FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration

NORTHEAST DISTRICT • LOWER ST. JOHNS BASIN

Final TMDL Report

Fecal Coliform TMDL for Big Davis Creek, WBID 2356

David Wainwright
Jessica Rich-Zeisler

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For additional information on the watershed management approach and impaired waters in the Lower St. Johns Basin, contact

Amy Tracy
Florida Department of Environmental Protection
Bureau of Watershed Management
Watershed Planning and Coordination Section
2600 Blair Stone Road, Mail Station 3565
Tallahassee, FL 32399-2400
amy.tracy@dep.state.fl.us
Phone: (850) 245–8506
Fax: (850) 245–8434

Access to all data used in the development of this report can be obtained by contacting

Jessica Rich-Zeisler
Florida Department of Environmental Protection
Bureau of Watershed Restoration
Watershed Assessment Section
2600 Blair Stone Road, Mail Station 3555
Tallahassee, FL 32399-2400
jessica.rich-zeisler@dep.state.fl.us
Phone: (850) 245–8441
Fax: (850) 245–8536

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Florida Department of Environmental Protection, Bureau of Watershed Management

TMDL Program

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Identification of Impaired Surface Waters Rule

http://www.dep.state.fl.us/legal/Rules/shared/62-303/62-303.pdf

STORET Program

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

2008 305(b) Report

http://www.dep.state.fl.us/water/docs/2008_Integrated_Report.pdf

Criteria for Surface Water Quality Classifications

http://www.dep.state.fl.us/water/wqssp/classes.htm

Basin Status Report for the Lower St. Johns Basin

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

Water Quality Assessment Report for the Lower St. Johns Basin

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

U.S. Environmental Protection Agency, National STORET Program

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 coliform for Big Davis Creek, located in the Julington Creek Planning Unit of the Lower St. Johns Basin. The creek has been verified as impaired for fecal coliform, and was included on the Verified List of impaired waters for the Lower St. Johns Basin that was adopted by Secretarial Order in May 2004. This TMDL establishes the allowable loadings to Big Davis Creek that would restore the waterbody so that it meets its applicable water quality criterion for fecal coliform.

1.2 Identification of Waterbody

The Big Davis Creek watershed, which is located in southeastern Duval County in northeast Florida, drains an area of approximately 10.56 square miles (mi^2). The watershed is located near the areas of Bayard and Greenland, on the northern side of Julington Creek and on the eastern side of the St. Johns River. The creek flows directly into Julington Creek, a tributary to the St. Johns River (**Figures 1.1** and **1.2**). Big Davis Creek is approximately 3.75 miles long and is a second-order stream. Additional information about the creek's hydrology and geology are available in the Basin Status Report for the Lower St. Johns Basin (Florida Department of Environmental Protection [Department], 2004).

For assessment purposes, the Department has divided the Lower St. Johns Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Big Davis Creek consists of one segment, WBID 2356 (**Figure 1.2**), which this TMDL addresses.

The Big Davis Creek watershed is part of the Julington Creek Planning Unit. Planning units are groups of smaller watersheds (WBIDs) that are part of a larger basin unit, in this case the Lower St. Johns Basin. The Julington Creek Planning Unit consists of 14 WBIDs. **Figure 1.3** shows the location of these WBIDs and Big Davis Creek's location in the planning unit, and lists the other WBIDs in the planning unit.

Figure 1.1. Location of Big Davis Creek, WBID 2356, and Major Geopolitical Features in the Lower St. Johns Basin

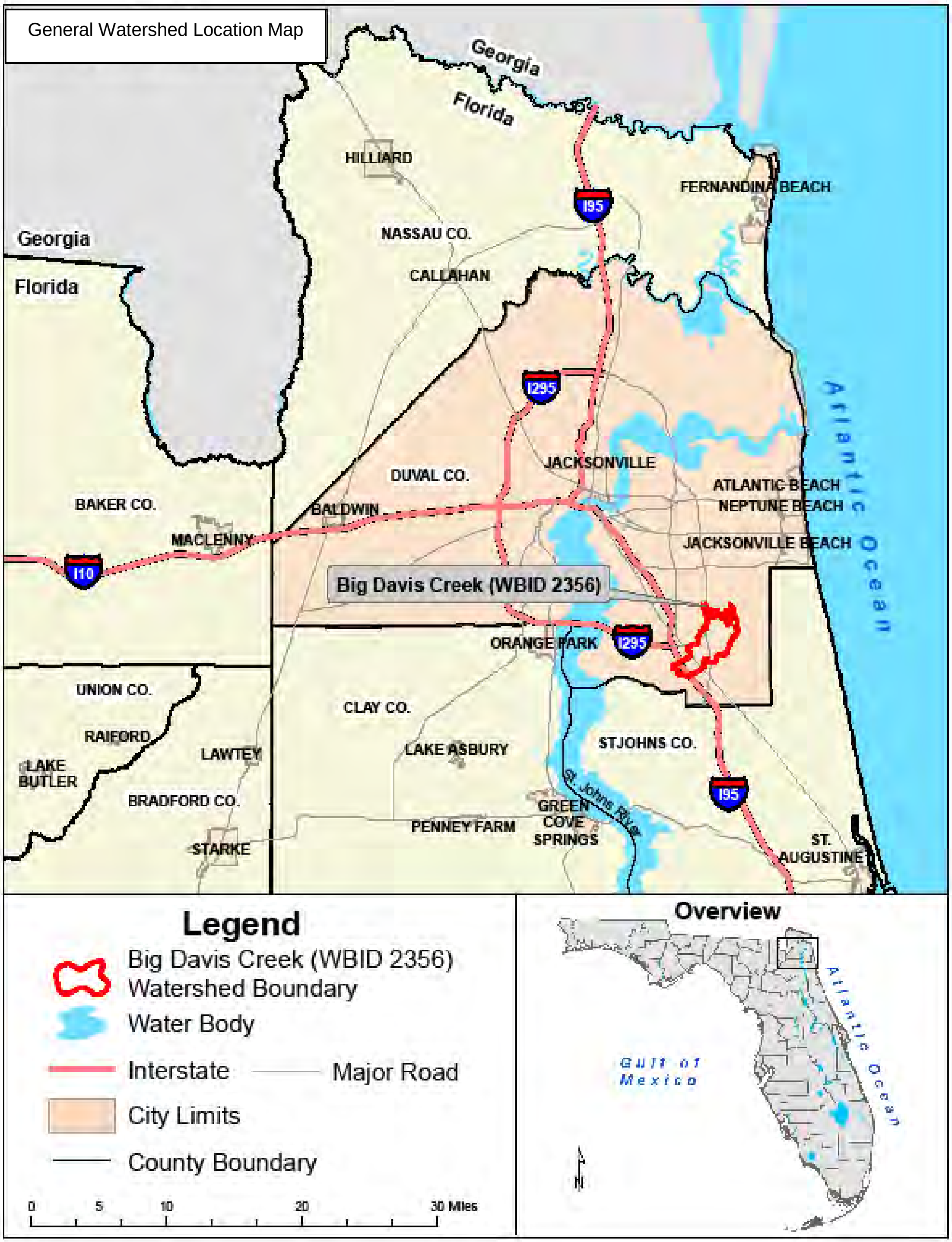


Figure 1.2. Overview of the Big Davis Creek Watershed, WBID 2356

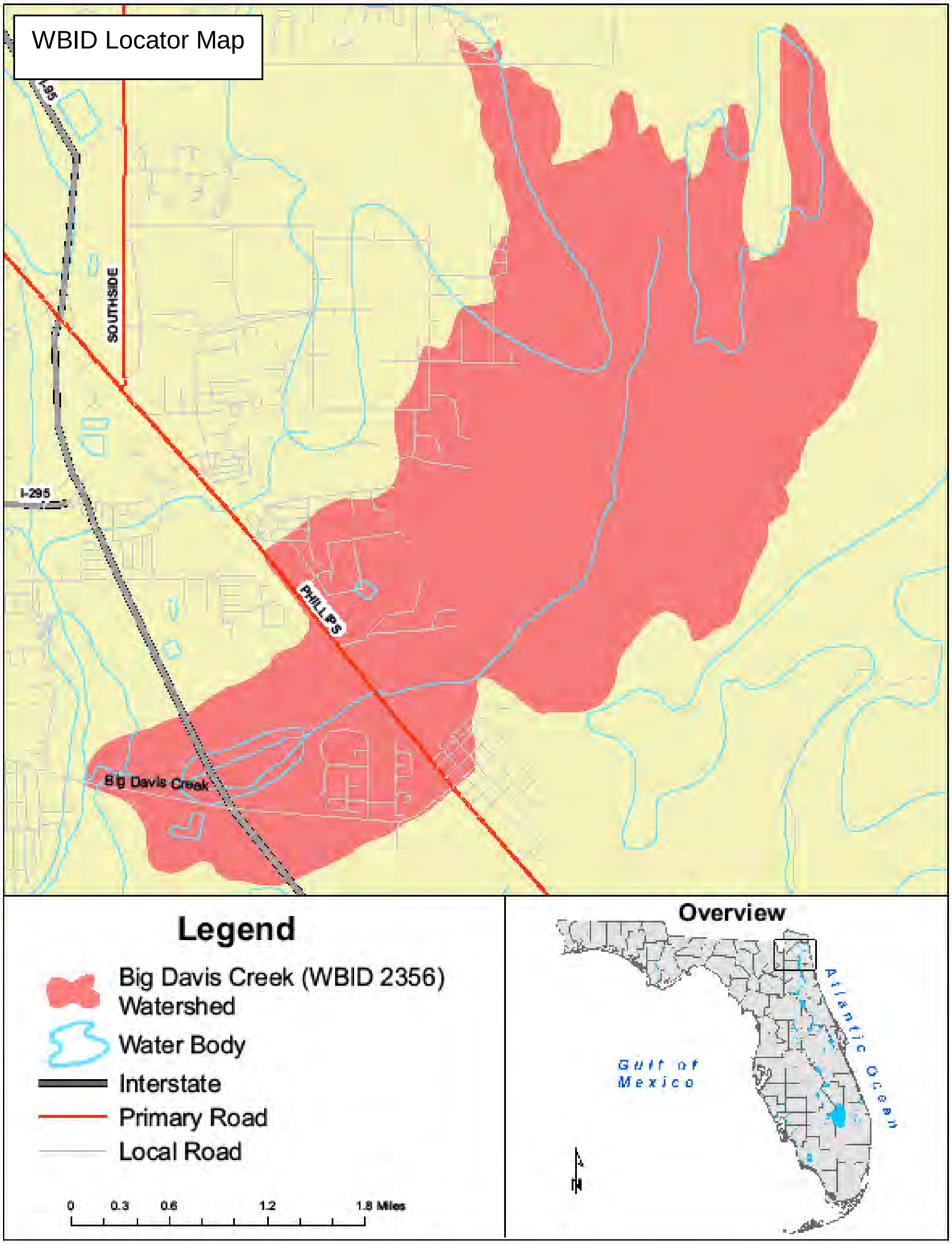


Figure 1.3. WBIDs in the Julington Creek Planning Unit

1.3 Background

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

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

While Big Davis Creek was ***not*** placed on the 1998 303(d) list, it met the requirements for impairment under the state's Impaired Surface Waters Rule (IWR) and was included on the Verified List for the Lower St. Johns Basin. When the list was adopted, the TMDL for Big Davis Creek was assigned a medium priority with a due date of 2008.

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

Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

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

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

2.2 Information on Verified Impairment

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

The overall exceedance rate for fecal coliform in Big Davis Creek during the verified period is 17.86 percent. There are 28 samples, ranging from 8 to 9,000 counts per 100 milliliters (counts/100mL). Exceedances occur in 5 of the 11 months sampled (**Table 2.1**). Both April and October have the highest monthly exceedance rate, at 50 percent. Sample size for each month is small, with all months having fewer than 4 samples. Exceedances occur in all seasons, but the exceedance rates are relatively low, ranging from 13 to 22 percent (**Table 2.2**). The largest percentage of exceedances occurs in the summer (22 percent). Even combining samples by season, sample size is small, with only summer having above 8 samples. When considering the data by year, it appears that exceedance rates are declining. There are no exceedances in 2000, 2002, or 2003. There was a 100 percent exceedance in 1997; howeve,r it is based on only 1 sample, and 1996 was not sampled at all.

There are two sampling sites with historical fecal coliform data. Both sites are located near each other and near the mouth of the creek. **Section 5.1.1** discusses sampling sites further.

Table 2.1. Summary of Fecal Coliform Data by Month for the Verified Period (January 1, 1996–June 30, 2003), WBID 2356

Month	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances	Mean Precipitation
January	2	170	170	170	170	0	0.00	2.55
February	-	-	-	-	-	-	-	2.82
March	3	8	1,000	20	343	1	33.33	4.26
April	2	50	1,100	575	575	1	50.00	2.79
May	3	8	130	112	83	0	0.00	1.61
June	3	60	260	110	143	0	0.00	6.18
July	3	20	300	80	133	0	0.00	6.36
August	3	70	9,000	70	3,047	1	33.33	6.97
September	3	80	1,100	170	450	1	33.33	10.01
October	2	220	1,300	760	760	1	50.00	3.74
November	3	8	240	240	163	0	0.00	1.81
December	1	400	400	400	400	0	0.00	3.46

- = No data available for February.

Coliform counts are #/100mL.

Exceedances represent values above 400 counts/100mL.

Mean precipitation is for Jacksonville International Airport (JIA) in inches. Means are monthly means based on data from 1955 ti 2008.

Table 2.2. Summary of Fecal Coliform Data by Season for the Verified Period (January 1, 1996–June 30, 2003), WBID 2356

Season	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances	Mean Precipitation*
Winter	5	8	1,000	170	274	1	20.00	3.21
Spring	8	8	1,100	111	229	1	12.50	3.53
Summer	9	20	9,000	80	1,210	2	22.22	7.78
Fall	6	8	1,300	240	401	1	16.67	3.00

Winter is January – March; spring is April – June; summer is July – September; fall is October – December.

Coliform counts are #/100mL.

Exceedances represent values above 400 counts/100mL.

Mean precipitation is for JIA in inches.

*Represents a monthly average for that season.

Table 2.3. Summary of Fecal Coliform Data by Year for the Verified Period (January 1, 1996–June 30, 2003), WBID 2356

Year	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances	Mean Precipitation
1996	-	-	-	-	-	-	-	5.05
1997	1	1,100	1,100	1,100	1,100	1	100.00	4.77
1998	3	260	1,300	300	620	1	33.33	4.73
1999	4	170	9,000	660	2,623	2	50.00	3.54
2000	4	130	400	170	218	0	0.00	3.31
2001	3	8	1,000	60	356	1	33.33	4.1
2002	11	8	240	70	86	0	0.00	4.56
2003	2	50	110	80	80	0	0.00	3.71

Table represents years for which data exist.

- = No data available for 1996.

Coliform counts are #/100mL.

Exceedances represent values above 400 counts/100mL.

Total precipitation is for JIA in inches.

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)**

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

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

3.2.1 Fecal Coliform Criterion

Numeric criteria for bacterial quality are expressed in terms of fecal coliform bacteria concentrations. The water quality criterion for 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.*

The criterion states that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. However, there were insufficient data (fewer than 10 samples in a given month) available to evaluate the geometric mean criterion for fecal coliform bacteria. Therefore, the criterion selected for the TMDL was not to exceed 400 counts/100mL.

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 System (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, such as those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

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

4.2 Potential Sources of Coliform in the Big Davis Creek Watershed

4.2.1 Point Sources

There are currently no facilities with a permit to discharge wastewater in the Big Davis Creek watershed (see **Figure 4.1**). Hertz Rental Equipment Corporation, located within the watershed on Phillips Road, does hold a nonsurface water discharge permit, but this is a 100 percent wash-water recycle facility (Permit FLA276693), and so there are no expected fecal coliform impacts to Big Davis Creek from this facility.

Municipal Separate Storm Sewer System Permittees

The city of Jacksonville and Florida Department of Transportation (FDOT) District 2 are copermittees for a Phase I NPDES municipal separate storm sewer system (MS4) permit (FLS000012) that covers the Big Davis Creek watershed. **Figure 4.2** shows the stormwater infrastructure of the watershed. Outfalls represent points where a conveyance of stormwater discharges into a separate stormwater system through a channelized or natural waterway.

Figure 4.1. Permitted Discharge Facilities in the Big Davis Creek Watershed, WBID 2356

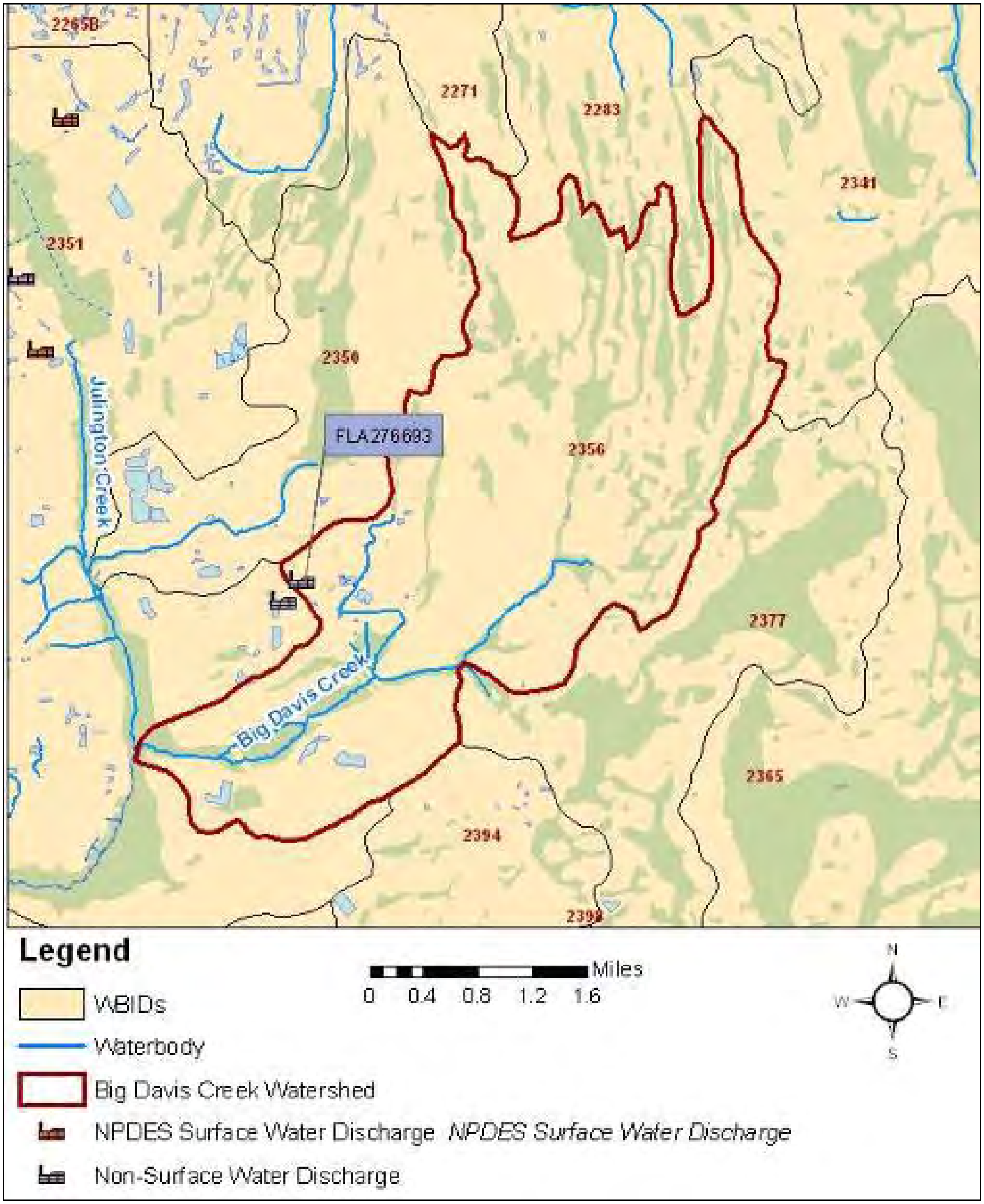
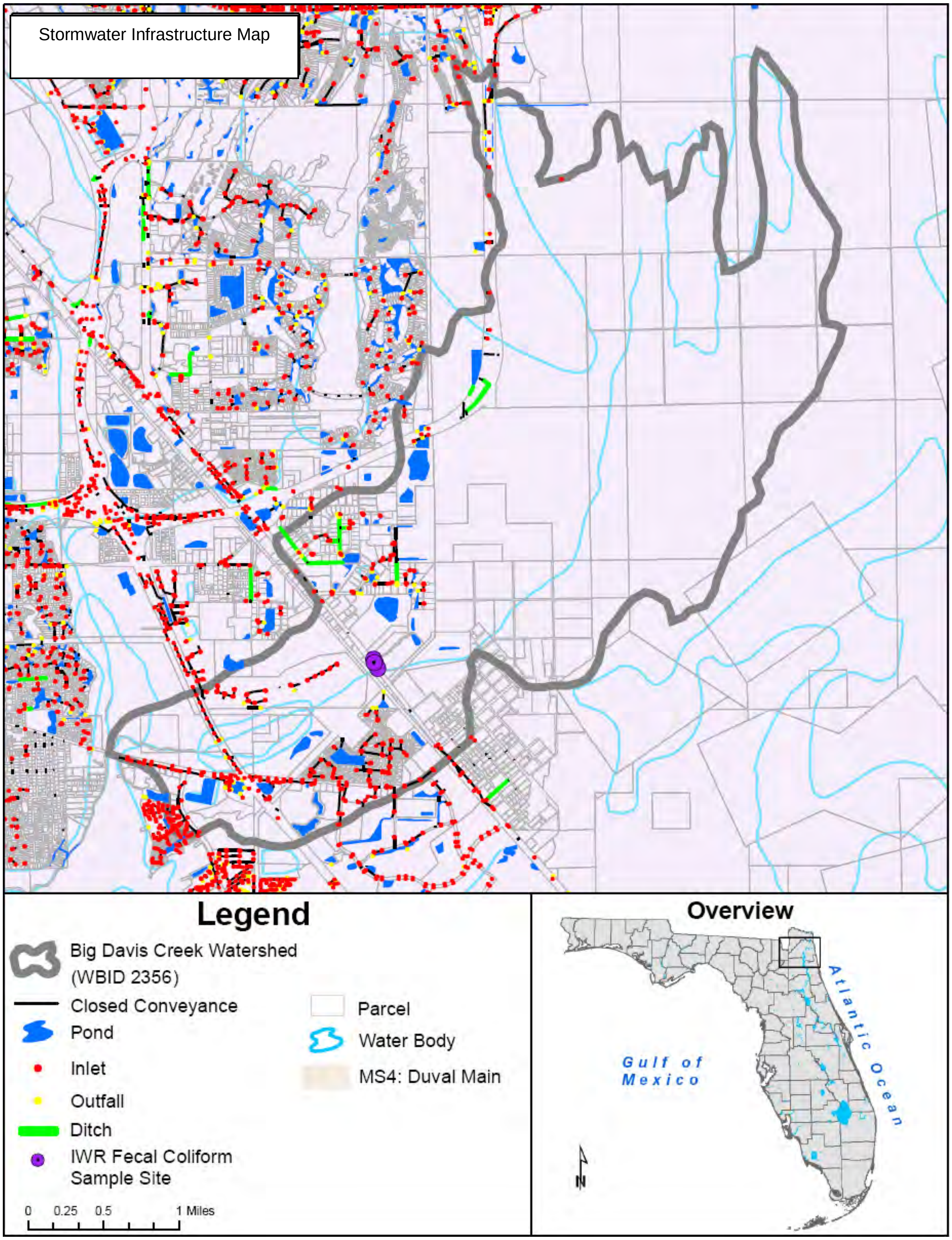


Figure 4.2. Stormwater Infrastructure in the Big Davis Creek Watershed, WBID 2356



Inlets are a component of the stormwater system located along the curbed edge of paved surfaces or the low point of an area to provide for the collection of stormwater runoff, access for inspection and maintenance, pipe junctions, sediment traps, or conflicts with other utilities (K. Grable, personal communication, October 16, 2008). In the Big Davis Creek watershed, there are 50 outfalls and 373 inlets.

4.2.2 Land Uses and Nonpoint Sources

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

Land Uses

The spatial distribution and acreage of different land use categories were identified using the 2004 land use coverage contained in the Department's Geographic Information System (GIS) library, initially provided by the SJRWMD. Land use categories and acreages in the watershed were aggregated using the Level 3 codes tabulated in **Table 4.1.** **Figure 4.3** shows the principal land uses in the watershed based on Level 1 land use codes.

Table 4.1. Level 3 Land Use Categories in the Big Davis Creek Watershed, WBID 2356

Level 3 Land Use Code	Attribute	Acres	% of Total
1100	Residential, low density–less than 2 dwelling units/acre	38	0.56%
1180	Rural residential	24	0.35%
1200	Residential, medium density–2-5 dwelling units/acre	150	2.22%
1400	Commercial and services	48	0.71%
1490	Commercial and services under construction	103	1.53%
1550	Other light industrial	315	4.66%
1600	Extractive	37	0.54%
1820	Golf courses	5	0.08%
1890	Other recreational (stables, go-carts, skeet ranges, etc.)	15	0.22%
2150	Field crops	3	0.04%
2430	Ornamentals	7	0.11%
3100	Herbaceous upland nonforested	61	0.90%
3200	Shrub and brushland	38	0.56%
3300	Mixed upland nonforested	3	0.05%
4110	Pine flatwoods	753	11.13%
4120	Longleaf pine–xeric oak	375	5.54%
4200	Upland hardwood forests	3	0.04%
4340	Upland mixed coniferous/hardwood	44	0.64%
4410	Coniferous pine	1,646	24.34%
4430	Forest regeneration	164	2.42%
5300	Reservoirs–pits, retention ponds, dams	118	1.74%
6110	Bay swamp (if distinct)	233	3.44%
6170	Mixed wetland hardwoods	806	11.92%
6210	Cypress	72	1.06%

Level 3 Land Use Code	Attribute	Acres	% of Total
6250	Hydric pine flatwoods	409	6.05%
6300	Wetland forested mixed	877	12.97%
6410	Saltwater marshes	20	0.29%
6430	Wet prairies	15	0.22%
6440	Emergent aquatic vegetation	6	0.09%
6460	Mixed scrub-shrub wetland	60	0.88%
8140	Roads and highways (divided 4-lanes with medians)	227	3.36%
8310	Electrical power facilities	21	0.32%
8320	Electrical power transmission lines	69	1.02%
	TOTAL:	**6,762.00**	**100.00%**

The Big Davis Creek watershed is mostly an undisturbed area. As **Table 4.1** shows, the majority of the land is coniferous pine (24 percent), wetland forested mix (13 percent), pine flatwoods (11 percent), and mixed wetland hardwoods (12 percent). In all, natural areas occupy approximately 82.54 percent (5,582 acres) of the watershed; residential and other urban areas occupy about 16 percent (1,109 acres); and rural areas comprise about 1 percent (71.25 acres). Most of the developed portions are located in the southern part of the watershed and there are no high-density residential areas.

Population

According to the U.S Census Bureau, census block population densities in the Big Davis Creek watershed in the year 2000 ranged from 0 to 7 people/acre (**Figure 4.4**) or 0 to 0.01 people /mi^2, with an average of 105 people/mi^2 in the watershed (calculated from Census information). The estimated population in the Big Davis Creek watershed is 1,113 people (**Table 4.3**). The Census Bureau reports that, for all of Duval County, the total population for 2000 was approximately 780,000, with 329,778 housing units and an average occupancy rate of 92.1 percent (303,747 units); additionally, 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 Website, 2005). The estimated average housing density in Big Davis Creek is 37 units/mi^2 (based on population), which is considerably lower than the county average.

Septic Tanks

Approximately 78 percent of the Duval County residences are connected to a wastewater treatment plant, while the rest use septic tanks (JEA Water and Sewer Expansion Authority [WSEA] septic files) (PBS&J, 2007). The Florida Department of Health (FDOH) reports that as of fiscal year 2003–04, there were 88,834 permitted septic tanks in Duval County, and for

Figure 4.3. Principal Level 1 Land Uses in the Big Davis Creek Watershed, WBID 2356, in 2004

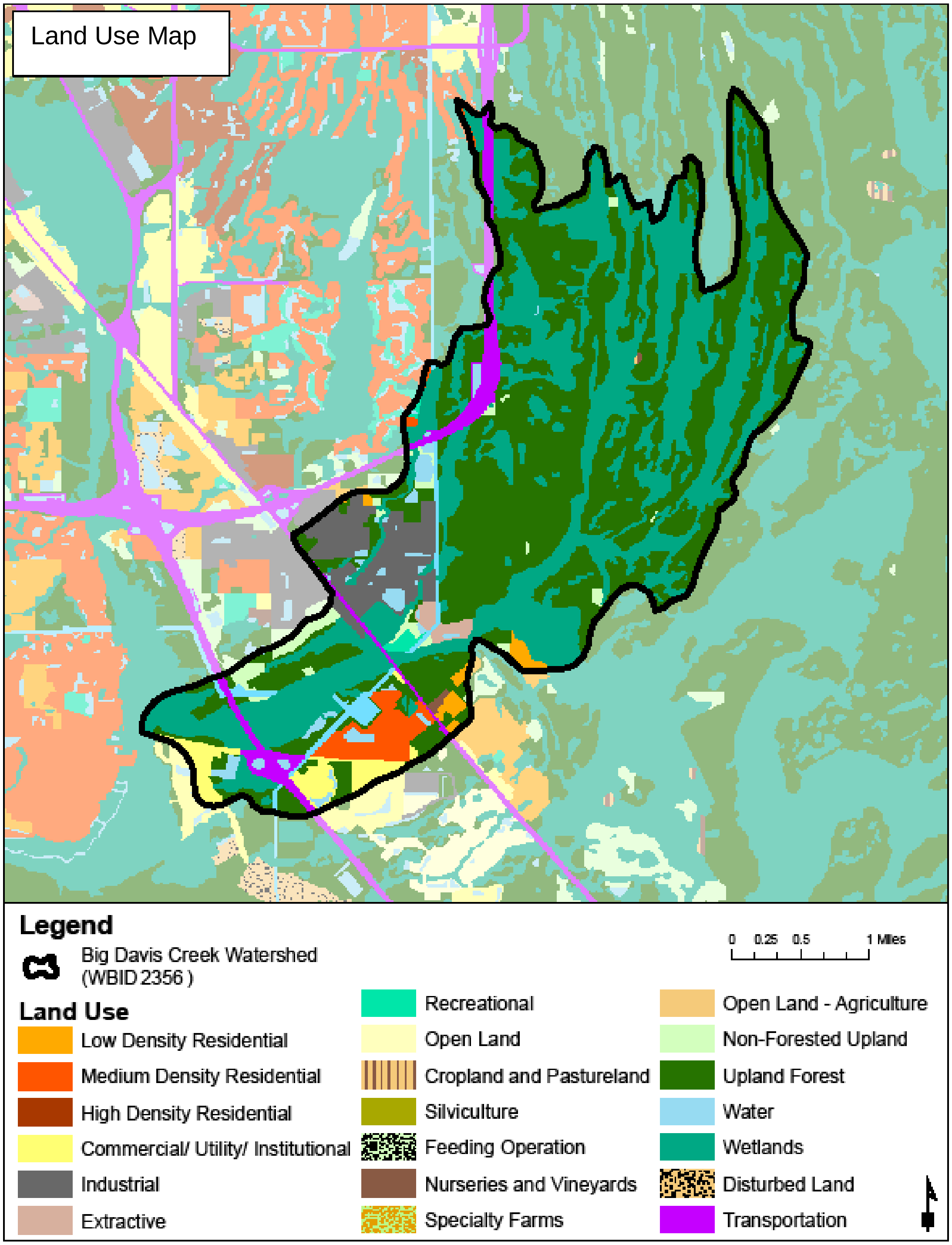


Figure 4.4. Population Density in the Big Davis Creek Watershed, WBID 2356, in 2000

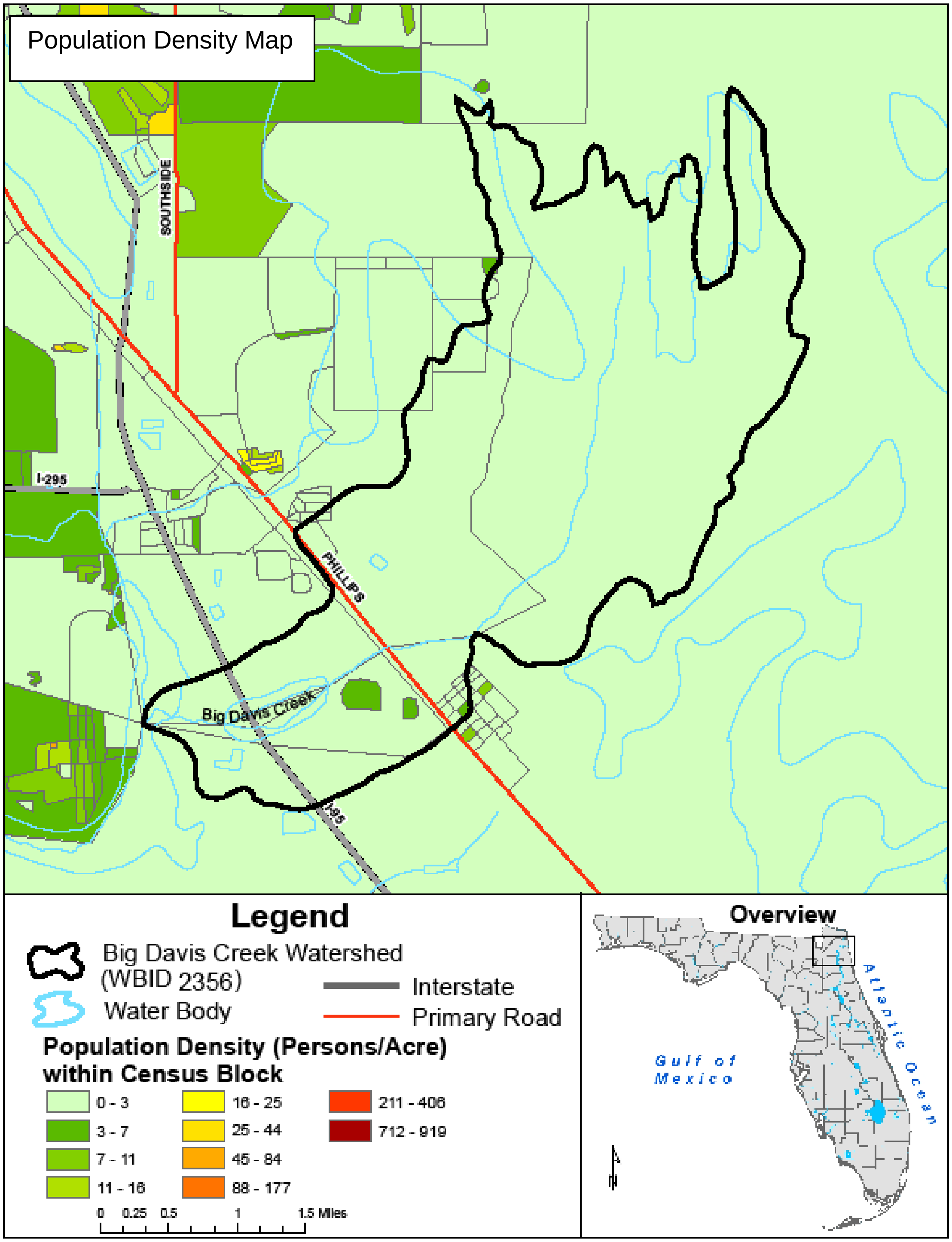


Table 4.2. Estimated Average Household Size in the Big Davis Creek Watershed, WBID 2356

Household Size*	Number of Households	% of Total	Number of People*
1-person household	41	10.56	41
2-person household	144	37.15	288
3-person household	82	21.17	247
4-person household	79	20.29	315
5-person household	31	8.06	157
6-person household	9	2.40	56
7-or-more-person household	1	0.36	10
TOTAL:	**388**	**100.00**	**1,113**
		AVERAGE HOUSEHOLD SIZE:	**2.87**

*Individual values for number of people per household size have been rounded to the nearest whole number, while total number of people remains based on unrounded values.

fiscal years 1993 to 2004, 5,479 permits for repairs were issued, or an average of approximately 457 repairs annually countywide.

To focus on the Big Davis Creek watershed, the Department obtained septic tank repair permit data from JEA for its service area, which includes the Big Davis Creek watershed. The data include septic tank repair permit records issued from March 1990 to April 2004, areas serviced by a WWTF, and areas where large numbers of failing septic tanks are present. **Figure 4.5** shows this information.

Based on these data, which are more watershed specific than the countywide FDOH data, there were 14 septic tank repair permits issued during this time, or an average of 1 permit per year. This is not surprising, considering the population and housing density in the Big Davis Creek watershed. If this estimate is rounded up to 2 (to allow for those septic tanks where failures may not be known or have not been repaired), and using an estimate of 70 gallons/day/person (EPA, 2001), a loading of 1.52 x 10^{10} colonies/day is derived. **Table 4.3** shows this estimation.

The data provided by JEA also include areas serviced by a WWTF and areas where large numbers of failing septic tanks are present. None of the Big Davis Creek watershed is in a septic tank phase-out area (an area with the highest priority to be sewered due to high septic tank failure rates). The watershed is serviced by the Mandarin and Arlington East WWTFs.

Figure 4.5. Septic Tank Repair Permits Issued in the Big Davis Creek Watershed, WBID 2356, 1990–2006

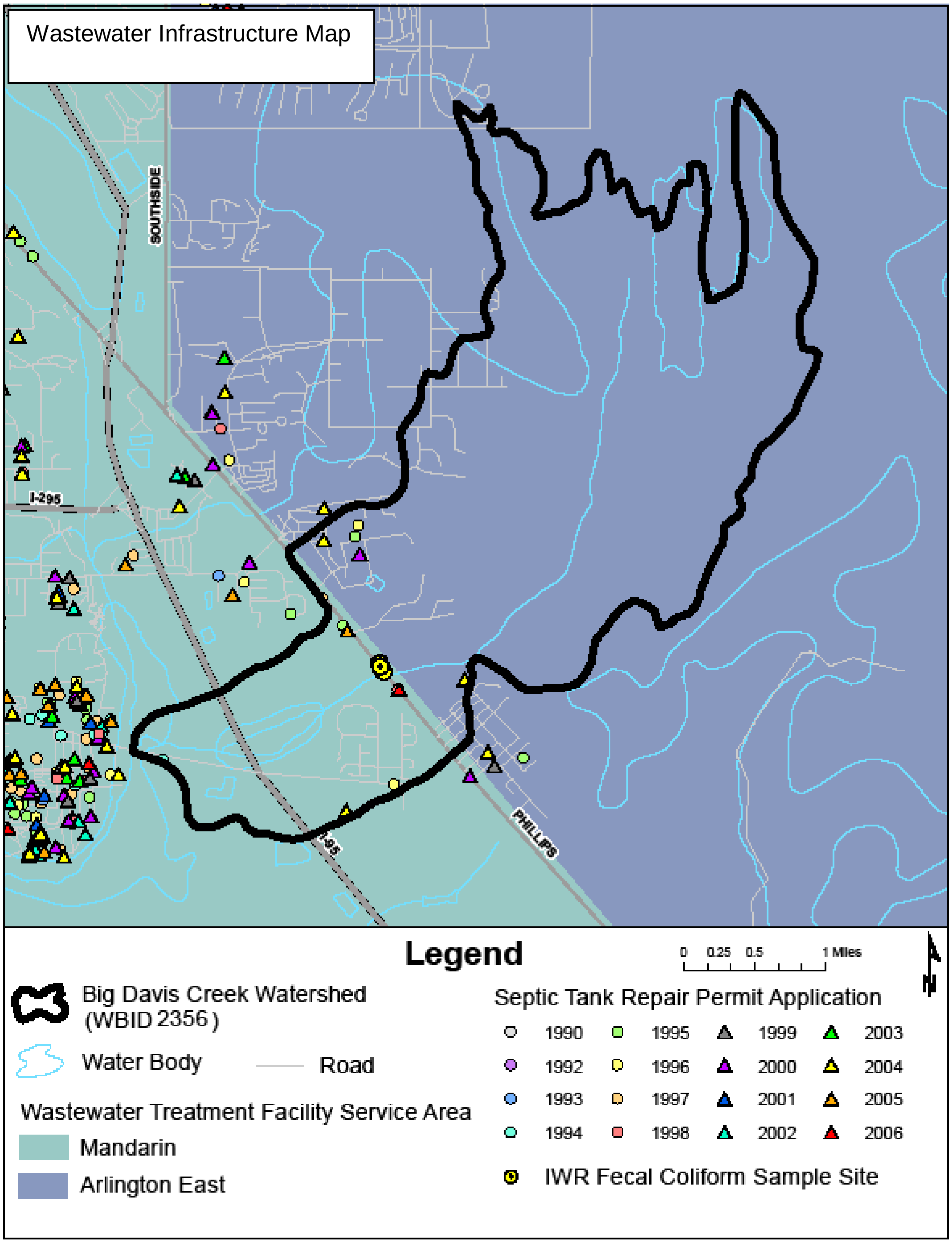


Table 4.3. Estimated Annual Fecal Coliform Loading from Failed Septic Tanks in the Big Davis Creek Watershed, WBID 2356

Estimated Population Density (people/mi^2)	WBID Area (mi^2)	Estimated Population in Watershed	Estimated Number of Tank Failures[1]	Estimated Load from Failed Tanks[2]	Gallons/ Person/ Day[2]	Estimated Number of People per Household[3]	Estimated Daily Load from Failing Tanks	Estimated Annual Load from Failing Tanks
105	10.6	1,113	2	1.00×10^4/mL	70	2.87	1.52×10^{10}	5.55×10^{12}

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

4.2.3 Other Potential Sources

Agriculture

According to Level 3 land use data, there are two agricultural land use types in the Big Davis Creek watershed, totaling only 0.15 percent of the entire watershed. Field crops, which usually consist of wheat, oats, hay, or grass crops, comprise 3 acres of the watershed. Seven acres are allocated as ornamentals or plants and shrubs grown for decorative effects. As noted in **Section 4.2.2,** the watershed area is primarily composed of undisturbed or natural land uses.

Pets

It is possible that pets, especially dogs, have an impact on the waterbody. The Department has been unable to obtain data on the number of dogs in the area; however, estimates can be made using literature-based values of dog ownership rates (**Table 4.4**). For example, using household-to-dog ratio estimates from the American Veterinary Medical Association (AVMA), the approximate loading is 1.13×10^{12} organisms/day. This is an estimate, as the actual loading from dogs is not known.

Table 4.4. Estimated Loading from Dogs in the Big Davis Creek Watershed, WBID 2356

Estimated Number of Households in WBID 2356	Estimated Dog: Household Ratio[1]	Estimated Number of Dogs in WBID 2356	Estimated Fecal Coliform (counts/dog/ day[2])	Estimated Fecal Coliform (counts/day)	Estimated Fecal Coliform (counts/year)
388	0.58	225	5×10^9	1.13×10^{12}	4.11×10^{14}

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

[2] EPA, 2001.

Leaking or Overflowing Wastewater Collection Systems

As noted previously, about 78 percent of households in Duval County are connected to a wastewater facility. Assuming that 303 homes in the watershed are connected to sewer systems, with 2.87 people per home, and a 70-gallon-per-person-per-day discharge, a daily flow of approximately 2.30×10^5 liters (L) is transported through the collection system. The EPA

(Davis, 2002) suggests that a 5 percent leakage rate from collection systems is a realistic estimate. Based on this rate and EPA values for fecal coliform in raw sewage, the potential loadings of fecal coliform from leaking sewer lines are 5.75×10^{11} counts/day (**Table 4.5**).

Table 4.5. Estimated Loading from Wastewater Collection Systems in the Big Davis Creek Watershed, WBID 2356

Estimated Number of Homes on Central Sewer in WBID 2356	Estimated Daily Flow (L)	Daily Leakage (L)	Raw Sewage (counts/ 100mL)	Estimated Fecal Coliform (counts/day)	Estimated Fecal Coliform (counts/year)
303	2.30×10^5	1.15×10^4	5×10^6	5.75×10^{11}	2.1×10^{14}

4.3 Source Summary

Table 4.6 summarizes the daily and annual loading 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, drainage features, soil characteristics, and temperature are just a few of the factors that could influence and determine the actual loadings from these sources that reach Big Davis Creek.

Table 4.6. Summary of Estimated Potential Coliform Loading from Various Sources in the Big Davis Creek Watershed, WBID 2356

Source	Fecal Coliform (counts/day)	Fecal Coliform (counts/year)
Septic Tanks	1.13×10^{12}	4.11×10^{14}
Dogs	1.52×10^{10}	5.55×10^{12}
Collection Systems	5.75×10^{11}	2.1×10^{14}

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

Because there is a U.S. Geological Survey (USGS) stream gaging station on Big Davis Creek, the load duration curve method was applied. This method, which is also known as the "Kansas approach" because it was developed by the state of Kansas (Stiles, 2002), is well-documented in the literature, with improved modifications used by EPA Region 4 (Davis, 2004). Basically, the method relates the pollutant concentration to the flow of the stream to establish the existing loading capacity and the allowable pollutant load (TMDL) under a spectrum of flow conditions. The maximum allowable pollutant load and load reduction requirement are then determined based on the analysis of the critical flow conditions. Using this method, it takes five steps to develop the TMDL and establish the required load reduction:

1. *Identify available flow and water quality data;*
2. *Develop the flow duration curve;*
3. *Develop the load duration curve for the existing loading;*
4. *Define the critical conditions; and*
5. *Establish the needed load reduction by comparing the existing loading with the allowable load under critical conditions.*

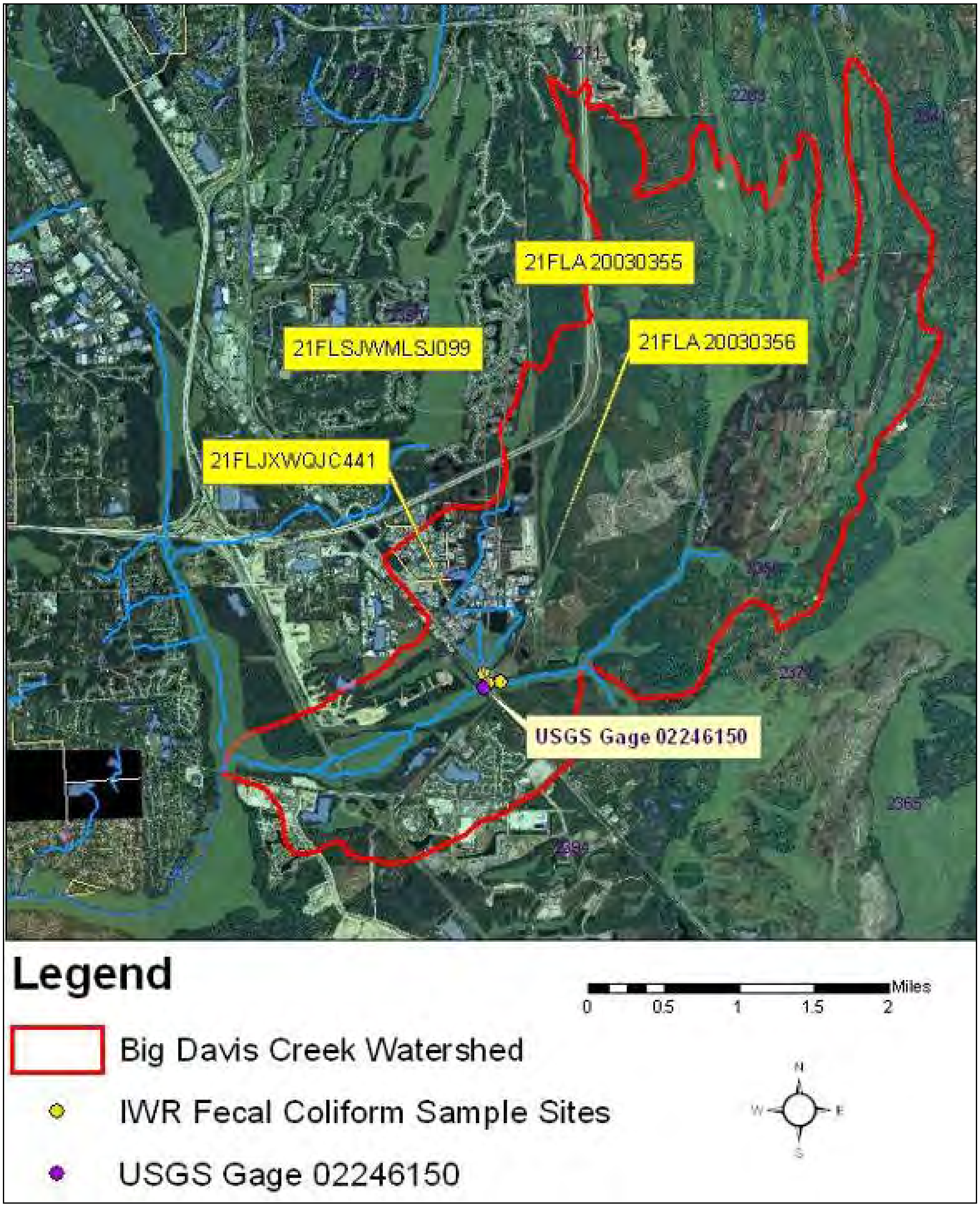
In the Big Davis Creek watershed, the USGS has maintained a stream gaging station at U.S. 1 (Gage 02246150; Big Davis Creek at Bayard, Fla) (**Figure 5.1** shows the location). Available data for the gage are from August 22, 1966, to September 30, 1969; June 1, 1974, to October 2, 2007; and October 4, 2007, to October 23, 2007.

When no stream gaging data are available for a stream, the required reduction is calculated based on the observed exceedances in the watershed. In developing this TMDL, the required reduction was calculated using both the load duration curve as well as the percent reduction method (**Appendix L**). The load duration curve results were similar to those calculated using the percent reduction method (68.71 and 59.18 percent, respectively). The load duration percent reduction of 68.71 is used for this particular watershed because it is based on watershed-specific flows.

5.1.1 Data Used in the Determination of the TMDL

Four sampling stations on Big Davis Creek have historical fecal coliform observations (**Figure 5.1**); all four (along with the USGS gage) are located near each other at U.S. 1. The primary collector of historical data is the city of Jacksonville, which increased sampling frequency in 2002

Figure 5.1. Historical Sample Sites in Big Davis Creek, WBID 2356



(STORET #21FLJXWQJC441). The Department sampled two stations: 21FLA 20030355 three times in 2007, and 21FLA 20030356 a total of five times in 2002 and 2007. The SJRWMD sampled the creek twice in 1995. **Table 5.1** shows data collection information for each of the stations, and **Figure 5.1** shows the location of the sample sites. **Table 5.2** shows the observed historical data analysis, and **Appendix B** contains all the historical fecal coliform observations from the sites for the planning and verified periods for the Lower St. Johns Basin. **Figure 5.2** shows these observations over time.

Of the 55 samples collected by the city of Jacksonville, 16 were exceedances. The Department's stations had a 33 percent exceedance rate (21FLA 20030355) and a 20 percent exceedance rate (21FLA 20030356). No exceedances were found at the SJRWMD sampling station. The lowest observation is 8 counts/100mL; the highest is 10,000 counts/100mL. Both of these observations were reported by the city of Jacksonville at the U.S. 1 site. All data in the IWR database as well as those supplied to the Department by the city of Jacksonville were considered in developing the TMDL.

Table 5.1. Sampling Station Summary for Big Davis Creek, WBID 2356

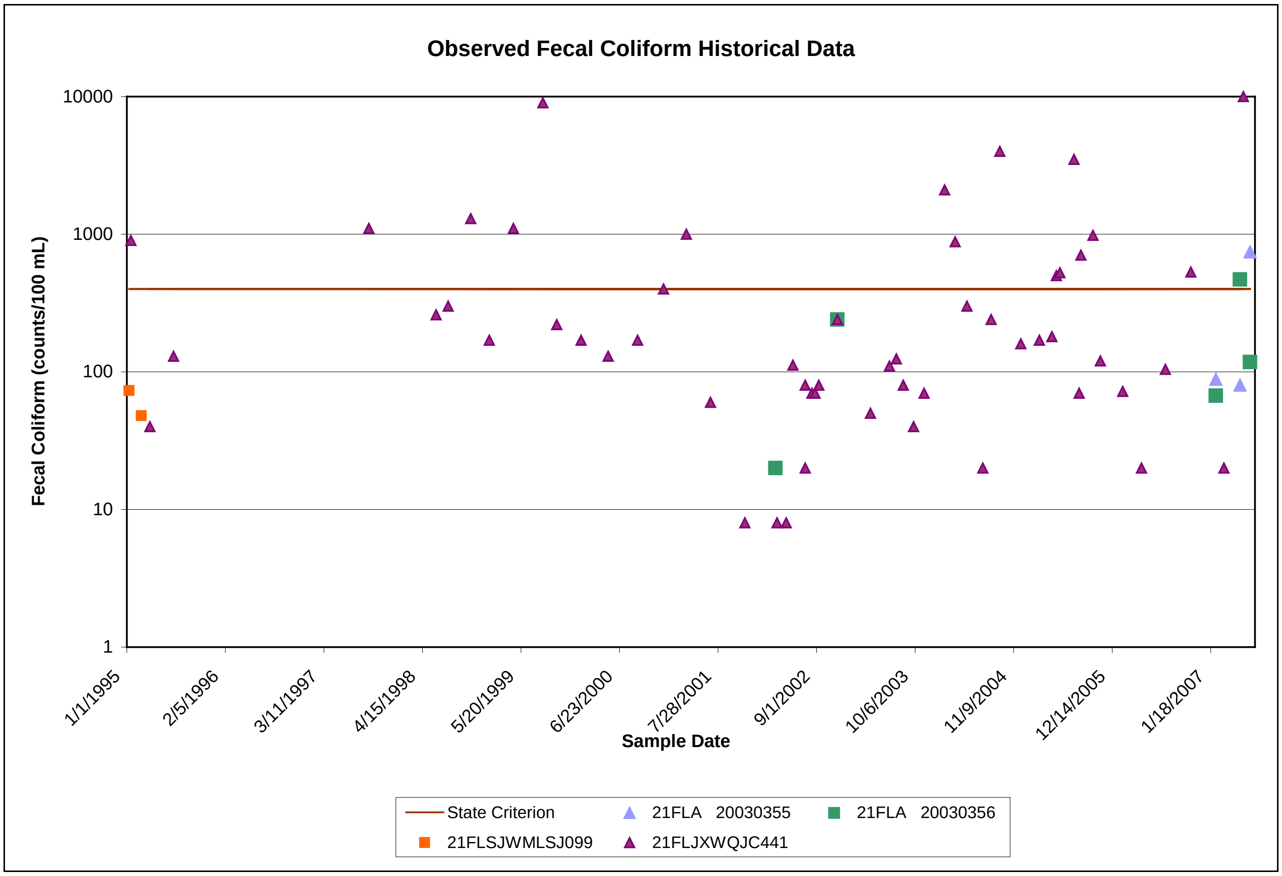
Station	STORET ID	Monitoring Agency	Years With Data	N
Little Davis Cr E US 1 @ Avenues Sports Bar Driveway	21FLA 20030355	Department (Northeast District)	2007	3
Big Davis Cr E of US 1 S of Golf Driving Range	21FLA 20030356	Department (Northeast District)	2002, 2007	5
Big Davis Creek at US 1	21FLSJWMLSJ099	SJRWMD	1995	2
Big Davis Creek at US 1	21FLJXWQJC441	City of Jacksonville	1995, 1997–2007	55

Table 5.2. Statistical Summary of Historical Data for Big Davis Creek, WBID 2356

Station	STORET ID	N	Minimum	Maximum	Median	Mean	Exceedances	% Exceedances
Little Davis Cr E US 1 @ Avenues Sports Bar Driveway	21FLA 20030355	3	80	741	88	303	1	33.33
Big Davis Cr E of US 1 S of Golf Driving Range	21FLA 20030356	5	20	470	118	183	1	20.00
Big Davis Creek at US 1	21FLSJWMLSJ099	2	48	73	61	61	0	0.00
Big Davis Creek at US 1	21FLJXWQJC441	55	8	10,000	170	170	16	29.09

Coliform concentrations are counts/100mL.

Figure 5.2. Historical Fecal Coliform Observations for Big Davis Creek, WBID 2356



After the individual results were calculated, the median of the individual values was calculated, which is 69 percent. This means that in order to meet the state criterion of 400 counts/100mL, a 69 percent reduction in current loading is necessary, and this is therefore the TMDL for Big Davis Creek. **Table 5.3** shows the individual reduction calculations for Big Davis Creek.

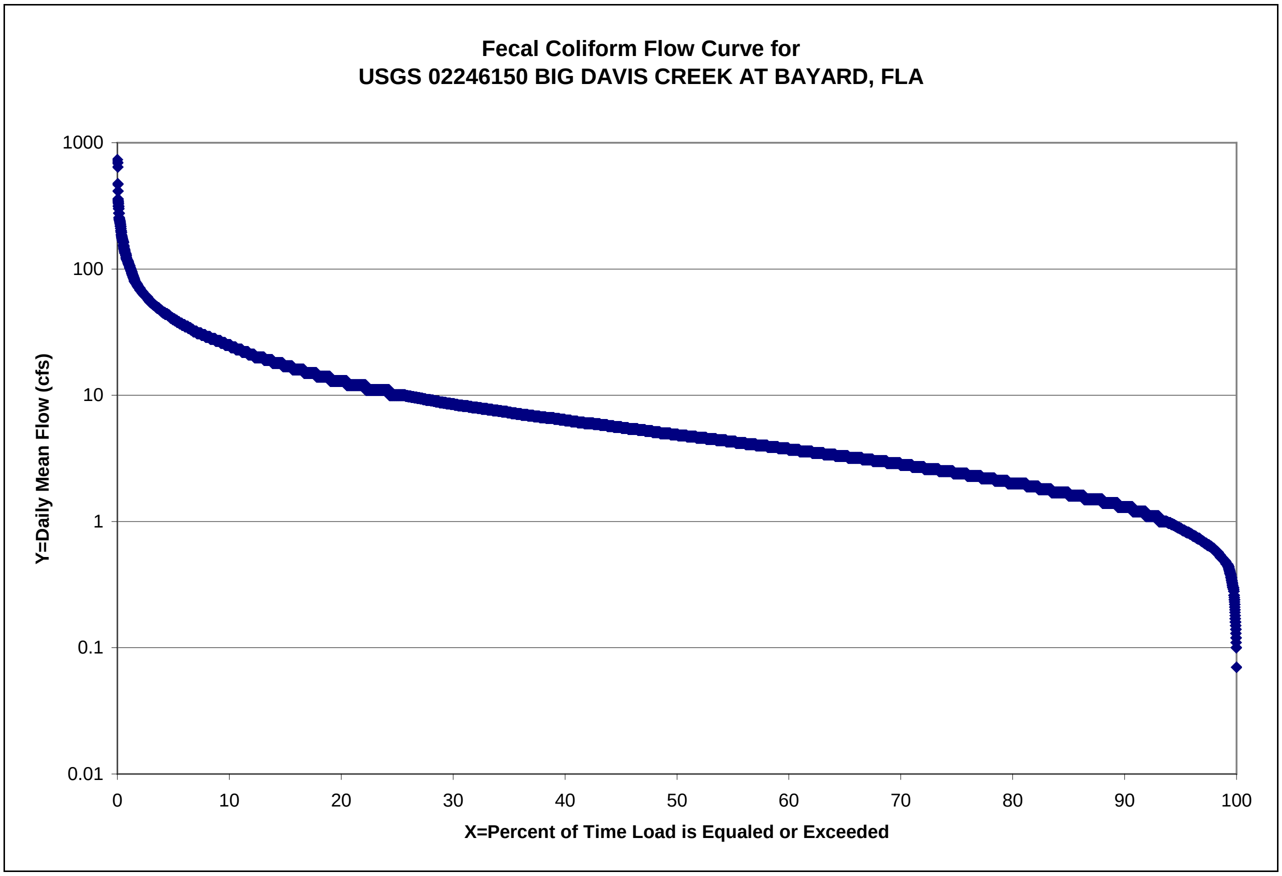
5.1.2 TMDL Development Process

Determination of Flow Duration Curve

The first step in the development of load duration curves is to create *flow duration curves*. A flow duration curve displays the cumulative frequency distribution of daily flow data over the period of record. The duration curve relates flow values measured at a monitoring station to the percent of time the flow values are equaled or exceeded. Flows are ranked from low, which are exceeded nearly 100 percent of the time, to high, which are exceeded less than 1 percent of the time.

The flow duration curve was developed based on flow records from USGS Gage 02246150, located on Big Davis Creek at Bayard, Florida (see **Figure 5.3**).

Figure 5.3. Flow Duration Curve for USGS Gage 02246150 (Big Davis Creek at Bayard, Fla)



Determination of Load Duration Curve for Existing Loading

Using the flows from the flow duration curve, a load duration curve for fecal coliform (**Figure 5.5**) was calculated using the following equation:

(1) (observed flow) x (conversion factor) x (state criterion) = ([fecal coliform quantity]/day or daily load)

where:
(conversion factor) = 24468480 colony-forming units (cfu)/day, and
(state criterion) = 400 cfu/100mL.

The above equation yields the load duration curve or allowable load curve (**Figure 5.5**). Using Equation 1 (above), a table was calculated (**Table 5.3**), substituting the observed data for the state criterion value. Fecal coliform observations were then plotted, noting where the samples are in relation to the allowable load curve (above or below the curve). Those above the curve (**Figure 5.4**) are noted as exceedances to the state criterion and are indicated by green triangles.

Figure 5.4. Load Duration Curve for Fecal Coliform with Line of Best Fit (Exponential Curve) for Exceedances

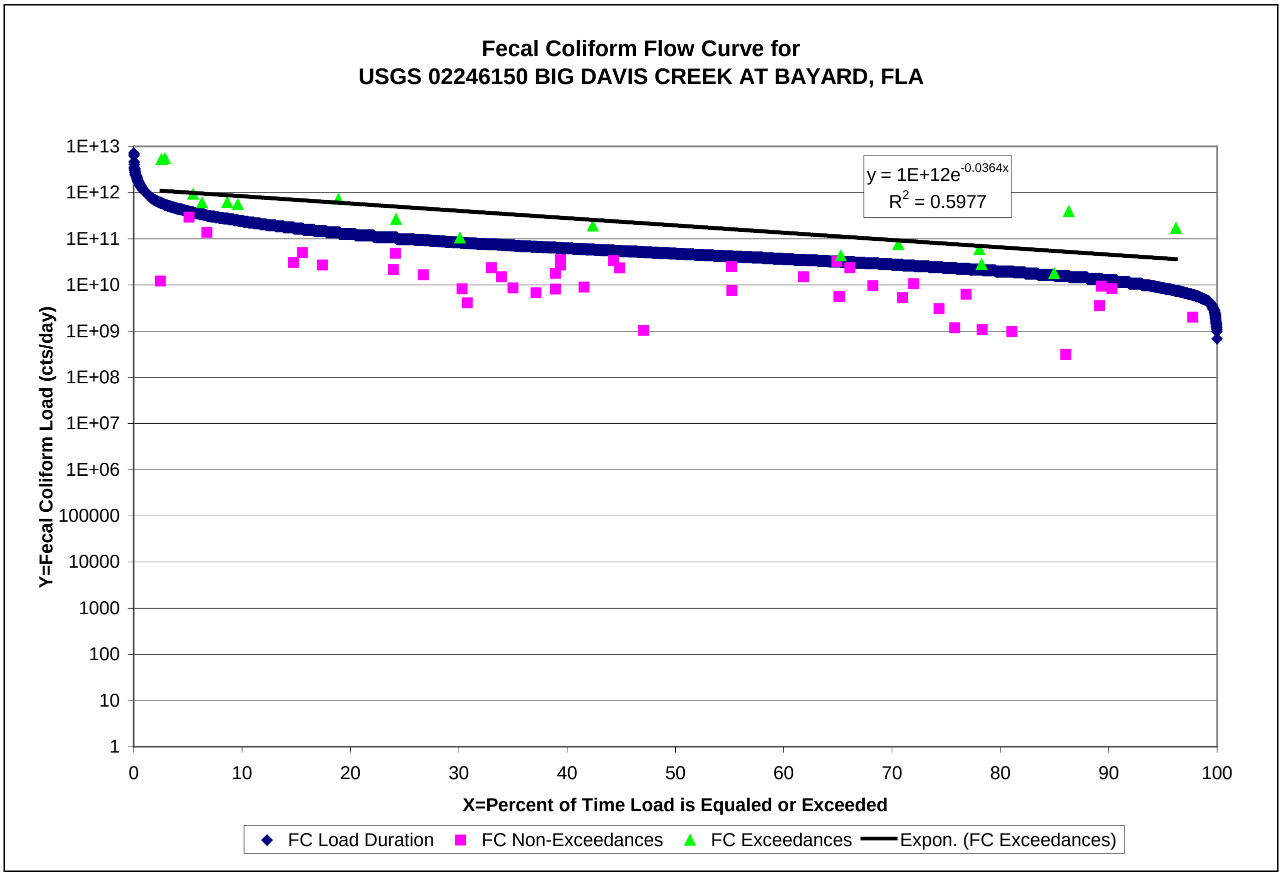
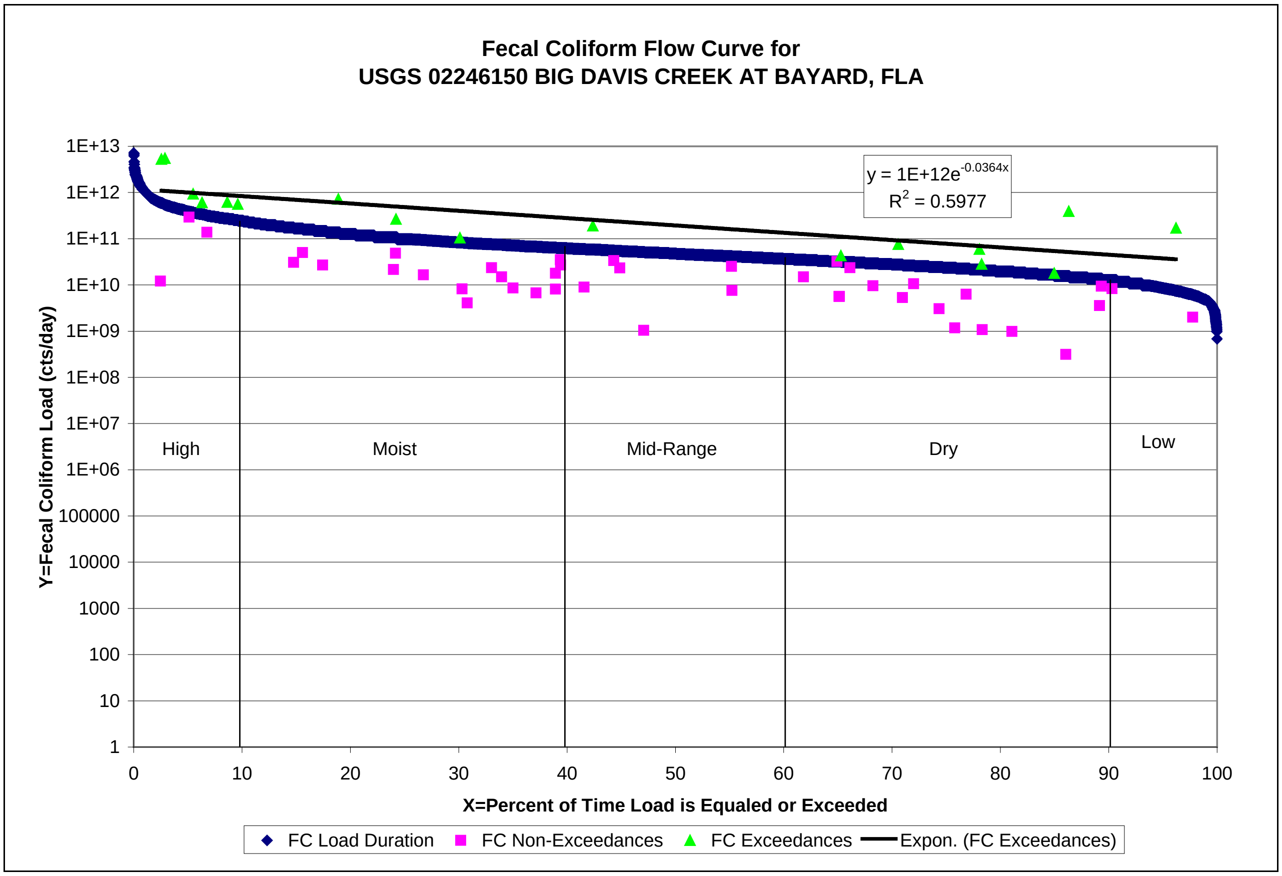


Figure 5.5. Loading Curve Showing Hydrologic Conditions for Fecal Coliform



Develop Loading Capacity

To determine the loading capacity, a trend line of best fit was applied through the exceedances (**Figure 5.4**). The best-fitting trend line was determined by evaluating different functions until the highest R^2 value was found. In this case, an exponential function was determined to be the best fit, and took the following form:

(2) $Y_{FC} = (1\ E{+}12)*(e^{(-0.0364*x)})$

where:
Y_{FC} = fecal coliform load (cfu/day), and
x =% duration interval.

This function (**Equation 2**) was used to determine the predicted loads by substituting different percentile numbers (from the 10th to 90th, in increments of 5; see **Table 5.3**, Column 1) for “x.” The result yields a predicted load within each 5th percentile (**Table 5.3**, Column 3). The “high flow” (<10th percentile flow exceedance) and “low flow” (> 90th percentile flow exceedance) hydrologic conditions are not used as critical conditions because these extreme flows are not representative of typical conditions (EPA, 2007). Furthermore, there are usually not enough observations during these flow regimes to reliably estimate loads under these conditions.

The Big Davis Creek TMDL is then calculated as the median of the percent reductions needed over the data range where exceedances occurred, which in this case is over the entire range of flow conditions. As shown in **Table 5.3**, the source loadings for fecal coliform discussed in Chapter 4 would need to be reduced by 69 percent for Big Davis Creek to meet the TMDL.

Table 5.3. Calculation of Percentage Reductions for the Fecal Coliform TMDL for Big Davis Creek, WBID 2356

% of Days Load Exceeded	Allowable Load (#colonies/day)	Predicted Load (#colonies/day)	Load Reduction Needed for Compliance (%)
10	2.54E+11	6.949E+11	63.38
15	1.66E+11	5.793E+11	71.28
20	1.37E+11	4.829E+11	71.62
25	1.08E+11	4.025E+11	73.25
30	8.32E+10	3.355E+11	75.21
35	7.14E+10	2.797E+11	74.46
40	6.36E+10	2.332E+11	72.72
45	5.48E+10	1.944E+11	71.80
50	5.19E+10	1.620E+11	67.98
55	4.21E+10	1.351E+11	68.84
60	3.52E+10	1.126E+11	68.71
65	3.23E+10	9.386E+10	65.59
70	2.74E+10	7.824E+10	64.97
75	2.35E+10	6.522E+10	63.98
80	1.96E+10	5.437E+10	64.00
85	1.66E+10	4.532E+10	63.29
90	1.27E+10	3.778E+10	66.32
MEDIAN:	**5.187E+10**	**1.620E+11**	**68.71**

5.1.3 Critical Conditions/Seasonality

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

A nonparametric test (Kruskal-Wallis) was applied to the fecal coliform dataset to determine whether there were significant differences among months or seasons. At an alpha (α) level of 0.05, there were no significant differences among seasons and months (**Appendices C** and **D**). It is very difficult to evaluate possible patterns among months due to the small sample sizes. For example, the range in monthly observations for fecal coliform varies from zero to three in a given month, with February having no observations. Grouping observations by season increased sample sizes for statistical comparison, as seen in **Table 2.2**. The greatest percentage of exceedances occurred in the summer (July to September). **Appendix E** presents comparisons of station and seasons. A factor that could likely contribute to these monthly or seasonal differences is the pattern of rainfall.

Rainfall records for JIA (**Appendix F** illustrates rainfall from 1990 to 2008) were used to determine rainfall amounts associated with individual sampling dates. Rainfall recorded on the day of sampling (1D), the cumulative total for the day of and the previous 2 days (3D), the cumulative total for the day of and the previous 6 days (7D), and the cumulative total for the day of and the previous 29 days (30D) 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 values (**Appendix G**). The simple correlations (r values in the Spearman correlation table) between both fecal coliform and the various rainfall totals were positive, except for the day of sampling (1D). Overall, this suggests that as rainfall (and possible runoff) increased, so did the number of coliform.

Simple linear regressions were performed between coliform observations and rainfall totals to determine whether any of the relationships were significant at an α level of 0.05. The r^2 values between fecal coliform and the 1D, 3D, 7D, and 30D precipitation groups showed no significance (**Appendix H**), although the 3D regression significance level was just above 0.05 (0.051).

A table of historical monthly average rainfall (**Appendix I**) indicates that monthly rainfall totals increase in June, peak in September, and by October return to the levels observed in February and March. **Appendix J** includes a graph of annual rainfall at JIA from 1955 to 2008 versus the long-term average (52.47 inches) over this period. The years 1996 to 1998 represented above-average rainfall years, while 1999 to 2001 were below average, and 2002 was again above average. In 1997, there was a 100 percent exceedance rate, but that was based on 1 sample collected. The next greatest percentage of exceedances occurred in 1999 (50 percent) and 2005 (56 percent). The lowest percentage of exceedances occurred in 2000, 2002, and 2003 (all 0.0 percent). There does not appear to be a correlation between total annual precipitation and fecal coliform exceedances.

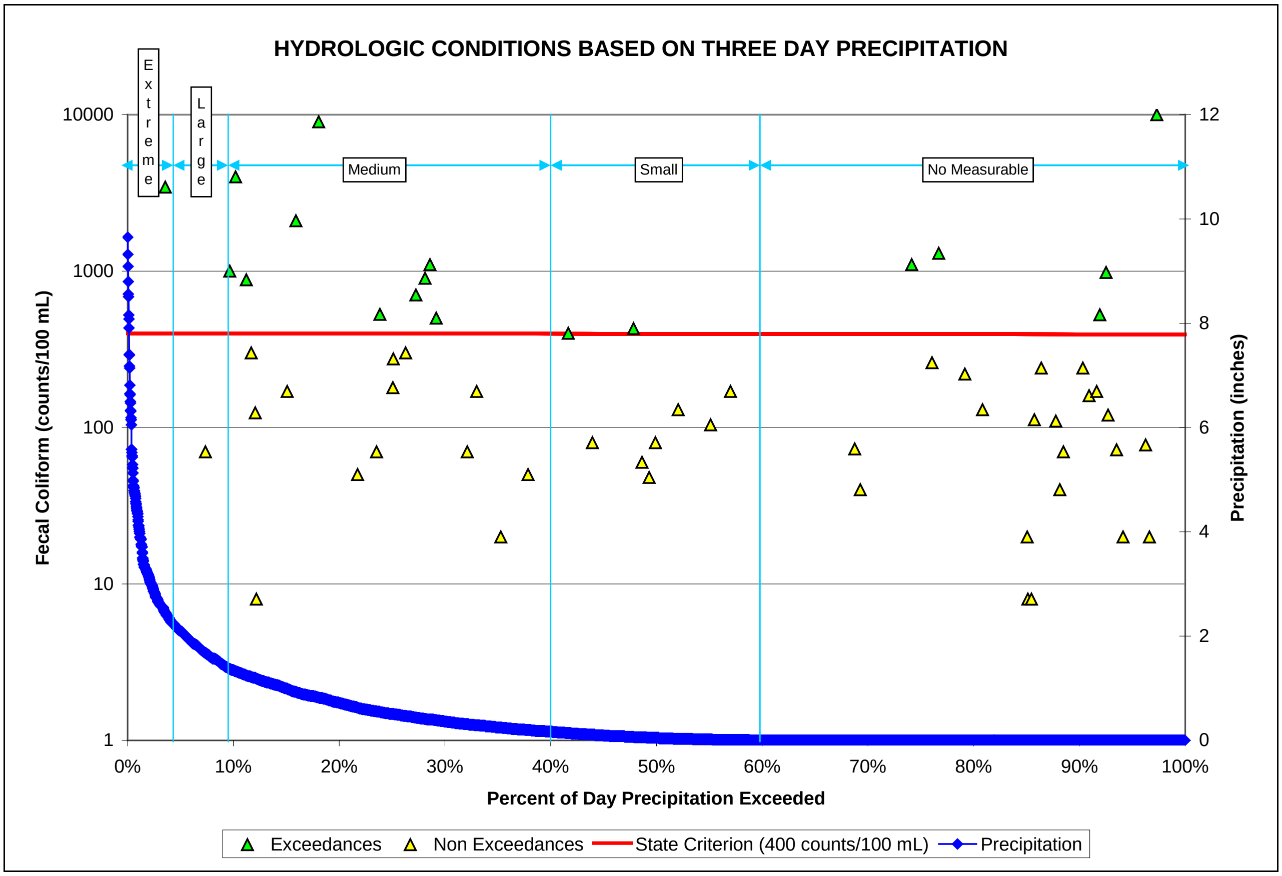
Additional analysis was considered using a loading curve. When enough flow data exist, a loading curve, designed to show the assimilative capacity of the waterbody based on flow, can be divided to show various hydrologic conditions. When exceedances are overlaid on the chart, it may be possible to determine what influences are affecting the exceedances. **Figure 5.6** and **Table 5.4** show this analysis for Big Davis Creek.

The chart is divided such that high flow conditions represent the upper percentiles (0 to 10^{th} percentile), followed by moist conditions (10^{th} to 40^{th} percentile), mid-range flows (40^{th} to 60^{th} percentile), dry conditions (60^{th} to 90^{th} percentile), and low-flow conditions (90^{th} to 100^{th} percentile). **Table 5.4** shows exceedances with all conditions. A pattern of exceedances increasing along with precipitation can be observed. The none/no measurable precipitation regime is matched with a 19 percent exceedance rate that increases to 100 percent in the extreme precipitation regime. If a large percentage of exceedances occurs during periods of increased flow, this may indicate that they are are nonpoint source driven; perhaps from stormwater conveyance systems or various land uses.

Table 5.4. Summary of Fecal Coliform Data by Hydrologic Condition for Big Davis Creek, WBID 2356

Precipitation Event	Event Range (inches)	Total Samples	Number of Exceedances	% Exceedances	Number of Nonexceedances	% Nonexceedances
Extreme	>2.1"	1	1	100.00	0	0.00
Large	1.33" - 2.1"	2	1	50.00	1	50.00
Medium	0.18" - 1.33"	22	9	40.91	13	59.09
Small	0.01" - 0.18"	9	2	22.22	7	77.78
None/ No Measurable	<0.01"	26	5	19.23	21	80.77

Figure 5.6. Fecal Coliform by Hydrologic Flow Condition for Big Davis Creek, WBID 2356



Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

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

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

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

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

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

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

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

6.2 Load Allocation

A fecal coliform reduction of 69 percent is 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.

Table 6.1. TMDL Components for Big Davis Creek, WBID 2356

WBID	Parameter	TMDL (colonies/100 mL)	WLA Wastewater (colonies/day)	WLA NPDES Stormwater	LA (% reduction)	MOS
2356	Fecal Coliform	400	N/A	69%	69%	Implicit

N/A – Not applicable

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

There are currently no permitted NPDES discharges in the Big Davis Creek watershed; however, any future discharge permits issued in the watershed are also required to meet the state Class III criterion for fecal coliform as well as the TMDL value, and therefore will not be allowed to exceed 200 counts/100mL as a monthly average, 400 counts/100 mL in more than 10 percent of the samples, or 800 counts/100mL at any given time.

6.3.2 NPDES Stormwater Discharges

The WLA for the city of Jacksonville and FDOT's MS4 permit is a 69 percent reduction in current anthropogenic fecal coliform loading. It should be noted that any MS4 permittee is only responsible for reducing the loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

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

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Department, 2001), an implicit MOS was used in the development of this 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 coliform was based on meeting the water quality criterion of 400 counts/100mL without any exceedances, while the actual criterion allows for 10 percent exceedances over the fecal coliform criterion. In addition, two different methods were applied to determine the TMDL, and the more conservative percent reduction determined from the load duration method was used (69 percent).

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Basin Management Action Plan

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

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

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

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

7.1.1 Determination of Worst-Case WBIDs

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

7.1.2 Identification of Probable Sources

Tributary Pollutant Assessment Project

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

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

Technical Reports

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

7.1.3 Issues To Be Addressed in Future Watershed Management Cycles

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

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

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

7.1.4 BMAP Implementation

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

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

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

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

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

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

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

Appendix B: Historical Fecal Coliform Observations in the Big Davis Creek Watershed, 1995–2007

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Big Davis Creek	2356	1/10/1995	21FLSJWMLSJ099	Big Davis Creek at US 1	73	
Big Davis Creek	2356	1/17/1995	21FLJXWQJC441	Big Davis Creek at US 1	900	
Big Davis Creek	2356	3/1/1995	21FLSJWMLSJ099	Big Davis Creek at US 1	48	
Big Davis Creek	2356	4/4/1995	21FLJXWQJC441	Big Davis Creek at US 1	40	
Big Davis Creek	2356	7/10/1995	21FLJXWQJC441	Big Davis Creek at US 1	130	
Big Davis Creek	2356	9/9/1997	21FLJXWQJC441	Big Davis Creek at US 1	1,100	
Big Davis Creek	2356	6/9/1998	21FLJXWQJC441	Big Davis Creek at US 1	260	
Big Davis Creek	2356	7/28/1998	21FLJXWQJC441	Big Davis Creek at US 1	300	
Big Davis Creek	2356	10/28/1998	21FLJXWQJC441	Big Davis Creek at US 1	1,300	
Big Davis Creek	2356	1/11/1999	21FLJXWQJC441	Big Davis Creek at US 1	170	
Big Davis Creek	2356	4/19/1999	21FLJXWQJC441	Big Davis Creek at US 1	1,100	
Big Davis Creek	2356	8/17/1999	21FLJXWQJC441	Big Davis Creek at US 1	9,000	
Big Davis Creek	2356	10/12/1999	21FLJXWQJC441	Big Davis Creek at US 1	220	
Big Davis Creek	2356	1/19/2000	21FLJXWQJC441	Big Davis Creek at US 1	170	
Big Davis Creek	2356	5/8/2000	21FLJXWQJC441	Big Davis Creek at US 1	130	
Big Davis Creek	2356	9/5/2000	21FLJXWQJC441	Big Davis Creek at US 1	170	
Big Davis Creek	2356	12/19/2000	21FLJXWQJC441	Big Davis Creek at US 1	400	
Big Davis Creek	2356	3/21/2001	21FLJXWQJC441	Big Davis Creek at US 1	1,000	
Big Davis Creek	2356	6/27/2001	21FLJXWQJC441	Big Davis Creek at US 1	60	
Big Davis Creek	2356	11/14/2001	21FLJXWQJC441	Big Davis Creek at US 1	8	
Big Davis Creek	2356	3/18/2002	21FLA 20030356	Big Davis Cr E of US 1 S of Golf Driving Range	20	
Big Davis Creek	2356	3/25/2002	21FLJXWQJC441	Big Davis Creek at US 1	8	
Big Davis Creek	2356	5/1/2002	21FLJXWQJC441	Big Davis Creek at US 1	8	
Big Davis Creek	2356	5/28/2002	21FLJXWQJC441	Big Davis Creek at US 1	112	
Big Davis Creek	2356	7/17/2002	21FLJXWQJC441	Big Davis Creek at US 1	20	
Big Davis Creek	2356	7/17/2002	21FLJXWQJC441	Big Davis Creek at US 1	80	
Big Davis Creek	2356	8/13/2002	21FLJXWQJC441	Big Davis Creek at US 1	70	
Big Davis Creek	2356	8/26/2002	21FLJXWQJC441	Big Davis Creek at US 1	70	
Big Davis Creek	2356	9/10/2002	21FLJXWQJC441	Big Davis Creek at US 1	80	
Big Davis Creek	2356	11/25/2002	21FLA 20030356	Big Davis Cr E of US 1 S of Golf Driving Range	240	
Big Davis Creek	2356	11/25/2002	21FLJXWQJC441	Big Davis Creek at US 1	240	
Big Davis Creek	2356	4/8/2003	21FLJXWQJC441	Big Davis Creek at US 1	50	
Big Davis Creek	2356	6/24/2003	21FLJXWQJC441	Big Davis Creek at US 1	110	
Big Davis Creek	2356	7/22/2003	21FLJXWQJC441	Big Davis Creek at US 1	124	
Big Davis Creek	2356	8/19/2003	21FLJXWQJC441	Big Davis Creek at US 1	80	
Big Davis Creek	2356	9/30/2003	21FLJXWQJC441	Big Davis Creek at US 1	40	
Big Davis Creek	2356	11/12/2003	21FLJXWQJC441	Big Davis Creek at US 1	70	
Big Davis Creek	2356	2/3/2004	21FLJXWQJC441	Big Davis Creek at US 1	2,100	

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Big Davis Creek	2356	3/17/2004	21FLJXWQJC441	Big Davis Creek at US 1	880	
Big Davis Creek	2356	5/4/2004	21FLJXWQJC441	Big Davis Creek at US 1	300	
Big Davis Creek	2356	7/7/2004	21FLJXWQJC441	Big Davis Creek at US 1	20	U
Big Davis Creek	2356	8/10/2004	21FLJXWQJC441	Big Davis Creek at US 1	240	
Big Davis Creek	2356	9/14/2004	21FLJXWQJC441	Big Davis Creek at US 1	4,000	
Big Davis Creek	2356	12/8/2004	21FLJXWQJC441	Big Davis Creek at US 1	160	
Big Davis Creek	2356	2/22/2005	21FLJXWQJC441	Big Davis Creek at US 1	170	
Big Davis Creek	2356	4/13/2005	21FLJXWQJC441	Big Davis Creek at US 1	180	
Big Davis Creek	2356	5/2/2005	21FLJXWQJC441	Big Davis Creek at US 1	500	
Big Davis Creek	2356	5/16/2005	21FLJXWQJC441	Big Davis Creek at US 1	525	
Big Davis Creek	2356	7/12/2005	21FLJXWQJC441	Big Davis Creek at US 1	3,500	
Big Davis Creek	2356	8/2/2005	21FLJXWQJC441	Big Davis Creek at US 1	70	
Big Davis Creek	2356	8/9/2005	21FLJXWQJC441	Big Davis Creek at US 1	705	
Big Davis Creek	2356	9/27/2005	21FLJXWQJC441	Big Davis Creek at US 1	980	
Big Davis Creek	2356	10/27/2005	21FLJXWQJC441	Big Davis Creek at US 1	120	
Big Davis Creek	2356	1/26/2006	21FLJXWQJC441	Big Davis Creek at US 1	72	
Big Davis Creek	2356	4/12/2006	21FLJXWQJC441	Big Davis Creek at US 1	20	
Big Davis Creek	2356	7/18/2006	21FLJXWQJC441	Big Davis Creek at US 1	104	
Big Davis Creek	2356	10/30/2006	21FLJXWQJC441	Big Davis Creek at US 1	530	
Big Davis Creek	2356	2/8/2007	21FLA 20030356	Big Davis Cr E of US 1 S of Golf Driving Range	67	A
Big Davis Creek	2356	2/8/2007	21FLA 20030355	Little Davis Cr E US1 @ Avenues Sports Bar Driveway	88	B
Big Davis Creek	2356	3/13/2007	21FLJXWQJC441	Big Davis Creek at US 1	20	
Big Davis Creek	2356	5/17/2007	21FLA 20030355	Little Davis Cr E US1 @ Avenues Sports Bar Driveway	80	B
Big Davis Creek	2356	5/17/2007	21FLA 20030356	Big Davis Cr E of US 1 S of Golf Driving Range	470	B
Big Davis Creek	2356	5/31/2007	21FLJXWQJC441	Big Davis Creek at US 1	10,000	
Big Davis Creek	2356	6/27/2007	21FLA 20030356	Big Davis Cr E of US 1 S of Golf Driving Range	118	A
Big Davis Creek	2356	6/27/2007	21FLA 20030355	Little Davis Cr E US1 @ Avenues Sports Bar Driveway	741	A

*Deleted blank result entries and dups.

(yellow)	City of Jacksonville data from PBS&J.
(gray)	Values that exceed the state criterion of 400 counts/100mL.

Remark Code:

A – Average value.

B – Results based on colony counts outside the acceptable range.

U – Not detected.

Appendix C: Kruskal–Wallis Analysis of Fecal Coliform Observations versus Month in Big Davis Creek, WBID 2356

Categorical values encountered during processing are:
MONTH (12 levels)
1, 2, 3, 4, 5, 6, 7,
8, 9, 10, 11, 12

Kruskal-Wallis One-Way Analysis of Variance for 64 cases
Dependent variable is FECALS
Grouping variable is MONTH

Group	Count	Rank Sum
1	5	164.000
2	4	133.500
3	6	132.000
4	5	121.000
5	9	335.000
6	5	162.000
7	7	209.000
8	7	226.500
9	6	240.500
10	4	177.000
11	4	100.500
12	2	79.000

Kruskal-Wallis Test Statistic = 7.139
Probability is 0.788 assuming Chi-square distribution with 11 df

Appendix D: Kruskal–Wallis Analysis of Fecal Coliform Observations versus Season in Big Davis Creek, WBID 2356

Categorical values encountered during processing are:
SEASON$ (4 levels)
FALL, SPRING, SUMMER, WINTER

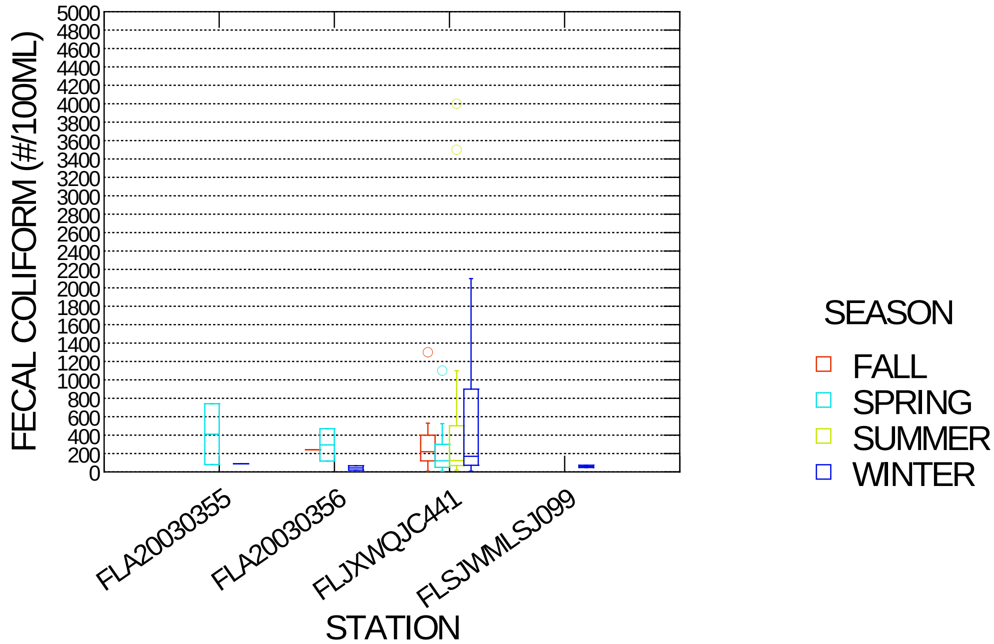
Kruskal-Wallis One-Way Analysis of Variance for 64 cases
Dependent variable is FECALS
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	10	356.500
SPRING	19	618.000
SUMMER	20	676.000
WINTER	15	429.500

Kruskal-Wallis Test Statistic = 1.032
Probability is 0.794 assuming Chi-square distribution with 3 df

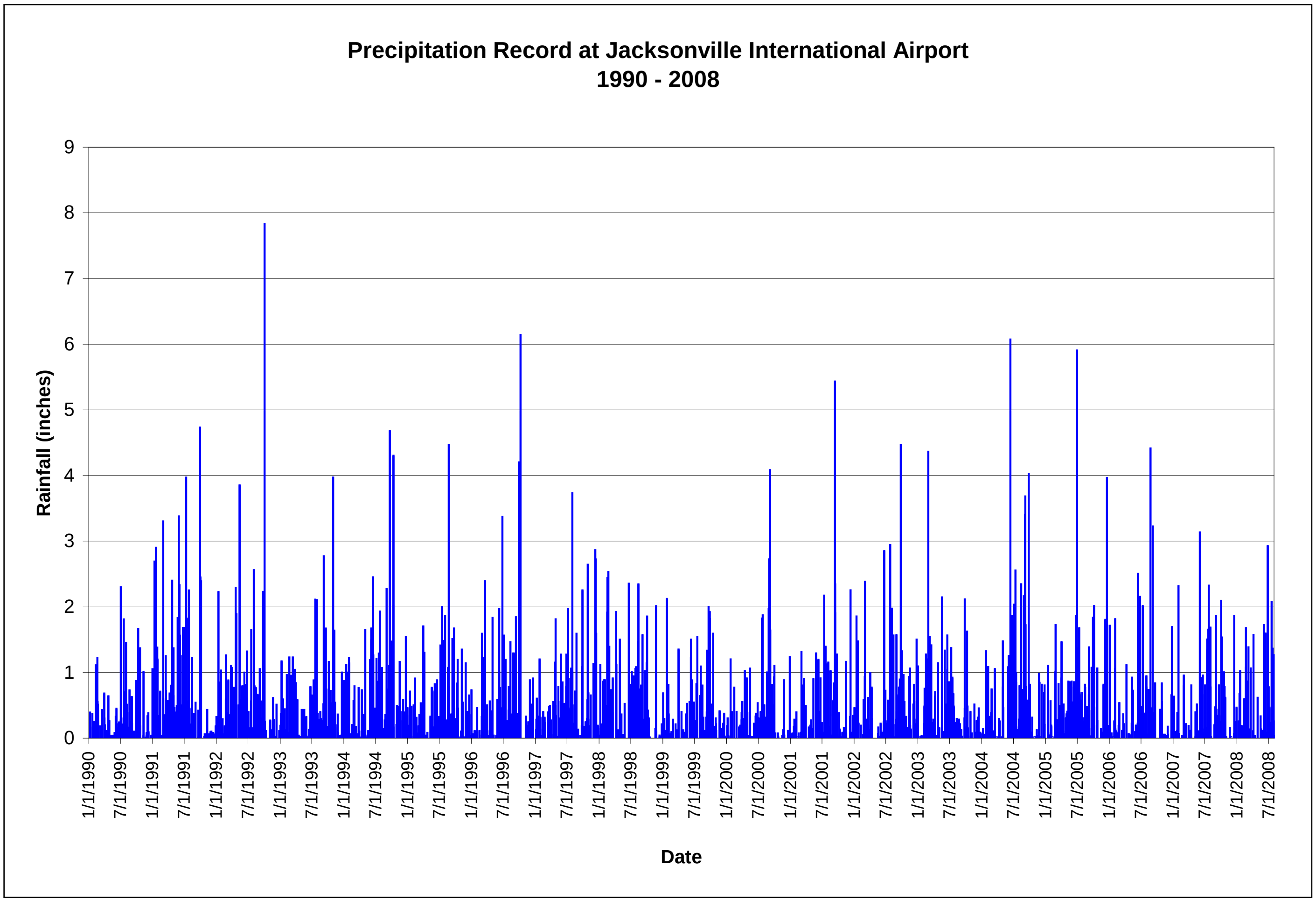
Appendix E: Chart of Fecal Coliform Observations by Season and Station in Big Davis Creek, WBID 2356

Of 64 cases, 2 were excluded by making graph range less than data range.



STORET ID	Station
21FLA 20030355	Little Davis Cr E US 1 @ Avenues Sports Bar Driveway
21FLA 20030356	Big Davis Cr E of US 1 S of Golf Driving Range
21FLSJWMLSJ099	Big Davis Creek at US 1
21FLJXWQJC441	Big Davis Creek at US 1

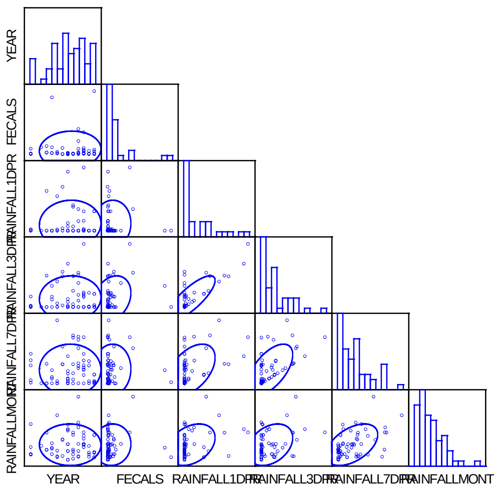
Appendix F: Chart of Rainfall for JIA, 1990–2008



Appendix G: Spearman Correlation Matrix Analysis for Precipitation and Fecal Coliform in Big Davis Creek, WBID 2356

	YEAR	FECALS	RAINFALL1DPR	RAINFALL3DPR	RAINFALL7DPR
YEAR	1.000				
FECALS	0.001	1.000			
RAINFALL1DPR	-0.004	-0.119	1.000		
RAINFALL3DPR	-0.004	0.276	0.682	1.000	
RAINFALL7DPR	0.031	0.060	0.457	0.598	1.000
RAINFALLMONT	-0.064	0.085	0.318	0.273	0.431

	RAINFALLMONT
RAINFALLMONT	1.000



Number of observations: 64

Appendix H: Analysis of Fecal Coliform Observations and Precipitation in Big Davis Creek, WBID 2356

FECAL COLIFORM DATA VERSUS DAY OF SAMPLING PRECIPITATION

Dep Var: FECALS N: 64 Multiple R: 0.041 Squared multiple R: 0.002

Adjusted squared multiple R: 0.000 Standard error of estimate: 1763.507

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	665.713	242.587	0.000	.	2.744	0.008
RAINFALL1DPR	193.154	594.600	0.041	1.000	0.325	0.746

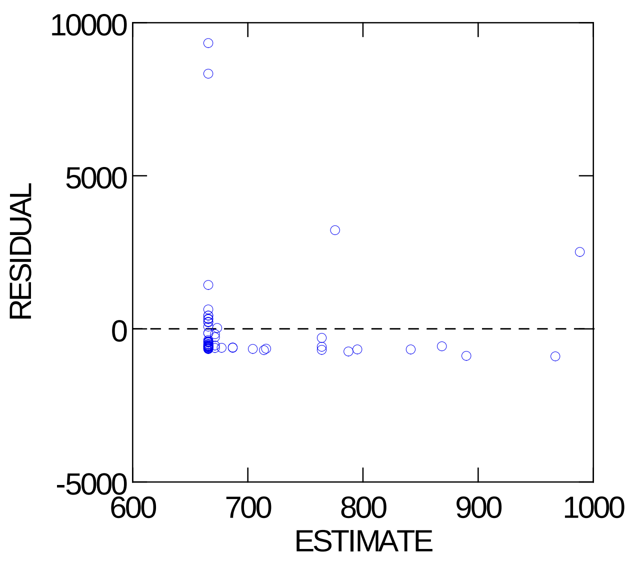
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	328179.653	1	328179.653	0.106	0.746
Residual	1.92817E+08	62	3109958.542		

*** WARNING ***
Case 12 is an outlier (Studentized Residual = 5.949)
Case 26 has large leverage (Leverage = 0.235)
Case 48 has large leverage (Leverage = 0.271)
Case 62 is an outlier (Studentized Residual = 7.217)

Durbin-Watson D Statistic 1.967
First Order Autocorrelation 0.015

Plot of residuals against predicted values



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

Dep Var: FECALS N: 64 Multiple R: 0.245 Squared multiple R: 0.060

Adjusted squared multiple R: 0.045 Standard error of estimate: 1711.163

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	419.084	255.863	0.000	.	1.638	0.107
RAINFALL3DPR	833.238	418.544	0.245	1.000	1.991	0.051

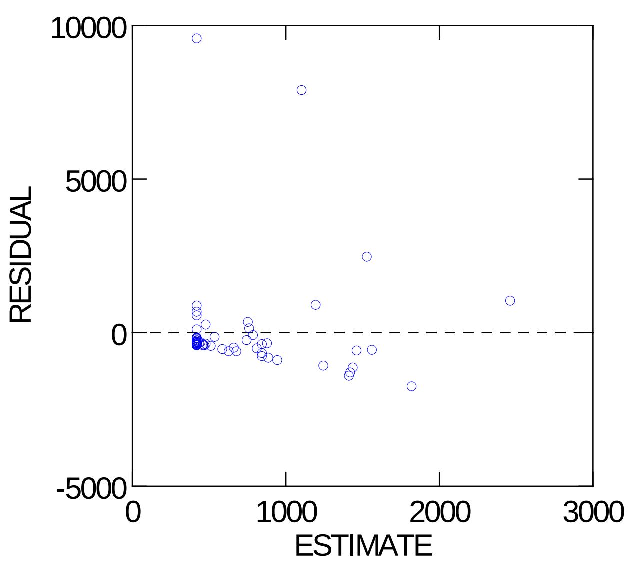
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.16048E+07	1	1.16048E+07	3.963	0.051
Residual	1.81541E+08	62	2928077.228		

*** WARNING ***
Case 12 is an outlier (Studentized Residual = 5.783)
Case 48 has large leverage (Leverage = 0.283)
Case 62 is an outlier (Studentized Residual = 8.084)

Durbin-Watson D Statistic 1.945
First Order Autocorrelation 0.027

Plot of residuals against predicted values



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

Dep Var: FECALS N: 64 Multiple R: 0.037 Squared multiple R: 0.001

Adjusted squared multiple R: 0.000 Standard error of estimate: 1763.825

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	641.062	297.402	0.000	.	2.156	0.035
RAINFALL7DPR	68.217	236.599	0.037	1.000	0.288	0.774

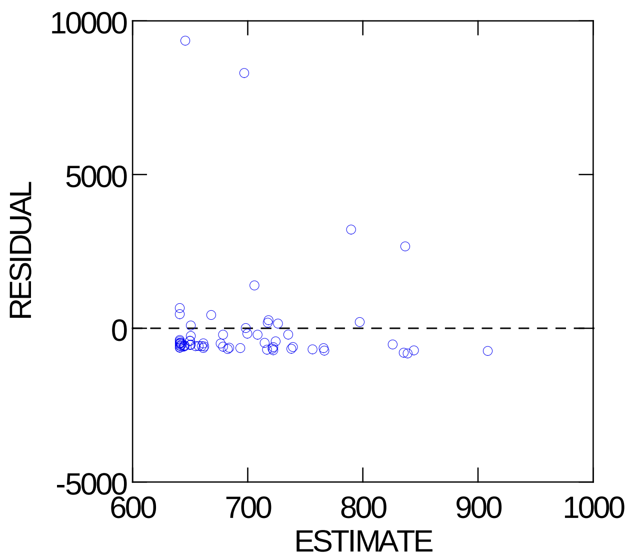
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	258628.406	1	258628.406	0.083	0.774
Residual	1.92887E+08	62	3111080.336		

*** WARNING ***
Case 12 is an outlier (Studentized Residual = 5.897)
Case 16 has large leverage (Leverage = 0.186)
Case 62 is an outlier (Studentized Residual = 7.295)

Durbin-Watson D Statistic 1.959
First Order Autocorrelation 0.019

Plot of residuals against predicted values



FECAL COLIFORM DATA VERSUS DAY OF SAMPLING AND 29 DAYS PRIOR PRECIPITATION

Dep Var: FECALS   N: 64   Multiple R: 0.043   Squared multiple R: 0.002

Adjusted squared multiple R: 0.000   Standard error of estimate: 1763.347

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	593.585	378.153	0.000	.	1.570	0.122
RAINFALLMONT	24.720	72.323	0.043	1.000	0.342	0.734

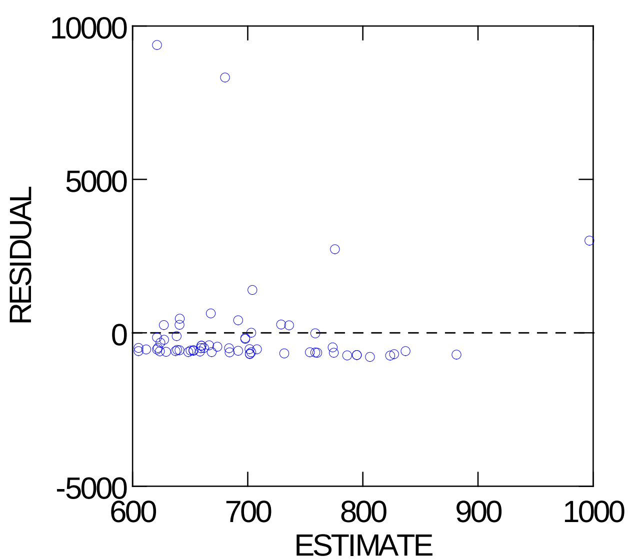
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	363256.546	1	363256.546	0.117	0.734
Residual	1.92782E+08	62	3109392.785		

*** WARNING ***
Case 12 is an outlier (Studentized Residual = 5.922)
Case 42 has large leverage (Leverage = 0.260)
Case 62 is an outlier (Studentized Residual = 7.376)

Durbin-Watson D Statistic 1.968
First Order Autocorrelation 0.014

Plot of residuals against predicted values



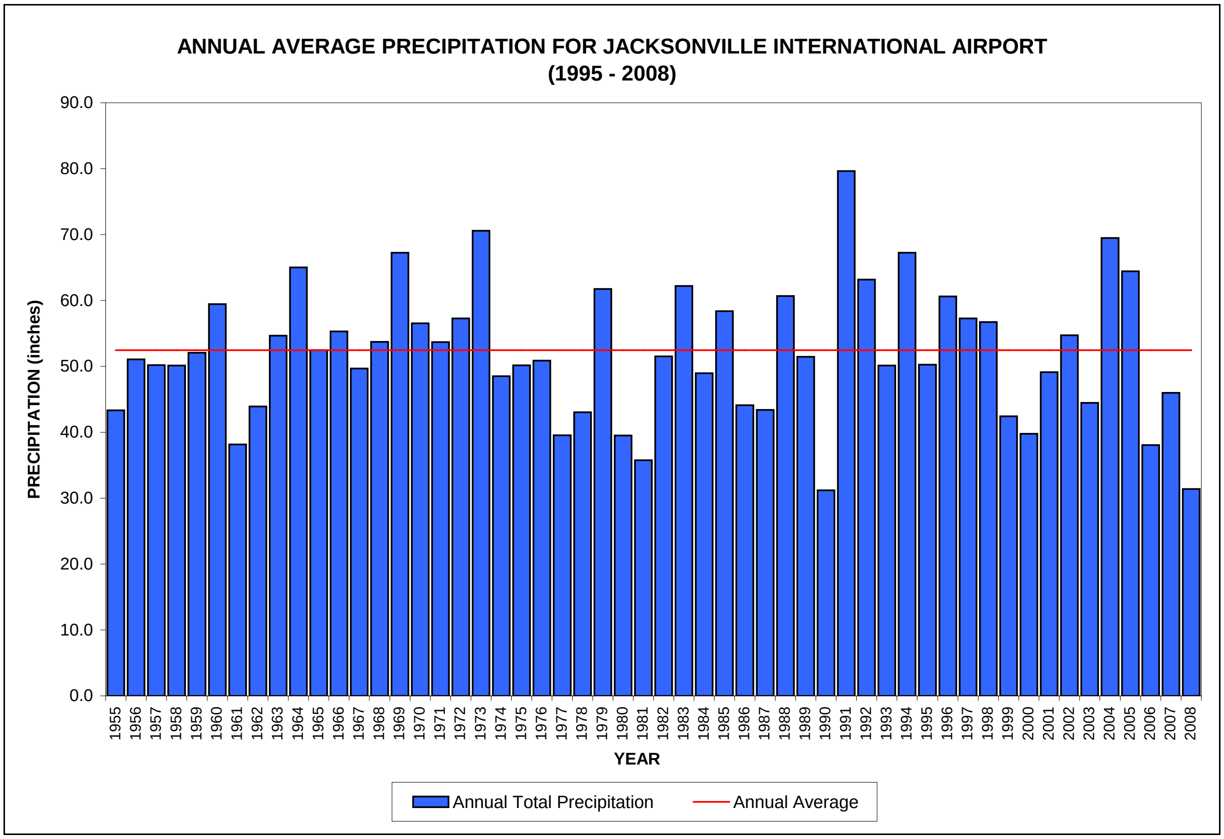
Appendix I: Monthly and Annual Precipitation from JIA, 1955–2008

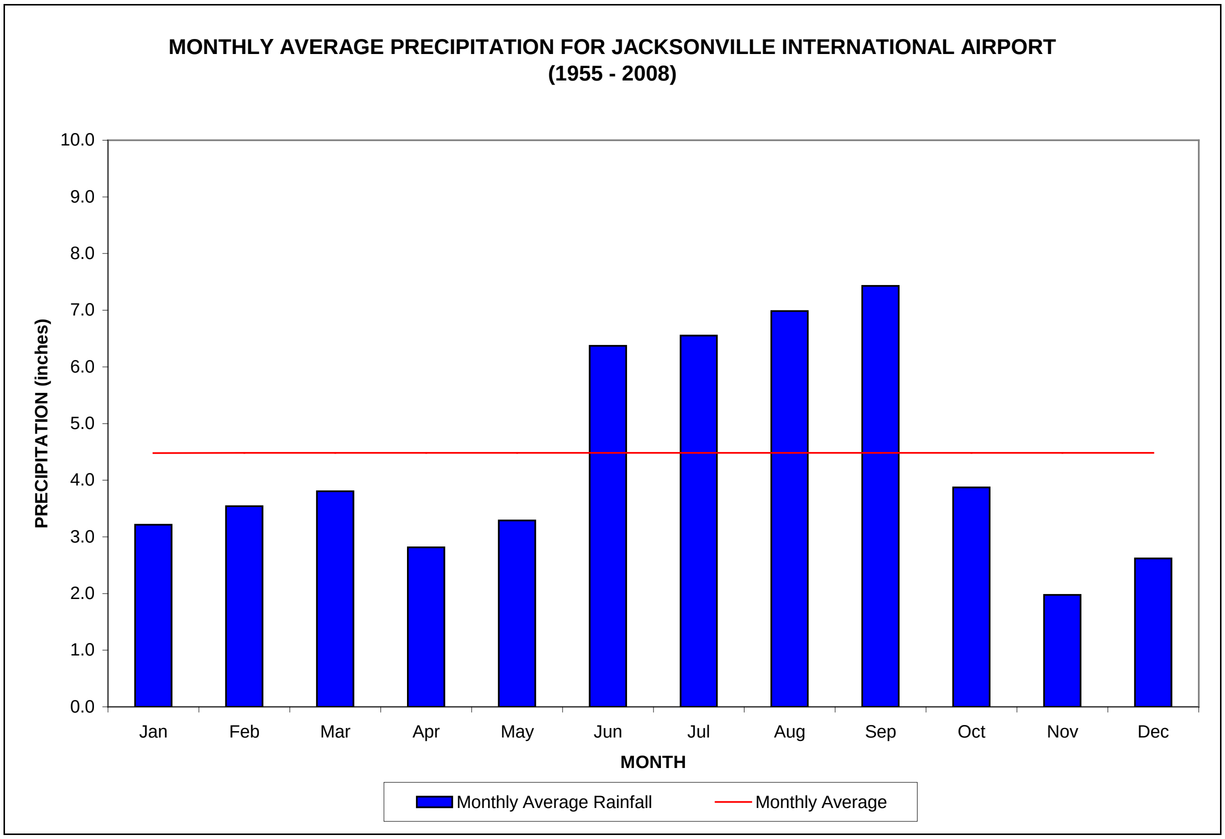
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1955	3.1	2.46	1.66	1.5	4.51	2.7	5.53	3.85	10.6	5.36	1.9	0.2	**43.33**
1956	2.9	2.94	0.81	2.33	3.98	7.87	8.25	5.24	2.89	13.4	0.4	0	**51.08**
1957	0.3	1.69	3.87	1.61	5.25	7.1	12.3	3.3	8.33	3.5	1.6	1.3	**50.18**
1958	3.4	3.74	3.38	8.24	3.79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

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

Rainfall is in inches, and represents data from JIA.

Appendix J: Annual and Monthly Average Precipitation at JIA




MONTHLY AVERAGE PRECIPITATION FOR JACKSONVILLE INTERNATIONAL AIRPORT
(1955 - 2008)
PRECIPITATION (inches)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
MONTH
Monthly Average Rainfall
Monthly Average

Appendix K: Executive Summary of Tributary Pollution Assessment Project

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

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

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

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

- JEA
- City of Jacksonville Environmental Quality Division
- City of Jacksonville Public Works Department
- Duval County Health Department
- Florida Department of Environmental Protection
- St. Johns Riverkeeper
- Water and Sewer Expansion Authority
- 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 L: Develop the Percent Reduction for the Big Davis Creek Watershed

The second approach, performed in conjunction with the load duration curve to determine the needed reduction in the Big Davis Creek watershed, was the percent reduction method. Exceedances of the state criterion were compared with the criterion of 400 counts/100mL. For each individual exceedance, an individual required reduction was calculated using the following:

$$(4)\quad \frac{[(\text{observed value}) - (\text{state criterion})] \times 100}{(\text{observed value})}$$

After the individual results were calculated, the median of the individual values was calculated, which is 59.18 percent. This means that in order to meet the state criterion of 400 counts/100mL, a 59.18 percent reduction in current loading is necessary, and this is therefore the TMDL for Big Davis Creek. The table below shows the individual reduction calculations for Big Davis Creek, including all exceedances. The load duration percent reduction of 68.71 is used for this particular watershed because it is based on watershed-specific flows and can be used as an MOS because it is the more conservative value.

Sample Date	Location	Observed Value (Exceedance) (counts/100mL)	Required % Reduction
1/17/1995	Big Davis Creek at US 1	900	55.56
9/9/1997	Big Davis Creek at US 1	1,100	63.64
10/28/1998	Big Davis Creek at US 1	1,300	69.23
4/19/1999	Big Davis Creek at US 1	1,100	63.64
8/17/1999	Big Davis Creek at US 1	9,000	95.56
3/21/2001	Big Davis Creek at US 1	1,000	60.00
2/3/2004	Big Davis Creek at US 1	2,100	80.95
3/17/2004	Big Davis Creek at US 1	880	54.55
9/14/2004	Big Davis Creek at US 1	4,000	90.00
5/2/2005	Big Davis Creek at US 1	500	20.00
5/16/2005	Big Davis Creek at US 1	525	23.81
7/12/2005	Big Davis Creek at US 1	3,500	88.57
8/9/2005	Big Davis Creek at US 1	705	43.26
9/27/2005	Big Davis Creek at US 1	980	59.18
10/30/2006	Big Davis Creek at US 1	530	24.53
5/17/2007	Big Davis Cr E of US 1 S of Golf Driving Range	470	14.89
5/31/2007	Big Davis Creek at US 1	10,000	96.00
6/27/2007	Little Davis Cr E US1 @ Avenues Sports Bar Driveway	741	46.02
	MEDIAN:	**980**	**59.18**

Florida Department of Environmental Protection
Division of Environmental Assessment and Restoration
Bureau of Watershed Restoration
2600 Blair Stone Road, Mail Station 3565
Tallahassee, Florida 32399-2400
www.dep.state.fl.us/water/