FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

CENTRAL DISTRICT • MIDDLE ST. JOHNS RIVER BASIN

TMDL Report

Fecal Coliform TMDL for Little Wekiva River and Little Wekiva Canal (WBIDs 2987 and 3004)

Benjamin Ralys

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

Jennifer Gihring
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
Jennifer.Gihring@dep.state.fl.us
Phone: (850) 245-8418; Suncom: 205-8418
Fax: (850) 245-8434

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

Ben Ralys
Florida Department of Environmental Protection
Bureau of Watershed Management
Watershed Assessment Section
2600 Blair Stone Road, Mail Station 3555
Tallahassee, FL 32399-2400
Benjamin.Ralys@dep.state.fl.us
Phone: (850) 245-8443; Suncom: 205-8443
Fax: (850) 245-8536

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Basin Status Report for the Middle St. John's River Basin

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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal coliform bacteria for the Little Wekiva River and the Little Wekiva Canal in the Middle St. Johns River Basin. These streams were verified as impaired for fecal coliform bacteria, and therefore were included on the Verified List of impaired waters for the Middle St. Johns River basin that was adopted by Secretarial Order on May 27, 2004. The TMDL establishes the allowable fecal coliform loading to the Little Wekiva River and the Little Wekiva Canal that would restore the waterbody so that it meets its' applicable water quality criteria for fecal coliform.

1.2 Identification of Waterbody

The Little Wekiva River and the Little Wekiva Canal are located in the northern part of Orange County and the southwestern portion of Seminole County and drain into one of the southern arms of the Wekiva Swamp, then into the Wekiva River **(Figure 1.1).** The Little Wekiva Canal is a man-made canal system that flows primarily in a northerly direction into the Little Wekiva River and drains an area of about 35 square miles. The Little Wekiva River is located to the north of the Little Wekiva Canal. The City of Winter Park is located to the east of the Little Wekiva Canal and the City of Orlando is located to the southeast. More detailed information about the Little Wekiva Canal can be found in the Little Wekiva River Watershed Management Plan (CDM, 2005).

For assessment purposes, the Department has divided the Middle 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. This TMDL addresses the following WBIDs:

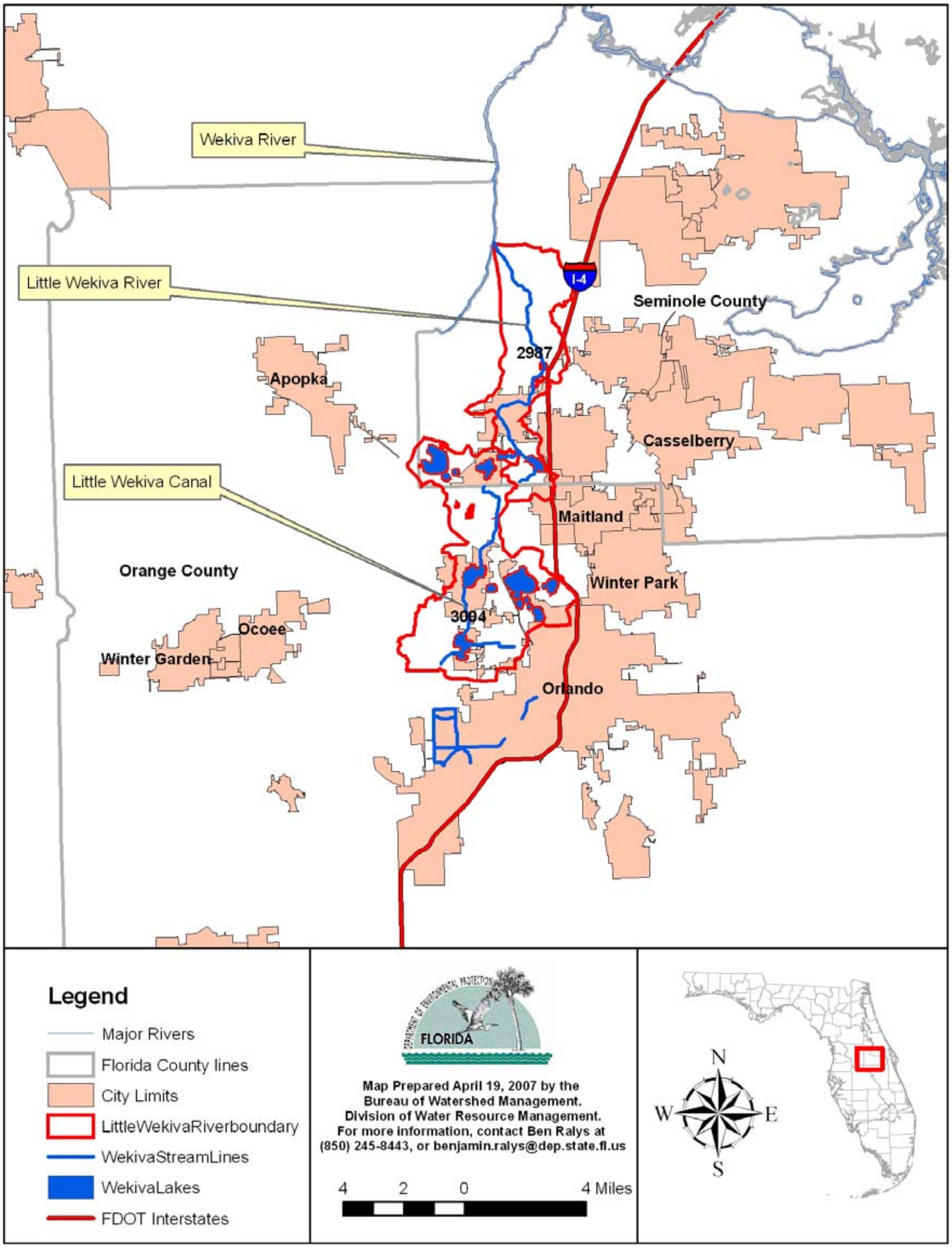
WBID 2987, Little Wekiva River – for fecal coliform
WBID 3004, Little Wekiva Canal – for fecal coliform

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 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. TMDLs provide important water quality restoration goals that will guide restoration activities.

Figure 1.1: Location of the Little Wekiva River and the Little Wekiva Canal and major geopolitical features around these basins.



This TMDL Report will be followed by the development and implementation of a Basin Management Action Plan, or BMAP, designed to reduce the amount of fecal coliform that caused the verified impairment of the Little Wekiva River and the Little Wekiva Canal. These activities will depend heavily on the active participation of local governments, 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) lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing impairment of listed 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.]); the state's 303(d) list is amended annually to include basin updates.

Florida's 1998 303(d) list included 22 waterbodies in the Middle St. Johns River 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 rulemaking 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 the Little Wekiva River and the Little Wekiva Canal and has verified that these waterbodies are impaired for fecal coliform bacteria. For the Little Wekiva River, the verification of impairment was based on the observations that 20 out of 44 fecal coliform samples collected during the verified period (January 1, 1996 through June 30, 2003) exceeded applicable fecal coliform water quality criteria (see FAC 62-302). For the Little Wekiva Canal, the verification of impairment was based on the observation that 21 out of 61 fecal coliform samples collected during the verified period exceeded applicable fecal coliform water quality criteria. **Table 2.1** summarizes the fecal coliform monitoring results for the verified period for each WBID.

It should be noted that on the 1998 303(d) list, fecal coliform TMDLs for the Little Wekiva River (WBID 2987) and the Little Wekiva Canal (WBID 3004) were assigned low priority and TMDLs for these waterbodies do not have to be developed until 2008. However, the Florida Legislature passed the Wekiva Parkway and Protection Act (WPPA) in 2004 (Chapter 369, Part III, FS), which requires that:

"By December 1, 2005, the St. Johns River Water Management District shall establish pollution load reduction goals for the Wekiva Study Area to assist the Department of Environmental Protection in adopting total maximum daily loads for impaired waters within the Wekiva Study Area by December 1, 2006" (Chapter 369.318 [8], FS)

Because the Little Wekiva River and the Little Wekiva Canal are both located within the boundary of the Wekiva Study Area defined by the WPPA, based on the WPPA, the Department expedited the development of fecal coliform TMDLs of these two waterbodies to 2007.

Table 2.1. Summary of Fecal Coliform Monitoring Data for the Little Wekiva River (WBID 2987) and the Little Wekiva Canal (WBID 3004)

Waterbody (WBID)	Parameter	Fecal Coliform
Little Wekiva River (2987)	Total number of samples	44
	IWR required number of exceedances for the verified list	8
	Number of observed exceedances	20
	Number of observed nonexceedances	24
	Number of seasons during which samples were collected	4
	Highest observation (MPN/100mL)*	5,800
	Lowest observation (MPN/100 mL)	1
	Median observation (MPN/100 mL)	420
	Mean observation (MPN/100 mL)	914
	FINAL ASSESSMENT	**Impaired**
Little Wekiva Canal (3004)	Total number of samples	61
	IWR required number of exceedances for the verified list	10
	Number of observed exceedances	21
	Number of observed nonexceedances	40
	Number of seasons during which samples were collected	4
	Highest observation (MPN/100mL)*	4,320
	Lowest observation (MPN/100 mL)	2
	Median observation (MPN/100 mL)	170
	Mean observation (MPN/100 mL)	415
	FINAL ASSESSMENT	**Impaired**

* Most probable number per 100 milliliters.

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)**

Both the Little Wekiva River and the Little Wekiva Canal are Class III waterbodies, with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. In addition, the Little Wekiva River is also part of the Wekiva River system, which was designated as an Outstanding Florida Water in December of 1988. The criteria applicable to this TMDL are the Class III criteria for fecal coliform bacteria.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

Numeric criteria for bacterial quality are expressed in terms of fecal coliform bacteria concentrations. The water quality criteria for protection of Class III waters, as established by Chapter 62-302, F.A.C., state 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 criteria state that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. During the development of load duration curves for the impaired stream (as described in subsequent chapters), 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 TMDLs was not to exceed 400 MPN/100 mL in any sampling event for fecal coliform. The 10 percent exceedance allowed by the water quality criterion for fecal coliform bacteria was not used directly in estimating the target load, but was included in the TMDL margin of safety (as described in subsequent chapters).

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 impaired waterbody and the amount of pollutant loadings 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 (NPDES) Program. 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 Fecal Coliform in the Little Wekiva River and the Little Wekiva Canal basins

4.2.1 Point Sources

There is one NPDES permitted wastewater facility that was identified to be within the Little Wekiva Canal and the Little Wekiva River basins. It is the Altamonte Springs Regional Water Reclamation Facility (FL 0033251). This facility is located in the southeastern part of the Wekiva Study Area. The facility currently has a 12.5 mgd annual average daily flow (AADF) permitted discharge to the Little Wekiva River. However, the majority of the treated wastewater from the facility has been directed to reuse through the City of Altamonte Springs for irrigation, within the 5,900 acre Reuse Service Area, of city parks, street, and highway medians, city owned nurseries, residential and commercial lawns. Reclaimed water is also used for street cleaning, dust control, fire protection, water-to-air heat pumps, chillers (cooling water towers), and at automatic car washers. The actual discharge from the facility to the Little Wekiva River is significantly lower than the permitted 12.5 mgd. In addition, the facility also has a planned project that would take the excess reclaimed water to the city of Apopka for reuse and recharge, which will further decrease the discharge to the surface water. **Table 4.1** listed the AADF from the facility to the Little Wekiva River, the annual average fecal coliform concentration of the discharge, and annual average daily loadings from the facility to the surface water.

Table 4.1. Annual average daily flow, annual average fecal coliform concentration, and annual average daily fecal coliform load from the Altamonte Springs Regional Water Reclamation Facility

Year	Annual average daily flow (mgd)	Annual average concentration) (counts/100ml)	Annual average daily loads (counts/day)
1997	0.43	16.79	2.73×10^{8}
1998	0.89	2.18	7.34×10^{7}
1999	0.42	28.24	4.49×10^{8}
2000	0.14	27.62	1.46×10^{8}
2001	1.59	0.08	4.82×10^{6}
2002	2.61	0.2	1.98×10^{7}
2003	1.50	0.59	3.35×10^{7}
2004	1.41	0.23	1.23×10^{7}
2005	1.43	0.36	1.95×10^{7}
2006	0.59	7.85	1.75×10^{8}
Mean	**1.10**	**8.39**	$\mathbf{1.21 \times 10^{8}}$

Based on the state water quality criteria, 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. During the ten year period from January 1st 1997 through December 31st 2006, the Altamonte Springs Regional Water Reclamation facility only exceeded the 800 counts/100ml limit one time. The monthly average (200counts/100ml) and the 10 percent threshold (400counts/100ml) were never exceeded. In addition, the target set for this TMDL was never exceeded during the ten year time period. Therefore, this facility should be allowed to continue discharging at their current rate.

Municipal Separate Storm Sewer System Permittees

The stormwater collection systems owned and operated by Orange County, Seminole County, City of Altamonte Spring, and City of Winter Park in the Little Wekiva River and the Little Wekiva Canal basins are covered by Phase I NPDES municipal separate storm sewer system (MS4) permits. Orange County and Seminole County are lead permittees for the corresponding permit. The Department of Transportation (DOT) is a co-permitee for these permits. There were no Phase II permittees identified in these basins.

4.2.2 Land Uses and Nonpoint Sources

Land Uses

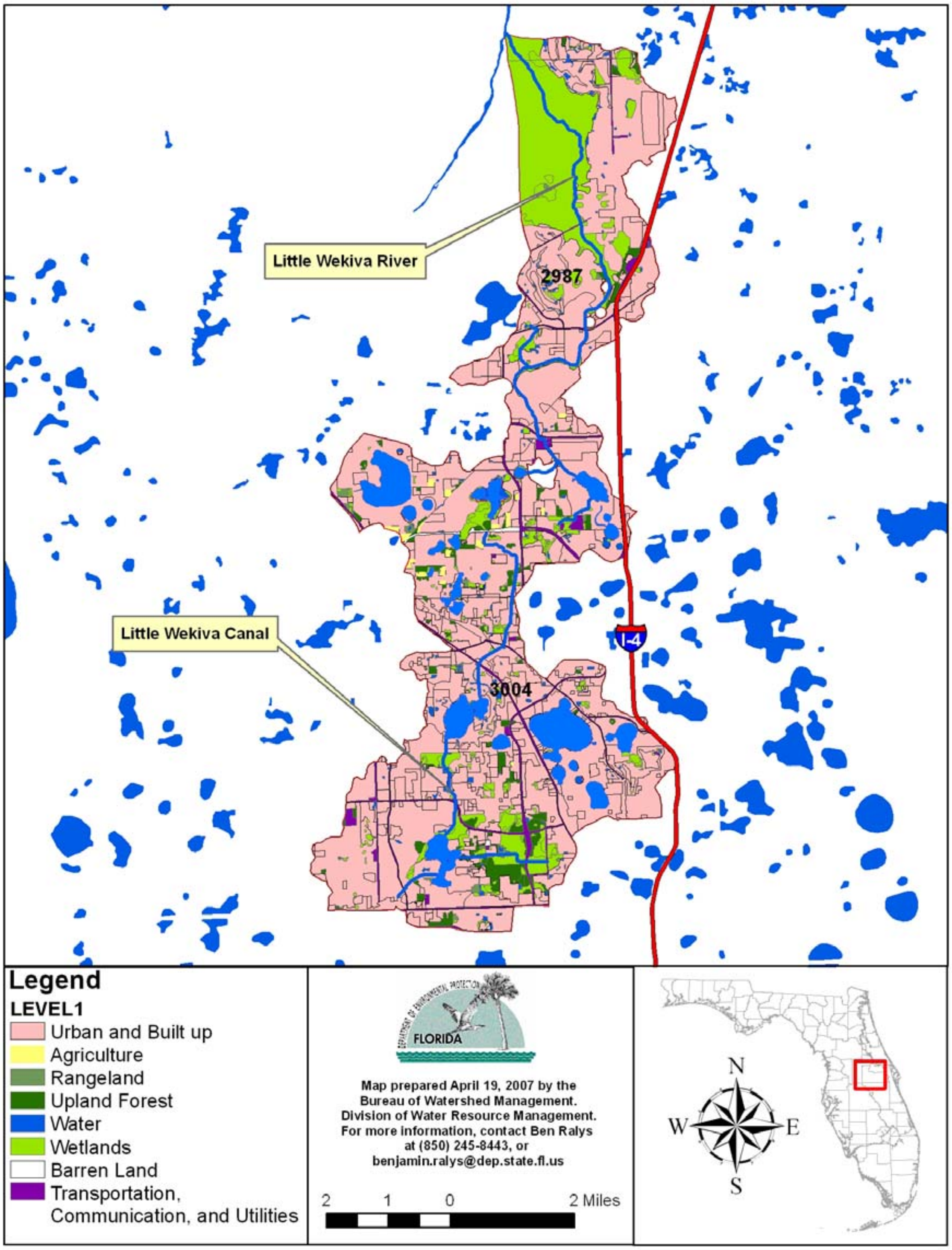
The spatial distribution and acreage of different land use categories were identified using the SJRWMD's year 2000 land use coverage (scale 1:40,000) contained in the Department's geographic information system (GIS) library. Land use categories in the watershed were aggregated using the simplified Level 1 codes and tabulated in **Table 4.2.** **Figure 4.1** shows the spatial distribution of the principal land uses in the watershed.

As shown in **Table 4.2,** the Little Wekiva River and the Little Wekiva Canal basins drain about 22,876 acres of land. The dominant land use category is the urban land (urban and build-up, low, medium, and high density residential and transport, communication, and utility), which accounts for about 78 percent of the total basin area. Wetlands, water, and upland forest account for the majority of the rest of the land uses within the study area, accounting for about 21 percent of the total basin area. Of the 17,797 acres of urban lands, residential area occupies about 11,525 acres, or about 50 percent of the total basin area. Natural landuse areas, which include water, wetlands and upland forest, occupy about 4,788 acres, accounting for about 21 percent of the total basin area.

Table 4.2. Classification of landuse categories for the Little Wekiva River and the Little Wekiva Canal basin

LEVEL 1	Land-Use	AREA (m2)	AREA (ACRE)	Percent Acreage
1000	Urban and Built-Up	21,876,193	5,406	23.6%
1100	Low-Density Residential	3,803,217	940	4.1%
1200	Medium-Density Residential	33,793,656	8,351	36.5%
1300	High-Density Residential	9,040,438	2,234	9.8%
2000	Agriculture	485,662	120	0.5%
3000	Rangeland	461,912	114	0.5%
4000	Upland Forest	3,157,584	780	3.4%
5000	Water	1,896,927	469	2.0%
6000	Wetlands	14,321,537	3,539	15.5%
7000	Barren Land	230,806	57	0.2%
8000	Transportation, Communication and Utilities	3,508,351	867	3.8%
	TOTAL	**92,576,284**	**22,876**	**100%**

Figure 4.1. Principal Land Uses in basins that drain to the Little Wekiva River and the Little Wekiva Canal



Source Assessment

Because only one traditional point source was identified in the Little Wekiva River and the Little Wekiva Canal basins, the primary loadings of fecal coliform into these canals are generated by nonpoint sources or MS4-permitted areas in the watershed. Nonpoint sources of coliform bacteria generally, but not always, come from the coliform bacteria that accumulate on land surfaces and wash off as a result of storm events, and the contribution from ground water from sources such as failed septic tanks and/or sewer line leakage. In addition, feces from pets in residential areas can be another important source of fecal coliform through the surface runoff.

Pets (especially dogs) could be a significant source of coliform pollution through the surface runoff in the Little Wekiva River and the Little Wekiva Canal basins. These two basins are largely urban areas (**Table 4.2**), and the dominant urban landuse is residential. Studies report that up to 95 percent of the fecal coliform found in urban stormwater can come from nonhuman origins (Alderiso et al, 1996 and Trial et al, 1993). The most important nonhuman fecal coliform contributors appear to be dogs and cats. In a highly urbanized Baltimore catchment, Oliveri et al. (1977) found that dog feces were the single greatest source for fecal coliform and fecal strep bacteria. Trial et al. (1993) also reported that cats and dogs were the primary source of fecal coliforms in urban subwatersheds. Using bacteria source tracking techniques, it was found in Stevenson Creek in Clearwater, Florida that the amount of fecal coliform bacteria contributed by dogs was as important as those from septic tanks (Watson, 2002). According to American Pet Products Manufacturers Association (APPMA), about 4 out of 10 U.S. households include at least one dog. A single gram of dog feces contains about 23 million fecal coliform bacteria (van der Wel 1995). Unfortunately, statistics showed that about 40 percent of American dog owners do not pick up their dog's feces. Table 4.3 shows the fecal coliform concentrations of the surface runoff measured in two urban areas (Bannerman et al. 1993, Steuer et al., 1997). While the bacteria levels were widely different in the two studies, both indicated that residential lawns, driveways and streets were the major source areas for bacteria.

Table 4.3. Concentrations (Geometric Mean Colonies per 100 ml) of Fecal Coliforms from Urban Source Areas (Steuer et al., 1997; Bannerman et al., 1993)

Geographic location	Marquette, MI	Madison, WI
Number of storms sampled	12	9
Commercial parking lot	4,200	1,758
High traffic street	1,900	9,627
Medium traffic street	2,400	56,554
Low traffic street	280	92,061
Commercial rooftop	30	1,117
Residential rooftop	2,200	294
Residential driveway	1,900	34,294
Residential lawns	4,700	42,093
Basin outlet	10,200	175,106

In addition to pets, some other animal fecal coliform contributors commonly seen in urban areas include rats, pigeons, and sometimes, raccoons.

The number of dogs in the Little Wekiva River and the Little Wekiva Canal basins is not known. Therefore, the statistics produced by APPMA was used in this study to estimate the possible fecal coliform loads contributed by dogs. According to the United States Census bureau, the number of households in Orange County in 2000 was 336,286. According to SJRWMD 2000 landuse GIS coverage, the total residential area in Orange County was about 88,667 acres. This gives a household density of about 3.79 households/acre residential area. According to **Table 4.2**, the Little Wekiva River and the Little Wekiva Canal basins have about 11,525 acres of residential area. This gives about 43,679 households in the entire study basin. Assuming that 40 percent of the households in this area have one dog, the total number of dogs in the project basin is about 17,471 dogs. According to the waste production rate for dogs and the fecal coliform counts per gram of dog wastes listed in **Table 4.4**, and assuming that 40 percent of the dog owners do not pick up dog feces, the total waste produced by dogs and left on the land surface of residential area would be 3,144,942 grams. The total fecal coliform produced by dogs would be 6.92×10^{12}/day. It should be noted that this load only represented the fecal coliform load that can be potentially created in the watershed and was not intended to be used to represent a part of the existing load that reached the receiving waterbody. The fecal coliform load that eventually reaches the receiving waterbody could be significantly less than this value due to the attenuation in the overland transport.

Table 4.4. Dog population density, waste load, and fecal coliform density.

Type	Population density (an/household)	Waste load (g/an-day)	Fecal coliform density (fecal coliform/g)
Dog (Weiskel et al. 1996)	0.4**	450	2,200,000

** Number from APPMA.

Septic tanks are another potentially important source of coliform pollution in urban watersheds. When properly installed, most of the coliform from septic tanks should be removed within 50 meters of the drainage field (Minnesota Pollution Control Agency, 1999). However, in areas with a relatively high ground water table, the drainage field can be flooded during the rainy season and coliform bacteria can pollute the surface water through storm runoff. Septic tanks may also cause coliform pollution when they are built too close to irrigation wells. Any well that is installed in the surficial aquifer system will cause a drawdown. If the septic tank system is built too close to the well (e.g. less than 75 feet), the septic tank discharge will be within the cone of influence of the well. As a result, septic tank effluent may go into the well and once the polluted water is used to irrigate lawns, coliform bacteria may get to the land surface and wash into surface waters during the rainy season.

Sanitary sewer overflows (SSO) can also be a potential source of fecal bacteria pollution. Human sewage can be introduced into surface waters even when storm and sanitary sewers are separated. Leaks and overflows are common in many older sanitary sewers where capacity is exceeded, high rates of infiltration and inflow occur (i.e., outside water gets into pipes, reducing capacity), frequent blockages occur, or sewers are simply falling apart due to poor joints or pipe materials. Power failures at pumping stations are also a common cause of SSOs. The greatest risk of an SSO occurs during storm events; however, little comprehensive data are available to quantify SSO frequency and bacteria loads in most watersheds. The Association of Metropolitan Sewage Agencies (AMSA, 1994), estimates that about 140 overflows occur per one thousand miles of sanitary sewer lines each year. (1,000 miles of sewer serves a population of about 250,000 people). The AMSA survey also found that 15 to 35 percent of sewer lines were over capacity and could potentially overflow during storms. At the time when this TMDL was developed, no sewer line leakage information for the project area was available to the Department. Therefore, no contribution from sewer line leakage is explicitly quantified in this TMDL.

A GIS shape file showing locations of septic tank-using land parcels within the boundary of the Wekiva River drainage basin was provided by the CDM (**Figure 4.5**). However, no data on the number of septic tanks located in the drainage basin were available to the Department at the time this TMDL was developed. To estimate the pollutant loading from septic tanks, the number of septic tanks in the basin is required. This number was estimated based on the following information:

(1) The total number of septic tanks located in the Lake County part of the Wekiva study Area was provided by the CDM, Inc., which comes to 9,286 septic tanks.
(2) The total acreage of the septic tank-using land parcels in Lake County part of the Wekiva Study Area was provided by the CDM, Inc. The total acreage is 20,599 acres.
(3) The number of septic tanks per acre of septic tank-using parcel were estimated as the quotient between the total number of septic tanks in (1) and the total acreage in (2), and is 0.45 septic tanks/per acre.
(4) The total acreage of septic tank-using land parcels in the Little Wekiva River and the Little Wekiva Canal is: 6,886 acres.
(5) The total number of septic tanks located in the Little Wekiva River and the Little Wekiva Canal is: 3,098 tanks.
(6) The discharge rate from each septic tank (Q) was calculated by multiplying the average household size by the per capita wastewater production rate per day. Based on the information published by US census bureau, the average household size for Orange County is about 2.5 people/household. The same population density was assumed for the Little Wekiva Canal and the Little Wekiva River basins. A commonly cited value for per capita wastewater production rate is 70 gallons/day/person (USEPA, 2001).

Assuming each household uses only one septic tank, the total discharge rate from each septic tank would be 2.5 people/household x 70 gallons/day/person and equal to: 175 gallons/day/household (septic tank).

(7) The commonly cited fecal coliform concentration (*C*) for septic tank discharge is 1×10^6 counts/100 ml (USEPA, 2001).

(8) The fecal coliform loading from each septic tank was calculated as the product between septic tank discharge rate and fecal coliform concentration, which is 175 gallons/day/household (septic tank) X 1 X 10^6 counts/100 ml * 3785.4118 ml/gallon = 6.62 X 10^9 counts/day/septic tank.

(9) Because the total number of septic tanks estimated for the project areas is 3098, the total fecal coliform loading from all septic tanks is: 2.05 X 10^{13} counts/day.

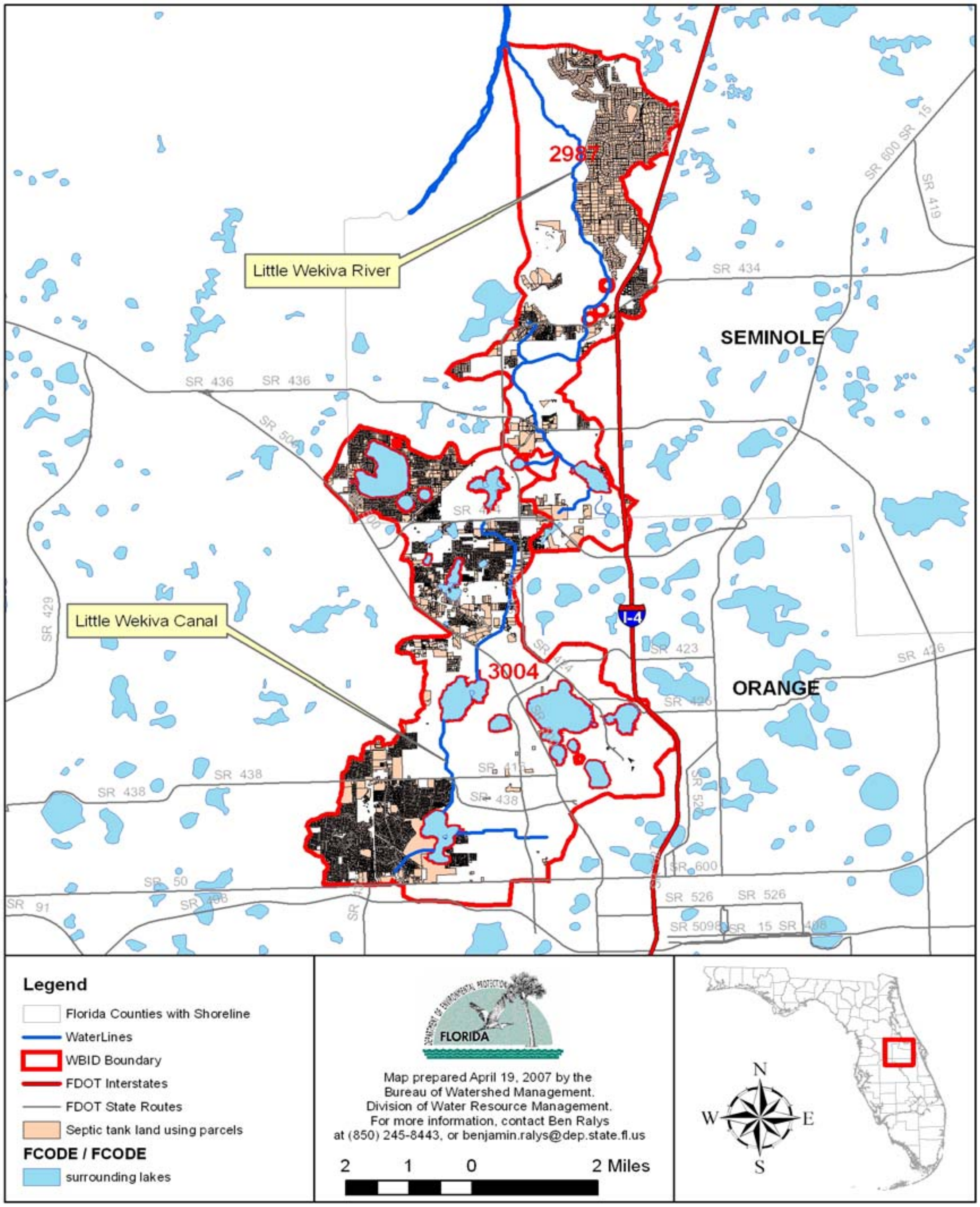
However, not all the septic tanks contribute fecal coliform to the receiving waters. Typically, normally functioning septic tanks should remove the majority of the fecal coliform within 50 meters of distance. The major contribution comes from septic tanks are those that are failed.

No measured septic tank failure rate data were available for the study area at the time this study was conducted. Therefore the failure rate was derived from the number of septic tanks and septic tank repair permits for the county published by the Florida Department of Health (FDOH) (http://www.doh.state.fl.us/environment/ostds/statistics/ostdsstatistics.htm). The number of septic tanks in the county were calculated assuming that none of the installed septic tanks will be removed after being installed (**Table 4.5**). Reported number of septic tank repair permits was also obtained from the FDOH website (**Table 4.5**). Based on this information, a discovery rate of failed septic tanks for each year between 1996 and 2001 was calculated and listed in **Table 4.5**. Based on **Table 4.5**, the average annual septic tank failure discovery rate for Orange County was about 1.1 percent. Assuming that failed septic tanks are not discovered for about 5 years, the estimated annual septic tank failure rate is about 5 times the discovery rate, which is equal to 5.5 percent.

Table 4.5. Estimated septic numbers and septic failure rate for Orange County

	1996	1997	1998	1999	2000	2001	Average
New installation (septic tanks)	996	557	441	589	728	902	702
Accumulated installation (septic tanks)	97536	98093	98534	99123	99851	100753	98982
Repair permit (septic tanks)	1601	803	970	665	1183	1117	1057
Failure discovery rate (%)	1.6	0.8	1.0	0.7	1.2	1.1	1.1
Failure rate (%)*	8.2	4.1	4.9	3.4	5.9	5.5	5.5

Figure 4.2. Location of septic tank using land parcels within the Little Wekiva River and the Little Wekiva Canal study area.



Based on **Table 4.5**, the long-term average septic tank failure rate in Orange County is about 5.5 percent. Multiplying this failure rate to the fecal coliform loadings from all the septic tanks located in the basin (2.05×10^{13} counts/day) gives the coliform loadings from failed septic tank, which is 1.13×10^{12} counts/day. It should be noted that this fecal coliform loading is the potential that all the failed septic tanks in the basin can create; it is not the final fecal coliform loading that may reach the receiving water. Because of the watershed detention effect, the final fecal coliform loading that reaches the receiving water could be significantly lower than this number.

As shown in **Figure 4.2,** the majority of land adjacent to the Little Wekiva River and the Little Wekiva Canal river systems are septic tank-using land parcels; however, there is still a good size area located within these WBIDs that is connected to the cities' sanitary sewer lines. Sanitary sewer lines have been known to be a contributing factor for coliforms in the past, and may be playing a role in the impairment for these waterbodies. Having said that, no information regarding the sewer line leakage in the Little Wekiva Canal and the Little Wekiva River was available to the Department at the time this TMDL is developed. So, potential fecal coliform loadings from sewer line leakage were not estimated in this TMDL.

Wildlife is another possible source of fecal coliform bacteria to the Little Wekiva Canal and the Little Wekiva River basins. As shown in Figure 4.1, there are wetland areas along both the Little Wekiva River and the Little Wekiva Canal, and these areas are likely habitats for small wildlife like rabbits and raccoons. For highly urbanized areas, birds and rats could also be important contributors to bacterial pollution.

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The methodology used for this TMDL is the load duration curve. Also known as the "Kansas Approach" because it was developed by the state of Kansas, this method has been well documented in the literature, with improved modifications used by EPA Region 4. Basically, the method relates the pollutant concentration to the flow of the stream, in order to establish the existing loading capacity and the allowable pollutant load (TMDL) under a spectrum of flow conditions. It then determines the maximum allowable pollutant load and load reduction requirement based on the analysis of the critical flow conditions. This method requires four steps to develop the TMDL and establish the required load reduction:

1. Develop the flow duration curve,
2. Develop the load duration curve for both the allowable load and existing loading,
3. Define the critical conditions, and
4. Establish the needed load reduction by comparing the existing loading with the allowable load under critical conditions.

5.1.1 Data Used in the Determination of the TMDL

Fecal coliform concentration and flow measurements were required to estimate both the allowable pollutant load and existing load to the Little Wekiva Canal and the Little Wekiva River. **Figure 5.1** shows the locations of the water quality sites from which fecal coliform data were collected and the U.S. Geological Survey (USGS) gauging station from which the flow measurements were taken. Fecal coliform data collected during the Verified Period (1996 through 2003) were used in this study. A total of 65 fecal coliform samples were collected from six sampling stations in the Little Wekiva River, and 73 fecal samples were collected from six stations located in the Little Wekiva Canal. Data used for this TMDL report were mainly provided by the Department's Central District office, Orange County, and Seminole County with other contributions from the St. John's River Water Management District.

Because flow measurements were only available from a USGS gauging station located on the Little Wekiva River, fecal coliform measurements from the six sites in the Little Wekiva River basin were combined with the fecal coliform measurements from the sites located on the Little Wekiva Canal, and a single fecal coliform TMDL was developed for the Little Wekiva River and the Little Wekiva Canal. **Table 2.1** provides a statistical summary of fecal coliform measurements. **Figures 5.2A and B** show the seasonal trends for fecal concentrations from various sampling sites within the verified period (1996 through 2003).

Figure 5.1. Locations of Water Quality Stations and USGS Gauging Station from which Water Quality Data and Flow Measurements Were Collected for This Report

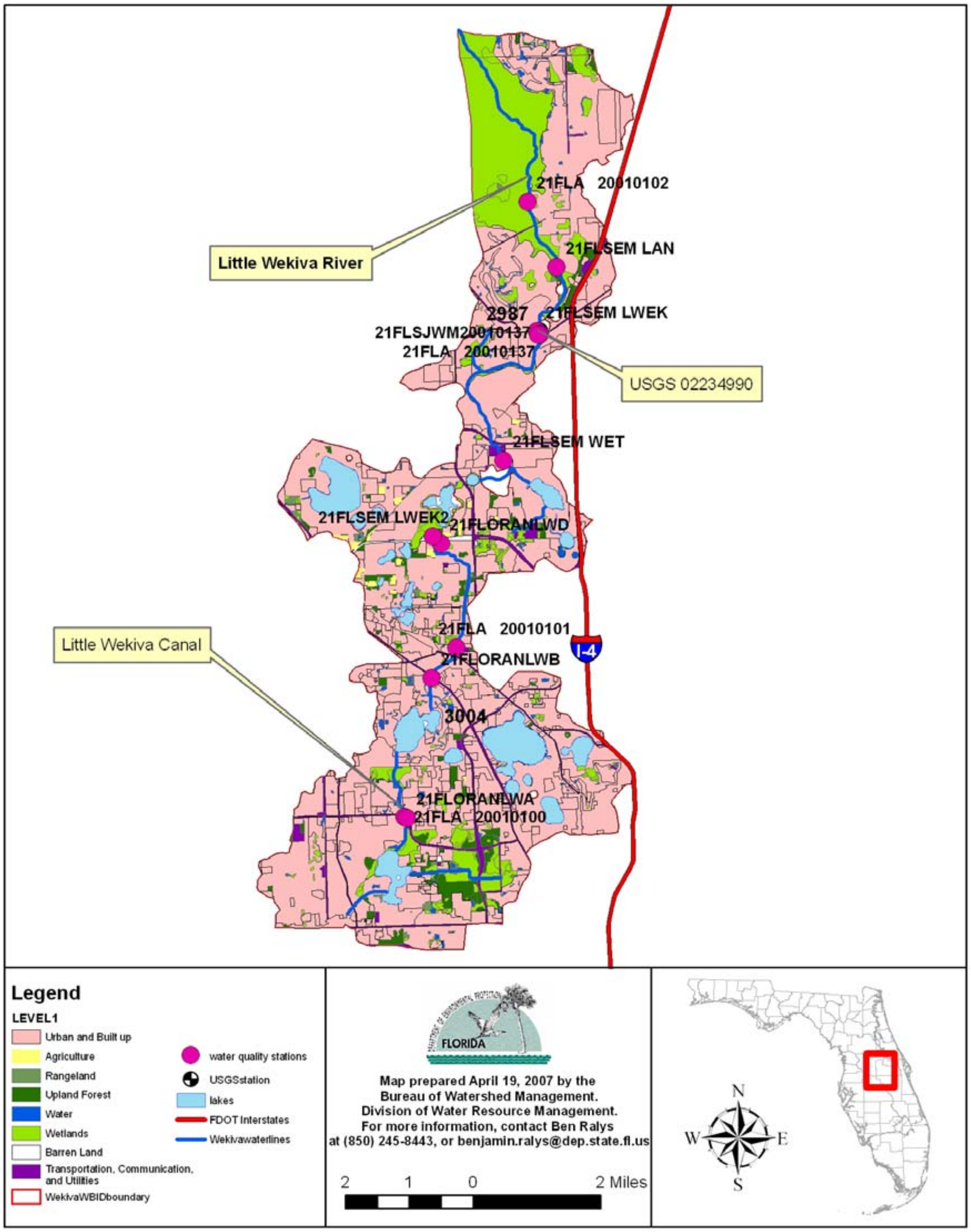


Figure 5.2A Historic trend of Fecal Coliform Concentrations in the Little Wekiva Canal. WA, WB, and WD represent Stations 21FLORANLWA, 21FLORANLWB, and 21FLORANLWD, respectively. Target represents 400 counts/100 ml.

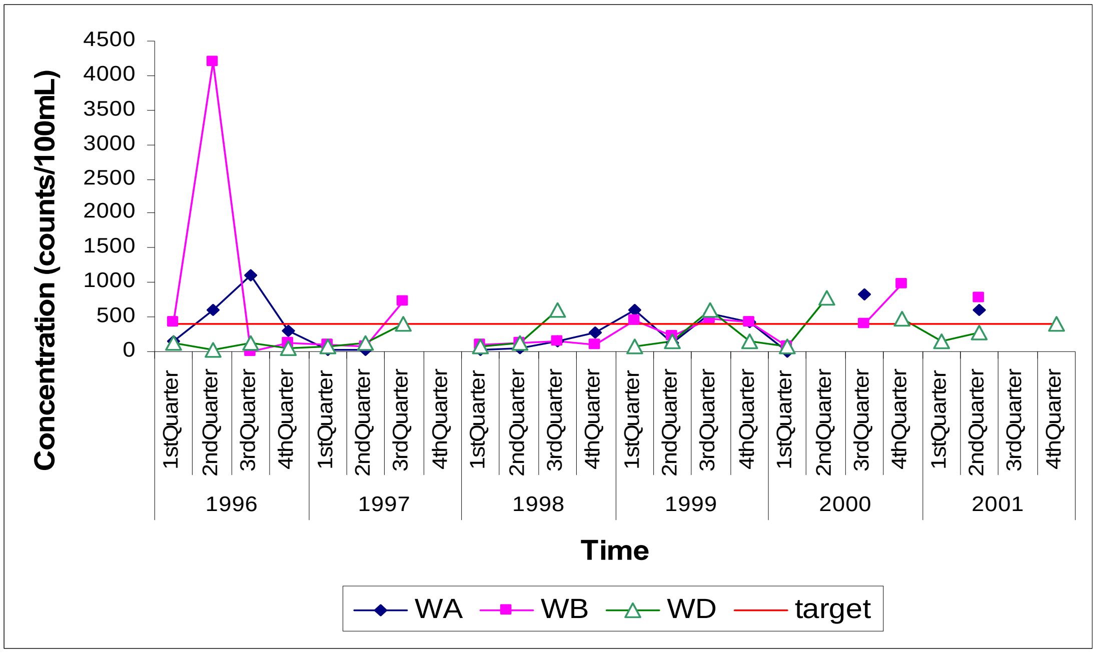
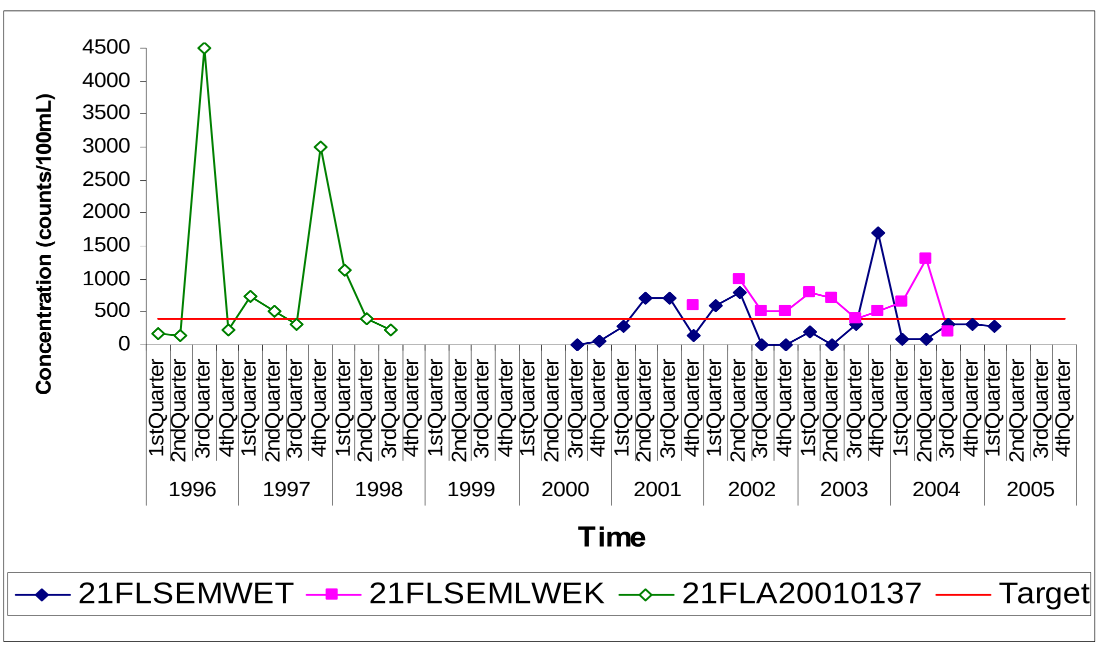


Figure 5.2B. Trend of Fecal Coliform Concentrations in the Little Wekiva River.



Based on **Figure 5.2A**, except for the data in 1996, fecal coliform concentrations in the three water quality stations located in the Little Wekiva Canal showed a similar seasonal trend. Typically, the highest fecal coliform concentrations were observed in the 2nd or 3rd quarters during the middle of the year, which typically is the rainy seasons in Florida, suggesting that the rise in the fecal coliform concentrations may be associated to surface water runoff. During the second quarter of 1996, there was a major spike in fecal coliform concentrations witnessed, in both the Little Wekiva River **Figure 5.2A**, and the Little Wekiva Canal **Figure 5.2B**.

The same fecal coliform concentration peaks in 1996 were also observed at station 21FLA20010137, which is located in the Little Wekiva River. Because station 21FLA20010137 is located 7.8 miles from Station 21FLORANLWA, and 5.6 miles from Station 21FLORANLWB, the similarity among these stations also suggested that the observed high concentrations are driven by the regional weather conditions, instead of local discharge. In addition, the scales of fecal coliform concentrations at stations were similar to those observed at stations located in the Little Wekiva Canal, which is consistent with the hypothesis that the fecal coliform in both the Little Wekiva Canal and the Little Wekiva River are from the similar type of sources. In this case, mostly likely, the major contributor is the residential area, through surface water runoff.

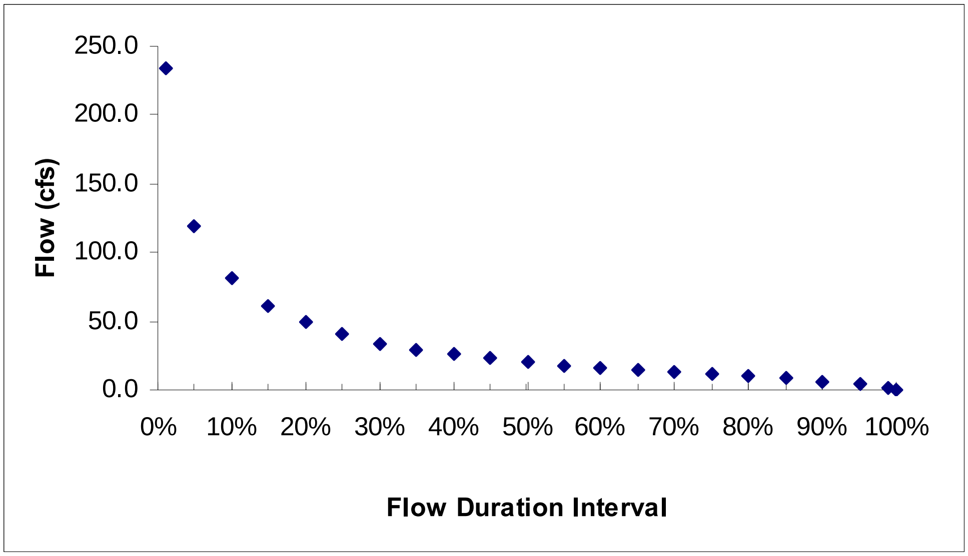
5.1.2 TMDL Development Process

Develop the Flow Duration Curve

The first step in the development of load duration curve is to create a *flow duration curve*. 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 were equalled 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.

Figure 5.3 shows the flow duration curve for the Little Wekiva River and the Little Wekiva Canal. The flow duration curve for this study was created based on flow data collected at the USGS gauging station of 02234990.

Figure 5.3. Flow Duration Curve for the Little Wekiva River and the Little Wekiva Canal.



Develop the Load Duration Curves for Both the Allowable Load and Existing Loading Capacity

Flow duration curves are transformed into load duration curves by multiplying the flow values along the flow duration curve by the fecal coliform concentration and the appropriate conversion factors. The final results of the load are typically expressed as MPN per day. The following equations were used to calculate the allowable loads and the existing loading:

Allowable load = (observed flow) x (conversion factor) x (state criteria) (1)

Existing loading = (observed flow) x (conversion factor) x (coliform measurement) (2)

On the load duration curve, allowable and existing loads are plotted against the flow duration ranking. The allowable load was calculated based on the water quality criterion and flow values from the flow duration curve, and the line drawn through the data points representing the allowable load is called the target line. The existing loads are based on the in-stream fecal coliform concentrations measured during ambient monitoring and an estimate of flow in the stream at the time of sampling. As noted previously, because insufficient data were collected to evaluate the fecal coliform geometric mean, 400 MPN/100mL was used as the target criteria for fecal coliform. **Figure 5.4** shows both the allowable loads and the existing loads over the flow duration ranking for the Little Wekiva River and the Little Wekiva Canal. The points of the existing load that were higher than the allowable load at a given flow duration ranking were considered an exceedance of the criteria.

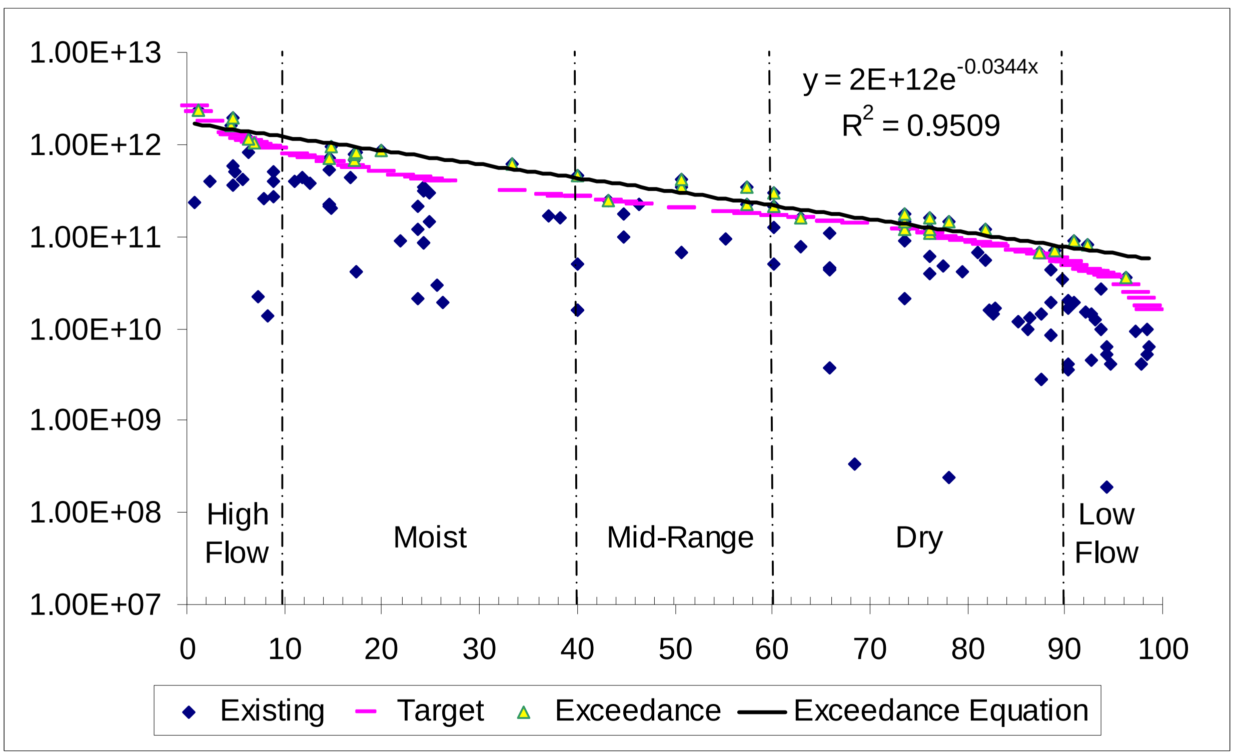
As shown in **Figure 5.4,** exceedances of the fecal coliform criteria in the Little Wekiva River and Little Wekiva Canal occur across the entire span of the flow record. In general, exceedances on the right side of the curve typically occur during low-flow events, which implies a contribution from either point sources or base flow, which could come from the load from failed septic tanks and sewer line leakage that interact with surface water. The exceedances that appear on the left side of the curve usually represent loading from stormwater-related sources. In this case, the potential sources may include contributions from pets, such as dogs and cats, wild animals, failed septic tanks, and sewer line leakage.

Define the Critical Condition

The critical condition for coliform loadings in a given watershed depends on many factors, including the presence of point sources and the land use pattern in the watershed. Typically, the critical condition for nonpoint sources is an extended dry period followed by a rainfall runoff event. During the wet weather period, rainfall washes off coliform bacteria that have built up on the land surface under dry conditions, resulting in the wet weather exceedances. However, significant nonpoint source contributions can also appear under dry conditions without any major surface runoff event. This usually happens when nonpoint sources contaminate the surficial aquifer, and fecal coliform bacteria are brought into the receiving waters through base flow. In addition, wildlife having direct access to the receiving water can contribute to the exceedance during dry weather. The critical condition for point source loading typically occurs during periods of low stream flow, when dilution is minimized.

For the Little Wekiva River and the Little Wekiva Canal, because exceedances occur throughout the flow record, no critical flow condition was defined for this TMDL. The Department used the flow records and water quality data available for the 10^{th} to 90^{th} percentile flow duration interval for the TMDL analysis. Flow conditions that were exceeded less than 10 percent of the time were not used because they represent abnormally high-flow events, and flow conditions occurring greater than 90 percent of the time were not used because they are extreme low-flow events.

Figure 5.4. Load Duration Curves for Allowable Load and Existing Loading Capacity of Fecal Coliform



Establish the Needed Load Reduction by Comparing the Existing Load with the Allowable Load under the Critical Condition

The fecal coliform load reductions required to achieve water quality criteria were established by comparing the existing loading with the allowable load at each flow recurrence interval between the 10^{th} and 90^{th} percentile (in increments of 5 percent). The actual needed load reduction was calculated using the following equation:

$$\textbf{Load reduction} = \frac{\textbf{Existing loading} - \textbf{Allowable loading}}{\textbf{Existing loading}} \times \textbf{100\%} \qquad \textbf{(3)}$$

The *Allowable loading* at each recurrence interval was calculated as the product of the water quality criterion and the flow corresponding to the given recurrence interval. To calculate the *Existing loading,* a trend line was fit to the loads that exceeded the *Allowable loading*. Several types of trend lines were examined, and the exponential function was found to have the highest correlation coefficient for fecal coliform loading ($R^2 = 0.9509$). Therefore, the exponential function was used to predict the existing loads corresponding to the flow recurrence intervals used by the *Allowable loading.* The following is the exponential equation developed for fecal coliform:

$$\textbf{For fecal coliform: } Y = (2E+12)e^{-0.0344x} \qquad \textbf{(4)}$$

Where:

X is the flow recurrence interval between the 10^{th} and 90^{th} percentile and
Y is the predicted *Existing loading* for fecal coliform (Equation 4).

Figure 5.4a shows the trend lines and an exponential equation between fecal coliform bacteria load and flow ranking. After the trend lines were developed, they were used to determine the median percent reduction required to achieve the numeric criterion. At each recurrence interval between the 10^{th} and 90^{th} percentile (in increments of 5 percent), the equation of the trend line was used to estimate the *Existing loading*.

The percent reduction required to achieve the target load was then calculated at each interval, and the final percent reduction needed was the median of these values. The TMDL and percent reductions were calculated as the median of all the loads and percent reductions calculated at the various recurrence intervals between the 10^{th} and 90^{th} percentile. **Table 5.1** shows the calculation of the TMDL and percent reductions for fecal coliform in the Little Wekiva River and the Little Wekiva Canal.

Table 5.1. Calculation of TMDL and Percent Reduction for Fecal Coliform in the Little Wekiva River and the Little Wekiva Canal basins, WBID 2987 and 3004

Interval	Allowable Load counts/day	Existing Load counts/day	Reduction (%)
90	5.19E+10	9.05E+10	42.7
85	7.14E+10	1.07E+11	33.5
80	8.71E+10	1.28E+11	31.7
75	1.08E+11	1.52E+11	29.0
70	1.27E+11	1.80E+11	29.3
65	1.47E+11	2.14E+11	31.3
60	1.66E+11	2.54E+11	34.5
55	1.86E+11	3.02E+11	38.3
50	2.06E+11	3.58E+11	42.6
45	2.25E+11	4.25E+11	47.1
40	2.54E+11	5.05E+11	49.6
35	2.94E+11	6.00E+11	51.1
30	3.43E+11	7.13E+11	51.9
25	4.01E+11	8.46E+11	52.6
20	4.89E+11	1.01E+12	51.3
15	6.26E+11	1.19E+12	47.5
10	8.32E+11	1.42E+12	41.3
Median	2.06E+11	3.58E+11	**42.6**

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 the Little Wekiva Canal and the Little Wekiva River are expressed in terms of MPN/day and percent reduction, and represent the maximum daily fecal coliform loads the stream can assimilate and maintain the fecal coliform criterion **(Table 6.1).**

Table 6.1. TMDL Components for Fecal Coliform in the Little Wekiva River and the Little Wekiva Canal basins, WBIDs 2987 and 3004

Parameter	TMDL (colonies/day)	WLA		LA (percent reduction)	MOS
		Wastewater (colonies/day)	NPDES Stormwater (percent reduction)		
Fecal coliform	2.06×10^{11}	1.21×10^{8}	42.6%	42.6 %	Implicit

6.2 Load Allocation (LA)

Based on a loading duration curve approach similar to that developed by Kansas (Stiles, 2002), the load allocation is a 42.6 percent reduction in fecal coliforms from nonpoint sources. It should be noted that the LA includes loading from stormwater discharges regulated by the Department and the water management districts that are not part of the NPDES Stormwater Program (see **Appendix A).**

6.3 Wasteload Allocation (WLA)

6.3.1 NPDES Wastewater Discharges

The City of Altamonte Springs Regional Wastewater Reclamation Facility has a wastewater outfall into the Little Wekiva River, which includes a permit limit for fecal coliforms. A fecal coliform load of 1.21E+08 counts/day is allocated to this facility. This allowable load is based on the facility's long-term annual average discharge rate (1.10 mgd) and long-term annual average discharge concentration (8.39 counts/100 ml) shown in **Table 4.1**.

6.3.2 NPDES Stormwater Discharges

The WLA for stormwater discharges with an MS4 permit is a 42.6 percent reduction in current fecal coliform loading. It should be noted that any MS4 permittee will only be responsible for reducing the anthropogenic 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.

6.4 Margin of Safety (MOS)

Consistent with the recommendations of the Allocation Technical Advisory Committee (Florida Department of Environmental Protection, February 2001), an implicit margin of safety (MOS) was used in the development of this TMDL. For fecal coliform, an implicit MOS was inherently incorporated by using 400 MPN/100 mL of fecal coliform as the water quality target for individual samples, instead of setting the criteria as that no more than 10 percent of the samples exceeding 400 MPN/100 mL. For fecal coliform TMDLs, using the load duration curve method to develop TMDL assumes there is no in-stream decay of fecal coliform bacteria after the watershed loading reaches to the receiving waterbody, while in reality fecal coliform loadings could diminish through processes including death, grazing, and deposition. Therefore, the load duration curve method tends to underestimate allowable fecal coliform loadings that a given waterbody receives and is therefore more conservative in establishing the TMDL. In addition, the correlation lines fitting through only the existing loadings that exceeded the allowable loadings could overestimate the actual existing loading, which makes the estimation of percent load reduction required more conservative and adds to the MOS. The estimate of the percent load reduction would reduce this discharger’s load to significantly less than the current permitted load allocation. Therefore, allowing the point source to discharge at there full permitted rate, one could assume that the fecal coliform levels would consistently fall below the departments acceptable level, adding to the implicit MOS.

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 the Middle St. Johns River Basin. 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.

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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 stormwater flood control requirements of the water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations.

Chapter 62-40 also 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 permitting program to designate certain stormwater discharges as "point sources" of pollution. The EPA promulgated regulations and began implementation of 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 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 implemented Phase I of the MS4 permitting program on a countywide basis, which brought 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. The Department received authorization to implement the NPDES stormwater program in 2000.

An important difference between the federal NPDES and the state's stormwater/environmental resource permitting programs is that the NPDES program covers both new and existing discharges, while the state's program focus on new discharges only. Additionally, Phase II of the NPDES Program, implemented in 2003, expands the need for these permits to construction sites between one and five acres, and to local governments with as few as 1,000 people. 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. It should be noted that all MS4 permits issued in Florida include a re-opener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Florida Department of Environmental Protection
Division of Water Resource Management
Bureau of Watershed Management
2600 Blair Stone Road, Mail Station 3565
Tallahassee, Florida 32399-2400
(850) 245-8561
www2.dep.state.fl.us/water/