 Squared multiple R: 0.002

Adjusted squared multiple R: 0.000 Standard error of estimate: 28291.509

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	10048.582	3970.415	0.000	.	2.531	0.013
V7D_PRE	-837.421	2181.412	-0.043	1.000	-0.384	0.702

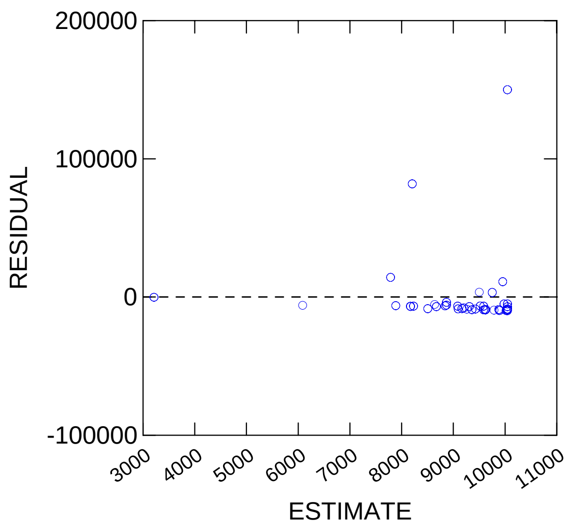
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.17957E+08	1	1.17957E+08	0.147	0.702
Residual	6.32323E+10	79	8.00409E+08		

*** WARNING ***
Case 5843 has large leverage (Leverage = 0.308)
Case 5844 has large leverage (Leverage = 0.308)
Case 5869 is an outlier (Studentized Residual = 6.663)
Case 5870 is an outlier (Studentized Residual = 6.663)

Durbin-Watson D Statistic 1.027
First Order Autocorrelation 0.486

Plot of residuals against predicted values



Appendix L: Analysis of Total Coliform Observations versus Precipitation in Williamson Creek

Analysis of sample day precipitation (1 day)

The following results are for:
WBID$ = 2316

Dep Var: VALUE N: 59 Multiple R: 0.128 Squared multiple R: 0.016

Adjusted squared multiple R: 0.000 Standard error of estimate: 7044.570

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	8227.997	955.981	0.000	.	8.607	0.000
V1D_PREC	-2499.003	2567.274	-0.128	1.000	-0.973	0.334

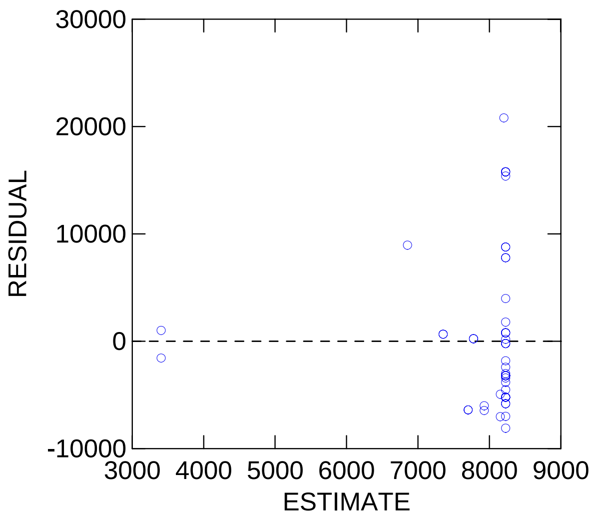
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	4.70217E+07	1	4.70217E+07	0.948	0.334
Residual	2.82868E+09	57	4.96260E+07		

*** WARNING ***
Case 1366 is an outlier (Studentized Residual = 3.214)
Case 1374 has large leverage (Leverage = 0.459)
Case 1375 has large leverage (Leverage = 0.459)

Durbin-Watson D Statistic 1.332
First Order Autocorrelation 0.320

Plot of residuals against predicted values



Analysis of sample day and two days prior precipitation

The following results are for:
WBID$ = 2316
Dep Var: VALUE N: 59 Multiple R: 0.170 Squared multiple R: 0.029

Adjusted squared multiple R: 0.012 Standard error of estimate: 6999.402

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	7310.137	1040.794	0.000	.	7.024	0.000
V3D_PREC	2024.081	1553.392	0.170	1.000	1.303	0.198

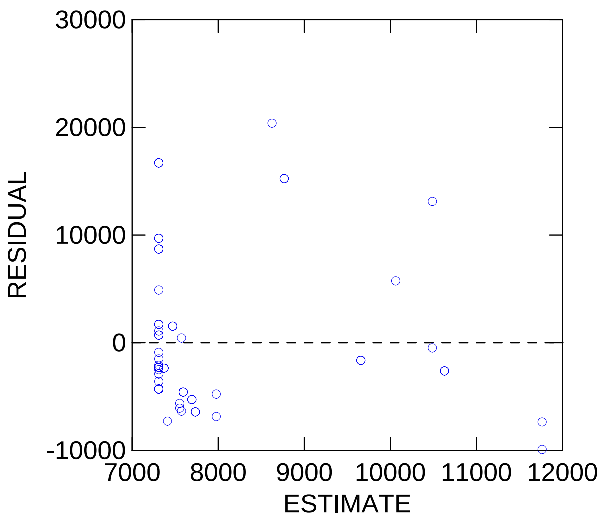
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	8.31794E+07	1	8.31794E+07	1.698	0.198
Residual	2.79252E+09	57	4.89916E+07		

*** WARNING ***
Case 1374 has large leverage (Leverage = 0.190)
Case 1375 has large leverage (Leverage = 0.190)

Durbin-Watson D Statistic 1.357
First Order Autocorrelation 0.316

Plot of residuals against predicted values



Analysis of sample day and six days prior precipitation (7 day)

The following results are for:
WBID$ = 2316

Dep Var: VALUE N: 59 Multiple R: 0.080 Squared multiple R: 0.006

Adjusted squared multiple R: 0.000 Standard error of estimate: 7080.299

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	8353.706	1124.167	0.000	.	7.431	0.000
V7D_PRE	-358.203	593.589	-0.080	1.000	-0.603	0.549

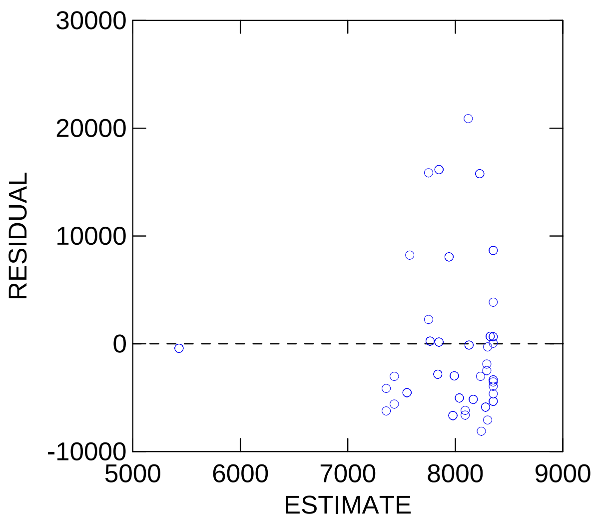
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.82553E+07	1	1.82553E+07	0.364	0.549
Residual	2.85745E+09	57	5.01306E+07		

*** WARNING ***
Case 1342 has large leverage (Leverage = 0.369)
Case 1343 has large leverage (Leverage = 0.369)
Case 1366 is an outlier (Studentized Residual = 3.210)

Durbin-Watson D Statistic 1.381
First Order Autocorrelation 0.298

Plot of residuals against predicted values

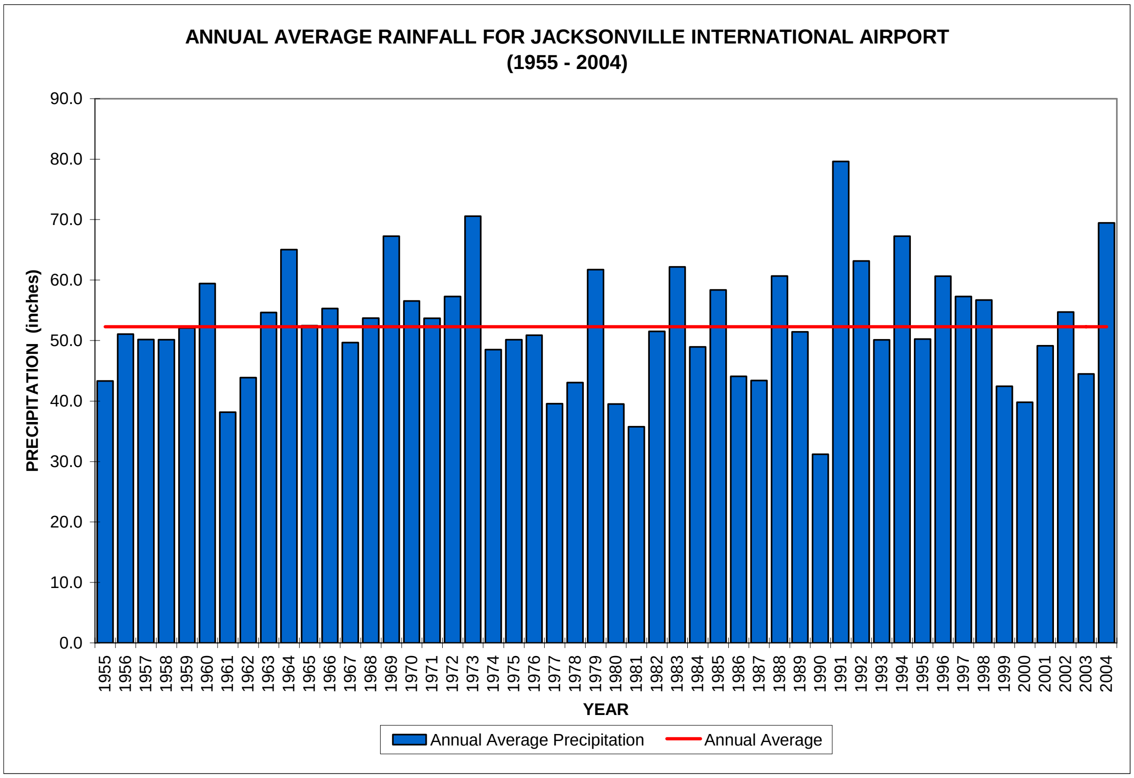


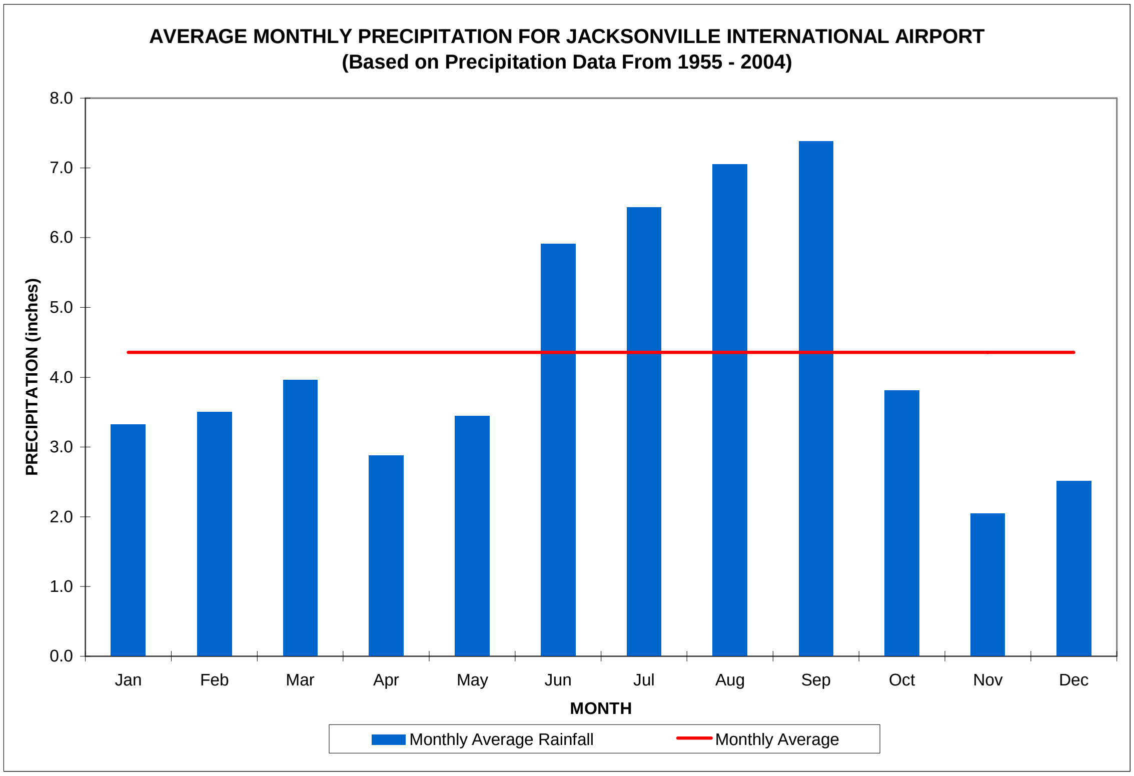
Appendix M: Monthly and Annual Precipitation 1955 – 2004 from JIA

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1955	3.09	2.46	1.66	1.5	4.51	2.7	5.53	3.85	10.56	5.36	1.9	0.21	**43.33**
1956	2.91	2.94	0.81	2.33	3.98	7.87	8.25	5.24	2.89	13.44	0.38	0.04	**51.08**
1957	0.33	1.69	3.87	1.61	5.25	7.1	12.34	3.3	8.33	3.5	1.55	1.31	**50.18**
1958	3.39	3.74	3.38	8.24	3.79	3.96	4.37	4.67	4.75	5.07	2.02	2.76	**50.14**
1959	2.97	5.22	9.75	2.65	9.2	2.94	4.51	2.86	5.67	3.12	2.24	0.95	**52.08**
1960	2.07	5.17	6.94	3.54	1.18	4.7	16.21	6.5	8.57	2.95	0.11	1.51	**59.45**
1961	2.87	4.85	1.17	4.16	3.06	5.27	3.48	10.64	1.02	0.27	0.89	0.47	**38.15**
1962	2.16	0.52	3.1	2.36	1.12	8.22	6.31	10.07	4.37	1.13	2.08	2.46	**43.90**
1963	5.39	6.93	2.23	1.75	1.74	12.49	6.47	4.95	4.88	1.53	2.7	3.6	**54.66**
1964	7.29	6.55	1.76	4.65	4.8	4.67	6.12	5.63	10.31	5.09	3.33	4.83	**65.03**
1965	0.65	5.5	3.91	0.95	0.94	9.79	2.71	9.58	11.02	1.75	1.92	3.75	**52.47**
1966	4.56	5.97	0.71	2.25	10.43	7.74	11.09	3.88	5.94	1.38	0.21	1.14	**55.30**
1967	3.05	4.35	0.81	2	1.18	12.9	5.22	12.31	1.8	1.13	0.24	4.69	**49.68**
1968	0.82	3.05	1.2	0.99	2.17	12.25	6.84	16.24	2.68	5.09	1.3	1.09	**53.72**
1969	0.84	3.39	4.23	0.34	3.78	5.12	5.89	15.1	10.33	9.81	4.56	3.87	**67.26**
1970	4.18	8.85	9.98	1.77	1.84	2.65	7.6	10.96	3.2	3.95	0	1.57	**56.55**
1971	2.01	2.55	2.41	4.07	1.9	5.52	5.07	12.83	4.17	6.46	0.83	5.87	**53.69**
1972	5.77	3.48	4.43	2.98	8.26	6.75	3.15	9.76	2.6	4.46	4.22	1.43	**57.29**
1973	4.64	5.07	10.18	11.61	5.33	4.1	5.45	7.49	7.86	4.08	0.44	4.32	**70.57**
1974	0.28	1.28	3.47	1.53	4.14	5.53	9.83	11.23	8.13	0.34	1.03	1.73	**48.52**
1975	3.48	2.58	2.46	5.78	7	5.21	6.36	6.23	5.24	3.63	0.39	1.79	**50.15**
1976	2.29	1.05	3.41	0.63	10.02	4.26	5.41	6.37	8.56	1.63	2.43	4.81	**50.87**
1977	2.96	3.24	1.03	1.76	3.07	2.65	1.97	7.26	7.45	1.68	3.11	3.38	**39.56**
1978	4.64	4.17	2.83	2.24	9.18	2.62	6.67	2.39	4.4	1.26	0.8	1.84	**43.04**
1979	6.28	3.75	1	4.18	7.54	5.91	4.67	4.78	17.75	0.25	3.64	2.01	**61.76**
1980	2.61	1.06	6.83	3.91	3.02	4.59	5.29	3.97	3.03	2.69	2.32	0.21	**39.53**
1981	0.92	4.53	5.41	0.32	1.48	3.31	2.46	6.47	1.22	1.35	4.92	3.38	**35.77**
1982	3	1.67	4.26	3.6	3.55	8.06	3.81	6.93	9.32	3.37	1.93	2.02	**51.52**
1983	7.19	4.27	8.46	4.65	1.38	6.86	6.11	4.63	4.61	4.29	3.32	6.42	**62.19**
1984	2.13	4.67	5.77	3.14	1.46	4.76	6.01	3.78	12.28	1.53	3.3	0.13	**48.96**
1985	1.05	1.45	1.26	2.76	2.08	3.71	6.33	8.93	16.82	8.34	2.07	3.59	**58.39**
1986	4.19	4.72	5.44	0.93	2.13	2.53	3.27	9.6	1.99	1.8	2.85	4.65	**44.10**
1987	4.09	6.47	6.27	0.14	0.75	4.18	4.4	4.48	7.13	0.3	5.02	0.16	**43.39**
1988	6.36	6.08	2.65	3.44	1.35	3.71	4.5	8.48	16.36	2.35	4.27	1.13	**60.68**
1989	1.73	1.77	2.14	2.79	1.55	3.66	8.98	9.16	14.37	1.39	0.51	3.4	**51.45**
1990	1.84	4.07	1.59	1.34	0.18	1.59	6.53	3.81	2.6	4.54	1.17	1.94	**31.20**
1991	10.2	1.52	7.33	6.31	9.35	11.7	15.9	3.48	6.2	6.36	0.71	0.57	**79.63**
1992	5.79	2.64	4.09	5.33	5.97	7.04	3.32	10.76	7.33	8.34	1.92	0.65	**63.18**
1993	3.86	2.89	5.98	0.85	1.6	2.52	7.54	2.96	7.6	8.84	3.58	1.9	**50.12**
1994	6.58	0.92	2.14	1.51	3.15	13.96	8.26	3.29	9.79	10.23	3.49	3.94	**67.26**
1995	1.91	2.07	3.67	1.77	1.77	5.35	9.45	9.93	5.41	3.53	3.2	2.19	**50.25**
1996	1.11	1.11	6.83	2.85	0.72	11.41	4.2	7.83	8.49	11.46	1.39	3.23	**60.63**
1997	2.91	1.28	1.84	4.56	3.43	6.33	7.69	8.24	3.97	4.84	2.41	9.77	**57.27**
1998	3.49	11.12	2.64	4.71	0.96	2.95	7.29	10.09	7.65	3.01	2.39	0.42	**56.72**
1999	4.63	1.7	0.4	1.92	1.02	7.75	3.56	3.51	13	3.24	0.83	0.88	**42.44**
2000	2.77	1.17	1.79	2.6	1.15	2.43	5.69	7.38	11.64	0.23	1.55	1.37	**39.77**
2001	0.91	0.68	5.48	0.62	2.56	5.59	8.31	3.58	16.03	0.81	1.44	3.13	**49.14**
2002	4.48	0.82	4.38	2.41	0.47	6.24	7.8	8.14	9.31	2.58	2.68	5.41	**54.72**
2003	0.07	4.66	10.71	2.63	2.54	6.75	7.33	1.83	3.04	2.98	0.74	1.19	**44.47**
2004	1.64	4.47	1.36	2.02	1.24	17.15	8.6	9.85	16.31	1.32	2.85	2.66	**69.47**
AVG	**3.32**	**3.50**	**3.96**	**2.88**	**3.45**	**5.92**	**6.44**	**7.05**	**7.38**	**3.81**	**2.05**	**2.51**	**52.27**

Rainfall is in inches, and represents data from Jacksonville International Airport (JIA)

Appendix N: Annual and Monthly Average Precipitation at JIA





Appendix O: Executive Summary of Tributary Pollution Assessment Project (TPAP)

Tributary Pollution Assessment Executive Summary

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
- US 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.

Appendix P: Department Responses to Comments Received Regarding this TMDL for Williamson Creek

1. In Section 4.1 reference is made to controlling sources of nutrients (see first sentence in paragraph). The word "nutrients" should be changed to "pollutants". This comment should be checked in all TMDLs.

   RESPONSE: "Nutrients" has been changed to "pollutant" in the text.

2. Reference is made to Moncrief Creek (see page 16) in the leaking sewer collection line section of the report. This is likely a typographic error.

   RESPONSE: The reference to Moncrief Creek has been changed to Williamson Creek in the text.

3. Details on how the total coliform loadings were derived from leaking septic systems and pet waste need to be provided in the report and updates should be made to Table 4.6 (only loadings for fecal coliform are given in the report).

   RESPONSE: After locating a source for total coliform concentrations from septic tanks, the text was updated to reflect the estimated loading. However, Department staff is currently unaware of a source stating total coliform concentrations associated with pets; therefore the Department is unable to calculate a specific total coliform load. Fecal coliform concentrations used to estimate loadings were taken from EPA's *Protocol for Developing Pathogen TMDLs*, but the manual does not include total coliform concentrations for pets. If EPA knows of a reliable source for total coliform concentrations from pets, the Department will review the information, and calculate total coliform loads from pets.

4. The fecal and total coliform loading rates given in Table 4.5 and 4.6 do not match those given in the text. The values in the text (E+13 for fecal and E+16 for total coliform) seem too high. Please see comments in the review of other coliform TMDLs regarding the method used to calculate the loads.

   RESPONSE: Loading numbers in the text have been edited to match those shown in the tables.
   Please refer to response 3 within the "recurring comments" section as to why loads from leaking collection systems were calculated the way they were.

5. The percent reduction reported in the text for total coliform (62%) does not match the value shown in Table 5.4 (66%).

   RESPONSE: Text has been edited to match required reduction shown in tables.

6. The TMDL (expressed as percent reduction) appear to be based on the median value of the data violating the water quality criteria using all data collected in the WBID (i.e., includes data collected prior to January 1996 for Group 2 waters). The resulting load reduction is 83% for fecal coliform and 66% for total coliform. As a check, the percent reduction was calculated using the median value of the data violations measured during the listing cycle and based on the 90th percentile concentration measured during the listing cycle. Using

only violations measured during the listing cycle, the data indicate a 75% reduction is needed for fecal coliform and a 62% reduction for total coliform. Basing the reduction on the 90th percentile concentration calculated during the listing cycle, the data requires a 98% reduction in fecal coliform and a 85% reduction in total coliform. Reductions based on the 90th percentile concentration are higher for both fecal and total coliform as compared to the reductions proposed by FDEP; however, proposing a 98% reduction for fecal coliform seems unrealistic to achieve. Modification of the TMDL value is not necessary as BMPs implemented to achieve an 83% reduction in fecal coliform should be sufficient to see improvements in water quality.

RESPONSE: No response necessary by FDEP.

The following comments were general comments regarding coliform TMDLs developed in the Lower St. Johns River basin.

1. Specifying a load rather than a concentration for the TMDL WLA - The Department does not currently issue load limit permits for coliforms. The Department feels that concentration based permits for coliforms are more appropriate. Concentrations are flow independent, and therefore should meet state water quality criteria no matter what the discharge flow is. A load limit would be discharge flow dependent, and could allow higher concentrations of coliforms if the facility is not discharging at permitted flow. For example, a facility may be discharging at 50 percent of design flow. If a load based WLA was in effect, effluent coliform concentrations could be two-times the state criterion, and still be meeting the WLA. A concentration based WLA would not allow effluent coliform concentrations to exceed the state criteria, no matter what the discharge flow is. The Department feels that a concentration based WLA is more appropriate, and more protective of state water quality criteria.

2. The septic tank loading estimates are higher than those for leaking wastewater collection systems, or seem high in general - As discussed in the document, the estimates of loading from collection systems are based on general information which is available to the Department. The document clearly states that these estimates are "potential" loads, and site specific information (such as soil types/characteristics, water level, proximity of drainfields to surface waters, etc.), which the Department does not have, would be required to calculate estimates closer to actual loading. The numbers used in the calculations are published numbers. The septic tank loading estimate is based on the number of failures, according to JEA data, which is much more site specific than that of collection systems.

   As mentioned at the end of the document, the City of Jacksonville is currently developing a sanitary survey manual, which will be used to more accurately assess potential sources of coliforms in this and other basins. What the Department proposed are just estimates, and further analysis will be done as part of the BMAP phase as an attempt to better quantify individual source contributions.

3. It may be more appropriate to base leaking wastewater collection system estimates on the design flow of the WWTP adjusted for the percent that leaks out of the system and the percent of linear feet of collection lines within the WBID rather than population - The Department feels that the approach used to estimate potential loads from leaking wastewater systems is adequate. The Department does not have direct access to the

linear feet of collection line in the basin, or for the service area. In addition, the wastewater facility services several industrial facilities, which if estimates were based on the method proposed above, would not fairly represent the true loads from the collection system. Even if the necessary data were available, the suggested approach would be very time intensive, but more importantly, would not be likely to produce better estimates.

Furthermore, the design capacity of the Buckman WWTF, which services many of the coliform TMDL WBIDs in the basin, is 52.5 MGD. From 2000 – 2004 the average monthly flow was 30.6 MGD – 58 percent of the design flow. By basing calculations on the design flow, in this case, could severely over estimate the loading from leaking collection pipes. Even if the average flow was used to calculate the loading, non-domestic discharges to the system would still be included in the estimate, and would still result in an overestimation.

The estimate proposed in the document is just that, an estimate, that the Department feels has been fairly calculated based on the estimated number of households in the basin and the number of people per household. The numbers used in the estimates (coliform concentrations and gallons/person/day) were based on numbers published by EPA in *Protocol for Developing Pathogen TMDLs.*

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