

*Technical Report
Lower St. Johns River Basin*

Fecal BMAP Implementation: Identification of Probable Sources in the Leeds Pond Watershed (WBID 2308)

Final Draft
December 2008

Prepared For:



**Contract No. WM913 Task Assignment No. 4
Florida Department of Environmental Protection
2600 Blair Stone Road, MS 3565
Tallahassee, FL 32399
(850) 245-8506**

Prepared By:



**7406 Fullerton Street, Suite 350
Jacksonville, FL 32256
(904) 363-6100**

<u>Section</u>	<u>Page</u>
----------------	-------------

PBSJ[®]

Contents

3.5.2	Nonpoint Sources	32
3.5.2.1	Seasonal Evaluation	34
Chapter 4.0 : Fecal Coliform Source Assessment Summary		39
Chapter 5.0 : Management Actions.....		41
5.1	Programs To Address the Sanitary Sewer System as a Source	41
5.1.1	Specific Improvement Programs by JEA in the Leeds Pond Watershed	42
5.1.1.1	TAT-Directed Reconnaissance of Sewer Infrastructure and Associated Sampling.....	42
5.1.2	Sufficiency of Effort	42
5.2	Programs To Address OSTDS as Sources	43
5.2.1	Septic System Failure Areas and the Role of the WSEA	43
5.2.2	Sufficiency of Effort	44
5.3	Programs To Address Stormwater as a Source	46
5.3.1	National Pollutant Discharge Elimination System (NPDES) MS4 Permit Monitoring Plan	46
5.3.2	Maintenance of Stormwater Conveyance Systems	46
5.3.3	Specific Stormwater Improvement Projects	47
5.3.4	Programs To Address Potential Illicit Connections as Sources.....	47
5.3.5	Sufficiency of Effort	48
Citations		51
Web Resources		54
Appendices		55
Appendix A. GIS Maps		56
Appendix B. Identification of Issues Regarding Data Analysis and Map Development		69
Appendix C. Available Assessment Techniques		75
Appendix D. DCHD Septic Tank Failure Area Ranking Protocol		80
Appendix E. Calculation of Stormwater Runoff Coefficients		85
Appendix F. Programs to Address the Sanitary Sewer Systems as a Source of Fecal Coliform Contamination		89
Appendix G. Programs to Address OSTDS as Sources of Fecal Coliform Contamination		93
Appendix H. 2006 Annual Monitoring Report, City of Jacksonville/FDOT NPDES Permit		97

List of Figures

Figure 1. Time-series analysis of fecal coliform data during the period of record (March 1984–April 2007)	14
Figure 2. A significant decrease in fecal coliform concentration was identified over time at station BP71 ($p=0.043$).....	15
Figure 3. T-test comparison of means showed no statistical difference between seasons at station BP71 (T-test, $p=0.11$)	37

List of Tables

Table 1. FDEP-adopted Criteria for Surface Water Quality Classifications (Section 62-302.530, F.A.C.).....	5
Table 2. Fecal coliform statistics for station BP71 over the verified period of impairment (January 1996–June 2003). Fecal coliform levels are indicated as CFU/100mL.....	12
Table 3. Fecal coliform statistics for all stations over the period of record (March 1984–April 2007). Fecal coliform levels are indicated as CFU/100mL.....	12
Table 4. SSOs reported in Leeds Pond from 2001–2008. *Reportable SSOs that spilled >1,000 gallons of sewage and/or affected surface waters	24
Table 5. Land Use Statistics for Leeds Pond, WBID 2308.....	28
Table 6. Stormwater treatment areas in the Leeds Pond watershed that have been permitted by the SJRWMD	33
Table 7. Fecal coliform values at station BP71 during the “wet” and “dry” seasons. Fecal coliform levels are indicated as CFU/100mL	37
Table 8. Summary of the efforts used to determine impairments and identify probable sources of fecal coliform contamination.....	40
Table 9. Summary of most probable sources of fecal contamination contributing to Leeds Pond sampling locations	40

List of Maps

Map 1. Watershed location map for Leeds Pond (WBID 2308)	8
Map 2. Leeds Pond hydrology. The northern branch of Leeds Pond is identified as #1. A green line represents the approximate location of an underground conveyance system that connects into the Leeds Pond WBID via a ditch that is depicted in the red circle	9
Map 3. Locations of water quality sampling stations in the Leeds Pond watershed.....	11
Map 4. Locations of SSOs within the Leeds Pond watershed reported by JEA between 2001 and 2008 and points of interest. Note: Shaded regions represent multiple and/or repetitive overflow reports. A 500-foot buffer defines adjacency	19
Map 5. Leeds Pond wastewater infrastructure with sanitary sewer lift stations, including private lift stations (2001–2008).....	22
Map 6. Locations of SSOs within the Leeds Pond watershed reported by JEA between 2001 and 2008. Black circles represent locations of SSOs that were reported to potentially impact surface waters.....	23
Map 7. OSTDS repair permits and potential locations in the Leeds Pond basin	26
Map 8. Analysis of impervious surface in the Leeds Pond watershed, using coefficients derived from those provided in the ISAT, developed by the NOAA Coast Services Center in partnership with the University of Connecticut NEMO Project	30
Map 9. Soils survey for the Leeds Pond watershed (USDA/NRCS, provided by the SSURGO Database 2006)	31
Map 10. Stormwater runoff coefficient distribution for Leeds Pond	32
Map 11. Location of SJRWMD rainfall stations within Duval County	36

Acronym List

ARA	Antibiotic Resistance Analysis
BMAP	Basin Management Action Plan
BMP	Best Management Practice
CAFO	Concentrated Animal Feeding Operation
CFU	Colony-forming Unit
cm	Centimeter
COJ	City of Jacksonville
COJ EQD	City of Jacksonville Environmental Quality Division
COJ PWD	City of Jacksonville Public Works Department
CWA	Clean Water Act
DCHD	Duval County Health Department
DNA	Deoxyribonucleic Acid
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
ETM	England-Thims and Miller
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FEHA	Florida Environmental Health Association
FOG	Fat, Oil and Grease
FOWA	Florida Onsite Wastewater Association
FWRA	Florida Watershed Restoration Act
GIS	Geographic Information System
HSD	Honestly Significant Difference
IDDE	Illicit Discharge Detection and Elimination
ISAT	Impervious Surface Analysis Tool
IWR	Impaired Waters Rule
MF	Membrane Filter
mL	Milliliter
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer System
MST	Microbial Source Tracking
NEMO	Nonpoint Education for Municipal Officials
NESC	National Environmental Services Center
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OSTDS	Onsite Sewage Treatment and Disposal Systems
PCR	Polymerase Chain Reaction
PHP	Preferred Hauler Program
PIC	Potential Illicit Connection

Acronym List

QA/QC	Quality Assurance/Quality Control
rep-PCR	Repetitive Extragenic Palindromic Polymerase Chain Reactions
RV	Recreational Vehicle
SCS	Soil Conservation Service
SJRWMD	St. Johns River Water Management District
SSE	Sewer System Event
SSO	Sanitary Sewer Overflow
SSURGO	Soil Survey Geographic (Database)
STORET	STORage and RETrieval (Database)
SWMP	Stormwater Management Program
TAT	Tributary Assessment Team
TMDL	Total Maximum Daily Load
USDA	U.S. Department of Agriculture
USF	University of South Florida
USGS	U.S. Geological Survey
UV	Ultraviolet
WAV	Watershed Action Volunteers
WBID	Waterbody Identification (Number)
WSEA	Water and Sewer Expansion Authority
WWTF	Wastewater Treatment Facility

Executive Summary

In Florida, and across the nation, many waterbodies fail to meet their designated uses (such as drinking water, recreation, and shellfish harvesting) and are found to be impaired because levels of fecal microbial indicators (coliform bacteria) exceed established water quality criteria. The federal Clean Water Act of 1972 requires states to establish Total Maximum Daily Loads (TMDLs) for impaired waters. TMDLs, which are adopted by rule, establish the maximum amount of specific pollutants that a waterbody can assimilate while maintaining its designated uses.

Beginning in 2001, an assessment of the Lower St. Johns River Basin was carried out as part of the Florida Department of Environmental Protection's (FDEP) watershed management approach, which rotates through the state's 52 river basins over a 5-year cycle. FDEP has verified 55 tributaries of the Lower St. Johns River—located throughout Duval County and in small portions of Clay and St. Johns Counties—as impaired for fecal coliform, and TMDLs must be developed for these waterbodies.

Local stakeholders in the Lower St. Johns River Basin, in conjunction with FDEP, are currently working to develop a Basin Management Action Plan (BMAP) to implement the TMDLs for fecal coliform. The BMAP will build on previous work, including efforts by the Tributary Assessment Team (TAT), to increase the understanding of bacteria sources in tributaries of the Lower St. Johns River.

FDEP contracted with PBS&J to work in cooperation with the Tributaries Technical Stakeholders in the Lower St. Johns River Basin towards the common goal of sufficiently reducing coliform levels to meet water quality standards. The Stakeholders comprise representatives from a number of agencies and organizations, including JEA, City of Jacksonville (COJ), Duval County Health Department (DCHD), FDEP, and the Florida Department of Transportation (FDOT).

This technical report on Leeds Pond (Waterbody Identification [WBID] Number 2308) is one of a series of technical reports (one each produced for 53 of the impaired tributaries of the Lower St. Johns River) intended to help identify sources of fecal coliform pollution by interpreting the information used to create a series of maps (found in **Appendices A and B**). These maps provide watershed context, summarize water quality sampling locations, and help identify sources of fecal contamination.

Leeds Pond is a Class III waterbody with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The creek was placed on the Verified List of impaired waters for fecal coliform in May 2004.

This report uses a weight-of-evidence approach, including data analysis in conjunction with background knowledge of the watershed and area land use patterns, to assess the contribution of various potential sources of fecal coliform bacteria to Leeds Pond. The determination of contributing sources is particularly important for fecal microbial exceedances because the measured indicators often do not readily discriminate among human, livestock, and wildlife sources. In addition, because pathogens from human

Executive Summary

sources present the highest potential for infection, identification of the type of source (human, livestock, or wildlife) affects the evaluation of risk (Scott et al. 2002, Colford et al. 2007). As a result, source identification is critical to achieving the goal of implementing management actions to improve water quality and protect human health.

The report provides background information on typical sources of fecal coliforms and associated assessment techniques, describes the results of analyses performed on data obtained from the Impaired Surface Waters Rule (IWR) database, assesses probable contributing sources, and documents management actions compiled by the Tributaries Technical Stakeholders as of June 7, 2007—including a preliminary determination of sufficiency of effort (i.e., whether these management actions will adequately address the most likely sources of fecal contamination). In addition, the Leeds Pond technical report is one of 11 reports augmented with information assembled by the TAT (July 2008–October 2008) to provide a more precise representation of the most probable sources of fecal coliform. These efforts supported the collection of supplemental source information, including data compilation and analysis, preliminary field review, project workshop, and field reconnaissance (“Walk the WBIDs”) discussed in **Section 2.0**.

The evaluation of available data discussed in this report indicates that the probable sources of fecal contamination in the Leeds Pond WBID are human related. More specifically, the three main sources (not listed in order of importance) appear to be: (1) existing utility infrastructure; (2) onsite sewage treatment and disposal systems (OSTDS); and (3) stormwater (as a conveyance system for nonpoint sources).

Although the effects of many of the management actions described in this document may not be fully realized, it is recommended that all of the currently identified programs discussed here continue with refinements derived from the assessment of the Leeds Pond watershed provided in this report.

Chapter 1.0: Introduction and Background

1.1 Background Information

The Florida Department of Environmental Protection (FDEP) is implementing a statewide watershed management approach for restoring and protecting water quality and addressing Total Maximum Daily Load (TMDL) Program requirements. The watershed approach rotates through the state's 52 river basins over a 5-year cycle.

Under Section 303(d) of the Clean Water Act (CWA) and the 1999 Florida Watershed Restoration Act (FWRA) (Chapter 99-223, Laws of Florida), TMDLs must be developed and implemented for all impaired waters in the state, unless the impairment is documented to be a naturally occurring condition that cannot be abated by a TMDL, or unless a management plan already in place is expected to correct the problem. Waters are defined as impaired if they do not meet their designated uses (such as drinking water, recreation, and shellfish harvesting). TMDLs, which are adopted by rule, establish the maximum amount of specific pollutants that a waterbody can assimilate while maintaining its designated uses.

Beginning in 2001, an assessment of the Lower St. Johns River Basin was carried out as part of FDEP's watershed management approach. FDEP has verified 55 tributaries of the Lower St. Johns River as impaired for fecal coliform bacteria, and TMDLs must be developed for these waterbodies. The tributaries are located throughout Duval County and in small portions of Clay and St. Johns Counties.

Local stakeholders, in conjunction with FDEP, are working to develop a Basin Management Action Plan (BMAP) to restore and protect water quality in the impaired waterbodies in the Lower St. Johns River Basin. FDEP contracted with PBS&J to work in cooperation with the Tributaries Technical Stakeholders towards the common goal of sufficiently reducing coliform levels to meet water quality standards. The Stakeholders comprise representatives from a number of agencies and organizations, including City of Jacksonville Public Works Department (COJ PWD) and Environmental Quality Division (COJ EQD), JEA, St. Johns River Water Management District (SJRWMD), Water and Sewer Expansion Authority (WSEA), and St. Johns Riverkeeper.

The BMAP will build on previous work, including efforts by the Tributary Assessment Team (TAT), to investigate fecal coliform sources in the Lower St. Johns River tributaries.¹ The original TAT process prioritized several tributaries, collected fecal contamination source information, and compiled source identification spatial data in a Geographic Information System (GIS) database.² This work, supported by PBS&J, increased the understanding of bacteria sources in selected tributaries. Currently, the TAT is responsible for continuing monitoring to assist in identifying sources of fecal contamination.

¹ The TAT is a cooperative effort of the following agencies: COJ EQD, JEA (the regional service provider), COJ PWD, FDEP, DCHD, St. Johns Riverkeeper, WSEA, and University of South Florida (USF).

² The spatial data were collected from JEA, COJ, WSEA, FDEP, and SJRWMD.

Leeds Pond (Waterbody Identification [WBID] Number 2308), one of the 55 impaired waterbody segments in the Lower St. Johns River Basin, is a Class III waterbody with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The creek was placed on the Verified List of impaired waters for the Lower St. Johns River Basin in May 2004, for levels of fecal coliform bacteria that did not meet water quality standards.

1.2 Purpose and Contents

This document is intended to help identify probable sources of fecal coliform pollution by interpreting the information used to create a series of maps of the Leeds Pond watershed (**Appendices A and B**). It comprises one of a series of technical reports (one each produced for 53 of the impaired tributaries in the Lower St. Johns River Basin).

The maps provide watershed context, summarize water quality sampling locations, and help identify potential sources of fecal contamination in Leeds Pond. The WBID boundary, determined by FDEP and depicted in this technical report and associated maps, was used to determine the most probable impacts to the tributary and may not depict the exact hydrological boundaries of the watershed. It is important to note that field investigations performed on September 10, 2008, indicate that a portion of the watershed currently identified as Pottsburg Creek—beginning approximately at the Knights Lane East and Barnes Road South intersection—drains west into a ditch that flows north just east of the Barnes Road South and Kegler Drive intersection, connecting into the Leeds Pond watershed. As such, the established watershed boundaries of Leeds Pond may require revision to include this area, which is currently designated as part of the Pottsburg Creek watershed.

This report provides background information on typical sources of fecal coliform and assessment techniques, discusses the analyses performed on data compiled from the Impaired Surface Waters Rule (IWR) database, and provides an assessment of probable contributing sources in the Leeds Pond watershed. It also provides a description and preliminary evaluation of management actions, including a determination of sufficiency of effort (i.e., whether the management actions described here will adequately address the most likely sources of fecal contamination). The report reflects information compiled and documented by the Tributaries Technical Stakeholders as of June 7, 2007. In addition, the Leeds Pond technical report is one of 11 reports augmented with information assembled by the TAT (July 2008–October 2008) to provide a more precise representation of the most probable sources of fecal coliform. These efforts supported the collection of supplemental source information, including data compilation and analysis, preliminary field review, project workshop, and field reconnaissance (“Walk the WBIDs”) discussed in **Section 2.0**.

1.3 Fecal Coliform Contamination

Microbiological indicators of fecal contamination, such as *Escherichia coli* (*E. coli*) and *Enterococcus* spp. (enterococci), found in the gastrointestinal tracts of humans, as well as those of warm-blooded and some cold-blooded animals (APHA 1995, Harwood et al. 2000), have been used for over a century to warn of the fecal contamination risk in water

and food. These organisms, along with enteric pathogens, are shed in feces that can contaminate surface and ground water. Microorganisms from fecal sources that enter waters used by the public can pose a health threat, whether the water is used as a drinking water source, for recreational activities such as fishing or swimming, or for aquatic farming activities such as shellfish harvesting. In addition to public health risks, fecal contamination can result in adverse economic impacts due to the closure of recreational beaches and shellfish-harvesting areas.

1.3.1 Determining Sources of Contamination

To effectively reduce fecal contamination to waterbodies, the sources of such contamination must be identified so that appropriate remediation techniques can be applied. Although the identification of probable sources may seem like an obvious exercise, the initiation of remedial measures should not be undertaken without further testing and “proof” of the contamination source.

This report uses a weight-of-evidence approach, including data analysis in conjunction with background knowledge of the watershed and area land use patterns, to assess the contribution of various potential sources to Leeds Pond, which is impaired by high levels of fecal coliform bacteria.

The determination of contributing sources is particularly important for fecal microbial exceedances, because the measured indicators often do not readily discriminate between human, livestock, and wildlife sources. In addition, because pathogens from human sources present the highest potential for infection, identification of the type of source (human, livestock, or wildlife) affects the evaluation of risk (Scott et al. 2002, Colford et al. 2007). As a result, attempts at source identification are critical to achieving the end goal of implementing action to improve water quality and protect human health.

1.3.2 Typical Sources of Fecal Coliforms

Fecal contamination results when untreated fecal material from humans, other warm-blooded animals, and some cold-blooded animals enters a waterbody. Probable sources can be recognized through a detailed Site Assessment. The Site Assessment begins with the compilation and review of existing information (preferably GIS data) about the waterbody—including, but not limited to, land use cover and classification, historical sampling data, infrastructure, and recorded incidents such as sanitary sewer overflows (SSOs). SSOs are releases of untreated sewage into the environment, and are generally prohibited under the CWA.

Once all pertinent information has been overlaid with the waterbody, potential sources may be apparent and can be field verified (depending on the source). Probable sources may include wastewater infrastructure, wildlife, and/or specific land uses (e.g., cattle farms, aquaculture, marinas, dog parks).

In many waterbodies, fecal coliform contamination stems from a combination of human, wildlife, and domestic animal sources. When there is no obvious probable source of fecal pollution, a more exhaustive search is required. The background information collected for an impaired waterbody should be supplemented with a thorough field examination. In

some cases, the use of more advanced techniques may be appropriate as part of the field examination. Once combined, visual inspections, sampling results, and historical data generally suggest potential source(s) of fecal contamination.

1.3.2.1 Centralized Sewage Infrastructure and Overflows

A centralized sewer system (i.e., public and privately owned sewer infrastructure) may contribute fecal coliform pollution to the environment through the slow and continuous leakage of sanitary sewer infrastructure, treatment failure in wastewater treatment plants, and SSOs. Common causes of SSOs may include (1) heavy rainfall resulting in the inflow of stormwater or infiltration of ground water into sewer lines; (2) breaks or blockages in sewer lines due to aging infrastructure or the accumulation of grease; and (3) malfunctioning equipment and pumps (possibly due to power failures). General information on SSOs can be found on the U.S. Environmental Protection Agency's (EPA) web site (available at <http://www.epa.gov/npdes/sso/control/>). It is uncertain how much leaking sewer infrastructure below ground may contribute to surface water contamination. Although there is evidence that in some soils bacteria do not readily transport to nearby surface waters, there are no local data for bacterial transport originating from sewer infrastructure in the soil types and ground water conditions of the Lower St. Johns River Basin.

1.3.2.2 Failing Onsite Sewage Treatment and Disposal Systems

Onsite sewage treatment and disposal systems (OSTDS) consist of a septic tank and a subsurface wastewater infiltration system, or drainfield, where most of the treatment occurs in the soil above the water table. The drainfield and underlying soils are the most critical components of septic systems for the treatment of wastewater. A failing septic system is one that is not functioning in a sanitary manner and that may result in the transport of untreated or partially treated wastewater to surface waters.

OSTDS failure can be due to a number of causes, including unsuitable soil conditions, improper design and installation, or inadequate maintenance practices. Improperly functioning septic systems are recognized as a significant contributor of pollutants, including microbiological pathogens (Hagedorn 1982, Bicki et al. 1984, Nicosia et al. 2001, EPA 2002b, McDowell et al. 2005). These failing systems may result in obvious sanitary nuisances, such as ponding on the ground and runoff into surface waters, and less conspicuous nuisances, including the leaching of untreated wastewater into ground water. Local data for bacterial transport in the Lower St. Johns River Basin suggest that septic systems may contribute small bacterial concentrations over time to surface waters via ground water in saturated soils at seasonally inundated areas (Brown et al. 2001). Though, there has been evidence that bacteria do not readily transport to nearby surface waters in some soils in areas outside of the Lower St. Johns River Basin.

1.3.2.3 Land Uses

Land use cover and classification data, when overlaid with a WBID's boundaries, can be used to determine probable sources of fecal contamination. Certain land uses are likely to impact microbial loading to surface waters, including agricultural activities and marinas. Runoff from agricultural areas containing animals (e.g., livestock grazing,

dairies, cattle farms, or concentrated animal feeding operations [CAFOs]) can contribute a significant amount of fecal contamination to surface waters. Marinas that provide onsite waste disposal areas (flush-out pumps) can leak or overflow and can dump raw sewage directly into a waterbody. In addition, as described in **Sections 1.3.2.1 and 1.3.2.2** urban and residential land-use areas with sewer and OSTDS infrastructure can impact surface waters if they are not functioning properly.

1.4 Fecal Contamination Thresholds

Water quality standards are based on the use of a lake, stream, or river (e.g., for drinking water, shellfishing, or recreation) and set specific water quality criteria to safely achieve that designated use. Under Section 304(a) of the CWA, the EPA is required to publish water quality criteria that accurately reflect the latest scientific knowledge for the protection of human health and aquatic life. The EPA's *Ambient Water Quality Criteria for Bacteria–1986* was developed for the protection of waters designated for recreational uses (EPA 1986).

Epidemiological studies conducted by the EPA have demonstrated that for fresh water, *E. coli* and enterococci are best suited for predicting the presence of pathogens that cause illness, and that for marine waters, enterococci are most appropriate (EPA 2002a). However, FDEP uses fecal coliform for regulating water quality and has adopted Criteria for Surface Water Quality Classifications (Section 62-302.530, Florida Administrative Code [F.A.C.]) (**Table 1**).

Table 1. FDEP-adopted Criteria for Surface Water Quality Classifications (Section 62-302.530, F.A.C.)
(<http://www.dep.state.fl.us/legal/Rules/shared/62-302/62-302.pdf>)

Parameter	Units	Class I	Class II	Class III: Fresh	Class III: Marine	Class IV	Class V
(6) Bacteriological Quality (Fecal Coliform Bacteria)	Number per 100 ml (Most Probable Number (MPN) or Membrane Filter (MF))	MPN or MF counts shall not exceed a monthly average of 200, nor exceed 400 in 10% of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 5 samples taken over a 30 day period.	MPN shall not exceed a median value of 14 with not more than 10% of the samples exceeding 43, nor exceed 800 on any one day.	MPN or MF counts shall not exceed a monthly average of 200, nor exceed 400 in 10% of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30 day period.	MPN or MF counts shall not exceed a monthly average of 200, nor exceed 400 in 10% of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30 day period.		

1.5 Available Assessment Techniques

The assessment and direct identification of sources of fecal contaminants are confounded by many variables inherent in the use of indicator organisms for monitoring, and by variables in the dynamics of microbial populations in various substrates and environmental conditions. As a result, no single method can determine the extent, severity, and causes of pathogen contamination. This and other technical reports use a combination of methods to better understand the presence of fecal coliform and practical control measures. These methods range from measuring indicator bacteria to looking for

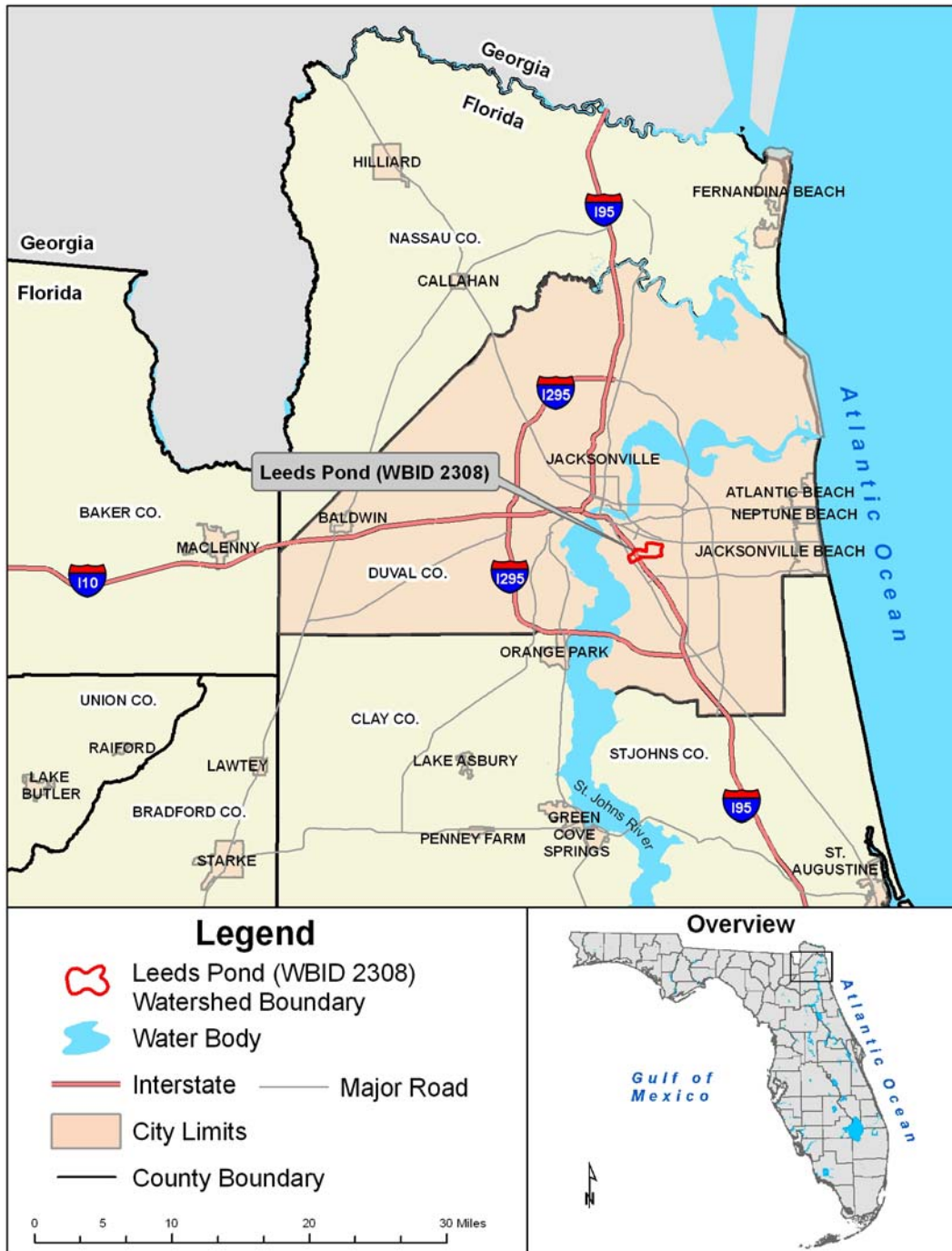
genetic “markers” of human and animal sources. Detailed descriptions of the microbial source tracking (MST) techniques used in these reports are provided in **Appendix C** and the Tributary Pollution Assessment Manual (2006); the techniques used in this report are restricted to indicator bacteria measurements.

Chapter 2.0: Data Compilation and Analysis

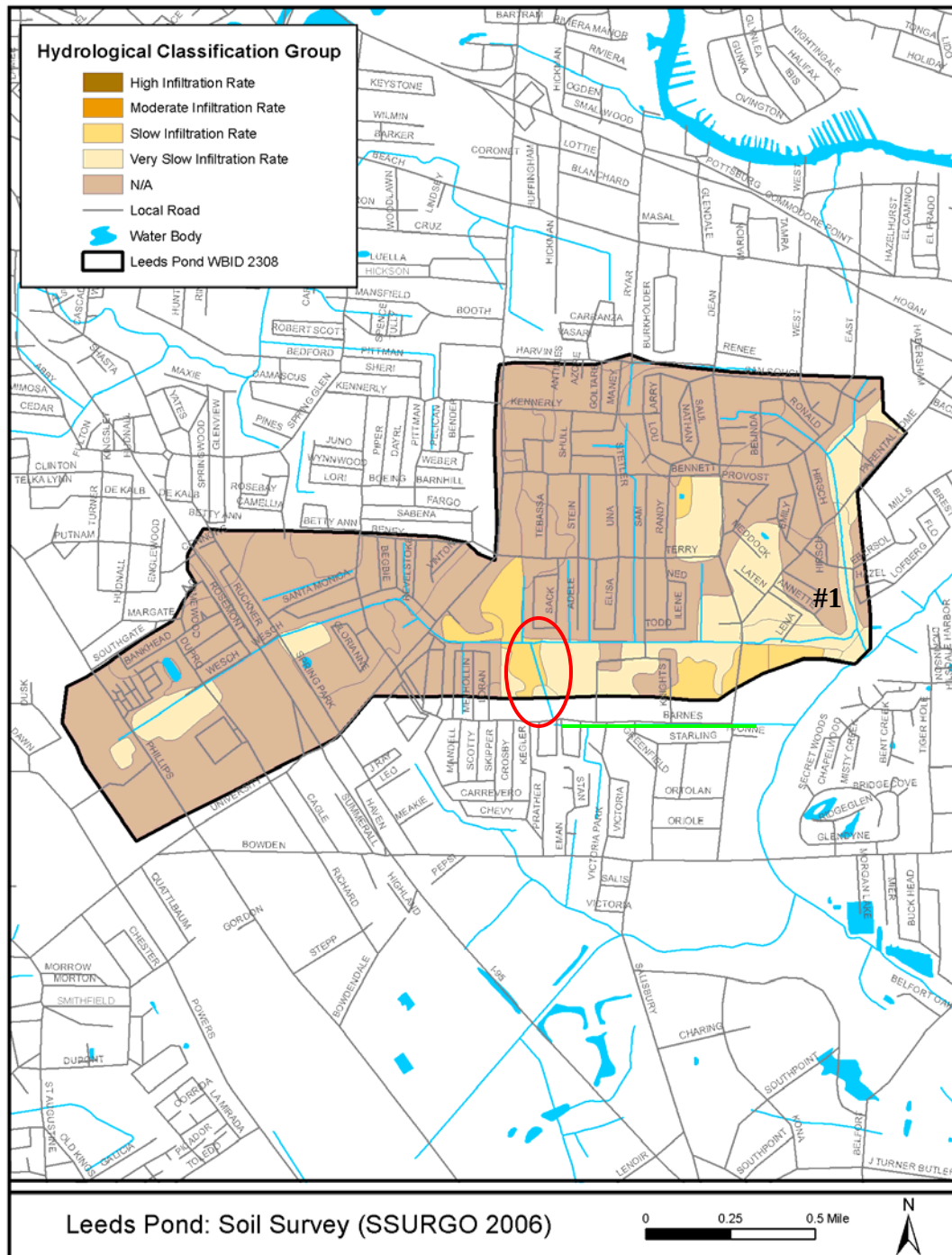
2.1 Background Information on Leeds Pond, WBID 2308

Leeds Pond, WBID 2308, is located in Duval County, east of the Lower St. Johns River within the North Mainstem Planning Unit, as designated by the SJRWMD (**Map 1; Appendix A, Figures 1–3**). The “headwaters” of Leeds Pond are comprised of stormwater that originates just west of Richard Street and from its associated branch and several ditches. The creek generally flows eastward, with the exception of one branch, “northern branch,” that joins Leeds Pond from the north. The northern branch extends north from the main channel approximately 84 meters (275 feet) southeast of Annette Circle to just south of the Ronald Lane and East Road intersection, where it forks north and northeast to San Souci Road and Wurn Park, respectively. The creek is also joined from the north and south by numerous ditches classified by the SJRWMD (**Appendix A, Figure 10**) and described in **Section 3.5.2**. Segments of the main channel from Sam Road west to Spring Park Road, as well as the northern branch from Parental Home Road north to the upstream extents of its forks are also classified as ditches.

It is important to note that field investigations indicate that a ditch, located just east of Kegler Drive, connects an underground conveyance system, which is currently included in the Pottsburg Creek WBID, to the Leeds Pond watershed. The underground system begins flowing west near the Knights Lane East and Barnes Road South intersection and connects to the ditch just east of the Barnes Road South and Kegler Drive intersection (**Appendix A, Figure 10**). The waters of Leeds Pond merge with Pottsburg Creek nearly 434 meters (1,450 feet) east of Parental Home Road. Pottsburg Creek flows into the Arlington River north of Atlantic Boulevard, which eventually joins the St. Johns River south of the Union Street Expressway. **Map 2** identifies Leeds Pond hydrology and major roads.



Map 1. Watershed location map for Leeds Pond (WBID 2308)



Map 2. Leeds Pond hydrology. The northern branch of Leeds Pond is identified as #1. A green line represents the approximate location of an underground conveyance system that connects into the Leeds Pond WBID via a ditch that is depicted in the red circle

2.2 Analysis of Water Quality Data

FDEP maintains and updates a comprehensive IWR database used for evaluating all waterbodies in the state. The database contains water quality information that has been uploaded to Florida STORET as well as additional data from other agencies (i.e., the U.S. Geological Survey [USGS]).

Using this database, FDEP is able to determine if a waterbody should be classified as impaired for a specific parameter. FDEP provided PBS&J with the IWR database (Run 28) to statistically analyze all stations containing fecal coliform data in the Leeds Pond watershed (WBID 2308). All statistical analysis was completed using the Statgraphics Centurion XV Version 15.1.03 pre-packaged software. Significance was determined using a p-value < 0.05.

One station, 21FLJXWQBP71 (“BP71”), provided fecal coliform data in the Leeds Pond watershed (**Map 3; Appendix B, Figure 9**). This station is located at Parental Home Road. In addition to data obtained from the IWR database, the COJ EQD provided additional data for station BP71 from 2003 to the present that had not already been uploaded to the IWR. This station is part of the regular ambient water quality monitoring program conducted by the COJ and all results are ultimately uploaded to the STORET database to be included in the next IWR run. This station provided all of the fecal coliform data over both the verified period of impairment, January 1996 to June 2003, and the period of record, March 1984 to April 2007 (N=59) (**Tables 2 and 3**).



Map 3. Locations of water quality sampling stations in the Leeds Pond watershed

2.2.1 General Statistics

Daily median values for all data provided by the IWR database were calculated for each station to eliminate duplicate information that resulted from the original data upload. The mean, median, geometric mean, minimum, and maximum value for each station over the verified period and period of record were calculated (**Tables 2 and 3**). Additionally, the number of samples that exceeded the maximum criteria for fecal coliform (400 colony-forming units per 100 milliliters [CFU/100mL]) was determined.

The water quality criterion for fecal coliform bacteria is detailed in Chapter 62-302, F.A.C. The requirements for exceeding maximum fecal coliform concentrations in a Class III waterbody are stated as follows:

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 samples, nor exceed 800 on any one day.

Due to the sampling frequency of the available data, it was not possible to calculate a geometric mean based on a minimum of 10 samples taken over a 30-day period. Therefore, the number and percent exceedances for each sampling event were evaluated based on a maximum fecal coliform count of 400 CFU/100mL.

Table 2. Fecal coliform statistics for station BP71 over the verified period of impairment (January 1996–June 2003). Fecal coliform levels are indicated as CFU/100mL

Station	N	Mean	Median	Geometric Mean	Minimum	Maximum	# of Exceedances	% Exceedances
21FLJXWQBP71	20	3160	1129	918	40	20000	14	70

Table 3. Fecal coliform statistics for all stations over the period of record (March 1984–April 2007). Fecal coliform levels are indicated as CFU/100mL

Station	N	Mean	Median	Geometric Mean	Minimum	Maximum	# of Exceedances	% Exceedances
21FLJXWQBP71	59	3620	800	714	20	31000	38	64

As discussed earlier, the verified period of impairment for fecal coliforms was January 1996 to June 2003 for the Group 2, Cycle 1 assessments (the Lower St. Johns Basin will be reassessed in 2008 with a new verified period). During the verified period, fecal coliform concentrations for station BP71 exceeded 400 CFU/100mL in a total of 14 out of 20 samples (70%; **Table 2**). In comparison, the data over the period of record show an exceedance in 38 of the 59 total samples collected (64%; **Table 3**).

A time-series analysis was completed over the period of record to determine (1) if an increasing or decreasing trend in fecal coliform concentrations was evident and (2) the nature of the impairment (i.e., chronic or episodic) (**Figure 1**). All fecal coliform data were log-transformed, a practice commonly performed with bacteria data to allow for an easier interpretation of trends due to a typically non-normal distribution. Values for the period of record remain consistently elevated (>800 CFU/100mL) with episodic peaks

over 10,000 CFU/100mL; 32% of samples were between 1,000 and 10,000 CFU/100mL and 12% were greater than 10,000 CFU/100mL. This indicates continual inputs from existing pollution sources with periods of increased bacteriological loadings originating from a more intermittent, large-scale source.

A linear regression between the date and log (fecal coliform) concentrations was evaluated at station BP71, resulting in a significant decreasing trend in fecal coliform concentrations over the sampling period (**Figure 2**; $p=0.043$). However, while values appear to be decreasing, concentrations continue to reach high levels ($>2,000$ CFU/100mL) with episodic peaks over 10,000 CFU/100mL, signifying continual contribution of fecal pollution at this location with periodic increases of fecal loading originating from a more sporadic source. The current reason for this trend is unknown.

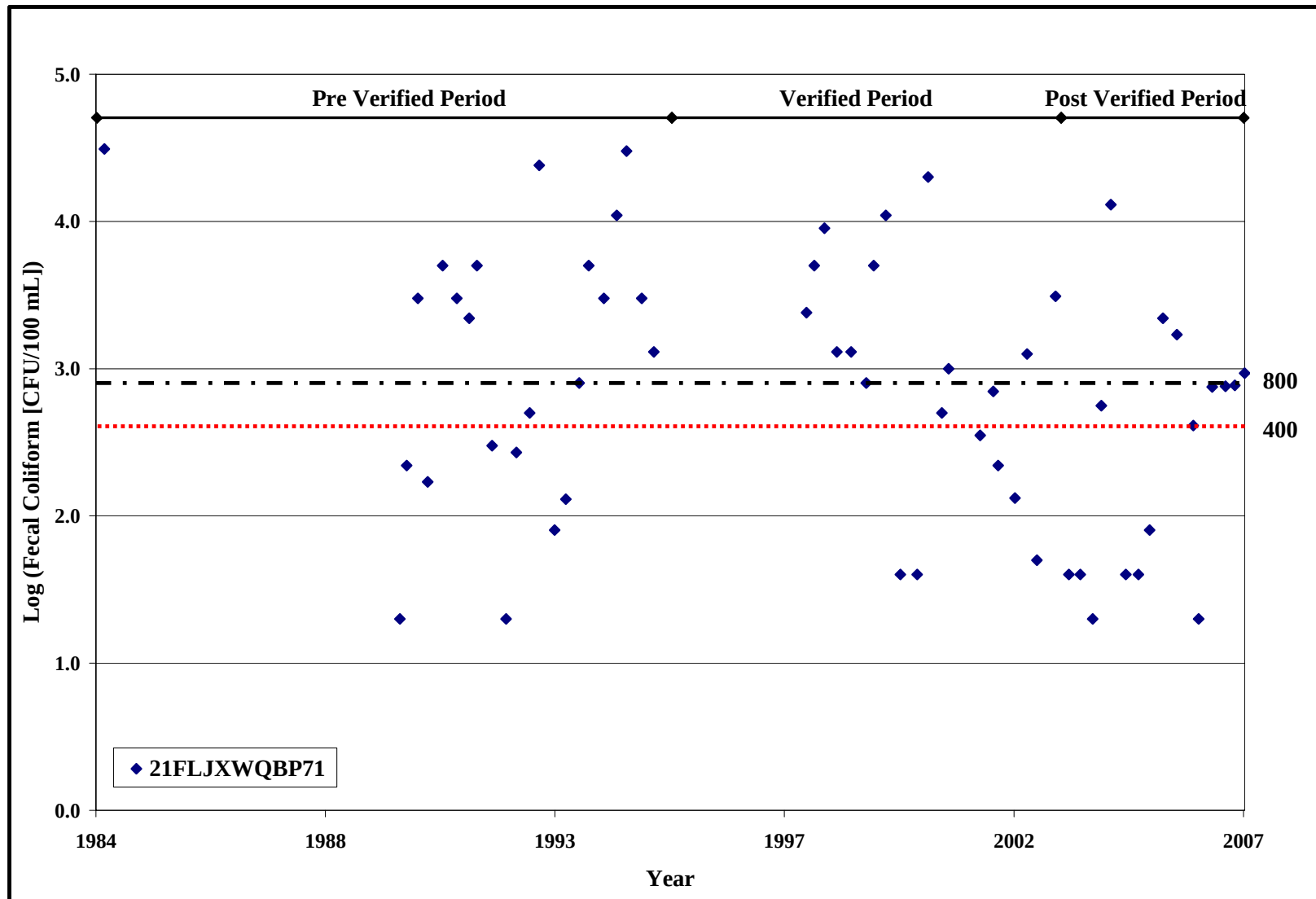


Figure 1. Time-series analysis of fecal coliform data during the period of record (March 1984–April 2007)

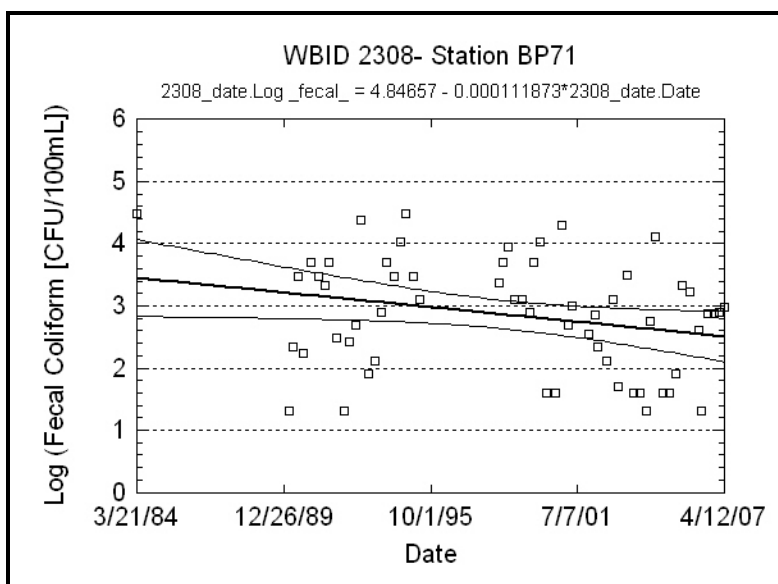


Figure 2. A significant decrease in fecal coliform concentration was identified over time at station BP71 ($p=0.043$)

2.2.2 Correlation with Physical Parameters

Additional physical parameter data (i.e., conductivity and temperature) were available to complete a correlation analysis (Pearson Product Moment Correlation) with the log (fecal coliform) data. There were a total of 59 fecal coliform samples available for analysis; however, only 36 of these samples, collected quarterly between 1998 and 2007, also included the corresponding physical parameter data. No significant relationships were evident between log (fecal coliform) concentrations and temperature, conductivity, pH, or dissolved oxygen (DO) at station BP71.

2.2.3 Identification of Future Sampling Locations

The purpose of collecting water quality monitoring information and analyzing those data is to establish the accurate level of impairment and potential sources of contaminants. A review of the available historical sampling data can provide good information about sources and the severity of contamination. If that information is insufficient to identify potential sources, there should be consideration of increasing sampling intensity and the use of additional sampling techniques such as MST.

Past experience with MST efforts in the Lower St. Johns River and Hillsborough River Basins (in collaboration with Dr. Valerie J. Harwood's laboratory at USF) has demonstrated that a detailed review of existing data is considered necessary to effectively guide the field reconnaissance and sampling approaches used. This detailed review helps to determine if the use of MST is necessary and appropriate to further define potential sources.

Before MST analyses are used, an "initial screening process" is conducted as the first stage (presampling) of the overall tiered approach to identifying sources of fecal pollution. The use of data such as GIS data, together with local knowledge of the

hydrological systems, is especially important in helping to identify sources and can reduce the need for more costly MST analyses. Presampling includes gathering existing information and data, evaluating this information as part of the preliminary data analysis for the WBID, and using the information to identify potential sources of fecal contamination.

In addition to the ambient water quality data collected regularly as part of the monitoring program, PBS&J, in collaboration with the USF and the TAT, identified potential future sampling locations for performing MST in the Leeds Pond watershed. Fixed stations (LP3, LP2, and LP1; **Map 3**) would be sampled monthly to provide consistency to the sampling program across seasons and would characterize the downstream, midstream, and upstream areas of the WBID, respectively. Station LP-3, the most upstream sampling station, is located at University Boulevard. Station LP-2 is positioned farther downstream on the main channel at Parental Home Road. The most downstream station, LP-1, is located on the northern branch at Parental Home Road.

In addition to the three “fixed” stations, two “flexible” stations (TLP2 and TLP1) were proposed; these would be used for supplemental analysis and sampled during specified periods of the monthly sampling program in order to help focus the investigation toward areas containing more likely sources (**Map 3**). Station TLP2, the most upstream sampling location, is located near the “headwaters” at the intersection of Wesch Boulevard and Richard Street. Station TLP-1 is positioned farther downstream at Sam Road. Additional flexible stations will likely be identified to further focus the identification of sources once the sampling program begins.

2.3 Supplemental Assessment Efforts

2.3.1 Data Collection and Preliminary Field Review

PBS&J used all of the previously compiled and documented data and analyses by the stakeholders as of June 7, 2007, for the Leeds Pond watershed. Additional data used in this report include (1) the most recent available SSO reports collected from JEA; (2) locations of private sanitary sewer lift stations received from the COJ; and (3) potential septic system locations provided by the WSEA. This information was used to identify any putative sources and guide field investigations.

PBS&J performed a preliminary field review of 11 WBIDs, including the Leeds Pond watershed, in conjunction with Dr. Valerie J. Harwood, to identify specific points of interest and potential sampling locations in the watershed. The findings of these efforts are included in **Sections 3.0** and **4.0** of this report.

2.3.2 Project Workshop

On August 15, 2008, PBS&J directed a project workshop that included a presentation of results from the preliminary field review. The presentation provided an evaluation of the compiled information, the identification of potential sources of fecal coliform contamination for each WBID from the preliminary field review, and an overview of the preliminary data analyses performed to date (**Section 2.2**). The information shared

served to introduce the WBIDs to the workshop participants, educate them on the findings of the preliminary field review, and provide a knowledge base from which to expand upon during the “Maps on the Table” exercise.

The “Maps on the Table” effort involved 20 participants, randomly divided into two groups, who were asked to combine the background information in the workshop presentation with their specific local knowledge. Participants developed a list of potential sources of fecal contamination and then spatially identified and recorded them onto the maps. The maps provided to the groups included aerial images, infrastructure, land use, historical sampling locations, and points of interest compiled for each WBID during the preliminary field review. Each group designated a recorder and a presenter and was given approximately 25 minutes to identify potential sources for each WBID. The results, later presented to the entire group, were evaluated and confirmed during the “Walk the WBIDs” exercise (**Section 2.4**) and are included in **Sections 3.0** and **4.0** of this report.

2.4 Walk the WBIDs

The “Walk the WBIDs” exercise took place on September 8–10, 2008, and September 29–October 2, 2008, and included participation from over 20 individuals representing eight organizations: COJ EQD, COJ PWD, DCHD, FDEP, FDOT, JEA, PBS&J, and USF. This effort had four main objectives, as follows:

1. Confirm tributary characteristics and sampling locations;
2. Verify land use and current ideas of potential sources in each watershed;
3. Elicit any additional information from participants; and
4. Improve the overall understanding of the characteristics of each WBID.

Specific points of interest and potential future sampling locations were verified through this process (see **Map 4**). **Sections 3.0** and **4.0** of this report include information resulting from this exercise.

Chapter 3.0: Identification of Potential Fecal Coliform Sources in Leeds Pond

The data compilation and analysis summarized in Chapter 2 were used to identify potential sources of fecal coliform contamination in the Leeds Pond watershed. The recognition of these potential sources and their potential geographic locations is a key element in designing the implementation portion of the project (e.g., determining sampling station locations and identifying appropriate and cost-effective source-tracking tests). **Sections 3.3** through **3.5** provide details of these results; **Tables 8** and **9** (in **Section 4.0**) summarize the efforts made to identify probable sources and the results of these efforts, respectively.

3.1 Types of Sources

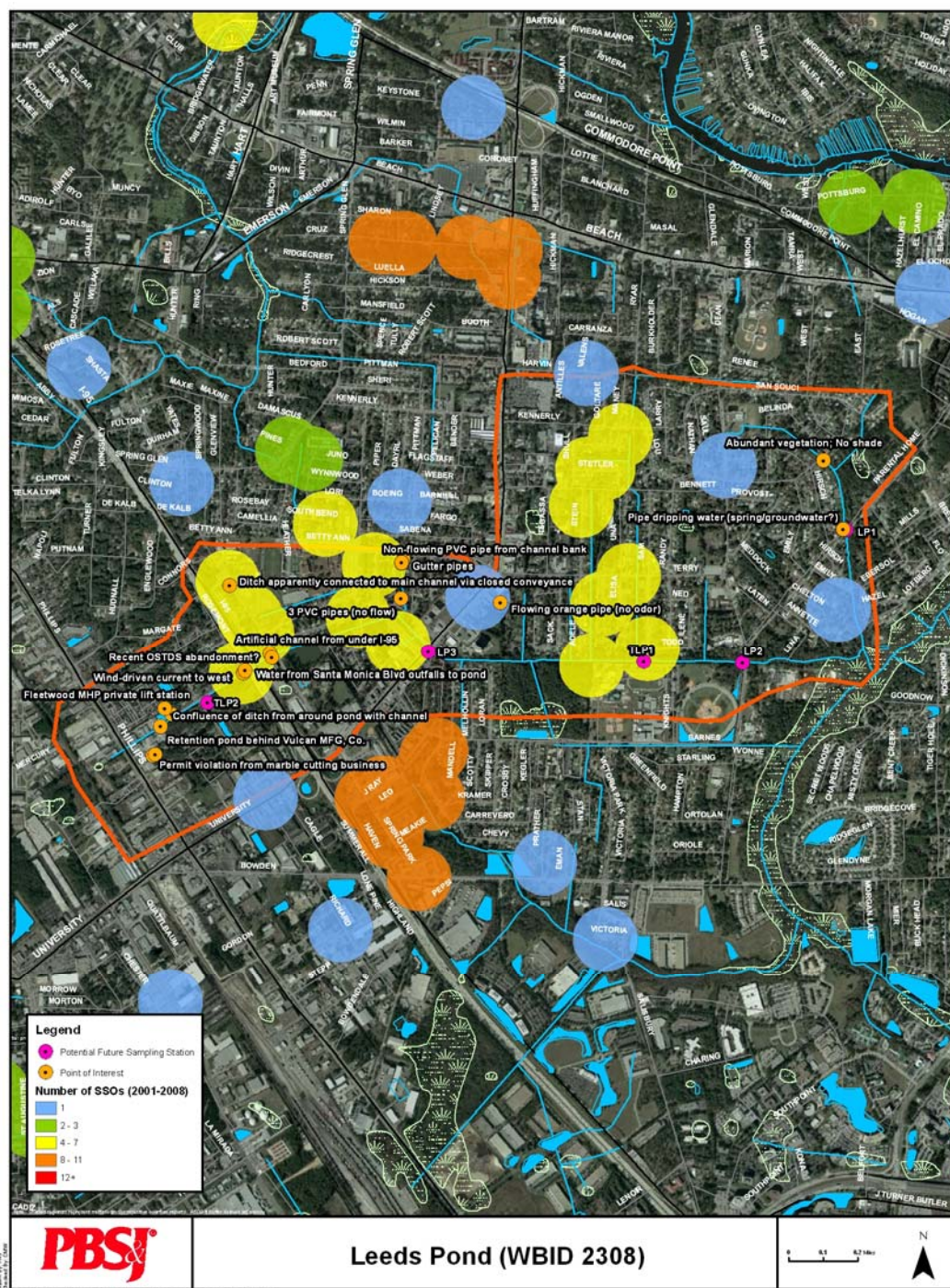
Sources are broadly classified as either “point sources” or “nonpoint sources.” For the purposes of this report, the term “point source” refers to discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term “nonpoint source” is used to describe intermittent, 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.

3.2 Point Sources

There are no industrial or domestic wastewater facilities, CAFOs, application sites for septic residuals, or landfills permitted to discharge to the Leeds Pond watershed (**Appendix A, Figures 4 and 11**). During the “Walk the WBIDs” exercise on September 10, 2008, an industrial discharge was found at Union of Marble, Unimer Inc., located at 5105 Phillips Highway (**Map 4**). The facility did not have a turbidity barrier in place and turbid water was flowing into a ditch near the headwaters of Leeds Pond. The facility is currently under investigation by FDEP and a citation to eliminate the discharge has been issued.

The COJ does have a Municipal Separate Storm Sewer System (MS4) permit (No. FLS000012, issued October 8, 2002–October 7, 2007) that includes the Leeds Pond basin.

Identification of Potential Fecal Coliform Sources in Leeds Pond



Map 4. Locations of SSOs within the Leeds Pond watershed reported by JEA between 2001 and 2008 and points of interest. Note: Shaded regions represent multiple and/or repetitive overflow reports. A 500-foot buffer defines adjacency

3.3 *Illicit Discharges*

Contamination of the stormwater drainage system and receiving waters by illegal and/or improper discharges occurs in a variety of ways. Such discharges may include, but are not limited to, sanitary sewer flow, industrial process water, chlorinated pool water, and laundry releases. Sanitary sewer flow may result from improper connections to sanitary sewage pipes, leaking and broken sewage pipes, backups and overflows of sewage conveyance systems during localized flooding, and the direct connection of septic systems to stormwater conveyance systems that short-circuits treatment provided by the drainfield.

The COJ EQD is continuing a program to identify, confirm, and respond to illicit connection issues in Jacksonville. As part of this effort, the COJ has confirmed approximately 1,100 potential illicit connections (PICs) to the MS4 (as of September 2006); most were related to swimming pools and washing machines and have been resolved (**Section 5.3.4**). No illicit connections were identified in the Leeds Pond watershed. It is important to note despite an effort to identify all PICs connected to MS4 ditches, it is not guaranteed that all PICs were found. In addition, the program did not include the inspection of closed conveyance systems. As a result, additional illicit connections may be present in the watershed.

For example, numerous PICs were observed along a ditch located between Vancouver Drive and Revelstoke Drive during the “Walk the WBIDs” exercise on September 10, 2008. The majority of these were determined to be originating from gutters and storm drains. Two pipes were also observed at a ditch west of 5930 University Boulevard. One orange pipe was discharging odorless water into the ditch and is suspected of originating at a heat pump from businesses located near 5930 University Boulevard (**Map 4**). The second pipe was not discharging during the field investigation and appeared to be a stormwater pipe from a storm drain, located in a nearby low-lying area. A pipe was also discovered dripping odorless water into the northern branch at Parental Home Road (**Map 4**). Though not confirmed, this appeared to be ground water.

3.3.1 Centralized Sewage Infrastructure and Overflows

The role of collection system influences on bacterial abundance in Leeds Pond was further assessed by reviewing the amount of sewer infrastructure in the basin and the information provided by JEA on recent SSOs in the COJ. As discussed earlier in **Section 1.3.2.1**, overflows are commonly caused by the inflow of stormwater or the infiltration of ground water into sewer lines resulting from heavy rainfall, breaks or blockages in sewer lines due to aging infrastructure or the accumulation of grease, and malfunctioning equipment and pumps (possibly due to power failures). The information presented contains locations of reported sewer overflows, as well as information on the volume of sewage believed to have been released accidentally. Data analyzed for this report covered the period from March 9, 2001, through July 2008.

The Leeds Pond basin is located within the Buckman WWTF Service Area. There are an estimated 1,747 households (approximately 69% of households) connected to the sanitary

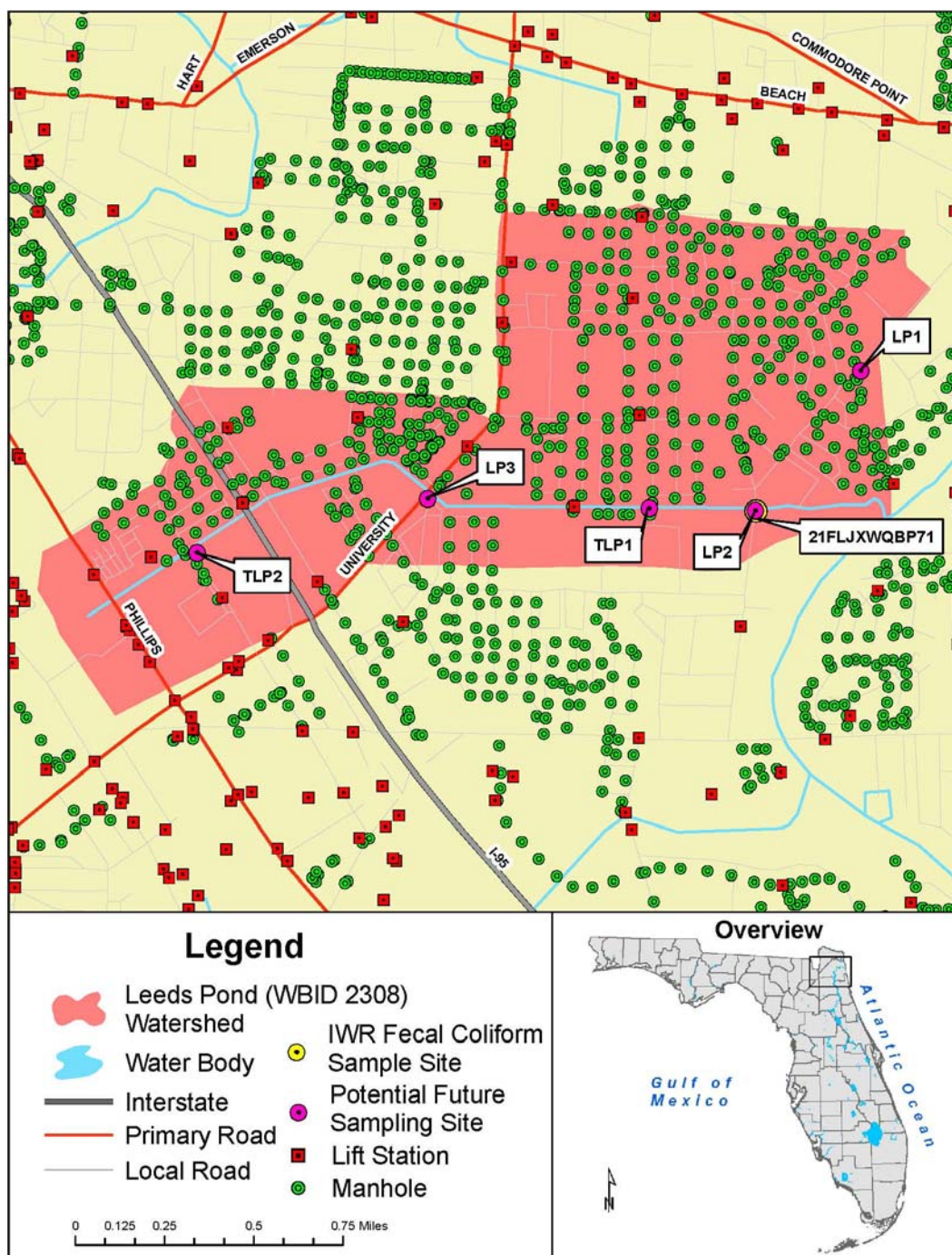
sewer system within the Leeds Pond basin. This basin supports nearly 40.5 kilometers (25 miles) of sewer lines and 20 sanitary sewer lift stations (including 10 private), as well as associated infrastructure (e.g., manholes) that comprise the central sanitary sewer system and have the potential to contribute fecal contamination to surface waters (**Appendix A, Figure 12**; see **Map 5** for lift station locations). One private lift station, belonging to the Fleetwood Mobile Home Park at 5001 Phillips Highway (**Map 4**) and did not appear to be maintained properly during the “Walk the WBIDs” effort on September 10, 2008, was inspected by the COJ EQD on October 30, 2008. No violations were noted at that time.

Available GIS data indicate that sewer infrastructure (e.g., sewer mains, lift stations, manholes) is generally located in close proximity to surface waters throughout the basin, primarily on the north side of Leeds Pond. A force main parallels the main channel from just north of the Richard Street and Wesch Boulevard Drive intersection east to Spring Park Road, and another force main crosses either above or below surface waters at Barnes Road. The close proximity of sanitary sewer infrastructure to Leeds Pond increases the possibility of potential spills and/or unidentified sewer infrastructure leaks (e.g., from underground sewer mains) to impact surface waters. There have been a total of 18 sanitary sewer overflows reported by JEA within the Leeds Pond WBID boundaries (**Map 6; Table 4; Appendix A, Figure 8**); areas with repetitive SSO events are located throughout the basin with the exception of the northern branch (**Map 4**). The most recent reported SSO occurred in 2006. The estimated volume of spills associated with these overflows ranged from 10 to 15,000 gallons and averaged approximately 2,391 gallons; nine SSOs were reported to have potentially impacted surface waters (**Map 6; Table 4**).

Monitoring results, as discussed in **Section 2.2**, demonstrate the consistency of elevated levels of fecal coliform bacteria throughout the period of record (March 1984–April 2007) at station BP71 (**Table 3**). Unfortunately, these sampling events did not coincide with SSO incidents. As such, it is unlikely that the nine reported SSOs that potentially affected surface waters were responsible for the consistent fecal coliform exceedances observed at station BP71. Additionally, the highest levels of fecal coliforms observed at all IWR stations did not correspond with the reported SSO incidents. This demonstrates that other sources, such as unidentified sewer infrastructure leaks (e.g., from underground sewer mains) and/or failing OSTDS may be contributing to the overall pollution of the Leeds Pond watershed. Additional sampling at upstream and midstream segments of the creek is needed to verify potential downstream transport to station BP71.

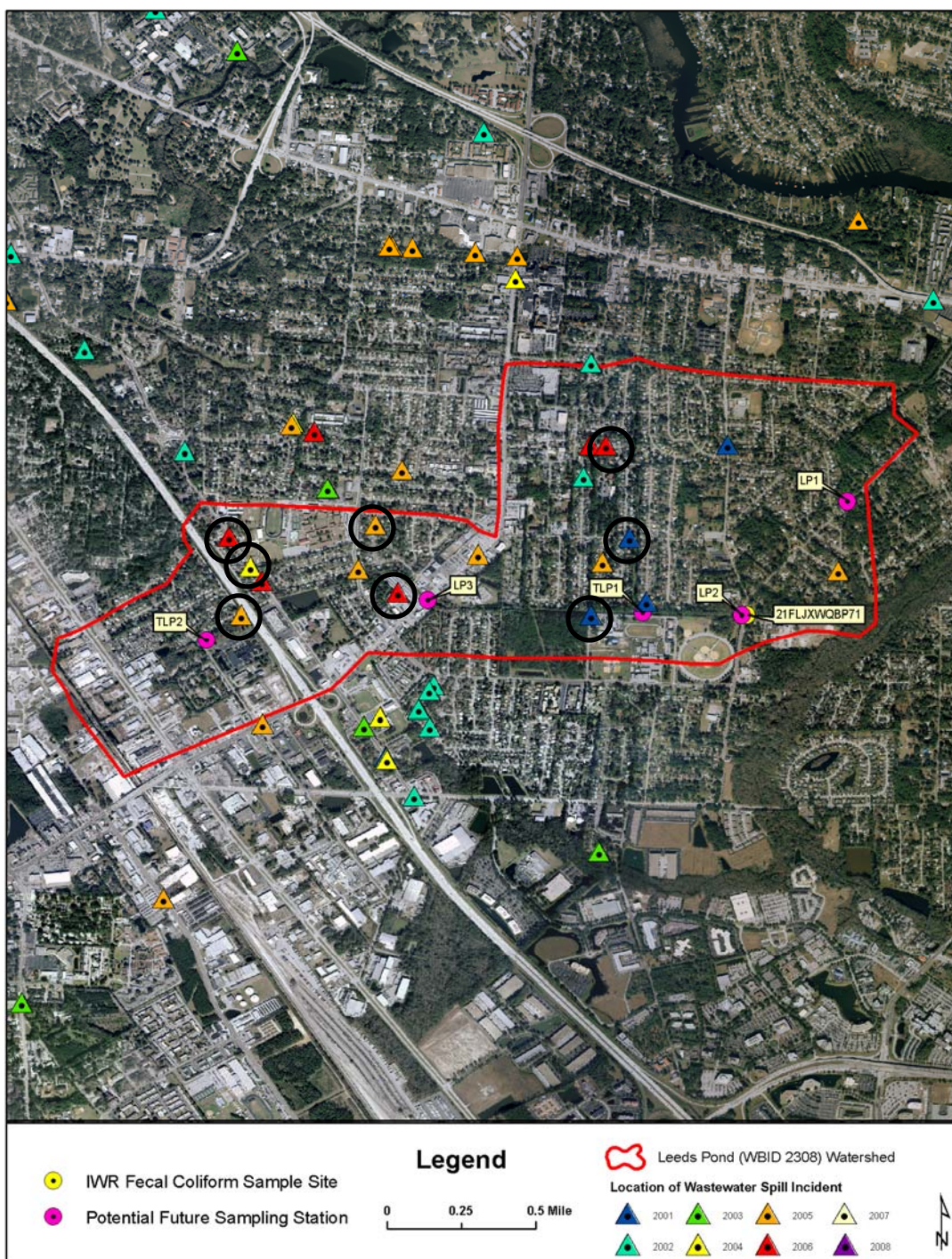
It is important to note that sediments provide ultraviolet (UV) radiation protection and key nutrient sources (e.g., carbon, nitrogen, and phosphorus) that allow bacteria to grow and survive, thus facilitating the development of reservoirs for fecal bacteria (Mallin et al. 2007). Inoculation of the sediments following an SSO event or unknown infrastructure leak may therefore lead to the persistence and likelihood of re-growth of indicator bacteria in sediments, thereby possibly allowing an influx of high levels of bacteria to receiving waters for an unspecified duration of time (Davies et al. 1995, Anderson et al. 2005, (Mallin et al. 2007).

Identification of Potential Fecal Coliform Sources in Leeds Pond



Map 5. Leeds Pond wastewater infrastructure with sanitary sewer lift stations, including private lift stations (2001–2008)

Identification of Potential Fecal Coliform Sources in Leeds Pond



Map 6. Locations of SSOs within the Leeds Pond watershed reported by JEA between 2001 and 2008. Black circles represent locations of SSOs that were reported to potentially impact surface waters

Identification of Potential Fecal Coliform Sources in Leeds Pond

Table 4. SSOs reported in Leeds Pond from 2001–2008. *Reportable SSOs that spilled >1,000 gallons of sewage and/or affected surface waters

WBID	WBID Name	Date of Overflow	Estimated Volume of Spill (gallons)	Potentially Impacted Surface Waters
2308	Leeds Pond	6-Aug-01*	10,000	Data not available prior to October 2001
2308	Leeds Pond	4-Sep-01	300	Data not available prior to October 2001
2308	Leeds Pond	16-Oct-01*	2,000	Y
2308	Leeds Pond	8-Nov-01*	1,200	Y
2308	Leeds Pond	10-Dec-01*	500	Y
2308	Leeds Pond	17-Jan-02*	700	Y
2308	Leeds Pond	25-Feb-04	100	N
2308	Leeds Pond	5-Jan-05*	3,500	Y
2308	Leeds Pond	24-Mar-05	20	N
2308	Leeds Pond	20-Jun-05	50	N
2308	Leeds Pond	23-Jun-05	250	N
2308	Leeds Pond	26-Aug-05	50	N
2308	Leeds Pond	13-Oct-05*	2,500	Y
2308	Leeds Pond	24-Jan-06*	15,000	Y
2308	Leeds Pond	5-Feb-06	10	N
2308	Leeds Pond	22-May-06*	3,800	Y
2308	Leeds Pond	20-Jun-06*	50	Y
2308	Leeds Pond	12-Dec-06*	3,000	N

3.4 OSTDS

Data on the number of septic systems within Duval County do not exist. As a result, the number of septic systems present in each watershed in the county represents an approximation based on the difference between (1) the 2000 U.S. Census results estimated for each watershed and (2) the total number of households in Duval County that receive sanitary sewer service from JEA (information obtained from JEA on May 23, 2007).

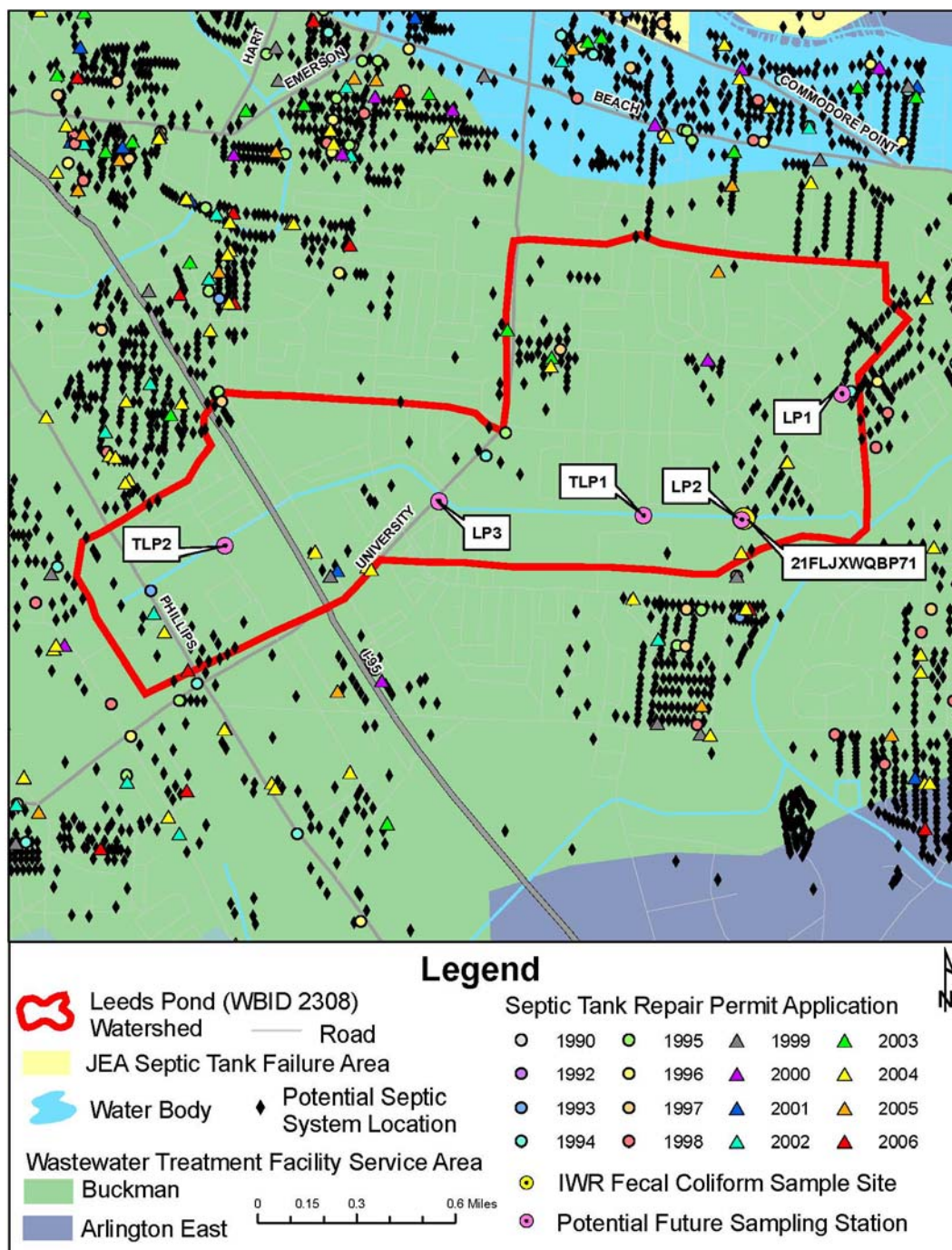
It is estimated that approximately 790 households (roughly 31% of households) use OSTDS in the Leeds Pond basin. Households that potentially utilize septic systems are located near Leeds Pond surface waters (1) between Parental Home Road and Annette Circle; (2) along the east side of the northern branch from the northern branch and Parental Home Road intersection north to Deloach Lane; and (3) within the current Pottsborg Creek WBID boundaries, just south of Barnes Road South between Knights Lane West and Knights Lane East (**Map 7**). In addition, according to the DCHD, 25 septic system repair permits were issued within the Leeds Pond watershed between 1993

and August 2006, resulting in a failure rate of approximately 3.2% over this period, or nearly two systems per year (0.2% per year). The permits, and presumably failed septic systems, were scattered throughout the basin. Parcels with repair permits that are in close proximity to surface waters are located (1) near the “headwaters” where Phillips Highway intersects the main channel; (2) just north of Leeds Pond at Parental Home Road; (3) at the eastern WBID boundary just east of Parental Home Road; and (4) within the current Pottsburg Creek WBID boundaries between Knights Lane West and Knights Lane East.

The proximity of parcels potentially connected to OSTDS and those with prior repair permits to surface waters suggests that septic systems potentially affect the water quality of Leeds Pond in these areas. During the “Walk the WBIDs” exercise on September 10, 2008, OSTDS were observed at industrial areas located along Phillips Highway near the “headwaters” of Leeds Pond. As parcels near the “headwaters” currently utilize OSTDS and have previous septic system repairs, there is a potential for OSTDS to contribute to the contamination in this area. No DCHD-designated septic system failure areas are located in close proximity to the boundary of the basin (**Map 7; Appendix A, Figure 7**). Septic system failure areas are identified and ranked by the DCHD using an eight-point criteria system (**Section 5.2.1**). It is important to note that as of July 2008, there were 37 septic system failure areas, one of which is designated as a “Sanitary Nuisance Area” in Duval County; six previously designated nuisance areas were removed from the list in July 2007.

Considering that an estimated 31% of households utilize OSTDS and that 25 repair permits were filed by property owners throughout the basin, it is possible that OSTDS play a contributing role in fecal loading of Leeds Pond, especially where OSTDS are potentially located and where repair permits occurred in close proximity to surface waters. Many of the potential septic system locations (**Map 7**) and septic system repair permits (**Appendix A, Figure 7**) are located in soils with very slow infiltration rates (**Map 9**), increasing the potential for OSTDS failures in these areas. Of course, it is also possible that failing septic systems that have not been issued repair permits exist in close proximity to the creek and may contribute to bacterial contamination in the receiving waters in other areas of the basin as well. It should be noted that no failing systems were identified within Leeds Pond during the Walk the WBIDs field effort on September 10, 2008.

Identification of Potential Fecal Coliform Sources in Leeds Pond



Map 7. OSTDS repair permits and potential locations in the Leeds Pond basin

3.5 Land Uses and Nonpoint Sources

As defined in **Section 3.1**, the term “nonpoint sources” is used to describe intermittent, rainfall-driven, diffuse sources of pollution (e.g., stormwater runoff) associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from failing septic systems; and atmospheric deposition. Additional nonpoint sources may include areas with concentrated wildlife (e.g., bird rookeries) or domestic animals (e.g., dog parks). As a result, information on land use can be instrumental in identifying probable nonpoint sources of fecal pollution.

3.5.1 Land Uses

The spatial distribution and acreage of different land use categories in the Leeds Pond watershed were identified using 2004 land-use coverage data from the SJRWMD (**Appendix A, Figure 5; Table 5**). The dominant land use (467.3 acres; 41.5% of total coverage) in the Leeds Pond watershed is classified as medium-density residential and is predominantly located (1) east of University Boulevard West; (2) along Spring Glen Road between Interstate 95 and University Boulevard South; and (3) in a small area southwest of the Wesch Boulevard and Richard Street intersection.

The next two most abundant land cover categories are (1) commercial/utility and institutional areas (340.5 acres; 30.2 % of total coverage), located adjacent to surface waters (i) on either side of Phillips Highway, (ii) along Interstate 95, south of Leeds Pond, (iii) paralleling University Boulevard West, and (iv) at Parental Home Road; and (2) high-density residential areas (101.1 acres; 9% of total coverage), located adjacent to Leeds Pond (i) between Interstate 95 and Phillips Highway in the northwest portion of the WBID, (ii) extending from South Santa Monica Boulevard south to South Glorianne Circle between West Glorianne Circle and Barnes Road, (iii) between University Boulevard West and West Loran Drive at the Palisades Apartments, and (iv) from University Boulevard West east to West Sack Drive at the Randal Court Apartments. Upland forests and wetland habitat accounted for less than 5% of land usage within the basin.

It is important to note, however, that any contamination transported to Leeds Pond from the area currently designated as part of Pottsburg Creek passes through a wetland system before joining with the main channel. No agricultural or specialty farm land uses (e.g., dog kennels, horse farms) were identified within the Leeds Pond watershed. Furthermore, there are no known areas of concentrated wildlife (e.g., bird rookeries) within the basin, although several (approximately 20) waterfowl were observed occupying a retention pond near the basin headwaters during the “Walk the WBIDs” effort on September 10, 2008.

The Leeds Pond basin is predominantly urban with no open land. According to the 2000 Census, there are 2,537 households within the basin, averaging 2 people per household. In addition, assuming that 40 percent of households have one dog (Tyler 2006), there are an estimated 1,015 dogs in the watershed.

Identification of Potential Fecal Coliform Sources in Leeds Pond

Table 5. Land Use Statistics for Leeds Pond, WBID 2308

WBID	Land Use	Acres	% of Total
2308	Medium Density Residential	467.3	41.5
2308	Commercial/ Utility/ Institutional	340.5	30.2
2308	High Density Residential	101.1	9.0
2308	Low Density Residential	85.8	7.6
2308	Recreational	52.4	4.7
2308	Transportation	39.1	3.5
2308	Wetlands	23.3	2.1
2308	Upland Forest	15.1	1.3
2308	Water	1.2	0.1
Total		1125.9	100

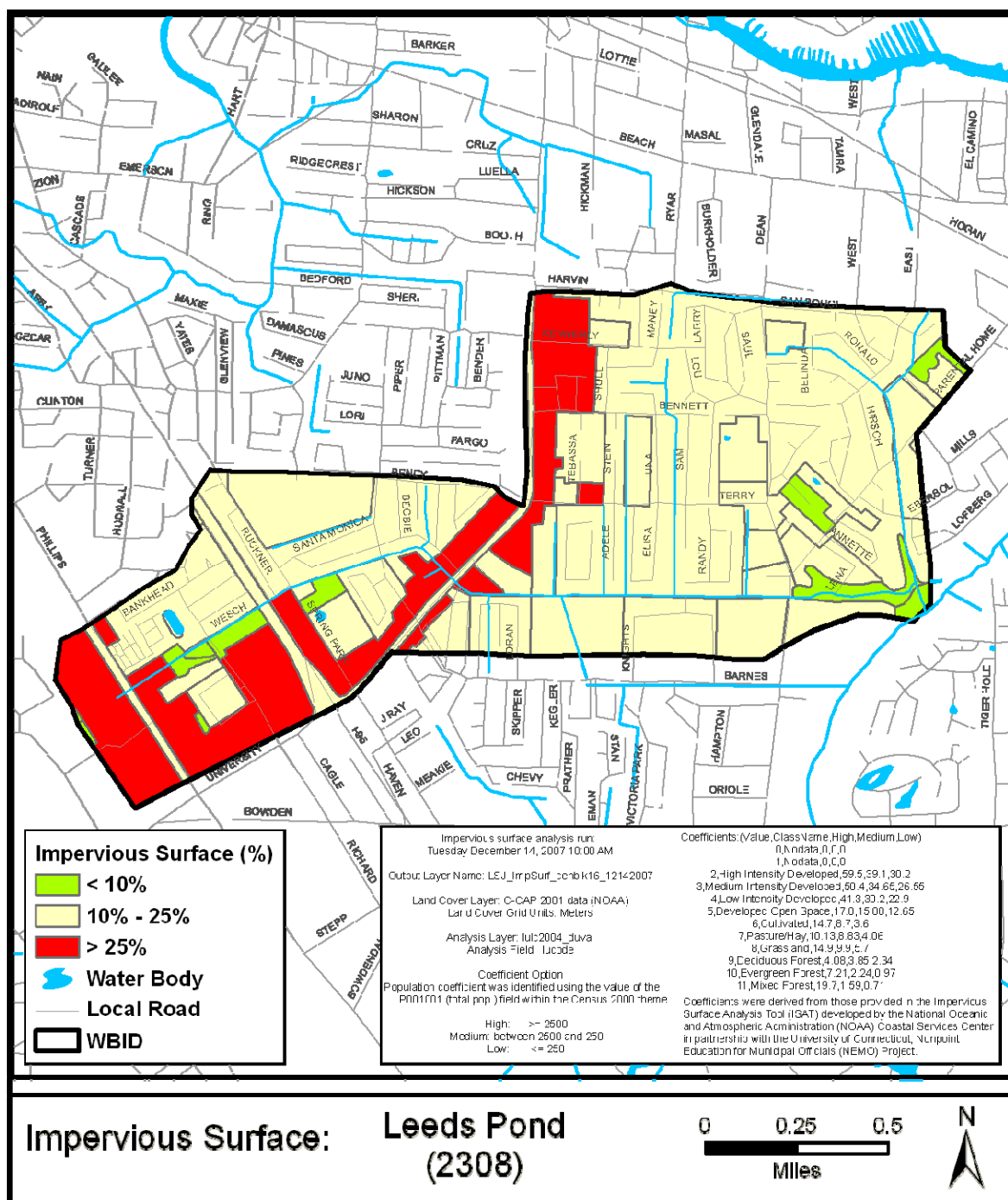
Analysis of impervious surface, using coefficients derived from those provided in the Impervious Surface Analysis Tool (ISAT) developed by the National Oceanic and Atmospheric Administration (NOAA) Coast Services Center in partnership with the University of Connecticut, Nonpoint Education for Municipal Officials (NEMO) Project, indicates that the Leeds Pond WBID contains predominantly 10 to 25% impervious surface (**Map 8**). The basin also contains land with >25% impervious surface. These areas generally correspond to commercial/utility and institutional and industrial land use classifications and are located primarily (1) in the east corner of the WBID on either side of Phillips Highway; (2) along Interstate 95 south of Leeds Pond; and (3) paralleling University Boulevard West.

A soils survey (U.S. Department of Agriculture/Natural Resources Conservation Service [USDA/NRCS], provided by the Soil Survey Geographic [SSURGO] Database 2006) indicates that the WBID contains a mixture of soils with slow and very slow infiltration rates (**Map 9**). Soils with slow infiltration rates are located in small patches within the WBID (1) south of Terry Road between University Boulevard West and Sack Drive West; (2) in a small area of Curtis Lovelace Park; (3) south of Leeds Pond between Knights Lane East and the eastern WBID boundary; and (4) just southeast of the Randy Road and Bennett Road intersection. Soils with very slow infiltration rates occur (1) along Leeds Pond between just east of Phillips Highway and Richard Street; (2) just southeast of the Wesch Boulevard and Spring Park Road intersection; (3) south of Leeds Pond from Loran Drive East to the eastern WBID boundary; (4) in areas from Ilene Road west to Lena Road between Emily Courts and Leeds Pond; (5) just southeast of the Randy Road and Bennett Road intersection; and (6) along the northern branch. As soils with very slow infiltration rates are characterized as clayey, have a high water table, or are shallow to an impervious layer, there is an increased potential of septic system failure in these areas. The majority of the WBID did not have soil information available, likely due to the extensive degree of urbanization that has occurred within the watershed.

Furthermore, the potential for stormwater runoff was predicted through the calculation of runoff coefficients using the U.S. Soil Conservation Service (SCS) Curve Number approach (U.S. Soil Conservation Service 1986). This analysis demonstrates that the

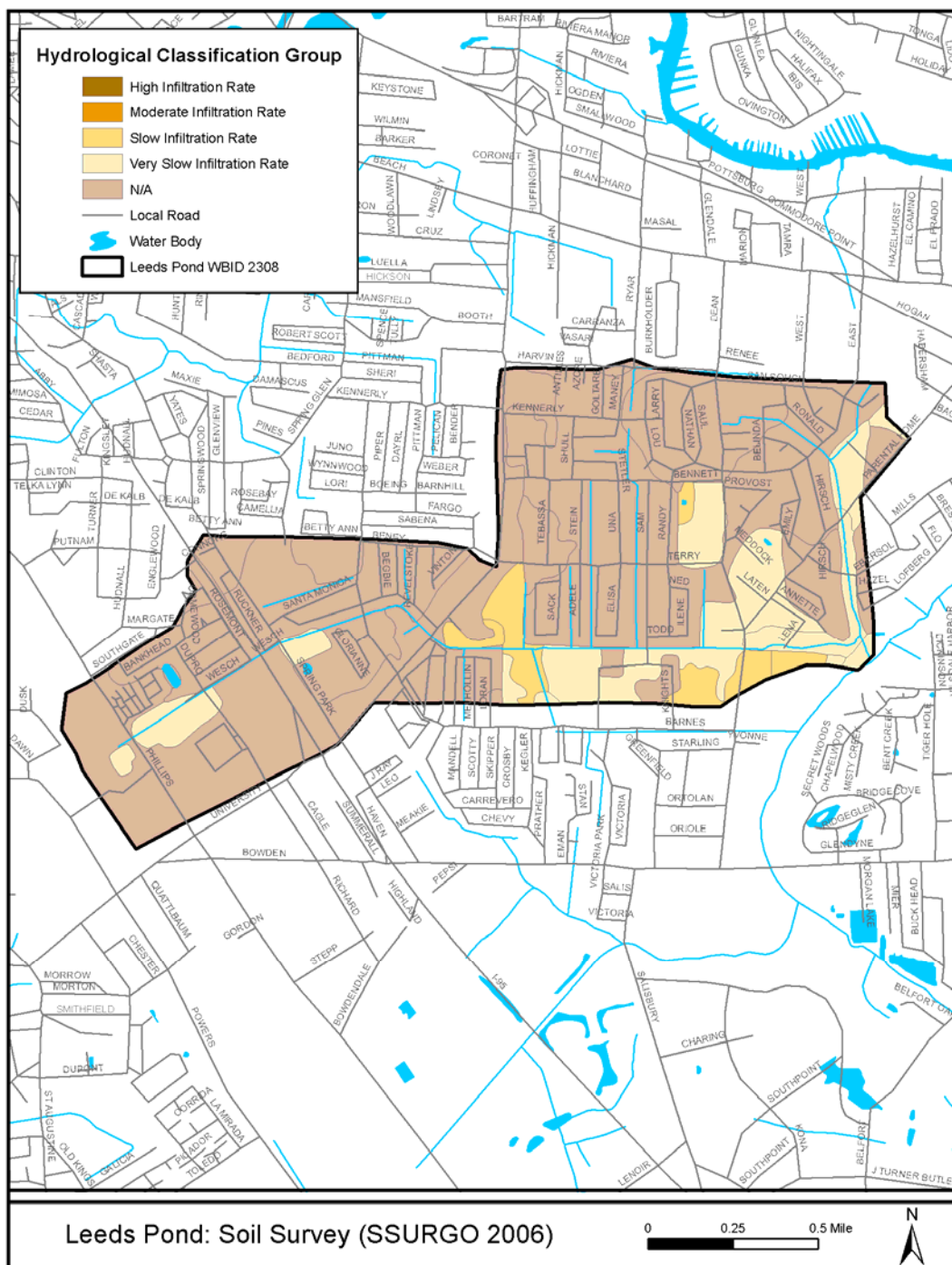
majority of the WBID contains a moderate-to-high potential for stormwater runoff, which includes areas in close proximity to the creek (**Map 10**). The highest runoff coefficients are located primarily (1) in the eastern corner of the WBID along Phillips Highway and Interstate 95; (2) paralleling University Boulevard; (3) between Knights Lane West and Knights Lane East; and (4) along Dean Road just south of the Terry Road and Dean Road intersection.

Identification of Potential Fecal Coliform Sources in Leeds Pond

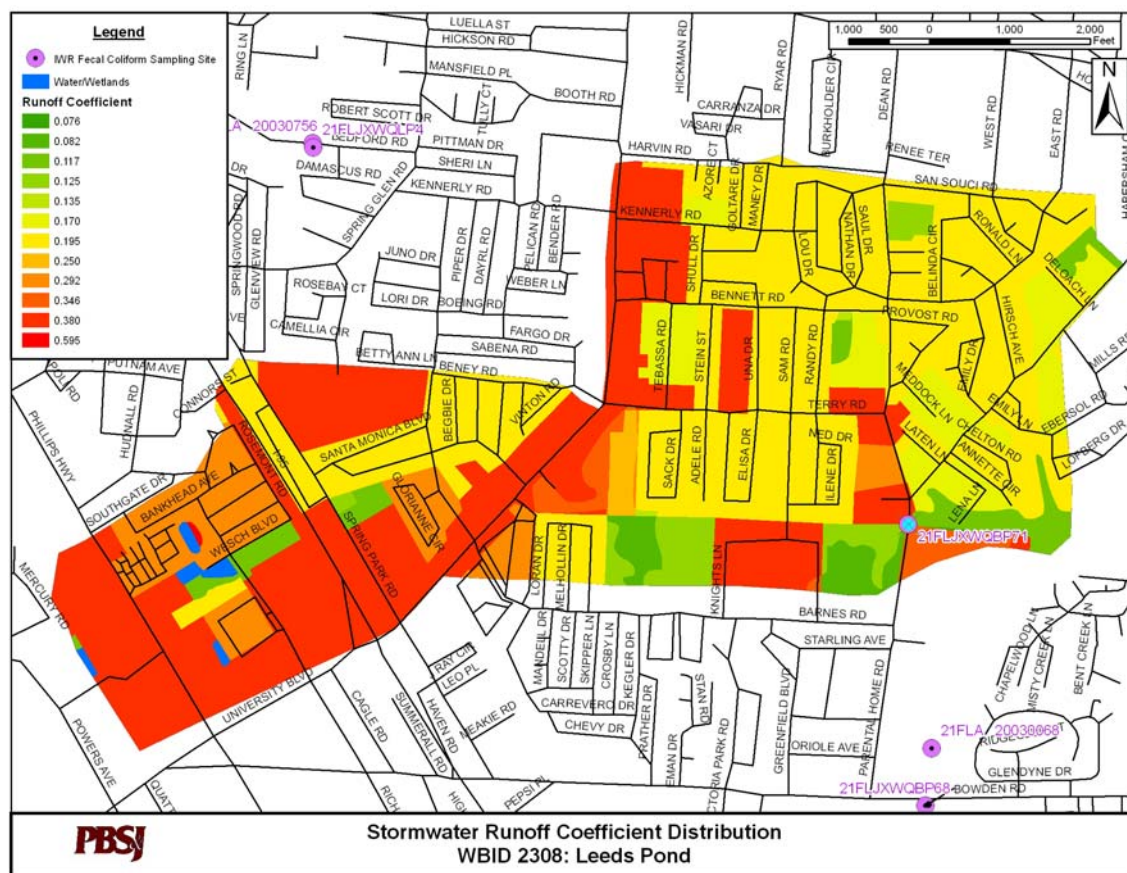


Map 8. Analysis of impervious surface in the Leeds Pond watershed, using coefficients derived from those provided in the ISAT, developed by the NOAA Coast Services Center in partnership with the University of Connecticut NEMO Project

Identification of Potential Fecal Coliform Sources in Leeds Pond



Map 9. Soils survey for the Leeds Pond watershed (USDA/NRCS, provided by the SSURGO Database 2006)



Map 10. Stormwater runoff coefficient distribution for Leeds Pond

Note: Runoff coefficients were calculated using the SCS Curve Number approach (SCS 1986). Areas in red indicate locations on land where the most stormwater runoff is expected to occur. Areas of water and wetlands will, by nature, have extremely high amounts of runoff. As a result, these areas were delineated separately to gain a better idea of the runoff potential on land.

3.5.2 Nonpoint Sources

The persistence and likelihood of re-growth of indicator bacteria in sediments allow stormwater conveyance systems, especially those underground, to act as reservoirs for contamination that periodically result in the influx of high levels of bacteria to receiving waters (Anderson et al. 2005, Brownell et al. 2007). The storm sewer network in the Leeds Pond watershed includes 26 permitted stormwater treatment areas, encompassing approximately 6% to 42% of the WBID area (**Table 6**). Stormwater infrastructure within the WBID includes 102 outfalls by receiving water (0 classified by FDEP as “major outfalls”) and 513 inlets. Closed conveyances and numerous contributing ditches are common throughout the WBID.

Identification of Potential Fecal Coliform Sources in Leeds Pond

Table 6. Stormwater treatment areas in the Leeds Pond watershed that have been permitted by the SJRWMD

WBID	SJRWMD Permit Number	Area Treated (acres)
2308	18063	36.8 ¹
2308	18106	11 ¹
2308	24922	32 ¹
2308	24924	269 ¹
2308	25405	33.78 ¹
2308	25672	1
2308	25712	1.32 ¹
2308	39247	0.85
2308	39525	1.4
2308	64144	0.17
2308	64179	0.2
2308	65351	2.41
2308	65830	1.4
2308	66894	43
2308	83131	1.37
2308	84577	2.5
2308	85477	2.89
2308	88391	2.04
2308	88819	1.5
2308	88826	15.49 ¹
2308	93327	1.8
2308	99022	0.75
2308	99197	0.98
2308	100349	2.87
2308	104894	4.17 ¹
2308	109149	2.34
Total area (acres) treated in WBID 2308 (26 permits)		69.47 to 473.03²
Total area (acres) not treated in WBID 2308		652.88³
Total area (acres) of WBID 2308		1,125.91
Total percent of area treated in WBID 2308		6.17 to 42.01%³

¹ Locations where only a portion of the permitted area is within the WBID.

² Varies from the minimum to the maximum treatment area based on the partial values.

³ Based on the maximum treatment area values.

Ditch systems that merge with Leeds Pond (listed from most upstream to downstream) are located (1) between Vancouver Drive and Revelstoke Drive, from Beney Road south to Leeds Pond; (2) between West Loran Drive and Melhollin Drive from South Barnes Road north to Leeds Pond; (3) from just south of the University Boulevard and Terry Road intersection south to Leeds Pond; (4) from immediately east of the South Barnes Road and East Loran Drive intersection north to Leeds Pond; (5) just east of University Boulevard, from Terry Road south to Leeds Pond; (6) extending from just east of a stormwater pond, approximately 173 meters (569 feet) west of the South Barnes Road and West Knights Lane intersection, northwest to Leeds Pond; (7) from Terry Road between East Sack Drive and Adele Drive south to Leeds Pond; (8) stretching from immediately east of the Bennett Road and Stein Street intersection south to Leeds Pond; (9) between East Elisa Drive and Sam Road, from Terry Road south to Leeds Pond; and (10) from just south of the Terry Road and Ilene Drive intersection south to Leeds Pond (**Appendix A, Figure 10**).

It is important to note that segments of the main channel from Sam Road west to Spring Park Road, as well as the northern branch from Parental Home Road north to the upstream extents of its forks, are classified as ditches. As described previously, recent field investigations also indicate that a portion of the Pottsburg Creek watershed, beginning at the Knights Lane East and Barnes Road South intersection, drains west into the Leeds Pond basin at a ditch just east of the Barnes Road South and Kegler Drive intersection.

There are few ponds within the Leeds Pond watershed. The two most upstream ponds are located east and south of the Fleetwood Mobile Home & Recreational Vehicle (RV) Park at Phillips Highway. Another pond is located at the Jacksonville General Hospital, east of Richard Street. The most downstream pond is at the Drew Memorial Softball Complex west of Parental Home Road. Private and public sewer lift stations are located in close proximity to the ponds at the Fleetwood Mobile Home & RV Park and at the Jacksonville General Hospital, respectively; increasing the likelihood of potential SSOs to affect surface waters and possibly Leeds Pond.

During the “Walk the WBIDs” exercise on September 10, 2008, human and dog feces were identified near a ditch south of the headwaters behind 5295 Phillips Highway. As this ditch likely connects into Leeds Pond surface waters, both humans and dogs may be a contributing source in this upstream portion of the watershed. There were also approximately 20 waterfowl observed during the field investigation at ditches that connect the pond south of the Fleetwood Mobile Home & RV Park to Leeds Pond, which may also contribute to fecal contamination near the “headwaters” of Leeds Pond. Farther downstream, evidence of homeless populations was observed in a wooded area at the ditch located just east of University Boulevard; however, no signs of human feces were identified.

3.5.2.1 Seasonal Evaluation

In the absence of any identified major point sources of fecal coliform bacteria, nonpoint sources are considered to be potential sources of bacterial loading. Rainfall transports

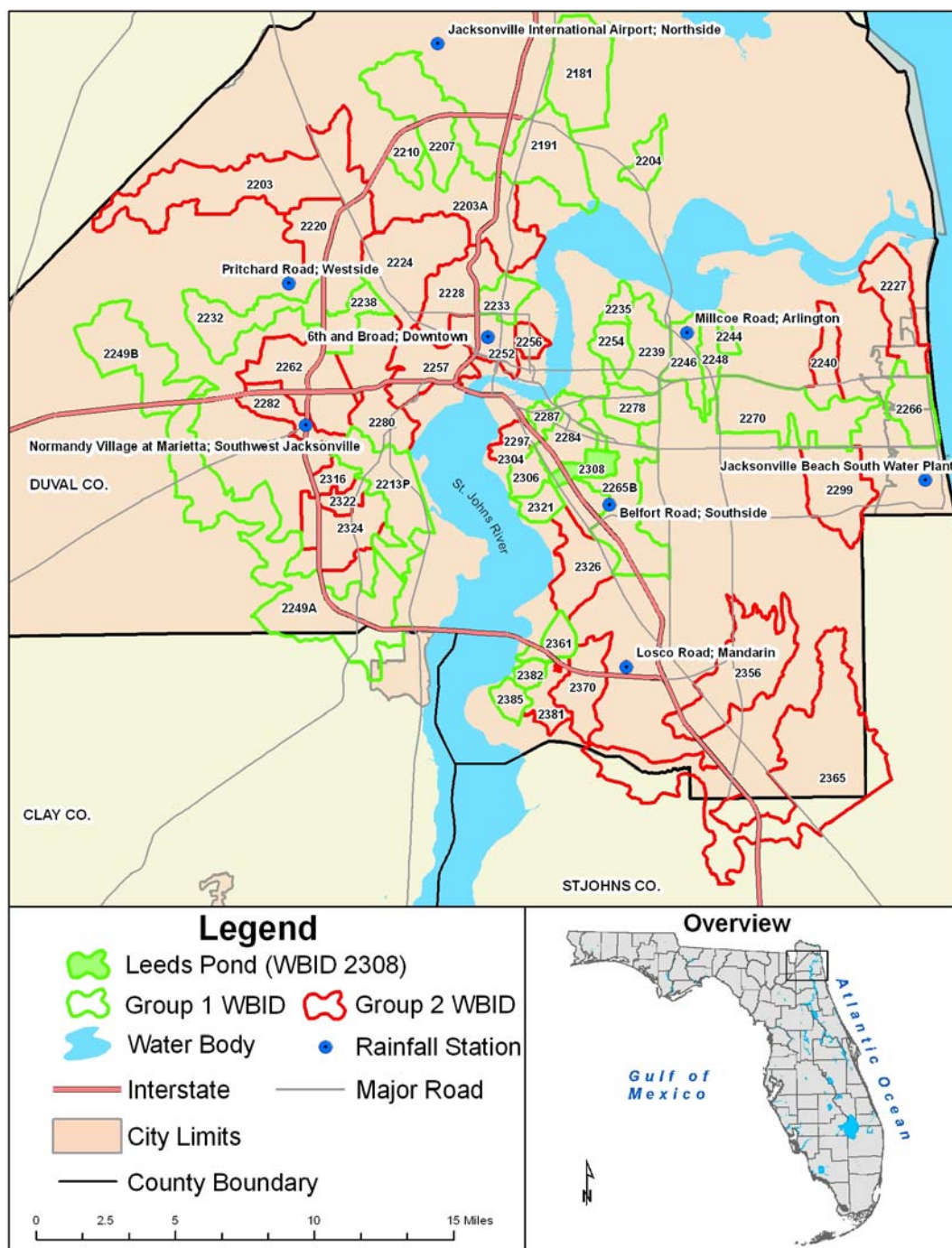
fecal coliform to waterbodies via runoff (stormwater, septic failure, and/or WWTF failure) (Eleria & Vogel 2005) and is therefore an important element to consider when identifying sources of fecal contamination.

As described in **Section 3.5.1**, the Leeds Pond watershed has a moderate-to-high potential for stormwater runoff. The fecal coliform data obtained from the IWR database were classified based on samples representing “wet” and “dry” seasons. The “wet” season was defined as June through October and the “dry” season as November through May (Winkler & Ceric 2006). The differentiation between the defined “wet” and “dry” seasons was confirmed by comparing the cumulative seasonal rainfall recorded daily at the Losco Road station (**Map 11**; <http://arcimspub.sjrwmd.com/website/dahds/design/index.html>) from January 18, 1996 to December 31, 2006 (T-test, $p < 0.001$).

The data used to examine seasonal differences in fecal coliform concentrations were log transformed for ease of statistical analysis and interpretation. The log-transformation of fecal coliform data is the standard method for interpretation. A comparison of the mean log-transformed fecal coliform concentrations between the “wet” and “dry” season at station BP71 was completed. A T-test was completed to compare the mean log-transformed fecal coliform concentrations between the “wet” and “dry” season at the station BP71. All assumptions required to complete the analysis were reviewed and satisfied (i.e., normality, equal variances, and independent samples); therefore, non-parametric analysis (Mann-Whitney comparison of medians) was not necessary. The mean fecal coliform concentration during the “dry” season, 3,217 CFU/100mL, was not statistically different from the “wet” season, 4,297 CFU/100mL (T-test, $p = 0.11$; **Table 7**; **Figure 3**).

Identifying a relationship between fecal coliform and rainfall data is challenging. In locations where failing septic systems are likely to be major contributors of bacterial loading, one may expect that bacterial concentrations in tributaries would be higher in the “dry” season due to continued influx via ground water combined with a reduced potential for dilution by large volumes of stormwater runoff. Alternatively, storms and heavy rainfall often encountered in the “wet” season may cause the failure of sewer or septic systems due to power outages, excessive volumes of water, or higher water tables, leading to elevated levels of fecal pollution. In other cases, increased volumes of water during the “wet” season may cause dilution of sources and appear to mitigate impacts. In instances where nonpoint sources (via stormwater runoff) are suspected as the major source of bacterial loading, higher concentration levels in the “wet” season would be anticipated. In this case, concentrations were not different during the “wet” and “dry” seasons at station “BP71,” suggesting a constant source of fecal coliform bacteria to Leeds Pond through nonpoint source discharges, failing wastewater conveyance systems, or septic systems independent of rainfall. It is possible that higher loadings occur in the “wet” season and are diluted by increased volumes of water, resulting in fecal coliform concentrations that appear to be independent of rainfall.

Identification of Potential Fecal Coliform Sources in Leeds Pond



Map 11. Location of SJRWMD rainfall stations within Duval County

Identification of Potential Fecal Coliform Sources in Leeds Pond

Table 7. Fecal coliform values at station BP71 during the “wet” and “dry” seasons. Fecal coliform levels are indicated as CFU/100mL

Station	Season	N	Mean	Median	Geometric Mean	Min	Max
BP71	Dry	37	3217	700	510	20	31000
	Wet	22	4297	2200	1259	40	30000

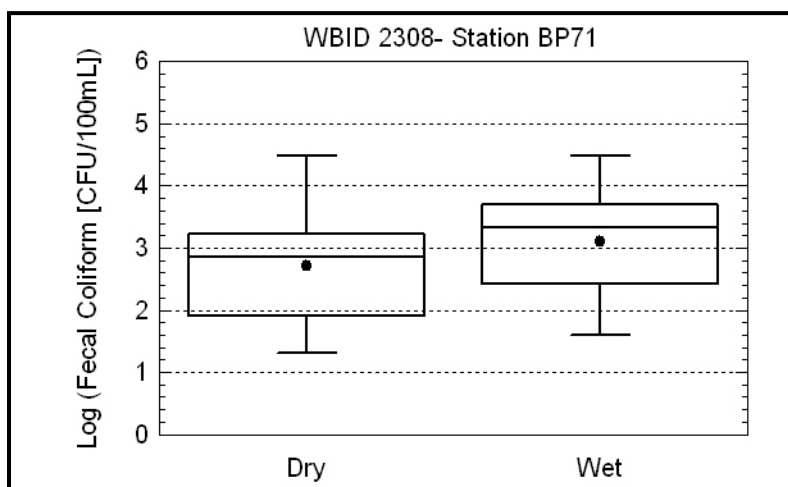


Figure 3. T-test comparison of means showed no statistical difference between seasons at station BP71 (T-test, $p=0.11$)

A more detailed analysis of the potential effect of rainfall on bacterial loadings was conducted for fecal coliform data obtained from the IWR database at station BP71. Daily rainfall data were retrieved from the Losco Road station (**Map 11**; <http://arcimspub.sjrwmd.com/website/dahds/design/index.htmL>), which reported rainfall data from January 18, 1996 to the present. The log-transformed fecal coliform concentrations for Leeds Pond were compared to daily rainfall. Additional comparisons between fecal coliform concentrations and total rainfall over a 2-, 3-, 4-, and 7-day period were also examined. No significant correlations were identified between the fecal coliform concentrations at station BP71 and rainfall. This analysis indicates that rainfall is not directly related to high bacteria loads in the waterbody at the timescales examined.

Additionally, 18 SSOs were documented within the WBID between March 2001 and July 2008; the most recent occurred on December 12, 2006 (**Map 6**; **Table 4**). Although almost half of the spills occurred during the “dry” season (N=8) compared to the “wet” season (N=10), 11 occurred within 2 days of a rainfall event (2-day total 0.01 to 2.48 inches). Of these, 5 occurred during the “dry” season, indicating that “dry” season rainfall may be a contributing factor to the occurrence of SSOs. Overflows that corresponded to rainfall possibly resulted from increased inflow of surface waters, infiltration of ground water, or mechanical failure due to a power outage. Fecal coliform data were not available during the events to determine the impacts on water quality and their potential relationship with rainfall. Additional data are needed to determine whether there is a definitive relationship between the occurrence of SSOs and rainfall.

Although SSOs often have an immediate impact on receiving waters, the chronic levels of fecal coliforms in the Leeds Pond basin indicate that continual inputs from unidentified existing pollution sources (e.g., underground sewer main leaks or failing OSTDS) are contributing to the overall bacteriological loading observed in the watershed. Unfortunately, the absence of multiple sampling stations prevents the ability to draw conclusions regarding bacteria transport or dilution from upstream to downstream locations.

Chapter 4.0: Fecal Coliform Source Assessment Summary

This evaluation indicates that the probable sources of fecal contamination in the Leeds Pond WBID are human related. Over 88% of this basin comprises residential (predominantly medium-density) and commercial/utility and institutional land uses that primarily utilize the centralized sewer system. Sanitary sewer infrastructure extends throughout the basin and has been responsible for 18 reported SSO incidents between 2001 and 2008, totaling an estimated 43,030 gallons of spilled sewage.

Although the SSOs do not appear to have contributed to the fecal pollution of surface waters during the sampling period since 2006, potential unidentified sewer infrastructure leaks (e.g., from underground sewer mains) may contribute to the overall fecal contamination in the Leeds Pond basin. Fewer households (approximately 31%) are connected to OSTDS; however, some of these systems may not be functioning properly, as reported by the 26 OSTDS repair permits filed by property owners throughout the basin.

In addition, stormwater runoff, as a conveyance system for a variety of more specific sources of bacterial contamination, is also a potential contributor, as >25% impervious surface and moderate-to-high runoff coefficients were calculated for areas of the basin in close proximity to surface waters. **Table 8** describes the efforts used to determine fecal coliform impairments and identify probable sources. **Table 9** identifies the most likely sources of fecal contamination for each area of Leeds Pond.

Fecal Coliform Source Assessment Summary

Table 8. Summary of the efforts used to determine impairments and identify probable sources of fecal coliform contamination

Sampling Location	Corresponding Station Identification	Regular Ambient Fecal Coliform Monitoring	Additional Fecal Coliform Monitoring	Additional Indicator Bacteria Measurements	MST Analysis	Correlation with Physical Parameters	Seasonal Evaluation	Rainfall Analysis
Parental Home Road	21FLJXWQBP71	X				X	X	X

Table 9. Summary of most probable sources of fecal contamination contributing to Leeds Pond sampling locations

IWR Station	Most Probable Source	Station Location	Weight-of-Evidence for Source Identification	Comments
21FLJXWQBP71	Human Sanitary Sewer OSTDS	Parental Home Road	Consistent elevated fecal coliform levels (N=59; 44% of samples >1,000 CFU/100mL) with episodic extremes (12% >10,000 CFU/100mL) Sanitary Sewer Located downstream of sewer infrastructure (e.g., sewer mains, lift stations, manholes) Located downstream of multiple SSOs, including nine events that totaled 29,250 gallons and potentially impacted surface waters OSTDS Located downstream of parcels with prior OSTDS repair permits	Illicit discharges at upstream ditches may also contribute to the fecal contamination at this location. Stormwater, including human, dog, and wildlife contributions primarily from upstream areas, may also contribute to fecal contamination of Leeds Pond.

Chapter 5.0: Management Actions

The evaluation of available data discussed above indicates that the dominant source of fecal coliform contamination in the Leeds Pond WBID is human related. More specifically, the three main sources (not listed in order of importance) appear to be (1) existing utility infrastructure; (2) OSTDS; and (3) stormwater (as a conveyance system for nonpoint sources and as a source unto itself).

This chapter provides information on specific management actions that are under way to reduce fecal coliform contamination. It also provides a preliminary determination of sufficiency of effort—i.e., whether the management actions will adequately address the most likely sources of contamination.

The effect of many of these actions may not be fully realized. Nevertheless, it is recommended that all of the programs continue with the refinements derived from the assessment of the Leeds Pond watershed provided in this report.

5.1 Programs To Address the Sanitary Sewer System as a Source

Severe utility infrastructure collapses are rare; however, as the infrastructure ages, failures become more likely. The continued inspection and rehabilitation of existing utility infrastructure, including proper preventative and predictive maintenance and the identification of problem areas, are important to help reduce or eliminate wastewater conveyance system leaks and SSOs. All area utility providers should implement these measures.

Often, as is the case in Duval County, a single utility is not responsible for all sewer infrastructure throughout the area. Private sewer infrastructure (e.g., lift stations), for instance, may be a potential source of fecal coliform contamination to area tributaries. Comprehensive geographic information data provided by the COJ for the Leeds Pond watershed included ten private lift stations that were identified within the WBID. The majority of these were located in the western portion of the basin along Philips Highway. In addition, service laterals that are part of every centralized sewer connection (e.g., for residences, hospitals, institutions) have a private component that is not routinely inspected by JEA. According to JEA, these service laterals are a significant source of SSOs and can contribute to fecal coliform contamination even if they do not involve the presence of a lift station (personal communication, Ed D. Cordova, March 28, 2008).

Currently, the COJ and JEA are implementing several countywide improvement programs to address the sanitary sewer system as a source of fecal coliform contamination. The COJ regularly inspects sanitary lift stations for which it issues construction permits. Additionally, sanitary lift stations constructed after August 1, 1991, are required to have certified operator attendance at least once a month. JEA programs include the following: (1) Fats, Oils, and Grease (FOG) Reduction Program; (2) SSO Root Cause Program; (3) Pop-Top Program; (4) Non-destructive Testing Program; and

(5) Time-out Program. **Appendix F** describes each of these programs. Specific information on how each program pertains specifically to the Leeds Pond watershed is currently being developed as part of a separate effort.

5.1.1 Specific Improvement Programs by JEA in the Leeds Pond Watershed

As of June 7, 2007, there were no identified JEA-specific improvement projects within the Leeds Pond watershed. However, during the “Walk the WBIDs” effort, JEA reported that households west of the Dean Road and Wurn Park intersection, near the headwaters of the western fork of the northern branch, were recently excavated for pipe bursting and a new high-density plastic pipe was installed in the entire neighborhood as part of a preventative maintenance program (personal communication, Ron Nelson, September 10, 2008). Recent excavation of several lots was observed in the area during the field exercise.

5.1.1.1 TAT-Directed Reconnaissance of Sewer Infrastructure and Associated Sampling

To date, JEA, as part of the TAT, has not conducted any intensive localized sampling within the Leeds Pond basin; however, it has been suggested by the TAT to include this basin in Phase IV TAT sampling. Additionally, the COJ EQD maintains a sampling station, sampled quarterly, at Parental Home Road (BP71) as a part of its countywide ambient water monitoring program.

5.1.2 Sufficiency of Effort

Based on information collected from JEA and the COJ as of October 31, 2008, as well as the analysis of water quality and land use described in this report, a preliminary effort has been made to relate identified management actions to the continual needs for monitoring and assessment in the Leeds Pond watershed. Additional efforts are currently under way to obtain further detail as to how these actions affect specific portions of the basin. This section also contains initial recommendations on monitoring activities.

An estimated 69% of the households within the Leeds Pond basin use centralized sewer. In addition, the basin includes approximately 40.5 kilometers (25 miles) of sewer lines, as well as a variety of associated infrastructure (e.g., sewer mains, lift stations, manholes) that may fail on occasion, resulting in varying levels of environmental impacts. Although sanitary sewer is potentially an episodic and localized contributor of fecal pollution within the Leeds Pond WBID, the ability to prevent and predict problem areas is imperative to decreasing the occurrence and associated effects of leaking conveyance systems that are a possible source of chronic bacterial contamination in the basin.

As described above, JEA initiated predictive and preventative maintenance programs throughout Jacksonville. At this time, however, the identified results have not been specified for areas in this watershed where these programs have been implemented. The identification of particular areas that have been determined through the JEA programs to be problematic and/or have a known root cause could be instrumental in revealing the primary sources of contamination in the Leeds Pond basin. This information may prove

useful in guiding a more focused reconnaissance of the Leeds Pond WBID by the TAT for overall source identification purposes.

This investigation may also be improved by (1) adjusting sampling locations using results from previous months; (2) coordinating sampling events using the results from different monitoring agencies (i.e., FDEP, COJ EQD, JEA); (3) sampling progressively upstream (on smaller spatial scales) of where elevated levels of fecal coliforms are observed as soon as possible after the increase is detected; (4) inspecting sewer infrastructure (e.g., smoke testing, dye testing, use of remote camera equipment), following additional sampling, upstream of where elevated levels of fecal contamination are identified; (5) sampling more frequently in order to detect episodic events and impacts related to sanitary sewer infrastructure leaks (e.g., from underground sewer mains); (6) sampling stations simultaneously to allow for determinations regarding potential transport and/or dilution of bacteria; and (7) establishing additional routine sampling locations to assist in targeting areas where potential sources of fecal pollution are contributing to bacteriological loading of Leeds Pond. As described in **Section 2.2** additional sampling locations should be positioned (i) near the “headwaters” of the main channel at the Richard Street and Wesch Boulevard intersection; (ii) midstream, at University Boulevard; (iii) farther downstream at Sam Road; and (iv) on the northern branch at Parental Home Road.

5.2 Programs To Address OSTDS as Sources

Properly designed, functioning, and maintained septic systems can effectively remove nearly all suspended solids, biodegradable organic compounds, and fecal coliforms (EPA 2002a); however, old, failing, and poorly maintained septic systems can be a major source of fecal coliform contamination. Few programs exist to address onsite system operation and maintenance, resulting in failures that lead to otherwise preventable costs and risks to public health and water resources (EPA 2002a).

Currently, the DCHD is implementing a variety of specific, countywide improvement programs and restoration activities to address OSTDS as sources of fecal coliform contamination. These include (1) an OSTDS inspection program, (2) training programs, and (3) the designation of septic system failure and nuisance areas for transfer to central sewer. **Appendix G** describes each of these programs. Specific information on how each program pertains specifically to the Leeds Pond watershed is currently being developed as part of a separate effort. In addition, the Florida Onsite Wastewater Association (FOWA) has proposed state legislation mandating OSTDS inspections.

5.2.1 Septic System Failure Areas and the Role of the WSEA

Failure and nuisance areas were first identified in 1999–2000. As of July 28, 2008, the DCHD updated the listing of failure and nuisance areas and corrected the accuracy of the defined geographic areas through the re-evaluation process. There are currently no designated septic system failure areas within the Leeds Pond basin.

The ranking is determined using an eight-point criteria system (**Appendix D**); information required to assess approximately half of the criteria may change over time

and is updated by various organizations such as the COJ EQD (provider of information on sanitary conditions) and the COJ PWD (provider of the review of flooding). Those areas scoring above a total of 56 points across all eight criteria (a maximum of 80 possible points) are identified as “nuisance areas”. It is important to note that as of July 2008, there was only one “Sanitary Nuisance Area” in Duval County; six previously designated Nuisance Areas were removed from the list in July 2007. The sanitary conditions criterion may need to be reviewed and expanded to include data beyond COJ EQD data or new sites.

The WSEA uses the ranking information for justification when seeking funding to phase out septic systems and transfer homes to central sewer. Running sewer lines for these phase-out programs is the responsibility of the COJ and not JEA. The COJ uses the WSEA to extend sewer lines into designated septic phase-out areas. JEA takes these lines over once they have been installed.

5.2.2 Sufficiency of Effort

As stated above, OSTDS are a viable solution for the treatment of sewage, when they function properly and are located appropriately. In some situations, these systems provide a better health protection alternative than the public sewer system as, by their nature, they include the provision for passive wastewater treatment and are relatively cost-effective. Based on this assessment of the Leeds Pond WBID, OSTDS appear to be a source of fecal contamination (1) near the headwaters at Phillips Highway; (2) midstream at University Boulevard; and (3) downstream at Parental Home Road, where potential septic systems are located (**Map 7**) and a number of repair permits have been filed by property owners in close proximity to surface waters (**Appendix A, Figure 7**). Since even one failing OSTDS may be a large and chronic source of bacteria contamination, the situation conveys a need to have consistent citywide measures to educate property owners to properly maintain their systems, to repair failing systems in a timely manner and/or connect to sanitary sewer for proper treatment, to educate professionals in the business of installing and repairing OSTDS, and to carefully monitor and inspect properties when there are complaints.

As these systems are privately owned, one of the most important aspects of increasing their effectiveness is public education and outreach. The DCHD and other local groups (e.g., FOWA) continue to focus a great deal of effort towards educating the public on various levels, ranging from the legislators who vote on state and city statutes, to local plumbers and environmental health professionals. One suggestion is to increase the direction of these outreach efforts to homeowners in communities with a high incidence or likelihood of OSTDS failures and educate the owners on proper preventative maintenance practices.

In areas where traditional OSTDS systems are not a viable option due to environmental conditions, new performance-based treatment systems may provide a practical and cost-effective alternative. According to Scott Turner, DCHD (personal communication, March 5, 2007), newer performance-based systems are now available to meet advanced secondary treatment levels. These systems are permitted in areas with decreased setbacks and smaller drainfields. As a result, failure of these systems can be more problematic and

are therefore subject to annual inspections by the DCHD, but should be inspected by the maintenance entity at a minimum of semi-annually, or more frequently depending on the performance criteria. It is suggested that owners of these systems be subject to a mandatory educational course instructing them in the proper maintenance of their systems. According to Elke Ursin, Florida Department of Health (FDOH) (personal communication, June 12, 2008), there are currently approximately 158 of these systems in Duval County.

Although Leeds Pond does not have a DCHD-septic system failure area, 25 parcels in the basin have reported OSTDS failures, as indicated by the existence of septic system repair permit applications. Therefore, it is possible that there remain isolated and problematic septic systems that are contaminating the neighboring surface waters. Systems such as these may be better served through alternative programs such as:

- *an FDOH-sponsored certification program for haulers, similar to the FOG program run by JEA (**Appendix F**), responsible for the proper pumping, hauling, disposal, and documentation of OSTDS maintenance procedures;*
- *a program in which septic systems must be inspected when home ownership changes or at regular intervals, such as five years;*
- *a program to execute new maintenance and design requirements that are based on environmental conditions (e.g., location within an impaired watershed, unsuitable soil conditions, proximity to surface water) and monitored by the COJ;*
- *a community-based onsite management system program in which clusters of conventional septic tanks are drained into centralized advanced wastewater treatment areas and are managed by a designated responsible party (e.g., local utility, FDEP, or FDOH) (NESC 2006); and*
- *a subsidized septic tank-pumping program that could be used in conjunction with septic system phase-out programs to help immediately alleviate impacts during the transition period.*

In addition to these programs, there are broad-ranging local septic system ordinances being proposed to proactively avoid future water quality impacts. Components of these proposed ordinances include:

- *delineation of areas where septic systems are inappropriate and other options are required;*
- *determination of critical habitat and environmentally sensitive areas where use of septic systems should be restricted;*
- *development and implementation of a mandatory septic system inspection and tracking program;*

- *encouragement of efforts to connect to the existing sanitary sewer system and wastewater treatment facilities where appropriate; and*
- *implementation of maintenance and community-based onsite management system programs.*

5.3 Programs To Address Stormwater as a Source

Typical fecal coliform bacteria concentrations for untreated stormwater runoff range from 10,000 to 100,000 MPN/100mL (Metcalf & Eddy 2003). Thus, it is important to consider stormwater as a potential and highly probable conveyance system for a variety of more specific sources of bacterial contamination. Although the first priority should always focus on the elimination of the sources contributing pollution to stormwater conveyance systems, stormwater must also be considered as a source unto itself in order to manage it more effectively.

Management actions to provide additional stormwater treatment reduce the sediment, oil and grease, and nutrient and bacteria loadings discharged into an affected waterbody. When focusing efforts on stormwater treatment, it is important to realize that the reduction of sediment loads to surface waters is critical because such particles frequently adsorb bacterial colonies, thus facilitating their survival, growth, and transportation from one area to another (Gerba & McLeod 1976, LaLiberte & Grimes 1982, Marino & Gannon 1991, Davies et al. 1995).

5.3.1 National Pollutant Discharge Elimination System (NPDES) MS4 Permit Monitoring Plan

According to Part V.B. of the COJ/FDOT NPDES MS4 permit, and supported by Title 40 of the Code of Federal Regulations, Part 122.26(d)(2)(iii), the COJ, FDOT, City of Atlantic Beach, and City of Neptune Beach are jointly required to implement a stormwater Monitoring Plan. The goals of this Monitoring Plan are to (1) identify problem areas through monitoring efforts and (2) evaluate the effectiveness of best management practices (BMPs) for specific projects.

Although there were no projects within the Leeds Pond watershed, monitoring efforts, evaluated at station BP71, showed that 75% of samples taken from October 1, 2005, to September 30, 2006, indicated coliform concentrations at or below state standards. The 2006 Annual Monitoring Plan Report (**Appendix H**) summarizes the results. It is important to note that BP71 is designated as within the Pottsburg Creek watershed in this Annual Report, but is actually located within the Leeds Pond watershed (**Map 3**). The Annual Report Form for Individual NPDES Permits for Municipal Separate Storm Sewer Systems (Rule 62-624.600[2], F.A.C) includes additional details on the Stormwater Management Program (SWMP).

5.3.2 Maintenance of Stormwater Conveyance Systems

The COJ PWD Streets and Drainage Division is responsible for maintaining all stormwater conveyance systems in Jacksonville. Although specific systems are included in a routine cleaning program, the majority of cleaning is complaint-driven. When

complaints occur, the surrounding area is also investigated for additional issues. If the TAT provides information to the COJ PWD on potential problem areas, the Streets and Drainage Division can respond appropriately.

Regional stormwater management systems (e.g., ponds) are added whenever possible to assist in the settling of sediments. Adding these facilities is difficult in an urbanized area, as there is a shortage of land; however, the COJ PWD obtains land for this purpose whenever possible.

5.3.3 Specific Stormwater Improvement Projects

As of September 10, 2008, there were no stormwater improvement projects identified within the boundaries of the Leeds Pond WBID. However, the Dean Road (Beach Boulevard to Parental Home Road) improvement project is listed in the Better Jacksonville Plan as in design phase. This project will include the reconstruction of Dean Road into a combination two-lane rural road with ditches, and a three-lane urban road with curb and gutter starting from Parental Home Road to just south of Beach Boulevard at the Hendricks Day School (1824 Dean Road).

5.3.4 Programs To Address Potential Illicit Connections as Sources

The keys to the PIC Program are education, the elimination of illicit discharges, and housekeeping (TMDL reduction). As of June 7, 2007, England-Thims and Miller (ETM), contracted by the COJ PWD, was assisting in the implementation of the PIC Program that began approximately nine years ago. ETM has developed an inventory and mapped MS4s in Duval County. Permits examined by ETM include those from the Cities of Jacksonville, Atlantic Beach, and Neptune Beach, and FDOT, beginning in 1997.

The entire system was inventoried; however, with the growth in Jacksonville, it must be noted that the systems are always changing. The use of digital as-built drawings in the future will prevent the need to revisit sites for inventory and will improve the program by allowing for the maintenance of a more accurate listing. Currently, ETM has had to relate as-built data to existing mapping data and re-inventory all structures in the field to establish conductivity and validation. This information has now been compiled into a database.

ETM's method of inventory included collecting data in the field, downloading the data in the office, quality assurance/quality control (QA/QC), linking the data to GIS, reporting the results, and distributing a spreadsheet to the property owner. ETM also developed correspondences from the most current property appraiser records and forwarded these letters to the COJ to begin the reconciliation process. It is important to note that the PIC program is now regulated by the COJ EQD due to the recent transfer of the NPDES program from PWD to EQD on October 1, 2007.

The COJ has the authority to conduct detailed investigation and enforcement, if necessary. When the COJ EQD obtains a report of a PIC, it is loaded into the CARE database (an Access database used for complaints) and the information is brought back

into GIS. This system is checked daily to determine where site visits are necessary. Two COJ inspectors conduct the site visits and talk to the people who live on the site, as well as their neighbors, to verify the nature of the issue. COJ EQD inspectors will sample if there is an observed discharge, or the inspector may call FDEP or DCHD for assistance in obtaining a sample, depending on the nature of the discharge. The COJ EQD, and formerly COJ PWD, assists the individual in remedying the situation and returns to ensure that the connection has been removed. In most cases, the property owner addresses the situation and the COJ EQD does not need to enforce any further actions. This program has been very successful and is ongoing citywide.

As a result of this process, a history of each PIC from identification to resolution has been included in the COJ database. As of September 2006, 2,156 PICs have been identified; 52% of these were confirmed to be illicit and most of these have been resolved. The majority of the confirmed PICs were related to swimming pools (55%), roughly 30% to washing machines, and approximately 5% to wastewater. As of June 7, 2007, 1.5 sweeps of the stormwater system (not including closed conveyances) in Jacksonville had been conducted. There were no illicit connections identified within the Leeds Pond watershed. During the “Walk the WBIDs” exercise, numerous potential illicit connections were observed; however, the majority of these were suspected of originating from gutters, stormwater drains, heat pumps, and ground water (**Section 3.3**).

In addition to the mapping and confirmation of PICs, the COJ PWD and COJ EQD also conducted an average of over 200 inspections annually, involving all types of industry. Many of the sites are not in compliance (more specifically, they are usually not aware of their specific responsibilities; they are not usually illegally discharging). When this occurs, the COJ educates the wrongdoer and informs them of the fee to be assessed as a penalty; the COJ does not have jurisdiction over these regulations unless there are discharges. Specific information on how this effort pertains specifically to the Leeds Pond watershed is currently being developed as part of a separate effort.

As stated, above, educational outreach is a vital part of the PIC program. The COJ EQD, and formerly COJ PWD, primarily provides this outreach by distributing materials to the public such as educational pamphlets and informational door hangers, and through a storm drain-stenciling program. The COJ also collaborates with the SJRWMD’s Watershed Action Volunteer (WAV) Program (<http://www.sjrwmd.com/education/wav/index.html>), which equips volunteers through training and education to perform a variety of tasks to improve the environmental quality of their local watersheds. These tasks include water quality monitoring, surveying streams for pollution sources, and public outreach through the distribution of door hangers and placement of informational placards on storm drains.

5.3.5 Sufficiency of Effort

In order to manage stormwater as it pertains to fecal coliform contamination, it must be considered as a source unto itself and not merely as a conveyance system. Although emphasis is directed towards water quality and fecal coliform contamination with regards to the NPDES MS4 Permit Monitoring Plan (**Section 5.3.1**), the COJ PWD and COJ EQD educational outreach efforts, and the PIC Program (**Section 5.3.4**), the majority of

Management Actions

COJ system projects are directed toward flood control. As a result, there have not been substantial efforts towards improvements of stormwater infrastructure.

Although the water quality data indicate that faulty wastewater infrastructure may be both a chronic and episodic source, depending on the area of the basin, the known SSO events do not account for the water quality impairments. Although wastewater and OSTDS are potential sources that should be investigated, as evidenced by the 18 SSOs that occurred between 2001 and 2006 and the 25 OSTDS repair permits filed by property owners from 1993 to 2006. Furthermore, stormwater may be responsible for the transport of high concentrations of bacteria and is a possible contributor to the bacteriological loading of Leeds Pond after rainfall. Therefore, sources related to stormwater should be addressed despite the lack of conclusive information about the degree to which they contribute compared to other potential sources.

As stormwater runoff appears to comprise the “headwaters” of Leeds Pond, it should be regarded as a possible source of fecal contamination at the upstream extent of the main channel, associated ditches, and northern branch. As discussed in **Section 3.0**, evidence of human and animal contributions, likely to be conveyed by stormwater, were observed in these areas during the “Walk the WBID” effort. Currently, there are no sampling locations in these areas. If elevated levels are observed at the sampling stations suggested above (**Section 5.1.2**), it is recommended that routine sampling stations also be established at the headwater locations to gain a better understanding of the levels of fecal coliforms that may be contributed by stormwater.

Improvements to the stormwater system, including retrofits and associated programs, may already be underway in the Leeds Pond basin and could be used to supplement additional, more focused efforts. If these programs are not already in place or are no longer functioning efficiently, implementation or reorganization may be a good place to start. Such programs may include, but are not limited to (1) public outreach directed specifically towards homeowners, with residences adjacent to surface waters, that include storm drain stenciling and the distribution of informational door flyers on how to properly dispose of pet waste; (2) citizen education programs on reclaimed water; (3) Illicit Discharge Detection and Elimination (IDDE) training for citizens, which would provide volunteers with the necessary information to conduct illicit discharge investigations in their respective neighborhoods and local watersheds; (4) stormwater pond inspection programs aimed at preventing excessive sediment and turbidity in surface waters; (5) construction site inspection programs; (6) effective street sweeping programs; and (7) more extensive routine maintenance of stormwater conveyance systems.

Additional stormwater-related management actions that should be considered include:

- *Additional redevelopment and stormwater retrofit (e.g., disconnection of directly connected impervious areas);*
- *Increased enforcement actions for zoning and management of proper pond design and creation;*

Management Actions

- *Identification of stormwater entities responsible for pond maintenance, if unknown;*
- *Use of flocculation via alum injection in stormwater treatment areas*
- *Use of UV light disinfection or ozone treatment for small systems;*
- *Use of individual product-line developments such as anti-microbial filters for stormwater conveyance systems;*
- *Increased sediment control;*
- *Implementation of pet waste control practices; and*
- *Application of nonstructural BMPs to the affected areas.*

All of the above, alone or in combination, can be effective in reducing coliform loadings to surface waters; however, each must be evaluated based on the area in question, the cost required, and the level of public acceptance. It is recommended that analysis be conducted on a life-cycle cost basis and factors such as capital costs, operation and maintenance costs and regulatory issues be considered in order to determine the most feasible approach.

Citations

- Anderson KL, Whitlock JE, Harwood VJ (2005) Persistence and differential survival of fecal indicator bacteria in subtropical waters and sediments. *Applied and Environmental Microbiology* 71:3041-3048
- APHA (ed) (1995) *Standard Methods for the Examination of Water and Wastewater*, Vol. American Public Health Association, Inc., Washington DC
- Bicki TJ, Brown RB, Collins ME, Mansell RS, Rothwell DJ (1984) Impact of on-site sewage disposal systems on surface and groundwater quality, University of Florida Institute of Food and Agricultural Science, Gainesville, FL
- Brown MT, Annable MD, Delfino JJ, Jawitz JW, Cohen M, Hall E, Harden H, Chanton J, Burnett W, Rose JB, Paul JH, Griffin DW, Lipp E, John D (2001) Determination of an appropriate onsite sewage system setback distance to seasonally inundated areas. Florida Department of Health, Tallahassee, FL, p 63
- Brownell MJ, Harwood VJ, Kurz RC, McQuaig SM, Lukasik J, Scott TM (2007) Confirmation of putative stormwater impact on water quality at a Florida beach by microbial source tracking methods and structure of indicator organism populations. *Water Research* 41:3747-3757
- Colford JM, Wade TJ, Schiff KC, Wright CC, Griffith JF, Sandhu SK, Burns S, Sobsey M, Lovelace G, Weisberg SB (2007) Water quality indicators and the risk of illness at beaches with nonpoint sources of fecal contamination. *Epidemiology* 18:27-35
- Davies CM, Long JA, Donald M, Ashbolt NJ (1995) Survival of fecal microorganisms in marine and freshwater sediments. *Applied and Environmental Microbiology* 61:1888-1896
- Eleria A, Vogel RM (2005) Predicting fecal coliform bacteria levels in the Charles River, Massachusetts, USA. *Journal of The American Water Resources Association* 41:1195-1209
- EPA (1986) Ambient water quality criteria for bacteria-1986. Report No. EPA/440/5-84-002, USEPA Office of Water Regulations and Standards, Washington, DC
- EPA (2002a) National beach guidance and required performance criteria for grants. Report No. EPA-823-B-02-004, USEPA, Office of Water (4305T), Washington, DC
- EPA (2002b) Onsite wastewater treatment systems manual, Office of Water, USEPA Office of Research and Development, USEPA, Washington, DC

Citations and Web Resources

- Gerba CP, McLeod JS (1976) Effect of sediments on the survival of *Escherichia coli* in marine waters. *Applied and Environmental Microbiology* 32:114-120
- Hagedorn C (1982) Transport and fate: bacterial pathogens in ground water *Microbial Health Considerations of Soil Disposal of Domestic Wastewaters*. U.S. Environmental Protection Agency, University of Oklahoma, Norman, p 153-171
- Harwood VJ, Whitlock J, Withington V (2000) Classification of antibiotic resistance patterns of indicator bacteria by discriminant analysis: use in predicting the source of fecal contamination in subtropical waters. *Applied and Environmental Microbiology* 66:3698-3704
- LaLiberte P, Grimes DJ (1982) Survival of *Escherichia coli* in lake bottom sediment. *Applied and Environmental Microbiology* 43:623-628
- Mallin MA, Cahoon LB, Toothman BR, Parsons DC, McIver MR, Ortwine ML, Harrington RN (2007) Impacts of a raw sewage spill on water and sediment quality in an urbanized estuary. *Marine Pollution Bulletin* 54:81-88
- Marino R, Gannon J (1991) Survival of fecal coliforms and fecal streptococci in storm drain sediment. *Water Research* 25:1089-1098
- McDowell W, Brick C, Clifford M, Frode-Hutchins M, Harvala J, Knudsen K (2005) Septic system impact on surface waters: a review for the inland Northwest, Tri-State Water Quality Council
- Metcalf & Eddy I (2003) *Wastewater Engineering, Treatment and Reuse*, Vol. The McGraw-Hill Companies, Inc., New York, NY
- NESC (2006) *Community onsite options: wastewater management in the new millennium and approaches to onsite management: community perspectives*, West Virginia University, Morgantown, West Virginia
- Nicosia L, Rose JB, Stark L, Stewart M (2001) Ground water quality: a field study of virus removal in septic tank drainfields. *Journal Environmental Quality* 30:1933-1939
- PBS&J (2006) *Tributary Pollution Assessment Manual*, prepared for the Tributary Pollution Assessment Team, July 2006, Jacksonville, Florida
- Scott TM, Rose JB, Jenkins TM, Farrah SR, Lukasik J (2002) Microbial source tracking: current methodology and future directions. *Applied and Environmental Microbiology* 68:5796-5803
- Tyler D (2006) *Draft Fecal and Total Coliform TMDL for Wagner Creek (WBID 3288A)*, FDEP Division of Water Resource Management, Bureau of Watershed Management

Citations and Web Resources

U.S. Soil Conservation Service S (1986) Urban hydrology for small watersheds. Report No. Technical Release 55, US Department of Agriculture

Winkler S, Ceric A (2006) 2004 status and trends in water quality and selected sites in the St. Johns River Management District, St. Johns River Water Management District, Palatka, Florida

Web Resources

Chapter 62-302, Surface Water Quality Standards:

<http://www.dep.state.fl.us/legal/Rules/shared/62-302/62-302.pdf>

Chapter 64E-6, F.A.C., Standards for Onsite Sewage Treatment and Disposal Systems:

<http://www.doh.state.fl.us/environment/ostds/pdfiles/forms/64e620070924.pdf>

EPA SSO Fact Sheet:

<http://www.epa.gov/npdes/ssso/control/>

JEA Fats, Oils and Grease (FOG) Program Workshop:

<http://www.jea.com/about/pub/downloads/fog/FOGTrainingSlideShow.pdf>

JEA Fats, Oils and Grease (FOG) Program, Preferred Hauler Program Registration:

<http://www.jea.com/about/pub/downloads/fog/FOGProgramPreferredHaulerRequestforParticipation.pdf>

St. Johns River Water Management District Hydrologic Data:

<http://arcimspub.sjrwmd.com/website/dahds/design/index.html>

St. Johns River Water Management District Watershed Action Volunteers Program:

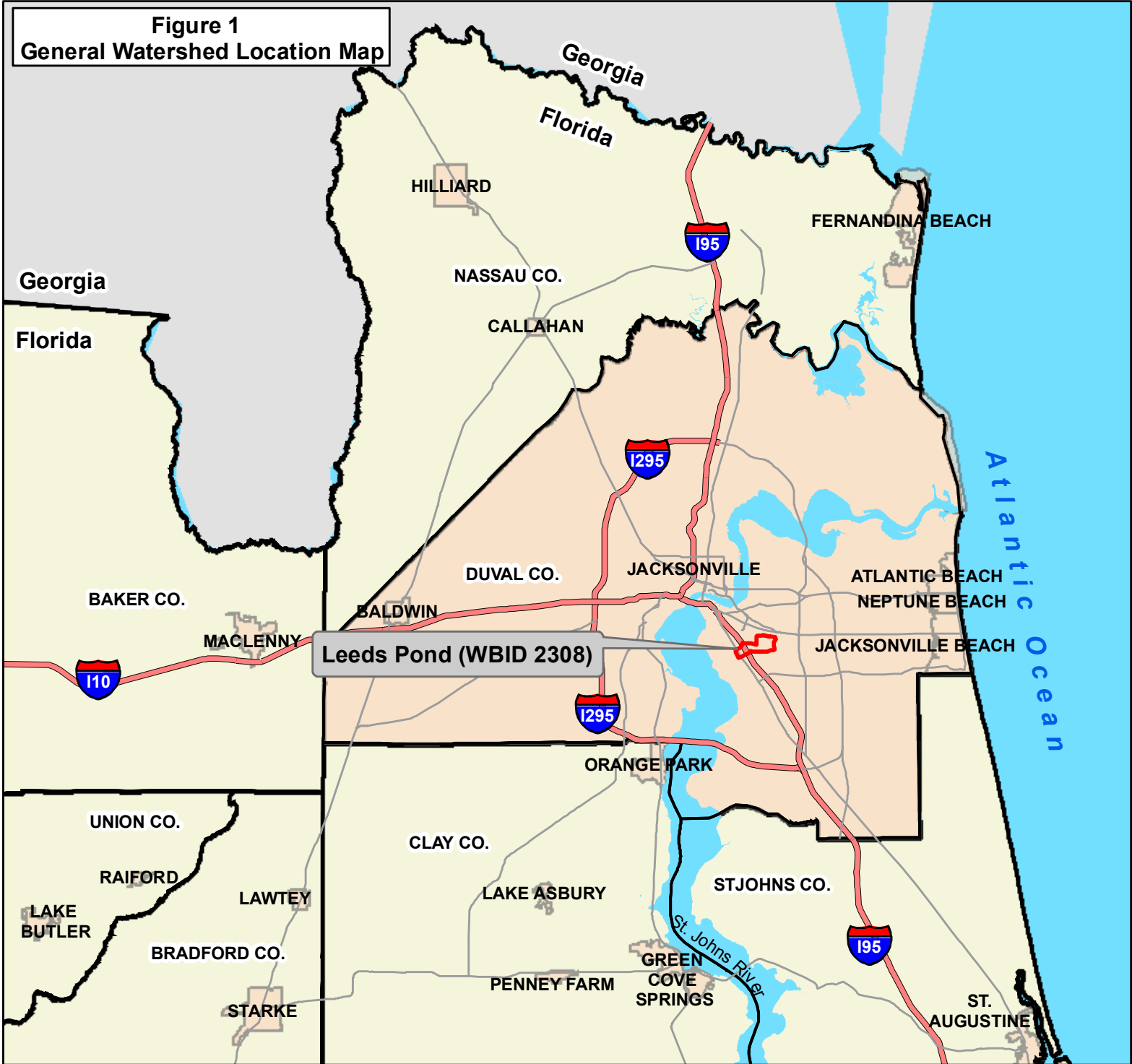
<http://www.sjrwmd.com/education/wav/index.html>

Appendices

Appendix A

GIS Maps

Figure 1
General Watershed Location Map



Legend

-  Leeds Pond (WBID 2308)
-  Watershed Boundary
-  Water Body
-  Interstate
-  Major Road
-  City Limits
-  County Boundary

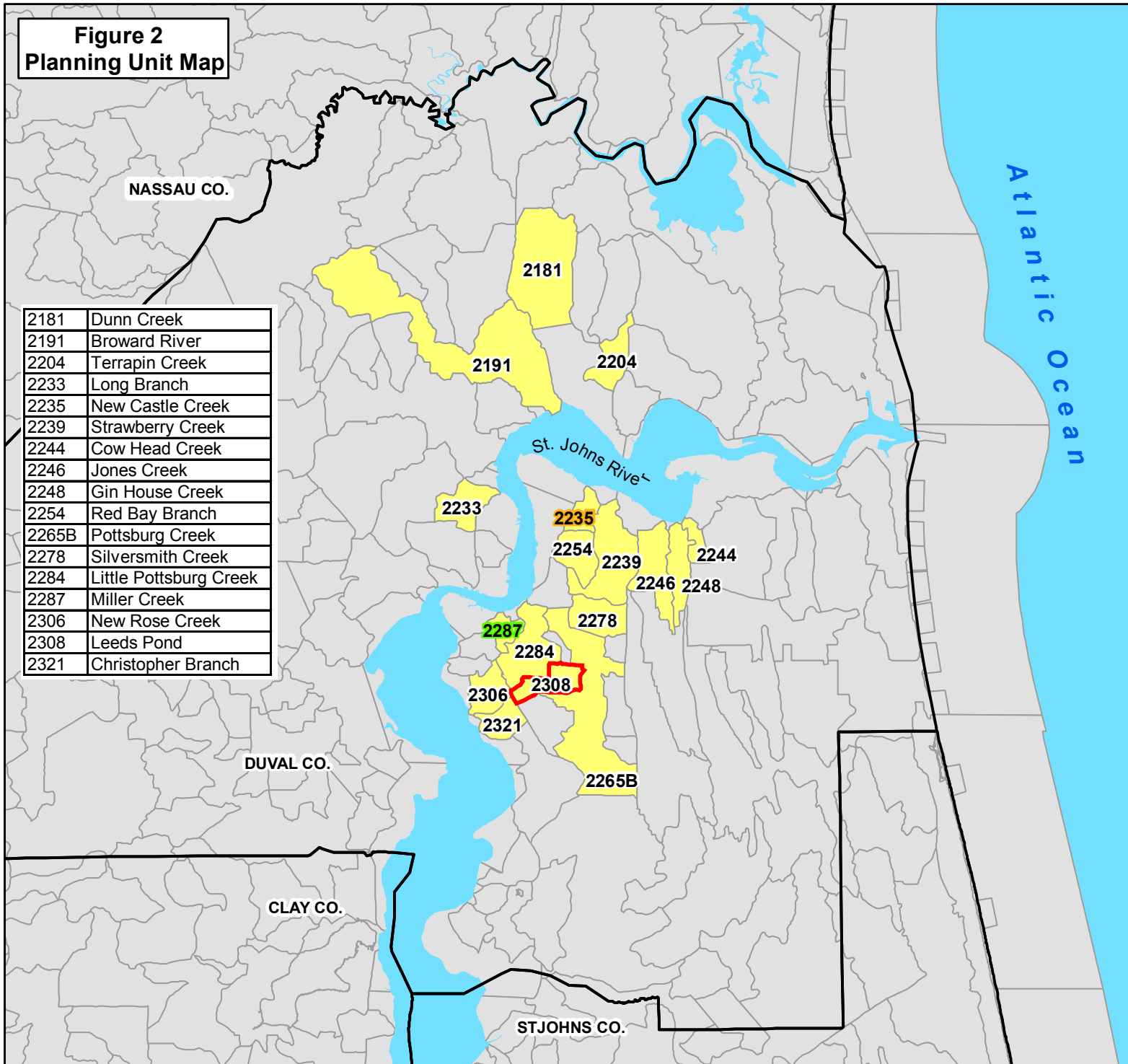
0 5 10 20 30 Miles

Overview



Figure 2
Planning Unit Map

2181	Dunn Creek
2191	Broward River
2204	Terrapin Creek
2233	Long Branch
2235	New Castle Creek
2239	Strawberry Creek
2244	Cow Head Creek
2246	Jones Creek
2248	Gin House Creek
2254	Red Bay Branch
2265B	Pottsburg Creek
2278	Silversmith Creek
2284	Little Pottsburg Creek
2287	Miller Creek
2306	New Rose Creek
2308	Leeds Pond
2321	Christopher Branch



Legend

-  Leeds Pond (WBID 2308)
-  North Mainstem Unit
-  Non-Mainstem WBID Boundary
-  TAT Phase 1
-  TAT Phase 2
-  County Boundary
-  Water Body

0 2.5 5 10 Miles

Overview

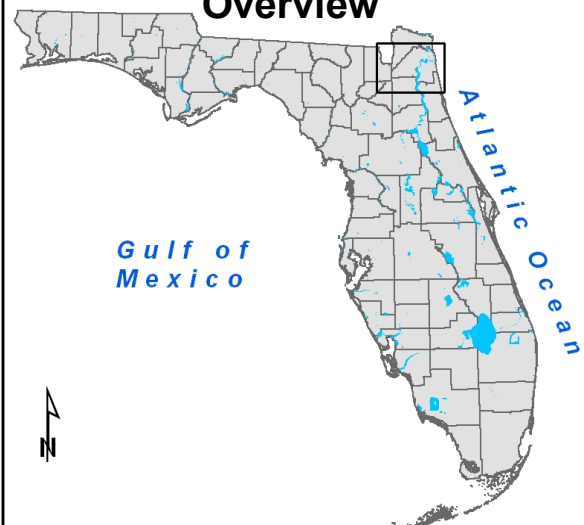
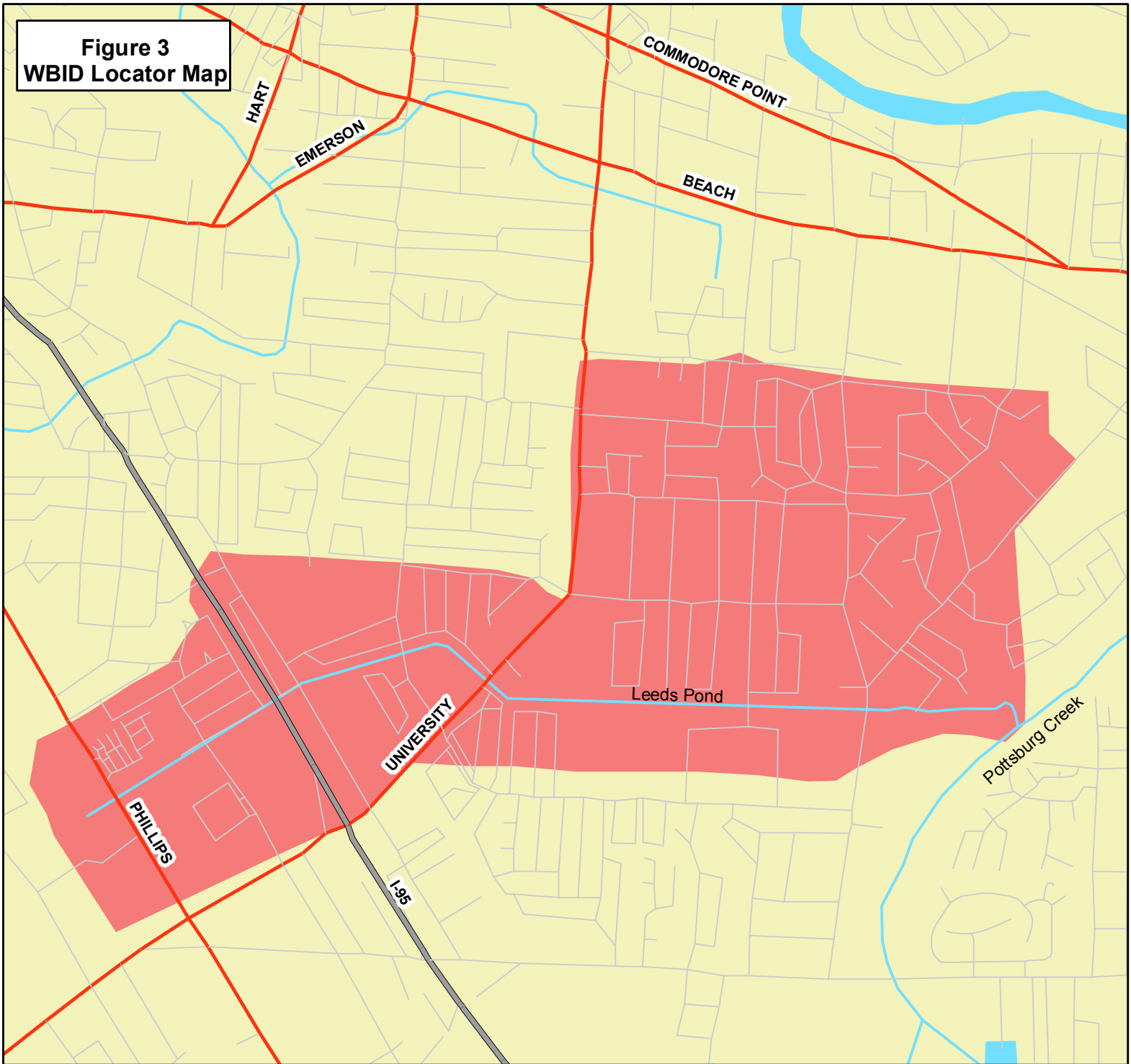


Figure 3
WBID Locator Map



Legend

-  Leeds Pond (WBID 2308) Watershed
-  Water Body
-  Interstate
-  Primary Road
-  Local Road

0 0.15 0.3 0.6 0.9 Miles

Overview

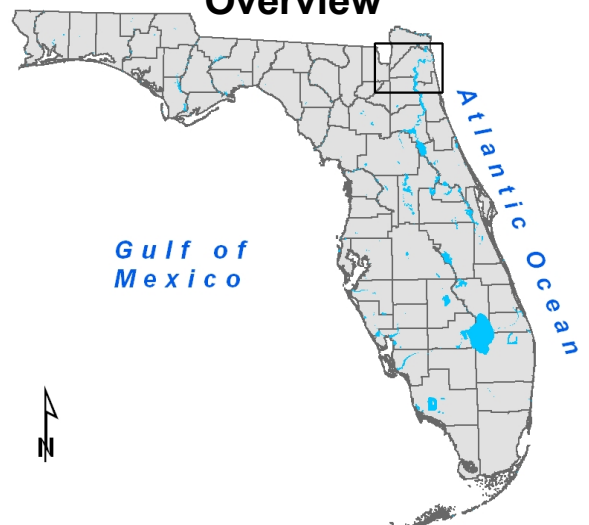
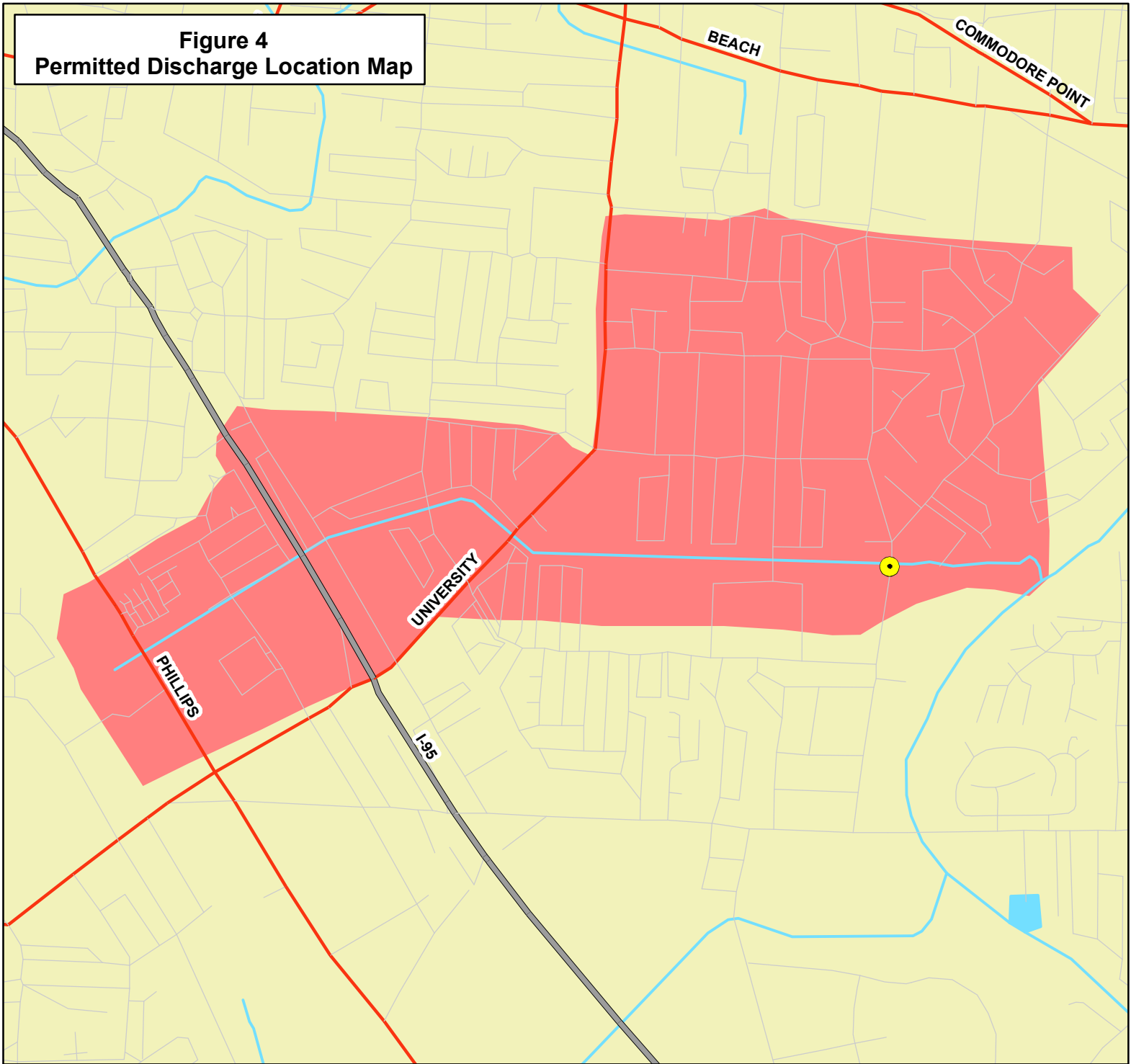


Figure 4
Permitted Discharge Location Map



Legend



Leeds Pond (WBID 2308) Watershed



Water Body



Interstate



Primary Road



Local Road



IWR Fecal Coliform
Sample Site

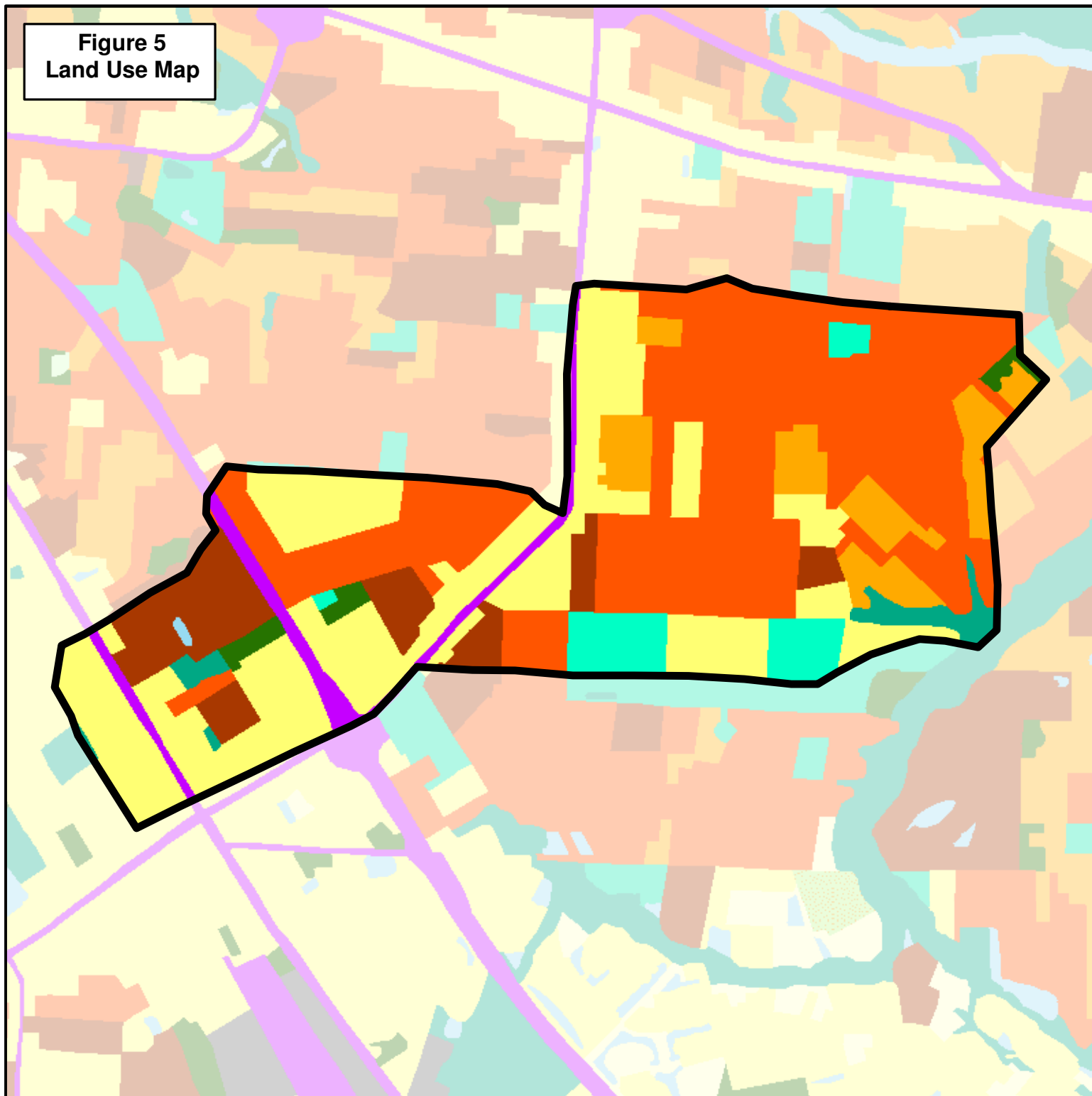
**Note: No permitted discharge
facilities are located in this WBID.**

0 0.15 0.3 0.6 Miles

Overview



Figure 5
Land Use Map



Leeds Pond
(WBID 2308) Watershed Boundary



Low Density Residential



Medium Density Residential



High Density Residential



Commercial/ Utility/ Institutional



Industrial



Extractive



Recreational



Open Land



Cropland and Pastureland



Silviculture



Feeding Operation



Nurseries and Vineyards



Specialty Farms



Open Land - Agriculture



Non-Forested Upland



Upland Forest



Water



Wetlands



Disturbed Land

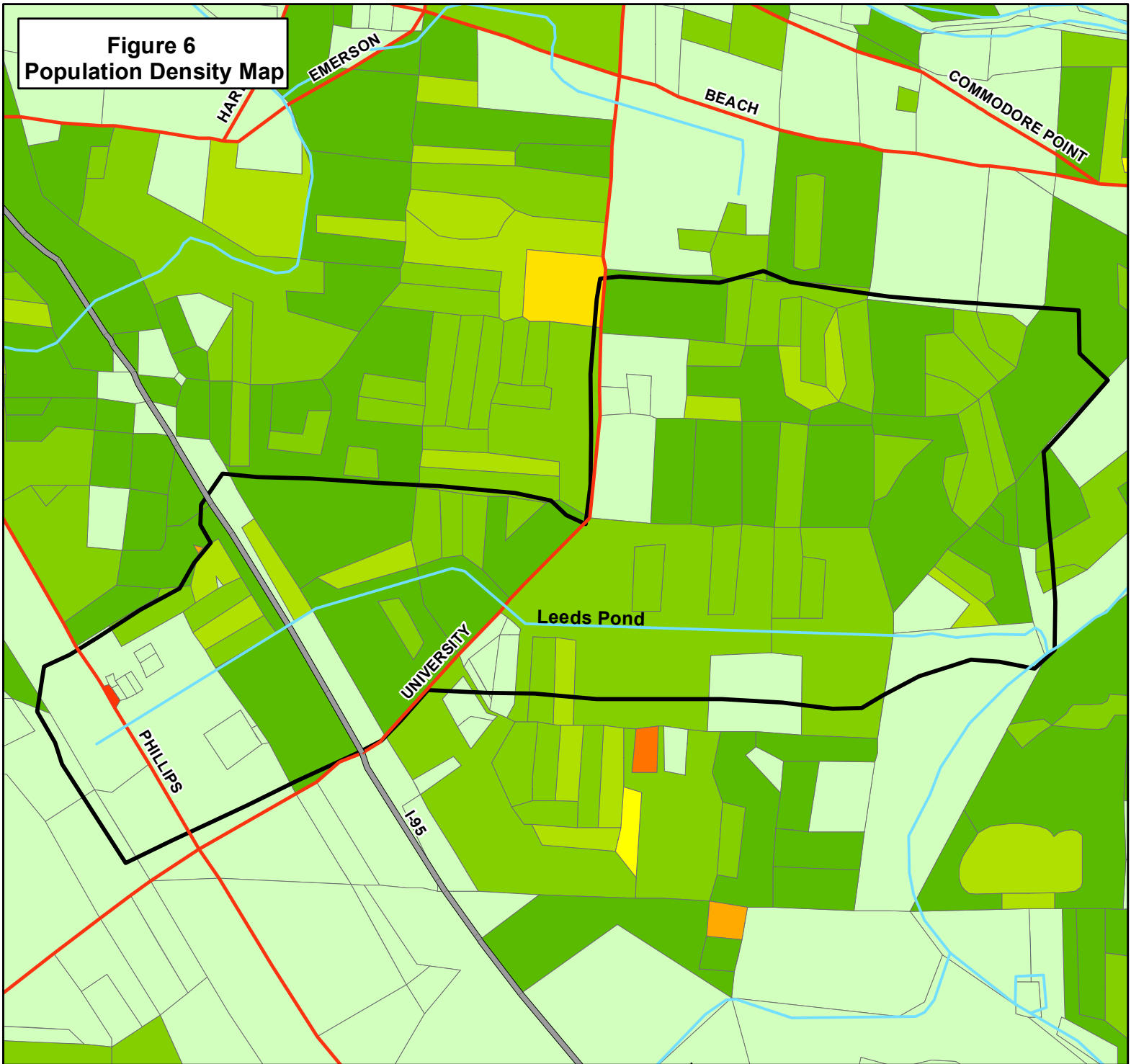


Transportation



0 0.1 Miles

Figure 6
Population Density Map



Legend



Leeds Pond (WBID 2308)

Watershed



Water Body



Interstate



Primary Road

Population Density (Persons/Acre) within Census Block



0 - 3



16 - 25



211 - 406



3 - 7



25 - 44



712 - 919



7 - 11



45 - 84



11 - 16



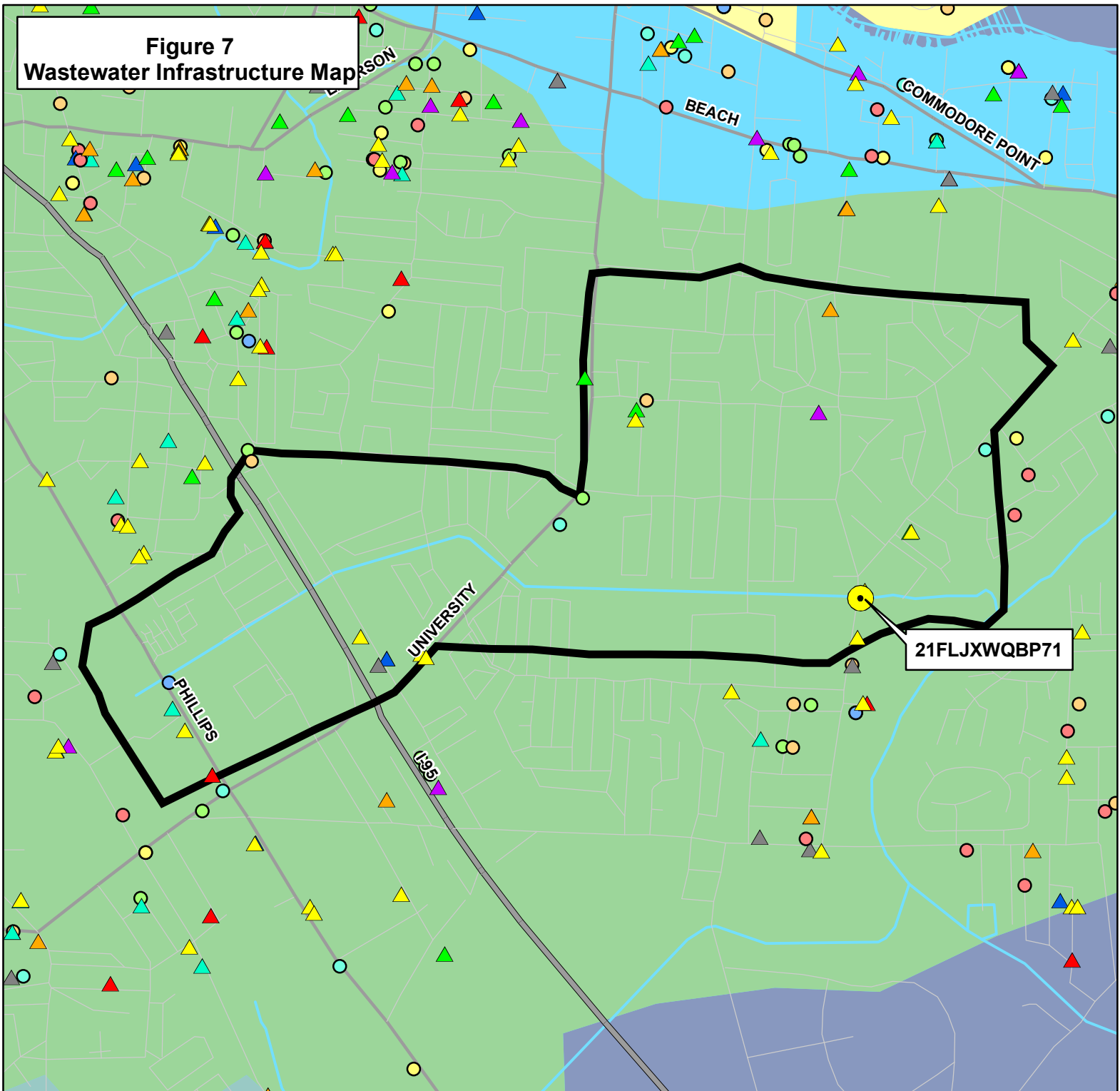
88 - 177

0 0.15 0.3 0.6 0.9 Miles

Overview



Figure 7
Wastewater Infrastructure Map



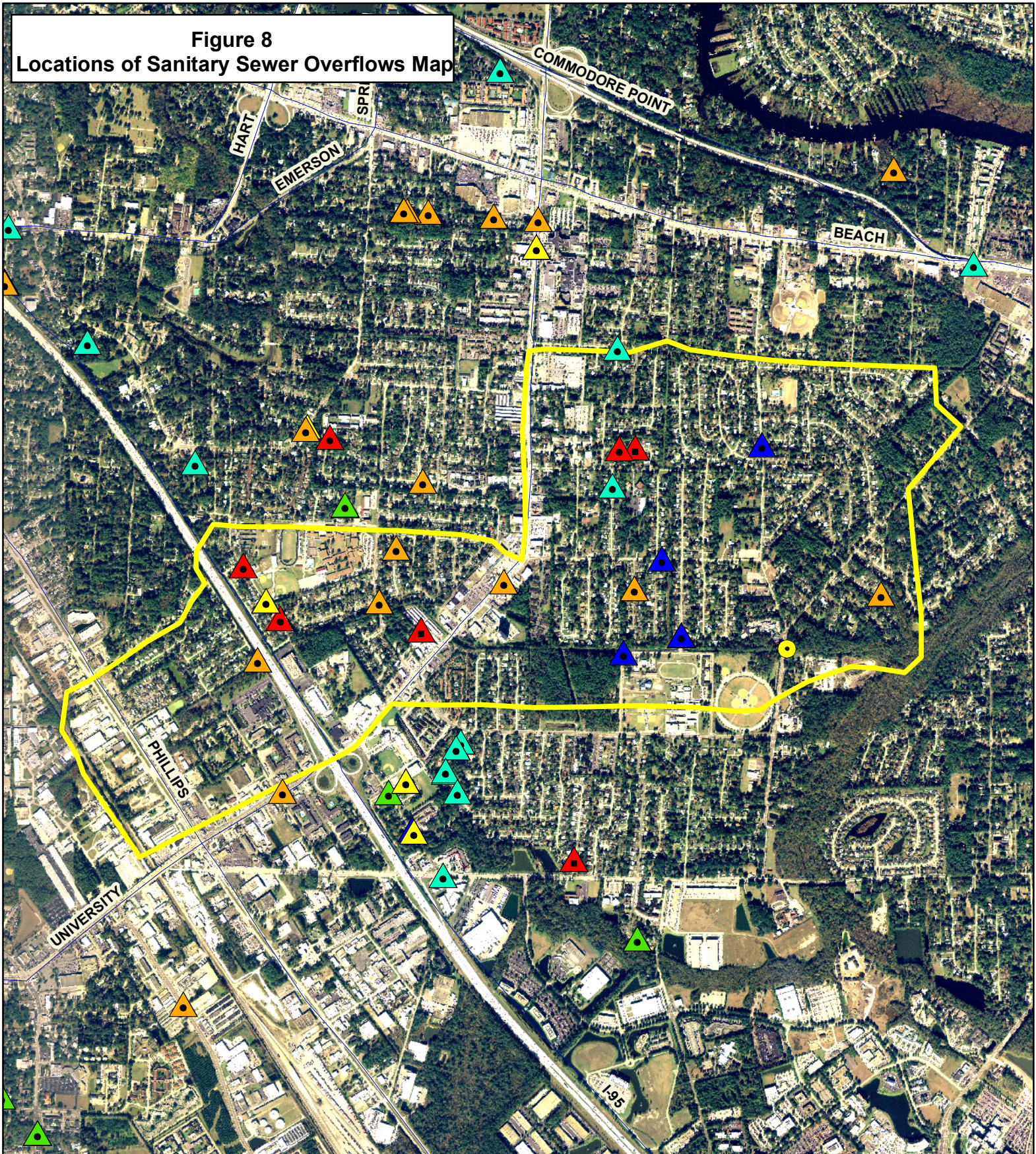
Legend

- | | | | | |
|---|--|--|--|--|
|  Leeds Pond (WBID 2308) Watershed | Septic Tank Repair Permit Application | | | |
|  JEA Septic Tank Failure Area |  1990 |  1995 |  1999 |  2003 |
|  Water Body |  1992 |  1996 |  2000 |  2004 |
|  Road |  1993 |  1997 |  2001 |  2005 |
| Wastewater Treatment Facility Service Area |  1994 |  1998 |  2002 |  2006 |
|  Buckman |  IWR Fecal Coliform Sample Site | | | |
|  Arlington East | | | | |

0 0.15 0.3 0.6 Miles



Figure 8
Locations of Sanitary Sewer Overflows Map



Legend

-  Leeds Pond (WBID 2308) Watershed
 -  IWR Fecal Coliform Sample Site
- | Location of Wastewater Spill Incident | | | |
|--|---|--|--|
|  2001 |  2003 |  2005 |  2007 |
|  2002 |  2004 |  2006 | |
- 0 0.125 0.25 0.5 0.75 Miles





Figure 9
Water Quality Sample Location Map



Legend

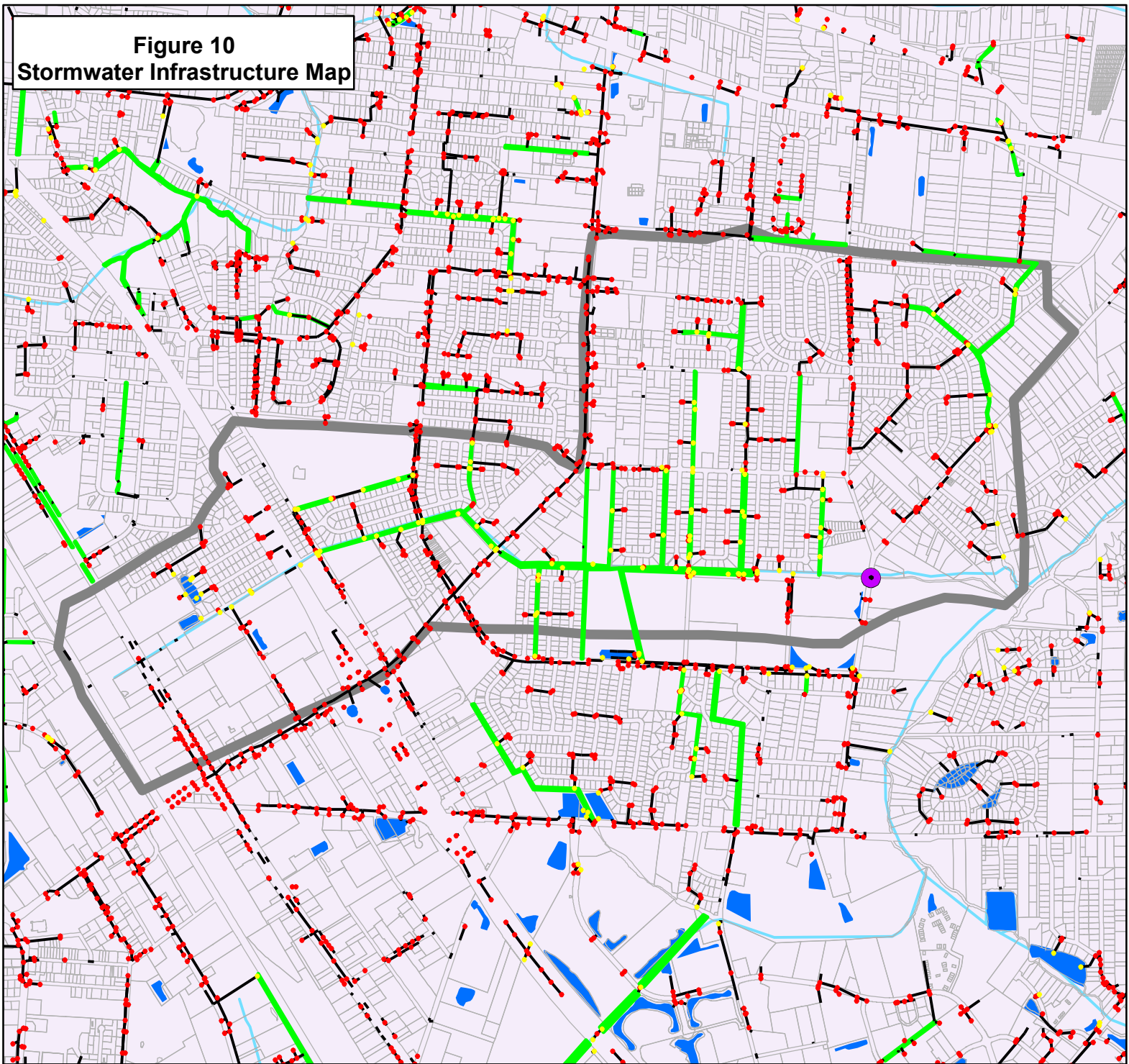
● IWR Fecal Coliform Sample Site



Leeds Pond (WBID 2308)
Watershed

0 0.125 0.25 0.5 Miles

Figure 10
Stormwater Infrastructure Map



Legend

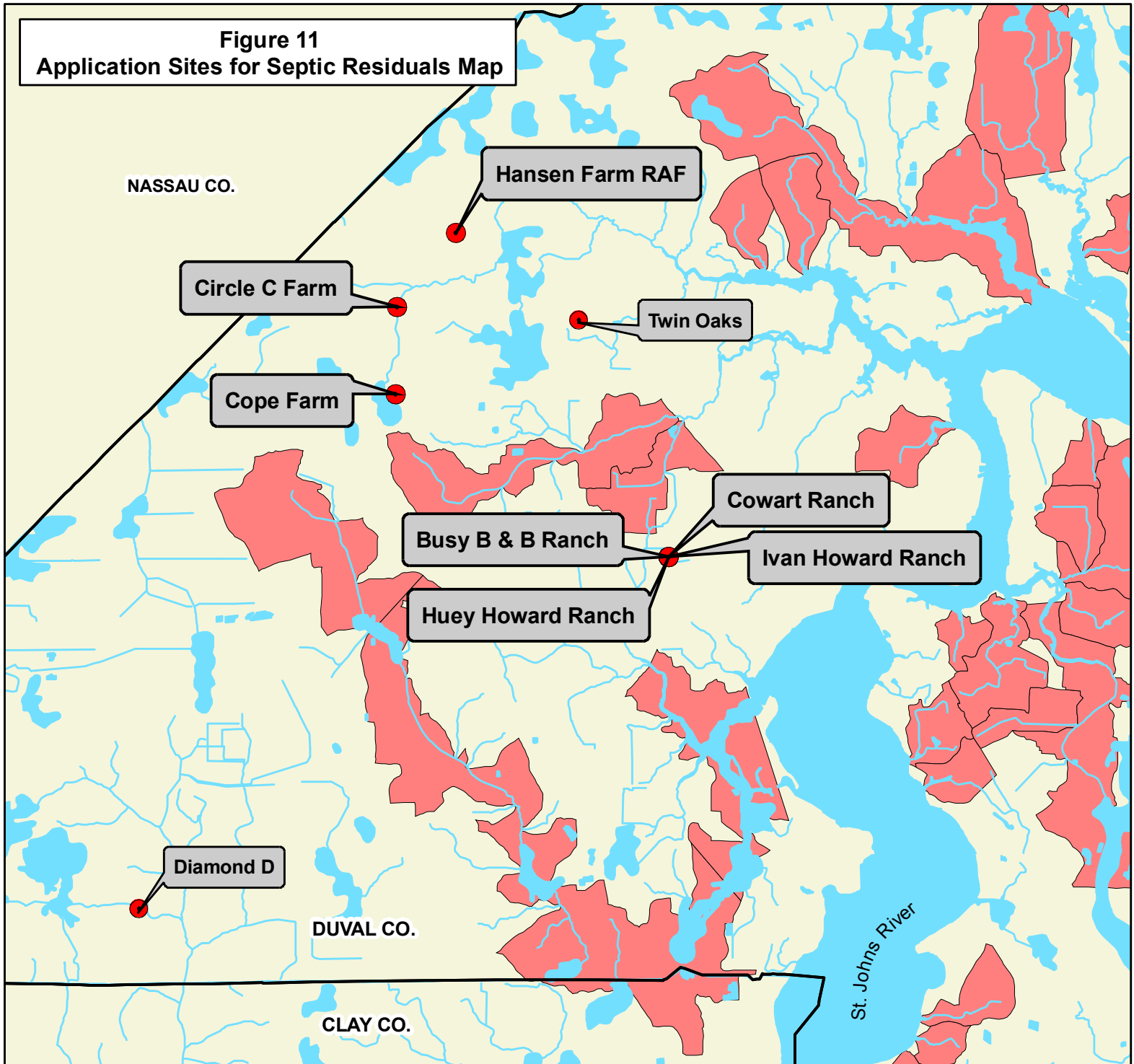
- | | | | |
|--|--------------------------------|---|-----------------|
|  | Leeds Pond (WBID 2308) |  | Parcel |
|  | Watershed Boundary |  | Water Body |
|  | Closed Conveyance |  | MS4: Duval Main |
|  | Pond | | |
|  | Inlet | | |
|  | Outfall | | |
|  | Ditch | | |
|  | IWR Fecal Coliform Sample Site | | |

0 0.125 0.25 0.5 Miles

Overview



Figure 11
Application Sites for Septic Residuals Map



Legend

-  Application Site for Septic Residuals
-  Water Body
-  Group 1 WBID Boundary
-  County Boundary

Note: There are no application sites for septic residuals within the WBID boundaries in Group 1.

0 1.25 2.5 5 7.5 Miles

Overview

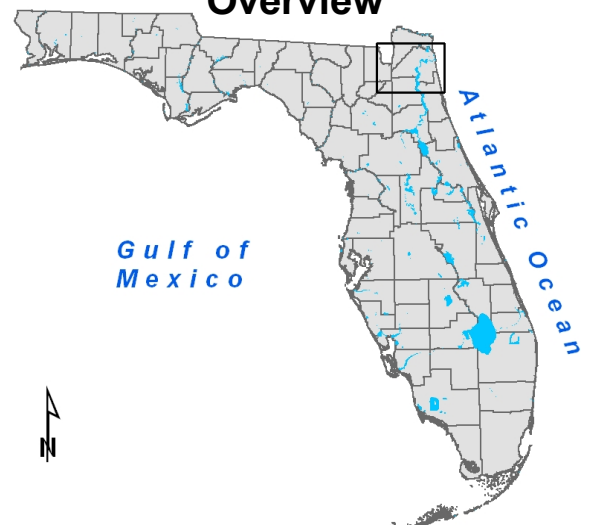
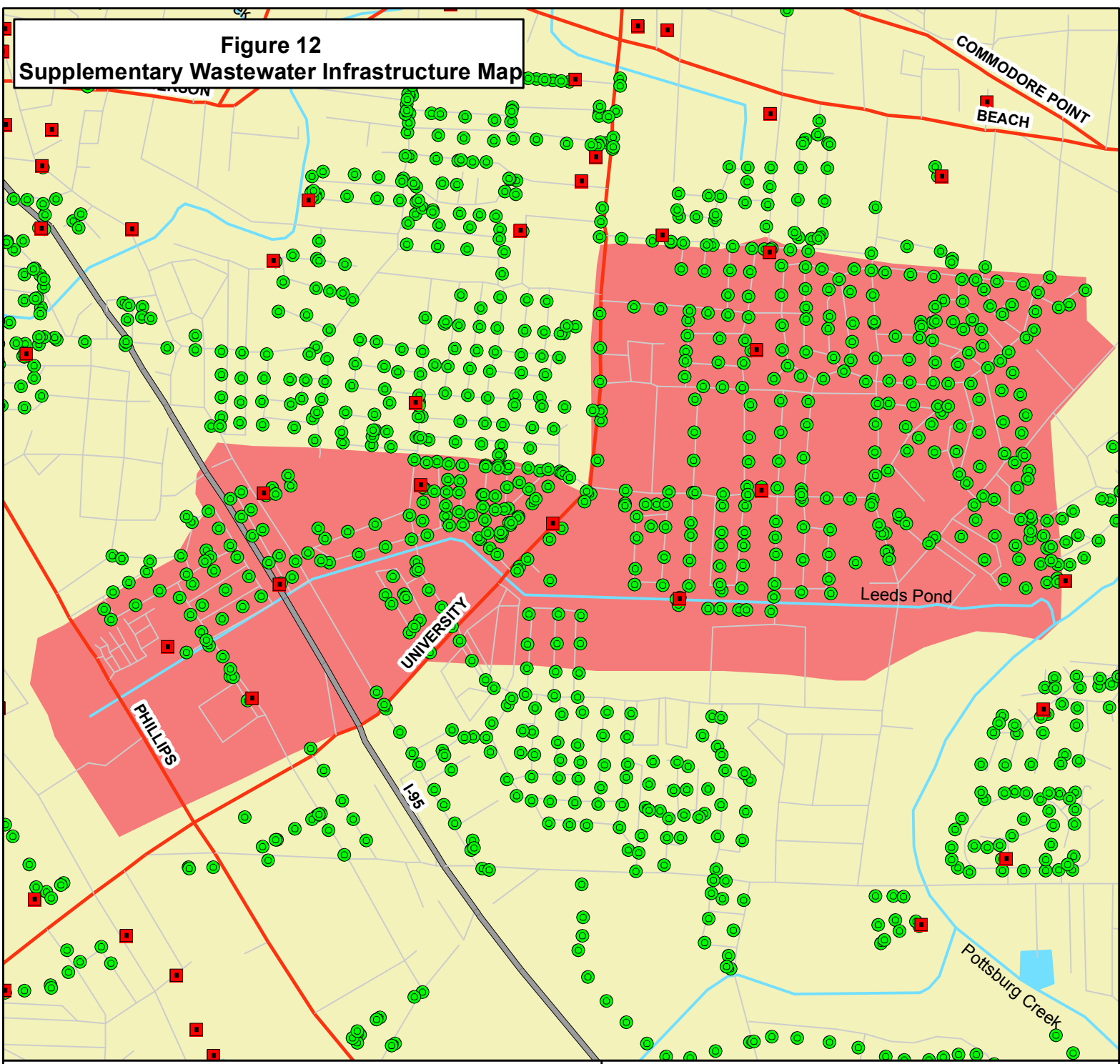


Figure 12
Supplementary Wastewater Infrastructure Map



Legend

- Leeds Pond (WBID 2308) Watershed
- Water Body
- Interstate
- Primary Road
- Local Road
- Lift Station
- Manhole

0 0.125 0.25 0.5 0.75 Miles

Overview



Appendix B

Identification of Issues Regarding Data Analysis and Map Development

Identification of Issues Regarding Data Analysis and Map Development

Highlights of key data and information resources

The fecal data obtained from the Impaired Waters Rule (IWR) Run 28 database was valuable; however, it did not contain the most recent data available. The majority of fecal coliform sampling stations were sampled by the City of Jacksonville Environmental Quality Division (COJ EQD). In order to enhance the IWR database, the COJ EQD (Dana Morton) provided PBS&J with the most recent (2003-present) data for all fecal coliform sampling stations. The supplemental information aided our statistical analysis and the identification of recent trends. Additionally, the microbial source tracking data available for select WBID's, provided through the JEA Tributary Pollution Assessment Project, assisted in a more accurate determination of the sources and locations of contamination.

Identification of key data that was unavailable

The majority of data included within the IWR database were collected during ambient conditions in order to satisfy agency monitoring programs. During the analysis of factors which may affect fecal coliform concentrations, it was observed that fecal coliform data were generally unavailable during periods of rainfall or after sanitary sewer overflows. Event-specific sampling would be beneficial for further isolation of fecal coliform contamination sources.

Stormwater data including closed conveyances, inlets, ditches, and ponds and wastewater data including septic tank repair permits, septic tank failure areas, and location of wastewater spill incidents were not available for Clay County.

Identification of any complications that arose during map development

Twelve maps were created for each WBID using GIS information acquired from multiple agencies (state, local and private; Table 1).

During the creation of the "Water Quality Sample Location Map", three complications arose. First, it was discovered that several of the sampling sites were not accurately assigned to the correct WBIDs and/or the station description was inconsistent with the coordinates. An extensive review of all sample sites was completed to verify site location and WBID association. Secondly, within the IWR database, there was a large amount of data duplication for each individual station. After discussions with Florida Department of Environmental Protection (FDEP) personnel (Tom Singleton), the daily median value for each station was calculated and used for all analyses. Finally, during data analysis, different sampling stations were found to contain identical data. In most cases, one station was reported by the FDEP and the other by the COJ EQD and the duplication occurred during only one sampling date. For data analysis, the station with duplicated information was removed. It is recommended that the stations be removed from the IWR dataset and eliminated from the "Water Quality Sample Location Map" and any additional maps containing station location information.

Table 1. GIS-data list utilized in Group 1 Maps

Figure Number	Data Type	Data Name	Source
1,3,4,5,7,8	USGS 1:100,000 Hydrography - Lines	hy100l10	USGS
1,3,4,5,7,8	USGS 1:100,000 Hydrography - Lines	hy100l16	USGS
1,3,4,5,7,8	US Census Bureau (TIGER) 1:100,000 Roads	tgrr_primaryrds	US Census Bureau
1,3,4,5,7,8	US Census Bureau (TIGER) 1:100,000 Roads	tgrr0010	US Census Bureau
1,3,4,5,7,8	US Census Bureau (TIGER) 1:100,000 Roads	tgrr0016	US Census Bureau
4, 7, 8, 9, 10	Group 1 Fecal Coliform Water Quality Sites	Grp1fecalWQ_PBSJ_New	PBS&J
4, 7, 8, 9, 10	Water Quality Data	Duval_Trib_Locations_9_05_april07	COJ
4	Wastewater Sites from WAFR IMS	LSJWWSitesfromWAFR	DEP
4	Wastewater Facilities	LSJWWFacilitiesfromWAFR	DEP
5	Land Use Land Cover	lulc2004_clay	SJRWMD
5	Land Use Land Cover	lulc2004_duval	SJRWMD
5	Land Use	lulc2004_group1	SJRWMD/PBSJ
6	2000 Census Blocks	cenblk10	US Census Bureau
6	2000 Census Blocks	cenblk16	US Census Bureau
7	Septic Tank Repair Permit Issued	repair3_30_04_8_15_05	DOH
7	Septic Tank Repair Permit Issued	repair816_05_809_06	DOH
7	Septic Tank Repair Permit Issued	repair98_3_04	DOH
7	Septic Tank Repair Permit Issued	rp993_1_1_98	DOH
7	WWTF Service Area	SewerServiceArea-DissolveByName	JEA
7	Septic Tank Failure Area	failure	DOH
8	Sanitary Sewer Overflow Locations	MasterSSO	JEA
8	Sanitary Sewer Overflow Locations	Revised_SSO_Locations_2006	JEA
8	Sanitary Sewer Overflow Locations	Revised_SSO_Locations_2007	JEA
10	Conveyances	Closed_Conveyances	COJ
10	Outfalls	MS4_outfalls	ETM

10	Inlets	Inlets	ETM
10	MS4 Data	LSJRB_MS4_42polys	DEP
10	Stormwater Ponds	Ponds	COJ
10	Ditches	ditches	ETM
10	Outfalls	cnty_outfalls_jax_ua	Clay County Property Appraiser
10	Clay County Parcel	parcel	Clay County Property Appraiser
10	Duval County Parcel	parcels	Duval County
11	Residual Application Sites from WAFR IMS	LSJResidualsApplicationSites_WAFR	DEP
12	JEA Sewer Infrastructure	JEA_Sewer	JEA
N/A	Water Quality Data	STORET_Run28	DEP
N/A	Endwalls	Endwalls	ETM
N/A	Households serviced by JEA	Sewer_GIS_Premise_Points	JEA

Table 2. GIS-data list utilized in Group 2 Maps

Figure Number	Data Type	Data Name	Source
1,3,4,5,7,8	USGS 1:100,000 Hydrography - Lines	hy100l45	USGS
1,3,4,5,7,8	USGS 1:100,000 Hydrography - Lines	hy100l55	USGS
1,3,4,5,7,8	USGS 1:100,000 Hydrography - Lines	hy100l16	USGS
1,3,4,5,7,8	US Census Bureau (TIGER) 1:100,000 Roads	tgrr_primaryrds	US Census Bureau
1,3,4,5,7,8	US Census Bureau (TIGER) 1:100,000 Roads	tgrr0055	US Census Bureau
1,3,4,5,7,8	US Census Bureau (TIGER) 1:100,000 Roads	tgrr0045	US Census Bureau
1,3,4,5,7,8	US Census Bureau (TIGER) 1:100,000 Roads	tgrr0016	US Census Bureau
4, 7, 8, 9, 10	Group 2 Fecal Coliform Water Quality Sites	Grp2fecalWQ_PBSJ_albers	PBS&J
4, 7, 8, 9, 10	Water Quality Data	Duval_Trib_Locations_9_05_april07	COJ
4	Wastewater Sites from WAFR IMS	LSJWWSitesfromWAFR	DEP
4	Wastewater Facilities	LSJWWFacilitiesfromWAFR	DEP
5	Land Use Land Cover	lulc2004_stjohns	SJRWMD
5	Land Use Land Cover	lulc2004_nassau	SJRWMD
5	Land Use Land Cover	lulc2004_duval	SJRWMD
5	Land Use	lulc2004_group2_albers	SJRWMD/PBSJ
6	2000 Census Blocks	cenblk45	SJRWMD/PBSJ
6	2000 Census Blocks	cenblk55	SJRWMD/PBSJ
6	2000 Census Blocks	cenblk16	US Census Bureau
7	Septic Tank Repair Permit Issued	repair3_30_04_8_15_05	DOH
7	Septic Tank Repair Permit Issued	repair816_05_809_06	DOH
7	Septic Tank Repair Permit Issued	repair98_3_04	DOH
7	Septic Tank Repair Permit Issued	rp993_1_1_98	DOH
7	WWTF Service Area	SewerServiceArea-DissolveByName	JEA

7	Septic Tank Failure Area	failure	DOH
8	Sanitary Sewer Overflow Locations	MasterSSO	JEA
8	Sanitary Sewer Overflow Locations	Revised_SSO_Locations_2006	JEA
8	Sanitary Sewer Overflow Locations	Revised_SSO_Locations_2007	JEA
10	Conveyances	Closed_Conveyances	COJ
10	Outfalls	MS4_outfalls	ETM
10	Inlets	Inlets	ETM
10	MS4 Data	LSJRB_MS4_42polys	DEP
10	Stormwater Ponds	Ponds	COJ
10	Ditches	ditches	ETM
10	St. Johns Parcel	parcel07	St. Johns County Property Appraiser
10	Duval County Parcel	parcels	Duval County
11	Residual Application Sites from WAFR IMS	LSJResidualsApplicationSites_WAFR	DEP
12	JEA Sewer Infrastructure	JEA_Sewer	JEA
N/A	Water Quality Data	STORET_Run28	DEP
N/A	Endwalls	Endwalls	ETM
N/A	Households serviced by JEA	Sewer_GIS_Premise_Points	JEA
N/A	WBID boundaries	WBID_boundaries	DEP
1,2,3,4,5,6,7,8,9,10,10A,11,12	Group 2 WBID boundaries	WBID_Group2	PBS&J
10	Stormwater	PW_ASSETS.mdb	St. Johns County

Appendix C

Available Assessment Techniques

Available Assessment Techniques

The microbial source tracking (MST) methods summarized below are tools that can be used to help identify sources of indicator bacteria pollution. These methods, including library-based and non-library-based techniques, have not been adopted by regulatory agencies but have been incorporated into a draft guide document released by the EPA (2005). Consistent with other emerging fields in the environmental sciences, development, assessment, and validation of each of the methods is an adaptive process. The following information was obtained from the Tributary Pollution Assessment Manual (2006a).

Suite of Indicators

The standard method for characterizing human health risks in drinking water, wastewater discharges, and surface waters is the use of indicator organisms. These indicator organisms are now being used as surrogates for pathogens in TMDL programs because the presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of man or other animals. At the time this occurred, the source water may have been contaminated by pathogens or disease producing bacteria or viruses which can also exist in fecal material. Although these bacteria do not directly cause disease, high quantities of fecal coliform bacteria suggest the presence of disease-causing agents.

A recent literature review by Bitton (2005) provides a thorough description of the ideal indicator organism criteria. Fecal coliform bacteria, *Escherichia coli* (*E. coli*, a member of the fecal coliforms), *Enterococcus* spp. (enterococci), and coliphage (viruses that infect *E. coli*), can be used as a suite of indicators to characterize microbial pollution in sediments and the water column. It is important to note that different indicators may be better suited for use in specific aquatic environments. For example, *E. coli* and enterococci are both appropriate for use in freshwater while enterococci are better suited as indicator organisms in the marine environment (EPA 2002). Since indicator organisms are present in the gastrointestinal tract of a variety of warm- and cold-blooded animals and are shed in feces that can contaminate surface and ground waters, it is often impossible to identify a specific source of contamination without discriminatory techniques to identify the genotypic or phenotypic properties of these organisms within a particular sample (Harwood et al. 2000). Additional water quality criteria information is available from the EPA (1986).

Polymerase Chain Reaction (PCR)

Polymerase chain reaction (PCR) is a process whereby many copies of a specific DNA sequence can be synthesized from a small amount of starting material (the “template”). The process of making many copies of the DNA sequence is called amplification, and generates enough material to be visualized or manipulated for further investigation. PCR applications related to microbial source tracking frequently target host-specific genes or

markers present in particular microorganisms. There are two distinct types of PCR techniques: 1) library independent, presence/absence testing, using PCR with human or ruminant specific primers; and 2) library-based identification using repetitive extragenic palindromic polymerase chain reaction (rep-PCR).

Library Independent Presence/Absence Testing using PCR with Human-or Ruminant-Specific Primers

The library independent presence/absence testing using PCR utilizes primers that target specific microbial DNA sequences unique to microbes from a specific source, such as humans or cattle. For example, *Bacteroides*, a fecal anaerobe genus present in both human and animal intestines, is used as a target for this type of source identification technique (Bernhard & Field 2000b, a). PCR analysis of a fecal sample from a ruminant source using primers designed to target a specific genetic sequence found only in a human source, would show no amplification. In contrast, PCR analysis of samples containing microbial DNA from a human source and a ruminant source would result in amplification of the genetic material (or “presence”) with both human specific and ruminant specific primers. Lastly, PCR analysis of samples without microbial DNA from a human or ruminant source would result in a lack of amplification of the genetic material (or “absence”) with both human specific and ruminant specific primers. Another target organism for this type of PCR technique is *Enterococcus faecium*, one of the dominant enterococci found in human feces. The virulence factor, enterococcal surface protein (*esp*), that is found in this species is linked to sewage originating from humans, not animals (Scott et al. 2004). Targeted sampling of another species of enterococci, *Enterococcus faecalis*, which is strongly associated with sewage, can be used to locate probable sewage inputs. For instance, a sampling assay that focuses on several points upstream and downstream of each site should help to locate pollutant inputs from wastewater. Although *Enterococcus faecalis* is usually the dominant member of the enterococci isolated from human sewage, it can also be found in the feces of other animals, thus, its presence should be interpreted in the context of supporting tests. One study (Kuntz et al. 2003) found that between 37% and 58% of enterococci isolated from raw sewage, a sewage lagoon, and a water body impacted by the sewage were *Enterococcus faecalis*. In a more recent study (McDonald et al. 2006), fecal contamination in samples with *Enterococcus faecalis* percentages of around 30% of total enterococci were judged to be from bird sources. This source attribution was supported by the absence of detection of the human-associated *esp* gene.

Library-based Identification using Repetitive Extragenic Palindromic Polymerase Chain Reaction (rep-PCR)

Library-based methods require the establishment of large known-source databases (“libraries”) of patterns (“fingerprints”) derived from indicator bacteria. The function of the library is to provide a database to which patterns derived from water samples can be matched in order to predict the most probable source. In order to be useful, a library must be representative, that is, it must contain patterns from the dominant sources that might impact water quality, and enough host individuals (e.g., cattle, dogs) or sites (e.g.,

sediments, wastewater treatment plants) to represent the diversity of possible impacts on the water (EPA 2005). For MST applications, the library consists of indicator bacteria fingerprints from human and animal feces from the sample region. The function of the library is to provide a database to which patterns derived from water samples can be matched in order to predict the most probable source.

Libraries are typically established using one specific indicator organism. *E. coli* or *Enterococcus* spp. are generally used since they are both recognized indicator organisms and are widely distributed in feces (Harwood et al. 2005). Harwood's group recently demonstrated that phenotypic fingerprinting of *Enterococcus* spp. by antibiotic resistance analysis (ARA) generally had a higher predictive capability for fecal source than similar fingerprinting of *E. coli* (Harwood et al. 2003, Moore et al. 2005). Furthermore, ARA fingerprinting of enterococci more accurately predicted the sources of blind challenge samples than did genotypic fingerprinting of *E. coli* (Moore et al. 2005).

A similar technique could also be employed to compare patterns within the genomic profiles of the sediments with those of the water column (PBS&J 2006b). The results of this methodology may indicate whether elevated fecal concentrations originated from existing sediment reservoirs or whether they were derived from more recent and ongoing sources.

Citations

Bernhard AE, Field KG (2000a) Identification of nonpoint sources of fecal pollution in coastal waters by using host-specific 16S ribosomal DNA genetic markers from fecal anaerobes. *Applied and Environmental Microbiology* 66:1587-1594

Bernhard AE, Field KG (2000b) A PCR assay to discriminate human and ruminant feces on the basis of host differences in *Bacteroides-Prevotella* genes encoding 16S rRNA. *Applied and Environmental Microbiology* 66:4571-4574

Bitton G (2005) Microbial indicators of fecal contamination: application to microbial source tracking, Florida Stormwater Association

EPA (1986) Ambient water quality criteria for bacteria-1986. Report No. EPA/440/5-84-002, USEPA Office of Water Regulations and Standards, Washington, DC

EPA (2002) National beach guidance and required performance criteria for grants. Report No. EPA-823-B-02-004, USEPA, Office of Water (4305T), Washington, DC

EPA (2005) Microbial source tracking guide document, Office of Research and Development, USEPA, Washington, DC

Harwood VJ, Shehane SD, Ulrich RM (2005) Microbial source tracking: tools for refining total maximum daily load assessments, Florida Department of Environmental Protection, Tallahassee, Florida

-
- Harwood VJ, Whitlock J, Withington V (2000) Classification of antibiotic resistance patterns of indicator bacteria by discriminant analysis: use in predicting the source of fecal contamination in subtropical waters. *Applied and Environmental Microbiology* 66:3698-3704
- Harwood VJ, Wiggins B, Hagedorn C, Ellender R, Gooch J, Kern J, Sampadpour M, Chapman A, Robinson B, Thompson B (2003) Phenotypic library-based microbial source tracking methods: efficacy in the California collaborative study. *Journal of Water and Health* 1:153-166
- Kuntz RL, Hartel PG, Godfrey DG, McDonald JL, Gates KW, Segars WI (2003) Targeted sampling protocol as prelude to bacterial source tracking with *Enterococcus faecalis*. *Journal of Environmental Quality* 32:2311-2318
- McDonald JL, Hartel PG, Gentit LC, Belcher CN, Gates KW, Rodgers K, Fisher JA, Smith KA, Payne K (2006) Identifying sources of fecal contamination inexpensively with targeted sampling and bacterial source tracking. *Journal of Environmental Quality* 35:889-897
- Moore D, Harwood VJ, Ferguson D, Lukasik J, Hannah P, Getrich M, Brownell M (2005) Evaluation of antibiotic resistance analysis and ribotyping for identification of fecal pollution sources in an urban watershed. *Journal of Applied Microbiology* 99:618-628
- PBS&J (2006a) Tributary Pollution Assessment Manual, The Tributary Assessment Team, Jacksonville, Florida
- PBS&J (2006b) Tributary Pollution Assessment Summary Report, The Tributary Assessment Team, Jacksonville, FL
- Scott TM, Jenkins TM, Lukasik J, Rose JB (2004) Potential use of a host associated molecular marker in *Enterococcus faecium* as an index of human fecal pollution. *Environmental Science and Technology* 39:283-287

Appendix D

Duval County Health Department Septic Tank Failure Area Ranking Protocol



Septic Tank Failure Area Ranking Protocol



I. Overview

The following is a step-by-step description of how to properly perform a Septic Tank Failure Area Ranking. This document will also provide information on how to format/calculate data and whom to contact to obtain such data.

Approximately half of the criteria required to complete the Septic Tank Failure Area Ranking are generally static in nature and will not change over time; the criteria are Average Lot Size, Soil Potential, Seasonal High Water Table, and Proximity to the River.

The remaining criteria such as # of OSTDS Failures, Threat to Potable Water, Sanitary Conditions, and Flooding can change depending on the time frame and may be affected by various Public Works initiatives or other outside agencies

II. Contacts for Data

The **# of OSTDS Failures** is calculated from data maintained by the Duval County Health Department; the primary contact for this information is the Environmental Supervisor of the Onsite Sewage Treatment and Disposal System Program, Scott Turner, MPA, RS - (904) 630-3274.

Threat to Potable Water is calculated from data provided by JEA. The # of customers receiving "City Water" from a centralized distribution system within the area in question can be used to determine properties that rely on private potable wells for drinking water. The primary contact for this is Kevin Holbrook and be contacted at (904) 665-4540.

The City of Jacksonville's Air and Water Quality Division supply the data for **Sanitary Conditions**. Point values for each area are provided by Dana Morton - (904) 630-1212 X3128.

The City of Jacksonville's Streets and Drainage Division perform the review of **Flooding** within specified areas. A determination of conditions to new or existing areas in the form of a point rating (severe, moderate, minor, and not significant) may be requested from Jeff Beck - (904) 630-1212 X7003.

III. Calculations for 8 Criteria

A.) OSTDS Failures

The OSTDS Failures are calculated by averaging the latest five years of OSTDS Repair Permit information on the individual failure area polygons and assigning points based on the Table 1. The dates should be from April of the preceding year to the end of March during the current year. This time span is maintained to keep the analysis consistent with the original ranking completed in April of 1999.

B.) Average Lot Size

Calculated with Arc View software. The City of Jacksonville supplies our office with parcel information on all recorded properties in the form of a shape file. The shape file contains lot size data which Arc View can be used to determine total number of

lots and total acreage within a failure area. Average Lot Size is calculated based on these results.

C. Soil Potential

Calculated with Arc View software. The Soil Potential for Duval County Layer (created by Frank Watts USGS Soils Survey Leader for Duval County and Tom Mallet City of Jacksonville) measures the potential of an OSTDS to be installed and maintained. A percentage of each soil potential type within the individual failure area polygons is provided. A portion of this polygon may have an amount of acreage that cannot have a soil potential assigned to it. If that is the case the area of the polygon should be normalized. Assigning the fraction of the whole that can be analyzed as the polygon total does this, and new percentages are calculated by dividing the area of individual soil type by this new polygon total. The result for each soil type is then multiplied by the point values from Table 1 (C) for that soil type and totaled for the area score. This can be done because the percentages are determined in units or graphically by the software. [See example calculation in D.) below.

D. Seasonal High Water Table

Calculated with Arc View software. The attributes table of the USGS Soils Survey layer provided by the St. Johns Water Management District is adjusted to map the soil types in Duval County according to their soil Taxonomy characteristic of "Seasonal High Water Table". The program will return a percentage of each soil type within the individual failure area polygons. A portion of this polygon may have an amount of acreage that cannot have a seasonal high water table assigned to it. If that is the case the area of the polygon should be normalized. Assigning the fraction of the whole that can be analyzed as the polygon total does this, and new percentages are calculated by dividing the area of individual soil type by this new polygon total. The result for each soil type is then multiplied by the point values from Table 1 (D) for that soil type and totaled for the area score. This can be done because the percentages are determined in units or graphically by the software.

Example: Typical results from Arc View analysis

SHWT

Very Good.....	0.0%
Good.....	0.0%
Moderate.....	20%
Poor.....	74%
Note rated.....	6.0%

Note the total percentages add up to 94%, therefore 6% is not rated.

The 94 now becomes our new total area and the percentage of moderate soil that can be analyzed is 20 divided by 94, which equals 21.3%. The percentage of poor soil is 74 divide by 94, which equals 78.7%

Referring to Table 1 (C) poor soil is worth 10 points and moderate soil is worth 7 points. Multiply the corresponding percentages by there soil class point value yields 7.87 points for poor and 1.07 points for moderate giving a total of 8.94 points for the Season High Water Table criteria.

This analysis is identical to the soil potential calculation on using different inputs.

E. Threat to Drinking Water

Calculated using the total lots (parcels) for each failure area polygon determined in B.) Average Lot size (above) and the total number of water customer in the same polygon provided by JEA. The result of the total JEA customers minus the number of lots is divided by total lots to give a simple percentage of individuals not connected to City Water in each polygon. A comparison to Table 1(D) will yield the points awarded by percentage.

F. Sanitary Conditions

No calculations required. The City of Jacksonville's Air and Water Quality Division provides data calculation results based upon the geometric mean of ambient water sampling locations throughout Duval County for the given year. The results are directly transferred to the appropriate score on the ranking form.

G. Proximity to the St. Johns River

Based upon the physical relationship of a conveyance (i.e. ditch creek or waterway) and the physical boundaries of the Failure Area. There are four categories described in Table 1 (G): on the river or tributary; drainage ditch within frequently flooded area and connects to a river or tributary; areas with isolated depressions; and not associated a surface water body. It may be possible to evaluate the conveyance using Arc View only, however if the conveyance is not a creek or tributary, field verification is required to determine if the conveyance is to be considered a surface water body.

H. Potential for Flooding

No calculations required. The City of Jacksonville's Streets and Drainage Division performs a review of Flooding within the specified areas and returns a designated score and the results are directly transferred to the appropriate score on the ranking form.

Appendix E

Calculation of Stormwater Runoff Coefficients

Calculation of Stormwater Runoff Coefficients

The potential for stormwater runoff was evaluated with runoff coefficients calculated using the U.S. Soil Conservation Service (SCS) Curve Number approach (SCS 1986). This method considers the influence on stormwater runoff from land-use categories, soil types and antecedent soil moisture conditions. Land-use information was obtained from the St. Johns River Water Management District (SJRWMD) and based on 2004 natural color and infrared aerial photography. Soil-type information was obtained from the SJRWMD and collected by soil scientists using remote sensing and additional information developed by the SJRWMD and National Resources Conservation Service (NRCS). Daily rainfall data obtained from the SJRWMD, collected from 2003 to 2006 in the vicinity of the WBID, were used for these calculations. Curve numbers generated for each land use are provided in Table 1. All runoff coefficients were calculated using conservative assumptions allowing the highest values for stormwater runoff. For instances where the soil type was given as a combination of two types, such as Type B/D, the more conservative curve number value for type D was used. In addition, for soil Type X (Urban Land), which is not included in the SCS Curve Number approach, the most conservative curve number value for type D was used.

The runoff coefficient for a given land-use category was estimated as the ratio between the annual stormwater runoff and the annual rainfall, calculated as the sum of daily stormwater runoff and daily rainfall, respectively. Annual runoff coefficients were calculated for each year and then averaged to obtain a composite runoff coefficient. Each year was calculated separately, then averaged to prevent a bias toward the years with higher annual rainfall. Areas of water and wetlands will, by nature, have extremely high amounts of runoff. As a result, these areas were delineated separately to gain a better idea of the runoff potential on land.

Table 1. Summary of U.S. Soil Conservation Service Curve (SCS) Numbers used to calculate runoff coefficients.

LAND USE	SOIL TYPE	SCS CURVE NUMBER		LAND USE	SOIL TYPE	SCS CURVE NUMBER
Citrus/Tree Crops	A	44		Medium Density Residential	A	57
Citrus/Tree Crops	B	65		Medium Density Residential	B	72
Citrus/Tree Crops	C	77		Medium Density Residential	C	81
Citrus/Tree Crops	D	82		Medium Density Residential	D	86
Citrus/Tree Crops	X	82		Medium Density Residential	X	86
Commercial	A	89		Miscellaneous Agriculture	A	49
Commercial	B	92		Miscellaneous Agriculture	B	69
Commercial	C	94		Miscellaneous Agriculture	C	79
Commercial	D	95		Miscellaneous Agriculture	D	84
Commercial	X	95		Miscellaneous Agriculture	X	84
Forest	A	36		Pasture	A	49
Forest	B	60		Pasture	B	69
Forest	C	73		Pasture	C	79
Forest	D	79		Pasture	D	84
Forest	X	79		Pasture	X	84
Golf Course	A	39		Recreation/Open/Rangeland	A	39
Golf Course	B	61		Recreation/Open/Rangeland	B	61
Golf Course	C	74		Recreation/Open/Rangeland	C	74
Golf Course	D	80		Recreation/Open/Rangeland	D	80
Golf Course	X	80		Recreation/Open/Rangeland	X	80
Industrial/Utility	A	89		Transportation Facilities	A	95
Industrial/Utility	B	92		Transportation Facilities	B	95

Industrial/Utility	C	94		Transportation Facilities	C	95
Industrial/Utility	D	95		Transportation Facilities	D	95
Industrial/Utility	X	95		Transportation Facilities	X	95
Institutional	A	89		Wetlands	A	98
Institutional	B	92		Wetlands	B	98
Institutional	C	94		Wetlands	C	98
Institutional	D	95		Wetlands	D	98
Institutional	X	95		Wetlands	X	98
High Density Residential	A	77		Water	W	98
High Density Residential	B	85				
High Density Residential	C	90				
High Density Residential	D	92				
High Density Residential	X	92				
Low Density Residential	A	50				
Low Density Residential	B	68				
Low Density Residential	C	79				
Low Density Residential	D	84				
Low Density Residential	X	84				

REFERENCES

U.S. Soil Conservation Service (SCS) (1986) Urban hydrology for small watersheds. Technical Release 55. U.S. Department of Agriculture.

Appendix F

Programs to Address the Sanitary Sewer Systems as a Source of Fecal Coliform Contamination

Programs to Address the Sanitary Sewer System as a Source of Fecal Coliform Contamination

Beginning in the late 1990's the regional utility provider undertook a comprehensive program of pipeline rehabilitation focusing on larger line throughout the service area. To date the utility has expended greater than \$500 million in pipeline rehabilitation alone. Since large-scale replacements of existing systems have large capital costs, it is necessary to routinely conduct investigations including but not limited to infiltration and inflow studies to evaluate the integrity of the infrastructure and use this type of assessment to locate severe problem areas with a high probability of impacts related to the utility. Examples of investigations and maintenance procedures include regularly 1) using remote camera equipment to inspect the lines, 2) cleaning lines, 3) inspecting manholes, and 4) testing pumps at lift stations to ensure proper function. Local utilities should also use "mean time to failure" estimates to replace pumps at lift stations prior to failing as well as warning systems for failures of utilities in order to help minimize impacts when failures occur. These systems have been implemented by the regional utility provider. In addition to performing remedial maintenance on an as-needed basis, the regional utility provider has routinely implemented a variety of corrective actions performed on a prioritized schedule. These include, but are not limited to:

- pipe bursting (to increase the carrying capacity of pipe)
- slip lining (to provide smoother surface within pipe)
- open cut (removal and replacement of pipe)
- fiberglass-line manholes
- replace manholes
- line wet wells
- re-routing
- replace force mains

Spills of untreated sewage from the regional sewer system in Duval County are addressed immediately and investigated thoroughly. When a SSO occurs, the cause is usually listed as a recent, immediately traceable condition, such as a pipe break or pump failure. However, merely repairing the ruptured pipe without understanding the underlying cause of its failure may not protect against future SSOs.

In every case of an untreated wastewater discharge, JEA conducts a two part investigation into the cause of the spill. The first is to address the immediate cause and the second is conducted to address any underlying causes. Historically, pipe breaks, cave-ins and grease have been major causes of spill events. Significant investments in pipe replacement focused on areas with the highest occurrence of events and have significantly reduced the number of events related to breaks and cave-ins. The introduction of an effective FOG (Fats, Oils and Grease) program has reduced the number of spills associated with grease stoppages. Continual focus on actions to reduce the causes of the events is the primary assignment of the Waste Water Preventive Maintenance team at JEA.

Specific City-Wide Improvement Programs by JEA

Fats, Oils, and Grease Reduction Program

Fats, oils and grease (FOG) generated during food preparation build-up in sanitary sewer lines. Without proper maintenance, these lines clog, eventually leading to the occurrence of SSOs. In order to help reduce these events, JEA requires that all food-service establishments (“FOG generators”) connected to JEA sewer participate in the FOG Program (<http://www.jea.com/about/pub/downloads/fog/FOGTrainingSlideShow.pdf>).

In order to assist FOG generators to meet the requirements of the program, JEA has developed the Preferred Hauler Program (PHP). The preferred haulers are vendors, approved by JEA, that pump, haul, and properly dispose of FOG materials for food-service establishments. In order to meet JEA’s expectations, these haulers must demonstrate, both initially and continually, that they are able to meet the following criteria (abbreviated version obtained from <http://www.jea.com/about/pub/downloads/fog/FOGProgramPreferredHaulerRequestforParticipation.pdf>):

1. Satisfactorily pump out grease traps/interceptors.
2. Attend waste hauler education meeting.
3. Accepts limited regulatory responsibility for the Generator.
4. Submits manifest document for disposal of all trap contents generated in JEA’s service area on a quarterly basis.

On April 2, 2007, JEA reported that the FOG Reduction Program identified approximately 10 establishments within Duval County in the last month that were either not enrolled (mandatory) or were found to be out of compliance. It was noted that these occurrence most commonly take place when a commercial industry changes ownership.

SSO Root Cause Program

The SSO Root Cause program, which began in January 2007, is run by a group of first responders who meet every two weeks to determine the root cause of each SSO so that an effective solution can be implemented. This program is ongoing, and some city-wide patterns have already become apparent.

Pop-Top Program

JEA implemented the six to seven week Pop-Top program in early 2007 to open and inspect all accessible manholes in Jacksonville (approximately 50,000) with the objective of preventing future Sanitary Sewer Events (SSEs) and SSOs. As of April 2, 2007, JEA reported that a skeleton crew had already begun this work and had identified several lines and manholes throughout the City in need of rehabilitation.

Non-Destructive Testing Program

The Non-Destructive Testing program, initiated in 2006, utilizes sonar to test sanitary sewer pipes (e.g., wall thickness) while maintaining the integrity of the structures. The Pump Replacement and Air Release Valve Programs are both incorporated under this larger entity, focusing on known critical force mains, iron pipes, and air valves that are located over water bodies.

Time-Out Program

The objective of the Time-Out program, implemented in January of 2007, is to enable all pump stations to automatically notify the operator if they do not operate as scheduled. As of April 2, 2007, JEA reported that although information exists to make improvements to this system, the data needs to be identified differently in order to make it useful and effective.

Appendix G

Programs to Address OSTDS as Sources of Fecal Coliform Contamination

Programs to Address OSTDS as Sources of Fecal Coliform Contamination

Duval County Health Department (DCHD) OSTDS Program

The objective of the OSTDS program is to provide safe and sanitary treatment and disposal of domestic and commercial sewage waste in the areas not served by public sewerage systems. Generally, OSTDS present no public health problems when they are properly designed, installed and maintained on sites having satisfactory soil and drainage features; however, where an installation site is unsuitable, and where no modification of the property is possible or practical, use of an OSTDS may contaminate ground or surface waters. The primary goals of the DCHD are to protect public health by eliminating the potential for the spread of infectious disease caused by improperly built or maintained OSTDS and to protect ground and surface water from OSTDS discharge.

The DCHD is responsible for all operational aspects of the OSTDS program as described in Chapter 64E-6, Florida Administrative Code (FAC) (<http://www.doh.state.fl.us/environment/ostds/pdfiles/forms/64e620070924.pdf>). To accomplish their program goals and objective, the DCHD utilizes the expertise of one field supervisor, eight field inspectors, and three administrative support staff. In addition, the DCHD office has a field inspector to perform complaint investigations and an enforcement officer to address legal cases.

During the permitting process, the OSTDS staff provides many services including, but not limited to:

- application/ plan review;
- site evaluation;
- system construction permitting; and
- installation inspection.

The DCHD must review all applications for construction permits relating to the installation, modification, replacement, or repair of OSTDS and make a determination within the time limitations prescribed by the Florida Administrative Procedures Act, Section 120.60, Florida Statutes (FS), whether to issue or deny a permit. The goal for the average number of days to issue a new construction permit is eight days and two days for a repair permit.

The review process involves a determination as to whether the site location and installation will comply with standards set forth in Chapter 381, FS and Chapter 64E-6, FAC. DCHD also inspects and evaluates all new installations, repairs, abandonments, or modifications of OSTDS; inspections are made to ensure adequate tank construction and capacity, fill material if needed, drainfield size, elevation, cover, dosing system construction, distance from surface water and potable wells, and other regulatory requirements. DCHD also inspects existing OSTDS for compliance when there is a

change of use or occupancy. When the COJ's Building and Zoning Department receives an application for a building permit, when a zoning change is requested or when COJ receives an application for occupational license, the applicant will be referred to the DCHD office for OSTDS review.

When a building served by an OSTDS is located in an area zoned or used for industrial/manufacturing purposes, or where a business generates commercial sewerage waste, DCHD issues an annual operating permit and requires at least one compliance inspection per year. The updated listing of these properties are identified by DCHD staff who cross-reference JEA and COJ data.

In addition to the actual permitting process for OSTDS systems, the DCHD also regulates the OSTDS maintenance industries. Service permits are issued to the following facilities on an annual basis, and one to two compliance inspections are performed by DCHD each year depending on the type of facility:

- Septic disposal services;
- Lime stabilization facilities;
- Land application facilities;
- Portable or temporary toilet services; and
- Septic tank manufacturers.

When an inspection determines that a DCHD-issued OSTDS permit is out of compliance, the inspector will notify the appropriate parties in writing. Proper documentation, in the following sequence, is required for any type of inspection:

- Step i. Written notice (i.e. inspection report);
- Step ii. Official notice;
- Step iii. Legal notice or corrective notice; and
- Step iv. Case referred to State Attorney's Office.

It should be noted that a complaint investigation will begin at Step ii, with issue of the official notice. By law, two versions of notice are required prior to enforcement. Depending on the severity of the case, the timeline between steps of this sequence may vary. For example, for more serious occurrences, the timeframe between Step i and Step iii can be under 24 hours.

Approximately 90% of cases in Duval County are corrected after Steps i and ii. For those cases that require enforcement, the DCHD has its own Enforcement Officer to take cases to court. FDEP law enforcement becomes involved in cases of willful pollution. The DCHD computer database includes a record of all complaints and investigations. This database is updated on a daily basis and may include approximately 16-20 complaints per week.

Florida Onsite Wastewater Association (FOWA) Proposed Legislation

FOWA proposed legislation for a State statute requiring that OSTDS be inspected every five years. Although the goal was to have the bill voted on during the 2007 legislative session, the bill failed in committee and was not brought to the full legislature. According to Mike McNarny, FOWA (personal communication June 5, 2007), it is currently the organization's goal to educate legislators in the upcoming year with the objective of resubmitting the bill during the 2008 legislative session.

At this point, the focus temporarily shifted to legislation on the local level. FOWA proposed a similar bill before the Jacksonville City Council. Mr. McNarny stated it will be the goal of FOWA to educate officials on the local level in order to increase support for the ordinance.

DCHD-Sponsored Training Programs

On April 25, 2006, First Coast District Florida Environmental Health Association (FEHA) hosted their first advanced OSTDS training opportunity "Perspectives on the use of OSTDS in Florida." The course was approved for six hours of continuing education for registered septic tank contractors and certified environmental health professionals. Approximately 70 people were in attendance. Speakers included representatives from associations such as the Florida Department of Health (FDOH), the USEPA, St. Johns Riverkeeper, WSEA, FOWA, and DCHD. Those in attendance included personnel from JEA and the FDEP as well as certified plumbers, septic tank contractors, and environmental health professionals from seven county health units.

Another training program, entitled Onsite Management: Alternative for a Better Community, was hosted by the DCHD and FDOH on November 16, 2006 in Jacksonville. This course was originally presented at the 2006 FEHA Annual Education Meeting in Sarasota, Florida. This training provided 6 contact hours for all septic tank contractors and certified environmental health professionals. It was an introduction to Onsite Wastewater Management and the EPA's Voluntary Management Guidelines. In addition, the speakers provided consideration for existing and future development and the opportunity for discussion of local issues that affect our community.

The DCHD intends to continue other such efforts in the future; however, the themes may change. One idea is to include a DCHD public outreach endeavor as a part of the City's annual environmental workshop.

Appendix H

**2006 Annual Monitoring Report
COJ/FDOT NPDES Permit**

**2006 Annual Monitoring Plan Report
City of Jacksonville/FDOT NPDES Permit**

EXECUTIVE SUMMARY:

Goal I of the monitoring plan is to identify water quality problem areas. This portion of the plan is implemented by the “Routine and Intensive” tributary programs. Both programs were fully implemented in 2002.

2006 routine tributary data indicate continued problems with fecal coliform levels through out Duval County. In 2006, 434 visits were made to routine tributary sites. Compliance with the State dissolved oxygen standard for those visits was 60 percent, compliance with the fecal coliform standard was 62 percent.

Five tributary intensive sampling events were completed in 2006. Nutrient data from these events identified a few potential problem areas. Data from Red Bay Branch (ARL3) indicates nutrient enrichment. Nitrate-nitrite levels in Red Bay Branch were especially high, and may be the result of shallow groundwater influence from a near by septic tank failure area (Eggleston Heights). Another tributary that was characterized by elevated nutrients was the upper reach of the Trout River, monitored at Old Kings Rd. (TREE10). A potential explanation for the elevated nutrients in this rural area is dairy operations. Monitoring this year documented a sanitary sewer leak into McCoys Creek. NH3 levels were extremely elevated for March and May sampling events

This year metals data collected discovered one violation for Class III standards for marine waters. The violation was for copper at TREE10 on 5/16/2006. It is believed that the drought conditions this year contributed to fewer metals violations.

Goal II of the monitoring plan, to assess effectiveness of BMP efforts is in the planning stages. Reconnaissance of the areas has begun to identify potential sampling locations that will best evaluate effectiveness of the proposed improvements. Due to various delays with project design and construction sampling has not been started for the four project areas. However, it appears very likely that “before” samples will be collected in 2006. Specifically, The newly added Deer Creek project and the Cedar River project are scheduled for sampling in 2006.

The water quality data collected through this monitoring plan is currently located in City of Jacksonville Access databases. These databases are partially formatted for annual upload to FDEP/STORET databases. The City will be meeting with State STORET coordinators and a database consultant in 2007 to improve the process of uploading City water quality data to the FDEP/STORET database.

One collaborative effort identified in the monitoring plan was the City of Jacksonville’s Reasonable Assurance Plan (RA Plan). This plan was proposed by the City to provide the State and the US EPA with “reasonable assurance” that the 51 Water Body IDs on the verified list as impaired for fecal coliform bacteria were being adequately addressed by local efforts. The State or the US EPA did not accept the RA Plan. In 2006, FDEP began writing and adopting the various fecal coliform TMDL’s for the 51 listed WBIDs. Also

in 2006, the “Tributary Pollution Assessment” project began to transition into the current “Lower St. Johns River Tributaries Basin Management Action Plan (BMAP) Working Group. This group is in the beginning stages of developing BMAPs for the fecal coliform impaired WBIDs. The final report of the “Tributary Pollution Assessment Project” has become an integral part of the tributary BMAP process.

2006 Annual Monitoring Plan Report City of Jacksonville/FDOT NPDES Permit

INTRODUCTION

The City of Jacksonville, FDOT, City of Atlantic Beach, and City of Neptune Beach submit the following 2006 annual monitoring plan report to fulfill the NPDES Permit monitoring requirement. This monitoring plan report is being submitted as required under Part V.B. of the NPDES MS4 permit and supported by Title 40 of the Code of Federal Regulations, Part 122.26(d)(2)(iii).

GOALS AND OBJECTIVES OF STORMWATER MONITORING

The goal and objectives of this Monitoring Plan is to assess the effectiveness of the Stormwater Management Program (SWMP) and the associated pollutant reduction from MS4 systems to the waters of the state to the Maximum extent Practicable (MEP)

Monitoring data, along with other appropriate program information and data, will be used when evaluating the overall effectiveness of the SWMP. In addition, this data will be used to support the conclusion reached for “Assessment of Controls” as required by 40 CFR 122.26(d)(2)(v).

To accomplish the goals and objectives of this monitoring plan the City of Jacksonville is integrating three different water quality efforts. Those programs are:

1. The City of Jacksonville’s “Routine Tributary” monitoring program.
2. The City of Jacksonville’s “Tributary Intensive” monitoring program.
3. The City of Jacksonville proposes to document water and sediment quality improvements attributable to four different stormwater pollution reduction measures located in four different sub-basins.

SPECIFIC MONITORING GOALS

This monitoring plan proposes to address two of the three possible Specific Monitoring Goals discussed in the “Guidance Document”.

- 1. Identify potential water quality problem areas related to stormwater runoff that can be targeted for corrective action, retrofits or non-structural BMPs.**

This monitoring goal will be achieved through the City of Jacksonville’s two ongoing tributary monitoring programs (routine and intensive) previously mentioned. These programs will be described later in the Plan.

- 2. Measure the effectiveness of the stormwater pollution reduction measures (BMPs) that have been or will be implemented.**

The City of Jacksonville proposes to document water and sediment quality improvements attributable to four different stormwater pollution reduction measures located in four different sub-basins.

MONITORING PLAN SPECIFICS

GOAL I:

Identify potential water quality problem areas related to stormwater runoff that can be targeted for corrective action, retrofits or non-structural BMPs.

TRIBUTARY PROGRAM (ROUTINE)

Objectives:

The Tributary Program has its original back in the 1970s. The program was initiated to assess the water quality impacts that the over 300 small wastewater treatment plants (WWTPS) were having on the tributaries of Duval County. In the beginning, tributary monitoring locations were upstream and downstream of the WWTPs. After the elimination (through connection to sanitary sewer) of most of the county's "package plants" (small WWTPS) water quality monitoring at many of the stations was discontinued. The current Tributary Program has data beginning in 1984 from approximately 115 stations scattered throughout Duval County's tributaries. At this time 104 sites are included in the sampling program. Station locations are often near bridges and roadways to facilitate sampling efforts; sites are both above and within tidal influence from the St. Johns River or Intracoastal Waterway. The primary objective of this program is collection long-term dataset that will enable the City to document water quality trends.

Constituents:

The constituents measured in the Routine Tributary Program are limited to field measurements and coliform bacteria.

Field Measurements (multi-parameter water quality probe):

Dissolved oxygen, percent saturation of dissolved oxygen, pH, temperature, salinity and specific conductance.

Laboratory Analyses:

Both total and fecal coliform bacteria were collected until 1996. For the current program, starting in 1996, laboratory analysis includes only fecal coliform bacteria.

Methodology

Field water quality measurements are collected and logged with an YSI 600XL multi-parameter water quality meter and YSI 650DM display unit. Fecal coliform samples are surface grab samples.

Frequency

Sampling frequency for the Tributary Program is quarterly.

Stations

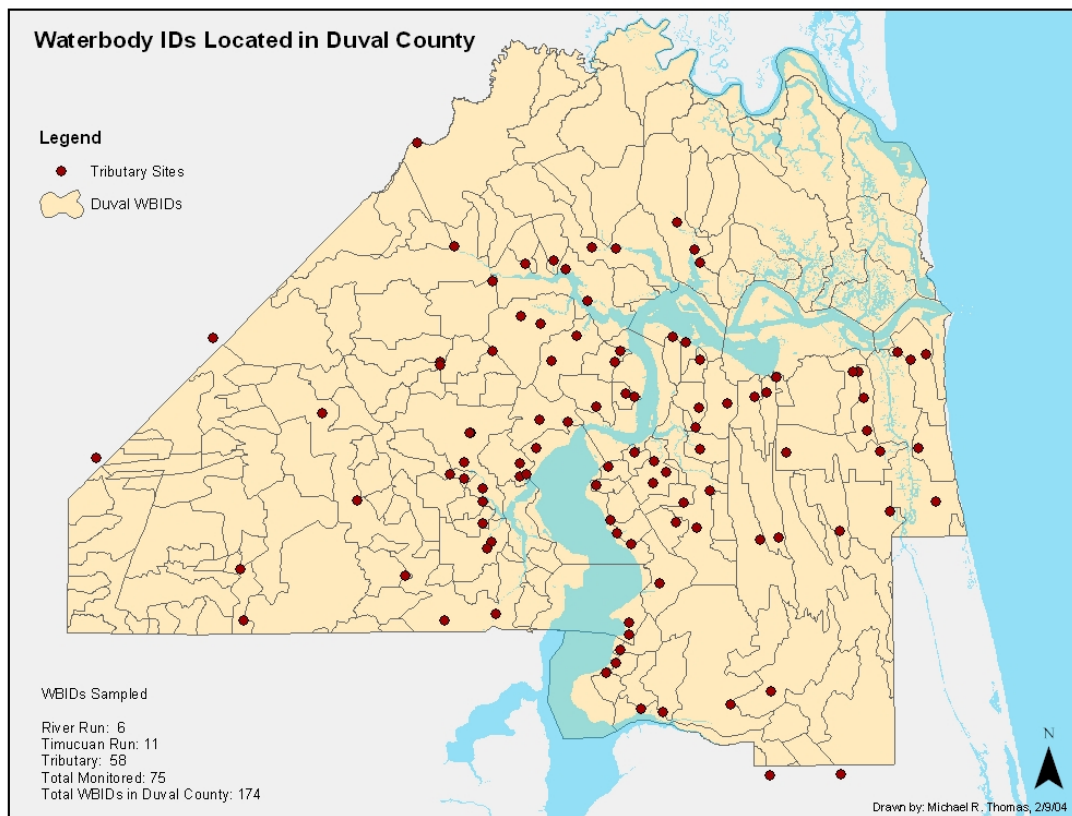
Active Tributary Program Station Locations (104) September 2006

Station ID	Location	WBID	LAT-Dec	LONG-Dec
ARL11	JONES CREEK AT MONUMENT RD	2246	30.34195	81.53925
ARL15	GINHOUSE CREEK AT MONUMENT RD	2248	30.34494	81.53151
ARL18	COWHEAD CREEK AT FT. CAROLINE RD	2244	30.35489	81.52299
ARL20	SANDALWOOD CANAL AT KERNAN RD	2270	30.30645	81.48918
ARL23	FAIRCHILD BRANCH AT EDENFIELD RD	2213C	30.38079	81.59997
ARL3	RED BAY BRANCH AT LONE STAR RD	2254	30.33534	81.58028
ARL325	STRAWBERRY CREEK AT LONE STAR RD	2239	30.33888	81.55959
ARL453	STRAWBERRY CREEK AT ARLINGTON RD	2239	30.32274	81.58279
ARL6	NEWCASTLE CREEK AT OLD FT. CAROLINE HILLS RD	2235	30.36564	81.57968
ARL7	UNNAMED STREAM AT FERBER ROAD	2213C	30.3768	81.59080
ARL8	SILVERSMITH CREEK AT ARLINGTON RD	2278	30.3087	81.57865
BB1	BRANDY BRANCH AT U.S. 301	2225	30.37783	81.9416
BP64	BIG POTTSBURG CREEK AT BELFORT RD S END	2265B	30.2576	81.58114
BP65	BENNETT BRANCH AT SALISBURY ROAD	2319	30.2611	81.5972
BP67	BIG POTTSBURG CREEK AT HOGAN RD	2265B	30.28157	81.57233
BP71	BIG POTTSBURG CREEK AT PARENTAL HOME RD	2308	30.27362	81.59591
BR146	BROWARD RIVER AT BISCAYNE BLVD	2191	30.446416	81.671
BR7	CEDAR CREEK AT DUVAL ROAD	2191	30.4582	81.6806
CR139	BIG FISHWEIR CREEK AT HERSHEL ST	2280	30.29012	81.71343
CR2	BUTCHER PEN CREEK AT WESCONNET BLVD	2322	30.2599	81.74004
CR21	WILLS BRANCH N BRANCH AT OLD MIDDLEBURG RD	2282	30.291444	81.7652777
CR22	WILLS BRANCH N BRANCH AT OLD MIDDLEBURG RD	2277	30.28491	81.7679
CR3A	WILLOW BRANCH CREEK AT AZALEA TERR	2213E	30.30418	81.69667
CR427	CEDAR RIVER E BRANCH AT STUART AVE	2262	30.31772	81.750333
CR428	CEDAR RIVER W BRANCH AT STUART AVE	2262	30.317694	81.751222
CR430	CEDAR RIVER AT LENOX AVE	2262	30.298916	81.70111111
CR5	LITTLE FISHWEIR CREEK AT PARK ST	2280	30.29859	81.71296
CR6	LITTLE FISHWEIR CREEK AT GREENWOOD AVE.	2280	30.2914	81.7083
CR84	WILLIAMSON CREEK AT HYDE PARK RD	2316	30.2737	81.74082
CR85	CEDAR RIVER AT SAN JUAN AVE	2262	30.28183	81.74015
CR95	WILLS BRANCH AT LANE AVE S	2282	30.288638	81.7539722
DC144	DUNN CREEK AT FAYE RD	2181	30.43764	81.58212
DC5	TERRAPIN CREEK AT ALTA RD	2204	30.428888	81.58083333
DC6	DUNN CREEK AT DUNN CREEK RD	2181	30.45497	81.59685
DC7	TERRAPIN CREEK AT FAYE RD	2204	30.43434	81.56528
DC8	RUSHING BRANCH AT ALTA RD	2189	30.45215	81.57904
DEC1	DEEP CREEK AT U.S. 90	2245	30.30033	82.03082
DR1	DEER CREEK AT TALLEYRAND AVE	2256	30.34173	81.62808
DR2	DEER CREEK E OF HAINES ST D/S OF S BRANCH	2256	30.34361	81.6364
DUC2	SAMPSON CREEK AT STATE RD 210	2419	30.06476	81.50143
DUC3	DURBIN CREEK AT RACETRACK RD	2365	30.09921	81.5253
DUC4	DURBIN CREEK AT U.S. 1	2365	30.09813	81.47266
GC1	GREENFIELD CREEK AT ATLANTIC BLVD	2240	30.32071	81.45522
GC2A	GREENFIELD CREEK DOCK AT 1585 GIRVIN RD.	2240	30.3541	81.4588

GC4	MT. PLEASANT CREEK AT MT. PLEASANT RD.	2234	30.35857	81.46651
HC3	HOGAN CREEK AT FIRST ST W OF LAURA ST	2252	30.3366	81.65727
IWW2	SHERMAN CREEK AT A1A BRIDGE	2227	30.37115	81.43194
IWWD	HOGPEN CREEK AT SAN PABLO RD	2270	30.30706	81.44531
IWWF	OPEN CREEK AT SAN PABLO RD	2299	30.27024	81.44069
IWWG	CRADLE CREEK BRANCH AT FAIRWAY LN	2205C	30.27481	81.40322
IWWH	HOPKINS CREEK AT KINGS RD	2266	30.30924	81.41693
JC15	CORMORANT BRANCH AT JULINGTON CREEK RD	2381	30.14045	81.62177
JC3	JULINGTON CREEK AT GREENLAND RD	2351	30.1618	81.5594
JC339	JULINGTON CREEK AT US 1	2351	30.1885	81.5622
JC440	JULINGTON CREEK AT OLD ST. AUGUSTINE RD	2351	30.14367	81.55546
JC441	BIG DAVIS CREEK AT U.S. 1	2356	30.15187	81.52608
JC5	OLDFIELD CREEK AT JULINGTON CREEK RD	2370	30.13857	81.60643
LB1	LONG BRANCH AT WIGMORE ST	2233	30.37185	81.63967
LB2	LONG BRANCH AT EVERGREEN AVE	2233	30.36434	81.64354
LP3	LITTLE POTTSBURG CREEK AT ART MUSEUM DR	2284	30.30038	81.61341
LP4	LITTLE POTTSBURG CREEK AT BEDFORD RD	2284	30.28619	81.61452
LP7	LITTLE POTTSBURG CREEK AT BEACH BLVD W OF K-MART	2284	30.294638	81.6059444
MC1	MCCOYS CREEK AT MYRTLE AVE	2257	30.32588	81.67771
MC3	MCCOYS CREEK AT LELAND ST	2257	30.32656	81.69858
OR13	MCGIRTS CREEK AT SHINDLER DR	2338	30.22575	81.7980555
OR344	MCGIRTS CREEK AT NORMANDY BLVD	2249A	30.27436	81.8340277
OR346	MCGIRTS CREEK AT OLD PLANK RD	2249B	30.33035	81.86166
OR348	ORTEGA RIVER AT KIRWIN RD-ARGYLE FORREST BLVD	2249A	30.19654	81.76864
OR4	FISHING CREEK AT TIMUQUANA RD	2324	30.24732	81.73386
OR434	ORTEGA RIVER AT COLLINS RD	2249A	30.201305	81.7305277
OR8	FISHING CREEK N BRANCH AT WESCONETT BLVD	2324	30.243611	81.7380555
OR9	FISHING CREEK S BRANCH AT WESCONETT BLVD	2324	30.23619	81.73922
OR110	FISHING CREEK S BRANCH AT 110 TH ST	2324	30.24100	81.73253
PC2	THIRD PUNCHEON BRANCH AT JTB BLVD	2271	30.25089	81.52431
PC3	MILL DAM BRANCH AT JTB BLVD	2273	30.25171	81.52109
PC8	CEDAR SWAMP CREEK AT GLEN KERNAN PKWY	2290	30.25129	81.47369
SC1	PUCKETT CREEK AT WONDERWOOD DR	2227	30.37036	81.41206
SC3	SHERMAN CREEK AT WONDERWOOD DR	2227	30.3665	81.42319
SS1	MILLER CREEK AT ATLANTIC BLVD	2287	30.30614	81.62877
SS10	NEW ROSE CREEK AT SAN JOSE BLVD	2306	30.261555	81.6460833
SS11	CHRISTOPHER CREEK AT SAN JOSE BLVD	2321	30.252916	81.6395833
SS16	NORTH CREEK OFF PLUMMERS COVE AT SCOTT MILL RD	2213F	30.19608	81.63125
SS17	SOUTH CREEK OFF PLUMMERS COVE AT SCOTT MILL RD	2213F	30.189277	81.6313611
SS18	DEEP BOTTOM CREEK AT SCOTT MILL RD	2361	30.178805	81.6380277
SS19	TACITO CREEK AT SCOTT MILL RD	2382	30.170194	81.6406666
SS20	UNNAMED CREEK AT MANDARIN RD AND LORETTO RD	2385	30.1635	81.64815
SS26	UNNAMED CREEK AT SAN JOSE BLVD	2213E	30.246416	81.631666
SS319	GOODBYS CREEK AT SANCHEZ RD	2326	30.221583	81.6090833
SS4	MIRAMAR CREEK AT SAN JOSE BLVD	2304	30.251472	81.6560555
SS63	CRAIG CREEK IN PARK AT HENDRICKS AVE	2297	30.278305	81.6488055
TC1	THOMAS CREEK AT U.S. 1	2161	30.505277	81.79166666
TR10	NINE MILE CREEK AT TROUT RIVER BLVD	2220	30.41585	81.73427
TR113A	TROUT RIVER AT BERT MAXWELL BOAT RAMP	2203A	30.40273	81.66393

TR114	MONCRIEF CREEK AT LEM TURNER RD	2228	30.38132	81.67134
TR123	TROUT RIVER AT U.S. 1 AT BOAT RAMP PIER	2203	30.436861	81.7614444
TR128	RIBAUT RIVER AT HARBORVIEW BOAT RAMP	2224	30.39379	81.71332
TR23	SIX MILE CREEK N BRANCH AT IMESON RD	2231	30.363277	81.7729722
TR3	CREEK AT PALMDALE ST AT LAKE PALMDALE OVERFLOW	2224	30.388722	81.6981388
TR314	LITTLE SIX MILE CREEK AT PICKETTville RD	2238	30.37091	81.73453
TR316	MONCRIEF CREEK AT 33RD. ST	2228	30.36482	81.69014
TR34	HIGHLANDS CREEK AT BROWARD RD	2203A	30.42356	81.67968
TR37	BLOCKHOUSE CREEK AT LEONID RD	2207	30.42977	81.68919
TR40	WEST BRANCH AT CAPPER RD	2210	30.42753	81.7099
TR422	SIX MILE CREEK S BRANCH AT IMESON RD	2232	30.361388	81.7730833
YWC1	YELLOW WATER CREEK AT NORMANDY BLVD	2323	30.229361	81.9209722
YWC2	YELLOW WATER CREEK D/S OF SAL TAYLOR CREEK	2323	30.195388	81.9180555

Station Location Map



2006 ROUTINE TRIBUTARY PROGRAM DATA:

The “raw” surface water quality data collected for this report can be found in Table1. at the end of this report.

DISCUSSION OF ROUTINE TRIBUTARY PROGRAM RESULTS

Water Quality Trends

Routine Tributary water quality trends are plotted from 1990 through 2006 in Figures 1 through 7. Figure 1. Charts percent compliance with the State's fecal coliform one time grab maximum standard of 800-colony forming units/100mL ((cfu/100mL). Basins represented in the figure are the six majors basins that the City monitors. They are Arlington River (11 sites), Julington/Durbin Creek (9 sites), Cedar River (8 sites), Ortega River (7 sites), Trout River (13 sites) and Broward River/Dunn Creek (7 sites). The data indicate a gradual improvement for the basins, most currently hover around 60 to 90 percent compliant with the 800 cfu/100mL standard.

Figures 2 - 7 present fecal coliform and dissolved oxygen compliance with State criteria for the same six basins. Dissolved oxygen compliance is generally better than fecal coliform compliance for the basins evaluated. Dissolved oxygen compliance typically is in the 70 percent range. The Julington/Durbin Creek system, due to the extensive wetlands in the basin and very dark water has poor compliance with the 5.0 mg/L freshwater standard. For this creek system the WQB has graphed actual dissolved oxygen values, the data indicate no clear trend for Julington and Durbin Creeks. Both Cedar and Ortega River basins experienced a marked decline with dissolved

In 2006 all basins, with the exception of the Trout River, displayed improved compliance with the fecal coliform standard. Trout River dropped from 75 to 62 percent compliance. For dissolved oxygen compliance Broward/Dunn and Trout River basins improved while the rest of the basins declined.

2006 Water Quality Data for Jacksonville WBIDs

In Table 2. all Water Body ID's (WBID's) monitored by the Routine Tributary Program are ranked by fecal coliform bacteria geometric mean for the October 1, 2005 – September 30, 2006 sample period. The City's routine tributary program added on station in the north branch of Wills Branch and now collects data from 70 different WBID's. When the data are sorted by WBID and ranked for fecal coliform geometric mean, it can be noted that 29 (41 percent) exceed the 800 cfu/100 mL one time grab maximum criteria.

Five of the worst ten for 2006 were present in the top ten for last year; they are Miller Creek, Miramar Creek, Willow Branch, Butcher Pen Creek and Fairchild Branch. With the exception of Butcher Pen Creek (a Cedar River tributary) all of these WBID's are relatively small minor tributaries to the St. Johns River, very low and prone to flooding. Additionally, all of these areas are: older development areas with septic tanks or served by older sanitary sewer service, with a high probability of infrastructure problems.

Routine Tributary Program
October 1, 2005 - September 30, 2006
WBIDs Ranked by Fecal Coliform Bacteria Geometric Means

Table 2.

Rank	Waterbody	WBID	Fecal Coliform Bacteria Geometric Mean (Colonies/100 mL)
1	Newcastle Creek	2235	4170
2	Miramar Creek	2304	4127
3	Willow Branch & minor trib.	2213E	3578
4	Rushing Branch	2189	3336
5	Miller Creek	2287	3189
6	Deep Bottom Creek	2361	2803
7	Moncrief Creek	2228	2785
8	Butcher Pen Creek	2322	2519
9	Hogan Creek	2252	2484
10	Fairchild Branch & minor trib.	2213C	2431
11	Little & Big Fishweir Creeks	2280	2278
12	McCoys Creek	2257	2024
13	Christopher Creek	2321	1907
14	Deer Creek	2256	1849
15	Tacito Creek	2382	1845
16	Fishing Creek	2324	1812
17	Craig Creek	2297	1693
18	Goodby's Creek	2326	1639
19	Cradle Creek Branch	2205C	1619
20	Williamson Creek	2316	1358
21	Cowhead Creek	2244	1213
22	Red Bay Branch	2254	1181
23	Blockhouse Creek	2207	1014
24	Terrapin Creek	2204	1013
25	West Branch	2210	988
26	Broward River	2191	901
27	Bennett Branch	2319	856
28	Long Branch	2233	843
29	Dunn Creek	2181	837
30	Little Pottsburg Creek	2284	800
31	Unnamed Creek Mandarin	2385	699
32	Wills Branch North	2282	684
33	Trout River	2203	675
34	Open Creek	2299	492
35	New rose Creek	2306	490
36	Big Pottsburg Creek	2308	420
37	Hopkins Creek	2266	418
38	Cedar River	2262	361
39	Julington Creek	2351	361

Routine Tributary Program
October 1, 2005 - September 30, 2006
WBIDs Ranked by Fecal Coliform Bacteria Geometric Means

Table 2.

Rank	Waterbody	WBID	Fecal Coliform Bacteria Geometric Mean (Colonies/100 mL)
40	North & South Creeks	2213F	360
41	Little Six Mile Creek	2238	341
42	Big Pottsburg Creek	2265B	318
43	Oldfield Creek	2370	318
44	Highlands Creek & Trout River	2203A	299
45	Six Mile Creek S Branch	2232	297
46	Sherman & Puckett Creeks	2227	291
47	McGirts Creek	2338	260
48	Wills Branch South	2277	240
49	Nine Mile Creek	2220	236
50	Hogpen Creek	2270	230
51	Cormorant Branch	2381	228
52	Strawberry Creek	2239	221
53	Ribault River & Palmdale Creek	2224	220
54	Silversmith Creek	2278	200
55	Ginhouse Creek	2248	182
56	Jones Creek	2246	179
57	Six Mile Creek N Branch	2231	166
58	Greenfield Creek	2240	159
59	Mt. Pleasant Creek	2234	156
60	Thomas Creek	2161	153
61	McGirts Creek	2249B	146
62	Ortega River	2249A	143
63	Cedar Swamp Creek	2290	126
64	Sampson Creek	2419	110
65	Durbin Creek	2365	69
66	Deep Creek	2245	67
67	Big Davis Creek	2356	65
68	Third Puncheon Branch	2271	55
69	Yellow water Creek	2323	45
70	Brandy Branch	2225	20

In Table 3. all WBID's monitored by the Routine Tributary Program are listed in order numerically. For each WBID, this table presents fecal coliform geometric mean, percent compliance for dissolved oxygen measurements and percent compliance for the fecal coliform bacteria Class III water quality standard of less than or equal to 800 colony forming units (cfu)/100mL.

Routine Tributary Program
October 1, 2005 - September 30,2006

Table 3.

Waterbody	WBID	FCC Gmean (Colonies/100mL)	Percent D.O. Compliance	Percent Fecal Compliance**
Thomas Creek	2161	153	0	75
Dunn Creek	2181	837	88	38
Rushing Branch	2189	3316	50	40
Broward River	2191	901	50	63
Trout River	2203	675	50	75
Highlands Creek & Trout River	2203A	299	75	63
Terrapin Creek	2204	1013	89	44
Cradle Creek Branch	2205C	1014	50	50
Blockhouse Creek	2207	1619	50	25
West Branch	2210	988	100	25
Fairchild Branch & minor trib.	2213C	2431	88	13
Willow Branch & minor trib.	2213E	3578	50	13
North & South Creeks	2213F	360	50	100
Nine Mile Creek	2220	236	50	75
Ribault River & Palmdale Creek	2224	220	50	88
Brandy Branch	2225	20	25	100
Sherman & Puckett Creeks	2227	591	67	58
Moncrief Creek	2228	2785	56	33
Six Mile Creek N Branch	2231	166	25	100
Six Mile Creek S Branch	2232	297	75	75
Long Branch	2233	843	40	60
Mt. Pleasant Creek	2234	156	75	100

Routine Tributary Program
October 1, 2005 - September 30, 2006

Table 3.

Waterbody	WBID	FCC Gmean (Colonies/100mL)	Percent D.O. Compliance	Percent Fecal Compliance
Newcastle Creek	2235	4170	75	25
Little Six Mile Creek	2238	341	25	75
Strawberry Creek	2239	221	63	88
Greenfield Creek	2240	159	75	100
Cowhead Creek	2244	1213	100	25
Deep Creek	2245	67	75	100
Jones Creek	2246	179	100	100
Ginhouse Creek	2248	182	25	75
McGirts Creek	2249B	143	75	100
Ortega River	2249A	146	75	100
Hogan Creek	2252	2484	20	40
Red Bay Branch	2254	1181	25	50
Deer Creek	2256	1849	20	40
McCoys Creek	2257	2024	10	30
Cedar River	2262	361	63	81
Big Pottsburg Creek	2265B	318	63	88
Hopkins Creek	2266	418	50	75
Hogpen Creek	2270	230	56	78
Third Puncheon Branch	2271	55	67	100
Wills Branch South Branch	2277	240	100	100
Silversmith Creek	2278	200	75	75
Little & Big Fishweir Creeks	2280	2278	33	25
Wills Branch North Branch	2282	684	80	60
Little Pottsburg Creek	2284	800	88	63
Miller Creek	2287	3189	100	0

Routine Tributary Program
October 1, 2005 - September 30, 2006

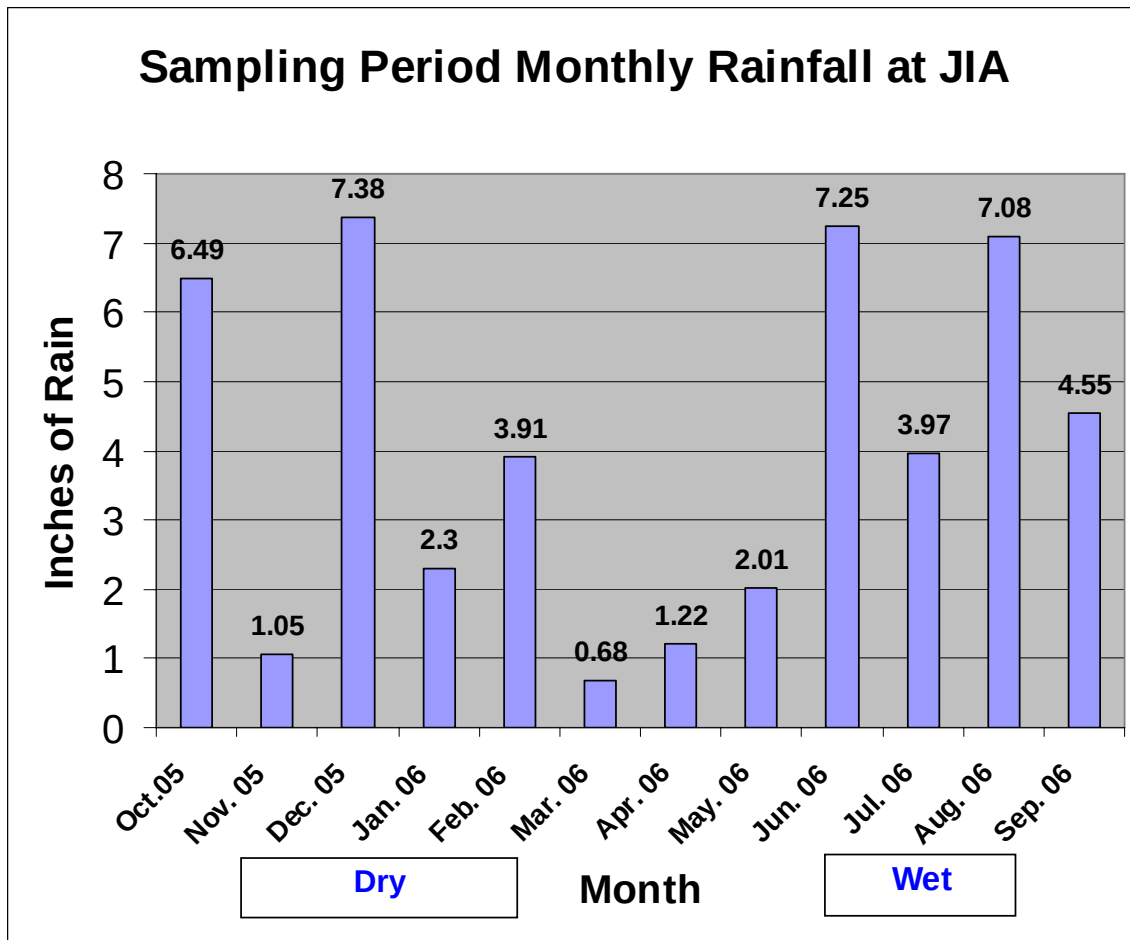
Table 3.

Waterbody	WBID	FCC Gmean (Colonies/100mL)	Percent D.O. Compliance	Percent Fecal Compliance
Cedar Swamp Creek	2290	126	100	100
Craig Creek	2297	1693	50	25
Open Creek	2299	492	75	75
Miramar Creek	2304	4127	50	25
New rose Creek	2306	490	100	50
Big Pottsburg Creek	2308	320	50	75
Williamson Creek	2316	1358	50	50
Bennett Branch	2319	856	50	50
Christopher Creek	2321	1907	75	25
Butcher Pen Creek	2322	2519	0	0
Yellow water Creek	2323	45	100	100
Fishing Creek	2324	1812	60	35
Goodby's Creek	2326	1639	75	25
McGirts Creek	2338	260	100	100
Julington Creek	2351	361	83	92
Big Davis Creek	2356	65	75	100
Deep Bottom Creek	2361	2803	50	0
Durbin Creek	2365	69	50	100
Oldfield Creek	2370	318	50	100
Cormorant Branch	2381	228	25	75
Tacito Creek	2382	1845	25	50
Unnamed Creek Mandarin	2385	699	0	50
Sampson Creek	2419	110	25	100

Notes:

* Dissolved Oxygen (D.O.) the standard is 5.0 mg/L for FW and 4.0 mg/L for marine conditions.

** Fecal coliform compliance is less than or equal to 800 colony forming units/100mL



TRIBUTARY INTENSIVE PROGRAM

Objectives:

AWQS started the Tributary Intensive Program in 2002. This program was initiated to collect surface water quality data that would provide a more detailed description of tributary conditions during wet and dry seasons. Wet months (July, August and September) are sampled to characterize the tributaries during peak storm water runoff periods. Dry months (November, February, May, April or December) are sampled to characterize “normal” or base-flow periods. The program includes 16 stations, 12 within four of Duval County’s “major” tributaries, and three from “minor” tributaries to the St. Johns River. All stations are already sampled in the “Routine” Tributary Program described previously, and are above the influence of tides from the St. Johns River. Selecting stations above tidal influence provides a more accurate assessment of conditions within the specific watershed being studied. In addition to providing detailed tributary watershed information to water quality managers the data will also improve the understanding of how Duval County’s tributaries affect water quality in the St. Johns River.

Constituents:

The constituents measured in the Tributary Intensive Program include: field measurements (water quality), laboratory analyses including 6 metals.

Field Measurements (multi-parameter water quality probe):

Dissolved oxygen, percent saturation of dissolved oxygen, pH, temperature, salinity and specific conductance.

Laboratory Analyses:

Major Inorganic Ions: chloride.

Aggregate Properties: color, turbidity, hardness, total suspended solids, biochemical oxygen demand (BOD).

Nutrients: total nitrate plus nitrite (NO₂), ortho-phosphate (OP), total phosphorus (TP), total Kjeldahl nitrogen (TKN), ammonia nitrogen (NH₃).

Biological: fecal coliform bacteria.

Metals: lead, nickel, cadmium, chromium, copper, and zinc.

Methodology

Field water quality measurements are collected and logged with an YSI 600XL multi-parameter water quality meter and YSI 650DM display unit. Water samples are surface grab samples.

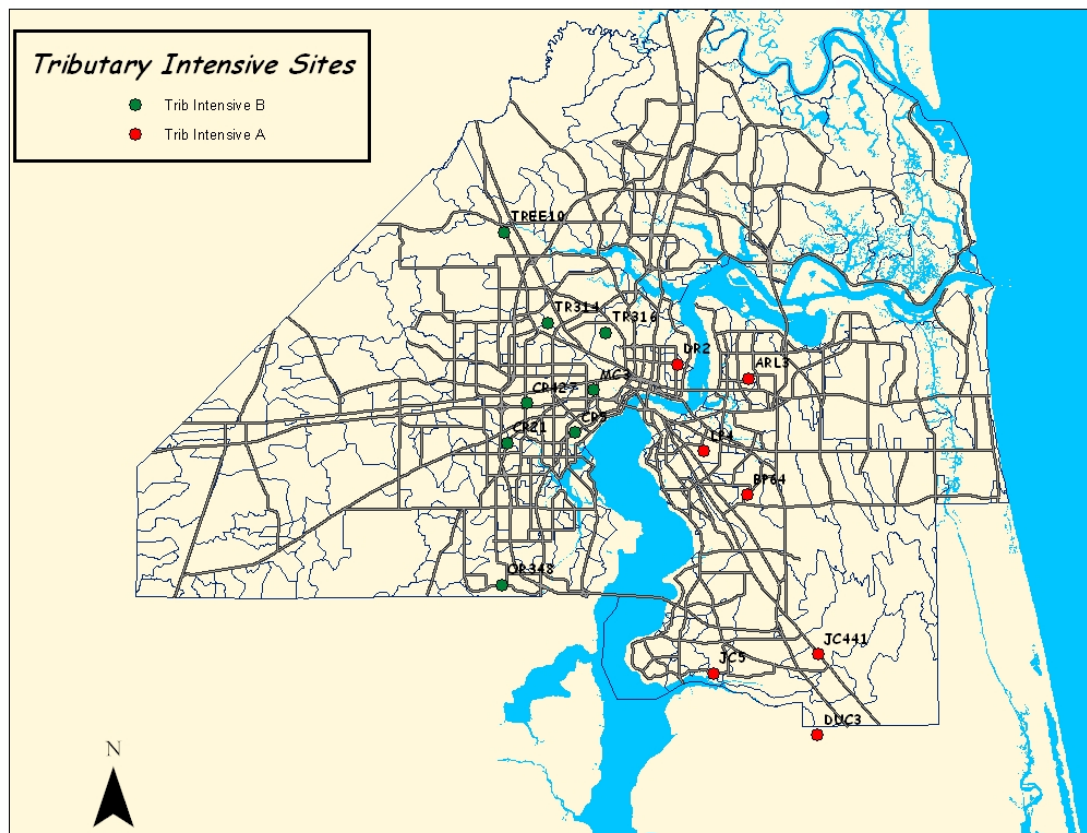
Frequency

Two complete sampling “runs” are conducted during dry months and three complete “runs” during wet months.

**Tributary Intensive Program Station Locations (16)
September 2005**

Station ID	Location	WBID	LAT-Dec	LONG-Dec
Arlington River Basin				
LP4	LITTLE POTTSBURG CREEK AT BEDFORD RD	2284	30.28619	81.61452
BP64	BIG POTTSBURG CREEK AT BELFORT RD S END	2265B	30.2576	81.58114
ARL3	RED BAY BRANCH AT LONE STAR RD	2254	30.33534	81.58028
Julington Creek Basin				
JC441	BIG DAVIS CREEK AT U.S. 1	2356	30.15187	81.52608
JC5	OLDFIELD CREEK AT JULINGTON CREEK RD	2370	30.13857	81.60643
JC339	JULINGTON CREEK AT US 1	2351	30.1885	81.5622
DUC3	DURBIN CREEK AT RACETRACK RD	2365	30.09921	81.5253
Cedar/Ortega River Basin				
OR348	ORTEGA RIVER AT KIRWIN RD-ARGYLE FORREST BLVD	2249A	30.19654	81.76864
CR21	WILLS BRANCH N BRANCH AT OLD MIDDLEBURG RD	2282	30.291444	81.7652777
CR427	CEDAR RIVER E BRANCH AT STUART AVE	2262	30.31772	81.750333
Trout River Basin				
TR314	LITTLE SIX MILE CREEK AT PICKETTville RD	2238	30.37091	81.73453
TR316	MONCRIEF CREEK AT 33RD. ST	2228	30.36482	81.69014
TREE10	TROUT RIVER AT OLD KINGS RD	2203	30.43108	81.76855
Minor Tributaries to the St. Johns River				
MC3	MCCOYS CREEK AT LELAND ST	2257	30.32656	81.69858
CR5	LITTLE FISHWEIR CREEK AT PARK ST	2280	30.29859	81.71296
DR2	DEER CREEK E OF HAINES ST D/S OF S BRANCH	2256	30.34361	81.6364

Station Location Map



2006 TRIBUTARY INTENSIVE PROGRAM DATA:

Field parameter data (temperature, pH, specific conductance, dissolved oxygen, percent saturation of dissolved oxygen) for the Tributary Intensive Program are located in Table 4. Results of laboratory analyses, with the exception of metals, for the Tributary Intensive sites are found in Table 5. Table 6 presents nutrient data for all sample dates; each site's nutrient parameter result is ranked in descending order for each sample event. Table 7 presents the 2006 metals data.

Figures 8 through 13 are a graphic representation of the nutrient data for individual sample events for the tributary intensive sites. The first two sample dates March and May 2006 represent the typical "dry" months, the following three dates, July, August and September, 2006 are typically the "wet" months. For comparison, average nutrient data for the St. Johns River off of NAS Jacksonville (JAXSJR30) is also plotted on these charts. Figures 14 through 19 are a graphic representation of average nutrient concentration for the "dry period" (two values) and "wet period" (three values) data for the Tributary Intensive sites.

Table 4.
Tributary intensives. Hydrolab Data October 1, 2005 - September 30,2006
Arlington River Basin

2265B	Big Pottsburg Creek at Belford Rd., South End					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
BP64	3/8/06	15.43	7.85	232	9.07	90.9
BP64	5/2/06	17.66	7.15	391	7.69	80.8
BP64	7/5/06	25.87	7.32	414	5.59	68.8
BP64	8/8/06	27.25	7.48	323	5.93	75
BP64	9/12/06	25.78	7.35	325	5.67	69.7

2254	Red Bay Branch at Lone Star Rd					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
ARL3	3/8/2006	16.1	7.69	399	6.69	68.2
ARL3	5/2/2006	19.03	6.71	423	6.3	68.3
ARL3	7/5/2006	24.86	7.11	460	4.73	58.6
ARL3	8/8/2006	26.08	7.04	465	3.48	43.2
ARL3	9/12/2006	24.85	6.79	390	3.23	39

2284	Little Pottsburg Creek at Bedford Rd.					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
LP4	3/8/2006	17.77	7.63	578	10.92	115.3
LP4	5/2/2006	20.42	6.78	739	6.63	73.9
LP4	7/5/2006	26.18	7.33	531	3.39	42.1
LP4	8/8/2006	27.34	7.37	595	3.44	44.1
LP4	9/12/2006	25.51	7.21	416	3.3	40.4

Table 4.
Tributary intensives. Hydrolab Data October 1, 2005 - September 30, 2006
Julington/Durbin Creek

2351	Julington Creek at U. S. 1					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
JC339	3/8/2006	17.09	7.86	341	8.5	88.3
JC339	5/2/2006	19.36	7.4	454	7.29	79.6
JC339	7/5/2006	26.34	7.46	256	5.34	66.6
JC339	8/8/2006	26.59	7.63	296	6.34	79.2
JC339	9/12/2006	25.34	7.15	260	5.37	65.4

2356	Big Davis Creek at U.S.1					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
JC441	3/8/2006	15.39	7.8	145	8.17	82
JC441	5/2/2006	19.1	7.53	196	6.81	74
JC441	7/5/2006	26.29	7.25	220	4.02	50.01
JC441	8/8/2006	27.4	7.78	225	4.87	60.8
JC441	9/12/2006	25.94	7.25	219	5	61.6

2370	Oldfield Creek at Julington Creek Rd.					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
JC5	3/8/2006	14.72	7.5	331	7.29	71.9
JC5	5/2/2006	19.03	6.99	578	2.49	27.1
JC5	7/5/2006	26.9	7.05	2608	1.04	13.2
JC5	8/8/2006	26.9	7.5	293	3.45	42.9
JC5	9/12/2006	26.45	6.56	2876	2.15	26.9

2365	Durbin Creek at Racetrack Rd.					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
DUC3	3/8/2006	15.61	7.79	149	6.58	66.5
DUC3	5/2/2006	19.38	7.36	242	4.14	44.2
DUC3	7/5/2006	26.37	7.2	270	2.6	33.2
DUC3	8/8/2006	26.81	7.68	264	3.44	47.3
DUC3	9/12/2006	25.41	5.99	2592	2.28	28

Table 4.

Tributary intensives. Hydrolab Data October 1, 2005 - September 30, 2006
Cedar Ortega River Basin

2282	Wills Branch North Branch at old Middleburg Rd.					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
CR21	3/20/2006	17.4	7.76	263	8.74	91.2
CR21	5/16/2006	20.23	7.59	281	7.73	85.4
CR21	7/31/2006	25.35	7.31	292	5.58	68
CR21	8/29/2006	26.55	7.35	301	6.06	75.2
CR21	9/26/2006	23.9	7.4	257	6.67	79.2

2262	Cedar River East Branch at Stuart Ave.					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
CR427	3/20/2006	18.43	7.51	603	8.01	85.5
CR427	5/16/2006	20.18	7.62	656	6.75	74.6
CR427	7/31/2006	26.08	7.22	404	5.19	64.1
CR427	8/29/2006	27	7.5	476	5.19	65.6
CR427	9/26/2006	24.28	7.59	508	6.62	79.2

2249A	Ortega River at Kirwin Rd. – Argyle Forest Blvd.					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
OR348	3/20/2006	17.57	7.73	176	7.54	79
OR348	5/16/2006	20.7	7.37	184	6.34	70.8
OR348	7/31/2006	25.56	7.15	200	5.12	62.6
OR348	8/29/2006	26.1	6.81	183	5.42	67
OR348	9/26/2006	23.86	7.27	204	7.44	88.4

Table 4.
Tributary intensives. Hydrolab Data October 1, 2005 - September 30,2006
Trout River Basin

2238	Little Six mile Creek at Picketville Rd					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
TR314	3/20/2006	18.46	7.19	856	4.89	52.3
TR314	5/16/2006	21.93	7.15	3157	2.42	27.9
TR314	7/31/2006	26.73	7.12	430	4.57	57.1
TR314	8/29/2006	27.14	7.11	1405	3.91	49.6
TR314	9/26/2006	24.69	7.14	674	3.49	42.8

2228	Moncrief Creek at 33 rd Street					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
TR316	3/20/2006	19.85	7.08	531	6.66	73.2
TR316	5/16/2006	21.82	7.27	522	5.79	66
TR316	7/31/2006	26.21	6.96	491	4.08	50.6
TR316	8/29/2006	27.01	7.47	526	4.21	52.9
TR316	9/26/2006	25.02	7.56	506	5.59	67.8

2203	Trout River at Old Kings Rd.					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
TREE10	3/20/2006	15.94	7.41	125	6.3	63.8
TREE10	5/16/2006	21.43	7.09	10055	2.34	27.4
TREE10	7/31/2006	25.55	6.94	2241	2.03	25
TREE10	8/29/2006	26.05	6.93	7385	1.96	24.9
TREE10	9/26/2006	26.19	7.27	289	3.99	51

Table 4.
Tributary intensives. Hydrolab Data October 1, 2005 - September 30, 2006
Minor Tributaries

2257	McCoys Creek at Leland St..					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
MC3	3/20/2006	19.24	7.6	576	4.55	49.3
MC3	5/16/2006	21.54	7	588	1.28	14.5
MC3	7/31/2006	27.66	7.12	400	1.24	15.7
MC3	8/29/2006	27.86	7.22	441	1.35	19.1
MC3	9/26/2006	25.34	7.31	480	2.13	26.3

2280	Little Fishweir Creek at Park St.					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
CR5	3/20/2006	18.38	7.63	450	5.6	59.7
CR5	5/16/2006	20.05	7.41	495	3.08	34
CR5	7/31/2006	26.69	7.12	318	3.11	38.8
CR5	8/29/2006	27.28	7.32	418	4.18	52.9
CR5	9/26/2006	24.42	7.4	408	5.3	64.5

2256	Deer Creek E. of Haines St., Downstream of S. Branch					
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.
DR2	3/8/2006	20.48	6.81	1305	5.01	55.8
DR2	5/2/2006	22.33	6.88	520	4.66	54
DR2	7/5/2006	26.37	7.47	518	4.72	58.7
DR2	8/8/2006	26.95	7.26	538	3.98	50
DR2	9/12/2006	26.13	7.27	468	3.98	49.3

Tributary Intensives 2006, Julington/Durbin Creeks

Table 5. Laboratory Data

JC441	Big Davis Creek at U.S.1				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	15	10	25	15	10
Color (PCU)	240	40	80	40	30
Fecal Coliform (cfu/100 mL)	15	17	6	450	1900
NH3 (mg/L)	0.036	0.053	0.026	0.031	0.015
NO23 (mg/L)	0.031	0.09	0.051	0.215	0.094
OP (mg/L)	0.113	0.019	0.056	0.036	0.057
TKN (mg/L)	0.675	0.806	0.713	0.757	0.588
TN (mg/L) Calc.	0.706	0.896	0.764	0.972	0.682
TP (mg/L)	0.113	0.084	0.099	0.07	0.086
TSS (mg/L)	5	2.5	7	3.3	5
Turbidity (NTU)	2.32	2.01	8.58	5.1	5.04
JC5	Oldfield Creek at Julington Creek Rd.				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
CBOD (mg/L)	2	2	2	2.14	2
Chlorides (mg/L)	35	125	75	35	800
Color (PCU)	30	50	30	30	50
Fecal Coliform (cfu/100 mL)	380	210	530	580	800
NH3 (mg/L)	0.033	0.023	0.026	0.043	0.047
NO23 (mg/L)	0.259	0.122	0.32	0.191	0.075
OP (mg/L)	0.022	0.033	0.047	0.05	0.035
TKN (mg/L)	0.42	0.728	0.744	1.314	0.875
TN (mg/L) Calc.	0.679	0.85	1.064	1.505	0.95
TP (mg/L)	0.056	0.071	0.12	0.183	0.062
TSS (mg/L)	2	2	6.5	0	2
Turbidity (NTU)	3.5	2.06	5.38	13	1.96
JC339	Julington Creek at U. S. 1				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	20	25	15	15	15
Color (PCU)	80	40	40	50	50
Fecal Coliform (cfu/100 mL)	88	2000	149	370	730
NH3 (mg/L)	0.026	0.044	0.01	0.01	0.025
NO23 (mg/L)	0.148	0.211	0.259	0.218	0.101
OP (mg/L)	0.079	0.082	0.078	0.09	0.052
TKN (mg/L)	0.377	0.653	0.643	0.576	0.705
TN (mg/L) Calc.	0.525	0.864	0.902	0.794	0.806
TP (mg/L)	0.101	0.12	0.083	0.075	0.091
TSS (mg/L)	7	13.5	2	2	3
Turbidity (NTU)	3.03	12	2	1.9	3.57

Tributary Intensives 2006, Julington/Durbin Creeks

Table 5. Laboratory Data

DUC3	Durbin Creek at Racetrack Rd.				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	25	20	25	20	700
Color (PCU)	240	80	80	60	100
Fecal Coliform (cfu/100 mL)	30	130	143	95	220
NH3 (mg/L)	0.032	0.046	0.026	0.015	0.032
NO23 (mg/L)	0.003	0.09	0.051	0.043	0.016
OP (mg/L)	0.073	0.035	0.056	0.056	0.024
TKN (mg/L)	0.873	0.684	0.713	0.75	1.17
TN (mg/L) Calc.	0.876	0.774	0.764	0.793	1.186
TP (mg/L)	0.073	0.068	0.099	0.068	0.04
TSS (mg/L)	3	10.6	7	4.3	2
Turbidity (NTU)	3.03	6.58	8.58	4.9	2.74

Note: ND = no data

NS = no sample

Tributary Intensives 2006, Arlington River Basin

Table 5. Laboratory Data

BP64	Big Pottsburg Creek at Belford Rd., South End				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	30	35	40	25	25
Color (PCU)	60	30	50	100	60
Fecal Coliform (cfu/100 mL)	130	66	123	200	460
NH3 (mg/L)	0.027	0.02	0.015	0.02	0.022
NO23 (mg/L)	0.052	0.136	0.139	0.141	0.101
OP (mg/L)	0.043	0.029	0.029	0.055	0.041
TKN (mg/L)	0.421	0.654	0.75	0.735	0.691
TN (mg/L) Calc.	0.473	0.79	0.889	0.876	0.792
TP (mg/L)	0.07	0.081	0.046	0.08	0.076
TSS (mg/L)	3	6	2	2	2
Turbidity (NTU)	4.12	10.1	3.2	4.4	5.01
ARL3	Red Bay Branch at Lone Star Rd.				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	55	55	55	50	40
Color (PCU)	10	10	10	10	10
Fecal Coliform (cfu/100 mL)	550	2100	1381	2450	1400
NH3 (mg/L)	0.064	0.017	0.065	0.061	0.074
NO23 (mg/L)	1.655	0.136	1.222	0.199	1.09
OP (mg/L)	0.016	0.028	0.028	0.036	0.038
TKN (mg/L)	0.277	0.476	0.537	0.434	0.44
TN (mg/L) Calc.	1.932	0.6	1.759	0.633	1.53
TP (mg/L)	0.044	0.036	0.039	0.051	0.051
TSS (mg/L)	2	3	2	2.3	2
Turbidity (NTU)	1.27	1.47	1.6	4.8	0.844
LP4	Little Pottsburg Creek at Bedford Rd.				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	35	55	35	40	25
Color (PCU)	20	40	40	40	40
Fecal Coliform (cfu/100 mL)	570	370	1118	1500	1100
NH3 (mg/L)	0.147	0.096	0.021	0.046	0.046
NO23 (mg/L)	0.27	0.06	0.072	0.133	0.197
OP (mg/L)	0.024	0.022	0.029	0.044	0.039
TKN (mg/L)	0.456	0.644	0.728	0.682	0.623
TN (mg/L) Calc.	0.726	0.704	0.8	0.815	0.82
TP (mg/L)	0.083	0.08	0.057	0.066	0.067
TSS (mg/L)	4	6.5	2	2	2
Turbidity (NTU)	7.78	8.55	4.57	5.7	3.74

Tributary Intensives 2006, Cedar/Ortega River Basin

Table 5. Laboratory Data

CR21	Wills Branch North Branch at old Middleburg Rd.				
Date	3/20/06	5/16/06	7/31/06	8/29/06	9/26/06
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	25	25	30	15	15
Color (PCU)	40	40	40	40	40
Fecal Coliform (cfu/100 mL)	2160	420	1300	3185	ND
NH3 (mg/L)	0.035	0.01	0.038	0.059	0.024
NO23 (mg/L)	0.429	0.208	0.046	0.191	0.171
OP (mg/L)	0.019	0.026	2	0.036	0.042
TKN (mg/L)	0.476	0.262	0.046	0.399	0.476
TN (mg/L) Calc.	0.905	0.47	0.092	0.59	0.647
TP (mg/L)	0.05	0.05	1.9	0.082	0.055
TSS (mg/L)	1.5	1.5	0.533	2	3
Turbidity (NTU)	3.25	2.3	3.07	3.29	2.21
CR427	Cedar River East Branch at Stuart Ave.				
Date	3/20/06	5/16/06	7/31/06	8/29/06	9/26/06
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	35	50	25	25	25
Color (PCU)	20	20	30	40	30
Fecal Coliform (cfu/100 mL)	40	130	1300	1100	ND
NH3 (mg/L)	0.022	0.035	0.043	0.087	0.023
NO23 (mg/L)	0.058	0.039	0.116	0.233	0.09
OP (mg/L)	0.026	0.047	0.074	0.097	0.061
TKN (mg/L)	0.341	0.418	0.445	0.435	0.492
TN (mg/L) Calc.	0.399	0.457	0.561	0.668	0.582
TP (mg/L)	0.063	0.081	0.098	0.172	0.078
TSS (mg/L)	1.5	1.5	2	4	4
Turbidity (NTU)	2.82	3.28	2.61	4.02	3.22
OR348	Ortega River at Kirwin Rd. – Argyle Forest Blvd.				
Date	3/20/06	5/16/06	7/31/06	8/29/06	9/26/06
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	20	20	20	20	15
Color (PCU)	80	50	50	80	50
Fecal Coliform (cfu/100 mL)	40	770	260	1150	ND
NH3 (mg/L)	0.021	0.01	0.016	0.033	0.01
NO23 (mg/L)	0.118	0.171	0.147	0.151	0.129
OP (mg/L)	0.013	0.019	0.024	0.021	0.026
TKN (mg/L)	0.445	0.334	0.347	0.381	0.394
TN (mg/L) Calc.	0.563	0.505	0.494	0.532	0.523
TP (mg/L)	0.046	0.037	0.024	0.224	0.032
TSS (mg/L)	1	1	2	2	2
Turbidity (NTU)	3.45	3	2	2.3	1.77

Tributary Intensives 2006, Trout River Basin

Table 5. Laboratory Data

TR314	Little Six mile Creek at Picketville Rd.				
Date	3/20/06	5/16/06	7/31/06	8/29/06	9/26/06
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	95	925	20	270	60
Color (PCU)	20	20	30	20	20
Fecal Coliform (cfu/100 mL)	1755	1100	1700	1400	ND
NH3 (mg/L)	0.264	0.215	0.249	0.235	0.343
NO23 (mg/L)	0.139	0.288	0.146	0.179	0.22
OP (mg/L)	0.028	0.064	0.076	0.091	0.07
TKN (mg/L)	0.697	0.831	0.694	0.525	0.845
TN (mg/L) Calc.	0.836	1.119	0.84	0.704	1.065
TP (mg/L)	0.162	0.229	0.15	0.214	0.201
TSS (mg/L)	5.5	23	4	4	6
Turbidity (NTU)	9.46	11.6	5.07	6.57	11
TR316	Moncrief Creek at 33 rd Street				
Date	3/20/06	5/16/06	7/31/06	8/29/06	9/26/06
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	25	20	15	20	20
Color (PCU)	20	10	20	20	20
Fecal Coliform (cfu/100 mL)	140	900	800	520	ND
NH3 (mg/L)	0.005	0.01	0.074	0.042	0.098
NO23 (mg/L)	0.07	0.079	0.106	0.12	0.196
OP (mg/L)	0.007	0.017	0.037	0.033	0.037
TKN (mg/L)	0.314	0.196	0.461	0.291	0.448
TN (mg/L) Calc.	0.384	0.275	0.567	0.411	0.644
TP (mg/L)	0.042	0.044	0.043	0.049	0.049
TSS (mg/L)	1.5	1.5	2	2	2
Turbidity (NTU)	4.58	3.07	3.32	3.62	5.45
TREE10	Trout River at Old Kings Rd.				
Date	3/20/06	5/16/06	7/31/06	8/29/06	9/26/06
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	15	3499	650	2250	25
Color (PCU)	200	60	80	60	120
Fecal Coliform (cfu/100 mL)	530	830	220	520	ND
NH3 (mg/L)	0.048	0.123	0.051	0.137	0.049
NO23 (mg/L)	0.115	0.143	0.103	0.102	0.05
OP (mg/L)	0.19	0.026	0.379	0.454	0.034
TKN (mg/L)	1.14	0.995	0.674	0.683	1.06
TN (mg/L) Calc.	1.255	1.138	0.777	0.785	1.11
TP (mg/L)	0.241	0.119	0.382	0.655	0.063
TSS (mg/L)	2.5	8	2	2	11
Turbidity (NTU)	10.8	7.21	1.53	1.81	25.6

Tributary Intensives 2006, Minor Tributaries

Table 5. Laboratory Data

MC3	McCoys Creek at Leland St..				
Date	3/20/06	5/16/06	7/31/06	8/29/06	9/26/06
CBOD (mg/L)	3.19	3.81	2.15	3.39	2
Chlorides (mg/L)	35	45	25	20	25
Color (PCU)	20	20	30	30	20
Fecal Coliform (cfu/100 mL)	3365	27000	1100	3200	ND
NH3 (mg/L)	0.768	0.817	0.367	0.327	0.162
NO23 (mg/L)	0.092	0.138	0.035	0.161	0.122
OP (mg/L)	0.11	0.167	0.116	0.087	0.087
TKN (mg/L)	1.363	1.483	0.965	0.755	0.855
TN (mg/L) Calc.	1.455	1.621	1	0.916	0.977
TP (mg/L)	0.221	0.3	0.217	0.227	0.159
TSS (mg/L)	15.5	14	3	5	3
Turbidity (NTU)	14.1	12.1	5.57	9.43	6.22
CR5	Little Fishweir Creek at Park St.				
Date	3/20/06	5/16/06	7/31/06	8/29/06	9/26/06
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	25	15	19	15	15
Color (PCU)	20	20	50	30	30
Fecal Coliform (cfu/100 mL)	1455	895	1700	1435	ND
NH3 (mg/L)	0.068	0.03	0.14	0.172	0.06
NO23 (mg/L)	0.12	0.139	0.088	0.13	0.056
OP (mg/L)	0.034	0.094	0.281	0.143	0.168
TKN (mg/L)	0.48	0.396	0.794	0.291	0.49
TN (mg/L) Calc.	0.6	0.535	0.882	0.421	0.546
TP (mg/L)	0.094	0.138	0.304	0.215	0.228
TSS (mg/L)	1	1	2	2	3
Turbidity (NTU)	6.19	2.33	ND	2.57	3.18
DR2	Deer Creek E. of Haines St., Downstream of S. Branch				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
CBOD (mg/L)	2	2	2	2	2
Chlorides (mg/L)	220	30	20	25	20
Color (PCU)	20	10	10	10	10
Fecal Coliform (cfu/100 mL)	40	220	240	220	18000
NH3 (mg/L)	0.797	0.581	0.197	0.238	0.374
NO23 (mg/L)	0.426	0.22	0.162	0.174	0.313
OP (mg/L)	0.006	0.011	0.011	0.013	0.025
TKN (mg/L)	1.365	0.951	0.627	0.678	0.775
TN (mg/L) Calc.	1.791	1.171	0.789	0.852	1.088
TP (mg/L)	0.048	0.053	0.033	0.02	0.05
TSS (mg/L)	5	5.5	9.5	3.5	5
Turbidity (NTU)	11.6	9.78	13.2	11	15.1

Table 6. Nitrate-Nitrite results ranked for each sampling period. Results in mg/L.

Mar. 06		May -06		Jul-06		Aug-06		Sep-06	
Site	Result	Site	Result	Site	Result	Site	Result	Site	Result
ARL3	1.655	TR314	0.288	ARL3	1.222	CR427	0.233	ARL3	1.09
CR21	0.429	DR2	0.22	JC5	0.32	JC339	0.218	DR2	0.313
DR2	0.426	JC339	0.211	JC339	0.259	JC441	0.215	TR314	0.22
LP4	0.27	CR21	0.208	DR2	0.162	ARL3	0.199	LP4	0.197
JC5	0.259	OR348	0.171	OR348	0.147	JC5	0.191	TR316	0.196
JC339	0.148	TREE10	0.143	TR314	0.146	CR21	0.191	CR21	0.171
TR314	0.139	CR5	0.139	BP64	0.139	TR314	0.179	OR348	0.129
CR5	0.12	MC3	0.138	CR427	0.116	DR2	0.174	MC3	0.122
OR348	0.118	ARL3	0.136	TR316	0.106	MC3	0.161	JC339	0.101
TREE10	0.115	BP64	0.136	TREE10	0.103	OR348	0.151	BP64	0.101
MC3	0.092	JC5	0.122	CR5	0.088	BP64	0.141	JC441	0.094
TR316	0.07	DUC3	0.09	LP4	0.072	LP4	0.133	CR427	0.09
CR427	0.058	JC441	0.09	DUC3	0.051	CR5	0.13	JC5	0.075
BP64	0.052	TR316	0.079	JC441	0.051	TR316	0.12	CR5	0.056
JC441	0.031	LP4	0.06	CR21	0.046	TREE10	0.102	TREE10	0.05
DUC3	0.003	CR427	0.039	MC3	0.035	DUC3	0.043	DUC3	0.016

Total Kjeldhal Nitrogen results ranked for each sampling period. Results in mg/L.

Mar. 06		May -06		Jul-06		Aug-06		Sep-06	
Site	Result	Site	Result	Site	Result	Site	Result	Site	Result
DR2	1.365	MC3	1.483	MC3	0.965	JC5	1.314	DUC3	1.17
MC3	1.363	TREE10	0.995	CR5	0.794	JC441	0.757	TREE10	1.06
TREE10	1.14	DR2	0.951	BP64	0.75	MC3	0.755	JC5	0.875
DUC3	0.873	TR314	0.831	JC5	0.744	DUC3	0.75	MC3	0.855
TR314	0.697	JC441	0.806	LP4	0.728	BP64	0.735	TR314	0.845
JC441	0.675	JC5	0.728	DUC3	0.713	TREE10	0.683	DR2	0.775
CR5	0.48	DUC3	0.684	JC441	0.713	LP4	0.682	JC339	0.705
CR21	0.476	BP64	0.654	TR314	0.694	DR2	0.678	BP64	0.691
LP4	0.456	JC339	0.653	TREE10	0.674	JC339	0.576	LP4	0.623
OR348	0.445	LP4	0.644	JC339	0.643	TR314	0.525	JC441	0.588
BP64	0.421	ARL3	0.476	DR2	0.627	CR427	0.435	CR427	0.492
JC5	0.42	CR427	0.418	ARL3	0.537	ARL3	0.434	CR5	0.49
JC339	0.377	CR5	0.396	CR21	0.533	CR21	0.399	CR21	0.476
CR427	0.341	OR348	0.334	TR316	0.461	OR348	0.381	TR316	0.448
TR316	0.314	CR21	0.262	CR427	0.445	CR5	0.291	ARL3	0.44
ARL3	0.277	TR316	0.196	OR348	0.347	TR316	0.291	OR348	0.394

Table 6. Ammonia results ranked for each sampling period. Results in mg/L.

Mar. 06		May -06		Jul-06		Aug-06		Sep-06	
Site	Result	Site	Result	Site	Result	Site	Result	Site	Result
DR2	0.797	MC3	0.817	MC3	0.367	MC3	0.327	DR2	0.374
MC3	0.768	DR2	0.581	TR314	0.249	DR2	0.238	TR314	0.343
TR314	0.264	TR314	0.215	DR2	0.197	TR314	0.235	MC3	0.162
LP4	0.147	TREE10	0.123	CR5	0.14	CR5	0.172	TR316	0.098
CR5	0.068	LP4	0.096	TR316	0.074	TREE10	0.137	ARL3	0.074
ARL3	0.064	JC441	0.053	ARL3	0.065	CR427	0.087	CR5	0.06
TREE10	0.048	DUC3	0.046	TREE10	0.051	ARL3	0.061	TREE10	0.049
JC441	0.036	JC339	0.044	CR427	0.043	CR21	0.059	JC5	0.047
CR21	0.035	CR427	0.035	CR21	0.038	LP4	0.046	LP4	0.046
JC5	0.033	CR5	0.03	JC441	0.026	JC5	0.043	DUC3	0.032
DUC3	0.032	JC5	0.023	JC5	0.026	TR316	0.042	JC339	0.025
BP64	0.027	BP64	0.02	DUC3	0.026	OR348	0.033	CR21	0.024
JC339	0.026	ARL3	0.017	LP4	0.021	JC441	0.031	CR427	0.023
CR427	0.022	CR21	0.01	OR348	0.016	BP64	0.02	BP64	0.022
OR348	0.021	TR316	0.01	BP64	0.015	DUC3	0.015	JC441	0.015
TR316	0.005	OR348	0.01	JC339	0.01	JC339	0.01	OR348	0.01

Total Nitrogen results ranked for each sampling period. Results in mg/L.

Mar. 06		May -06		Jul-06		Aug-06		Sep-06	
Site	Result	Site	Result	Site	Result	Site	Result	Site	Result
ARL3	1.932	MC3	1.621	ARL3	1.759	JC5	1.505	ARL3	1.53
DR2	1.791	DR2	1.171	JC5	1.064	JC441	0.972	DUC3	1.186
MC3	1.455	TREE10	1.138	MC3	1	MC3	0.916	TREE10	1.11
TREE10	1.255	TR314	1.119	JC339	0.902	BP64	0.876	DR2	1.088
CR21	0.905	JC441	0.896	BP64	0.889	DR2	0.852	TR314	1.065
DUC3	0.876	JC339	0.864	CR5	0.882	LP4	0.815	MC3	0.977
TR314	0.836	JC5	0.85	TR314	0.84	JC339	0.794	JC5	0.95
LP4	0.726	BP64	0.79	LP4	0.8	DUC3	0.793	LP4	0.82
JC441	0.706	DUC3	0.774	DR2	0.789	TREE10	0.785	JC339	0.806
JC5	0.679	LP4	0.704	TREE10	0.777	TR314	0.704	BP64	0.792
CR5	0.6	ARL3	0.6	DUC3	0.764	CR427	0.668	JC441	0.682
OR348	0.563	CR5	0.535	JC441	0.764	ARL3	0.633	CR21	0.647
JC339	0.525	OR348	0.505	CR21	0.706	CR21	0.59	TR316	0.644
BP64	0.473	CR21	0.47	TR316	0.567	OR348	0.532	CR427	0.582
CR427	0.399	CR427	0.457	CR427	0.561	CR5	0.421	CR5	0.546
TR316	0.384	TR316	0.275	OR348	0.494	TR316	0.411	OR348	0.523

Table 6. Ortho-phosphate results ranked for each sampling period. Results in mg/L.

Mar. 06		May -06		Jul-06		Aug-06		Sep-06	
Site	Result	Site	Result	Site	Result	Site	Result	Site	Result
TREE10	0.19	MC3	0.167	TREE10	0.379	TREE10	0.454	CR5	0.168
JC441	0.113	CR5	0.094	CR5	0.281	CR5	0.143	MC3	0.087
MC3	0.11	JC339	0.082	MC3	0.116	CR427	0.097	TR314	0.07
JC339	0.079	TR314	0.064	JC339	0.078	TR314	0.091	CR427	0.061
DUC3	0.073	CR427	0.047	TR314	0.076	JC339	0.09	JC441	0.057
BP64	0.043	DUC3	0.035	CR427	0.074	MC3	0.087	JC339	0.052
CR5	0.034	JC5	0.033	DUC3	0.056	DUC3	0.056	CR21	0.042
TR314	0.028	BP64	0.029	JC441	0.056	BP64	0.055	BP64	0.041
CR427	0.026	ARL3	0.028	JC5	0.047	JC5	0.05	LP4	0.039
LP4	0.024	CR21	0.026	CR21	0.046	LP4	0.044	ARL3	0.038
JC5	0.022	TREE10	0.026	TR316	0.037	JC441	0.036	TR316	0.037
CR21	0.019	LP4	0.022	LP4	0.029	CR21	0.036	JC5	0.035
ARL3	0.016	OR348	0.019	BP64	0.029	ARL3	0.036	TREE10	0.034
OR348	0.013	JC441	0.019	ARL3	0.028	TR316	0.033	OR348	0.026
TR316	0.007	TR316	0.017	OR348	0.024	OR348	0.021	DR2	0.025
DR2	0.006	DR2	0.011	DR2	0.011	DR2	0.013	DUC3	0.024

Total phosphorus results ranked for each sampling period. Results in mg/L.

Mar. 06		May -06		Jul-06		Aug-06		Sep-06	
Site	Result	Site	Result	Site	Result	Site	Result	Site	Result
TREE10	0.241	MC3	0.3	TREE10	0.382	TREE10	0.655	CR5	0.228
MC3	0.221	TR314	0.229	CR5	0.304	MC3	0.227	TR314	0.201
TR314	0.162	CR5	0.138	MC3	0.217	OR348	0.224	MC3	0.159
JC441	0.113	JC339	0.12	TR314	0.15	CR5	0.215	JC339	0.091
JC339	0.101	TREE10	0.119	JC5	0.12	TR314	0.214	JC441	0.086
CR5	0.094	JC441	0.084	DUC3	0.099	JC5	0.183	CR427	0.078
LP4	0.083	BP64	0.081	JC441	0.099	CR427	0.172	BP64	0.076
DUC3	0.073	CR427	0.081	CR427	0.098	CR21	0.082	LP4	0.067
BP64	0.07	LP4	0.08	JC339	0.083	BP64	0.08	TREE10	0.063
CR427	0.063	JC5	0.071	LP4	0.057	JC339	0.075	JC5	0.062
JC5	0.056	DUC3	0.068	BP64	0.046	JC441	0.07	CR21	0.055
CR21	0.05	DR2	0.053	CR21	0.046	DUC3	0.068	ARL3	0.051
DR2	0.048	CR21	0.05	TR316	0.043	LP4	0.066	DR2	0.05
OR348	0.046	TR316	0.044	ARL3	0.039	ARL3	0.051	TR316	0.049
ARL3	0.044	OR348	0.037	DR2	0.033	TR316	0.049	DUC3	0.04
TR316	0.042	ARL3	0.036	OR348	0.024	DR2	0.02	OR348	0.032

Tributary Intensives 2006 Julington/Durbin Creeks

Table 7. Laboratory Data Metals

JC441	Big Davis Creek at U.S.1				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
Cadmium (ug/L)	0.038	0.07	0.038	0.038	0.04
Chromium (ug/L)	0.106	0.106	0.106	0.106	0.21
Copper (ug/L)	0.067	3.8	3.1	0.067	0.13
Hardness (mg/L)	298	144	89	87	94
Lead (ug/L)	0.195	0.17	ND	ND	0.28
Nickel (ug/L)	0.064	ND	ND	0.113	0.59
Zinc (ug/L)	0.569	1.3	0.68	0.1	0.71
JC5	Oldfield Creek at Julington Creek Rd.				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
Cadmium (ug/L)	0.248	0.038	0.17	0.26	0.2
Chromium (ug/L)	0.24	0.106	0.106	0.16	0.15
Copper (ug/L)	1.56	3.7	5.3	4.7	1.3
Hardness (mg/L)	419	144	128	115	377
Lead (ug/L)	0.29	0.012	ND	ND	0.25
Nickel (ug/L)	0.419	ND	ND	0.99	0.59
Zinc (ug/L)	2	2.3	6	0.99	4.2
JC339	Julington Creek at U. S. 1				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
Cadmium (ug/L)	0.066	0.038	0.038	0.038	0.043
Chromium (ug/L)	0.412	0.106	0.106	0.106	0.21
Copper (ug/L)	1.9	6.1	5.4	1.4	1.6
Hardness (mg/L)	148	171	163	136	112
Lead (ug/L)	0.177	0.34	ND	ND	0.44
Nickel (ug/L)	0.508	ND	ND	0.113	0.59
Zinc (ug/L)	1.39	2.1	1	0.1	2
DUC3	Durbin Creek at Racetrack Rd.				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
Cadmium (ug/L)	0.038	0.87	0.038	0.038	0.2
Chromium (ug/L)	0.106	0.106	0.106	0.106	0.21
Copper (ug/L)	0.067	5	3.1	0.11	0.4
Hardness (mg/L)	64	90.6	89	87	439
Lead (ug/L)	0.228	1.2	ND	ND	0.35
Nickel (ug/L)	0.185	ND	ND	0.113	0.59
Zinc (ug/L)	0.397	2.6	0.68	0.1	5.4

Note: ND = no data, NS = no sample, **BOLD= Exceeds Class III Std.**

Detection Limits:

Cadmium: 0.038 ug/L

Chromium: 0.106 ug/L

Copper: 0.067 ug/L

Lead: 0.012 ug/L

Nickel: 0.048 ug/L

Zinc: 0.078 ug/L

Tributary Intensives 2006 Arlington River Basin

Table7. Laboratory Data Metals

BP64	Big Pottsburg Creek at Belford Rd., South End				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
Cadmium (ug/L)	0.055	0.04	0.18	0.038	0.24
Chromium (ug/L)	0.106	0.106	0.106	0.106	0.21
Copper (ug/L)	1.28	5.5	5.4	1.4	1.1
Hardness (mg/L)	124	157	156	124	126
Lead (ug/L)	0.15	0.24	ND	ND	0.61
Nickel (ug/L)	1.06	ND	ND	4	2.9
Zinc (ug/L)	1.43	3	1.6	0.1	1.5
ARL3	Red Bay Branch at Lone Star Rd.				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
Cadmium (ug/L)	0.038	0.08	0.038	0.038	0.06
Chromium (ug/L)	0.106	0.106	0.106	0.106	0.21
Copper (ug/L)	0.411	5.5	4.9	0.39	0.31
Hardness (mg/L)	126	105	156	155	129
Lead (ug/L)	0.652	0.63	ND	ND	0.57
Nickel (ug/L)	0.201	ND	ND	0.113	0.59
Zinc (ug/L)	6.09	5	2.6	0.49	3.4
LP4	Little Pottsburg Creek at Bedford Rd.				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
Cadmium (ug/L)	0.038	0.09	0.57	0.038	0.25
Chromium (ug/L)	0.28	0.106	0.106	0.106	0.21
Copper (ug/L)	0.402	6.7	6.6	0.79	0.91
Hardness (mg/L)	248	328	229	260	182
Lead (ug/L)	0.279	0.17	ND	ND	0.63
Nickel (ug/L)	0.501	ND	ND	0.49	1.1
Zinc (ug/L)	3.1	2	2.9	4	2.6

Tributary Intensives 2006 Cedar/Ortega River Basin

Table7. Laboratory Data Metals

CR21	Wills Branch North Branch at old Middleburg Rd.				
Date	3/20/2006	5/16/2006	7/31/2006	8/29/2006	9/26/2006
Cadmium (ug/L)	0.038	0.04	0.043	0.2	0.24
Chromium (ug/L)	0.219	0.106	0.106	0.21	0.21
Copper (ug/L)	0.746	4	0.77	0.5	1.1
Hardness (mg/L)	106	105	105	124	98
Lead (ug/L)	0.184	0.17	ND	0.52	0.79
Nickel (ug/L)	0.345	ND	0.173	0.59	0.71
Zinc (ug/L)	2.63	2.8	0.1	2.2	3.7
CR427	Cedar River East Branch at Stuart Ave.				
Date	3/20/2006	5/16/2006	7/31/2006	8/29/2006	9/26/2006
Cadmium (ug/L)	0.038	0.25	0.038	0.25	0.24
Chromium (ug/L)	0.661	0.106	0.106	0.21	0.21
Copper (ug/L)	1.33	7	1.4	1.2	1.1
Hardness (mg/L)	264	276	169	200	222
Lead (ug/L)	0.17	0.11	ND	1.3	0.91
Nickel (ug/L)	1.1	ND	0.92	1.8	1.9
Zinc (ug/L)	15.9	12	0.92	12	14
OR348	Ortega River at Kirwin Rd. – Argyle Forest Blvd.				
Date	3/20/2006	5/16/2006	7/31/2006	8/29/2006	9/26/2006
Cadmium (ug/L)	0.084	0.038	0.038	0.2	0.2
Chromium (ug/L)	0.383	0.106	0.106	0.21	0.21
Copper (ug/L)	1.29	3	0.59	1	0.39
Hardness (mg/L)	62	65.9	68	74	73
Lead (ug/L)	0.348	0.31	ND	0.46	0.32
Nickel (ug/L)	0.911	ND	0.113	0.16	0.59
Zinc (ug/L)	2.29	2.1	0.11	2.5	0.51

Tributary Intensives 2006 Trout River Basin

Table 7. Laboratory Data Metals

TR314	Little Six mile Creek at Picketville Rd.				
Date	3/20/2006	5/16/2006	7/31/2006	8/29/2006	9/26/2006
Cadmium (ug/L)	0.038	0.038	0.24	0.04	0.2
Chromium (ug/L)	0.614	0.106	0.106	0.21	0.4
Copper (ug/L)	1.16	6.3	2.6	0.81	1.2
Hardness (mg/L)	308	530	177	380	259
Lead (ug/L)	0.375	0.2	ND	0.39	0.57
Nickel (ug/L)	0.277	ND	1.4	0.59	0.26
Zinc (ug/L)	5.44	4.9	1.39	3.8	7.3
TR316	Moncrief Creek at 33 rd Street				
Date	3/20/2006	5/16/2006	7/31/2006	8/29/2006	9/26/2006
Cadmium (ug/L)	0.038	0.25	0.05	0.2	0.2
Chromium (ug/L)	0.106	0.106	0.106	0.21	0.29
Copper (ug/L)	0.52	7.5	0.93	0.63	0.72
Hardness (mg/L)	234	241	216	260	228
Lead (ug/L)	0.086	0.1	ND	0.46	0.5
Nickel (ug/L)	0.325	ND	0.28	0.59	0.13
Zinc (ug/L)	1.62	3.3	0.28	2.5	6.1
TREE10	Trout River at Old Kings Rd.				
Date	3/20/2006	5/16/2006	7/31/2006	8/29/2006	9/26/2006
Cadmium (ug/L)	0.038	0.038	0.04	0.2	0.04
Chromium (ug/L)	0.442	0.106	0.106	0.22	0.21
Copper (ug/L)	0.408	9.3	0.86	0.53	0.57
Hardness (mg/L)	42	1220	288	900	100
Lead (ug/L)	0.419	0.012	ND	0.2	0.59
Nickel (ug/L)	0.487	ND	0.21	0.59	0.19
Zinc (ug/L)	2.26	3.6	0.21	1.2	3

Tributary Intensives 2006 Minor Tributaries

Table 7. Laboratory Data Metals

MC3	McCoys Creek at Leland St..				
Date	3/20/2006	5/16/2006	7/31/2006	8/29/2006	9/26/2006
Cadmium (ug/L)	0.038	0.13	0.04	0.2	0.2
Chromium (ug/L)	0.692	0.106	0.106	0.21	0.11
Copper (ug/L)	0.935	8.6	1	0.75	0.78
Hardness (mg/L)	242	229	181	185	198
Lead (ug/L)	0.75	0.77	ND	0.99	0.95
Nickel (ug/L)	1.03	ND	0.77	0.66	0.56
Zinc (ug/L)	5.96	7.8	0.77	3.7	4.5
CR5	Little Fishweir Creek at Park St.				
Date	3/20/2006	5/16/2006	7/31/2006	8/29/2006	9/26/2006
Cadmium (ug/L)	0.038	0.23	0.24	0.05	0.2
Chromium (ug/L)	0.141	0.106	0.106	0.21	0.21
Copper (ug/L)	0.434	8.8	0.99	0.32	0.38
Hardness (mg/L)	188	235	142	186	204
Lead (ug/L)	0.123	0.14	ND	0.92	0.51
Nickel (ug/L)	0.405	ND	1	0.18	0.3
Zinc (ug/L)	2.43	3.3	1.03	3.1	2.9
DR2	Deer Creek E. of Haines St., Downstream of S. Branch				
Date	3/8/2006	5/2/2006	7/5/2006	8/8/2006	9/12/2006
Cadmium (ug/L)	0.038	0.13	0.038	0.038	0.27
Chromium (ug/L)	0.641	0.106	0.106	0.106	0.14
Copper (ug/L)	0.434	6	5.9	0.37	1.7
Hardness (mg/L)	366	646	229	237	200
Lead (ug/L)	0.226	0.36	ND	ND	1.7
Nickel (ug/L)	0.067	ND	ND	0.113	1.5
Zinc (ug/L)	3.61	4.5	3.5	0.1	8.6

DISCUSSION OF TRIBUTARY INTENSIVE RESULTS:

NUTRIENTS:

Tributary Intensive data is presented in Tables 4 – 6, and Figures 8 – 20. As a point of comparison for the tributary data, a mainstem St. Johns River station located center channel of off NAS Jacksonville (JAX30). The annual average for 2005 is graphed for each respective nutrient. In general terms, with the exception of NH₃, nitrogen is higher at JAX30, OP was also more often higher at JAX30, on the other hand, TP was usually higher in the tributaries.

Red Bay Branch (WBID 2254):

One of the most significant finding of this portion of the monitoring program remains to be the discovery of the elevated nitrite-nitrate (NO₂3) values at ARL3. ARL3 is located on Red Bay Branch at Lone Star Rd., WBID number 2254. Values ranged from 0.136 mg/L in May to a high of 1.655 mg/L in March (Figure 8). NO₂3 values for the majority

of the sites in 2006 was less than 0.2 mg/L, indicating a four to seven-fold increase in Red Bay Branch. Figure 20 is a bar chart indicating the number of times a given site ranked as one of the highest three concentrations for the different nutrients measured for the five sampling events. ARL3 was in the top three and highest for three events. This year ARL3 NO₂₃ data was much more variable than in past years. The May and August data were at what could be consider “normal” 0.136 and 0.199 mg/L respectively. However, the March value of 1.655 mg/L was the highest recorded since 2004.

The thought to explain these elevated values remain unchanged. It is believed that nitrate enriched shallow groundwater influence from the adjacent Eggleston Heights neighborhood is reaching Red Bay Branch. Eggleston Heights has been identified by the City and the Duval County Health Department (DCHD) as a septic tank failure area. There are over 1000 septic tanks in the subdivision, and the area has a very high rate of septic tank repair permits being issued by DCHD. Homes in the area are 40 to 50 years old, creating a high probability of septic tank problems. This age of the subdivision would also allow ample time for the groundwater to become nitrate enriched and migrate to Red Bay Branch. Red Bay Branch results, coupled with the proximity of the Eggleston Heights septic tanks area have raised the interest of the SJRWMD lower basin surface water group. This group has a project to assess how different land uses affect surficial aquifer water quality. One land use under study is septic tanks. The SJRWMD continues to monitor three shallow ground water monitoring wells in the Eggleston Heights/Red Bay Branch area. Samples have been collected quarterly since 2005. The City plans to work closely with the SJRWMD in an effort to document the source of elevated nitrates in Red Bay Branch.

Trout River (WBID2203)

Elevated nutrients documented in the Trout River, WBID 2203, measured at Old Kings Rd. (TREE10) persisted in 2006. TREE10 was in the highest three concentration category for four sampling events for TP, was in the top three three times for TKN and OP. Nearly all of the measured TP in found to be in the OP form. Land use in this WBID is largely agricultural and rural with very low density housing served by septic tanks. Agricultural sources in the watershed include livestock (dairy) and silvaculture operations. The sample site TREE10 at Old Kings Rd. has previously been used as a downstream station to measure impacts to water quality from agriculture/silvaculture practices in the area. The TREE10 data indicates nutrient enrichment in the upper Trout River and is likely from anthropogenic sources, dairy farms being the most likely candidate.

Deer Creek (WBID 2256)

Deer Creek at Haines St. (DR2, WBID 2256) was again characterized by elevated NH₃ values, for all five events DR2 was one of the top three. Values ranged from 0.197 to a high of 0.797 mg/L in March. DR2 was in the top three for OP four times and three times for TP and NO₂₃. The Deer Creek water shed is somewhat complex with a variety of potential sources ranging from aging sanitary sewer infrastructure to industrial land uses.

Julington Creek (WBID 2351)

Julington Creek at U.S. 1 (WBID 2351) was somewhat of a surprise this year for elevated NO₃, in the top three three times. While the levels were not particularly high (0.211 to 0.259 mg/L) it represent a significant increase over 2005 measurements. At this time there is not a clear explanation for the increase.

McCoys Creek (WBID 2257)

McCoys Creek (WBID 2257) as characterized by MC3 ranked in the top three all five events for NH₃ and TP. MC3 was in the top three four times for TKN, TN and OP. The explanation for the extremely high levels of NH₃ for March and May (0.768 and 0.817 respectively) appears fairly straight forward for 2006. In early April Water Quality Branch staff found evidence of a raw sewage discharge into McCoys Creek upstream of MC3. Based on the extensive and extremely heavy *Spaerotilus* growth, the City's Water Quality Branch believes that the sewage had been impacting the creek since April 10th or earlier. MC3 data on 3/20/06 was fecal coliform 3365 cfu/100mL and NH₃ 0.768 mg/L. The NH₃ level appears to be a particularly strong indicator of a recent and ongoing sewage discharge. It was not until late on 5/15/06 that the actual sewer line was discovered and repaired. Sampled again on 5/16/06 values were 27,000 cfu/100 mL and 0.817 mg/L respectively, indicating the spill was still impacting the creek.. By 7/31/06, NH₃ levels had returned to "normal" levels for McCoys Creek. The McCoys Creek basin in the downtown area of Jacksonville contains very old residential areas with potentially failing infrastructure and failing septic tanks. It is a minor tributary, prone to flooding. Both of these features continue to contribute to the observed water quality problems in the basin.

Little Six Mile Creek (WBID 2238)

Little Six Mile Creek as characterized by TR314 ranked in the top three five times for NH₃ again in 2006 with values persisting between 0.215 and 0.343 mg/L. While these values are lower than 2005 levels they are still notably higher than the other tributaries sampled. The explanation for elevated NH₃ in the basin is unclear, but may indicate a source of untreated organic waste in the watershed.

Dry Season/Wet Season:

The dry season/wet season sampling strategy of this program is an attempt to differentiate pollution loading to surface waters with the increase runoff accompanying the wet season. The 2006 sampling period was extremely dry, the January through September rainfall totals for 2006, 2005 and 2004 respectively were 33, 50 and 63 inches of rain respectively. Figures 14 through 19 present average nutrient concentrations for each site during dry and wet season periods. Generally speaking, nitrogen compounds showed little correlation to wet and dry season. Known anthropogenic source for ARL3 and MC3 overwhelmed any seasonal influence. In 2006, for both TREE10 and CR5 (Little Fishwiler Creek) there was a noticeable increase during the wet sampling events for OP and TP.

METALS:

Metals results are “Total Recoverable”, metals analyzed for and their detection limits are: Cadmium (0.038 ug/L), Chromium (0.106 ug/L), Copper (0.067 ug/L), Lead (0.012 ug/L), Nickel (0.048 ug/L) and Zn (0.078ug/L). Metals results are found in Table 7. All of the sites monitored for metals are “Tributary Intensive” sites that are above head of tide, therefore predominantly fresh water in nature. The Class III standards for freshwater are all hardness based for these six metals. To determine if a given result was a violation the samples hardness value (in mg/L) is placed into a formula. The resulting value is the Class III FW standard for that particular sample. The higher the hardness result, the higher the Class III criteria.

In 2006 there was only one documented metals violation. On 5/16/2006, the TREE10 copper concentration measured 9.3 ug/L. While this would not have been a freshwater violation due to the very high hardness level of 1220 mg/L, it does constitute a violation of Class III “marine” standards. On that date chlorides were measured at 3499 mg/L, well above the 1500 mg/L to qualify for marine waters. The marine standard for copper is 2.9 ug/L. The fact that there were no other violations for metals in 2006 may be a result of the extremely dry year it was. As noted earlier, the total rainfall from January through September 2006 was 33 inches, 17 inches less than the 50 inches measured in 2005. Further evidence of the drought is found when hardness and chlorides levels are compared between 2005 and 2006. Average hardness and chloride concentrations for 2005 were 139 and 29 mg/L respectively. In 2006 average concentrations were 210 and 131 mg/L respectively.

GOAL II

Measure the effectiveness of the stormwater pollution reduction measures (BMPs) that have been or will be implemented.

STORMWATER BMP EFFECTIVENESS

To accomplish this monitoring goal the City of Jacksonville proposes to conduct an intensive water and sediment quality assessment before and after four separate storm water pollution reduction measures are implemented. No monitoring has been conducted in 2006 for Goal II. The City is still in the design phase for three of the four projects under consideration for effectiveness measurement.

The exception is the recently added upper Deer Creek storm water detention pond. This detention pond was completed in late 2006 and subsequently connected into Deer Creek near the Haines Street Expressway (approximately the same location as the existing tributary site DR2. As a condition of the construction of this regional storm water treatment facility the City of Jacksonville is required to conduct “BMP Effectiveness” monitoring. The City will be evaluating the effectiveness of the treatment system for three “dry season rain events and four “wet season rain events. As of early 2007 it appears that one qualifying “dry event” has been successfully sampled. The City has retained the services of the engineering firm CDM, to assist in the evaluation of the facilities effectiveness. A copy of the Quality Assurance Project Plan for this project is included as Appendix A.

Figure 1.

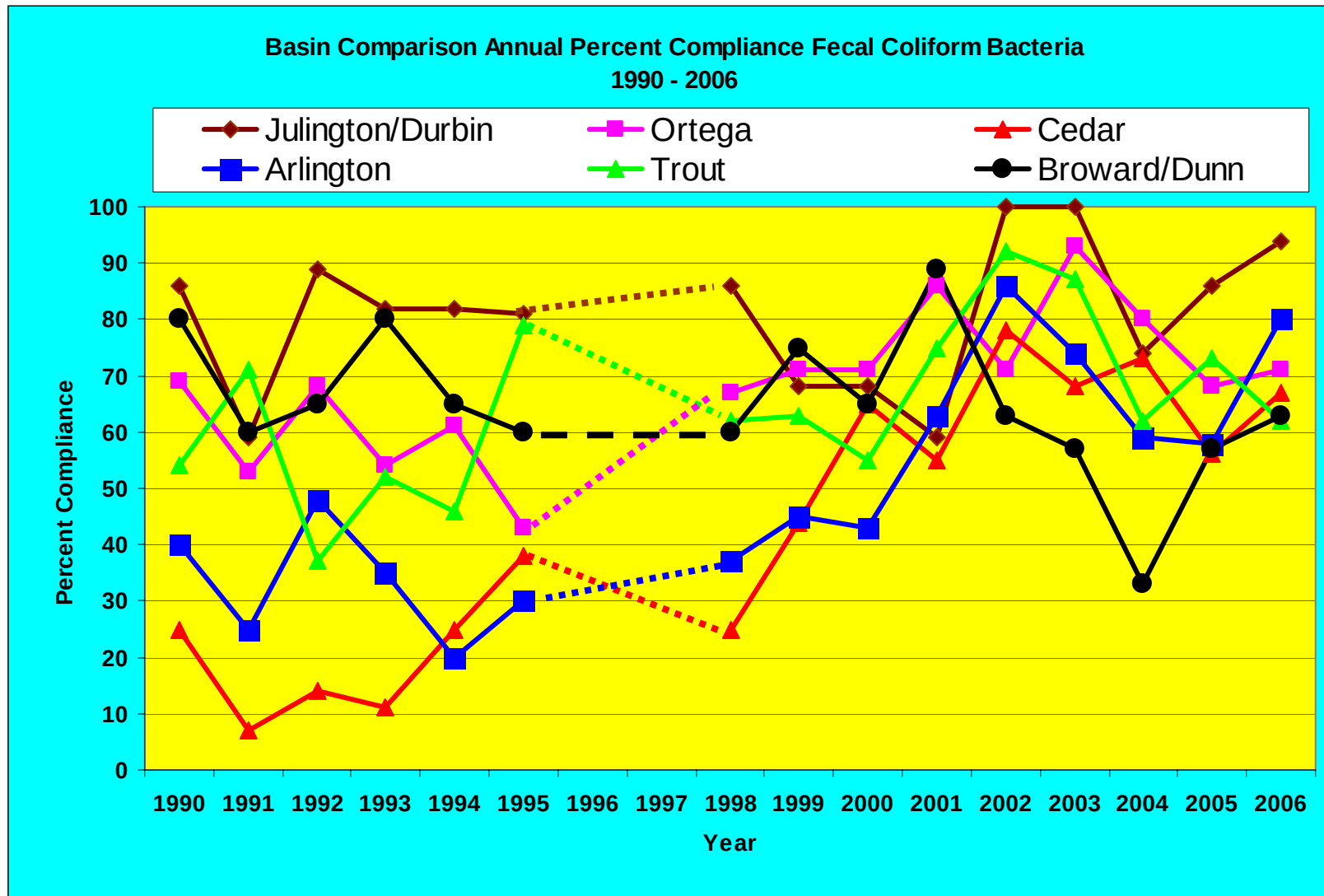


Figure 2.

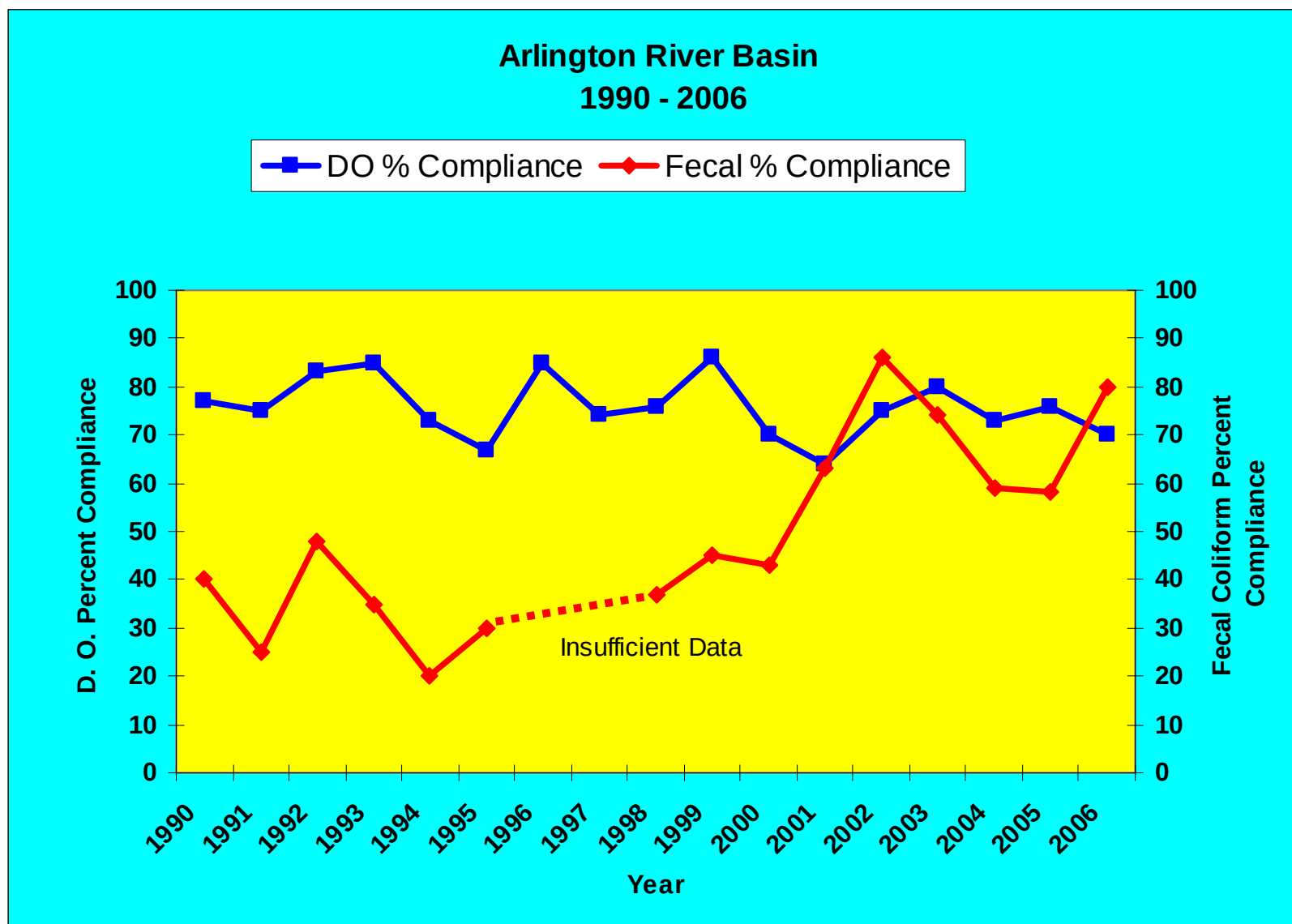


Figure 3.

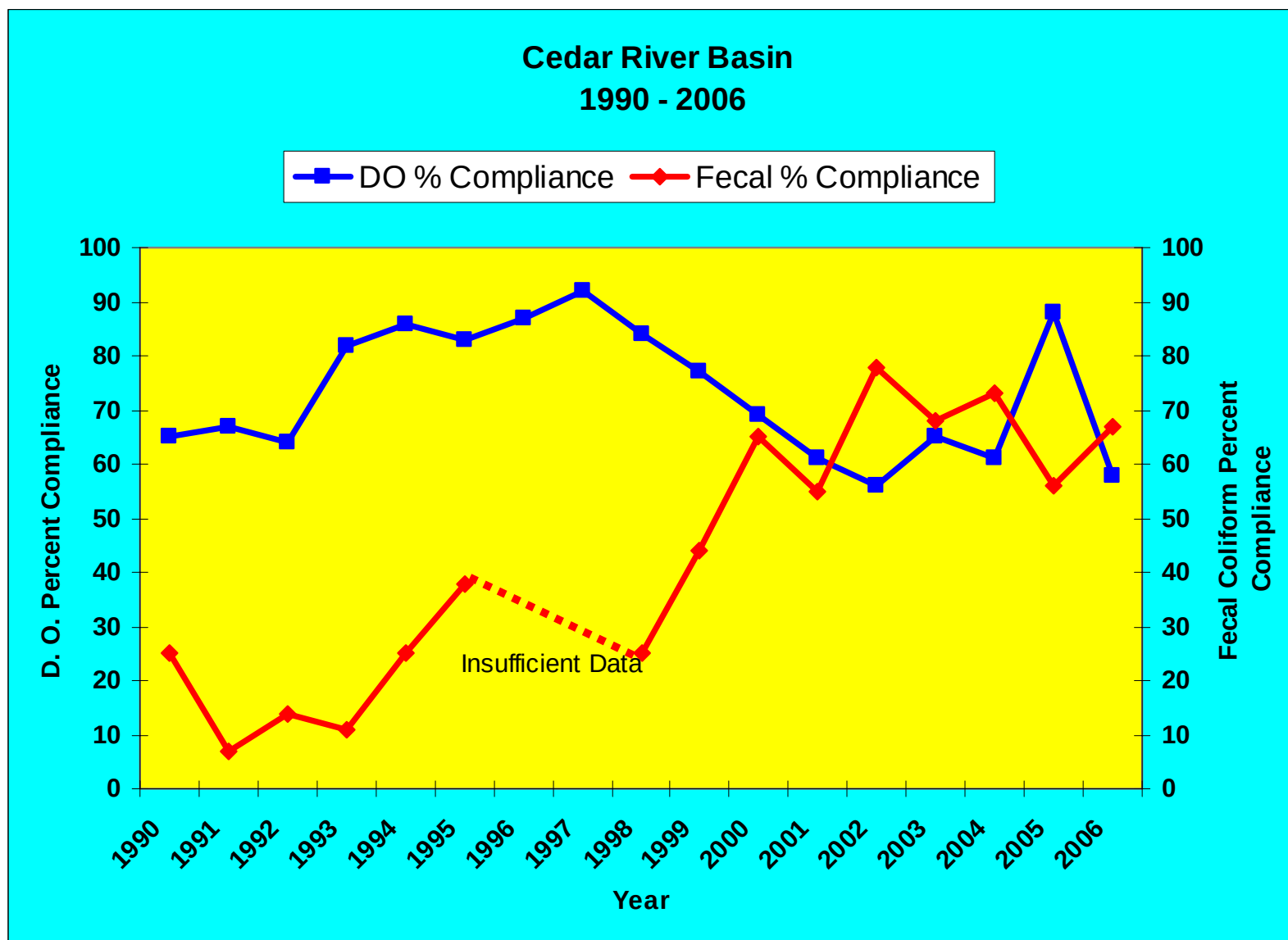


Figure 4.

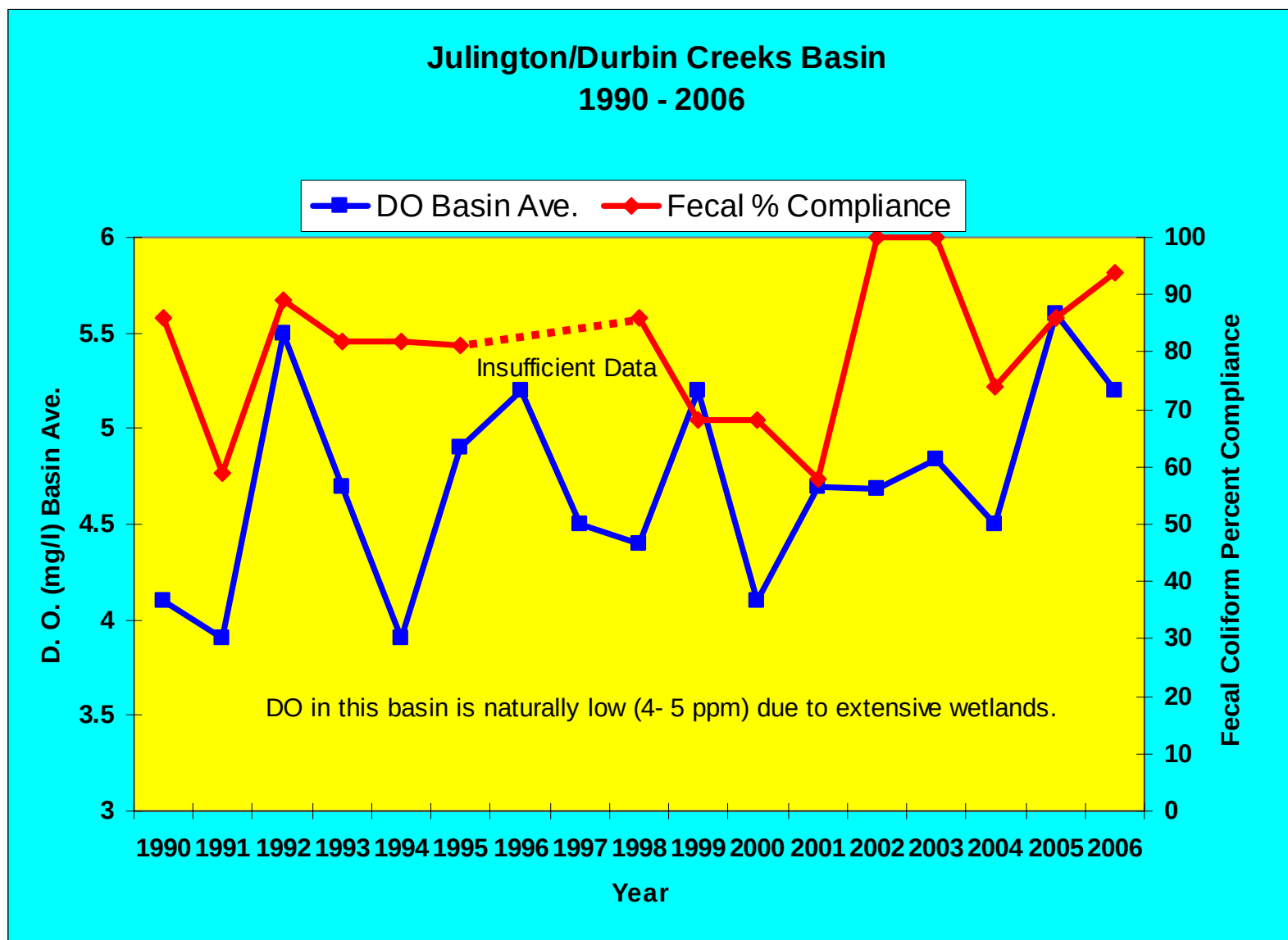


Figure 5.

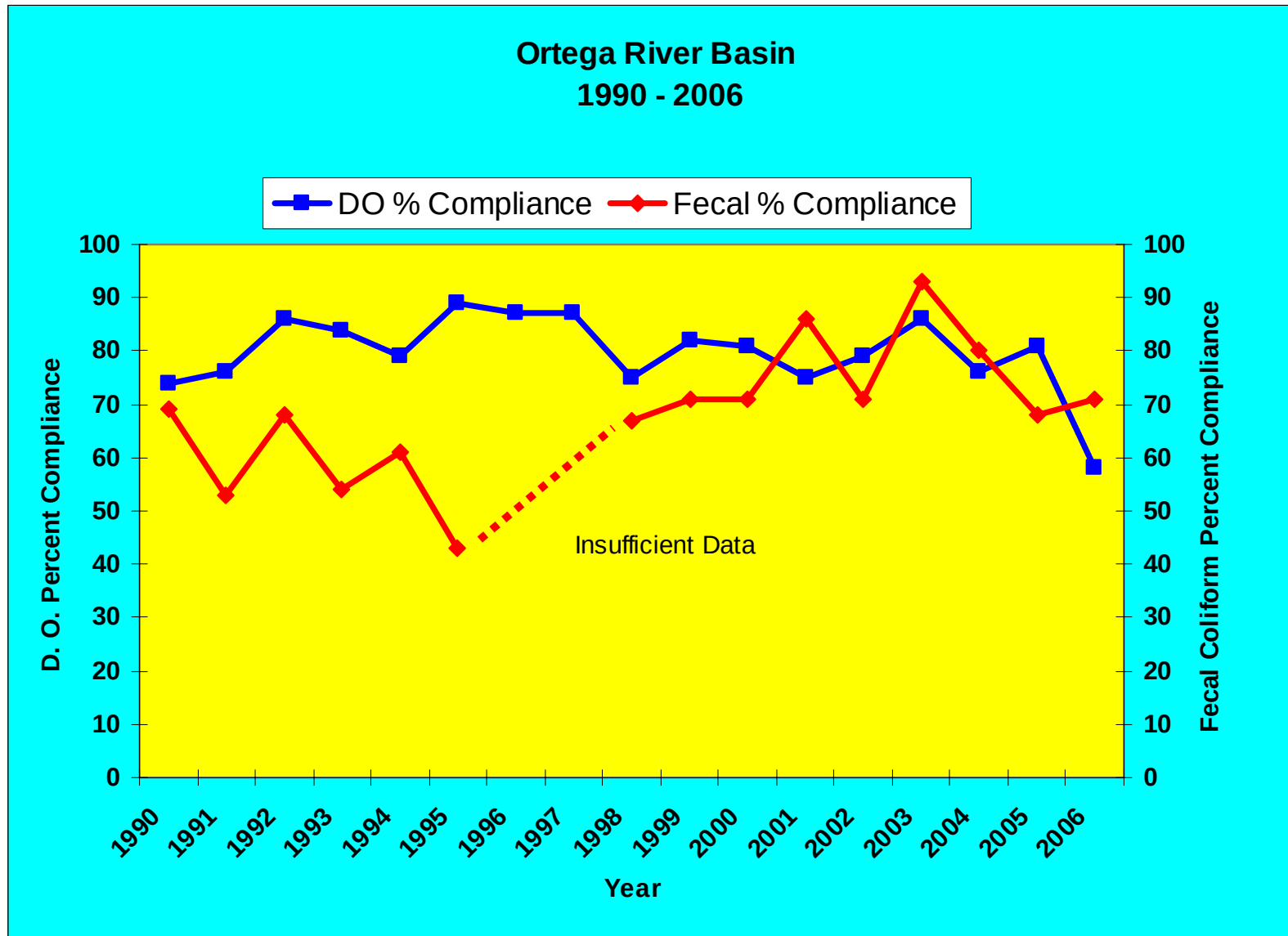


Figure 6.

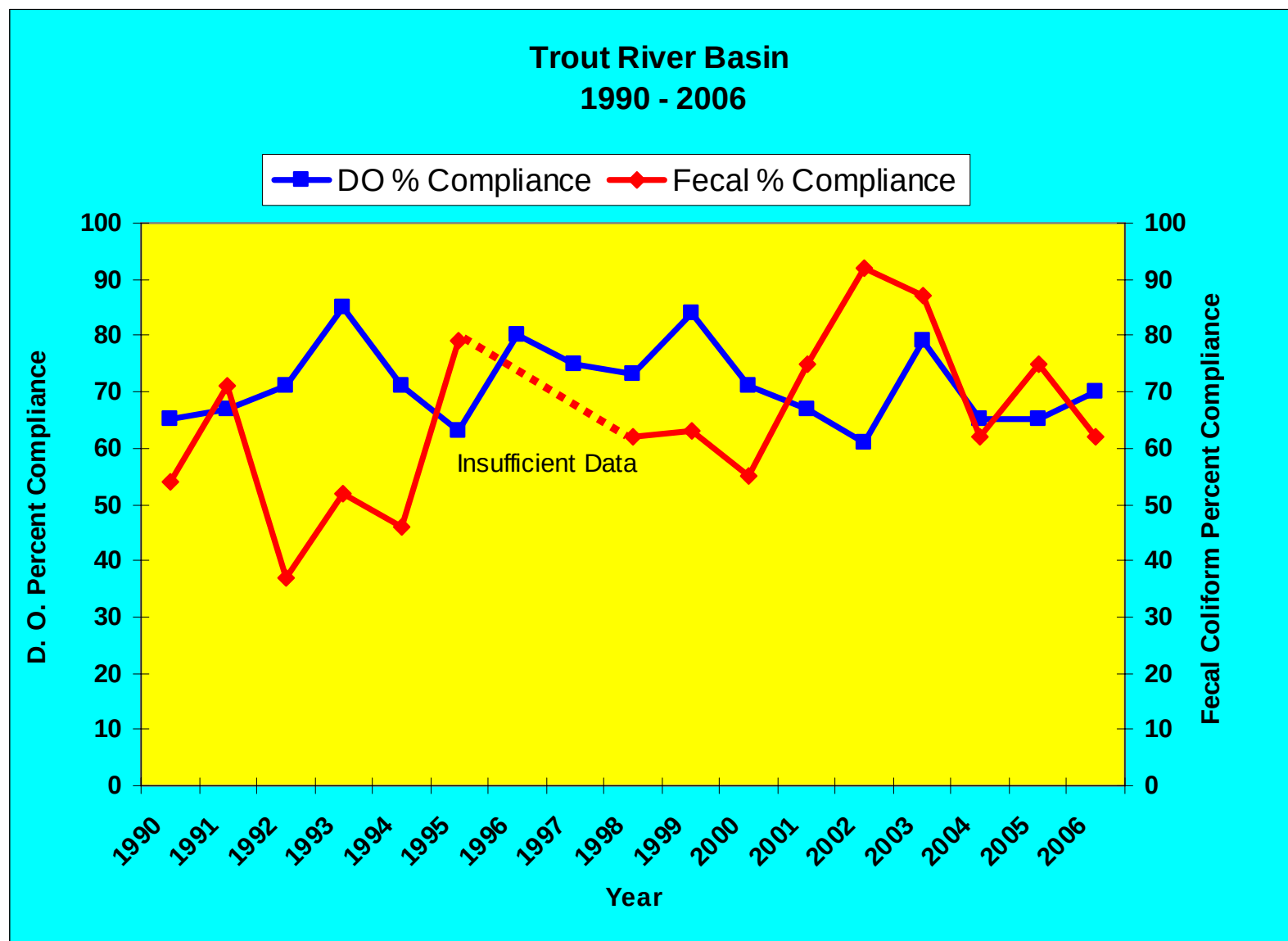


Figure 7.

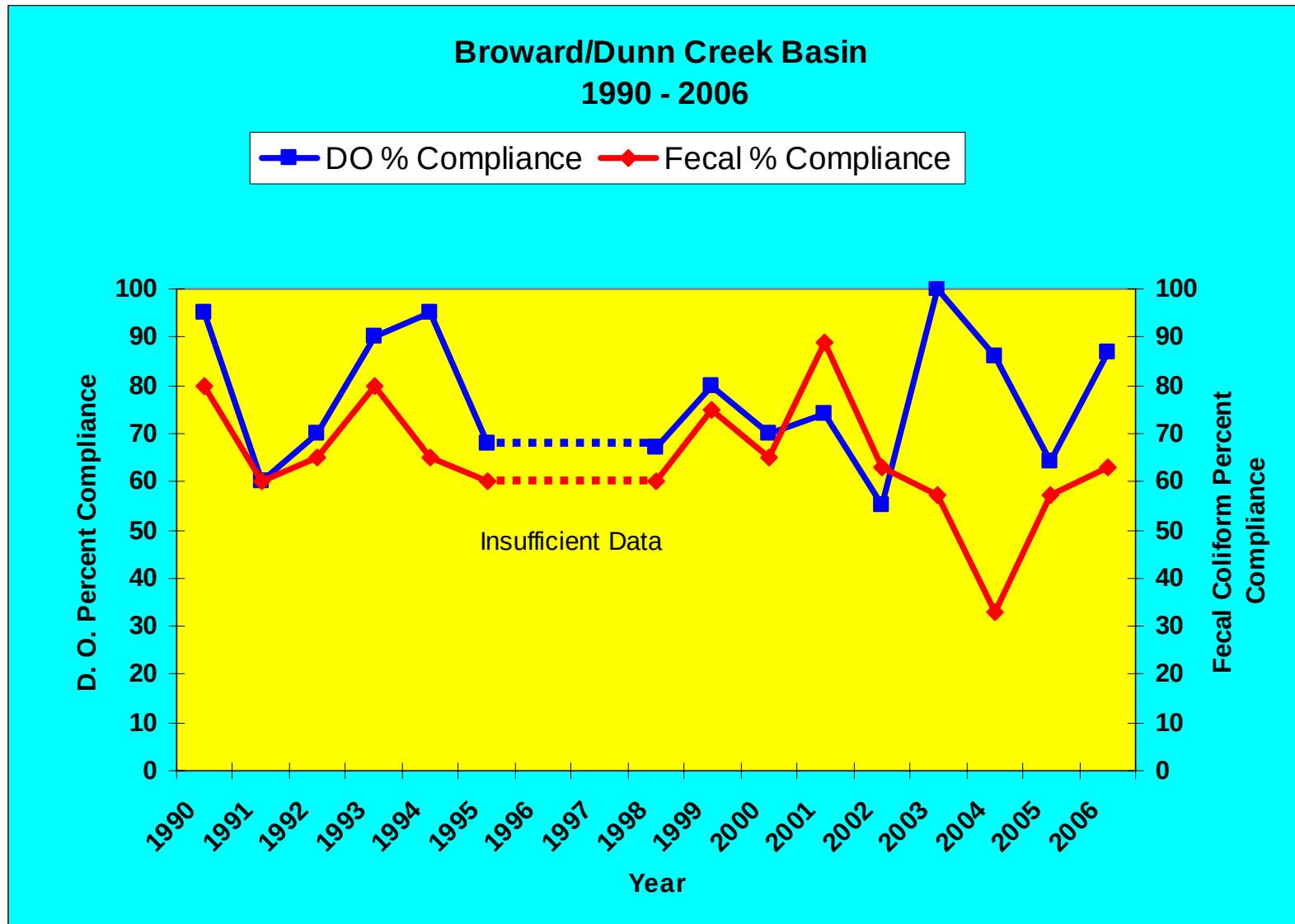


Figure 8.

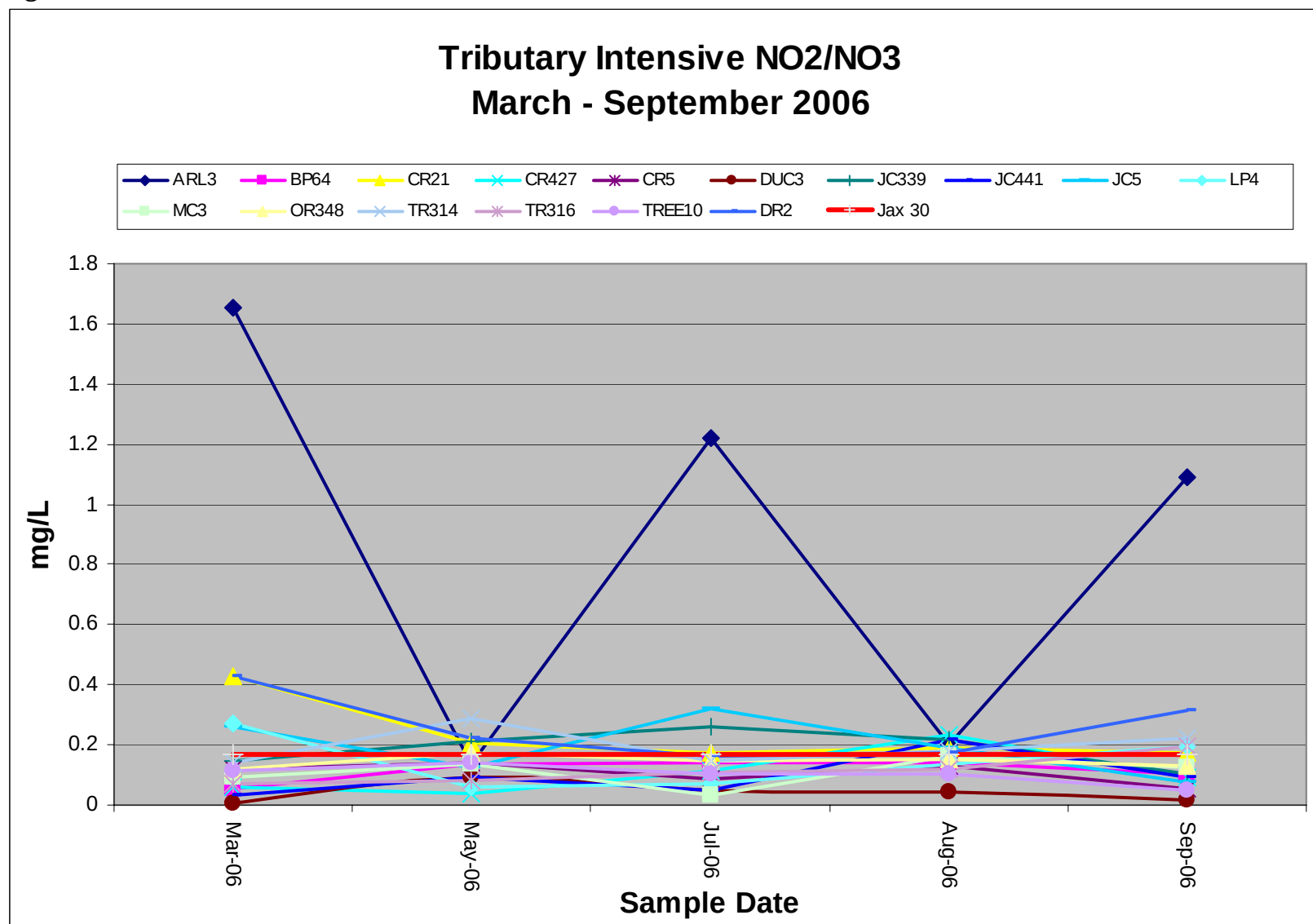


Figure 9.

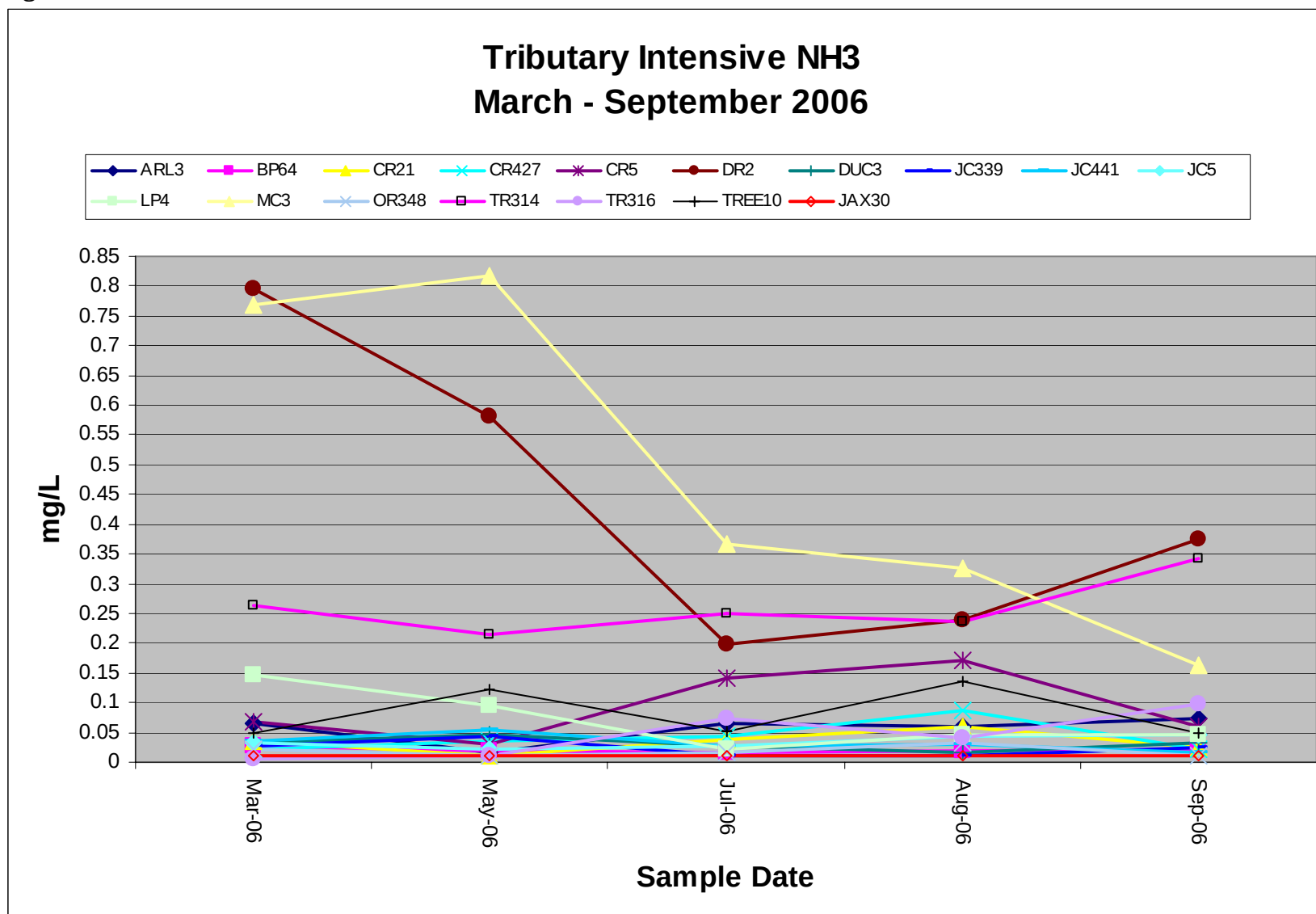


Figure 10.

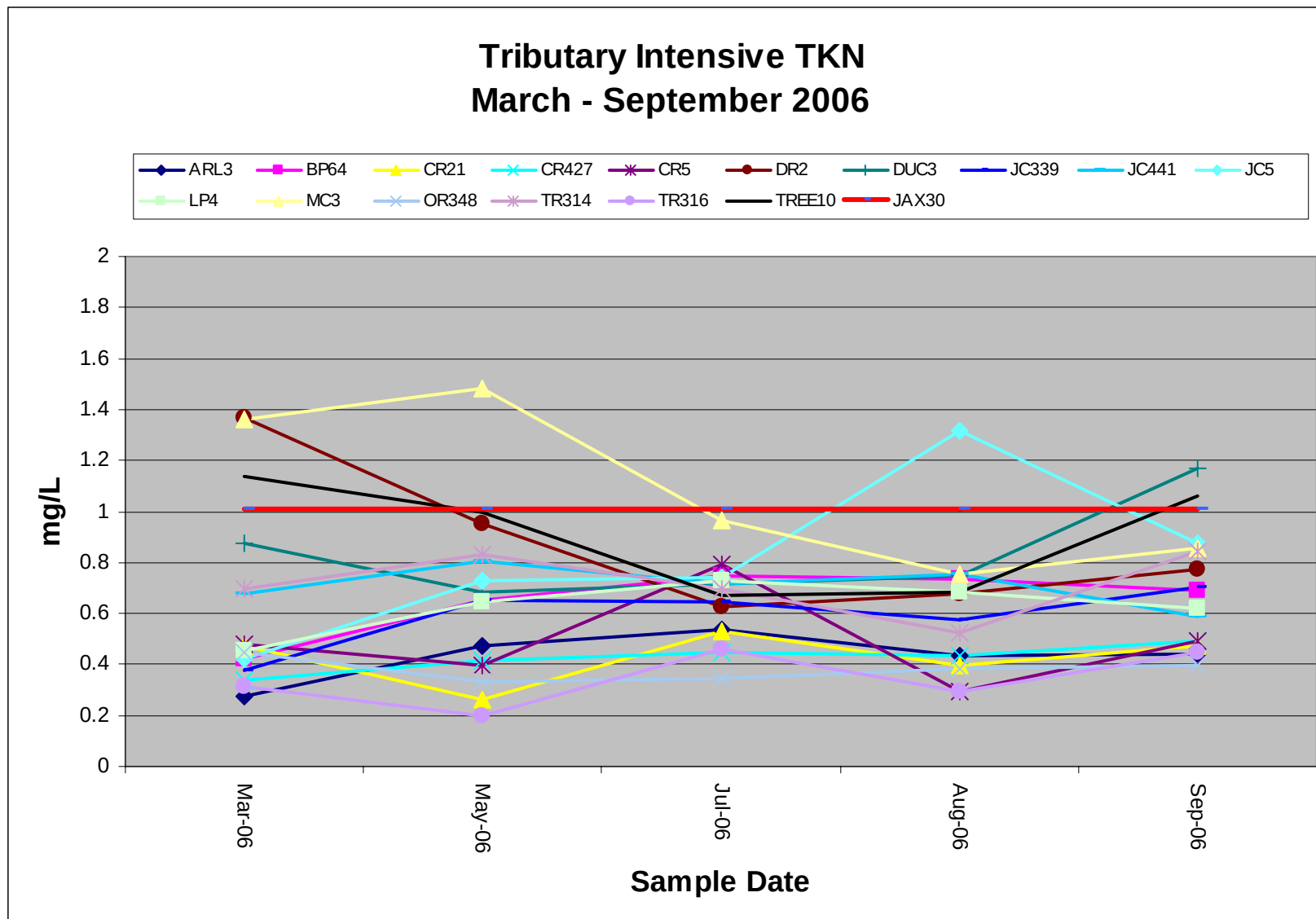


Figure 11.

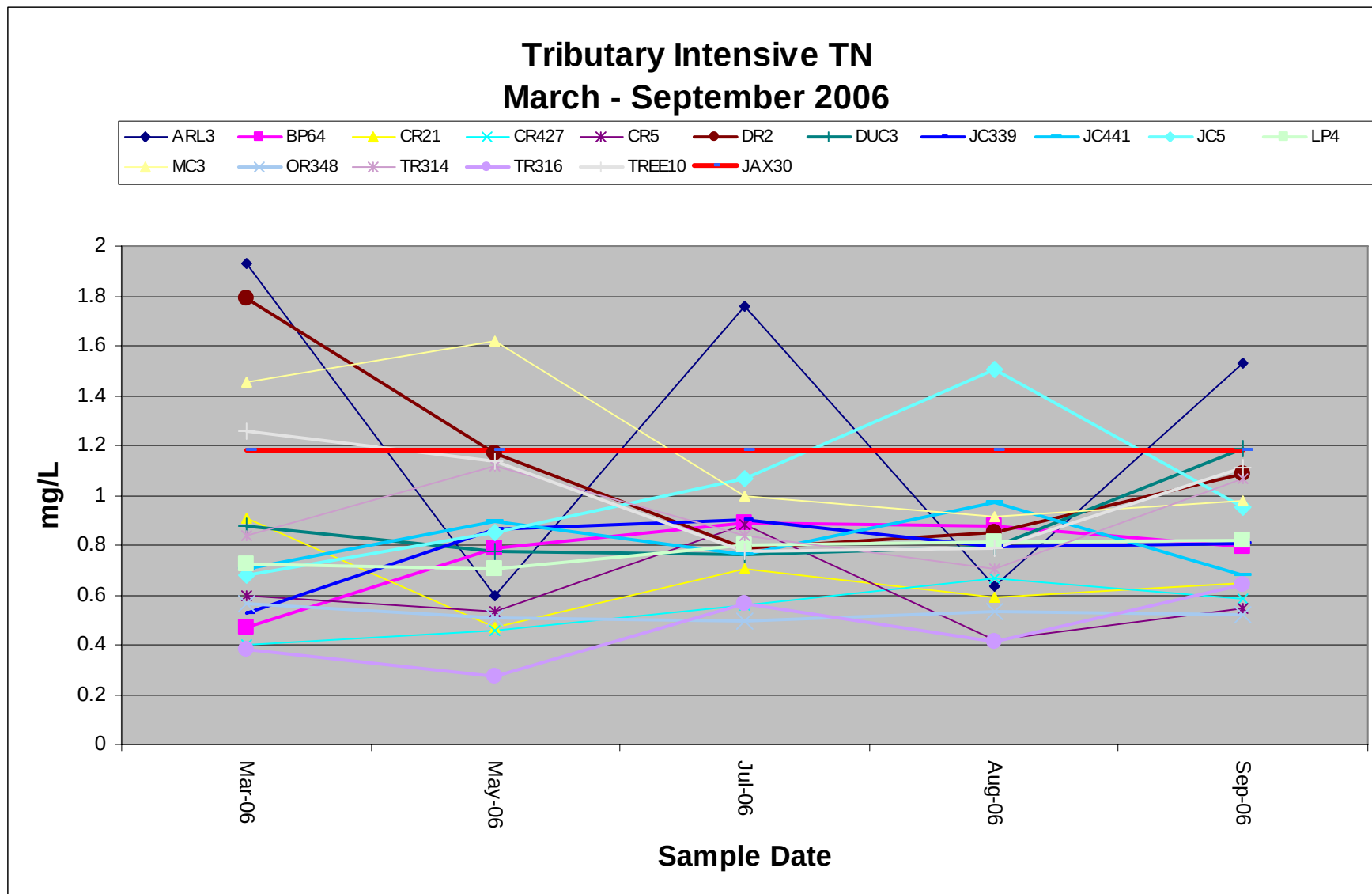


Figure 12.

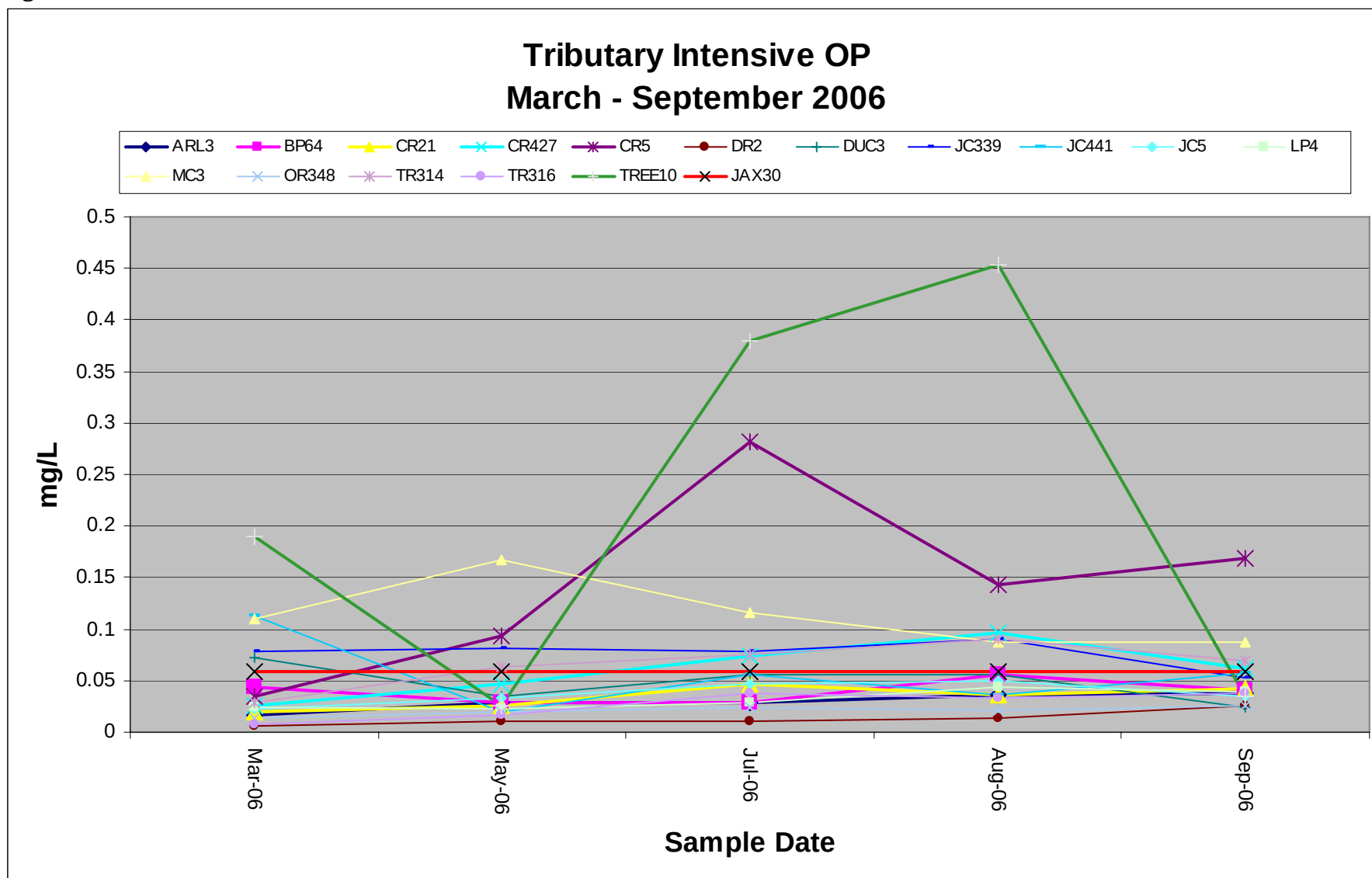


Figure 13.

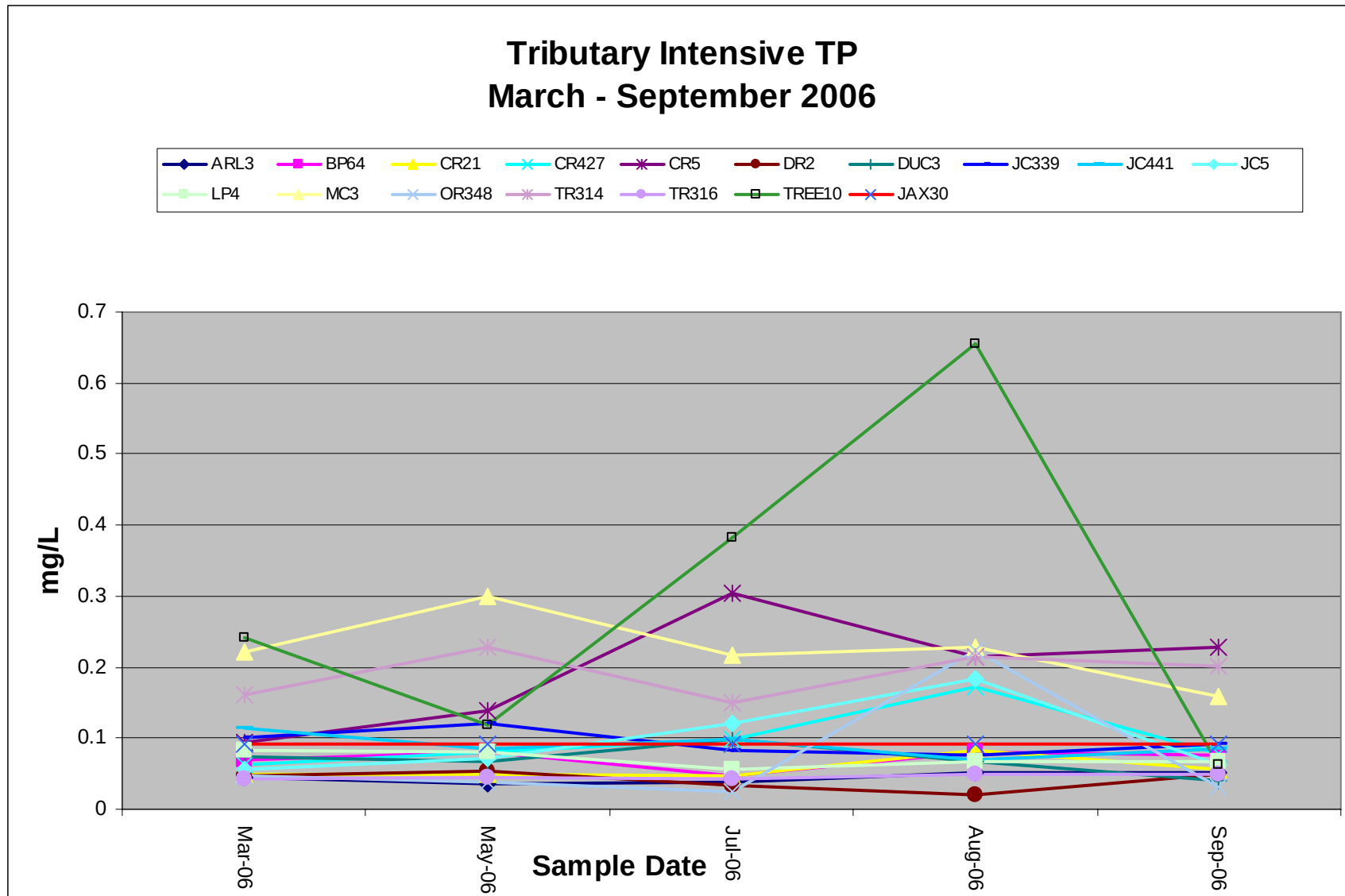


Figure 14.

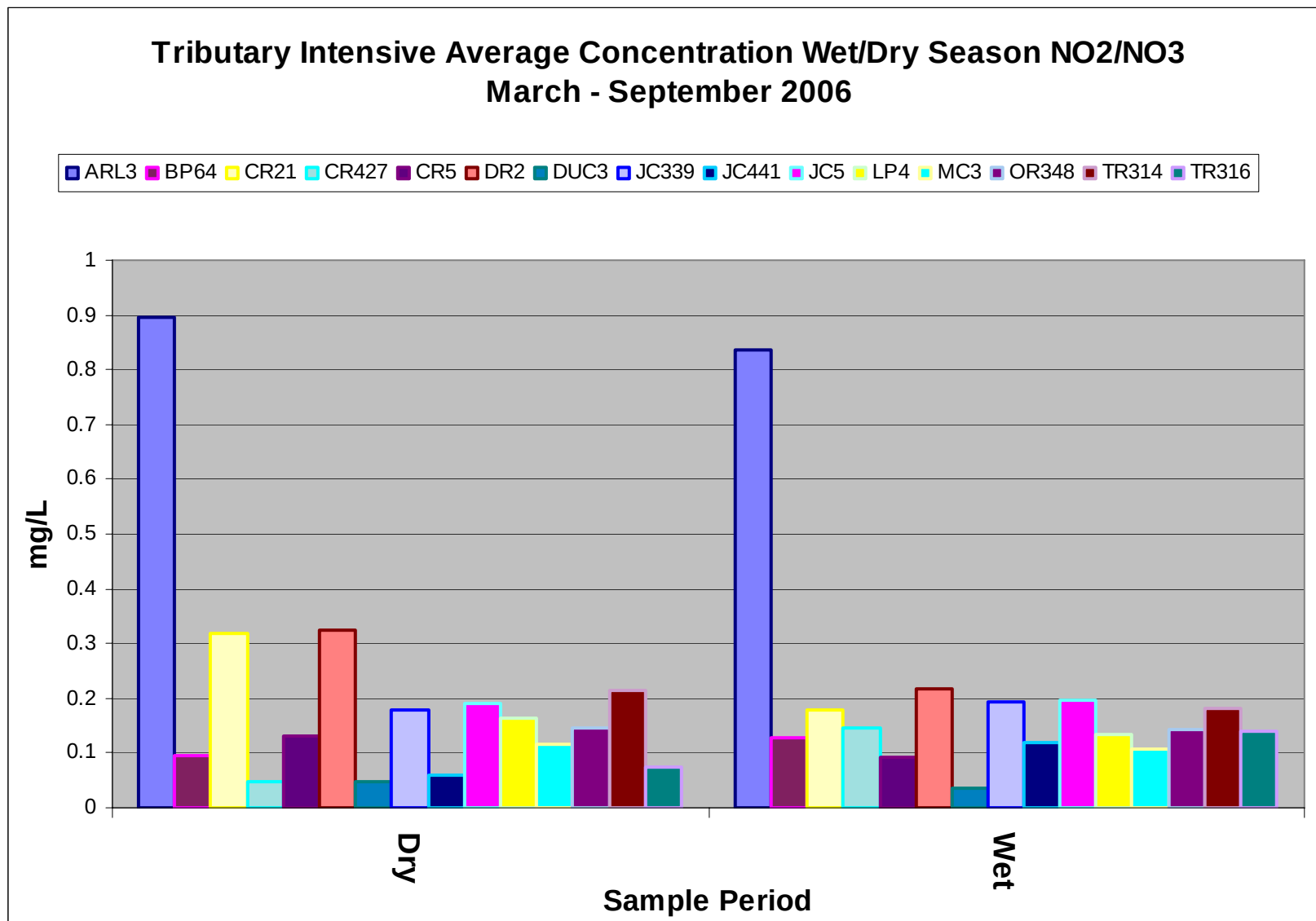


Figure 15.

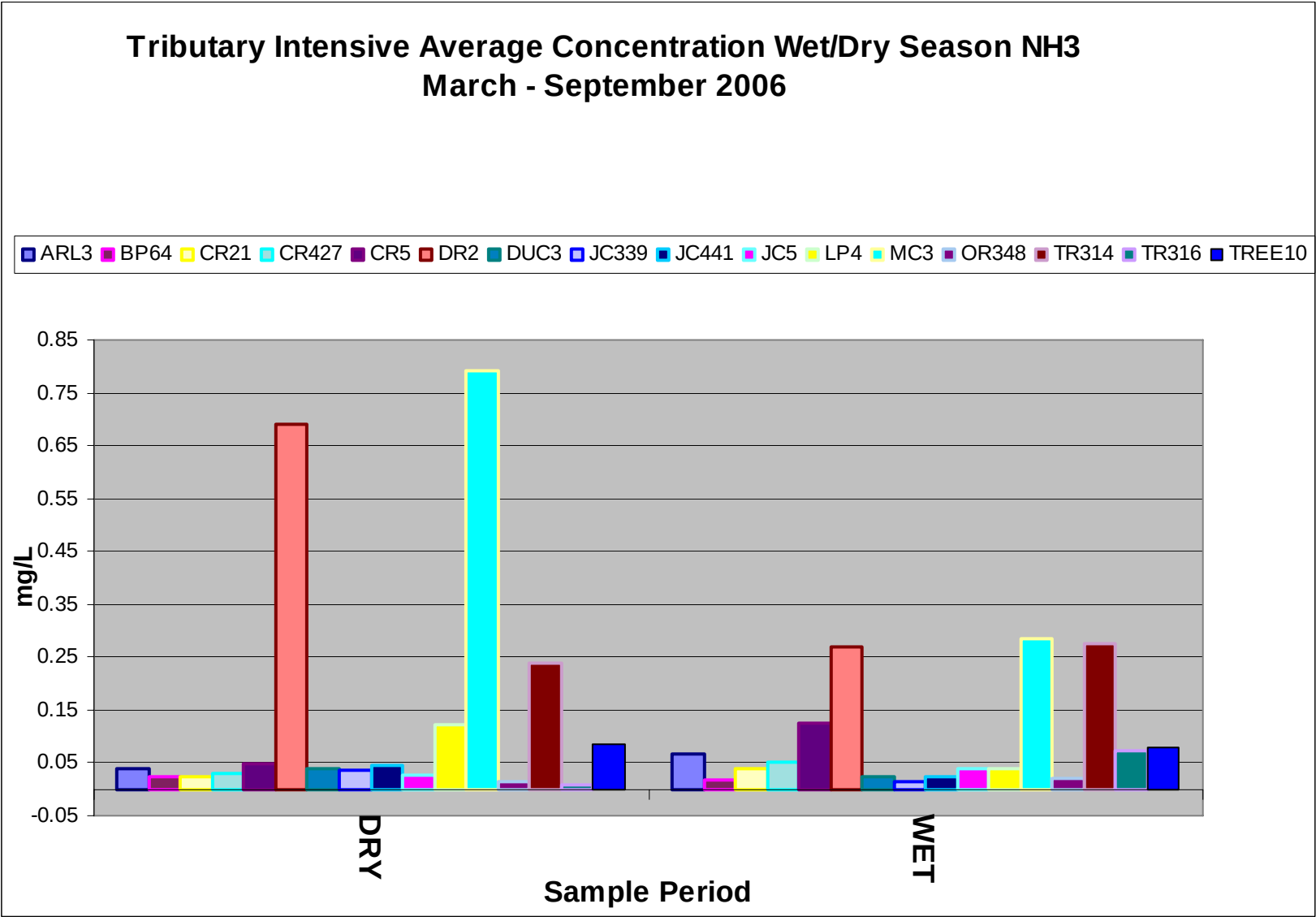


Figure 16.

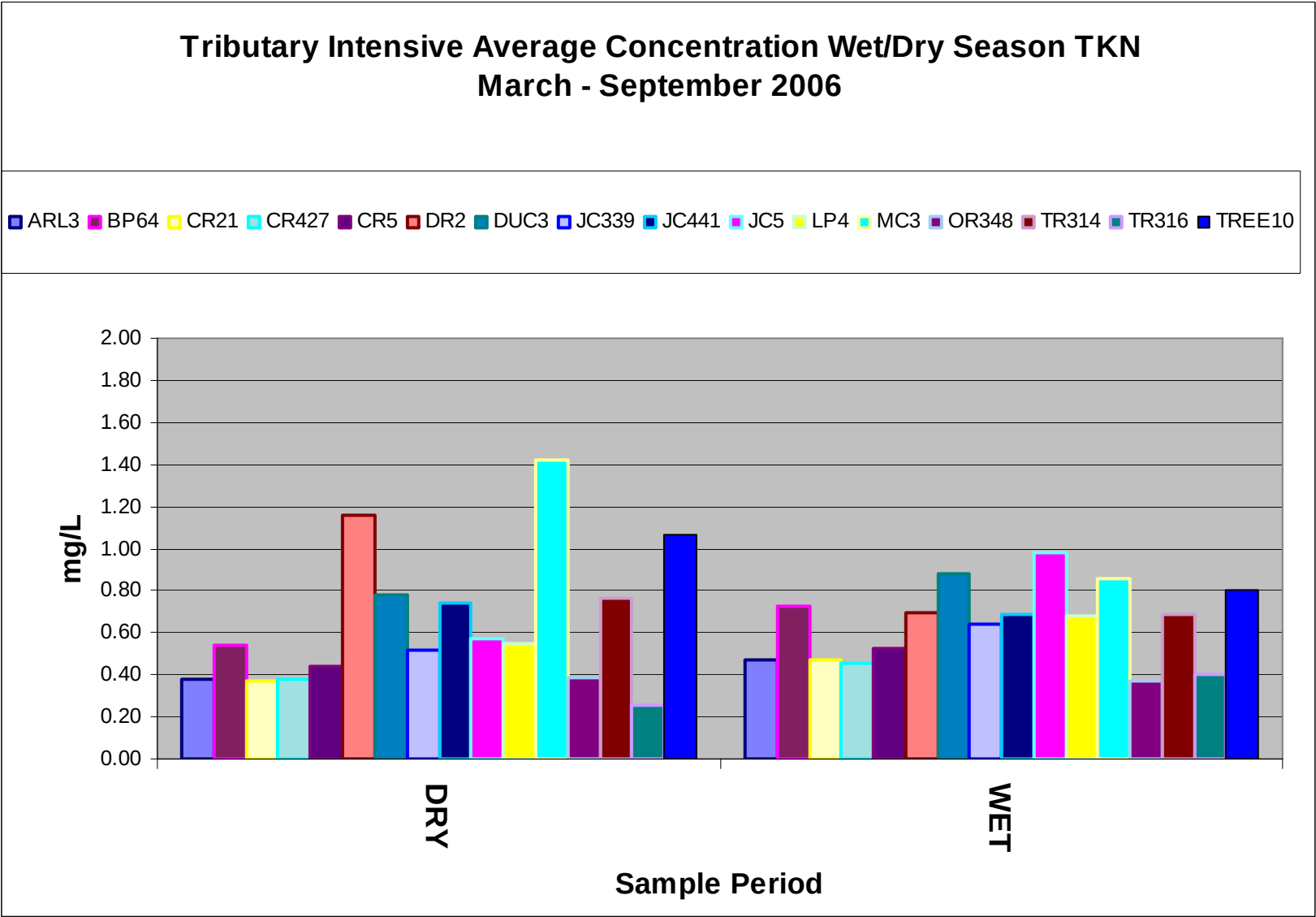


Figure 17.

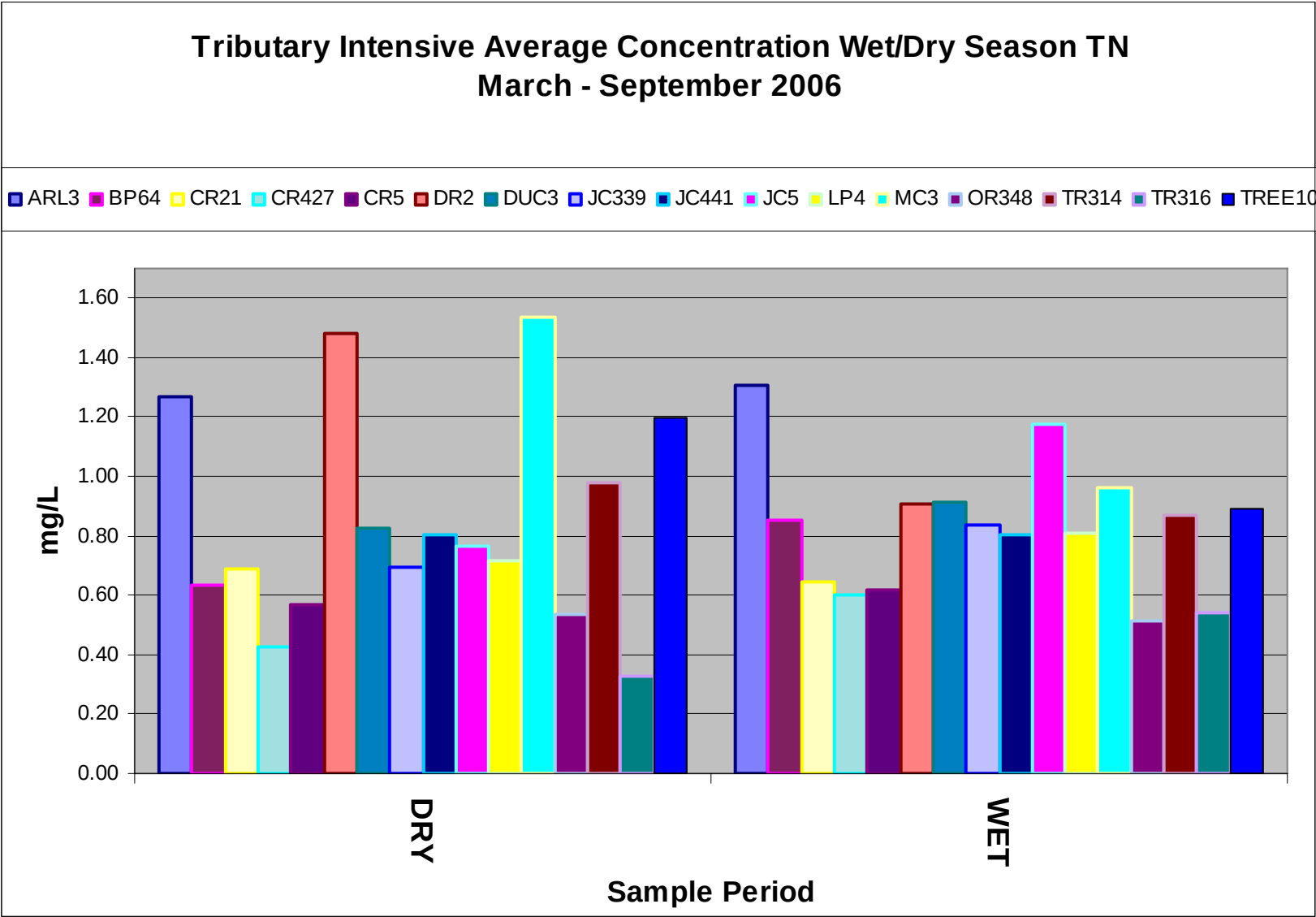


Figure 18.

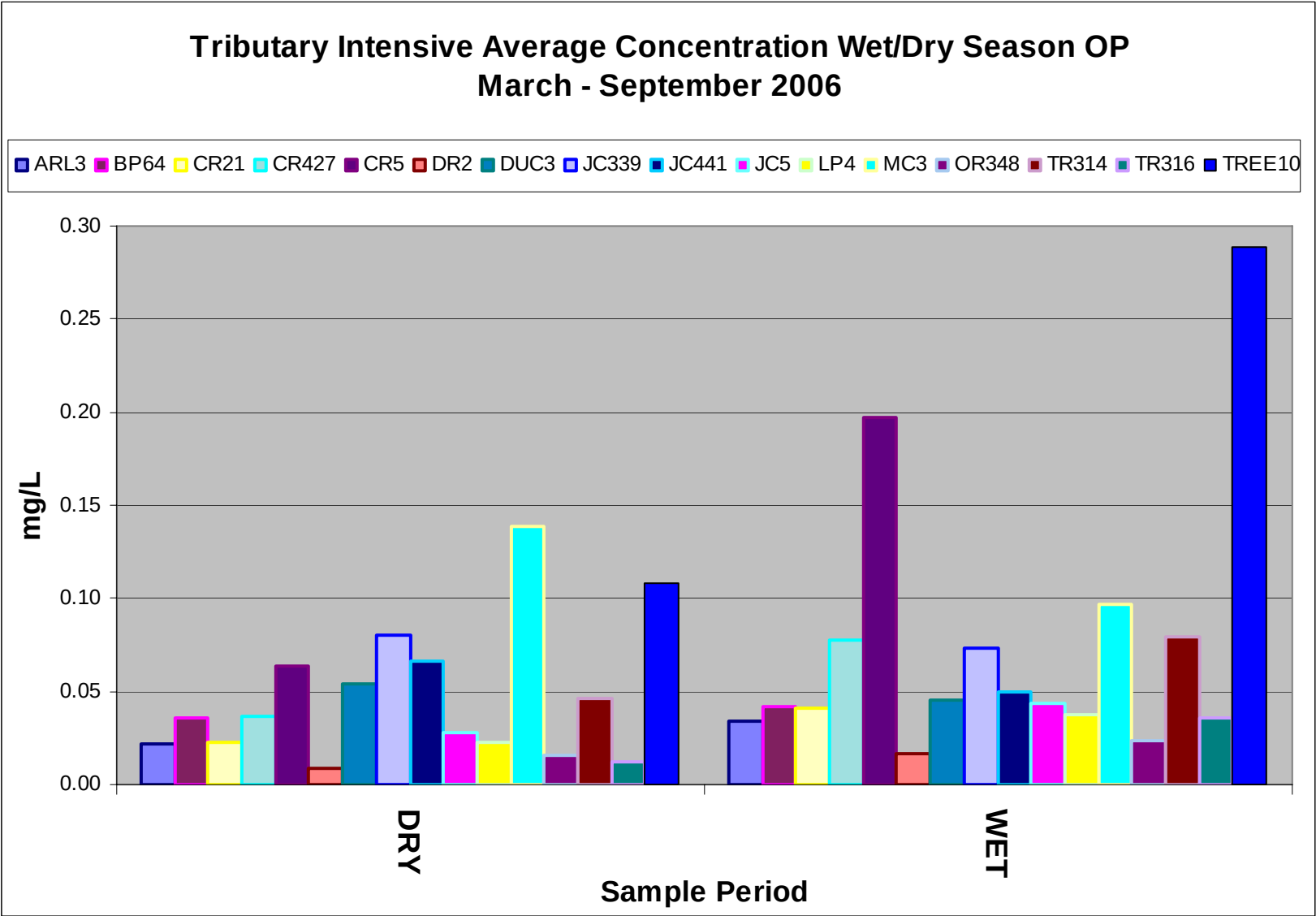


Figure 19.

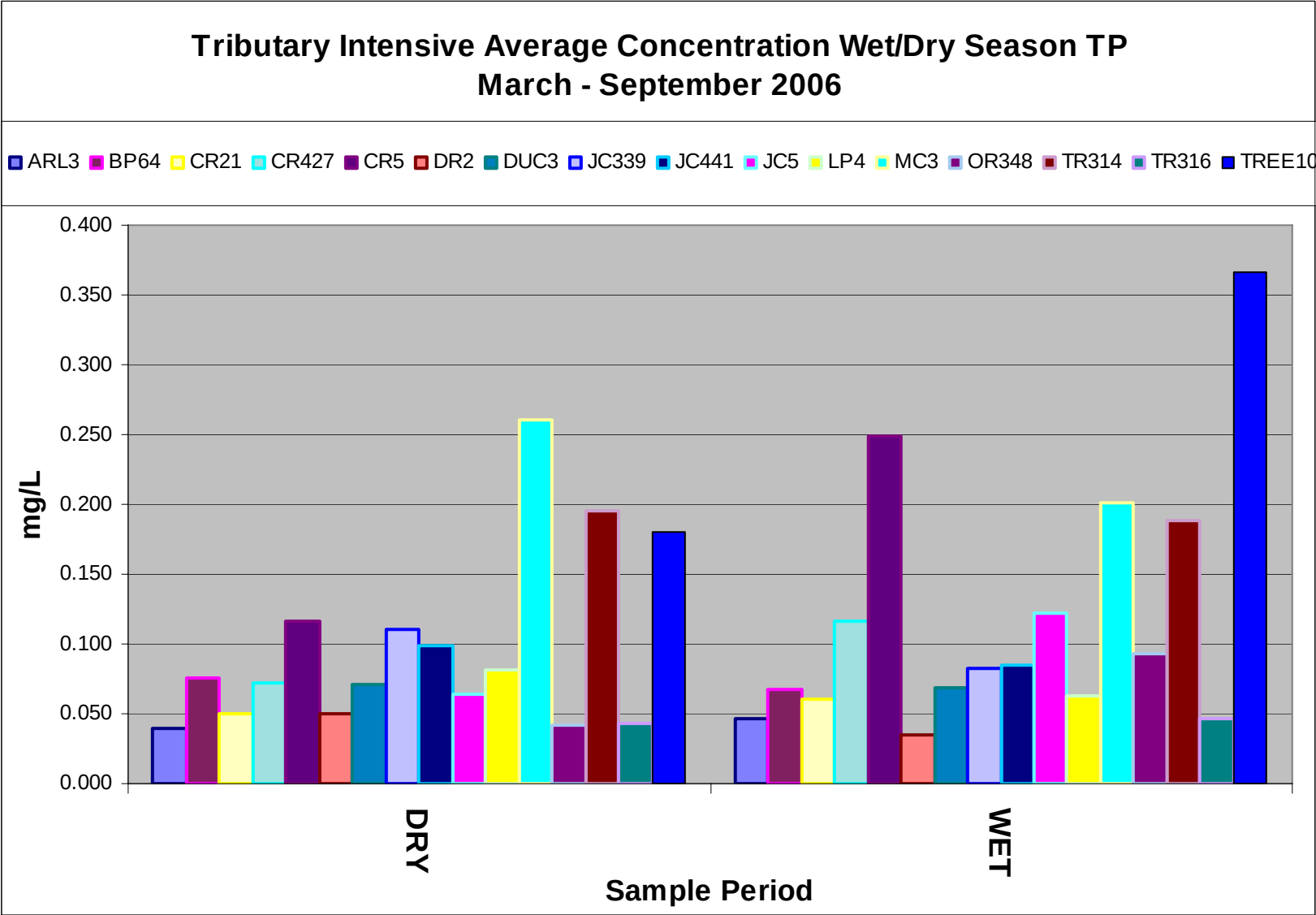


Figure 20.

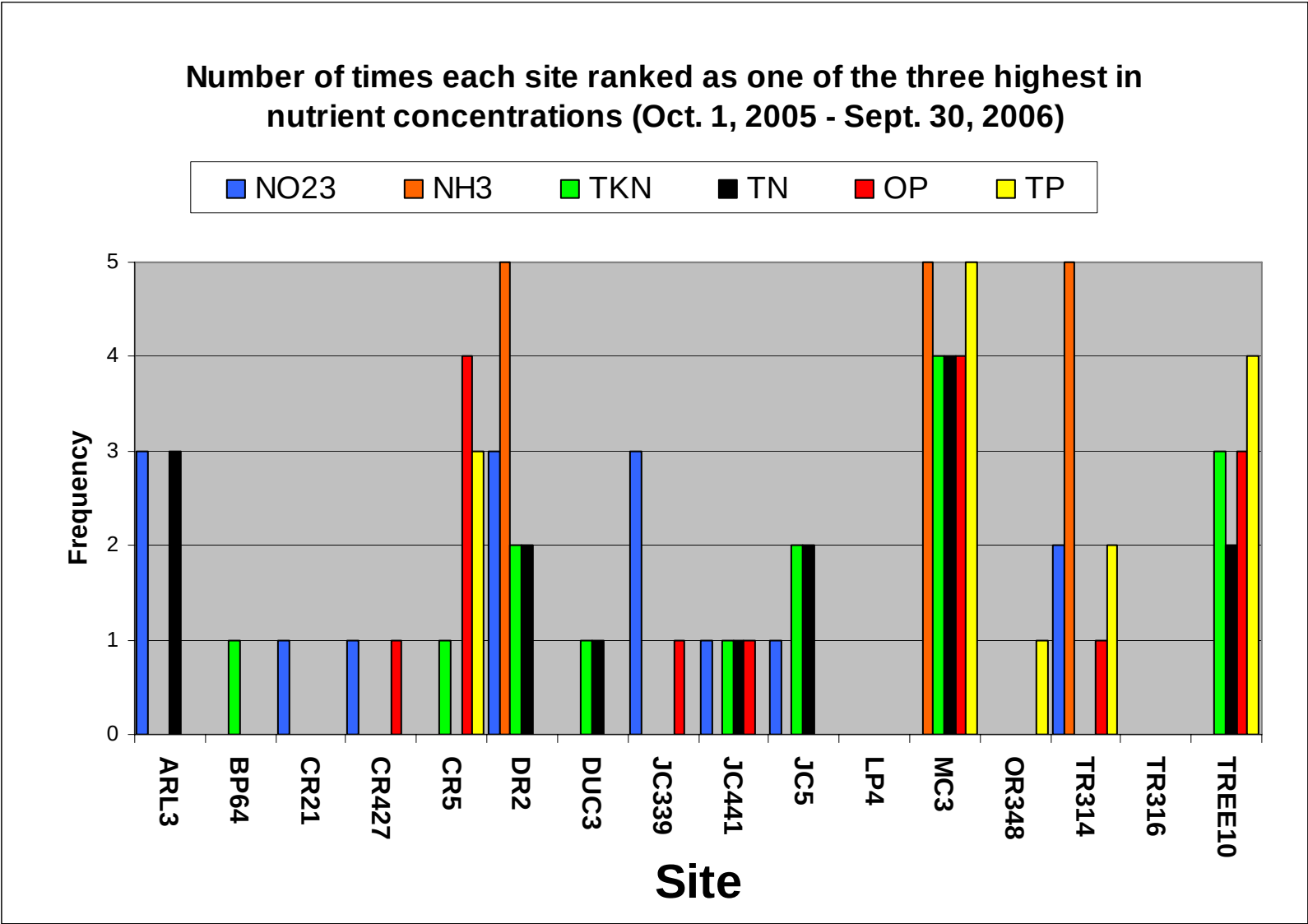


Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

Water Body ID	Waterbody	Water Quality Data					
2161	Thomas Creek						Fecal Coliform (CFU/100mL)
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	
TC1	11/29/2005	18.71	7.2	79	2.13	22.8	300
TC1	1/24/2006	18.78	7.6	60	3.18	34.1	70
TC1	6/14/2006	24.81	7	172	1.78	21.5	1300
TC1	7/17/2006	28.66	7.8	181	2.53	32.7	20

2181	Dunn Creek						Fecal Coliform (CFU/100mL)
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	
DC6	11/29/2005	18.57	7.3	1324	5.41	58	3000
DC144	11/29/2005	18.97	7.2	9692	7.18	79.9	1400
DC6	1/10/2006	11.87	7.2	311	8.95	82.9	1300
DC144	1/10/2006	12.75	6.7	2432	10.44	99.3	270
DC6	6/13/2006	26.09	7.1	28139	4.45	72.6	9000
DC144	6/13/2006	25.36	6.3	4482	5.67	62.3	170
DC6	8/15/2006	27.56	6.7	7767	2.69	34.9	1650
DC144	8/15/2006	29.94	6.9	29768	4.07	59.5	65

2189	Rushing Branch						Fecal Coliform (CFU/100mL)
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	
DC8	11/29/2005	19.1	7.4	635	3.6	39	7000
DC8	1/10/2006	11.92	6.9	317	8.66	80.3	340
DC8	6/13/2006	24.59	6.9	375	5.2	62.5	160000
DC8	8/15/2006	26.59	6.6	5218	2.35	29.8	695

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2191	Broward River						Fecal Coliform (CFU/100mL)
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	
BR7	11/29/2005	18.31	7.4	278	3.54	37.6	700
BR146	11/29/2005	18.67	7.4	810	3.57	38.3	3000
BR7	1/10/2006	10.85	7.1	149	8.68	78.5	170
BR146	1/10/2006	10.96	7.7	241	9.23	83.7	140
BR7	6/13/2006	22.86	6.8	225	4.86	56.5	7000
BR146	6/13/2006	26.83	6.8	1647	5.05	39.9	9000
BR7	9/21/2006	22.55	7.1	163	4.17	48.2	460
BR146	9/21/2006	26.07	7	6514	4.35	54.7	300

2203	Trout River						Fecal Coliform (CFU/100mL)
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	
TREE10	12/5/2005	13.16	7.7	146	7.36	70.1	90
TR123	12/5/2005	13.9	7.5	856	5.8	56.3	800
TREE10	1/24/2006	19.51	7.1	110	5.04	54.9	700
TR123	1/24/2006	17.24	7.7	148	5.62	58.5	700
TREE10	6/14/2006	24.74	6.7	888	3.16	38.2	1300
TR123	6/14/2006	26.87	6.7	13899	3.58	46.9	17000
TREE10	7/17/2006	26.16	7.1	2879	2.64	32.9	110
TR123	7/17/2006	30.42	6.9	14711	2.14	29.9	500

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2203A	Highlands Creek & Trout River						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
TR34	12/5/2005	15.94	7.3	7693	8.74	90.8	170
TR113A	12/5/2005	16.07	7	7547	8.23	85.7	40
TR34	1/10/2006	13.2	6.8	6758	9.6	93.7	330
TR113A	1/10/2006	12.93	6.7	7028	10.65	103.4	40
TR34	6/13/2006	26.55	6.3	26301	5.33	72.6	1700
TR113A	6/13/2006	26.64	6.7	28210	5.47	75.1	2400
TR34	7/17/2006	29.05	6.8	26212	2.02	28.7	2200
TR113A	7/17/2006	29.14	6.8	27567	2.92	41.8	80

2204	Terrapin Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
DC7	11/29/2005	19.53	8	230	6.31	68.8	3000
DC5	11/29/2005	19.04	7	12090	6.07	68.2	500
DC7	1/10/2006	12.95	7.1	284	10.91	103.5	1100
DC5	1/10/2006	15.02	6.9	1263	9.4	93.6	500
DC7	6/13/2006	22.96	6.4	322	6.54	76.2	5000
DC5	6/13/2006	25.81	6.8	27287	5.34	76.5	130
DC7	6/26/2006	24.48	8.1	161	6.23	74.7	1245
DC5	8/15/2006	28.23	6.8	33167	3.07	44.2	700
DC7	9/21/2006	22.39	7.1	132	5.55	64	2400

2205C	Cradle Creek Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
IWWG	11/14/2005	20.39	6.9	16263	3.28	38.5	1100
IWWG	2/1/2006	14.8	7.2	22066	6.46	69.3	240
IWWG	5/22/2006	28.89	7.1	1339	6.51	84.8	8000
IWWG	9/18/2006	27.92	7.1	1338	4.94	63.2	500

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2207	Blockhouse Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
TR37	12/5/2005	15.46	7.4	6892	8.27	84.8	1300
TR37	1/10/2006	15.77	6.9	257	2.07	20.9	800
TR37	6/14/2006	27.1	6.8	20980	4.89	66	3000
TR37	7/17/2006	27.4	6.9	9339	0.24	3.1	2200

2210	West Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
TR40	12/5/2005	14.95	7.6	793	5.85	58.1	1100
TR40	1/10/2006	14.89	6.9	219	9.84	97.4	300
TR40	6/14/2006	24.7	7.1	705	5.16	62.2	1700
TR40	7/17/2006	27.22	7	844	6.17	77.9	1700

2213C	Fairchild Branch & minor trib.						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
ARL7	11/28/2005	21.24	7.3	334	6.9	77.8	1100
ARL23	11/28/2005	19.96	7.3	431	6.85	75.3	12000
ARL7	2/14/2006	12.19	7.1	300	9.53	88.9	1100
ARL23	2/14/2006	9.29	7.4	319	9.6	83.7	2200
ARL7	4/26/2006	22.39	7	306	6.68	77	1300
ARL23	4/26/2006	23.72	6.3	31587	5.04	66.6	14000
ARL7	8/22/2006	25.29	7	326	6.1	74.2	700
ARL23	8/22/2006	27.58	7.1	35192	1.87	26.8	3000

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2213E	Willow Branch & minor trib.						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
SS26	10/25/2005	18.05	7.3	461	6.28	66.5	1460
CR3A	11/2/2005	22.39	7.7	525	2.39	27.6	16000
SS26	1/17/2006	16.11	7.4	446	5.99	60.9	770
CR3A	2/28/2006	16.55	7	8188	5.85	61.6	1100
CR3A	4/10/2006	20.13	7.4	573	6.74	74.4	5000
SS26	4/24/2006	21.88	7.5	617	2.45	28	1700
SS26	7/12/2006	25.17	7.9	444	2.79	33.9	17750
CR3A	9/13/2006	27.39	6.8	22414	1.14	15.5	9000

2213F	South Creeks						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
SS17	10/26/2005	16.11	7.9	261	5.99	60.8	520
SS17	1/23/2006	17.12	7.1	307	5.68	59	290
SS17	4/12/2006	19.26	6.6	280	4.76	51.7	300
SS17	7/12/2006	28.89	7.8	236	3.45	44.8	370

2220	Nine Mile Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
TR10	12/5/2005	15.46	7.1	5231	7.91	80.6	170
TR10	1/24/2006	17.25	7.4	850	6.93	72.3	130
TR10	6/14/2006	26.42	6.5	17617	3.93	51.8	7000
TR10	7/17/2006	31.07	6.6	22044	2.95	42.6	20

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2224	Ribault River & Palmdale Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
TR3	12/5/2005	16.94	7.7	377	3.91	40.4	20
TR128	12/5/2005	16.25	7.5	3157	8.14	83.7	110
TR3	1/24/2006	18.75	7.4	334	9.57	102.8	130
TR128	1/24/2006	17.59	7.4	499	7.49	78.5	170
TR3	6/14/2006	26.85	7.1	341	4.81	60.2	300
TR128	6/14/2006	24.85	6.8	906	3.75	45.4	3000
TR3	9/21/2006	26.63	7.7	253	4.42	55.2	220
TR128	9/21/2006	27.09	7.2	18811	5.16	69	570

2225	Brandy Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
BB1	12/14/2005	10.26	6.8	119	7.65	68.2	20
BB1	3/14/2006	20.94	5.7	59	2.37	26.6	20
BB1	5/24/2006	21.91	6.8	160	2.64	30.1	20
BB1	7/17/2006	26.17	6.8	122	2.42	30	20

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2227	Sherman & Puckett Creeks						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
SC3	11/14/2005	20.8	7.3	14922	4.15	48.7	3000
SC1	11/14/2005	22.34	7.3	18575	4.96	60.9	1400
IWW2	11/14/2005	21.71	7.3	23847	4.86	60.1	230
SC3	2/1/2006	13.59	7.3	23832	6	63.1	4200
SC1	2/1/2006	14.2	7.2	28635	6.76	73.4	450
IWW2	2/1/2006	15.19	7.7	38790	7.96	92.2	31
SC3	5/22/2006	27.54	7.1	32256	3.79	53.7	260
SC1	5/22/2006	27.71	7.1	37711	4.67	67.7	3000
IWW2	5/22/2006	26.17	6.9	46111	4.29	62.7	130
SC3	9/18/2006	25.76	7.3	3810	2.56	31.7	5600
SC1	9/18/2006	27.89	7	28996	3.51	49.4	760
IWW2	9/18/2006	27.61	7.2	46725	3.33	50	74

2228	Moncrief Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
TR114	12/5/2005	15.64	6.8	1507	5.44	55	340
TR316	12/14/2005	15.57	6.9	510	7.22	72.6	700
TR316	1/24/2006	21.33	7	532	5.72	64.7	270
TR114	1/24/2006	20.24	7	616	4.48	49.6	1700
TR114	6/13/2006	23.65	7.3	727	5.41	64	28000
TR316	6/14/2006	25.06	6.8	367	4.27	51.7	2800
TR114	6/26/2006	26.2	7.1	1878	3.15	39.1	14000
TR316	9/21/2006	22.92	7.4	441	3.8	44.3	21000
TR114	9/21/2006	25.64	7.2	27152	4.02	54	4000

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2231	Six Mile Creek N Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
TR23	12/12/2005	12.73	7.4	184	7.33	69.2	300
TR23	1/24/2006	18.67	7.6	198	3.83	41	40
TR23	5/24/2006	22.72	7.4	336	1.98	22.9	80
TR23	7/25/2006	26.85	7.1	341	4.81	60.2	790

2232	Six Mile Creek S Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
TR422	12/12/2005	11.46	7.6	147	8.98	82.3	500
TR422	1/24/2006	11.46	7.6	147	8.98	82.3	20
TR422	6/5/2006	22.26	7.5	191	4.41	50.7	1010
TR422	7/25/2006	24.23	6.4	198	5.86	69.9	770

2233	Long Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
LB2	11/2/2005	20.95	7.7	405	2.52	28.3	3500
LB1	11/2/2005	20.33	7.4	6025	6.99	78.9	800
LB2	2/28/2006	14.78	7.2	416	4.51	44.5	270
LB1	2/28/2006	15.64	6.2	19874	8.31	89.8	40
LB2	4/10/2006	18.24	7.6	370	2.77	29.4	9000
LB1	4/10/2006	19.2	6.6	9689	5.1	57.1	17000
LB2	4/19/2006	21.69	8.1	520	4.29	48.8	400
LB1	4/19/2006	24.48	7.1	30148	8.5	113.4	250
LB2	8/21/2006	27.6	6.9	4205	1.24	16	1700
LB1	8/21/2006	28.69	7.4	38776	3.77	55.9	230

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2234	Mt. Pleasant Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
GC4	11/14/2005	21.39	7.4	18187	5.75	69.2	300
GC4	2/1/2006	14.72	7.1	33989	7.75	87.1	140
GC4	4/26/2006	25.42	6.7	39461	5.31	74.7	70
GC4	9/18/2006	27.78	7.1	40612	3.99	58.7	200

2235	Newcastle Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
ARL6	11/28/2005	20.79	7.4	289	2.83	31.7	14000
ARL6	2/14/2006	13.25	7	278	7.62	72.8	800
ARL6	4/26/2006	22.26	6.7	273	5.71	65.7	3000
ARL6	8/22/2006	23.89	6.8	261	5.97	70.8	9000

2238	Little Six Mile Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
TR314	12/5/2005	14.64	7.2	402	5.53	54.5	130
TR314	1/24/2006	21.22	7	631	4.43	50	210
TR314	6/14/2006	25.37	6.8	335	4.65	56.7	330
TR314	9/21/2006	23.04	7.1	448	2.57	30	1500

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2239	Strawberry Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
ARL453	11/28/2005	19.28	7.8	517	4.59	49.8	5000
ARL325	11/28/2005	19.79	7.5	309	5.73	62.8	40
ARL453	2/14/2006	10.77	7.1	501	8.29	74.9	700
ARL325	2/14/2006	11.05	7.1	333	9.15	83.2	260
ARL453	4/24/2006	26.12	6.9	750	6.72	83.1	220
ARL325	4/26/2006	25.61	6.9	336	4.38	53.6	20
ARL453	8/22/2006	29.92	7.1	13225	4.53	62.4	270
ARL325	8/22/2006	27.58	6.8	354	3.21	40.7	130

2240	Greenfield Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
GC1	11/14/2005	21.12	7.6	372	5.65	63.5	130
GC1	2/1/2006	13.52	7.8	372	6.62	63.6	120
GC1	4/26/2006	23.88	7.4	507	7.33	87	80
GC1	9/18/2006	25.01	7	344	4.85	58.8	510

2244	Cowhead Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
ARL18	11/29/2005	20.53	7.1	345	5.6	62.3	700
ARL18	2/14/2006	11.78	7	305	8.56	79.1	1400
ARL18	4/26/2006	22.88	7	1616	5.22	61	1300
ARL18	8/22/2006	24.98	7.1	363	5.4	65.4	1700

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2245	Deep Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
DEC1	12/14/2005	8.49	6.9	110	9.33	79.8	300
DEC1	3/14/2006	20.3	6.3	132	5.17	57.3	170
DEC1	5/24/2006	23.06	7	488	3.87	45.2	20
DEC1	7/17/2006	26.73	6.8	323	5.33	66.6	20

2246	Jones Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
ARL11	11/29/2005	19.78	7	249	5.8	63.5	700
ARL11	2/14/2006	10.56	7.3	263	9.25	83.1	20
ARL11	4/26/2006	22.96	7.1	322	5.92	69	270
ARL11	8/22/2006	25.69	7.1	296	5.22	64	270

2248	Ginhouse Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
ARL15	11/29/2005	19.58	6.9	325	3.5	38.2	3000
ARL15	2/14/2006	7.59	7.2	377	9.35	78.2	40
ARL15	4/26/2006	22.86	6.9	413	2.64	30.7	130
ARL15	8/22/2006	25.7	6.8	396	1.17	14.3	70

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2249A	Ortega River						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
OR344	12/14/2005	11.01	6.8	138	8.66	78.6	80
OR434	12/21/2005	10.6	6.7	81	8.46	76	390
OR348	12/21/2005	10.47	6.8	73	9.96	89.3	420
OR344	3/14/2006	21.02	6.7	154	3.64	40.8	40
OR434	3/28/2006	14.24	6.3	251	5.19	50.7	230
OR348	3/28/2006	12.99	6.5	186	8.89	84.4	20
OR344	5/10/2006	20.77	7	143	5.6	62.5	300
OR434	5/24/2006	25.14	6.6	11974	2.28	28.7	170
OR348	5/24/2006	23.22	6.7	208	5.55	65	90
OR344	7/25/2006	24.83	6.5	190	5.53	66.7	480
OR434	9/19/2006	25.58	6.4	4044	2.76	34.1	160
OR348	9/19/2006	25.47	7	211	7.25	88.6	108

2249B	McGirts Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
OR346	12/14/2005	10.4	7	112	9.6	85.8	20
OR346	3/14/2006	19.39	7.1	139	6.31	68.6	40
OR346	5/24/2006	21.41	6.8	207	5.03	56.9	700
OR346	7/25/2006	24.28	6.5	197	4.91	58.6	750

2252	Hogan Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
HC3	11/2/2005	21.64	7	541	2.3	26.1	5000
HC3	2/28/2006	16.74	7.4	1185	4.13	42.6	260
HC3	4/10/2006	20.47	6.8	585	2.38	26.4	160000
HC3	4/19/2006	23.09	7.1	570	6.58	76.9	350
HC3	8/21/2006	28.68	7.2	2932	1.37	17.9	1300

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2254	Red Bay Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
ARL3	11/28/2005	19.98	7.5	412	4.68	51.5	900
ARL3	2/14/2006	13.12	7.1	391	7.7	73.4	270
ARL3	4/26/2006	24.05	7.1	420	4.44	52.9	500
ARL3	8/22/2006	27.64	6.8	352	3.07	39	16000

2256	Deer Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
DR2	11/2/2005	24.03	7.1	2344	4.68	56	1300
DR1	11/2/2005	22.54	7	2652	2	23.3	1400
DR2	2/28/2006	20.09	7.1	1719	5.29	58.5	80
DR1	2/28/2006	16.59	7.2	1783	3.36	34.6	110
DR2	4/10/2006	23.01	7.2	326	3.78	44.1	160000
DR1	4/10/2006	19.16	7	316	1.17	12.7	160000
DR2	4/19/2006	24.5	7.4	395	8.79	105.6	62
DR1	4/19/2006	21.78	7.2	607	2.9	33.1	120
DR2	8/21/2006	28.06	7.1	472	3.6	46.1	90000
DR1	8/21/2006	27.41	7.1	559	0.66	8.3	1700

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2257	McCoys Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
MC3	11/2/2005	21.4	7.7	521	2.9	32.8	16000
MC1	11/2/2005	20.24	7.8	570	4.11	45.5	170
MC3	2/28/2006	15.29	7.6	472	4.64	46.4	2800
MC1	2/28/2006	15.87	7.2	6003	6	61.8	2200
MC3	4/10/2006	19.71	7.3	416	2.4	26.3	3000
MC1	4/10/2006	20.41	7.1	1449	0.68	7.6	28000
MC3	4/19/2006	22.21	7.3	612	2.07	23.8	710
MC1	4/19/2006	23.33	7.1	5956	2.6	31	210
MC3	7/31/2006	27.66	7.1	400	1.24	15.7	1100
MC1	7/31/2006	29.45	7	6207	2.15	28.7	5000

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2262	Cedar River						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
CR430	12/12/2005	12.48	7.4	377	7.91	74.3	300
CR85	12/12/2005	14.56	7.3	278	5.94	58.4	170
CR428	12/12/2005	12.38	7.6	304	9.06	84.9	210
CR427	12/12/2005	14.27	7.5	454	8.65	84.6	300
CR427	3/14/2006	20.23	7.1	608	5.87	65	40
CR428	3/14/2006	19.89	6.9	351	5.31	58.3	110
CR85	3/28/2006	18.18	6.6	3927	8.23	88.3	40
CR430	3/28/2006	15.23	6.8	496	8.44	84.2	230
CR428	5/10/2006	22.15	6.7	256	1.01	11.6	2200
CR430	5/10/2006	23.78	7.1	4033	2.29	27.4	3000
CR85	5/10/2006	26.26	7.2	18126	4.6	60.5	16000
CR427	6/22/2006	26.48	6.5	455	5.42	67.5	140
CR430	7/25/2006	27.01	6.6	209	1.45	18.3	560
CR427	7/25/2006	25.76	7.3	322	4.48	55	580
CR428	7/25/2006	26.3	6.8	194	2.58	32	800
CR85	9/13/2006	27.98	6.9	11521	2.19	29	170

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2265B	Big Pottsburg Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
BP67	11/28/2005	17.45	7.2	448	3.6	37.7	700
BP64	11/28/2005	18.25	7.3	358	6.19	65.8	300
BP67	3/29/2006	17.59	6.9	3064	5.9	62.3	740
BP64	3/29/2006	16.44	7.3	401	8.02	82.1	240
BP67	5/8/2006	25.95	6.4	14312	3.9	50.3	130
BP64	5/8/2006	22.71	7	411	7.15	82.9	3000
BP67	8/15/2006	28.82	6.6	3521	2.59	33.9	20
BP64	8/15/2006	27.21	6.9	316	6	75.7	355

2266	Hopkins Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
IWWH	11/14/2005	21.25	7.1	21657	5.1	62	1300
IWWH	2/1/2006	15.83	7.5	33819	7.92	91.1	94
IWWH	5/22/2006	27.63	7	39758	3.41	49.8	500
IWWH	9/18/2006	28.15	6.9	40614	2.57	38	500

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2270	Hogpen Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
IWWD	11/14/2005	19.8	6.7	5854	5.58	62.3	170
ARL20	11/14/2005	19.86	7.3	354	1.92	21.1	20
ARL20	1/26/2006	14.12	7.2	357	5.3	51.6	76
IWWD	2/1/2006	14.49	6.8	14267	8.42	86.9	210
ARL20	4/26/2006	25.05	7.2	391	4.18	50.7	130
IWWD	5/22/2006	24.58	6.7	16754	4.43	56.3	900
IWWD	6/27/2006	29.42	6.9	38839	4.51	67.6	1450
IWWD	9/18/2006	27.96	6.9	37184	2.38	34.7	600
ARL20	9/18/2006	24.33	6.8	408	1.07	12.8	320

2271	Third Puncheon Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
PC2	1/26/2006	16.4	7	627	8.1	82.9	2
PC2	6/27/2006	30.47	7.6	483	7.64	102	595
PC2	9/28/2006	27.65	7.1	423	3.25	41.3	140

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2277	Wills Branch South Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
CR22	12/12/2005	12.82	7.55	269	10.27	97.2	70
CR22	3/14/2006	21.27	6.95	382	7.64	86.2	800
CR22	5/10/2006	21.39	7.27	378	6.26	70.8	80
CR22	7/25/2006	25.52	6.58	339	5.15	63	740

2278	Silversmith Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
ARL8	11/28/2005	19.23	8.51	325	6.19	67.1	220
ARL8	2/14/2006	12.65	7.31	308	9.23	87	20
ARL8	4/24/2006	23.69	6.98	330	5.07	59.9	1100
ARL8	8/22/2006	26.65	7.06	304	4.99	62.3	330

2280	Little & Big Fishweir Creeks						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
CR6	11/2/2005	19.75	7.6	513	1.76	19.3	800
CR5	11/2/2005	20.84	7.8	441	5.12	57.3	340
CR139	12/19/2005	13.35	6.8	328	7.82	74.8	13300
CR6	2/28/2006	15.11	7.4	1100	2.88	28.7	170
CR5	2/28/2006	14.9	7.8	464	7.35	72.9	2200
CR139	2/28/2006	16.25	7.4	4209	6.91	71.4	1100
CR6	5/10/2006	26.27	7.1	18080	0.83	10.9	30000
CR5	5/10/2006	22.73	7.8	377	2.41	27.9	1300
CR139	5/10/2006	26.61	7.2	17543	3.95	52.2	3000
CR139	8/21/2006	31.95	7.1	16225	3.51	50.6	1700
CR6	9/13/2006	28.04	6.9	21535	0.25	3.5	22000
CR5	9/13/2006	24.77	7.4	468	3.85	46.4	3000

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2282	Wills Branch North Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
CR95	12/12/2005	14.56	7.4	277	10.4	102.2	500
CR21	12/12/2005	13.38	7.6	240	9.62	92.2	1700
CR95	3/14/2006	22.8	7.2	345	8.6	100	1400
CR21	3/14/2006	21.21	6.9	266	8.29	93.4	1700
CR95	5/10/2006	25.21	7.1	7775	3.24	40.3	340
CR21	6/22/2006	25.83	6.4	273	6.92	85	400
CR95	7/25/2006	27.5	6.8	342	6.08	77.1	450
CR21	7/25/2006	25.25	6.6	220	5.99	72.9	960
CR95	9/19/2006	28.91	6.8	12634	3.74	50.5	650
CR21	9/19/2006	24.6	7.3	325	6.33	76.1	290

2284	Little Pottsburg Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
LP4	10/26/2005	15.78	7.47	521	6.93	70	1640
LP3	10/26/2005	16.01	7.27	473	3.47	35.2	6520
LP4	3/29/2006	15.44	7.11	593	6.95	69.7	530
LP3	3/29/2006	19.04	6.39	15429	9.59	109.1	687
LP4	5/8/2006	26.77	6.59	636	7.65	95.7	130
LP3	5/8/2006	27.13	6.35	19933	4.35	58.5	2200
LP4	7/19/2006	29.64	7.47	574	5.49	72.3	580
LP3	7/19/2006	32.01	7.62	10819	9.28	131.3	260

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2287	Miller Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
SS1	10/26/2005	15.92	6.99	866	5.03	51	5200
SS1	2/14/2006	13.52	7.23	594	8.44	81.1	17000
SS1	4/24/2006	23.74	6.53	16115	5.45	68	900
SS1	7/19/2006	34.98	7.76	19414	7.53	115.1	1300

2290	Cedar Swamp Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
PC8	10/27/2005	16.56	6.9	344	6.91	70.9	160
PC8	1/26/2006	14.09	7.1	364	7.88	76.7	110
PC8	5/22/2006	22.83	6.7	404	5.3	61.6	130
PC8	9/21/2006	23.1	6.9	356	5.11	59.7	110

2297	Craig Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
SS63	10/25/2005	18.53	7	383	5.72	61.1	2500
SS63	1/17/2006	14.05	6.8	1758	5.89	57.5	2300
SS63	4/24/2006	25.44	6.9	5832	1.57	19.5	130
SS63	7/12/2006	29.45	6.5	20239	1.35	18.9	11000

2299	Open Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
IWWF	11/14/2005	20.82	6.73	15743	5.18	61.2	270
IWWF	2/1/2006	15.56	7.01	23592	6.66	72.9	220
IWWF	5/22/2006	24.34	6.57	15709	5.23	65.8	1300
IWWF	9/18/2006	26.29	6.78	21999	2.93	39.1	760

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2304	Miramar Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
SS4	10/25/2005	19.34	7	410	5.2	56.5	4600
SS4	1/17/2006	15.83	6.9	427	6.42	64.9	740
SS4	4/24/2006	22.03	7.2	473	4.17	47.8	11000
SS4	7/12/2006	26.82	7.3	416	4.57	57.3	7750

2306	New rose Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
SS10	10/25/2005	18.18	7.4	280	6.99	74.1	820
SS10	1/17/2006	13.68	7.8	431	15.98	154.1	260
SS10	4/24/2006	26.52	7.3	490	6.09	75.8	300
SS10	7/12/2006	28.72	7.3	352	6.04	78.2	900

2308	Big Pottsburg Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
BP71	11/28/2005	18.95	7.3	524	5.77	62.2	1700
BP71	3/29/2006	17.06	7.1	546	6.89	71.5	410
BP71	5/8/2006	24.85	6.6	545	4.67	56.4	20
BP71	8/15/2006	27.99	7.2	414	4.96	63.5	750

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2316	Williamson Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform (CFU/100mL)
CR84	12/12/2005	13.05	7.3	302	7.82	74.4	700
CR84	3/28/2006	17.36	6.4	3986	8.26	87.2	220
CR84	5/10/2006	26.62	7.2	17477	3.57	47.2	1300
CR84	9/13/2006	28.45	6.9	12166	1.88	25.1	17000

2319	Bennett Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
BP65	11/28/2005	19.09	7.1	357	4.55	49.2	800
BP65	3/29/2006	18.43	5.8	431	5.12	54.7	2240
BP65	5/8/2006	22.64	6.6	358	5.45	63.2	130
BP65	8/15/2006	27.62	6.8	240	4.44	56.3	2300

2321	Christopher Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
SS11	10/25/2005	17.94	7.3	364	3.38	35.7	3340
SS11	1/17/2006	14.03	7.8	562	11.24	109.3	150
SS11	4/24/2006	25.46	6.9	7654	4.81	60.2	1100
SS11	7/12/2006	29.69	7	16707	5.62	78	24000

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2322	Butcher Pen Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
CR2	12/12/2005	11.71	7.1	363	3.41	31.5	1700
CR2	3/28/2006	12.71	6.5	429	4.24	40	2200
CR2	6/26/2006	25.77	7.1	284	4.8	59	6500
CR2	9/13/2006	25.74	6.9	2646	0.46	5.7	2200

2323	Yellow water Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
YWC2	12/14/2005	11.44	6.9	99	9.46	86.6	20
YWC1	12/14/2005	10.01	7	100	9.66	85.7	500
YWC2	3/14/2006	20.13	6.6	107	6.95	76.7	20
YWC1	3/14/2006	20	6.8	129	5.77	63.5	80
YWC2	5/24/2006	22.92	7.1	119	7.07	82.3	20
YWC1	5/24/2006	23.8	7.1	90	5.72	67.7	20
YWC2	9/19/2006	24.79	7.1	116	6.21	74.8	40
YWC1	9/19/2006	24.91	6.8	85	5.15	62.2	64

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2324	Fishing Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
OR8	12/14/2005	16.03	7.5	381	11.36	115.3	1100
OR9	12/14/2005	11.48	6.9	237	8.86	81.3	300
OR4	12/14/2005	14.34	7.4	364	8.05	78.8	2200
OR110	12/14/2005	15.74	7	248	8.46	85.3	300
OR110	3/28/2006	14.31	6.3	279	6.98	68.2	1700
OR9	3/28/2006	13.18	6.3	352	7.95	75.9	300
OR8	3/28/2006	16.53	6.6	454	10.76	110.4	500
OR4	3/28/2006	16.58	6.7	427	7.37	75.7	1700
OR9	6/5/2006	24.14	6.4	338	2.92	34.8	715
OR110	6/5/2006	23.08	6.4	331	1.63	19.1	11100
OR8	6/5/2006	26.99	7	517	7.6	95.4	14750
OR4	6/5/2006	26.68	7	2883	2.92	36.7	7600
OR110	6/26/2006	24.76	6.6	273	4.09	49.3	3365
OR4	6/26/2006	26.1	7.1	300	4.83	59.6	4900
OR8	6/26/2006	27.76	6.9	286	7.16	91.1	3620
OR9	6/26/2006	25.79	6.8	261	3.35	41.2	3080
OR9	9/13/2006	25	7.2	267	2.31	28	500
OR110	9/13/2006	25.94	7.3	244	5.17	63.7	14000
OR8	9/13/2006	27.03	7.5	459	6.43	80.8	270
OR4	9/13/2006	26.61	7.1	1594	4.49	56.2	5000

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2326	Goodby's Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
SS319	10/26/2005	16.74	7.8	337	4.16	42.9	5760
SS319	1/17/2006	12.86	7.4	388	9.1	86.2	330
SS319	4/24/2006	25.53	7.2	3705	7.09	87.6	1700
SS319	7/12/2006	30.03	6.9	10401	4.11	56.1	2235

2338	McGirts Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
OR13	12/21/2005	11.48	7	97	9.66	88.6	480
OR13	3/28/2006	13.48	6.9	151	8.32	79.8	170
OR13	5/24/2006	21.71	6.9	150	6.05	68.8	130
OR13	9/19/2006	24	6.7	181	6.43	76.4	430

2351	Julington Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
JC440	10/27/2005	14.33	7	186	5.6	54.7	140
JC339	10/27/2005	14.4	7.2	264	7.81	76.5	300
JC3	10/27/2005	14.81	7.3	288	7.48	73.9	380
JC440	1/23/2006	18.96	7.5	216	7.13	76.8	72
JC339	1/26/2006	11.46	7	344	7.99	73.3	390
JC3	1/26/2006	12.09	6.9	353	7.4	68.9	220
JC440	4/12/2006	18.91	7.2	284	4.54	48.9	1300
JC339	4/12/2006	19.23	7.2	303	7.41	80.4	800
JC3	4/12/2006	18.7	7.1	326	6.89	73.9	800
JC440	7/18/2006	28.14	7.1	302	4.34	55.6	200
JC3	7/18/2006	26.28	6.8	350	5.17	64.1	390
JC339	7/24/2006	25.27	7.4	264	5.43	66.1	760

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2356	Big Davis Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
JC441	10/27/2005	14.23	7	101	7.42	72.4	120
JC441	1/26/2006	12.61	7.2	153	7.66	72.1	72
JC441	4/12/2006	18.76	7.2	183	6.58	70.6	20
JC441	7/18/2006	27.17	6.9	222	4.35	54.8	104

2361	Deep Bottom Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
SS18	10/26/2005	18.15	7.7	294	5.04	53.5	1106
SS18	1/23/2006	18.33	6.9	349	5.51	58.6	3100
SS18	4/12/2006	20.35	6.7	330	4.74	52.6	2400
SS18	7/12/2006	27.49	6.7	4188	2.14	27.5	7500

2365	Durbin Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
DUC4	10/27/2005	14.23	6.8	150	5.21	50.9	100
DUC3	10/27/2005	14.35	7	115	6.71	65.6	180
DUC4	1/26/2006	13.39	7.1	217	5.5	52.7	64
DUC3	1/26/2006	11.75	7.1	181	5.64	52	62
DUC4	4/12/2006	17.89	7	340	2.5	26.4	20
DUC3	4/12/2006	17.71	7	224	2.59	27.2	80
DUC4	7/18/2006	26.18	6.8	348	1.79	22.1	32
DUC3	7/18/2006	26.97	6.8	350	2.57	32.2	140

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2370	Oldfield Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
JC5	10/26/2005	15.74	7.4	282	5.38	54.3	240
JC5	1/23/2006	18.63	7.1	306	7.45	79.7	140
JC5	4/24/2006	22.48	7.1	354	3.59	41.5	500
JC5	7/18/2006	26.34	7.1	337	3.45	42.9	610

2381	Cormorant Branch						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
JC15	10/26/2005	16.11	7.4	257	3	30.5	2200
JC15	1/23/2006	18.89	7	289	5.49	59	68
JC15	4/24/2006	24.58	7.1	946	2.32	27.9	60
JC15	7/18/2006	29.09	6.9	3376	4.32	56.7	300

2382	Tacito Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
SS19	10/26/2005	14.48	7.5	384	2.53	24.8	460
SS19	1/23/2006	17.61	6.9	502	2.88	30.2	1200
SS19	4/12/2006	21	6.4	4746	6.05	68.9	35000
SS19	7/18/2006	29.46	6.7	8981	1.66	22.3	600

Table 1. Routine Tributary Program. October 1, 2005 - September 30, 2006

2385	Unnamed Creek Mandarin						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
SS20	10/26/2005	15.38	7.5	269	1.78	17.9	380
SS20	1/23/2006	18.22	7.1	244	2.67	28.4	156
SS20	4/12/2006	17.23	7.1	277	4.31	44.8	1300
SS20	7/18/2006	25.49	7.2	374	2.76	33.7	3100

2419	Sampson Creek						
Station	DATE	Temp ©	pH	Specific Cond.	D.O. (mg/L)	D.O. % Sat.	Fecal Coliform
DUC2	10/27/2005	14.31	7.1	90	8.74	85.4	180
DUC2	1/26/2006	13.7	7.1	213	6.66	64.2	72
DUC2	4/12/2006	18.27	7.1	299	5.2	55.3	20
DUC2	7/18/2006	26.94	7.1	305	4.68	58.8	560