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 Wills Branch (WBID 2282)

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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/62-302t.pdf

Basin Status Reports

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

Water Quality Assessment Reports

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

Allocation Technical Advisory Committee (ATAC) Report

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

U.S. Environmental Protection Agency

Region 4: Total Maximum Daily Loads in Florida

http://www.epa.gov/region4/water/tmdl/florida/

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 coliform for the Wills Branch watershed in the North Mainstem 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. This TMDL establishes the allowable loadings to Wills Branch that would restore the waterbody so that it meets its applicable water quality criteria for coliforms.

1.2 Identification of Waterbody

Wills Branch is located in Duval County, in northeast Florida, with an approximate 3.21 square-mile (mi^2) drainage area that flows directly into the Cedar River, the Ortega River, then into the St. Johns River (**Figures 1.1** and **1.2**). The creek is approximately 1.75 miles long and is a Class III freshwater, first order stream. The Wills Branch 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. Wills Branch consists of one segment (WBID 2282) as shown in **Figure 1.2**, which this TMDL addresses.

Wills Branch is part of the Ortega River Planning Unit (PU). Planning units are groups of smaller watersheds (WBIDs) that are part of a larger basin unit, which 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, Wills Branch's location within the planning unit, and a list of the other WBIDs in the planning unit.

Figure 1.1. Location of Wills Branch and Major Geopolitical Features in the St. Johns River Basin

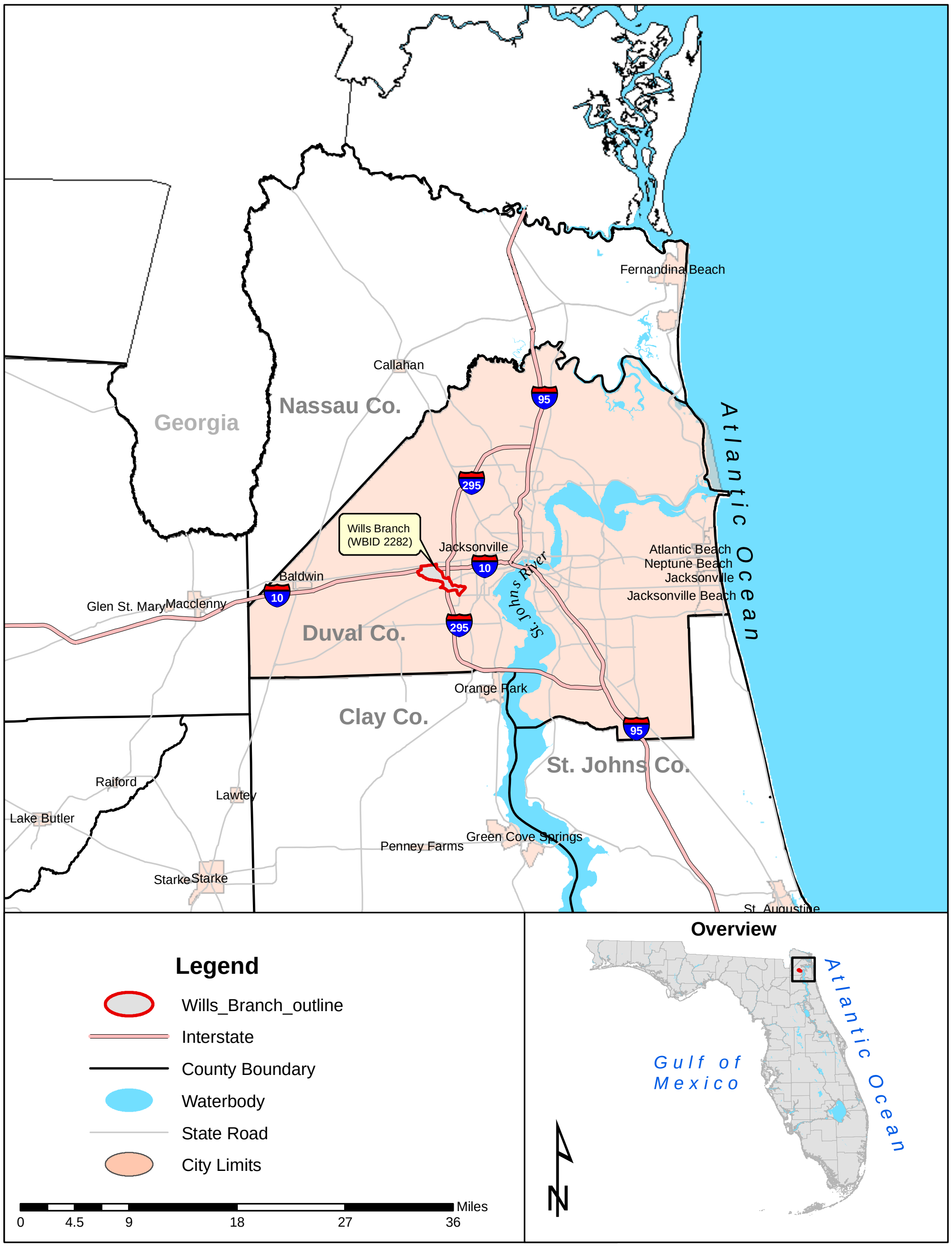


Figure 1.2. Overview of Wills Branch Watershed

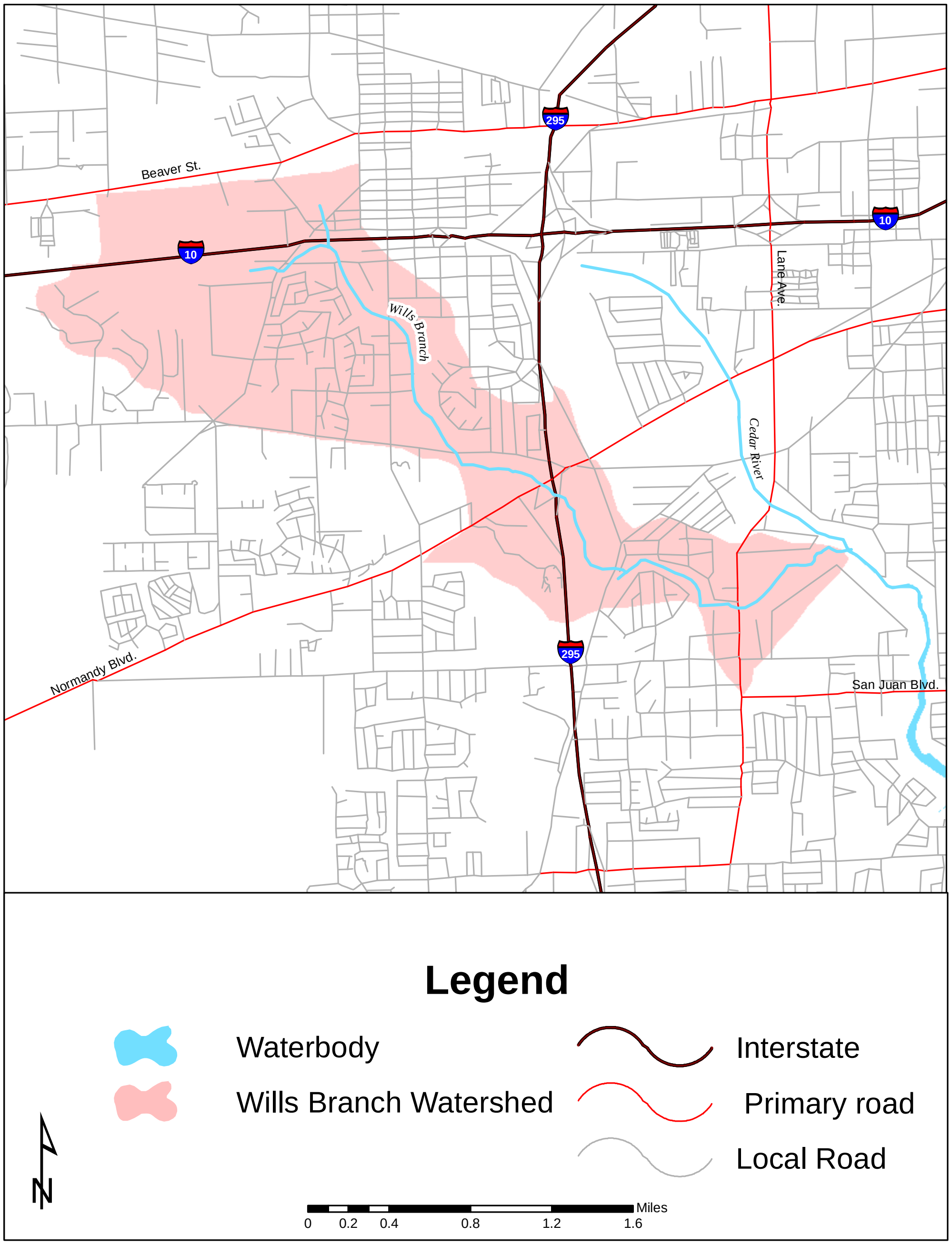
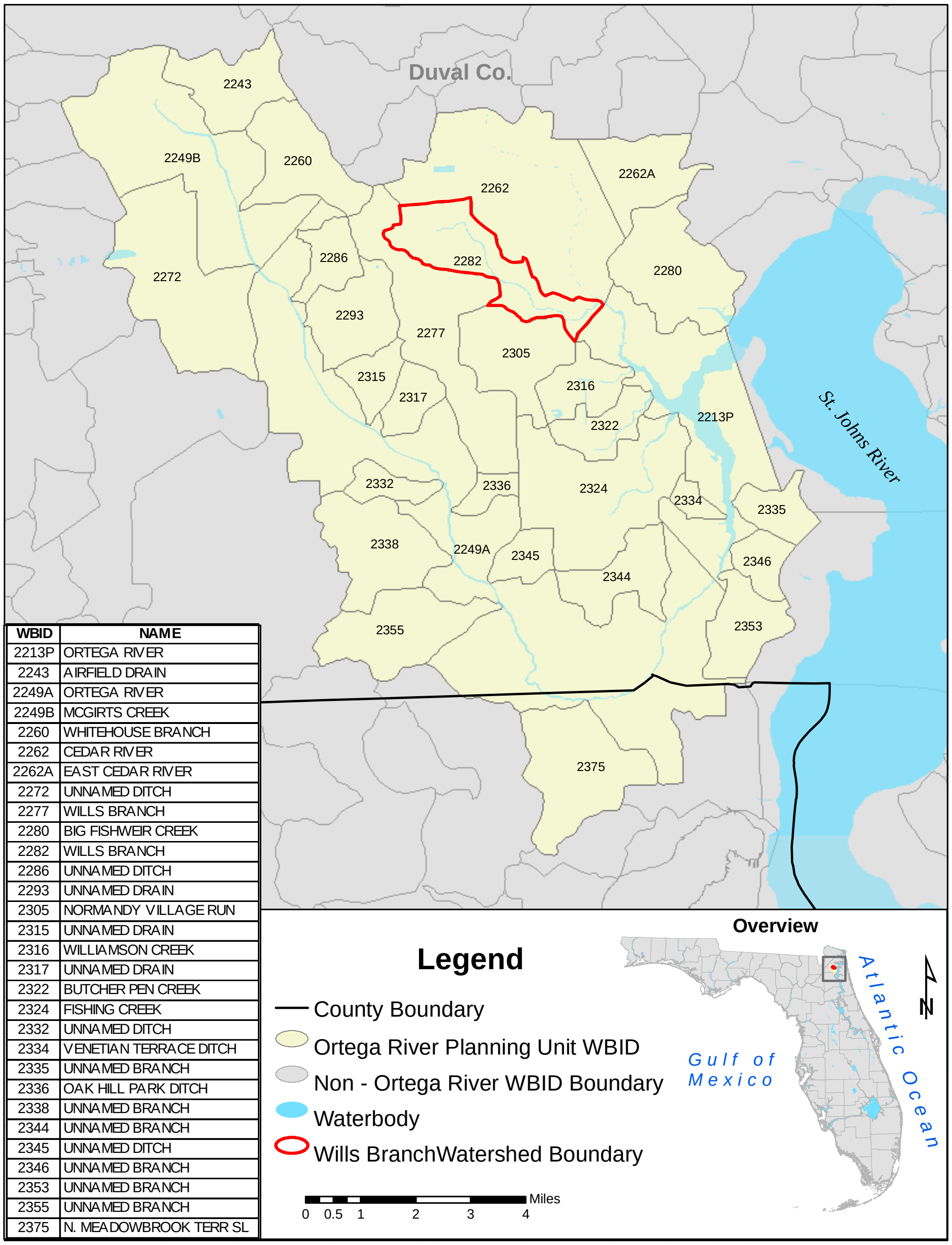


Figure 1.3. WBIDs in the Ortega River Planning Unit



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 Wills Branch. These activities will depend heavily on the active participation of the St. Johns River Water Management District (SJRWMD), the City of Jacksonville, Jacksonville Electric Authority (JEA), local businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for impaired waterbodies.

Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

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

Florida's 1998 303(d) list included 55 waterbodies and 277 parameters in the Lower St. Johns River Basin, and the state's 303(d) list is amended annually to include basin updates, 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 Wills Branch and has verified the impairments listed in **Table 2.1**. **Tables 2.2** through **2.4** 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.

Table 2.1. Verified Impaired Parameters in Wills Branch

WBID	Waterbody Segment	Parameters of Concern	Priority for TMDL Development	Projected Year for TMDL Development
2282	Wills Branch	Fecal Coliforms	High	2004
2282	Wills Branch	Total Coliforms	High	2004

For fecal coliform, there are a total of 91 samples in the IWR; 53 (58.2 percent) of those are exceedances. Forty-eight samples were collected during the Verified Period; 29 (60.4 percent) exceeded the state criterion. Most of the fecal coliform exceedances occurred during the months of February and November; the least in March (**Table 2.2**). The highest counts occurred during July and August (160,000 and 50,000 counts/100 mL respectively). March was the only month for which data exist and no exceedances occurred. There are fecal coliform exceedances in all seasons; however as shown in **Table 2.3**, a greater number occur in the summer months (July – September), while the least amount occur in the spring (April – June).

For total coliform, there are a total of 41 samples in the IWR; 30 (58.2 percent) of those are exceedances. Twenty-two samples were collected during the Verified Period; 13 (59.1 percent) exceeded the state criterion. With total coliform there were 100% exceedances in the months of June, July and August. No exceedances occurred during March or October (**Table 2.2**). Exceedances occurred in the spring (April – June), summer (July – September), and fall (October – December) (**Table 2.3**). As with fecal coliform, the highest number of exceedances occurred in the summer season. No exceedances occurred during the winter season. Most of the exceedances occur during the warmer months, when precipitation may fall on an almost daily basis.

Table 2.2. 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**	**Number of Exceedances**	**% Exceedance**	**Mean Precipitation**
January	4	110	5,000	1,170	1,863	2	50%	2.39
February	2	8,000	10,000	9,000	9,000	2	100%	3.14
March	2	96	228	162	162	0	0%	3.95
April	6	30	1,300	515	560	3	50%	2.8
May	5	140	1,300	370	650	2	40%	1.61
June	0	---	---	---	---	---	---	7.4
July	3	90	160,000	17,000	59,030	2	67%	6.72
August	5	220	50,000	1,100	10,904	4	80%	6.72
September	8	150	7,000	750	1,804	6	75%	9.94
October	4	110	1,700	200	553	1	25%	3.39
November	1	8,000	8,000	8,000	8,000	1	100%	1.81
December	8	25	4,000	900	1,150	6	75%	3.12
TOTAL COLIFORMS[2]								
Month	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Number. of Exceedances**	**% Exceedance**	**Mean Precipitation**
January	0	---	---	---	---	---	---	2.39
February	0	---	---	---	---	---	---	3.14
March	2	833	842	720	838	0	0%	3.95
April	2	2000	2800	255	2400	1	50%	2.8
May	1	1900	1900	17,000	1900	0	0%	1.61
June	2	3633	6200	80045	4917	2	100%	7.4
July	2	5400	6400	950	5900	2	100%	6.72
August	2	8000	9400	26,200	8700	2	100%	6.72
September	4	2000	7200	260	3850	3	75%	9.94
October	2	1048	2167	3,900	1608	0	0%	3.39
November	2	2400	7600	590	5000	1	50%	1.81
December	3	2117	8600	1,700	5639	2	67%	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 2.3. Summary of Fecal Coliform Data by Season for Verified Period (January 1, 1996 – June 30, 2003)

FECAL COLIFORMS[1]								
Season	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Number of Exceedances**	**% Exceedance**	**Mean Total Precipitation**
Winter	8	96	10,000	1,214	3,222	4	50%	10.72
Spring	11	30	1,300	370	601	5	45%	12.41
Summer	16	90	160,000	950	15,378	12	75%	21.15
Fall	13	25	8,000	800	1,493	8	62%	8.34
TOTAL COLIFORMS[2]								
Season	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Number of Exceedances**	**% Exceedance**	**Mean Total Precipitation**
Winter	2	833	842	255	838	0	0%	10.72
Spring	5	1,900	6,200	2,400	3,307	3	60%	12.41
Summer	8	2,000	9,400	950	5,575	7	88%	21.15
Fall	7	1,048	8,600	700	4,305	3	43%	8.34

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, and is the long term mean (1955 – 2004) for all three months of the season

There does seem to be a trend with respect to stations, however many stations do not have but a few samples, which makes it difficult to do too much analysis. For fecal coliforms, there are two stations which have more than five samples. When considering fecal coliforms, even using all the data, coliform values seem to decrease going downstream. The trend does not appear to exist with the total coliform data, but again, many of the station have limited data, and overall there is less data than for fecal coliform. Sampling stations are discussed further in **Section 5.1**.

Table 2.4. 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	8,000	8,000	8,000	8,000	1	100%	60.63
1997	2	300	2,400	1,350	1,350	0	0%	57.27
1998	7	110	160,000	1,300	25,937	2	29%	56.72
1999	8	130	5,000	950	1,450	1	13%	42.44
2000	8	110	7,000	800	1,760	2	25%	39.77
2001	8	25	50,000	1,303	8,858	3	38%	49.14
2002	14	90	2,600	425	645	1	7%	54.72
TOTAL COLIFORMS[2]								
Year	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Number of Exceedances**	**% Exceedance**	**Total Precipitation**
1998	1	2,800	2,800	2,800	2,800	1	100%	56.72
2002	21	833	9,400	370	4,292	12	57%	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 was only reported for 1998 and 2002
Total precipitation is from Jacksonville International Airport (JIA) in inches, and represents total precipitation for year shown

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)**

Wills Branch is a Class III Fresh waterbody, with a designated use 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 and Total Coliform Criteria

Numeric criteria for bacterial quality are expressed in terms of fecal and total 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. 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 criteria selected for the TMDLs were not to exceed 400 in 10 percent of the samples for fecal coliforms, nor exceed 2,400 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 Wills Branch Watershed

4.2.1 Point Sources

There are no permitted domestic wastewater treatment facilities or industrial wastewater facilities that discharge into Wills Branch.

Municipal Separate Storm Sewer System Permittees

Phase 1 or Phase 2 MS4s. The entire City of Jacksonville is covered by a Phase I NPDES municipal separate storm sewer system (MS4) permit (permit FLS000012) issued to the Florida Department of Transportation (FDOT) District 2, along with the Cities of Jacksonville, Neptune Beach, and Atlantic Beach.

4.2.2 Land Uses and Nonpoint Sources

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

Land Uses

The spatial distribution and acreage of different land use categories were identified using the 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 Level 1 land uses in the watershed.

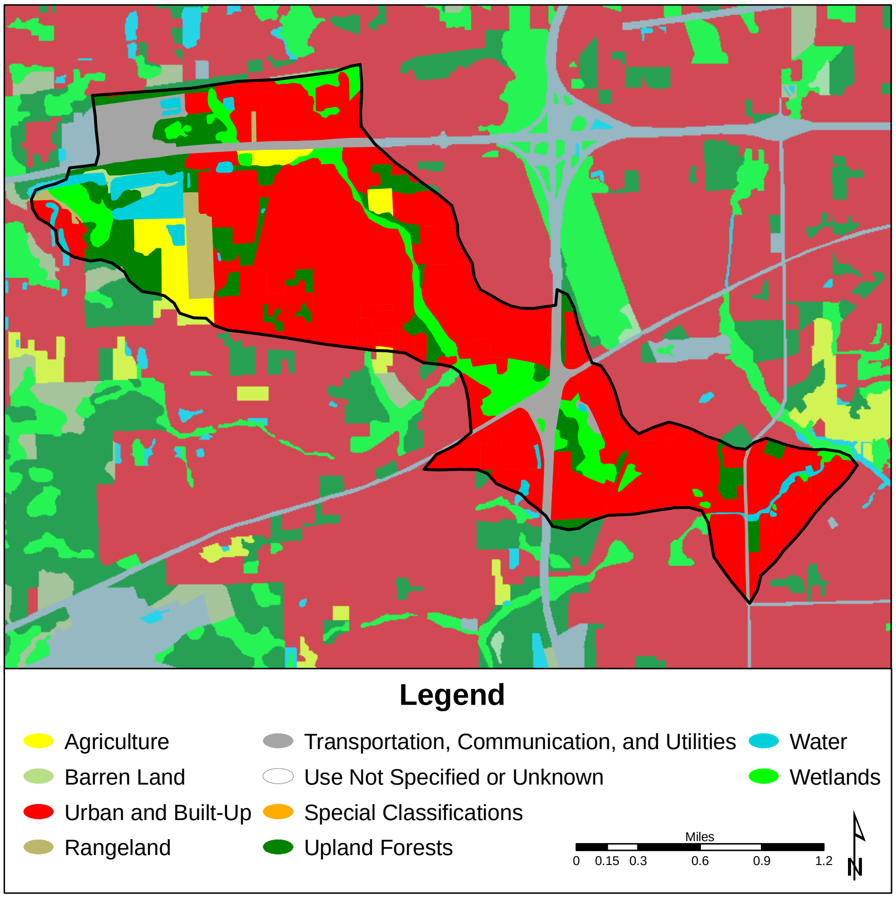
The Wills Branch watershed is a fairly small urban area, occupying approximately 2,056 acres (3.21 mi^2). As **Table 4.1** shows, the majority of the land is medium density residential (32.82 percent), followed by low density residential (8.43 percent). Non-natural land uses, including residential areas (high, medium, and low), institutional uses, commercial services, golf courses, etc., comprise 73.7 percent of the watershed area or 1,515 acres. Natural land use types, such as pine flatwoods, upland mixed coniferous/hardwoods, streams, mixed scrub-shrub wetlands, etc., comprise 26.3 percent, or 542 acres.

According to data in the land use coverage, there are no livestock land use types in the watershed. There are 60.43 acres of improved pasture over three parcels, but they are shown as being used for planted forage crops with no indication of livestock.

Table 4.1. Classification of Land Use Categories in the Wills Branch Watershed

Level 3 Land Use Code	Attribute	Acres	Percent of Total
1200	Residential, medium density - 2-5 dwelling units/acre	674.88	32.82%
1100	Residential, low density - less than 2 dwelling units/acre	173.38	8.43%
6170	Mixed wetland hardwoods	156.04	7.59%
1700	Institutional	141.31	6.87%
4340	Upland mixed coniferous/hardwood	136.29	6.63%
1400	Commercial and services	99.69	4.85%
8140	Roads and highways (divided 4-lanes with medians)	96.66	4.70%
4110	Pine flatwoods	77.67	3.78%
5300	Reservoirs - pits, retention ponds, dams	71.31	3.47%
2110	Improved pastures (monocult, planted forage crops)	60.43	2.94%
8130	Bus and truck terminals	53.82	2.62%
1300	Residential, high density - 6 or more dwelling units/acre	51.80	2.52%
1480	Cemeteries	48.26	2.35%
3100	Herbaceous upland nonforested	41.02	1.99%
1550	Other light industrial	31.10	1.51%
1820	Golf courses	27.56	1.34%
4410	Coniferous pine	22.75	1.11%
6300	Wetland forested mixed	19.54	0.95%
2430	Ornamentals	12.15	0.59%
1490	Commercial & services under construction	9.69	0.47%
5100	Streams and waterways	8.57	0.42%
4430	Forest regeneration	8.05	0.39%
1190	Low density under construction	6.25	0.30%
6460	Mixed scrub-shrub wetland	5.33	0.26%
3200	Shrub and brushland	5.06	0.25%
1920	Inactive land with street pattern but no structures	4.27	0.21%
7430	Spoil areas	3.45	0.17%
7400	Disturbed land	3.25	0.16%
8340	Sewage treatment	3.12	0.15%
1850	Parks and zoos	2.71	0.13%
1900	Open land	1.09	0.05%
	TOTAL:	**2,056.50**	**100.00%**

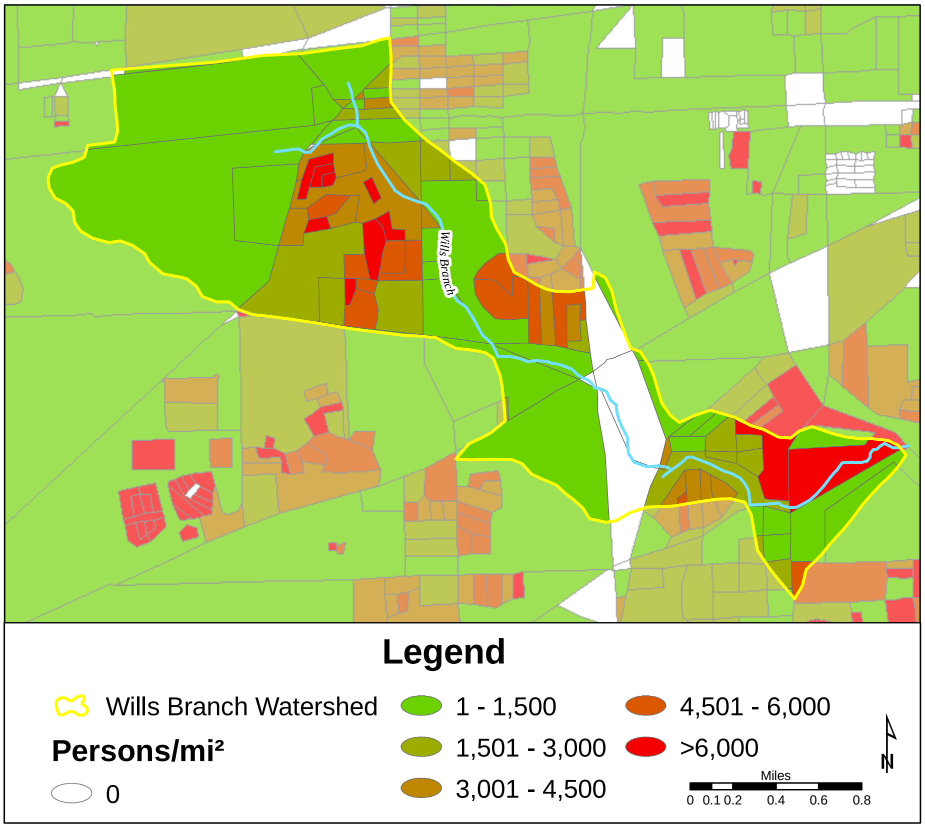
Figure 4.1. Principle Land Uses in the Wills Branch Watershed



Population

According to the U.S Census Bureau, census block population densities in WBID 2282 in the year 2000 ranged from 0 – 10,306 persons per square mile, with an average 3,702 persons per square mile in the watershed **(Figure 4.2).** The 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 the Wills Branch is 1,436 units/mi², which is several times higher than that of the countywide average.

Figure 4.2. Population Density in the Wills Branch 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). The DoH reports that as of fiscal year 2003-2004, there were 88,834 permitted septic tanks in Duval County (DoH Website). From fiscal years 1994–2004, 4,954 permits for repairs were issued, or an average of approximately 450 repairs annually (DoH Website) countywide.

Comment [DAW1]:

As noted previously, there are an estimated 3,702 persons/mi^2 in the WBID, or 11,883 persons in the watershed area. The average household in the Wills Branch watershed has 2.58 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 approximately 2 failures in the Wills Branch watershed annually.

To focus on the Wills Branch watershed, the Department obtained septic tank repair permit data from JEA for their service area, which includes the Wills Branch 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 63 permits for repairs issued during this time in the watershed, or an average of 4.2 repairs per year. This estimate is twice that of the estimates based on DoH countywide data.

Based on this data provided by JEA, which is more watershed specific than that of the countywide DoH data, there was an average of 4.2 permits issued in the watershed for septic tank repairs. If this estimate is rounded up to six (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 4.10 x 10^{10} counts/day is derived. This estimation is shown in **Table 4.3.**

Table 4.2. Estimation of Average Household Size in the Wills Branch Watershed

Household Size	Number of Households	Percentage of Total	Number of People
1-person household	1,088	23.60%	1,088
2-person household	1,524	33.05%	3,048
3-person household	870	18.87%	2,610
4-person household	699	15.16%	2,796
5-person household	284	6.16%	1,420
6-person household	101	2.19%	606
7-or-more-person household	45	0.98%	315
TOTAL:	**4,611**	**100.00%**	**11,883**
		AVERAGE	**2.58**

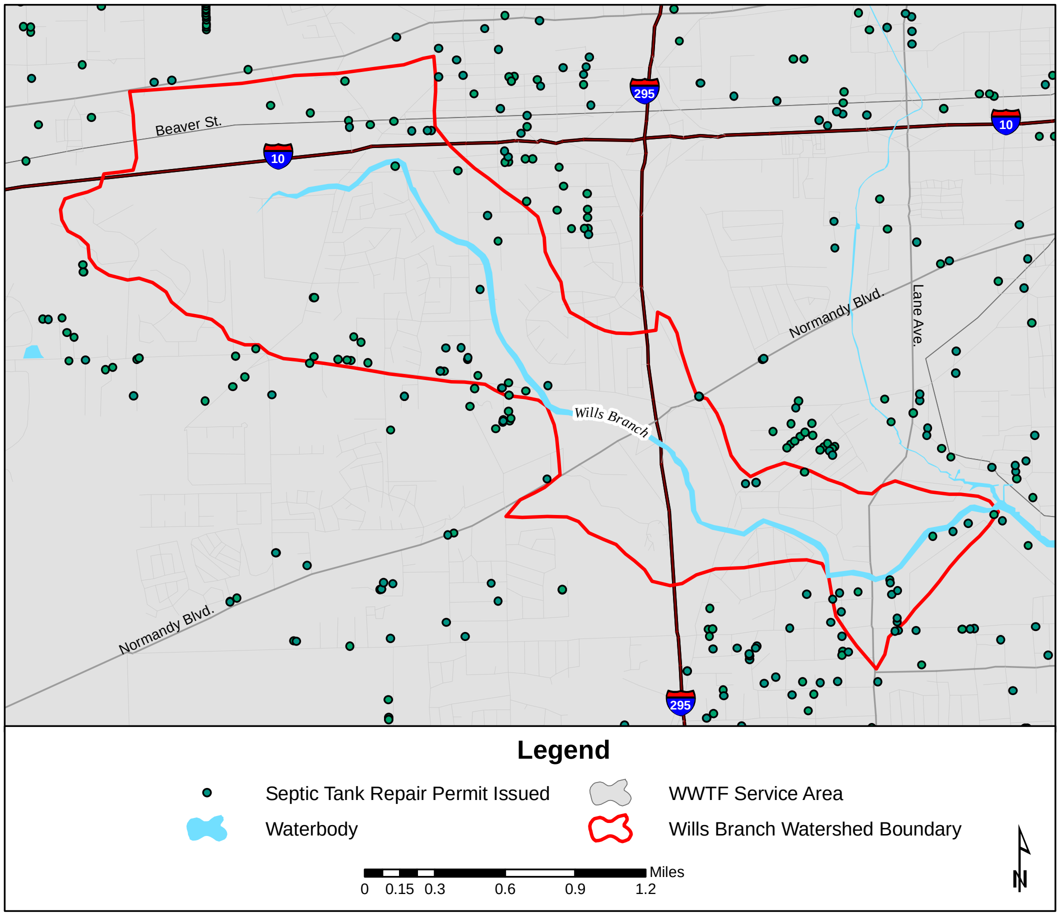
Data from U.S. Census Bureau web site, 2005, based on Duval County tracts which are present in the Wills Branch watershed

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

Estimated Population Density	WBID Area (mi^2)	Estimated Population in Watershed	Estimated Number of Tank Failures[1]	Estimated Load From Failed Tank[2]	Gallons/ Person/ Day[2]	Estimated Number Persons Per Household[3]	Estimated Load From Failing Tanks
3,702 persons/mi^2	3.21	11,883	6	1.00 x 10^4/mL	70	2.58	4.10 x 10^{10}
3,702 persons/mi^2	3.21	11,883	6	1.00 x 10^9/mL	70	2.58	4.10 x 10^{15}

[1] Based on septic tank repair permits issued in the watershed from March 1990 – April 2004 (FL. DoH and JEA information) – see text
[2] From EPA document "Protocol for Developing Pathogen TMDLs."
[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 Wills Branch Area



According to Level 3 land use, the only agricultural land uses in the Wills Branch watershed are a few parcels of improved pasture used for monoculture and are not being shown as livestock areas. As noted in **Section 4.2.2,** the majority of the land use (73.7 percent) consists of residential, commercial and services, and other non-natural categories. While it is likely that agriculture has little, if any, influence on the basin, because the area is highly urbanized with a large number of people per square mile, it is very possible that pets, especially dogs, have 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 8.32×10^{11} counts/day. Total coliform concentrations from pets are not known, but since fecal coliform is a component of total coliforms, this loading would be expected to be greater than that of fecal coliforms. This is an estimate, as the actual loading from dogs is not known.

Table 4.4. Estimated Loading from Dogs in the Wills Branch Watershed

Coliform Type	Estimated Number of Households	Estimated Household:Dog Ratio[1]	Estimated Total Dog Population	Estimated Loading of Total	Estimated Number of Dogs with Impact to Stream	Estimated Counts/ Pet/ Day[2]	Estimated Daily Loading from Dogs (counts/day)	Estimated Annual Loading from Dogs (counts/year)
Fecal	4,611	0.361	1,665	10%	165	5×10^9	8.32×10^{11}	3.04×10^{14}
Total	4,611	0.361	1,665	10%	165	5×10^9	$>8.32 \times 10^{11}$	$>3.04 \times 10^{14}$

[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 4,611 homes in the watershed, with 2.58 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 Wills Branch, a daily flow of approximately 0.475 MGD is transported through the collection system in this watershed. The EPA Protocol for Developing Pathogen TMDLs (EPA, 2001) suggests that a 5% leakage rate from collection systems is realistic. Based on this rate and EPA values for fecal coliforms in raw sewage, the potential loadings of fecal coliforms from leaking sewer lines is 4.49×10^{12}, and for total coliforms 8.98×10^{13} (**Table 4.5**).

Table 4.5. Estimated Loading from the Wastewater Collection Systems

Coliform	Estimated Homes on Central Sewer	Estimated Daily Flow (g)	Daily Leakage (g)	Raw Sewage Coliform Concentration[1] (counts/100mL)	Estimated Daily Load (counts/day)	Estimated Annual Load (counts/year)
Fecal	2,628	474,617	23,730	5×10^6	4.49×10^{12}	1.64×10^{15}
Total	2,628	474,617	23,730	1×10^9	8.98×10^{14}	3.28×10^{17}

[1] From EPA document, "Protocol for Developing Pathogen TMDLs," 2001.

4.4 Source Summary

4.4.1 Summary of Fecal Coliform Loadings into Wills Branch from the Various Sources

Table 4.6 summarizes the various estimates from 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 Wills Branch.

Table 4.6. Summary of Estimated Potential Coliform Loading From Various Sources in the Wills Branch 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)
Point Sources	N/A*	N/A*	N/A*	N/A*
Septic Tanks	4.10×10^{10}	1.50×10^{13}	4.10×10^{15}	1.50×10^{18}
Dogs	8.32×10^{11}	3.04×10^{14}	$>8.32 \times 10^{11}$	$>3.04 \times 10^{14}$
Collection Systems	4.49×10^{12}	1.64×10^{15}	8.98×10^{13}	3.28×10^{17}

* There are no permitted discharges in this watershed

Due to the lack of flow data, no correlation between exceedances and flow can be made. However, there is a 76.9 percent overall exceedance rate for fecal coliforms and a 76.7 percent overall exceedance rate for total coliforms.

It is possible that the chronic exceedances are a combination of factors. For example, it may be that failing septic tanks contribute during low flow conditions and leaking wastewater collection systems. Areas within the basin are known to have high rates of failing septic tanks (see **Figure 4.3**). During higher flows, influenced by rain events, run-off containing feces from dogs and other wildlife may be contributing to exceedances.

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

This TMDL was developed using a "percent reduction" methodology. The Department generally prefers to use the load duration curve of "Kansas" method for coliform TMDLs. However, this method could not be used because there are no USGS stream gaging stations on Wills Branch. To determine the required reduction for this TMDL, the required percent reduction that would be required for each of the exceedances was determined using all available data, and the percent reduction required to meet the state standard of 400 counts/100 mL for fecal coliforms and 2,400 counts/100 mL for total coliforms was determined. The median value of all of these reductions for both fecal and total coliform 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 WBID 2282 that have historical coliform observations. The primary data collector of historical data is the City of Jacksonville, with some data being collected by the Department and the SJRWMD. Fecal coliform and total coliform data were collected between January 1991 and December 2002 from these sites. **Table 5.1** shows annual summaries for years in which data have been collected. **Figure 5.1** shows the location of the sample site, and **Table 5.2** provides a brief overview of the 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. All data within the IWR database was used in the determination of these TMDLs.

Table 5.1. Sampling Station Summary for Wills Branch Watershed

FECAL COLIFORMS				
Station	**STORET ID**	**Station Owner[1]**	**Year(s) with Data**	**N**
WILLS BR AT OLD MIDDLEBURG RD.	21FLA 20030582	FDEP	1998, 2002	3
WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	21FLJXWQCR21	COJ	1991 - 1995; 1997 - 2002	42
WILLS BRANCH AT LANE AVENUE SOUTH	21FLJXWQCR95	COJ	1991 - 2002	40
WILLS BRANCH LANE AVE	21FLA 20030095	FDEP	2002	1
WILLS BRANCH NEAR MOUTH	21FLSJWMLSJ912	SJRWMD	1992 - 1993	5
TOTAL COLIFORMS				
Station	**STORET ID**	**Station Owner[1]**	**Year(s) with Data**	**N**
WILLS BRANCH AT LENOX AVE	21FLA 20030680	FDEP	2002	2
WILLS BR AT OLD MIDDLEBURG RD.	21FLA 20030582	FDEP	1998, 2002	13
WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	21FLJXWQCR21	COJ	1991 - 1995	19
WILLIS BRANCH LANE AVE	21FLA 20030095	FDEP	2002	7
WILLS BRANCH AT LANE AVENUE SOUTH	21FLJXWQCR95	COJ	1991 - 1995	19

[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 Wills Branch Watershed

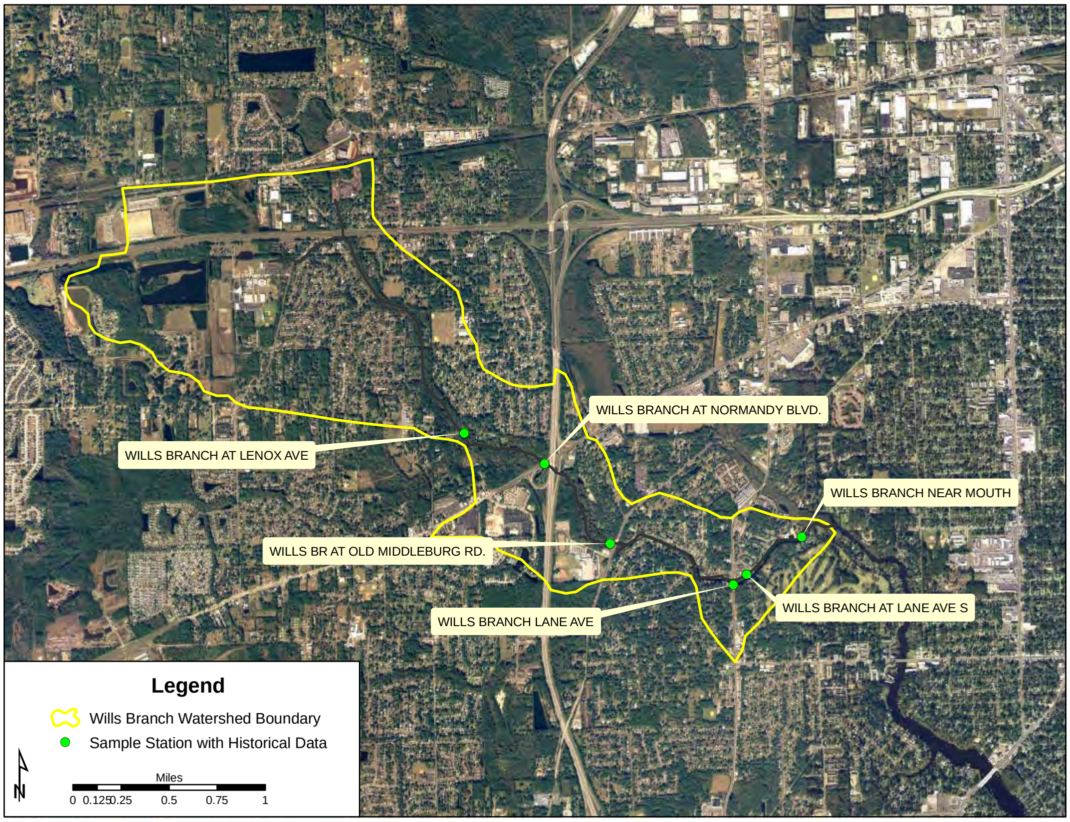


Table 5.2. Statistical Summary of Observed Historical Coliform Data for Wills Branch

FECAL COLIFORMS							
Station	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Exceedances**	**% Exceedances**
WILLIS BRANCH LANE AVE	1	1,185	1,185	1,185	1,185	1	100%
WILLS BRANCH NEAR MOUTH	5	20	1,310	530	640	2	40%
WILLS BR AT OLD MIDDLEBURG RD.	3	150	2,600	800	1,183	1	33%
WILLS BRANCH AT LANE AVENUE SOUTH	40	30	90,000	2,700	7,495	28	70%
WILLS BRANCH AT NORMANDY BLVD.	42	25	160,000	900	7,712	21	50%
TOTAL COLIFORMS							
Station	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Exceedances**	**% Exceedances**
WILLIS BRANCH LANE AVE	7	833	9,400	3,400	4,354	4	57%
WILLS BR AT OLD MIDDLEBURG RD.	13	842	8,600	2,800	3,835	7	54%
WILLS BRANCH AT LANE AVENUE SOUTH	19	1,300	160,000	17,000	36,553	17	89%
WILLS BRANCH AT LENOX AVE	2	6,200	6,400	6,300	6,300	2	100%
WILLS BRANCH AT NORMANDY BLVD.	19	800	160,000	9,000	39,184	16	84%

Coliform concentrations are #/100 mL

Figure 5.2. Historical Observations of Fecal Coliforms for Wills Branch

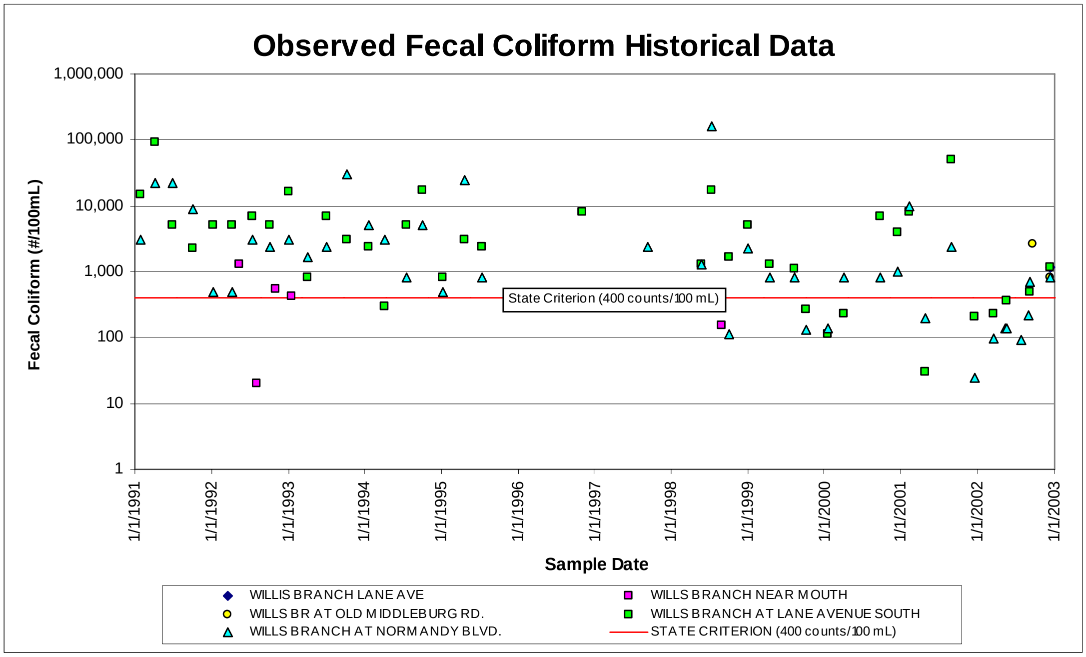
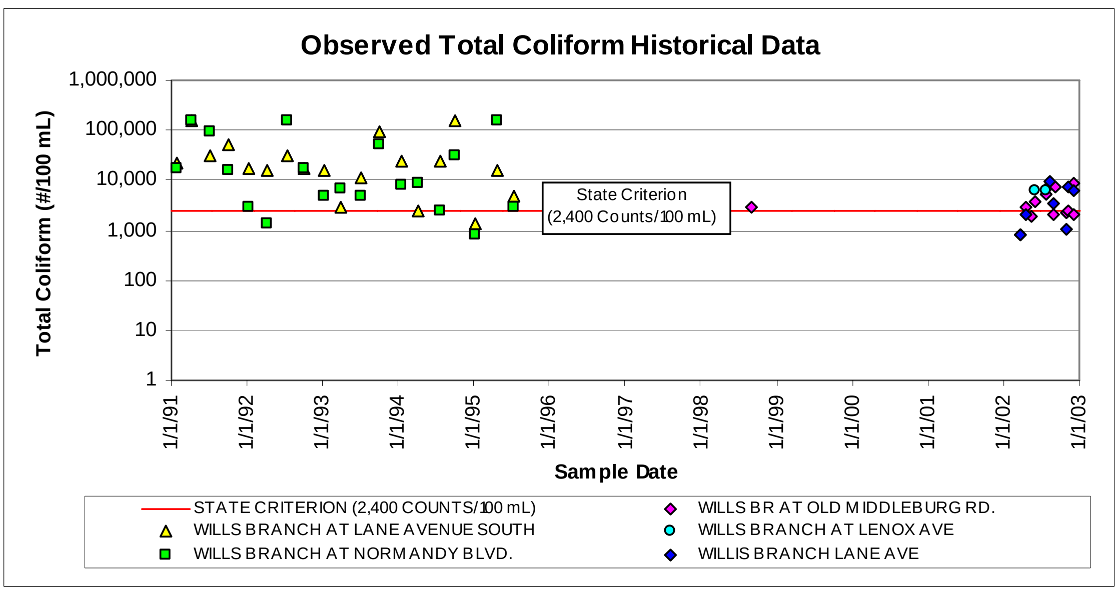


Figure 5.3. Historical Observations of Total Coliform for Wills Branch



5.1.2 TMDL Development Process

Due to the lack of supporting flow information, a simple calculation was performed to determine the needed reduction. Exceedances of the state criterion for fecal coliforms were compared to the criterion of 400 counts/100mL and total coliforms were compared to 2,400 counts/100 mL. For each individual 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 the individual values was calculated, which is 80 percent for fecal coliforms and 82 percent for total coliforms. This means that in order to meet the state criterion of 400 counts/100mL, an 80.0 percent reduction in current loading for fecal coliforms, and an 81.59 percent reduction for total coliforms are necessary, and are therefore the TMDLs for Wills Branch. **Tables 5.3** and **5.4** show the individual calculations for fecal coliform and total coliform for Wills Branch, respectively. Included are the exceedances used in the calculation.

Table 5.3. Calculation of Reductions for the Fecal Coliform TMDL for Wills Branch

Sample Date	Sample Location	Observed Value (#/100 mL)	Required Reduction
1/29/1991	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	3,000	73.33%
1/29/1991	WILLS BRANCH AT LANE AVENUE SOUTH	15,000	94.67%
4/9/1991	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	22,000	96.36%
4/9/1991	WILLS BRANCH AT LANE AVENUE SOUTH	90,000	99.11%
7/2/1991	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	84.00%
7/2/1991	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	22,000	96.36%
10/7/1991	WILLS BRANCH AT LANE AVENUE SOUTH	2,300	65.22%
10/7/1991	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	9,000	91.11%
1/7/1992	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	84.00%
4/6/1992	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	84.00%
5/11/1992	WILLIS BRANCH NEAR MOUTH	910	12.09%
5/11/1992	WILLIS BRANCH NEAR MOUTH	1,310	38.93%
7/15/1992	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	3,000	73.33%
7/15/1992	WILLS BRANCH AT LANE AVENUE SOUTH	7,000	88.57%
10/6/1992	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	2,400	66.67%
10/6/1992	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	84.00%
1/6/1993	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	3,000	73.33%
1/6/1993	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	95.00%
4/1/1993	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	1,700	52.94%
7/1/1993	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	2,400	66.67%
7/1/1993	WILLS BRANCH AT LANE AVENUE SOUTH	7,000	88.57%
10/6/1993	WILLS BRANCH AT LANE AVENUE SOUTH	3,000	73.33%
10/6/1993	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	30,000	97.33%
1/19/1994	WILLS BRANCH AT LANE AVENUE SOUTH	2,400	66.67%
1/19/1994	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	5,000	84.00%
4/5/1994	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	3,000	73.33%
7/19/1994	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	84.00%
10/4/1994	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	5,000	84.00%
10/4/1994	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	95.29%
4/25/1995	WILLS BRANCH AT LANE AVENUE SOUTH	3,000	73.33%
4/25/1995	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	24,000	96.67%
7/11/1995	WILLS BRANCH AT LANE AVENUE SOUTH	2,400	66.67%
11/6/1996	WILLS BRANCH AT LANE AVENUE SOUTH	8,000	90.00%
9/10/1997	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	2,400	66.67%
5/26/1998	WILLS BRANCH AT LANE AVENUE SOUTH	1,300	38.46%
5/26/1998	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	1,300	38.46%
7/13/1998	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	95.29%
7/13/1998	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	160,000	99.50%
10/6/1998	WILLS BRANCH AT LANE AVENUE SOUTH	1,700	52.94%
1/4/1999	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	2,200	63.64%
1/4/1999	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	84.00%
4/14/1999	WILLS BRANCH AT LANE AVENUE SOUTH	1,300	38.46%
8/11/1999	WILLS BRANCH AT LANE AVENUE SOUTH	1,100	27.27%
9/25/2000	WILLS BRANCH AT LANE AVENUE SOUTH	7,000	88.57%
12/18/2000	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	1,000	20.00%
12/18/2000	WILLS BRANCH AT LANE AVENUE SOUTH	4,000	80.00%
2/8/2001	WILLS BRANCH AT LANE AVENUE SOUTH	8,000	90.00%
2/8/2001	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	10,000	92.00%
8/29/2001	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	2,400	66.67%
8/29/2001	WILLS BRANCH AT LANE AVENUE SOUTH	50,000	98.40%
9/24/2002	WILLS BR AT OLD MIDDLEBURG RD.	2,600	69.23%
12/10/2002	WILLIS BRANCH LANE AVE	1,185	32.49%
12/10/2002	WILLS BRANCH AT LANE AVENUE SOUTH	1,185	32.49%
		MEDIAN:	**80.00%**

Table 5.4. Calculation of Reductions for the Total Coliform TMDL for Wills Branch

Sample Date	Sample Location	Observed Value (#/100 mL)	Required Reduction
1/29/1991	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	17,000	85.88%
1/29/1991	WILLS BRANCH AT LANE AVENUE SOUTH	22,000	89.09%
4/9/1991	WILLS BRANCH AT LANE AVENUE SOUTH	160,000	98.50%
4/9/1991	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	160,000	98.50%
7/2/1991	WILLS BRANCH AT LANE AVENUE SOUTH	30,000	92.00%
7/2/1991	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	90,000	97.33%
10/7/1991	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	16,000	85.00%
10/7/1991	WILLS BRANCH AT LANE AVENUE SOUTH	50,000	95.20%
1/7/1992	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	3,000	20.00%
1/7/1992	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	85.88%
4/6/1992	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	85.00%
7/15/1992	WILLS BRANCH AT LANE AVENUE SOUTH	30,000	92.00%
7/15/1992	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	160,000	98.50%
10/6/1992	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	85.88%
10/6/1992	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	17,000	85.88%
1/6/1993	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	5,000	52.00%
1/6/1993	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	85.00%
4/1/1993	WILLS BRANCH AT LANE AVENUE SOUTH	2,800	14.29%
4/1/1993	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	7,000	65.71%
7/1/1993	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	5,000	52.00%
7/1/1993	WILLS BRANCH AT LANE AVENUE SOUTH	11,000	78.18%
10/6/1993	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	50,000	95.20%
10/6/1993	WILLS BRANCH AT LANE AVENUE SOUTH	90,000	97.33%
1/19/1994	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	8,000	70.00%
1/19/1994	WILLS BRANCH AT LANE AVENUE SOUTH	24,000	90.00%
4/5/1994	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	9,000	73.33%
7/19/1994	WILLS BRANCH AT LANE AVENUE SOUTH	24,000	90.00%
10/4/1994	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	30,000	92.00%
10/4/1994	WILLS BRANCH AT LANE AVENUE SOUTH	160,000	98.50%
4/25/1995	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	85.00%
4/25/1995	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	160,000	98.50%
7/11/1995	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	3,000	20.00%
7/11/1995	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	52.00%
9/1/1998	WILLS BR AT OLD MIDDLEBURG RD.	2,800	14.29%
4/18/2002	WILLS BR AT OLD MIDDLEBURG RD.	2,800	14.29%
6/6/2002	WILLS BR AT OLD MIDDLEBURG RD.	3,633	33.94%
6/6/2002	WILLS BRANCH AT LENOX AVE	6,200	61.29%
7/24/2002	WILLS BR AT OLD MIDDLEBURG RD.	5,400	55.56%
7/24/2002	WILLS BRANCH AT LENOX AVE	6,400	62.50%
8/14/2002	WILLS BR AT OLD MIDDLEBURG RD.	8,000	70.00%
8/14/2002	WILLIS BRANCH LANE AVE	9,400	74.47%
9/3/2002	WILLIS BRANCH LANE AVE	3,400	29.41%
9/9/2002	WILLS BR AT OLD MIDDLEBURG RD.	7,200	66.67%
11/7/2002	WILLIS BRANCH LANE AVE	7,600	68.42%
12/10/2002	WILLIS BRANCH LANE AVE	6,200	61.29%
12/10/2002	WILLS BR AT OLD MIDDLEBURG RD.	8,600	72.09%
		MEDIAN:	**81.59%**

5.1.3 Critical Conditions/Seasonality

Exceedances in Wills Branch can't be associated with flows, as no flow data within the basin have been reported. Therefore, the effects of flow under various conditions can't be determined or be considered as a critical condition.

Historical fecal and total coliform observations in Wills Branch 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, but not among seasons (**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 coliforms varies from zero to eight in a given month, with 10 months having five or less observations. The sample sizes for total coliforms were even smaller, with no month having more than five observations. Grouping observations by season increased sample sizes for statistical comparison and, as seen in **Table 2.3**, for fecal coliforms the summer (July – September) and fall (October – December) seasons had the highest exceedance rate (75 percent and 62 percent, respectively). For total coliforms, the highest exceedances rate occurred in summer (July – September) and spring (April – June), with 88 percent and 60 percent exceedances, respectively. 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), as well as the total rainfall for the month that sampling occurred 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 coliforms and the various rainfall totals were positive, suggesting that as rainfall (and possible runoff) increased, so did the number of coliforms.

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 coliforms and the 1D and 7D precipitation were not significant, but when compared to the 3D rainfall totals, there is some significance (**Appendix K**). In the case of total coliforms, none of the total coliforms versus rainfall totals were significant at α=0.05 (**Appendices L**). As noted previously, the highest percentage of exceedances of fecal coliforms and total coliforms occurred between July and September. The historical plot of monthly 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. Fecal coliforms do not appear to follow the same trend as annual precipitation. There are only two years with total coliform data (1998 and 2000); therefore a trend with precipitation can't be made. Observations at individual stations were too limited to determine any spatial trends or patterns along the stream. With exception of two stations, most stations have less than eight samples, and many only have one or two. However, for those two stations that do have at least 19 samples, both fecal and total concentrations increase with the downstream station.

Hydrologic conditions were analyzed using rainfall, since no flow data were 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 ($0\text{-}5^{th}$ percentile), followed by large precipitation events (5^{th} – 15^{th} percentile), medium precipitation events (15^{th} – 40^{th} percentile), small precipitation events (40^{th} – 60^{th} percentile), and no recordable precipitation events (60^{th} – 100^{th} percentile). Three day (day of and two days prior) precipitation accumulations were used in the analysis.

Data show that fecal coliform exceedances occurred over all hydrologic conditions; however, the least percentage of exceedances (73.08 percent) occurred under what would be considered medium precipitation events. The greatest percentage of exceedances (90.91 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. However, with respect to fecal coliforms in Wills Branch it is difficult to tell, as there doesn't appear to be a clear pattern. This most likely indicates that there is a combination of factors contributing to exceedances. **Table 5.5** is a summary of data and hydrologic conditions. **Figure 5.3** shows the same data visually.

Unlike fecal coliforms, total coliform exceedances increase with increasing amounts of rain. The least percentage of exceedances (50 percent) occurs when there is no or very little rain, with the greatest percentage (100 percent) of exceedances occurring around extreme precipitation events. This suggests that exceedances are tied to nonpoint sources.

Table 5.5. Summary of Fecal Coliform Data by Hydrological Condition

Precipitation Event	Precipitation Event Range	Total Values	Number of Exceedances	Percent Exceedance	Number of Non-Exceedances	Percent Non-Exceedance
Extreme	>2.1"	8	7	87.50%	1	12.50%
Large	1.33" - 2.1"	11	10	90.91%	1	9.09%
Medium	0.18" - 1.33"	26	19	73.08%	7	26.92%
Small	0.01" - 0.18"	23	18	78.26%	5	21.74%
None/Not Measurable	<0.01"	22	15	68.18%	7	31.82%

Table 5.6. Summary of Total Coliform Data by Hydrological Condition

Precipitation Event	Precipitation Event Range	Total Values	Number of Exceedances	Percent Exceedance	Number of Non-Exceedances	Percent Non-Exceedance
Extreme	>2.1"	8	8	100.00%	0	0.00%
Large	1.33" - 2.1"	9	8	88.89%	1	11.11%
Medium	0.18" - 1.33"	17	14	82.35%	3	17.65%
Small	0.01" - 0.18"	14	10	71.43%	4	28.57%
None/Not Measurable	<0.01"	12	6	50.00%	6	50.00%

Figure 5.4. Fecal Coliform Data by Hydrological Condition Based on Rainfall

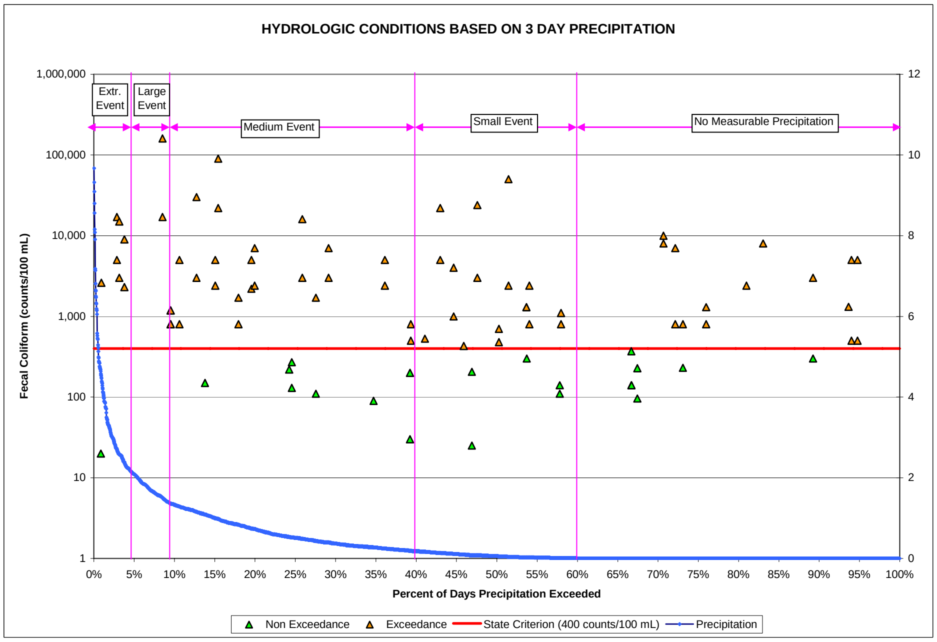
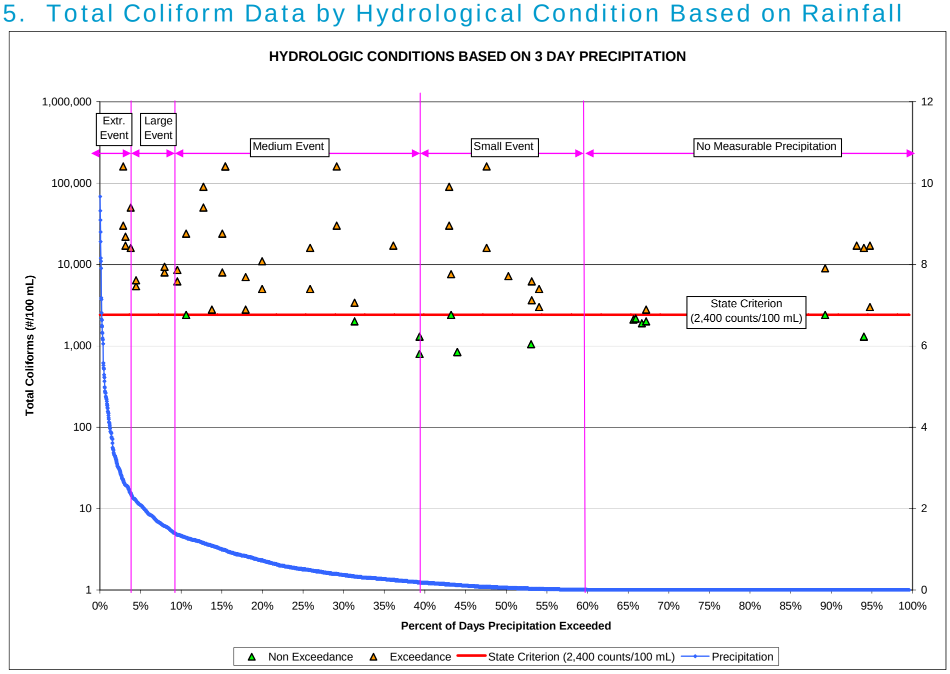


Figure 5.5. Total Coliform Data by Hydrological Condition Based on Rainfall



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 Wills Branch are expressed in terms of both counts per 100 mL and percent reduction, and represent the maximum daily fecal and total coliform load the creek can assimilate and maintain the applicable coliform criterion **(Table 6.1).**

Table 6.1. TMDL Components for Wills Branch

WBID	Parameter	TMDL (colonies/100 mL)	WLA		LA (Percent Reduction)	MOS
			Wastewater (colonies/day)	NPDES Stormwater		
2282	Fecal Coliform	400	N/A	80%	80%	Implicit
2282	Total Coliform	2,400	N/A	81%	82%	Implicit

6.2 Load Allocation (LA)

A fecal coliform reduction of 80 percent and a total coliform reduction of 82 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)

There are currently no permitted NPDES discharges in this basin. However, as part of this TMDL, any future discharge permits issued within the Wills Branch 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 200 counts/100 mL as a monthly average or 400 counts/100 mL at any given time for fecal coliforms. Similarly, total coliform values shall not 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.

6.3.1 NPDES Wastewater Discharges

There are currently no permitted NPDES wastewater discharges in this basin.

6.3.2 NPDES Stormwater Discharges

The City of Jacksonville, including the Williamson Creek drainage basin, is covered by a Phase I MS4 permit (permit FL000012), which includes the City of Jacksonville, City of Atlantic Beach, and the City of Neptune Beach. Permit responsibility is shared among the City of Jacksonville, City of Atlantic Beach, the City of Neptune Beach, and the Florida Department of Transportation (FDOT) District 2. The WLA for stormwater discharges with MS4 permit is an 80 percent reduction in current anthropogenic fecal coliform and an 82 percent reduction in anthropogenic total coliform loading. 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 criterion allows for 10 percent exceedances over the fecal coliform 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 Wills Branch. 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:

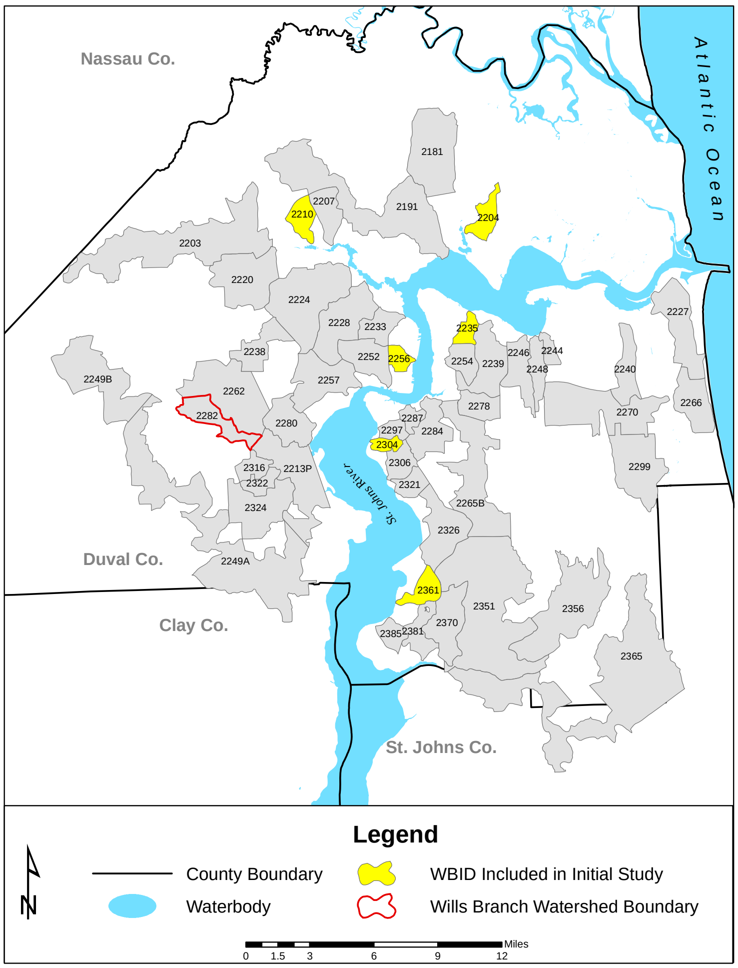
- Appropriate allocations among the affected parties,
- A description of the load reduction activities to be undertaken,
- Timetables for project implementation and completion,
- Funding mechanisms that may be utilized,
- Any applicable signed agreement,
- Local ordinances defining actions to be taken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

The BMAP for Wills Branch 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 Wills Branch. 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 six 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 4.5** shows, potential impacts from dogs and cats could be significant. It pet owners are educated on the potential impacts their pets are having on Wills Branch, and they are inclined to take action, this could potentially decrease a source load.

References

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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 Wills Branch

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
WILLS BRANCH	2282	1/29/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	15,000	
WILLS BRANCH	2282	1/29/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	15,000	
WILLS BRANCH	2282	1/29/1991	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	1/29/1991	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	4/9/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	90,000	
WILLS BRANCH	2282	4/9/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	90,000	
WILLS BRANCH	2282	4/9/1991	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	22,000	
WILLS BRANCH	2282	4/9/1991	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	22,000	
WILLS BRANCH	2282	7/2/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	7/2/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	7/2/1991	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	22,000	
WILLS BRANCH	2282	7/2/1991	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	22,000	
WILLS BRANCH	2282	10/7/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	2,300	
WILLS BRANCH	2282	10/7/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	2,300	
WILLS BRANCH	2282	10/7/1991	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	9,000	
WILLS BRANCH	2282	10/7/1991	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	9,000	
WILLS BRANCH	2282	1/7/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	1/7/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	1/7/1992	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	500	
WILLS BRANCH	2282	1/7/1992	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	500	
WILLS BRANCH	2282	4/6/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	4/6/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	4/6/1992	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	500	
WILLS BRANCH	2282	4/6/1992	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	500	
WILLS BRANCH	2282	5/11/1992	21FLSJWMLSJ912	WILLIS BRANCH NEAR MOUTH	1,310	B
WILLS BRANCH	2282	5/11/1992	21FLSJWMLSJ912	WILLIS BRANCH NEAR MOUTH	910	B
WILLS BRANCH	2282	7/15/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	7,000	
WILLS BRANCH	2282	7/15/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	7,000	
WILLS BRANCH	2282	7/15/1992	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	7/15/1992	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	8/4/1992	21FLSJWMLSJ912	WILLIS BRANCH NEAR MOUTH	20	
WILLS BRANCH	2282	10/6/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	10/6/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	10/6/1992	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	2,400	
WILLS BRANCH	2282	10/6/1992	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	2,400	
WILLS BRANCH	2282	11/4/1992	21FLSJWMLSJ912	WILLIS BRANCH NEAR MOUTH	530	
WILLS BRANCH	2282	1/6/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	
WILLS BRANCH	2282	1/6/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	
WILLS BRANCH	2282	1/6/1993	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	1/6/1993	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	1/20/1993	21FLSJWMLSJ912	WILLIS BRANCH NEAR MOUTH	430	
WILLS BRANCH	2282	4/1/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	800	
WILLS BRANCH	2282	4/1/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	800	
WILLS BRANCH	2282	4/1/1993	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	1,700	
WILLS BRANCH	2282	4/1/1993	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	1,700	
WILLS BRANCH	2282	7/1/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	7,000	

Appendix B: Historical Fecal Coliform Observations in Wills Branch (Continued)

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
WILLS BRANCH	2282	7/1/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	7,000	
WILLS BRANCH	2282	7/1/1993	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	2,400	
WILLS BRANCH	2282	7/1/1993	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	2,400	
WILLS BRANCH	2282	10/6/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	3,000	
WILLS BRANCH	2282	10/6/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	3,000	
WILLS BRANCH	2282	10/6/1993	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	30,000	
WILLS BRANCH	2282	10/6/1993	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	30,000	
WILLS BRANCH	2282	1/19/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	2,400	
WILLS BRANCH	2282	1/19/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	2,400	
WILLS BRANCH	2282	1/19/1994	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	5,000	
WILLS BRANCH	2282	1/19/1994	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	5,000	
WILLS BRANCH	2282	4/5/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	300	
WILLS BRANCH	2282	4/5/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	300	
WILLS BRANCH	2282	4/5/1994	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	4/5/1994	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	7/19/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	7/19/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	7/19/1994	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	7/19/1994	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	10/4/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	
WILLS BRANCH	2282	10/4/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	
WILLS BRANCH	2282	10/4/1994	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	5,000	
WILLS BRANCH	2282	10/4/1994	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	5,000	
WILLS BRANCH	2282	1/9/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	800	
WILLS BRANCH	2282	1/9/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	800	
WILLS BRANCH	2282	1/9/1995	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	500	
WILLS BRANCH	2282	1/9/1995	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	500	
WILLS BRANCH	2282	4/25/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	3,000	
WILLS BRANCH	2282	4/25/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	3,000	
WILLS BRANCH	2282	4/25/1995	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	24,000	
WILLS BRANCH	2282	4/25/1995	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	24,000	
WILLS BRANCH	2282	7/11/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	2,400	
WILLS BRANCH	2282	7/11/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	2,400	
WILLS BRANCH	2282	7/11/1995	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	7/11/1995	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	11/6/1996	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	8,000	
WILLS BRANCH	2282	11/6/1996	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	8,000	
WILLS BRANCH	2282	9/10/1997	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	2,400	
WILLS BRANCH	2282	9/10/1997	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	2,400	
WILLS BRANCH	2282	9/16/1997	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	300	
WILLS BRANCH	2282	9/16/1997	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	300	
WILLS BRANCH	2282	5/26/1998	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	1,300	
WILLS BRANCH	2282	5/26/1998	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	1,300	
WILLS BRANCH	2282	5/26/1998	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	1,300	
WILLS BRANCH	2282	5/26/1998	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	1,300	
WILLS BRANCH	2282	7/13/1998	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	
WILLS BRANCH	2282	7/13/1998	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	
WILLS BRANCH	2282	7/13/1998	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	160,000	

Appendix B: Historical Fecal Coliform Observations in Wills Branch (Continued)

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
WILLS BRANCH	2282	7/13/1998	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	160,000	
WILLS BRANCH	2282	9/1/1998	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	150	Q
WILLS BRANCH	2282	10/6/1998	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	1,700	
WILLS BRANCH	2282	10/6/1998	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	1,700	
WILLS BRANCH	2282	10/6/1998	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	110	
WILLS BRANCH	2282	10/6/1998	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	110	
WILLS BRANCH	2282	1/4/1999	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	1/4/1999	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	1/4/1999	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	2,200	
WILLS BRANCH	2282	1/4/1999	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	2,200	
WILLS BRANCH	2282	4/14/1999	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	1,300	
WILLS BRANCH	2282	4/14/1999	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	1,300	
WILLS BRANCH	2282	4/14/1999	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	4/14/1999	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	8/11/1999	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	1,100	
WILLS BRANCH	2282	8/11/1999	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	1,100	
WILLS BRANCH	2282	8/11/1999	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	8/11/1999	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	10/5/1999	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	270	
WILLS BRANCH	2282	10/5/1999	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	270	
WILLS BRANCH	2282	10/5/1999	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	130	
WILLS BRANCH	2282	10/5/1999	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	130	
WILLS BRANCH	2282	1/18/2000	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	110	
WILLS BRANCH	2282	1/18/2000	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	110	
WILLS BRANCH	2282	1/18/2000	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	140	
WILLS BRANCH	2282	1/18/2000	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	140	
WILLS BRANCH	2282	4/3/2000	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	230	
WILLS BRANCH	2282	4/3/2000	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	230	
WILLS BRANCH	2282	4/3/2000	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	4/3/2000	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	9/25/2000	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	7,000	
WILLS BRANCH	2282	9/25/2000	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	7,000	
WILLS BRANCH	2282	9/25/2000	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	9/25/2000	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	12/18/2000	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	4,000	
WILLS BRANCH	2282	12/18/2000	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	4,000	
WILLS BRANCH	2282	12/18/2000	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	1,000	
WILLS BRANCH	2282	12/18/2000	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	1,000	
WILLS BRANCH	2282	2/8/2001	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	8,000	
WILLS BRANCH	2282	2/8/2001	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	8,000	
WILLS BRANCH	2282	2/8/2001	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	10,000	
WILLS BRANCH	2282	2/8/2001	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	10,000	
WILLS BRANCH	2282	4/26/2001	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	30	
WILLS BRANCH	2282	4/26/2001	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	30	
WILLS BRANCH	2282	4/26/2001	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	200	
WILLS BRANCH	2282	4/26/2001	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	200	
WILLS BRANCH	2282	8/29/2001	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	50,000	
WILLS BRANCH	2282	8/29/2001	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	50,000	

Appendix B: Historical Fecal Coliform Observations in Wills Branch (Continued)

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
WILLS BRANCH	2282	8/29/2001	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	2,400	
WILLS BRANCH	2282	8/29/2001	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	2,400	
WILLS BRANCH	2282	12/19/2001	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	206	
WILLS BRANCH	2282	12/19/2001	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	206	
WILLS BRANCH	2282	12/19/2001	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	25	
WILLS BRANCH	2282	12/19/2001	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	25	
WILLS BRANCH	2282	3/20/2002	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	228	
WILLS BRANCH	2282	3/20/2002	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	96	
WILLS BRANCH	2282	5/15/2002	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	140	
WILLS BRANCH	2282	5/16/2002	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	370	
WILLS BRANCH	2282	5/16/2002	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	140	
WILLS BRANCH	2282	7/30/2002	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	90	
WILLS BRANCH	2282	8/28/2002	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	220	
WILLS BRANCH	2282	9/9/2002	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	480	
WILLS BRANCH	2282	9/9/2002	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	700	
WILLS BRANCH	2282	9/24/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	2,600	
WILLS BRANCH	2282	12/10/2002	21FLA 20030095	WILLIS BRANCH LANE AVE	1,185	
WILLS BRANCH	2282	12/10/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	800	
WILLS BRANCH	2282	12/10/2002	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	1,185	
WILLS BRANCH	2282	12/10/2002	21FLJXWQCR21	WILLS BRANCH AT NORMANDY BLVD.	800	

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
Q – Sample held beyond normal holding time

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 Wills Branch

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
WILLS BRANCH	2282	1/29/1991	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	17,000	
WILLS BRANCH	2282	1/29/1991	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	17,000	
WILLS BRANCH	2282	1/29/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	22,000	
WILLS BRANCH	2282	1/29/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	22,000	
WILLS BRANCH	2282	4/9/1991	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	160,000	
WILLS BRANCH	2282	4/9/1991	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	160,000	
WILLS BRANCH	2282	4/9/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	160,000	L
WILLS BRANCH	2282	4/9/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	160,000	L
WILLS BRANCH	2282	7/2/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	30,000	
WILLS BRANCH	2282	7/2/1991	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	90,000	
WILLS BRANCH	2282	7/2/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	30,000	
WILLS BRANCH	2282	7/2/1991	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	90,000	
WILLS BRANCH	2282	10/7/1991	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	16,000	L
WILLS BRANCH	2282	10/7/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	50,000	
WILLS BRANCH	2282	10/7/1991	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	16,000	L
WILLS BRANCH	2282	10/7/1991	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	50,000	
WILLS BRANCH	2282	1/7/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	
WILLS BRANCH	2282	1/7/1992	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	1/7/1992	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	1/7/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	
WILLS BRANCH	2282	4/6/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	
WILLS BRANCH	2282	4/6/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	
WILLS BRANCH	2282	4/6/1992	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	1,300	
WILLS BRANCH	2282	4/6/1992	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	1,300	
WILLS BRANCH	2282	7/15/1992	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	160,000	L
WILLS BRANCH	2282	7/15/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	30,000	
WILLS BRANCH	2282	7/15/1992	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	160,000	L
WILLS BRANCH	2282	7/15/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	30,000	
WILLS BRANCH	2282	10/6/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	
WILLS BRANCH	2282	10/6/1992	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	17,000	
WILLS BRANCH	2282	10/6/1992	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	17,000	
WILLS BRANCH	2282	10/6/1992	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	17,000	
WILLS BRANCH	2282	1/6/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	L
WILLS BRANCH	2282	1/6/1993	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	5,000	

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
WILLS BRANCH	2282	1/6/1993	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	5,000	
WILLS BRANCH	2282	1/6/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	L
WILLS BRANCH	2282	4/1/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	2,800	
WILLS BRANCH	2282	4/1/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	2,800	
WILLS BRANCH	2282	4/1/1993	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	7,000	
WILLS BRANCH	2282	4/1/1993	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	7,000	
WILLS BRANCH	2282	7/1/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	11,000	
WILLS BRANCH	2282	7/1/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	11,000	
WILLS BRANCH	2282	7/1/1993	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	5,000	
WILLS BRANCH	2282	7/1/1993	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	5,000	
WILLS BRANCH	2282	10/6/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	90,000	
WILLS BRANCH	2282	10/6/1993	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	90,000	
WILLS BRANCH	2282	10/6/1993	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	50,000	
WILLS BRANCH	2282	10/6/1993	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	50,000	
WILLS BRANCH	2282	1/19/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	24,000	
WILLS BRANCH	2282	1/19/1994	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	8,000	
WILLS BRANCH	2282	1/19/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	24,000	
WILLS BRANCH	2282	1/19/1994	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	8,000	
WILLS BRANCH	2282	4/5/1994	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	9,000	
WILLS BRANCH	2282	4/5/1994	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	9,000	
WILLS BRANCH	2282	4/5/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	2,400	
WILLS BRANCH	2282	4/5/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	2,400	
WILLS BRANCH	2282	7/19/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	24,000	
WILLS BRANCH	2282	7/19/1994	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	2,400	
WILLS BRANCH	2282	7/19/1994	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	2,400	
WILLS BRANCH	2282	7/19/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	24,000	
WILLS BRANCH	2282	10/4/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	160,000	
WILLS BRANCH	2282	10/4/1994	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	160,000	
WILLS BRANCH	2282	10/4/1994	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	30,000	
WILLS BRANCH	2282	10/4/1994	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	30,000	
WILLS BRANCH	2282	1/9/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	1,300	
WILLS BRANCH	2282	1/9/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	1,300	
WILLS BRANCH	2282	1/9/1995	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	1/9/1995	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	800	
WILLS BRANCH	2282	4/25/1995	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	160,000	

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
WILLS BRANCH	2282	4/25/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	
WILLS BRANCH	2282	4/25/1995	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	160,000	
WILLS BRANCH	2282	4/25/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	16,000	
WILLS BRANCH	2282	7/11/1995	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	7/11/1995	21FLJXWQCR21	WILLS BRANCH NORTH BRANCH AT NORMANDY BLVD.	3,000	
WILLS BRANCH	2282	7/11/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	7/11/1995	21FLJXWQCR95	WILLS BRANCH AT LANE AVENUE SOUTH	5,000	
WILLS BRANCH	2282	9/1/1998	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	2,800	Q
WILLS BRANCH	2282	3/26/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	842	
WILLS BRANCH	2282	3/26/2002	21FLA 20030095	WILLIS BRANCH LANE AVE	833	
WILLS BRANCH	2282	4/18/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	2,800	
WILLS BRANCH	2282	4/18/2002	21FLA 20030095	WILLIS BRANCH LANE AVE	2,000	
WILLS BRANCH	2282	5/16/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	1,900	
WILLS BRANCH	2282	6/6/2002	21FLA 20030680	WILLS BRANCH AT LENOX AVE	6,200	
WILLS BRANCH	2282	6/6/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	3,633	
WILLS BRANCH	2282	7/24/2002	21FLA 20030680	WILLS BRANCH AT LENOX AVE	6,400	
WILLS BRANCH	2282	7/24/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	5,400	
WILLS BRANCH	2282	8/14/2002	21FLA 20030095	WILLIS BRANCH LANE AVE	9,400	
WILLS BRANCH	2282	8/14/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	8,000	
WILLS BRANCH	2282	9/3/2002	21FLA 20030095	WILLIS BRANCH LANE AVE	3,400	
WILLS BRANCH	2282	9/3/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	2,000	
WILLS BRANCH	2282	9/9/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	7,200	
WILLS BRANCH	2282	10/28/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	2,167	
WILLS BRANCH	2282	10/29/2002	21FLA 20030095	WILLIS BRANCH LANE AVE	1,048	
WILLS BRANCH	2282	11/7/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	2,400	
WILLS BRANCH	2282	11/7/2002	21FLA 20030095	WILLIS BRANCH LANE AVE	7,600	
WILLS BRANCH	2282	12/3/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	2,117	
WILLS BRANCH	2282	12/10/2002	21FLA 20030582	WILLS BR AT OLD MIDDLEBURG RD.	8,600	
WILLS BRANCH	2282	12/10/2002	21FLA 20030095	WILLIS BRANCH LANE AVE	6,200	

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

Remark Codes: L – Off-scale high. Actual value not known, but known to be greater then value shown

Q – Sample held beyond normal holding time

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 – Wallace Analysis of Fecal Coliform Observations and Month in Wills Branch

The following results are for:
WBID$ = 2282

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 162 cases
Dependent variable is VALUE
Grouping variable is MONTH

Group	Count	Rank Sum
1	29	2374.000
2	4	548.000
3	2	31.000
4	32	2424.000
5	9	487.000
7	25	2688.000
8	10	754.000
9	12	796.000
10	24	2156.000
11	3	311.000
12	12	634.000

Kruskal-Wallis Test Statistic = 28.229
Probability is 0.002 assuming Chi-square distribution with 10 df

Appendix E: Kruskall – Wallace Analysis of Fecal Coliform Observations and Season in Wills Branch

The following results are for:
WBID$ = 2282

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

Kruskal-Wallis One-Way Analysis of Variance for 162 cases
Dependent variable is VALUE
Grouping variable is SEASON2

Group	Count	Rank Sum
1	35	2953.000
2	41	2911.000
3	47	4238.000
4	39	3101.000

Kruskal-Wallis Test Statistic = 3.874
Probability is 0.275 assuming Chi-square distribution with 3 df

Appendix F: Kruskall – Wallace Analysis of Total Coliform Observations and Month in Wills Branch

The following results are for:
WBID$ = 2282

Categorical values encountered during processing are:
MONTH (11 levels)
1, 3, 4, 5, 6, 7, 8,
9, 10, 11, 12

Kruskal-Wallis One-Way Analysis of Variance for 98 cases
Dependent variable is VALUE
Grouping variable is MONTH

Group	Count	Rank Sum
1	20	879.000
3	2	7.000
4	22	1090.000
5	1	10.000
6	2	66.500
7	22	1208.000
8	2	95.000
9	4	103.000
10	18	1235.000
11	2	60.000
12	3	97.500

Kruskal-Wallis Test Statistic = 22.391
Probability is 0.013 assuming Chi-square distribution with 10 df

Appendix G: Kruskall – Wallace Analysis of Total Coliform Observations and Season in Wills Branch

The following results are for:
WBID$ = 2282

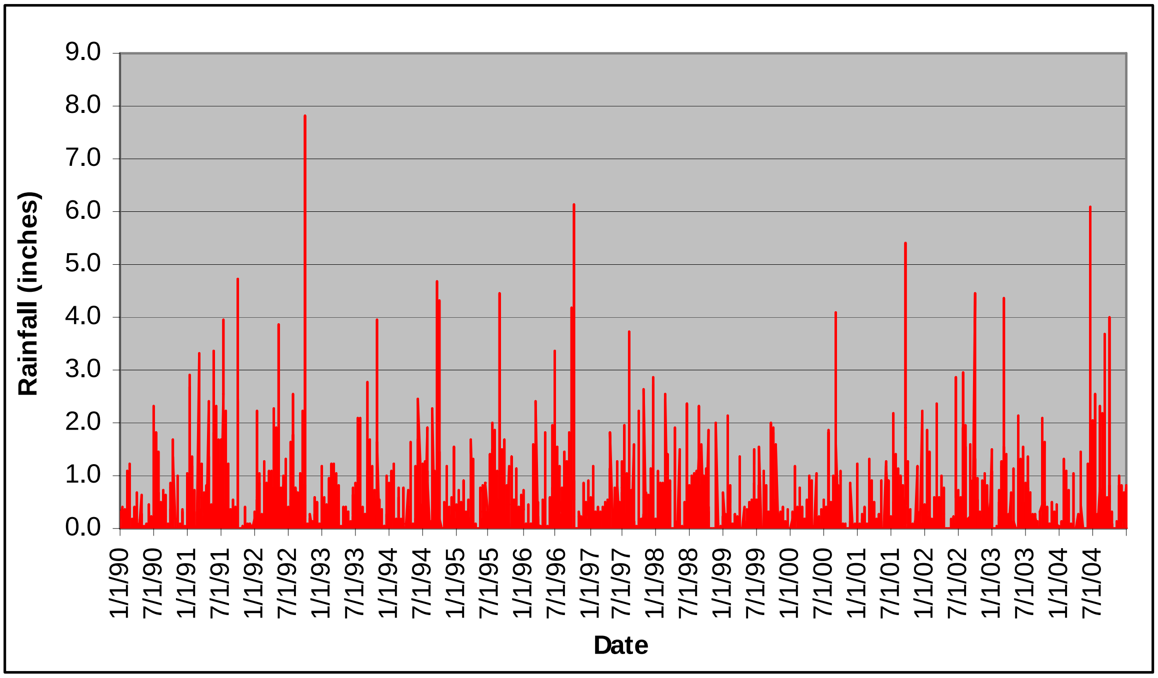
Categorical values encountered during processing are:
SEASON (4 levels)
1, 2, 3, 4

Kruskal-Wallis One-Way Analysis of Variance for 98 cases
Dependent variable is VALUE
Grouping variable is SEASON

Group	Count	Rank Sum
1	22	886.000
2	25	1166.500
3	28	1406.000
4	23	1392.500

Kruskal-Wallis Test Statistic = 6.072

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 Wills Branch

The following results are for:
WBID$ = 2282
Spearman correlation matrix

	MONTH	DAY	VALUE	V1D_PREC	V3D_PREC
MONTH	1.000				
DAY	-0.073	1.000			
VALUE	-0.033	-0.105	1.000		
V1D_PREC	0.178	0.001	0.124	1.000	
V3D_PREC	0.197	-0.117	0.288	0.616	1.000
V7D_PRE	0.203	-0.215	0.284	0.474	0.755
MONTH_PR	0.206	-0.096	0.336	0.362	0.433
SEASON2	0.978	-0.153	0.022	0.224	0.287
EXCEEDANCE2	-0.053	-0.114	0.699	-0.001	0.160
PEREXCEED	-0.031	-0.094	0.996	0.134	0.302

	V7D_PRE	MONTH_PR	SEASON2	EXCEEDANCE2	PEREXCEED
V7D_PRE	1.000				
MONTH_PR	0.582	1.000			
SEASON2	0.287	0.262	1.000		
EXCEEDANCE2	0.278	0.292	-0.022	1.000	
PEREXCEED	0.298	0.342	0.024	0.702	1.000

Appendix J: Spearman Correlation Matrix Analysis for Precipitation and Total Coliforms in Wills Branch

The following results are for:
WBID$ = 2282
Spearman correlation matrix

	MONTH	SEASON	VALUE	V1D_PREC	V3D_PREC
MONTH	1.000				
SEASON	0.986	1.000			
VALUE	0.179	0.244	1.000		
V1D_PREC	0.182	0.176	0.158	1.000	
V3D_PREC	0.241	0.264	0.439	0.574	1.000
V7D_PRE	0.315	0.339	0.291	0.451	0.791
MONTH_PR	0.365	0.384	0.387	0.443	0.461

	V7D_PRE	MONTH_PR
V7D_PRE	1.000	
MONTH_PR	0.621	1.000

Appendix K: Analysis of Fecal Coliform Observations and Precipitation in Wills Branch

Analysis of sample day precipitation

Dep Var: VALUE N: 162 Multiple R: 0.116 Squared multiple R: 0.013

Adjusted squared multiple R: 0.007 Standard error of estimate: 20974.061

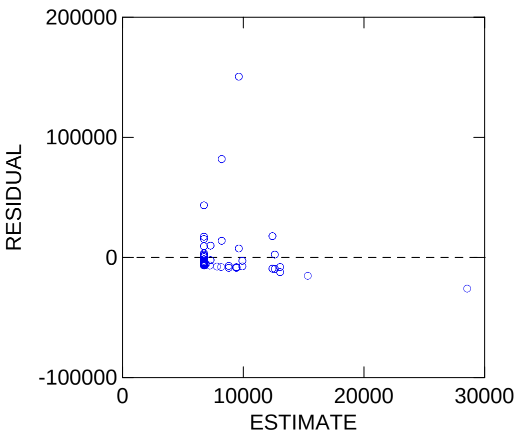
Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	6751.982	1774.211	0.000	.	3.806	0.000
V1D_PREC	4891.465	3317.253	0.116	1.000	1.475	0.142

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	9.56502E+08	1	9.56502E+08	2.174	0.142
Residual	7.03858E+10	160	4.39911E+08		

Durbin-Watson D Statistic 1.173
First Order Autocorrelation 0.412

Plot of residuals against predicted values



Analysis of sample day and two days prior precipitation

Dep Var: VALUE   N: 162   Multiple R: 0.177   Squared multiple R: 0.031

Adjusted squared multiple R: 0.025   Standard error of estimate: 20784.253

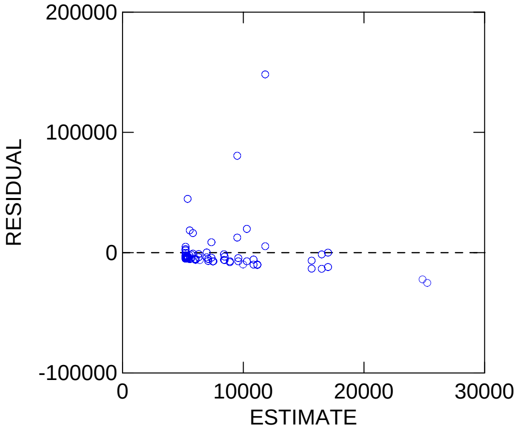
Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	5223.169	1969.415	0.000	.	2.652	0.009
V3D_PREC	4375.014	1927.886	0.177	1.000	2.269	0.025

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	2.22467E+09	1	2.22467E+09	5.150	0.025
Residual	6.91176E+10	160	4.31985E+08		

Durbin-Watson D Statistic 1.190
First Order Autocorrelation 0.403

Plot of residuals against predicted values



Analysis of sample day and six days prior precipitation

Dep Var: VALUE N: 162 Multiple R: 0.046 Squared multiple R: 0.002

Adjusted squared multiple R: 0.000 Standard error of estimate: 21093.341

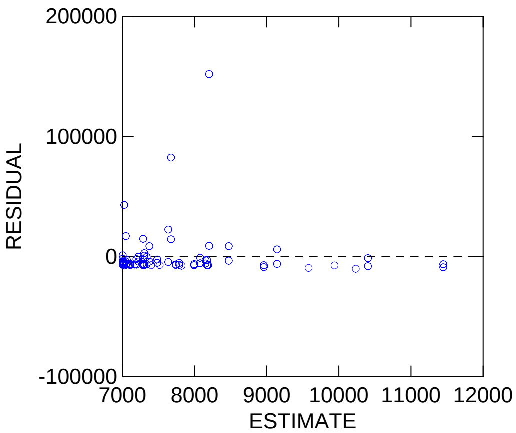
Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	7004.893	2057.559	0.000	.	3.404	0.001
V7D_PRE	544.656	926.821	0.046	1.000	0.588	0.558

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.53654E+08	1	1.53654E+08	0.345	0.558
Residual	7.11886E+10	160	4.44929E+08		

Durbin-Watson D Statistic 1.150
First Order Autocorrelation 0.424

Plot of residuals against predicted values



Appendix L: Analysis of Total Coliform Observations and Precipitation in Wills Branch

Analysis of sample day precipitation

Dep Var: VALUE N: 98 Multiple R: 0.014 Squared multiple R: 0.000

Adjusted squared multiple R: 0.000 Standard error of estimate: 48168.118

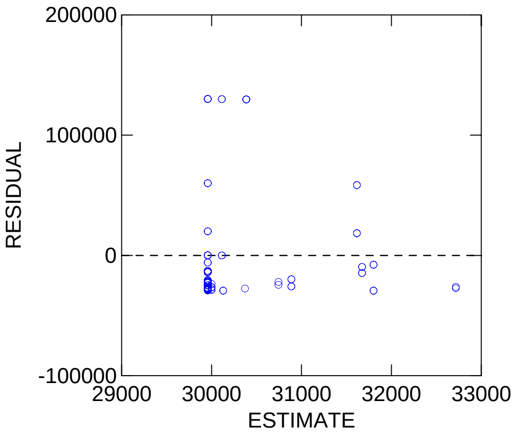
Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	29958.461	5501.770	0.000	.	5.445	0.000
V1D_PREC	1430.180	10280.138	0.014	1.000	0.139	0.890

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	4.49059E+07	1	4.49059E+07	0.019	0.890
Residual	2.22736E+11	96	2.32017E+09		

Durbin-Watson D Statistic 1.213
First Order Autocorrelation 0.391

Plot of residuals against predicted values



Analysis of sample day and two days prior precipitation

Dep Var: VALUE N: 98 Multiple R: 0.194 Squared multiple R: 0.038

Adjusted squared multiple R: 0.028 Standard error of estimate: 47255.773

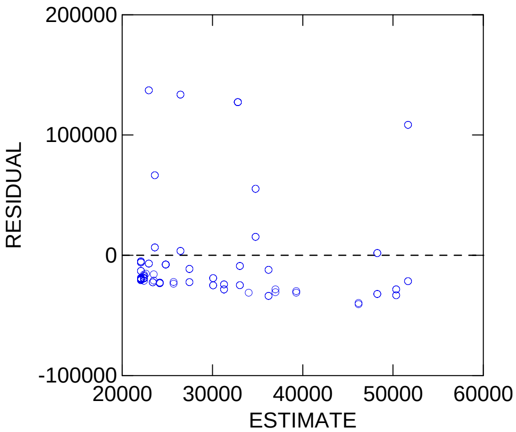
Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	22082.017	6387.794	0.000	.	3.457	0.001
V3D_PREC	10955.903	5648.013	0.194	1.000	1.940	0.055

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	8.40262E+09	1	8.40262E+09	3.763	0.055
Residual	2.14378E+11	96	2.23311E+09		

Durbin-Watson D Statistic 1.259
First Order Autocorrelation 0.365

Plot of residuals against predicted values



Analysis of sample day and six days prior precipitation

Dep Var: VALUE N: 98 Multiple R: 0.034 Squared multiple R: 0.001

Adjusted squared multiple R: 0.000 Standard error of estimate: 48145.026

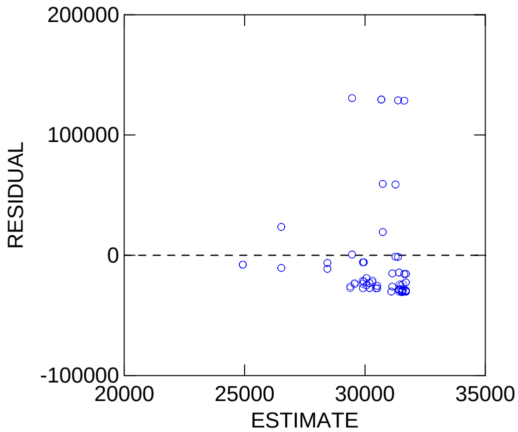
Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	31705.214	6400.822	0.000	.	4.953	0.000
V7D_PRE	-830.058	2485.989	-0.034	1.000	-0.334	0.739

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	2.58417E+08	1	2.58417E+08	0.111	0.739
Residual	2.22523E+11	96	2.31794E+09		

Durbin-Watson D Statistic 1.210
First Order Autocorrelation 0.394

Plot of residuals against predicted values

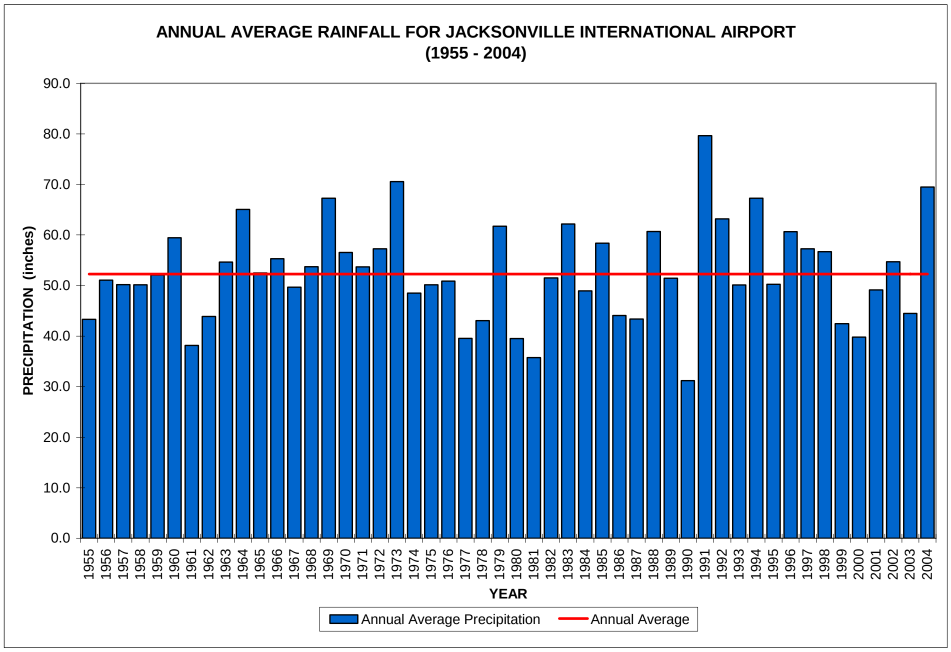


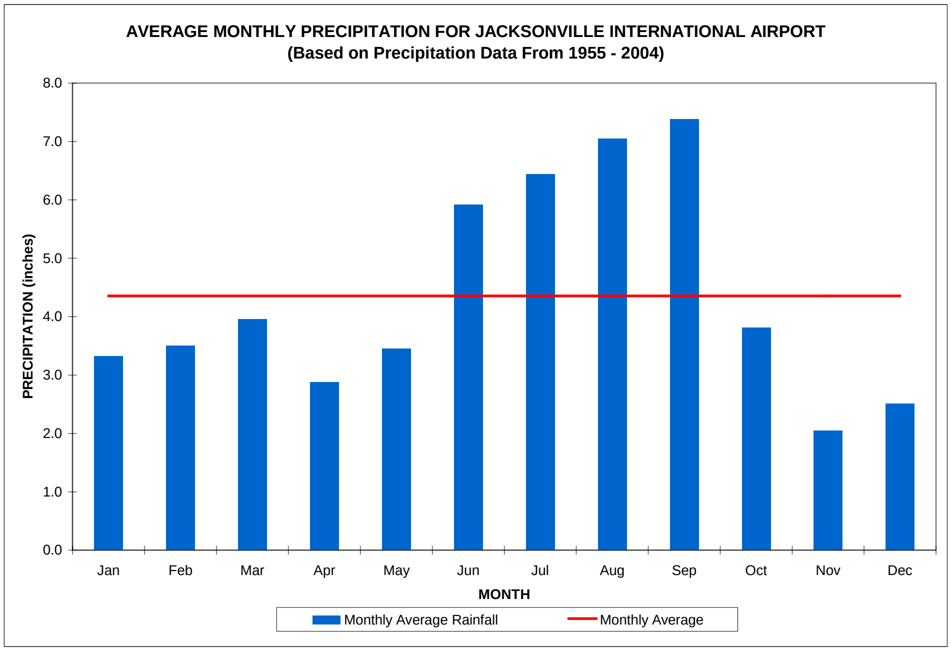
Appendix M: Monthly and Annual Precipitation 1955 – 2004 from JIA

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: Departmental Responses to Comments Regarding this TMDL for Wills Branch

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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".

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

2. The source assessment should discuss sources other than leaking septic systems and pet waste. In an urban environment, leaking sewer collection lines can be a large source of coliforms.

   RESPONSE: Text has been updated to include estimates of fecal and total loadings from leaking wastewater collection systems.

3. 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 80% for fecal coliform and 82% 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 69% reduction is needed for fecal coliform and a 61% reduction for total coliform. Basing the reduction on the 90th percentile concentration calculated during the listing cycle, the data requires a 95% reduction in fecal coliform and a 71% 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 95% reduction for fecal coliform seems unrealistic to achieve. Modification of the TMDL value is not necessary as BMPs implemented to achieve an 80% reduction in fecal coliform should be sufficient to see improvements in water quality. The reductions proposed by FDEP are conservative relative to the reductions achieved using only data collected during the listing cycle.

   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 the majority 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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