FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration

NORTHEAST DISTRICT • LOWER ST. JOHNS BASIN

Final TMDL Report

Dissolved Oxygen and Nutrient TMDLs for Trout River (WBID 2203)

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Florida Department of Environmental Protection, Bureau of Watershed Management

TMDL Program

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Identification of Impaired Surface Waters Rule

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

STORET Program

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

2008 305(b) Report

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

Criteria for Surface Water Quality Classifications

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

Basin Status Report for the Lower St. Johns Basin

http://www.dep.state.fl.us/water/basin411/sj_lower/status.htm

Water Quality Assessment Report for the Lower St. Johns Basin

http://www.dep.state.fl.us/water/basin411/sj_lower/assessment.htm

U.S. Environmental Protection Agency, National STORET Program

Region 4: Total Maximum Daily Loads in Florida

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

National STORET Program

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

Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for dissolved oxygen (DO) and nutrients for the Trout River in the Trout River Planning Unit of the Lower St. Johns Basin. The river was verified as impaired for DO, and was included on the Cycle 1 Verified List of impaired waters for the Lower St. Johns Basin that was adopted by Secretarial Order in May 2004.

Since the DO impairment was associated with nutrients, Trout River was verified as impaired for nutrients in the Cycle 2 assessment and placed on the Lower St. Johns Basin Verified List that was adopted by Secretarial Order in May 2009. This TMDL establishes the allowable loadings to the Trout River that would restore the waterbody so that it meets its applicable water quality criteria for DO and nutrients.

1.2 Identification of Waterbody

The Trout River is located in Duval County, in northeast Florida, in the west central part of the county. This TMDL is for one of the three WBIDs in the Trout River watershed (**Figures 1.1** and **1.2**). The Trout River (Middle Reach, WBID 2203) is approximately 8.8 miles in length, drains an area of about 15.5 square miles (mi^2), and adjoins WBID 2203A on its western side. Water flows through WBID 2203 and through WBID 2203A before reaching the St. Johns River. The two watersheds occupy a combined area of approximately 27.6 mi^2 that is situated between the St. Johns River and the Duval/Nassau County line. The downstream segment WBID (2203A) is predominantly marine and tidally influenced, while WBID 2203 is not. Additional information about the river's hydrology and geology are available in the Basin Status Report for the Lower St. Johns (Florida Department of Environmental Protection [Department], 2002).

For assessment purposes, the Department has divided the Lower St. Johns Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. The Trout River consists of three segments—WBIDs 2203A, 2203, and 2223. This TMDL addresses the middle segment, WBID 2203, as shown in **Figure 1.2,** for DO and nutrients.

The Trout River is part of the Trout River Planning Unit. Planning units are groups of smaller watersheds (WBIDs) that are part of a larger basin unit, in this case the Lower St. Johns Basin. The Trout River Planning Unit consists of 18 WBIDs. **Figure 1.3** shows the locations of these WBIDs and the Trout River's location in the planning unit.

Figure 1.1. Location of the Trout River Watershed (WBID 2203) in the Lower St. Johns Basin

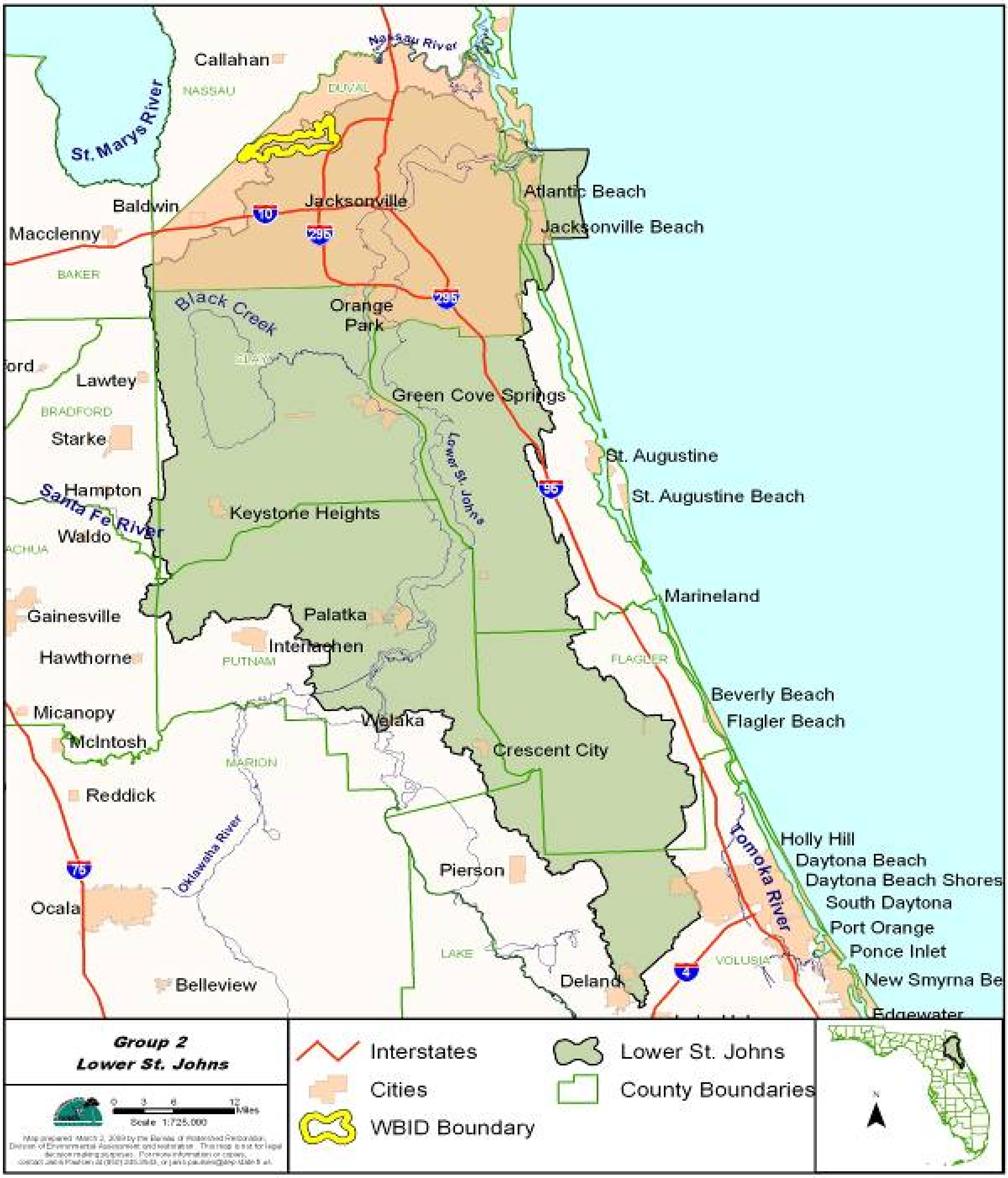


Figure 1.2. Location of the Trout River Watershed (WBID 2203) in Duval County and Major Hydrologic Features in the Area

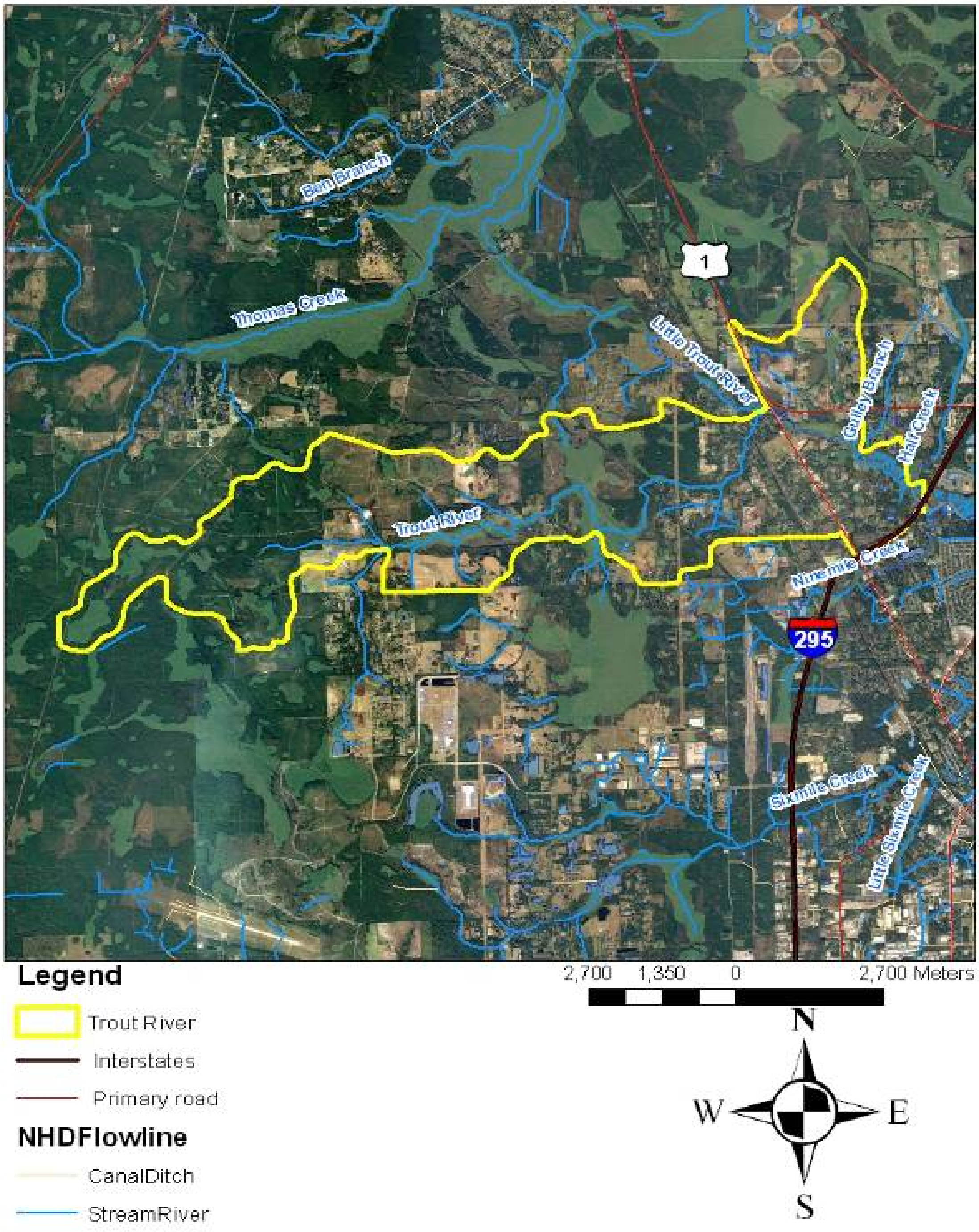
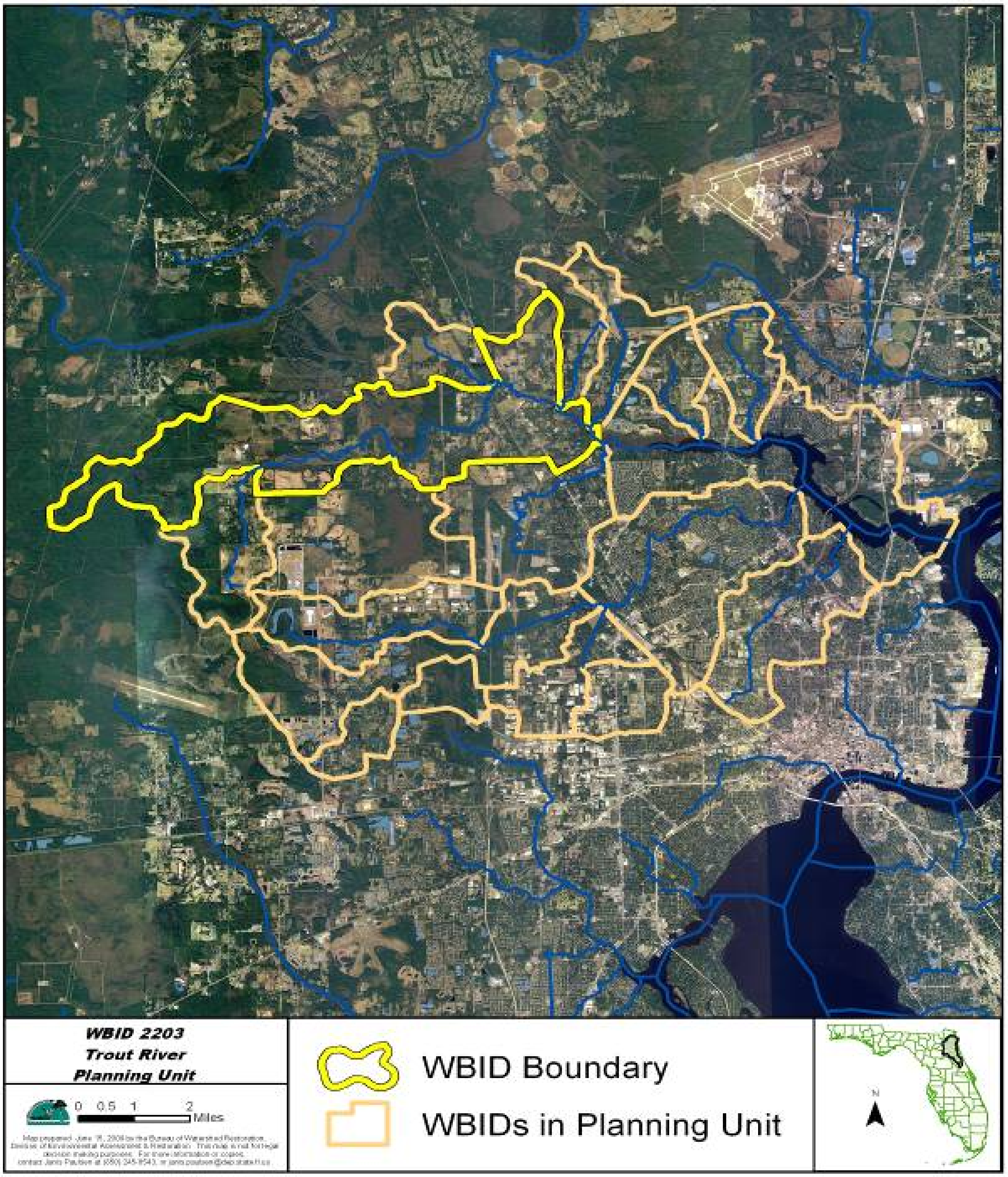


Figure 1.3. WBIDs in the Trout River Planning Unit



1.3 Background

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

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

A nutrient TMDL was adopted in April 2008 for the main stem of the Lower St. Johns River that required a 30 to 50 percent reduction in anthropogenic loadings of nitrogen to the marine portion of the Lower St. Johns. A Basin Management Action Plan, or BMAP, was adopted in October 2008 that outlined a number of activities designed to reduce the amount of total nitrogen (TN) to the marine portion of the river. These activities will depend heavily on the active participation of the St. Johns River Water Management District (SJRWMD), local governments, businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for impaired waterbodies, including tributaries to the Lower St. Johns such as the Trout River.

Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

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

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

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in the Trout River watershed and verified in the Cycle 1 assessment that this waterbody segment was impaired for DO, based on data in the Department's IWR database. **Table 2.1** summarizes the DO data for the Cycle 1 verified period, which for Group 2 waters was January 1, 1996, through June 30, 2003; **Tables 2.3** through **2.4** provide data summaries by month, season, and year, respectively, during the verified period. The DO impairment was reaffirmed in the Cycle 2 verified period, which for Group 2 waters was January 1, 2001, through June 30, 2008 (**Table 2.5**).

There was a 63.8 percent overall exceedance rate for DO in the Trout River during the verified period (**Table 2.1**). Exceedances occured in all seasons and in all months except February and November (**Tables 2.2** and **2.3**). During the verified period, samples ranged from 0.5 to 8.62 milligrams per liter (mg/L). As DO solubility is influenced by both salinity and water temperature, ranges in DO saturation (DOSAT) were also evaluated. DOSAT ranged from 7.0 to 99.3 percent, averaging 47.1 percent. Fewer than 10 percent of the DOSAT values were less than 21 percent.

When aggregating data by season, the lowest percentage of exceedances occurred in the winter and the highest in spring. Possible relationships between DO and other water quality parameters are further assessed in Chapter 5, using the complete historical dataset.

Table 2.1. Summary of DO Monitoring Data for the Trout River (WBID 2203) During the Cycle 1 Verified Period (January 1, 1996–June 30, 2003)

- = Empty cell
BOD = Biochemical oxygen demand
TN = Total nitrogen
TP = Total phosphorus

Waterbody (WBID)	Parameter	DO (mg/L)
Trout River (2203)	Total number of samples	69
Trout River (2203)	IWR-required number of exceedances for the Verified List	11
Trout River (2203)	Number of observed exceedances	44 (63.8%)
Trout River (2203)	Number of observed nonexceedances	25
Trout River (2203)	Number of seasons during which samples were collected	4
Trout River (2203)	Highest observation (mg/L)	8.62
Trout River (2203)	Lowest observation (mg/L)	0.5
Trout River (2203)	Median observation (mg/L)	4.03
Trout River (2203)	Mean observation (mg/L)	4.26
Trout River (2203)	Median value for 34 BOD observations (mg/L)[1]	2.0
Trout River (2203)	Median value for 40 TN observations (mg/L)[2]	1.22
Trout River (2203)	Median value for 40 TP observations (mg/L)[3]	0.51
Trout River (2203)	Possible causative pollutant by IWR	TP
-	**FINAL ASSESSMENT:**	**Impaired**

Table 2.2. Summary of DO Data by Month for the Cycle 1 Verified Period (January 1, 1996–June 30, 2003)

[1] DO units are mg/L.
[2] Mean precipitation is for Jacksonville International Airport (JIA), in inches.

Month	N	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Number of Exceedances	% Exceedances	Mean Precipitation[2]
January	6	3.00	7.63	6.40	6.00	1	16.67%	2.03
February	2	5.00	5.98	5.49	5.49	0	0.00%	3.32
March	8	3.84	8.62	5.80	5.63	3	37.50%	4.05
April	6	1.50	4.45	4.00	3.39	6	100.00%	1.99
May	9	2.10	5.19	3.40	3.45	8	88.89%	1.85
June	9	1.20	5.45	3.30	3.21	8	88.89%	9.08
July	3	1.60	2.69	2.60	2.29	3	100.00%	7.71
August	7	1.20	6.26	2.80	3.61	5	71.43%	5.50
September	3	1.56	4.80	4.40	3.58	3	100.00%	8.63
October	5	0.50	5.29	4.20	3.20	4	80.00%	3.55
November	3	5.29	7.70	7.30	6.76	0	0.00%	1.33
December	8	2.90	7.80	5.40	5.29	3	37.50%	3.63

Table 2.3. Summary of DO Data by Season for the Cycle 1 Verified Period (January 1, 1996–June 30, 2003)

[1] DO units are mg/L.
[2] Mean total precipitation is for JIA, in inches.

Season	N	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Number of Exceedances	% Exceedance	Mean Total Precipitation[2]
Winter	16	3.00	8.62	6.00	5.75	4	25.00%	9.40
Spring	24	1.20	5.45	3.30	3.35	22	91.67%	12.92
Summer	13	1.20	6.26	2.70	3.30	11	84.62%	21.84
Fall	16	0.50	7.80	5.20	4.91	7	43.75%	8.51

Table 2.4. Summary of DO Data by Year for the Cycle 1 Verified Period (January 1, 1996 – June 30, 2003)

[1] DO units are mg/L.
[2] Mean total precipitation is for JIA, in inches.

Year	N	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Number of Exceedances	% Exceedances	Total Precipitation[2]
1996	16	1.60	8.62	4.70	4.85	9	56.25%	60.63
1997	6	1.99	6.80	5.50	4.76	2	33.33%	57.27
1998	7	2.59	6.90	4.20	4.49	5	71.43%	56.72
1999	7	2.90	6.75	5.30	5.25	2	28.57%	42.44
2000	9	1.56	7.63	4.00	4.21	6	66.67%	39.77
2001	5	3.00	3.84	3.50	3.40	5	100.00%	49.14
2002	16	0.50	7.70	2.60	3.18	13	81.25%	54.72
2003	3	3.79	5.31	4.45	4.52	2	66.67%	44.47

Table 2.5. Summary of DO Monitoring Data for the Trout River (WBID 2203) During the Verified Period (January 1, 2001–June 30, 2008)

- = Empty cell

Waterbody (WBID)	Parameter	DO
Trout River (2203)	Total number of samples	96
Trout River (2203)	IWR-required number of exceedances for the Verified List	14
Trout River (2203)	Number of observed exceedances	60 (62.5%)
Trout River (2203)	Number of observed nonexceedances	36
Trout River (2203)	Number of seasons during which samples were collected	4
Trout River (2203)	Highest observation (mg/L)	9.39
Trout River (2203)	Lowest observation (mg/L)	0.5
Trout River (2203)	Median observation (mg/L)	3.85
Trout River (2203)	Mean observation (mg/L)	4.30
Trout River (2203)	Median value for 34 BOD observations (mg/L)	2.0
Trout River (2203)	Median value for 40 TN observations (mg/L)	1.43
Trout River (2203)	Median value for 40 TP observations (mg/L)	0.296
Trout River (2203)	Possible causative pollutant by IWR	TP
-	**FINAL ASSESSMENT:**	**Impaired**

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criteria Applicable to the TMDL

Florida's surface waters are protected for five designated use classifications, as follows:

Class I	**Potable water supplies**
Class II	**Shellfish propagation or harvesting**
Class III	**Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife**
Class IV	**Agricultural water supplies**
Class V	**Navigation, utility, and industrial use (there are no state waters currently in this class)**

The Trout River (WBID 2203) is a Class III fresh waterbody, with a designated use of recreation, propagation, and the maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criteria applicable to the impairment addressed by this TMDL are for DO and nutrients.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

3.2.1 Dissolved Oxygen Criterion

Numeric criteria for DO are expressed in terms of minimum and daily average concentrations. The water quality criterion for the protection of Class III fresh waterbodies, as established by Rule 62-302, F.A.C., states the following:

> ***Dissolved Oxygen Criterion:***
> *Shall not be less than 5.0 [mg/L]. Normal daily and seasonal fluctuations above these levels shall be maintained.*

DO concentrations in ambient waters can be affected by many factors, including DO solubility, which is controlled by temperature and salinity; DO enrichment processes influenced by reaeration, which is controlled by flow velocity; the photosynthesis of phytoplankton, periphyton, and other aquatic plants; DO consumption from the decomposition of organic materials in the water column and the sediment and oxidation of some reductants such as ammonia and metals; and respiration by aquatic organisms.

The nutrient criterion in Rule 62-302, F.A.C., is expressed as a narrative:

> ***Nutrients:***
> *In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna [Note: For Class III waters in the Everglades Protection Area, this criterion has been numerically interpreted for phosphorus in Section 62-302.540, F.A.C.].*

To assess whether this narrative criterion was being exceeded, the IWR provides thresholds for nutrient impairment in estuaries based on annual average chlorophyll *a* (chl*a*) levels. The following language is found in Rule 62-303, F.A.C.:

> ***62-303.353 Nutrients in Estuaries and Open Coastal Waters.***
> *Estuaries, estuary segments, or open coastal waters shall be included on the planning list for nutrients if their annual mean chlorophyll a for any year is greater than 11 μg/L[1] or if data indicate annual mean chlorophyll a values have increased by more than 50% over historical values for at least two consecutive years.*
>
> ***62-303.450 Interpretation of Narrative Nutrient Criteria.***
> *(1) A water shall be placed on the verified list for impairment due to nutrients if there are sufficient data from the last five years preceding the planning list assessment, combined with historical data (if needed to establish historical chlorophyll a levels or historical TSIs), to meet the data sufficiency requirements of subsection 62-303.350(2), FA.C. If there are insufficient data, additional data shall be collected as needed to meet the requirements. Once these additional data are collected, the Department shall determine if there is sufficient information to develop a site-specific threshold that better reflects conditions beyond which an imbalance in flora or fauna occurs in the water segment. If there is sufficient information, the Department shall re-evaluate the data using the site-specific thresholds. If there is insufficient information, the Department shall re-evaluate the data using the thresholds provided in Rules 62-303.351-.353, F.A.C., for streams, lakes, and estuaries, respectively. In any case, the Department shall limit its analysis to the use of data collected during the five years preceding the planning list assessment and the additional data collected in the second phase. If alternative thresholds are used for the analysis, the Department shall provide the thresholds for the record and document how the alternative threshold better represents conditions beyond which an imbalance in flora or fauna is expected to occur.*

Although the annual average chl*a* concentration did not exceed the IWR stream thresholds (2007 annual average = 3.2 μg/L), nutrients were considered the cause of impairment based on the DO impairment being linked to nutrients. The median TP concentration over the Cycle 2 verified period of 0.295 mg/L (40 samples) exceeded the stream threshold of 0.22 mg/L used in the identification of a causative pollutant for DO impairment.

[1] μg/L = Micrograms per liter

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of pollutants in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either “point sources” or “nonpoint sources.” Historically, the term “point sources” has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term “nonpoint sources” was used to describe intermittent, rainfall-driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from failing septic systems; and atmospheric deposition.

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA’s National Pollutant Discharge Elimination System (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, such as those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

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

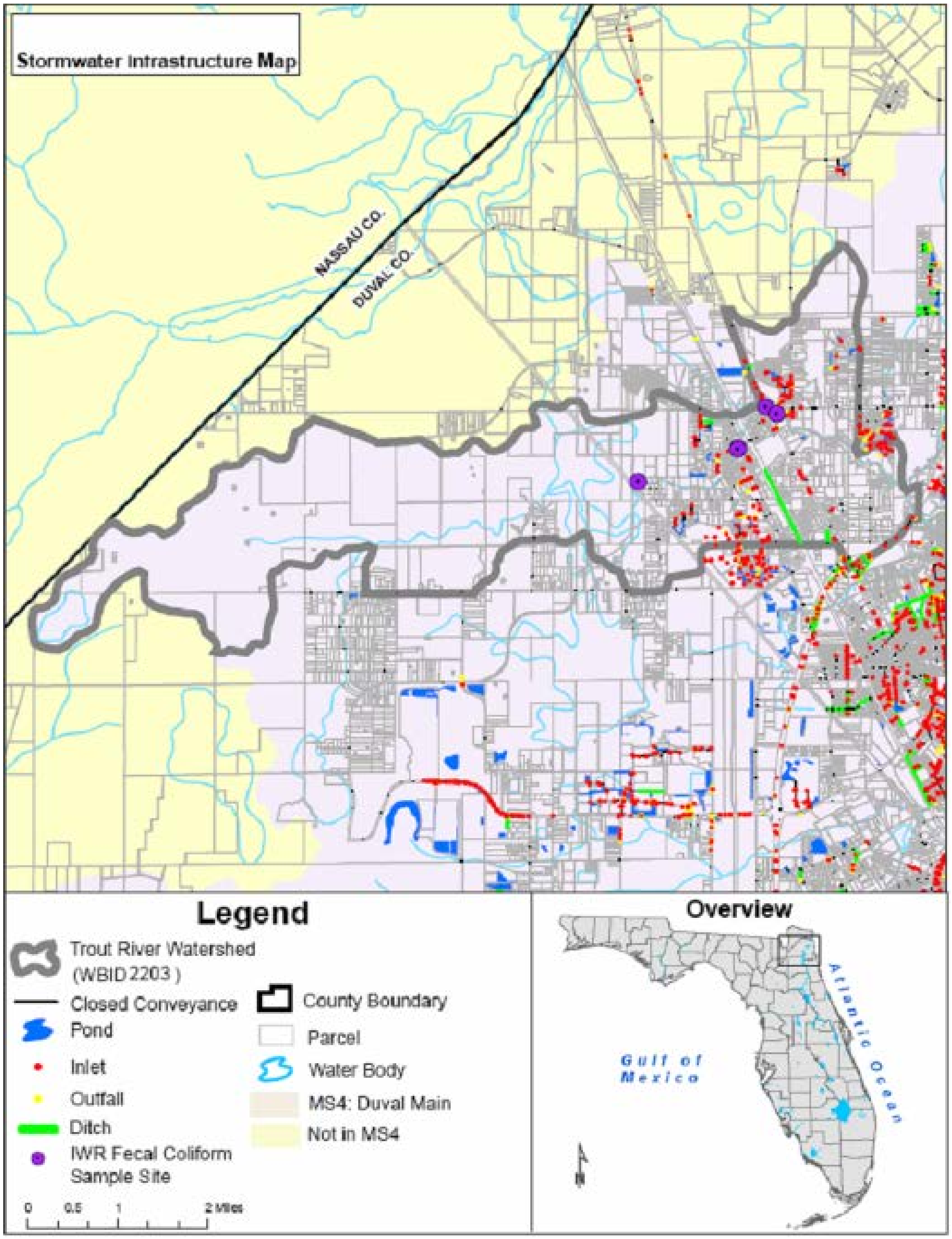
4.2 Potential Sources of Nutrients in the Trout River Watershed

4.2.1 Point Sources

There are currently no facilities with an NPDES domestic or industrial permit to discharge wastewater in the Trout River watershed (**Figure 4.1**). The city of Jacksonville has developed geographic information system (GIS) coverage of the stormwater infrastructure (**Figure 4.2**). There are 33 outfalls and 212 inlets. Outfalls represent points where a conveyance of stormwater discharges into a separate stormwater system, channelized or natural waterway. Inlets are a component of the stormwater system located along the curbed edge of paved surfaces or the low point of an area to provide for the collection of stormwater runoff, access for inspection and maintenance, pipe junctions, sediment traps, or conflicts with other utilities (K. Grable, personal communication, October 16, 2008).

Figure 4.1. Location of Permitted Facilities in the Trout River Watershed (WBID 2203)

Figure 4.2. Stormwater Infrastructure in the Trout River Watershed (WBID 2203)



Municipal Separate Storm Sewer System Permittees

The city of Jacksonville and Florida Department of Transportation (FDOT) District 2 are copermittees for a Phase I NPDES municipal separate storm sewer system (MS4) permit (Permit FLS000012) that includes all of the Trout River watershed.

4.2.2 Land Uses and Nonpoint Sources

Nutrient loadings to the Trout River are generated from nonpoint sources in the watershed. These potential sources include loadings from surface runoff, ground water inflow, leakage from collection systems, and septic tanks.

Land Uses

The spatial distribution and acreage of different land use categories were identified using the 2004 land use coverage contained in the Department's GIS library, initially provided by the SJRWMD. Land use categories and acreages in the watershed were aggregated using the Level 2 codes tabulated in **Table 4.1.**

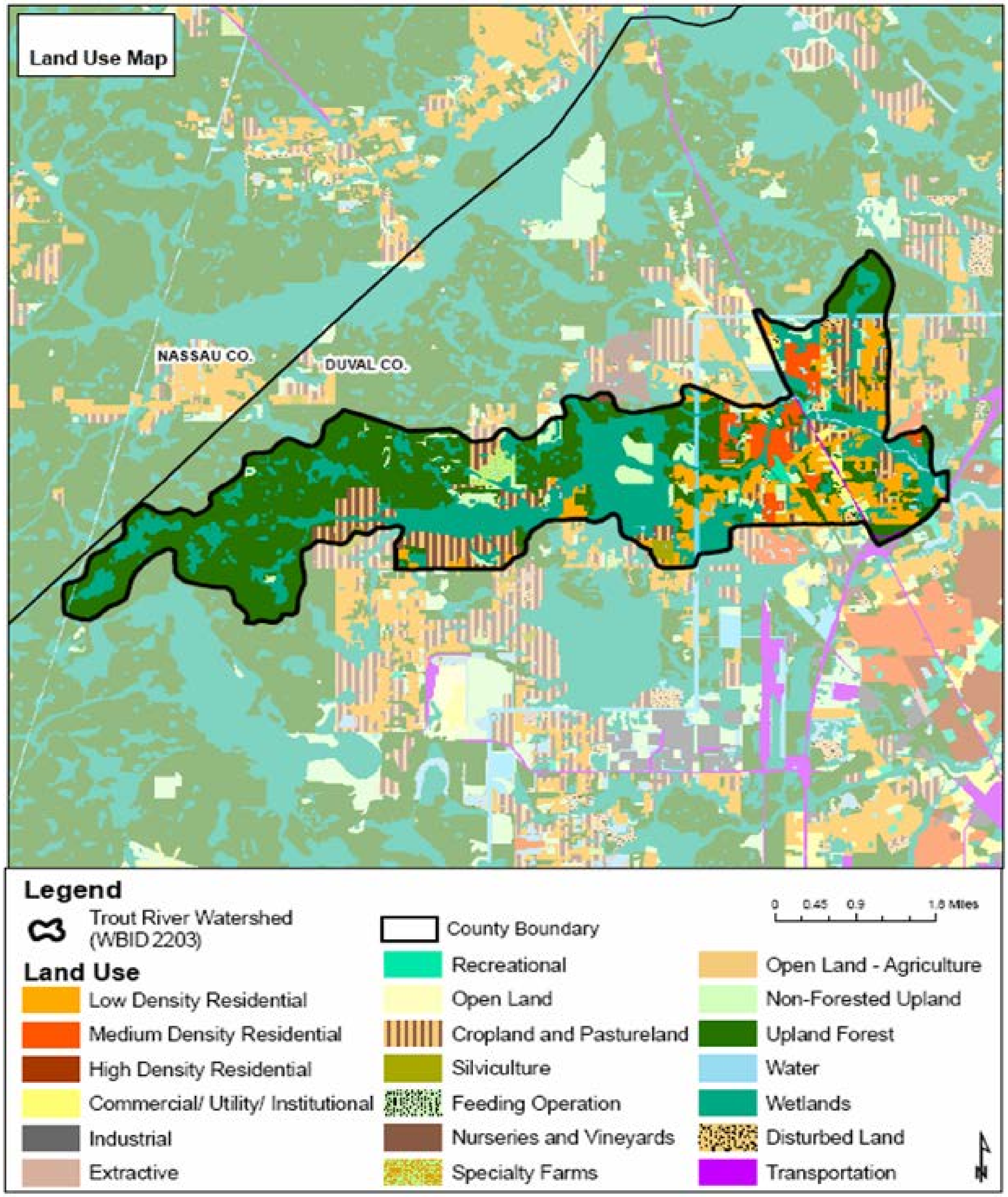
The principal land uses in WBID 2303 (**Figure 4.3**) are coniferous pine (21.7 percent), and wetland forested mixed (10.9 percent). Residential areas total only 14.1 percent (1,402.0 acres); there are no high-density residential areas, only medium- and low-density residential and rural (**Table 4.1**), mainly in the eastern part of the watershed. Human-impacted areas represent 27.95 percent (2,772.2 acres), and natural areas cover 72.05 percent (7,145.6 acres). The watershed has some agricultural areas. For example, in the eastern part of the watershed, there are 45.4 acres of cattle-feeding operations comprising 0.46 percent of land use, and a 4.4-acre poultry-feeding operation comprising 0.04 percent of land use.

Table 4.1. Classification of Land Use Categories in the Trout River Watershed (WBID 2203)

- = Empty cell

Level 2 Land Use Code	Attribute	Acres	% of Total
1100	Residential, low density – less than 2 dwelling units/acre	1,024.58	10.33%
1200	Residential, medium density – 2-5 dwelling units/acre	377.45	3.81%
1400	Commercial and services	79.85	0.81%
1500	Industrial	1.3	0.01%
1600	Extractive	2.14	0.02%
1700	Institutional	31.16	0.31%
1800	Parks and zoos	10.42	0.11%
2100	Cropland and pastureland	938.36	9.46%
2300	Feeding operations	49.78	0.50%
2400	Nurseries and vineyards	11.53	0.12%
2500	Specialty farms	87.81	0.89%
3100	Herbaceous upland nonforested	147.19	1.48%
3200	Shrub and brushland (wax myrtle or saw palmetto, occasionally scrub)	232.44	2.34%
3300	Mixed upland nonforested	55.55	0.56%
4100	Upland coniferous forests	403.91	4.07%
4200	Upland hardwood forests	2.55	0.03%
4300	Upland hardwood forests cont.	283.58	2.86%
4400	Tree plantations	2,934.58	29.59%
5100	Streams and waterways	40.62	0.41%
5300	Reservoirs – pits, retention ponds, dams	44.29	0.45%
6100	Wetland hardword forests	538.28	5.43%
6200	Wetland coniferous forests	146.91	1.48%
6300	Wetland forested mixed	1,081.75	10.91%
6400	Vegetated nonforested wetlands	1,183.9	11.94%
7400	Disturbed land	49.95	0.50%
8100	Transportation	66.73	0.67%
8300	Utilities	91.12	0.92%
-	**TOTAL:**	**9,917.73**	**100.00%**

Figure 4.3. Principal Level 2 Land Uses in the Trout River Watershed (WBID 2203) in 2004



Soil Characteristics

The Soil Survey Geographic Database (SSURGO) in the Department's GIS database from the SJRWMD was accessed to provide coverage of hydrologic soil groups in the Trout River watershed (**Figure 4.4**). **Table 4.2** briefly describes the major hydrology soil classes. Soil groups A and B/D are the most common in the watershed, with Type D found in the lower portion of the watershed and along the stream corridor.

Table 4.2. Description of Hydrologic Soil Classes from the SSURGO Database

Hydrology Class	Description
A	High infiltration rates. Soils are deep, well-drained to excessively drained sands and gravels.
A/D	Drained/undrained hydrology class of soils that can be drained and are classified.
B	Moderate infiltration rates. Deep and moderately deep, moderately well- and well-drained soils that have moderately coarse textures.
B/D	Drained/undrained hydrology class of soils that have moderately coarse textures.
C	Slow infiltration rates. Soils with layers impeding downward movement of water, or soils that have moderately fine or fine textures.
C/D	Drained/undrained hydrology class of soils that can be drained and classified.
D	Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.

Population

Population and housing unit information from the 2000 census at the block level was obtained from the U.S. Census Bureau. GIS was used to estimate the fraction of each block in the Trout River watershed and then applied to the block information to estimate the population and number of housing units. Based on **Table 4.3**, the population in the watershed is estimated at 2,325 people living in 923 households.

Figure 4.4. Hydrologic Soil Groups Distribution in the Trout River Watershed (WBID 2203)

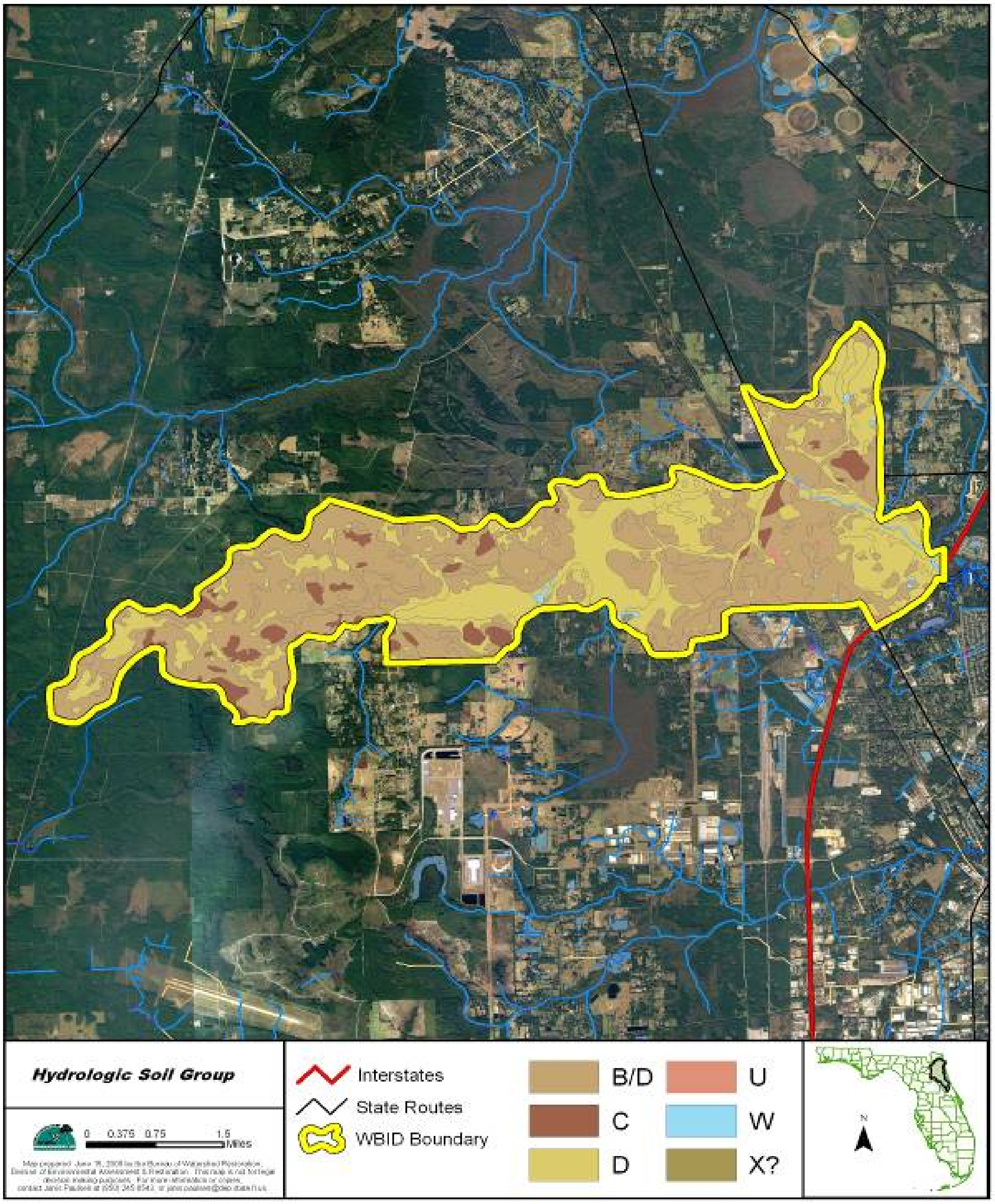


Table 4.3. Estimated Average Household Size in the Trout River Watershed (WBID 2203)

- = Empty cell
Data from U.S. Census Bureau Website, 2005, based on Duval County blocks present in the Trout River watershed

Tract	Block	Population	Housing Units
105	3	187	70
105	4	770	330
105	5	899	339
105	9	165	69
106	1	1	0
106	9	303	114
107	4	0	0
-	**Total:**	**2,325**	**923**
-	**-**	**AVERAGE HOUSEHOLD SIZE:**	**2.52**

Septic Tanks

Approximately 78 percent of Duval County residences are connected to a wastewater treatment plant, while the rest are using septic tanks (Post Buckley Schuh & Jernigan [PBS&J], 2007; Florida Department of Health [FDOH] Website, 2008). Based on the 2000 census estimates, it was assumed that 137 residences in the Trout River watershed are using septic tanks. Using an estimated per capita wastewater production rate of 70 gallons/day/person (EPA, 1999) and drainfield TN and TP concentrations of 36 and 15 mg/L, respectively, potential annual ground water loads of TN and TP were calculated. This is a screening level calculation, and soil types, the age of the system, vegetation, proximity to a receiving water, and other factors will influence the degree of attenuation of this load (**Table 4.4**).

Table 4.4. Estimated Nitrogen and Phosphorus Annual Loading from Septic Tanks in the Trout River Watershed (WBID 2203)

[1] U.S. Census Bureau; see **Table 4.3** for more information on this estimate.
[2] EPA, 1999

Estimated Number of Households on Septic	Estimated Number of People per Household[1]	Gallons/ Person/ Day[2]	TN in Drainfield (mg/L)	TP in Drainfield (mg/L)	Estimated Annual TN Load (pounds per year [lbs/yr])	Estimated Annual TP Load (lbs/yr)
137	2.52	70	36	15	2,650	1,104

4.3 Source Summary

4.3.1 Summary of Nutrient Loadings to the Trout River from Various Sources

Screening level estimates of annual nitrogen and phosphorus loadings to the watershed were developed based on 2004 land use and hydrologic soil groups. GIS shapefiles of land use and hydrologic soil groups were used to determine the acreage associated with various Level 2 land uses and soils. Estimates for annual runoff coefficients and event mean concentrations (EMCs) were based on Harper and Baker (2007) and Gao (2006). A screening level estimate of annual runoff was calculated by multiplying the long-term annual average rainfall of 52.44 inches (JIA, 1955–2007, Appendix F) by the respective runoff coefficient and area. Estimates of annual nitrogen and phosphorus loading were obtained by multiplying the annual runoff by the corresponding EMC. A more detailed loading analysis could be performed based on development of site-specific runoff coefficients, EMCs, and knowledge of best management practices (BMPs) that have been implemented in the watershed.

Agriculture

At the Level 3 land use category, 9 agricultural codes were identified in the Trout River watershed. Improved and unimproved pasture represent approximately 6.1 percent of the watershed area, or 603 acres. Field crops represent approximately 3.2 percent, or 318 acres. Aggregating land use to Level 1 for the Trout River watershed yields 1,087 acres in agriculture and 435 acres in rangeland. **Table 4.5** summarizes the screening level estimates for nitrogen and phosphorus loads from agricultural sources.

Urban Areas

There are 1,527 acres in the Level 1 category of urban and built-up in the watershed and 158 acres in transportation, communication, and utilities. Low-density residential represents 1,009 acres of the 1,527 acres in the urban and built-up category, and approximately 10 percent of the total acreage in the watershed. **Table 4.6** summarizes the screening level estimates for nitrogen and phosphorus loads from urban and built-up categories in the watershed.

Forest/Wetland/Water/Open Lands

Table 4.7 summarizes estimates for nitrogen and phosphorus loadings from Level 2 land use classifications for forest, wetland, and water. Wetlands and upland forests represent 30 and 36 percent, respectively, of the acreage in the watershed.

Table 4.5. Estimated Annual Average TN and TP Loading from Agriculture in the Trout River Watershed (WBID 2203)

- = Empty cell/no data

Land Use Classification	Soil Group	Acres	Annual Runoff Coefficient	Gross Runoff (acre-feet)	Estimated TN Load (lbs)	Estimated TP Load (lbs)
Cropland and Pastureland	C	127.15	0.166	92.24	700.23	108.17
-	D	156.56	0.226	154.62	1,173.83	181.33
-	B/D	653.81	0.089	254.29	1,930.44	298.21
-	W	0.8	0.435	1.52	11.54	1.78
Feeding operations	C	1.28	0.166	0.93	7.05	1.09
-	B/D	44.71	0.089	17.39	132.01	20.39
-	D	3.79	0.226	3.74	28.42	4.39
Nurseries and vineyards	B/D	11.54	0.089	4.49	34.07	5.26
Specialty farms	D	3.6	0.226	3.56	26.99	4.17
-	B/D	64.57	0.089	25.11	190.65	29.45
-	C	19.64	0.166	14.25	108.16	16.71
Herbaceous upland nonforested	D	13.64	0.226	13.47	42.15	2.02
-	B/D	127.44	0.089	49.57	155.10	7.42
-	C	6.07	0.166	4.40	13.78	0.66
Shrub and brushland (wax myrtle or saw palmetto, occasionally scrub)	D	35.83	0.226	35.39	110.73	5.30
-	B/D	196.63	0.089	76.48	239.30	11.44
-	W	0.01	0.435	0.02	0.06	0.00
Mixed upland nonforested	B/D	27.9	0.089	10.85	33.95	1.62
-	**D**	**27.61**	**0.226**	**27.27**	**85.33**	**4.08**
-	**SUM:**	**1,522.58**	**-**	**789.57**	**5,023.78**	**703.51**

Table 4.6. Estimated Annual Nitrogen and Phosphorus Loading from Urban and Built-up Land Uses in the Trout River Watershed (WBID 2203)

- = Empty cell/no data

Land Use Classification	Soil Group	Acres	Annual Runoff Coefficient	Gross Runoff (acre-feet)	Estimated TN Load (lbs)	Estimated TP Load (lbs)
Residential, low density – less than 2 dwelling units/acre	C	41.08	0.166	29.80	130.55	15.49
-	D	296.04	0.226	292.38	1,280.84	151.95
-	B/D	681.76	0.083	247.28	1,083.29	128.51
-	W	2.12	0.435	4.03	17.65	2.09
-	U	3.53	0.435	6.71	29.40	3.49
Residential, medium density – 2-5 dwelling units/acre	B/D	280.26	0.108	132.27	745.02	117.69
-	D	64.12	0.252	70.61	397.72	62.83
-	C	32.24	0.186	26.21	147.60	23.32
-	W	0.04	0.435	0.08	0.43	0.07
-	U	0.76	0.435	1.44	8.14	1.29
Commercial and services	D	11.82	0.435	22.47	109.44	16.02
-	B/D	60.36	0.35	92.32	449.66	65.82
-	U	7.68	0.435	14.60	71.11	10.41
Industrial	B/D	1.3	0.241	1.37	5.59	1.04
-	D	0	0.35	0.00	0.00	0.00
Extractive	D	0.39	0.375	0.64	2.00	0.26
-	B/D	1.75	0.278	2.13	6.65	0.87
Institutional	B/D	14.8	0.241	15.59	50.89	11.03
-	C	1.48	0.309	2.00	6.53	1.41
-	D	1.27	0.35	1.94	6.34	1.37
-	U	13.62	0.435	25.89	84.54	18.32
Recreational	B/D	4.95	0.089	1.93	6.02	0.29
-	D	2.26	0.226	2.23	6.98	0.33
-	W	0.05	0.435	0.10	0.30	0.01
-	U	3.17	0.435	6.03	18.86	0.90
Disturbed land	D	15.6	0.226	15.41	67.08	8.38
-	B/D	34.34	0.089	13.36	58.15	7.27
-	W	0	0.435	0.00	0.00	0.00
Transportation	B/D	29.75	0.293	38.09	169.98	22.80
-	D	6.26	0.375	10.26	45.78	6.14
-	U	30.43	0.435	57.85	258.13	34.63
-	W	0.28	0.435	0.53	2.38	0.32
Utilities	C	1.98	0.35	3.03	13.51	1.81
-	B/D	39.18	0.293	50.17	223.86	30.03
-	D	44.78	0.375	73.38	327.47	43.93
-	W	5.16	0.435	9.81	43.77	5.87
-	**SUM:**	**1,734.61**	**-**	**1,271.91**	**5,875.65**	**795.99**

Table 4.7. Estimated Annual Nitrogen and Phosphorus Loading from Forest/Wetland/Water/Open Lands Land Uses in the Trout River Watershed (WBID 2203)

- = Empty cell/no data

Land Use Classification	Soil Group	Acres	Annual Runoff Coefficient	Gross Runoff (acre-feet)	Estimated TN Load (lbs)	Estimated TP Load (lbs)
Upland coniferous forests	D	82.28	0.226	81.26	254.28	12.16
-	B/D	288.14	0.089	112.07	350.67	16.77
-	C	27.25	0.166	19.77	61.86	2.96
-	U	6.01	0.435	11.42	35.75	1.71
-	W	0.2	0.435	0.38	1.19	0.06
Upland hardwood forests	B/D	2.55	0.089	0.99	3.10	0.15
-	B/D	181.48	0.089	70.58	220.86	10.56
-	W	0.33	0.435	0.63	1.96	0.09
-	D	65.29	0.226	64.48	201.77	9.65
-	C	33.46	0.166	24.27	75.95	3.63
-	U	2.99	0.435	5.68	17.79	0.85
Tree plantations	B/D	2,255.49	0.089	877.23	2,744.98	131.28
-	C	255.76	0.166	185.53	580.56	27.77
-	D	423.18	0.226	417.94	1,307.80	62.55
-	U	0.07	0.435	0.13	0.42	0.02
Streams and waterways	D	10.24	0.435	19.47	66.21	5.83
-	B/D	0.13	0.435	0.25	0.84	0.07
-	C	0.16	0.435	0.30	1.03	0.09
-	U	0.84	0.435	1.60	5.43	0.48
-	W	29.25	0.435	55.60	189.12	16.64
Reservoirs - pits, retention ponds, dams	W	8.42	0.435	16.01	54.44	4.79
-	B/D	24.56	0.435	46.69	158.80	13.97
-	D	11.34	0.435	21.56	73.32	6.45
Wetland hardwood forests	D	362.22	0.435	688.56	2,997.72	112.41
-	C	0.6	0.435	1.14	4.97	0.19
-	B/D	175.21	0.435	333.07	1,450.03	54.38
-	W	0.26	0.435	0.49	2.15	0.08
Wetland coniferous forests	B/D	44.81	0.435	85.18	370.85	13.91
-	D	101.09	0.435	192.17	836.62	31.37

Land Use Classification	Soil Group	Acres	Annual Runoff Coefficient	Gross Runoff (acre-feet)	Estimated TN Load (lbs)	Estimated TP Load (lbs)
-	C	0.54	0.435	1.03	4.47	0.17
-	W	0.44	0.435	0.84	3.64	0.14
Wetland forested mixed	B/D	406.43	0.435	772.60	3,363.60	126.14
-	D	663.08	0.435	1,260.48	5,487.63	205.79
-	C	8.52	0.435	16.20	70.51	2.64
-	W	2.75	0.435	5.23	22.76	0.85
-	U	0.2	0.435	0.38	1.66	0.06
-	X?	0.79	0.435	1.50	6.54	0.25
Vegetated nonforested wetlands	B/D	262.95	0.435	499.85	2,176.17	81.61
-	D	896.6	0.435	1,704.39	7,420.24	278.26
-	C	3.53	0.435	6.71	29.21	1.10
-	W	16.68	0.435	31.71	138.04	5.18
-	X?	4.13	0.435	7.85	34.18	1.28
-	**SUM:**	**6,660.25**	**-**	7,643.22	30,829.13	1,244.33

Upstream Contributing Watersheds

The upper segment of the Trout River (WBID 2223) and Gulley Branch (WBID 2201) are contributing watersheds to the Middle Trout River (WBID 2203) (**Figure 4.5**). The same procedure used for the Middle Trout River watershed was used to estimate annual TN and TP loading from the Upper Trout River and Gulley Branch watersheds (**Table 4.8**).

Table 4.8. Estimated Annual Nitrogen and Phosphorus Loading to WBID 2203 from WBIDs 2223 and 2201

- = Empty cell

WBID	Land Use Category	Acres	Gross Runoff (acre-feet)	Estimated TN Load (lbs)	Estimated TP Load (lbs)
2223	Urban	422.71	183.01	792.95	94.31
2223	Agriculture	682.44	324.01	2,000.27	274.64
2223	Forest/ Wetland/ Water	1,304.94	1507.05	6,079.69	246.43
-	**SUM:**	**2,410.09**	**2,014.07**	**8,872.91**	**615.37**
2201	Urban	399.97	270.92	1,217.00	153.82
2201	Agriculture	218.56	124.72	752.23	101.65
2201	Forest/ Wetland/ Water	637.47	697.10	2,726.70	112.91
-	**SUM:**	**1,256**	**1,092.74**	**4,695.93**	**368.37**
-	**TOTAL:**	**3,666.1**	**3,106.81**	**13,568.84**	**983.74**

Figure 4.5. Contributing Watersheds to the Middle Trout River (WBID 2203)

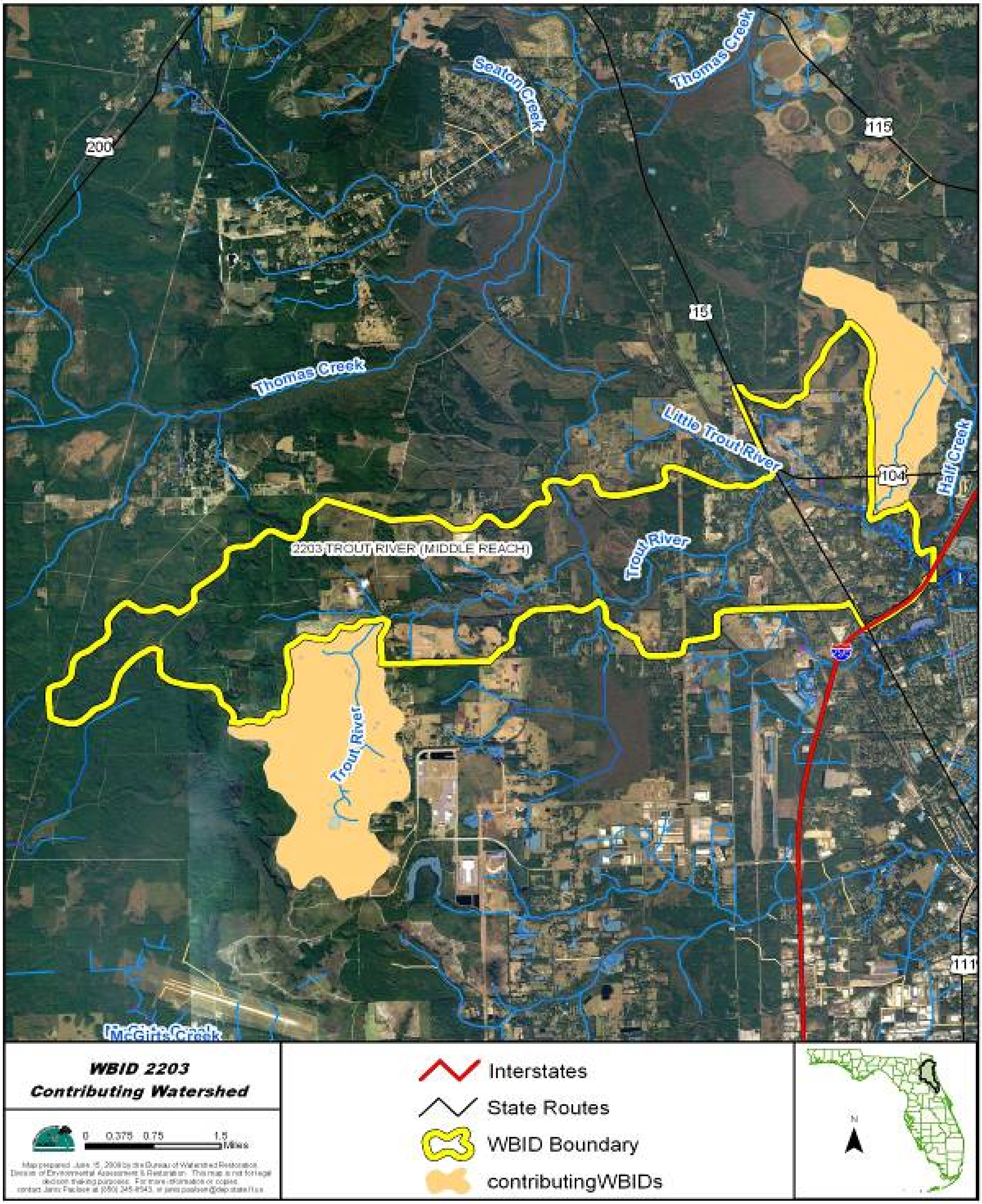


Table 4.9 summarizes the estimates from various land uses in the watershed. It is important to note that this is not a complete list and represents estimates of potential loadings. In addition, proximity to the waterbody, site specific soil characteristics, and rainfall frequency and magnitude are just a few of the factors that could influence and determine the actual loadings from these sources that reach the Trout River. For example, where are the improved pasture and high-density residential areas relative to the Trout River, and is there a riparian buffer area between these land uses and the stream? What types of BMPs, both structural and nonstructural, have been implemented for specific land uses in the watershed that reduce the actual nutrient loads delivered to the Trout River? Finally, the age and condition of the septic systems and drainage characteristics in the watershed could affect assumptions about the assimilation and/or retention of nutrients.

Table 4.9. Summary of Estimated Potential Annual Nitrogen and Phosphorus Loading from Various Sources in the Trout River Watershed (WBID 2203)

[1] Potential contribution to ground water

Source	TN (lbs/yr)	TP (lbs/yr)
Septic Tanks[1]	11,065	4,611
Urban and Built-up	5,875.6	796.0
Agriculture	5,023.8	703.5
Forest/Wetland/Water/ Open Lands	30,829.1	1,244.3
Upper Trout (WBID 2223)	8,872.91	615.37
Gulley Branch (WBID 2201)	4,695.93	368.37

The screening model approach described previously resulted in an estimated annual surface runoff of 12,811 acre-feet, or 11.3 inches per year, based on the combined Upper Trout River, Middle Trout River, and Gulley Branch watershed area. Dividing the combined estimated TN load by the surface runoff volume yielded an average TN concentration of 1.58 mg/L. The average and median TN concentrations from the available data were 1.64 and 1.45 mg/L, respectively. Dividing the combined estimated TP load by the surface runoff volume yielded an average TP concentration of 0.107 mg/L. The average and median TP concentrations from the available data were 0.314 and 0.291 mg/L, respectively. As this information was not available, flow and nutrient contributions from ground water inputs to the Middle Trout River were not included in this screening level calculation, but would likely have an influence on in-stream concentrations.

A U.S. Geological Survey (USGS) gaging station (02246599) was located in the Upper Trout River WBID near the confluence with the Middle Trout River WBID from October 1, 2002, through August 10, 2006. The average total discharge 2003 to 2005 at this station was 4,011 acre-feet. A gross surface runoff of 2,017 acre-feet was estimated from the simple screening model. Note that the screening model assumed a long-term rainfall value of 52.44 inches, while the rainfall average over the 2003–05 period was 59.46 inches, and ground water contributions were not included in the screening model.

Camp Dresser & McKee, Inc. (CDM) is currently working with the city of Jacksonville on an update to the Master Stormwater Management Plan and is using the Watershed Management Model (WMM) to develop nutrient loads for sub-basins. The Trout River watershed is one of the drainage basins in which the WMM is being applied.

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

5.1.1 Data Used in the Determination of the TMDL

Eight sampling stations on the Trout River have historical DO observations (**Figure 5.1**). **Table 5.1** contains summary information on each of the stations. **Table 5.2** provides a statistical summary of DO observations at each station, and **Appendix B** contains available historical DO, corrected chl*a* (CHLAC), TN, TP, and BOD observations from sampling sites in WBID 2203. **Figure 5.2** displays the historical observations of DO over time. DO exceedance rates by station range between 50 and 100 percent. A linear regression of DO versus sampling date in **Figure 5.2** was not significant at an alpha (α) level of 0.05 (R^2 = 0.007). **Appendix C** contains plots of DO by season, station, and year.

Figures 5.3 through **5.6** present historical CHLAC, TN, TP, and BOD observations, respectively. Linear regressions of TN and TP versus sampling date were not significant at an α level of 0.05. **Appendix C** contains additional plots by season, station, and year. **Table 5.3** presents a statistical summary of major water quality parameters from the available data.

Table 5.1. Sampling Station Summary for the Trout River (WBID 2203)

Station	STORET ID	Station Owner	Years With Data	N
Trout River at Dinsmore, Fla.	112WRD 02246600	USGS	1966–1974	5
Trout R US 1 off Perrets Dairy	21FLA 20030123	Department	1975–2008	20
Trout River at U.S. 1 at Boat Ramp Pier	21FLJXWQTR123	City of Jacksonville	1984–2007	194
Trout River at Old Kings Road	21FLJXWQTREE10	City of Jacksonville	2002–2007	28
Trout River - Dinsmore @ US 1 Bridge	FLVOL TRR010	Volunteer	1995–97	17
Trout River at Old Kings Rd	21FLA 20030753	Department	2002–07	16
SJ2-SS-2046 Trout River	FLGW 27947	Department	2005	2
Trout R @ End of Colorado Springs Rd	21FLA 20030047	Department	2006–07	8

Figure 5.1. Historical Sampling Sites in the Trout River (WBID 2203)

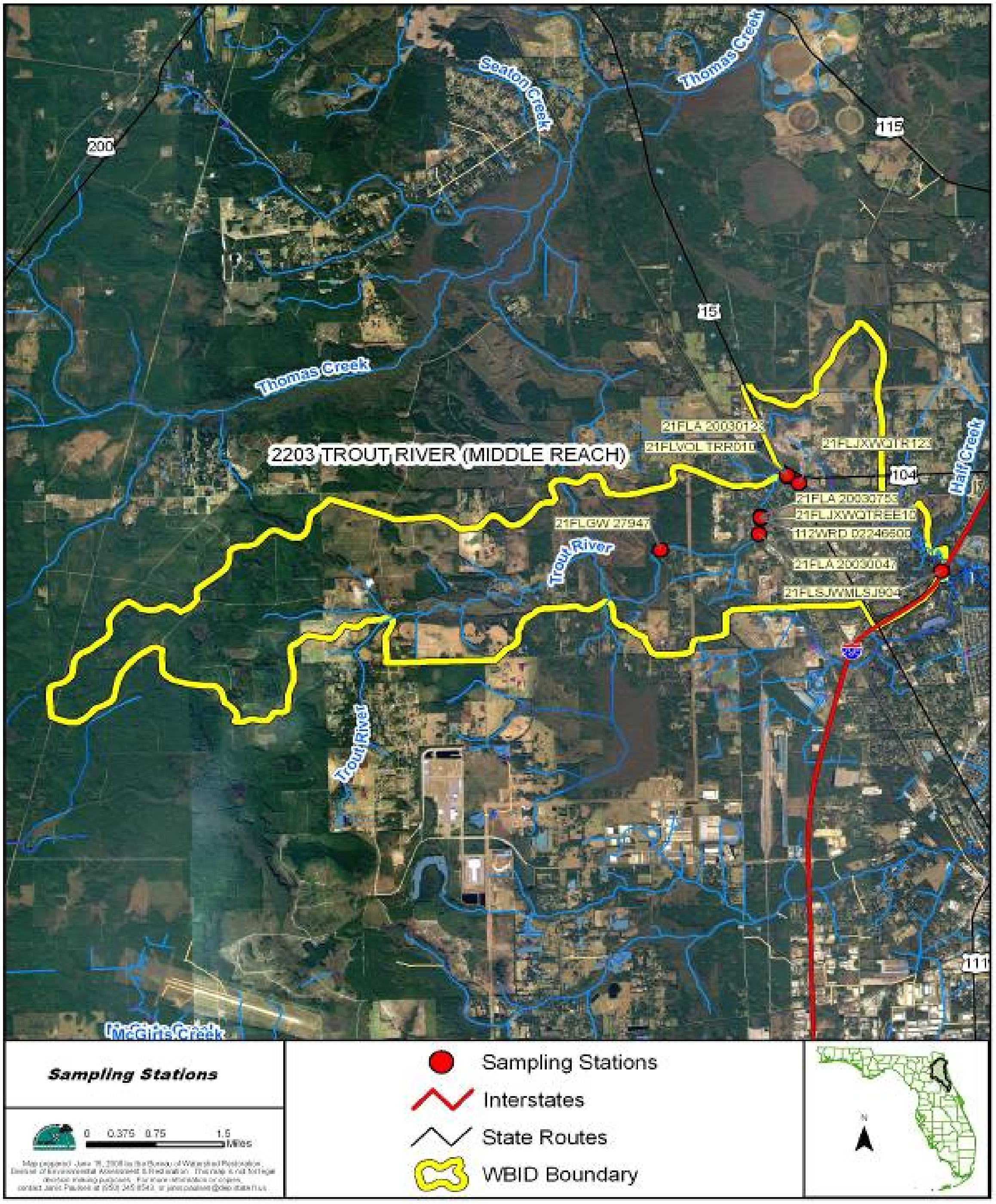


Table 5.2. Statistical Summary of Historical DO Data for the Trout River (WBID 2203)

[1] DO concentrations are mg/L.
[2] Exceedances are values less than 5 mg/L.

Station	N	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Exceedances[2]	% Exceedances
Trout River at Dinsmore, Fla.	5	3.00	7.20	3.60	4.26	4	80.00%
Trout R US 1 off Perrets Dairy	20	0.50	8.10	3.55	3.82	14	70.00%
Trout River at U.S. 1 at Boat Ramp Pier	194	1.19	17.60	4.30	4.68	119	61.34%
Trout River at Old Kings Road	28	1.10	9.39	4.84	4.94	14	50.00%
Trout River - Dinsmore @ US 1 Bridge	17	1.00	7.80	4.50	4.46	11	64.71%
Trout River at Old Kings Rd	16	1.20	7.60	2.90	4.03	10	62.50%
SJ2-SS-2046 Trout River	2	4.56	4.57	4.57	4.57	2	100.00%
Trout R @ End of Colorado Springs Rd	8	2.20	8.80	4.60	4.99	5	62.50%

Table 5.3. Summary Statistics for Major Water Quality Parameters Measured in the Trout River (WBID 2203)

PARM	N	MIN	25%	MEDIAN	MEAN	75%	MAX
BOD (mg/L)	55	0.7	1.0	2.0	2.0	2.0	13.0
CHLAC (ug/L)	25	1.0	1.0	1.0	3.8	3.5	25.0
CHLORIDE (mg/L)	142	0	0	0	308	21	7700
COLOR (PCU)	48	30	100	200	241	400	600
COND (uS/cm)	186	54	219	1028	5122	6400	30600
DO (mg/L)	290	0.50	3.00	4.33	4.60	5.89	17.60
DOSAT (%)	287	6.19	36.30	48.50	50.97	62.49	192.55
NH4 (mg/L)	151	0.00	0.00	0.04	0.35	0.50	2.20
NO3O2 (mg/L)	62	0.01	0.03	0.06	0.07	0.11	0.24
PH (su)	288	5.50	6.40	6.70	6.71	7.02	8.43
SO4 (mg/L)	29	0.80	19.88	60.00	213.56	287.50	1000.00
TEMP (C)	296	5.00	16.50	22.60	21.55	26.55	34.20
TKN (mg/L)	62	0.62	1.12	1.35	1.57	1.80	3.40
TN (mg/L)	62	0.64	1.20	1.45	1.64	1.86	3.51
TOC (mg/L)	27	10.00	15.00	20.00	27.70	41.75	68.00
TORTHO (MG/L)	15	0.188	0.212	0.282	0.309	0.378	0.583
TP (mg/L)	49	0.034	0.170	0.291	0.314	0.436	0.860
TSS (mg/L)	59	1	4	5	9	16	35
TURB (NTU)	45	1	4	7	8	9	39

Figure 5.2. Historical DO Observations for the Trout River (WBID 2203)

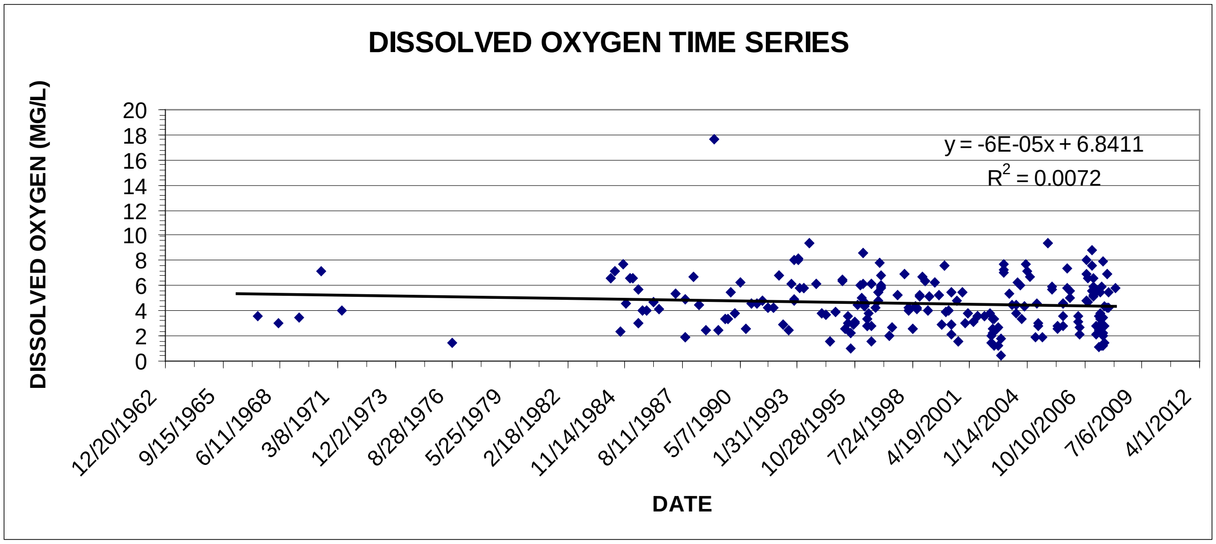


Figure 5.3. Historical CHLAC Observations for the Trout River (WBID 2203)

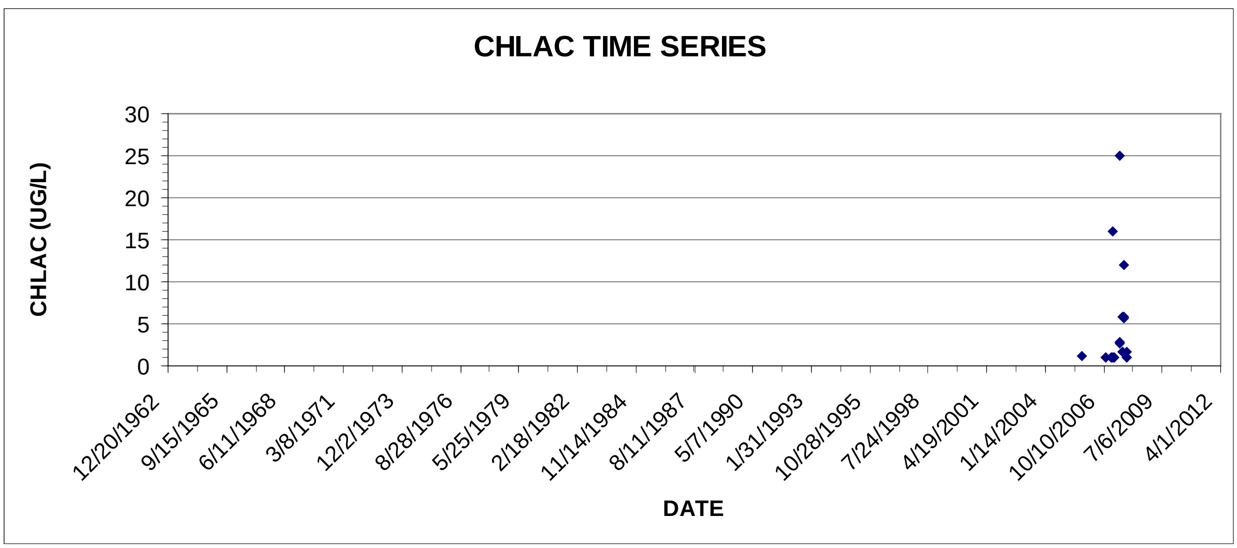


Figure 5.4. Historical TN Observations for the Trout River (WBID 2203)

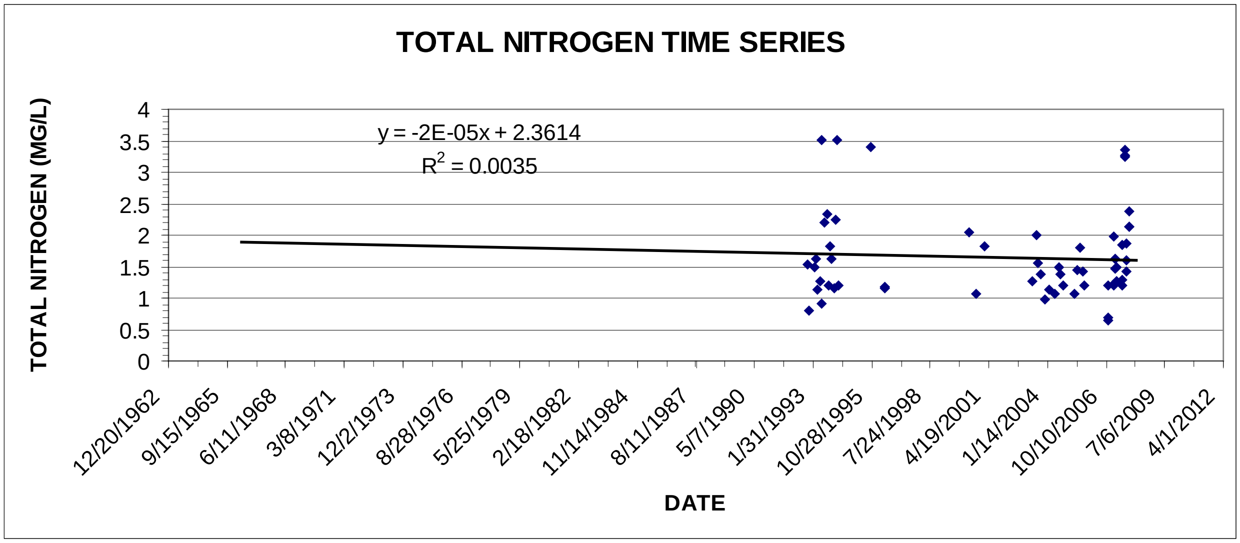


Figure 5.5. Historical TP Observations for the Trout River (WBID 2203)

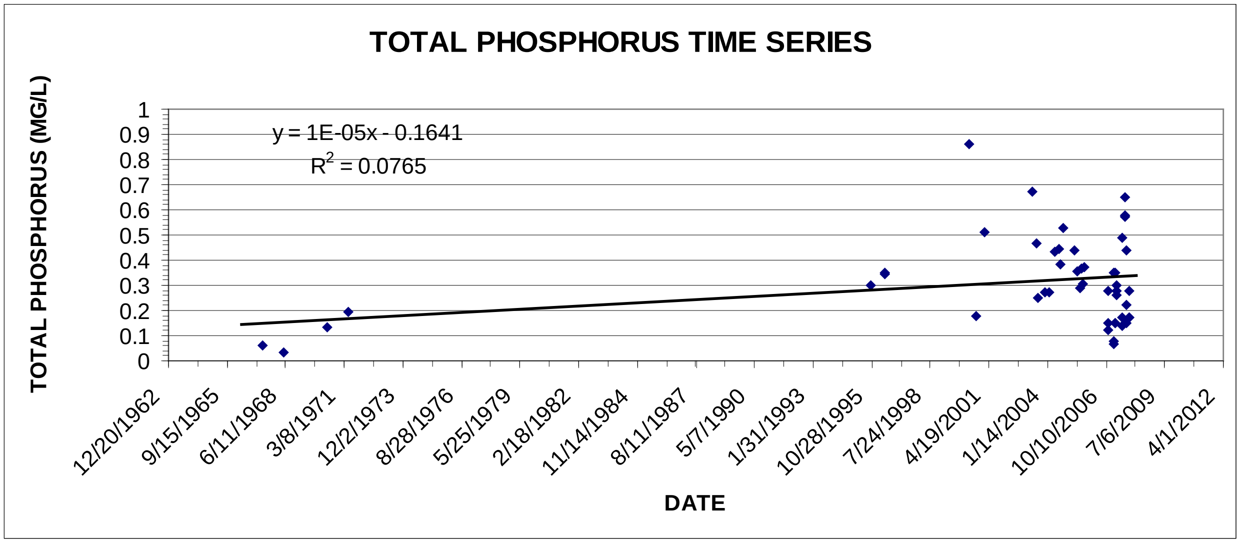
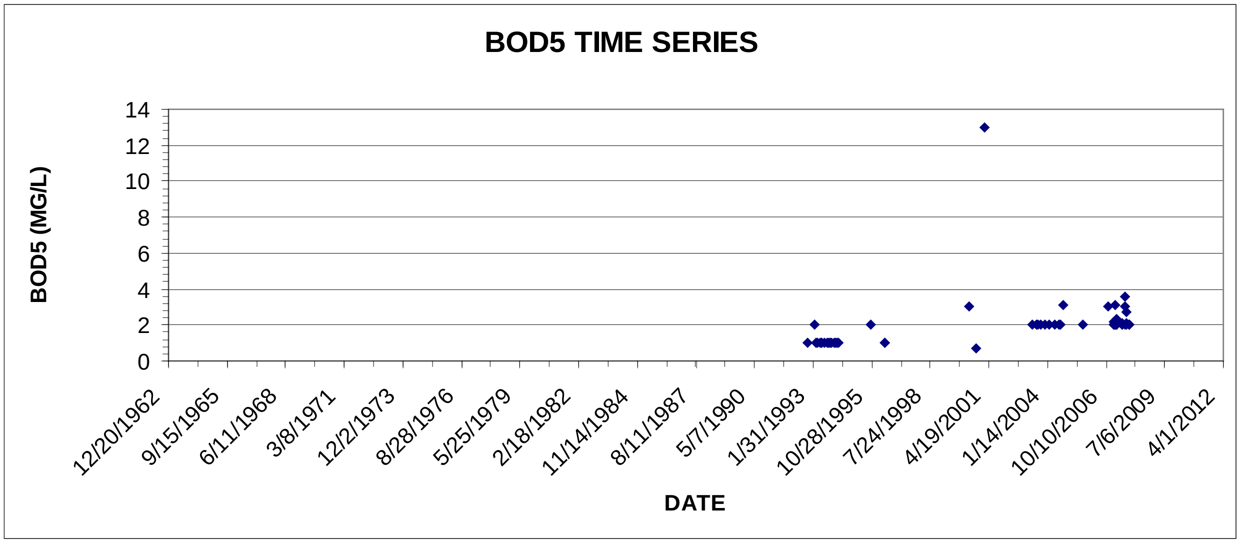


Figure 5.6. Historical BOD5 Observations for the Trout River (WBID 2203)



Available DO measurements were also summarized by year (**Table 5.4**) and by season (**Table 5.5**).

A nonparametric test (Kruskal-Wallis) was applied to the DO, DOSAT, CHLAC, TN, TP, and BOD5 datasets to determine whether there were significant difference among seasons (**Appendix D**). At an α level of 0.05, differences were significant among seasons for DO, DOSAT,TN, TP, and BOD5. A similar test for differences among months was significant for DO, DOSAT, CHLAC, TN, TP, and BOD5 (**Appendix E**). **Tables 5.6a** through **5.6f** provide seasonal summary statistics for DO, TEMP, TN, TP, BOD5, and CHLAC, respectively, for the Trout River.

Table 5.4. Statistical Summary of Historical DO Data by Year for the Trout River (WBID 2203), 1985–2008

[1] DO concentrations are mg/L.
[2] Exceedances are values less than 5 mg/L.

Year	N	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Exceedances[2]	% Exceedances
1985	15	2.1	8.65	3.9	4.43	12	80.00%
1986	5	2.8	6.5	3.2	3.80	4	80.00%
1987	6	1.7	6	4.4	4.00	3	50.00%
1988	7	2.5	7.8	4.6	4.77	4	57.14%
1989	4	4	7.2	5.25	5.43	2	50.00%
1991	11	2.01	6.59	3.63	4.14	7	63.64%
1992	13	1.52	9.66	3.57	4.40	8	61.54%
1993	13	1.59	9.56	4.64	4.75	7	53.85%
1994	12	2.68	11.5	4.5	4.93	9	75.00%
1995	13	1.85	9.56	4.47	4.64	7	53.85%
1996	10	1.55	6.42	4.705	4.34	7	70.00%
1997	20	2.63	7.7	5.89	5.43	7	35.00%
1998	20	2.74	8.46	5.505	5.43	7	35.00%
1999	18	2.35	9.32	5.045	5.40	8	44.44%
2000	19	3.78	8.42	5.13	5.43	9	47.37%
2001	20	1	9.96	4.66	5.06	11	55.00%
2002	20	1.97	8.19	5.02	4.38	9	45.00%
2003	20	1.23	10.5	4.605	4.71	13	65.00%
2004	20	1.57	11.68	4.06	4.49	12	60.00%
2005	19	2.01	8.38	4.58	4.78	13	68.42%
2006	10	3.59	7.56	5.985	5.69	3	30.00%
2007	14	1.6	9.73	5.81	5.23	6	42.86%
2008	2	3.72	4.11	3.915	3.92	2	100.00%

Table 5.5. Statistical Summary of Historical DO Data by Season for the Trout River (WBID 2203)

[1] DO concentrations are mg/L.
[2] Exceedances are values less than 5 mg/L.

Season	N	Minimum[1]	Maximum[1]	Median[1]	Mean[1]	Exceedances[2]	% Exceedances
Winter	78	2.45	11.50	6.07	6.37	15	16.67%
Spring	83	1.60	11.68	4.77	5.01	44	53.01%
Summer	76	1.23	7.70	3.30	3.53	65	85.53%
Fall	74	1.00	9.32	4.32	4.45	46	62.16%

Table 5.6a. Seasonal Summary Statistics for DO for the Trout River (WBID 2203)

[1]DO concentrations are mg/L.

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	65	3.00	3.80	5.09	6.38	6.35	6.80	17.60
Spring	79	1.10	1.91	2.80	3.60	3.78	4.55	7.20
Summer	77	1.00	1.28	2.29	2.96	3.44	4.36	9.40
Fall	69	0.50	2.90	4.19	4.85	5.17	6.20	9.39

Table 5.6b. Seasonal Summary Statistics for TEMP for the Trout River (WBID 2203)

Water temperature is in ° C.

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	66	8.10	9.72	13.10	16.00	15.73	18.30	22.06
Spring	81	15.00	16.61	23.00	25.50	25.03	27.75	30.50
Summer	78	23.00	23.40	25.40	26.98	27.42	29.67	34.20
Fall	71	5.00	10.09	14.00	16.37	16.52	18.90	26.10

Table 5.6c. Seasonal Summary Statistics for TN for the Trout River (WBID 2203)

TN concentrations are mg/L.

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	13	1.14	1.14	1.21	1.61	1.70	1.86	3.51
Spring	14	0.91	0.94	1.13	1.23	1.27	1.28	2.04
Summer	22	1.06	1.14	1.37	1.58	1.89	2.20	3.51
Fall	13	0.64	0.65	0.93	1.54	1.58	2.14	3.41

Table 5.6d. Seasonal Summary Statistics for TP for the Trout River (WBID 2203)

TP concentrations are mg/L.

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	8	0.068	0.068	0.113	0.211	0.241	0.350	0.510
Spring	14	0.034	0.039	0.196	0.323	0.337	0.435	0.860
Summer	19	0.140	0.145	0.228	0.370	0.368	0.484	0.650
Fall	8	0.120	0.120	0.160	0.221	0.218	0.280	0.300

Table 5.6e. Seasonal Summary Statistics for BOD5 for the Trout River (WBID 2203)

BOD5 concentrations are mg/L.

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	13	1.0	1.0	1.0	2.0	2.6	2.1	13.0
Spring	12	1.0	1.0	1.0	1.5	1.6	2.0	3.0
Summer	20	0.7	0.9	2.0	2.0	2.0	2.1	3.6
Fall	10	1.0	1.0	1.0	2.0	1.7	2.0	3.0

Table 5.6f. Seasonal Summary Statistics for CHLAC for the Trout River (WBID 2203)

CHLAC concentrations are µg/L.

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	6	1.0	1.0	1.0	1.0	3.5	1.0	16.0
Spring	3	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Summer	10	1.2	1.2	1.7	4.2	6.4	5.8	25.0
Fall	6	1.0	1.0	1.0	1.0	1.1	1.0	1.7

5.1.2 TMDL Development Process

A Spearman correlation matrix was used to assess potential relationships between DO and other water quality parameters (**Appendix G**). At an alpha (α) level of 0.05, correlations between DO and DOSAT, TN, TP, and water temperature (TEMP) were significant. A simple linear regression of DO versus TEMP explained 27 percent of the variance in DO (**Appendix H**).

Based on a median TP concentration of 0.296 mg/L during the Cycle 2 verified period, phosphorus was identified as the causative pollutant linked to the DO impairment and the associated nutrient impairment listing.

In order to determine the influence of nutrients on DO without the confounding effects of water temperature on all these variables, the general linear model (GLM) was used to develop an expression that included TEMP, TN, and TP. Based on 30 cases with DO, TN, TP, and TEMP observations, the following expression was significant at an α level of 0.05 and explained nearly 72 percent of the variance in DO:

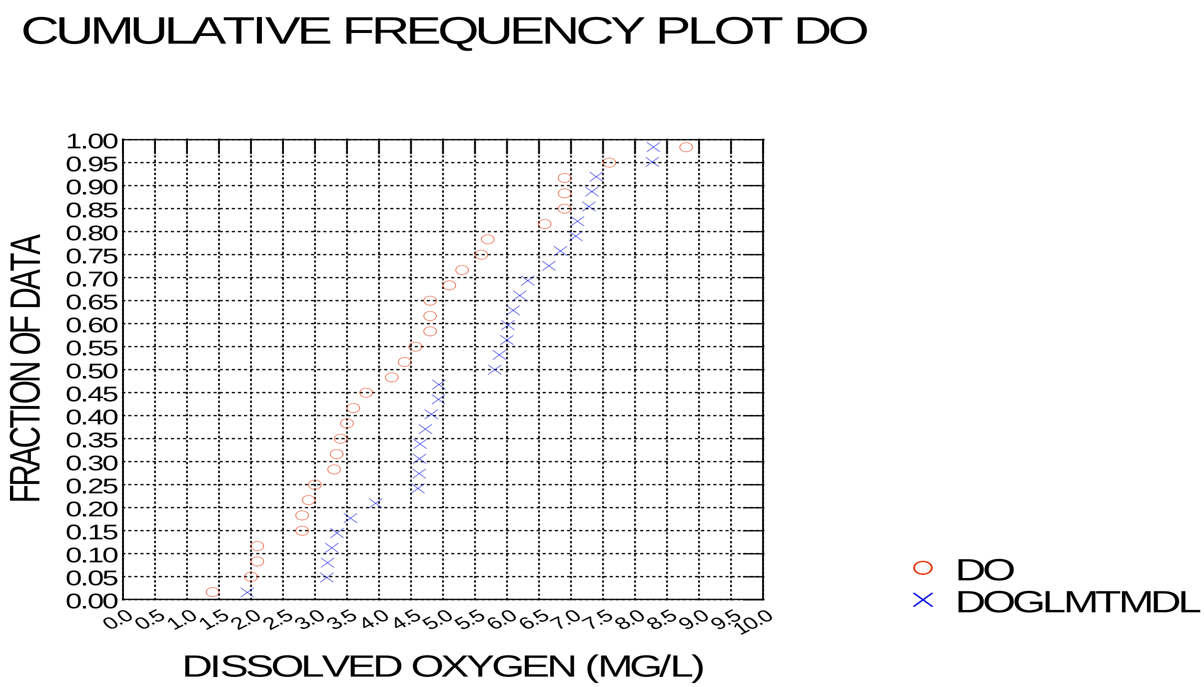
$$\mathbf{DO = 8.471 - 0.098*TEMP - 23.699*TP + 2.315*TN + 0.670*TP*TEMP + 2.202*TN*TP - 0.131*TN*TEMP}$$

Since DO is influenced by water temperature, the TMDL was developed using the historical record of TN, TP, and TEMP values (**Appendix B**).

In light of the adopted nutrient TMDL for the Lower St. Johns River that requires a 30 to 50 percent reduction in anthropogenic nitrogen loads to the marine portion of the river, the GLM model for DO was used to estimate the DO concentration with the historical dataset temperature following a 30 percent reduction in TN and reductions in TP. The historical average TEMP was 21.56 °C, and the historical TN and TP concentrations were 1.64 and 0.314 mg/L, respectively. After checking several combinations of TN (at 30 percent reduction) with various TP reductions, the model predicted that with a 30 percent reduction in TN (1.15 mg/L) and a 70 percent reduction in TP (0.094 mg/L) the mean DO concentration would be 5.1 mg/L. The historical mean DO was 4.6 mg/L (**Table 5.3**).

The DO GLM with a 30 percent reduction in TN and a 70 percent reduction in TP concentrations was applied to a paired dataset of observed DO, TEMP, TN, and TP (30 observations). Predicted DO concentrations were compared with observed concentrations (**Figure 5.7**). The predicted mean and median DO concentrations were 5.45 and 5.81 mg/L, respectively, versus the observed mean and median values of 4.45 and 4.30 mg/L. Predicted DO concentrations through the 75th percentile increased by 0.1 to 1.5 mg/L over the corresponding observed concentrations.

Figure 5.7. Cumulative Frequency Plot of Historical DO Observations for the Trout River (WBID 2203) versus GLM-Predicted Concentrations with a 30 Percent Reduction in TN and a 70 Percent Reduction in TP



The Upper Trout River (WBID 2223) exceeded the listing thresholds for DO in the Cycle 2 assessment (over 20 percent of observations below 5.0 mg/L); however, a "natural condition" determination was made based on existing land uses and biological and chemical characteristics of the segment. Approximately 54 percent of the Upper Trout River WBID is forest/wetland/water. The median TN, TP, and BOD_5 concentrations for the Upper Trout River segment for the Cycle 2 verified period were 0.55,0.068, and 2.0 mg/L, respectively. In contrast, the median TN, TP, and BOD_5 concentrations for the same period in the Middle Trout River segment were 1.43, 0.296, and 2.0 mg/L, respectively. Annual average CHLAC concentrations in 2007 for the Upper Trout River and Middle Trout River segments were 2.2 and 2.58 ug/L, respectively. No water quality data were available from the Gulley Branch WBID.

As part of a year-long statewide study of DO in Florida streams and lakes during the 2004–05 period, datasondes were deployed quarterly at three-day intervals. During each deployment, water quality samples were collected for analysis, and, during two of the deployments, biological assessments were conducted. Three reference streams are located near the Trout River in Nassau County. All of the Stream Condition Index (SCI) assessment scores from the 3 reference sites exceeded 40 and indicated full support of the designated use for propagation and maintenance of a healthy, well-balanced population of fish and wildlife.

A September 2005 SCI assessment conducted in the Middle Trout River WBID (SJ2SS204627947) was fair; under the IWR assessment methodology, this result would not represent a biological impairment. Two subsequent SCI assessments were conducted in the Middle Trout River WBID at the same location in May and November 2009. Both assessments passed with the May assessment in category 2 (healthy) and the November assessment in category 1 (exceptional).

Table 5.7a through **5.7c** summarize DO, TN, and TP observations from the 3 reference sites. Both the Alligator Creek and Thomas Creek sites had DO measurements below 5 mg/L. The proposed reduction in TN would result in a concentration similar to the reference site values, while the TP predicted concentration would be within the range observed at these sites.

Table 5.7a. Summary Statistics for DO from Three Reference Stream Sites (Statewide DO Study, 2004–05)

[1] All measurements in mg/L

Measurement[1]	NAS206GS Alligator Creek	NAS207LV Thomas Creek	NAS348LV Deep Creek
Average of daily averages	5.27	4.14	5.62
Average of daily mininum	4.91	3.82	5.15
Average of daily maximum	5.65	4.41	6.02

Table 5.7b. Summary Statistics for TN from Three Reference Stream Sites (Statewide DO Study, 2004–05)

[1] All measurements in mg/L

Measurement[1]	NAS206GS Alligator Creek	NAS207LV Thomas Creek	NAS348LV Deep Creek

Average	1.03	1.11	0.86
Minimum	0.93	0.69	0.72
Maximum	1.14	1.40	0.95

Table 5.7c. Summary Statistics for TP from Three Reference Stream Sites (Statewide DO Study, 2004–05)

[1] All measurements in mg/L

Measurement[1]	NAS206GS Alligator Creek	NAS207LV Thomas Creek	NAS348LV Deep Creek
Average	0.234	0.049	0.027
Minimum	0.185	0.022	0.019
Maximum	0.307	0.079	0.032

Although the DO GLM predicted that the minimum DO may be below the Class III freshwater criterion of 5.0 mg/L at times, reductions in TN and TP will have indirect benefits to DO levels, such as reducing algal biomass and BOD, which contribute to sediment oxygen demand. In shallow stream systems like the middle segment of the Trout River, SOD can be a significant factor influencing DO. For example, in the modeling analysis for the Sixmile Creek DO TMDL (EPA, Region 4, 2010), EPA reduced SOD rates by 50 percent under a natural conditions scenario and the predicted minimum DO increased to 4.9 mg/L compared to the existing conditions minimum DO of 1.2 mg/L. In addition, over 67 percent of the watershed area consists of natural land use categories (forests, water, and wetlands). Based on the passing SCI assessements conducted in the Middle Trout River WBID (September 2005, May 2009, and November 2009)I as well as similarities with 3 reference sites, the TMDL is not expected to cause an imbalance in the natural populations of flora and fauna or cause nuisance conditions that depress DO below natural levels.

5.1.3 Critical Conditions/Seasonality

A nonparametric test (Kruskal-Wallis) was applied to the DO, DOSAT, CHLAC, TN, and TP datasets to determine whether there were significant differences among months or seasons. At an alpha (α) level of 0.05, there were significant differences among seasons for DO, DOSAT, CHLAC, and TN, while DO, DOSAT, and CHLAC showed significant differences among months (**Appendices D** and **E**). As seen in **Table 5.5**, all seasons had at least a 16 percent exceedance rate. All months had exceedance rates of at least 9 percent (January), while June, July, and September had the highest exceedance rates (88 percent). The percent reductions in TN and TP were calculated based on the long-term average TEMP, TN, and TP based on the historical record.

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

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

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

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

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

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

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

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. The TMDL for the Trout River (WBID 2203) is expressed in terms of a percent reduction in total phosphorus, to meet both the DO and nutrient criteria (**Table 6.1**).

Table 6.1. TMDL Components for the Trout River (WBID 2203)

[1] As the TMDL represents a percent reduction, it also complies with EPA requirements to express the TMDL on a daily basis.
[2] N/A = Not applicable

WBID	Parameter	TMDL (mg/L)	WLA for Wastewater (mg/L)	WLA for NPDES Stormwater (% Reduction)[1]	LA (% Reduction)[1]	MOS
2203	TN	1.15	N/A[2]	30%	30%	Implicit
2203	TP	0.094	N/A[2]	70%	70%	Implicit

6.2 Load Allocation

A TN reduction of 30 percent and a TP reduction of 70 percent are required from nonpoint sources. It should be noted that the load allocation includes loading from stormwater discharges that are not part of the NPDES Stormwater Program.

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

There are currently no permitted NPDES discharges in the Trout River watershed; however, any discharge permits issued in the watershed in the future will also be required to meet the state's Class III criterion for DO and contain appropriate discharge limitations on nitrogen and phosphorus that will comply with the TMDL.

6.3.2 NPDES Stormwater Discharges

The city of Jacksonville and FDOT District 2 are co-permittees for a Phase I NPDES MS4 permit (FLS000012) that includes all areas of the Trout River watershed and would be responsible for a 30 percent reduction in current anthropogenic TN loading and a 70 percent reduction in current anthropogenic TP loading. It should be noted that any MS4 permittee is only responsible for reducing the loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Department, 2001), an implicit MOS was used in the development of this TMDL. The TMDL was based on long-term averages for TEMP, TN, and TP based on historical data. Under these conditions, a mean DO was predicted that would exceed the minimum criterion of 5 mg/L. Information was also presented for reference streams in the same geographic area for which mean DO levels were naturally below 5 mg/L.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Basin Management Action Plan

Following the adoption of this TMDL by rule, the Department will determine the best course of action regarding its implementation. Depending on the pollutant(s) causing the waterbody impairment and the significance of the waterbody, the Department will select the best course of action leading to the development of a plan to restore the waterbody. Often this will be accomplished cooperatively with stakeholders by creating a Basin Management Action Plan, referred to as the BMAP. BMAPs are the primary mechanism through which TMDLs are implemented in Florida (see Subsection 403.067[7], F.S.). A single BMAP may provide the conceptual plan for the restoration of one or many impaired waterbodies.

If the Department determines that a BMAP is needed to support the implementation of this TMDL, a BMAP will be developed through a transparent, stakeholder-driven process intended to result in a plan that is cost-effective, technically feasible, and meets the restoration needs of the applicable waterbodies. Once adopted by order of the Department Secretary, BMAPs are enforceable through wastewater and municipal stormwater permits for point sources and through BMP implementation for nonpoint sources. Among other components, BMAPs typically include the following:

- *Water quality goals (based directly on the TMDL);*
- *Refined source identification;*
- *Load reduction requirements for stakeholders (quantitative detailed allocations, if technically feasible);*
- *A description of the load reduction activities to be undertaken, including structural projects, nonstructural BMPs, and public education and outreach;*
- *A description of further research, data collection, or source identification needed in order to achieve the TMDL;*
- *Timetables for implementation;*
- *Implementation funding mechanisms;*
- *An evaluation of future increases in pollutant loading due to population growth;*
- *Implementation milestones, project tracking, water quality monitoring, and adaptive management procedures; and*
- *Stakeholder statements of commitment (typically a local government resolution).*

BMAPs are updated through annual meetings and may be officially revised every five years. Completed BMAPs in the state have improved communication and cooperation among local stakeholders and state agencies; improved internal communication within local governments; applied high-quality science and local information in managing water resources; clarified the obligations of wastewater point source, MS4, and non-MS4 stakeholders in TMDL implementation; enhanced transparency in the Department's decision making; and built strong relationships between the Department and local stakeholders that have benefited other program areas.

7.2 Other TMDL Implementation Tools

However, in some basins, and for some parameters, particularly those with fecal coliform impairments, the development of a BMAP using the process described above will not be the most efficient way to restore a waterbody, such that it meets its designated uses. This is because fecal coliform impairments result from the cumulative effects of a multitude of potential sources, both natural and anthropogenic. Addressing these problems requires good old-fashioned detective work that is best done by those in the area.

A multitude of assessment tools is available to assist local governments and interested stakeholders in this detective work. The tools range from the simple (such as Walk the WBIDs and GIS mapping) to the complex (such as bacteria source tracking). Department staff will provide technical assistance, guidance, and oversight of local efforts to identify and minimize fecal coliform sources of pollution. Based on work in the Lower St Johns River tributaries and the Hillsborough Basin, the Department and local stakeholders have developed a logical process and tools to serve as a foundation for this detective work. In the near future, the Department will be releasing these tools to assist local stakeholders with the development of local implementation plans to address fecal coliform impairments. In such cases, the Department will **rely on these local initiatives** as a more cost-effective and simplified approach to identify the actions needed to put in place a road map for restoration activities, while still meeting the requirements of Subsection 403.067(7), F.S.

Earlier in the document, reference was made to the BMAP that was adopted in October 2008 that outlined implementation activities in the marine portion of the Lower St. Johns River to achieve the nutrient TMDL. Since the Trout River represents a contributing watershed to the Lower St. Johns, applicable activities undertaken in the Trout River watershed as part of the Lower St. Johns River BMAP should be beneficial in addressing the DO and nutrient impairment in the Trout River.

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

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

Rule 62-40 also requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka.

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

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

Appendix B: Historical DO, CHLAC, TN, TP, and BOD5 Observations in the Trout River (WBID 2203), 1967–2008

- = Empty cell/no data

Station	Sample Date	DO (mg/L)	CHLAC (μg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
112WRD02246600	5/10/1967	3.6	-	-	-	0.0589
112WRD02246600	5/1/1968	3	-	-	-	0.0341
112WRD02246600	4/29/1969	3.5	-	-	-	-
112WRD02246600	5/13/1970	7.2	-	-	-	0.1333
112WRD02246600	5/20/1971	4	-	-	-	0.1956
FLA20030123	8/25/1976	1.4	-	-	-	-
FLJXWQTR123	3/13/1984	6.6	-	-	-	-
FLJXWQTR123	3/13/1984	6.6	-	-	-	-
FLJXWQTR123	5/22/1984	7.1	-	-	-	-
FLJXWQTR123	5/22/1984	7.1	-	-	-	-
FLJXWQTR123	8/28/1984	2.3	-	-	-	-
FLJXWQTR123	8/28/1984	2.3	-	-	-	-
FLJXWQTR123	10/5/1984	7.7	-	-	-	-
FLJXWQTR123	10/5/1984	7.7	-	-	-	-
FLJXWQTR123	12/6/1984	4.6	-	-	-	-
FLJXWQTR123	12/6/1984	4.6	-	-	-	-
FLJXWQTR123	2/5/1985	6.6	-	-	-	-
FLJXWQTR123	2/5/1985	6.6	-	-	-	-
FLJXWQTR123	3/26/1985	6.6	-	-	-	-
FLJXWQTR123	3/26/1985	6.6	-	-	-	-
FLJXWQTR123	6/27/1985	3	-	-	-	-
FLJXWQTR123	6/27/1985	3	-	-	-	-
FLJXWQTR123	6/27/1985	5.7	-	-	-	-
FLJXWQTR123	6/27/1985	5.7	-	-	-	-
FLJXWQTR123	9/23/1985	4	-	-	-	-
FLJXWQTR123	9/23/1985	4	-	-	-	-
FLJXWQTR123	12/4/1985	4	-	-	-	-
FLJXWQTR123	12/4/1985	4	-	-	-	-
FLJXWQTR123	3/20/1986	4.7	-	-	-	-
FLJXWQTR123	3/20/1986	4.7	-	-	-	-
FLJXWQTR123	6/25/1986	4.1	-	-	-	-
FLJXWQTR123	6/25/1986	4.1	-	-	-	-
FLJXWQTR123	4/9/1987	5.4	-	-	-	-
FLJXWQTR123	4/9/1987	5.4	-	-	-	-
FLJXWQTR123	9/16/1987	4.9	-	-	-	-
FLJXWQTR123	9/16/1987	4.9	-	-	-	-
FLJXWQTR123	9/24/1987	1.9	-	-	-	-
FLJXWQTR123	9/24/1987	1.9	-	-	-	-
FLJXWQTR123	2/12/1988	6.65	-	-	-	-
FLJXWQTR123	2/12/1988	6.7	-	-	-	-
FLJXWQTR123	5/20/1988	4.5	-	-	-	-

Station	Sample Date	DO (mg/L)	CHLAC (μg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
FLJXWQTR123	5/20/1988	4.5	-	-	-	-
FLJXWQTR123	9/22/1988	2.5	-	-	-	-
FLJXWQTR123	9/22/1988	2.5	-	-	-	-
FLJXWQTR123	2/15/1989	17.6	-	-	-	-
FLJXWQTR123	2/15/1989	17.6	-	-	-	-
FLJXWQTR123	4/26/1989	2.5	-	-	-	-
FLJXWQTR123	4/26/1989	2.5	-	-	-	-
FLJXWQTR123	8/18/1989	3.3	-	-	-	-
FLJXWQTR123	8/18/1989	3.3	-	-	-	-
FLJXWQTR123	10/10/1989	3.4	-	-	-	-
FLJXWQTR123	10/10/1989	3.4	-	-	-	-
FLJXWQTR123	12/1/1989	5.5	-	-	-	-
FLJXWQTR123	12/1/1989	5.5	-	-	-	-
FLJXWQTR123	1/30/1990	-	-	-	-	-
FLJXWQTR123	1/30/1990	-	-	-	-	-
FLJXWQTR123	2/8/1990	3.8	-	-	-	-
FLJXWQTR123	2/8/1990	3.8	-	-	-	-
FLJXWQTR123	4/23/1990	-	-	-	-	-
FLJXWQTR123	4/23/1990	-	-	-	-	-
FLJXWQTR123	5/9/1990	6.3	-	-	-	-
FLJXWQTR123	5/9/1990	6.3	-	-	-	-
FLJXWQTR123	8/7/1990	-	-	-	-	-
FLJXWQTR123	8/7/1990	-	-	-	-	-
FLJXWQTR123	8/23/1990	2.55	-	-	-	-
FLJXWQTR123	8/23/1990	2.6	-	-	-	-
FLJXWQTR123	10/16/1990	-	-	-	-	-
FLJXWQTR123	10/16/1990	-	-	-	-	-
FLJXWQTR123	11/15/1990	4.6	-	-	-	-
FLJXWQTR123	11/15/1990	4.6	-	-	-	-
FLJXWQTR123	2/22/1991	4.6	-	-	-	-
FLJXWQTR123	2/22/1991	4.6	-	-	-	-
FLJXWQTR123	3/19/1991	-	-	-	-	-
FLJXWQTR123	3/19/1991	-	-	-	-	-
FLJXWQTR123	4/16/1991	-	-	-	-	-
FLJXWQTR123	4/16/1991	-	-	-	-	-
FLJXWQTR123	6/5/1991	4.8	-	-	-	-
FLJXWQTR123	6/5/1991	4.8	-	-	-	-
FLJXWQTR123	9/5/1991	4.3	-	-	-	-
FLJXWQTR123	9/5/1991	4.3	-	-	-	-
FLJXWQTR123	9/16/1991	-	-	-	-	-
FLJXWQTR123	9/16/1991	-	-	-	-	-
FLJXWQTR123	10/21/1991	-	-	-	-	-
FLJXWQTR123	10/21/1991	-	-	-	-	-
FLJXWQTR123	12/4/1991	4.3	-	-	-	-
FLJXWQTR123	12/4/1991	4.3	-	-	-	-

Station	Sample Date	DO (mg/L)	CHLAC (μg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
FLJXWQTR123	2/4/1992	-	-	-	-	-
FLJXWQTR123	2/4/1992	-	-	-	-	-
FLJXWQTR123	3/11/1992	6.8	-	-	-	-
FLJXWQTR123	3/11/1992	6.8	-	-	-	-
FLJXWQTR123	4/22/1992	-	-	-	-	-
FLJXWQTR123	4/22/1992	-	-	-	-	-
FLJXWQTR123	6/2/1992	2.9	-	-	-	-
FLJXWQTR123	6/2/1992	2.9	-	-	-	-
FLJXWQTR123	8/4/1992	-	-	-	-	-
FLJXWQTR123	8/4/1992	-	-	-	-	-
FLJXWQTR123	9/9/1992	2.5	-	-	-	-
FLJXWQTR123	9/9/1992	2.5	-	-	-	-
FLJXWQTR123	10/20/1992	-	-	-	-	-
FLJXWQTR123	10/20/1992	-	-	-	-	-
FLJXWQTREE10	10/20/1992	6.15	-	1	1.54	-
FLJXWQTR123	12/1/1992	4.85	-	-	-	-
FLJXWQTR123	12/1/1992	4.9	-	-	-	-
FLJXWQTREE10	12/1/1992	8.05	-	-	0.81	-
FLJXWQTR123	1/26/1993	-	-	-	-	-
FLJXWQTR123	1/26/1993	-	-	-	-	-
FLJXWQTREE10	2/23/1993	8.06	-	2	1.48	-
FLJXWQTR123	2/25/1993	8.2	-	-	-	-
FLJXWQTR123	2/25/1993	8.2	-	-	-	-
FLJXWQTREE10	3/23/1993	5.86	-	1	1.62	-
FLJXWQTR123	4/22/1993	-	-	-	-	-
FLJXWQTR123	4/22/1993	-	-	-	-	-
FLJXWQTREE10	4/26/1993	-	-	1	1.13	-
FLJXWQTREE10	5/24/1993	-	-	1	1.27	-
FLJXWQTR123	5/26/1993	5.8	-	-	-	-
FLJXWQTR123	5/26/1993	5.8	-	-	-	-
FLJXWQTREE10	6/22/1993	-	-	1	0.91	-
FLJXWQTREE10	7/5/1993	-	-	1	3.51	-
FLJXWQTR123	7/7/1993	-	-	-	-	-
FLJXWQTR123	7/7/1993	-	-	-	-	-
FLJXWQTREE10	8/2/1993	-	-	1	2.2	-
FLJXWQTR123	9/1/1993	9.4	-	-	-	-
FLJXWQTR123	9/1/1993	9.4	-	-	-	-
FLJXWQTREE10	9/28/1993	-	-	1	2.33	-
FLJXWQTREE10	10/17/1993	-	-	1	1.2	-
FLJXWQTR123	10/19/1993	-	-	-	-	-
FLJXWQTR123	10/19/1993	-	-	-	-	-
FLJXWQTREE10	11/9/1993	-	-	1	1.83	-
FLJXWQTR123	12/13/1993	6.2	-	-	-	-
FLJXWQTR123	12/13/1993	6.2	-	-	-	-
FLJXWQTREE10	12/14/1993	-	-	1	1.62	-

Station	Sample Date	DO (mg/L)	CHLAC (μg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
FLJXWQTREE10	1/25/1994	-	-	1	1.15	-
FLJXWQTR123	2/1/1994	-	-	-	-	-
FLJXWQTR123	2/1/1994	-	-	-	-	-
FLJXWQTREE10	2/15/1994	-	-	1	2.25	-
FLJXWQTREE10	3/15/1994	-	-	1	3.51	-
FLJXWQTR123	3/21/1994	3.8	-	-	-	-
FLJXWQTR123	3/21/1994	3.8	-	-	-	-
FLJXWQTR123	4/19/1994	-	-	-	-	-
FLJXWQTR123	4/19/1994	-	-	-	-	-
FLJXWQTREE10	4/19/1994	-	-	1	1.2	-
FLJXWQTR123	6/21/1994	3.7	-	-	-	-
FLJXWQTR123	6/21/1994	3.7	-	-	-	-
FLJXWQTR123	8/10/1994	-	-	-	-	-
FLJXWQTR123	8/10/1994	-	-	-	-	-
FLJXWQTR123	8/30/1994	1.6	-	-	-	-
FLJXWQTR123	8/30/1994	1.6	-	-	-	-
FLJXWQTR123	10/18/1994	-	-	-	-	-
FLJXWQTR123	10/18/1994	-	-	-	-	-
FLJXWQTR123	12/7/1994	3.9	-	-	-	-
FLJXWQTR123	12/7/1994	3.9	-	-	-	-
FLJXWQTR123	1/30/1995	-	-	-	-	-
FLJXWQTR123	1/30/1995	-	-	-	-	-
FLJXWQTR123	3/21/1995	6.43	-	-	-	-
FLJXWQTR123	3/21/1995	6.4	-	-	-	-
FLJXWQTR123	4/19/1995	-	-	-	-	-
FLJXWQTR123	4/19/1995	-	-	-	-	-
FLJXWQTR123	5/18/1995	2.58	-	-	-	-
FLJXWQTR123	5/18/1995	2.6	-	-	-	-
FLVOL TRR010	7/7/1995	3.6	-	-	-	-
FLVOL TRR010	7/10/1995	3	-	-	-	-
FLVOL TRR010	8/15/1995	1	-	-	-	-
FLJXWQTR123	8/22/1995	2.24	-	-	-	-
FLJXWQTR123	8/22/1995	2.2	-	-	-	-
FLJXWQTR123	10/4/1995	2.87	-	-	-	-
FLJXWQTR123	10/4/1995	2.9	-	2	3.41	0.3
FLJXWQTR123	10/31/1995	3.07	-	-	-	-
FLJXWQTR123	10/31/1995	3.1	-	-	-	-
FLVOL TRR010	12/18/1995	4.5	-	-	-	-
FLVOL TRR010	1/23/1996	6	-	-	-	-
FLVOL TRR010	2/23/1996	5	-	-	-	-
FLJXWQTR123	3/12/1996	8.63	-	-	-	-
FLJXWQTR123	3/12/1996	8.6	-	-	-	-
FLVOL TRR010	3/27/1996	6.2	-	-	-	-
FLVOL TRR010	4/23/1996	4.4	-	-	-	-
FLVOL TRR010	5/17/1996	4.6	-	-	-	-

Station	Sample Date	DO (mg/L)	CHLAC (µg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
FLJXWQTR123	5/22/1996	2.8	-	-	-	-
FLJXWQTR123	5/22/1996	2.8	-	-	-	-
FLJXWQTR123	6/4/1996	3.34	-	1	1.165	0.345
FLJXWQTR123	6/4/1996	3.3	-	1	1.17	0.35
FLVOL TRR010	6/28/1996	3.8	-	-	-	-
FLVOL TRR010	7/30/1996	1.6	-	-	-	-
FLJXWQTR123	8/15/1996	6.18	-	-	-	-
FLJXWQTR123	8/15/1996	6.2	-	-	-	-
FLVOL TRR010	8/21/1996	2.8	-	-	-	-
FLVOL TRR010	10/19/1996	4.2	-	-	-	-
FLJXWQTR123	11/12/1996	-	-	-	-	-
FLJXWQTR123	11/12/1996	-	-	-	-	-
FLVOL TRR010	12/3/1996	4.8	-	-	-	-
FLJXWQTR123	12/5/1996	5.53	-	-	-	-
FLJXWQTR123	12/5/1996	5.5	-	-	-	-
FLVOL TRR010	12/23/1996	7.8	-	-	-	-
FLVOL TRR010	1/15/1997	6.8	-	-	-	-
FLVOL TRR010	1/29/1997	5.8	-	-	-	-
FLJXWQTR123	2/6/1997	5.96	-	-	-	-
FLJXWQTR123	2/6/1997	6	-	-	-	-
FLJXWQTR123	6/26/1997	1.98	-	-	-	-
FLJXWQTR123	6/26/1997	2	-	-	-	-
FLJXWQTR123	7/28/1997	2.67	-	-	-	-
FLJXWQTR123	7/28/1997	2.7	-	-	-	-
FLJXWQTR123	11/3/1997	5.28	-	-	-	-
FLJXWQTR123	11/3/1997	5.3	-	-	-	-
FLJXWQTR123	3/3/1998	6.89	-	-	-	-
FLJXWQTR123	3/3/1998	6.9	-	-	-	-
FLJXWQTR123	5/12/1998	4.24	-	-	-	-
FLJXWQTR123	5/12/1998	4.2	-	-	-	-
FLJXWQTR123	5/27/1998	4.02	-	-	-	-
FLJXWQTR123	5/27/1998	4	-	-	-	-
FLJXWQTR123	7/27/1998	2.57	-	-	-	-
FLJXWQTR123	7/27/1998	2.6	-	-	-	-
FLJXWQTR123	9/15/1998	4.35	-	-	-	-
FLJXWQTR123	9/15/1998	4.4	-	-	-	-
FLJXWQTR123	10/19/1998	4.17	-	-	-	-
FLJXWQTR123	10/19/1998	4.2	-	-	-	-
FLJXWQTR123	12/8/1998	5.18	-	-	-	-
FLJXWQTR123	12/8/1998	5.2	-	-	-	-
FLJXWQTR123	1/20/1999	6.75	-	-	-	-
FLJXWQTR123	1/20/1999	6.75	-	-	-	-
FLJXWQTR123	3/10/1999	6.38	-	-	-	-
FLJXWQTR123	3/10/1999	6.38	-	-	-	-
FLJXWQTR123	4/21/1999	3.98	-	-	-	-

Station	Sample Date	DO (mg/L)	CHLAC (μg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
FLJXWQTR123	4/21/1999	3.98	-	-	-	-
FLJXWQTR123	5/26/1999	5.19	-	-	-	-
FLJXWQTR123	5/26/1999	5.19	-	-	-	-
FLJXWQTR123	8/25/1999	6.26	-	-	-	-
FLJXWQTR123	8/25/1999	6.26	-	-	-	-
FLJXWQTR123	10/19/1999	5.29	-	-	-	-
FLJXWQTR123	10/19/1999	5.29	-	-	-	-
FLJXWQTR123	12/15/1999	2.9	-	-	-	-
FLJXWQTR123	12/15/1999	2.9	-	-	-	-
FLJXWQTR123	1/31/2000	7.63	-	-	-	-
FLJXWQTR123	1/31/2000	7.63	-	-	-	-
FLJXWQTR123	3/2/2000	3.95	-	-	-	-
FLJXWQTR123	3/2/2000	3.95	-	-	-	-
FLJXWQTR123	4/26/2000	4.03	-	-	-	-
FLJXWQTR123	4/26/2000	4.03	-	-	-	-
FLA20030123	5/25/2000	2.1	-	3	2.039	0.86
FLJXWQTR123	6/7/2000	2.88	-	-	-	-
FLJXWQTR123	6/7/2000	2.88	-	-	-	-
FLJXWQTR123	6/13/2000	5.45	-	-	-	-
FLJXWQTR123	6/13/2000	5.45	-	-	-	-
FLJXWQTR123	6/13/2000		-	-	-	-
FLA20030123	9/12/2000	4.8	-	0.7	1.06	0.18
FLJXWQTR123	9/21/2000	1.56	-	-	-	-
FLJXWQTR123	9/21/2000	1.56	-	-	-	-
FLJXWQTR123	12/5/2000	5.52	-	-	-	-
FLJXWQTR123	12/5/2000	5.52	-	-	-	-
FLA20030123	1/31/2001	3	-	13	1.819	0.51
FLJXWQTR123	3/7/2001	3.84	-	-	-	-
FLJXWQTR123	3/7/2001	3.84	-	-	-	-
FLJXWQTR123	6/19/2001	3.08	-	-	-	-
FLJXWQTR123	6/19/2001	3.08	-	-	-	-
FLJXWQTR123	8/29/2001		-	-	-	-
FLJXWQTR123	8/29/2001	3.52	-	-	-	-
FLJXWQTR123	8/29/2001	3.52	-	-	-	-
FLJXWQTR123	8/29/2001	3.52	-	-	-	-
FLJXWQTR123	12/20/2001	3.54	-	-	-	-
FLJXWQTR123	12/20/2001	3.54	-	-	-	-
FLJXWQTR123	3/27/2002	3.85	-	-	-	-
FLA20030123	4/24/2002		-	-	-	-
FLA20030123	4/24/2002	2	-	-	-	-
FLA20030753	4/24/2002		-	-	-	-
FLA20030753	4/24/2002	1.5	-	-	-	-
FLA20030123	5/20/2002		-	-	-	-
FLA20030123	5/20/2002	2.2	-	-	-	-
FLA20030753	5/20/2002		-	-	-	-

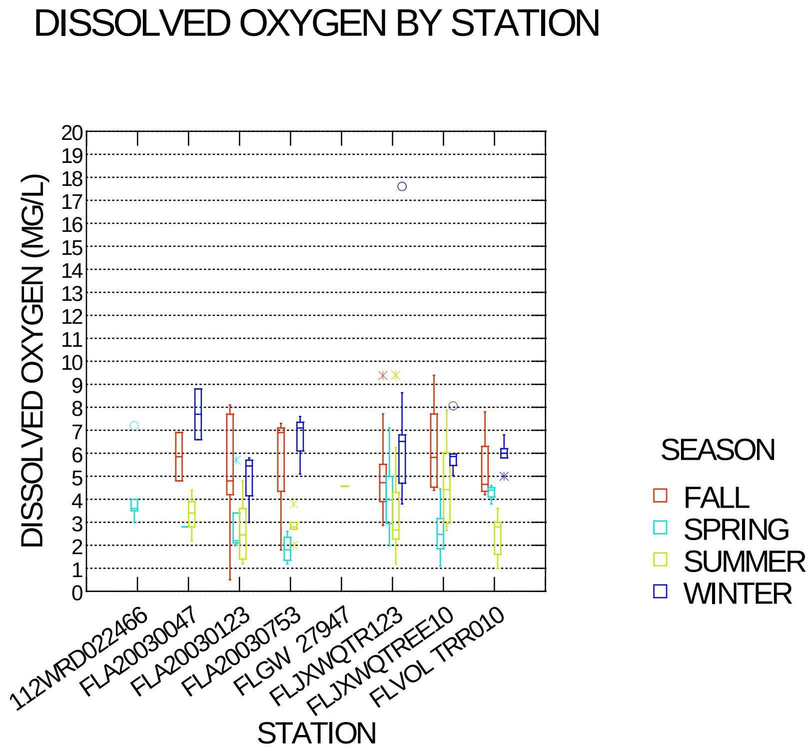
Station	Sample Date	DO (mg/L)	CHLAC (μg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
FLA20030753	5/20/2002	2.6	-	-	-	-
FLJXWQTR123	5/30/2002	3.37	-	-	-	-
FLA20030123	6/13/2002		-	-	-	-
FLA20030123	6/13/2002	3.4	-	-	-	-
FLA20030753	6/13/2002	-	-	-	-	-
FLA20030753	6/13/2002	1.2	-	-	-	-
FLA20030123	8/12/2002	-	-	-	-	-
FLJXWQTR123	8/12/2002	2.6	-	-	-	-
FLA20030123	8/20/2002	-	-	-	-	-
FLA20030123	8/20/2002	1.2	-	-	-	-
FLA20030753	8/20/2002	-	-	-	-	-
FLA20030753	8/20/2002	2.7	-	-	-	-
FLA20030123	10/7/2002	0.5	-	-	-	-
FLA20030753	10/7/2002	1.8	-	-	-	-
FLA20030123	11/20/2002	-	-	-	-	-
FLA20030123	11/20/2002	7.7	-	-	-	-
FLA20030753	11/20/2002	-	-	-	-	-
FLA20030753	11/20/2002	7.3	-	-	-	-
FLA20030123	12/5/2002	-	-	-	-	-
FLJXWQTR123	12/5/2002	7.02	-	-	-	-
FLJXWQTR123	3/13/2003	5.31	-	-	-	-
FLJXWQTREE10	4/22/2003	4.45	-	-	-	-
FLJXWQTREE10	4/22/2003	-	-	2	1.276	0.67
FLJXWQTR123	6/25/2003	3.79	-	-	-	-
FLJXWQTREE10	7/8/2003	4.42	-	-	-	-
FLJXWQTREE10	7/8/2003	-	-	2	2.001	0.467
FLJXWQTREE10	8/5/2003	6.23	-	-	-	-
FLJXWQTREE10	8/5/2003	-		2	1.549	0.252
FLJXWQTREE10	9/10/2003	-	-	2	1.371	-
FLJXWQTREE10	9/10/2003	6.03	-	-	-	-
FLJXWQTR123	9/29/2003	3.33	-	-	-	-
FLJXWQTREE10	11/18/2003	-	-	-	-	-
FLJXWQTREE10	11/18/2003	4.41	-	-	-	-
FLJXWQTREE10	11/25/2003	-	-	2	0.971	0.272
FLJXWQTREE10	11/25/2003	4.39	-	-	-	-
FLJXWQTR123	12/15/2003	7.71	-	-	-	-
FLA20030753	1/13/2004	-	-	-	-	-
FLA20030753	1/13/2004	7.1	-	-	-	-
FLJXWQTREE10	2/18/2004	-	-	-	-	-
FLJXWQTREE10	2/18/2004	-	-	2	1.144	0.271
FLJXWQTR123	3/3/2004	6.68	-	-	-	-
FLJXWQTREE10	5/25/2004	-	-	2	1.056	0.435
FLJXWQTREE10	5/25/2004	1.85	-	-	-	-
FLJXWQTR123	6/23/2004	4.56	-	-	-	-
FLA20030753	7/28/2004	3	-	-	-	-

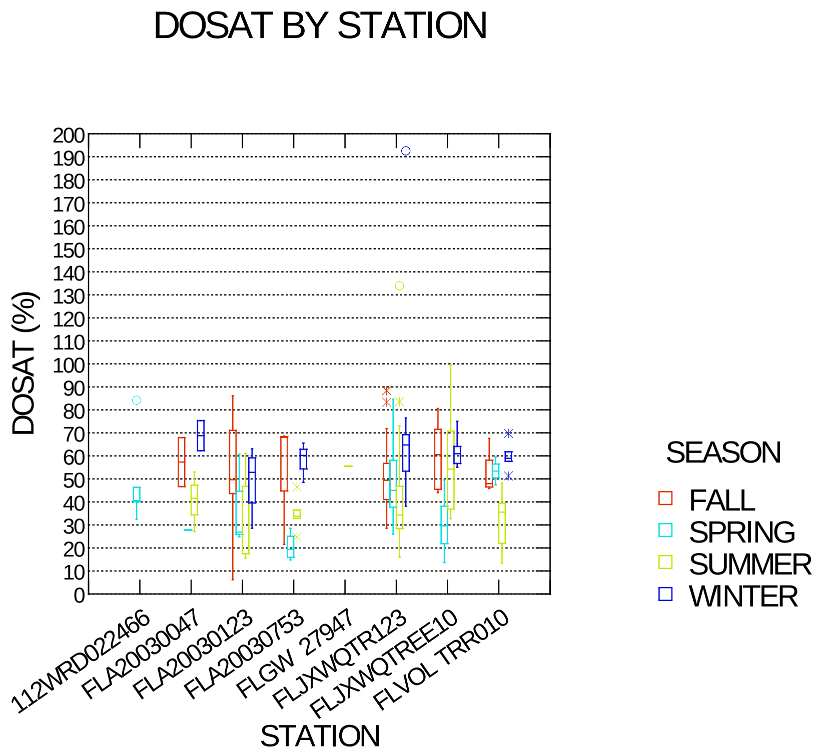
Station	Sample Date	DO (mg/L)	CHLAC (µg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
FLJXWQTREE10	8/3/2004	-	-	2	1.5	0.447
FLJXWQTREE10	8/3/2004	2.74	-	-	-	-
FLJXWQTREE10	8/24/2004	-	-	2	1.371	0.385
FLJXWQTR123	9/23/2004	1.91	-	-	-	-
FLJXWQTREE10	9/29/2004	-	-	3.1	1.202	0.527
FLJXWQTR123	12/29/2004	9.38	-	-	-	-
FLJXWQTREE10	12/29/2004	9.39	-	-	-	-
FLJXWQTR123	3/23/2005	5.65	-	-	-	-
FLJXWQTREE10	3/23/2005	5.97	-	-	-	-
FLJXWQTREE10	4/26/2005	-	-	-	1.06	0.438
FLJXWQTREE10	6/2/2005	-	-	-	1.435	0.358
FLJXWQTR123	6/22/2005	2.83	-	-	-	-
FLJXWQTREE10	6/22/2005	2.53	-	-	-	-
FLJXWQTREE10	7/12/2005	-	-	-	1.801	0.291
FLJXWQTREE10	8/23/2005	-	-	-		0.365
FLJXWQTREE10	9/6/2005	-	-	2	1.412	0.303
FLJXWQTR123	9/20/2005	2.77	-	-	-	-
FLJXWQTREE10	9/20/2005	3.61	-	-	-	-
FLGW 27947	9/21/2005	4.57	1.2	-	1.197	0.37
FLGW 27947	9/21/2005	4.56	-	-	-	-
FLJXWQTR123	12/5/2005	5.8	-	-	-	-
FLJXWQTREE10	12/5/2005	7.36	-	-	-	-
FLJXWQTR123	1/24/2006	5.62	-	-	-	-
FLJXWQTREE10	1/24/2006	5.04	-	-	-	-
FLJXWQTR123	6/14/2006	3.58	-	-	-	-
FLJXWQTREE10	6/14/2006	3.16	-	-	-	-
FLJXWQTR123	7/17/2006	2.14	-	-	-	-
FLJXWQTREE10	7/17/2006	2.64	-	-	-	-
FLA20030047	11/13/2006	4.8	1	-	0.641	0.12
FLA20030123	11/13/2006	-	1	-	-	-
FLA20030123	11/13/2006	4.8	-	-	1.194	0.28
FLA20030753	11/13/2006	-	1	-	-	-
FLA20030753	11/13/2006	6.9	-	-	0.689	0.15
FLA20030123	11/14/2006	-	-	-	-	-
FLA20030123	11/14/2006	8.1	-	3	-	-
FLJXWQTR123	12/7/2006	6.56	-	-	-	-
FLJXWQTREE10	12/7/2006	4.64	-	-	-	-
FLA20030047	2/20/2007	8.8	1	2	1.21	0.076
FLA20030123	2/20/2007	-	-	-	-	-
FLA20030123	2/20/2007	-	1	-	-	-
FLA20030123	2/20/2007	5.6	-	2.2	1.988	0.35
FLA20030753	2/20/2007	-	-	-	-	-
FLA20030753	2/20/2007	7.6	1	2	1.213	0.068
FLJXWQTR123	3/12/2007	5.91	-	-	-	-
FLJXWQTREE10	3/12/2007	5.47	-	-	-	-

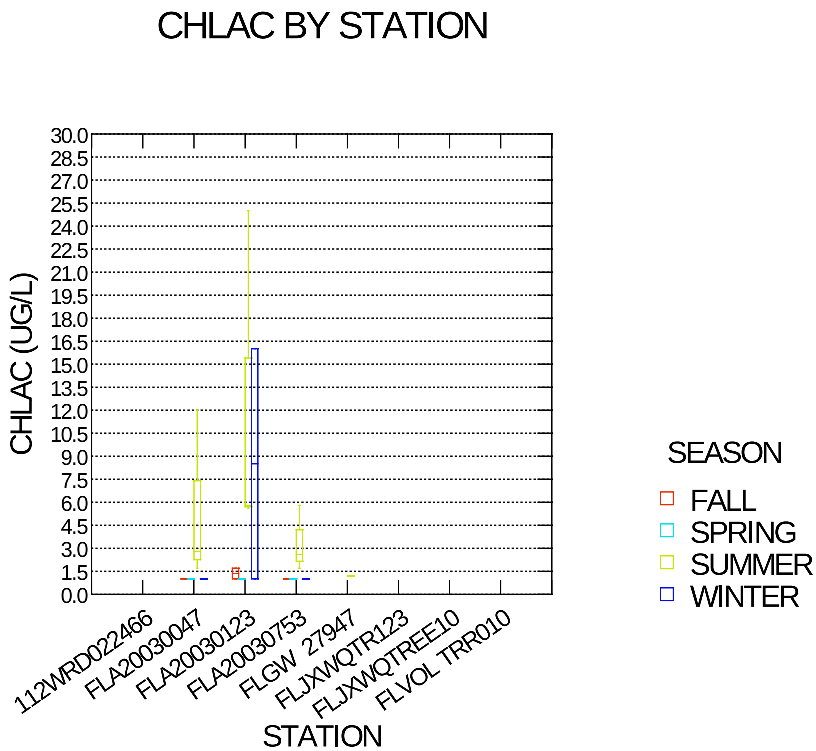
Station	Sample Date	DO (mg/L)	CHLAC (μg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
FLA20030047	3/20/2007	-	-	-	-	-
FLA20030047	3/20/2007	6.59	1	2	1.624	0.15
FLA20030123	3/20/2007	-	-	-	-	-
FLA20030123	3/20/2007	-	16	-	-	-
FLA20030123	3/20/2007	5.3	-	3.1	1.469	0.35
FLA20030753	3/20/2007	-	-	-	-	-
FLA20030753	3/20/2007	5.1	1	2	1.612	0.15
FLA20030047	4/17/2007	-	-	-	-	-
FLA20030047	4/17/2007	2.8	1	2	1.259	0.28
FLA20030123	4/17/2007	-	-	-	-	-
FLA20030123	4/17/2007	-	1	-	-	-
FLA20030123	4/17/2007	5.7	-	2.3	1.491	0.26
FLA20030753	4/17/2007	-	-	-	-	-
FLA20030753	4/17/2007	2.1	1	2	1.275	0.3
FLJXWQTR123	6/11/2007	3.6	-	-	-	-
FLJXWQTREE10	6/11/2007	1.1	-	-	-	-
FLJXWQTR123	6/25/2007	2.61	-	-	-	-
FLJXWQTREE10	6/25/2007	2.42	-	-	-	-
FLA20030047	7/17/2007	-	-	-	-	-
FLA20030047	7/17/2007	3.4	2.8	2	1.189	0.14
FLA20030123	7/17/2007	-	-	-	-	-
FLA20030123	7/17/2007	3.6	25	2.1	1.845	0.49
FLA20030753	7/17/2007	-	-	-	-	-
FLA20030753	7/17/2007	3.8	2.6	2	1.281	0.17
FLJXWQTR123	7/17/2007	5.42	-	-	-	-
FLJXWQTREE10	7/17/2007	2.96	-	-	-	-
FLJXWQTREE10	7/24/2007	5.89	-	-	-	-
FLJXWQTR123	8/13/2007	1.19	-	-	-	-
FLA20030047	8/21/2007	-	-	-	-	-
FLA20030047	8/21/2007	-	-	-	-	-
FLA20030047	8/21/2007	-	1.7	2	3.271	0.57
FLA20030123	8/21/2007	-	-	-	-	-
FLA20030123	8/21/2007	-	-	-	-	-
FLA20030123	8/21/2007	3.5	5.8	3	3.347	0.65
FLJXWQTREE10	8/21/2007	7.88	-	-	-	-
FLA20030047	8/22/2007	2.2	-	-	-	-
FLA20030753	8/22/2007	-	-	-	-	-
FLA20030753	8/22/2007	2	1.7	3.6	3.243	0.58
FLJXWQTR123	8/27/2007	1.21	-	-	-	-
FLA20030047	9/18/2007	-	-	-	-	-
FLA20030047	9/18/2007	-	12	-	-	-
FLA20030047	9/18/2007	4.4	-	2.7	1.43	0.15
FLA20030123	9/18/2007	-	-	-	-	-
FLA20030123	9/18/2007	-	5.6	-	-	-
FLA20030123	9/18/2007	1.4	-	2	1.856	0.44

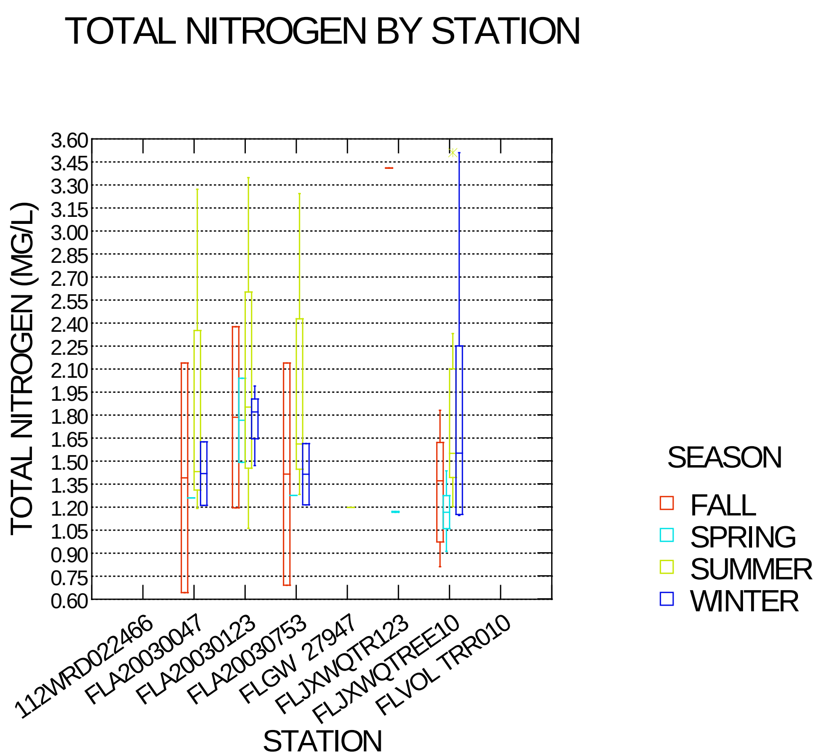
Station	Sample Date	DO (mg/L)	CHLAC (μg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
FLA20030753	9/18/2007	-	-	-	-	-
FLA20030753	9/18/2007	-	5.8	-	-	-
FLA20030753	9/18/2007	2.8	-	2.1	1.61	0.22
FLA20030047	11/6/2007	-	-	-	-	-
FLA20030047	11/6/2007	6.9	1	2	2.138	0.17
FLA20030123	11/6/2007	-	-	-	-	-
FLA20030123	11/6/2007	-	1.7	-	-	-
FLA20030123	11/6/2007	4.2		2	2.375	0.28
FLA20030753	11/6/2007	-	-	-	-	-
FLA20030753	11/6/2007	-	1	-	-	-
FLA20030753	11/6/2007	6.9	-	2	2.138	0.17
FLJXWQTR123	12/11/2007	4.21	-	-	-	-
FLJXWQTREE10	12/11/2007	5.49	-	-	-	-
FLA20030123	3/17/2008	5.8	-	-	-	-

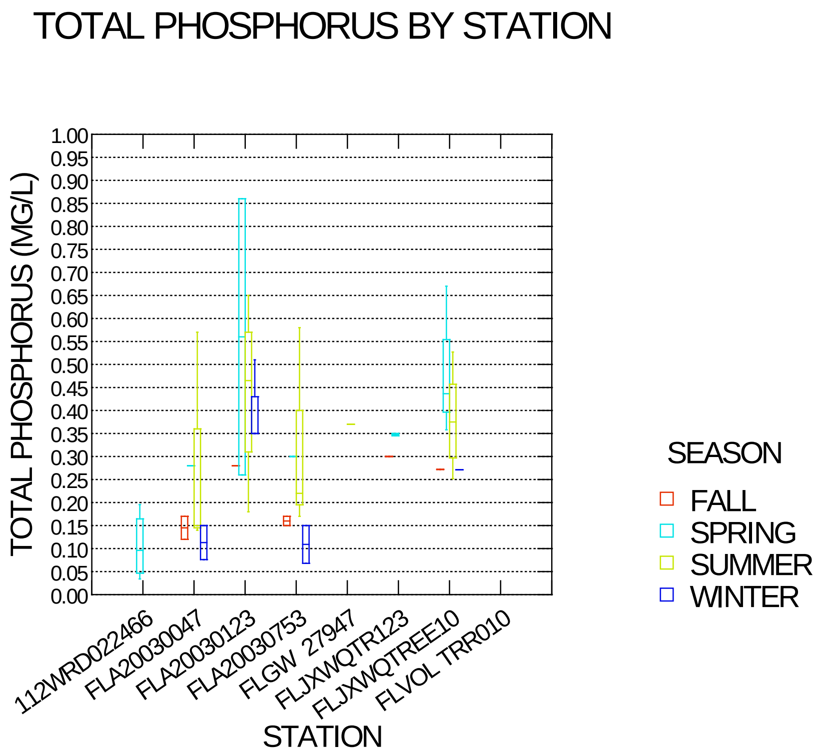
Appendix C: Chart of DO, DOSAT, CHLAC, TN, TP, and BOD5 Observations by Station, Year, and Season in the Trout River (WBID 2203)

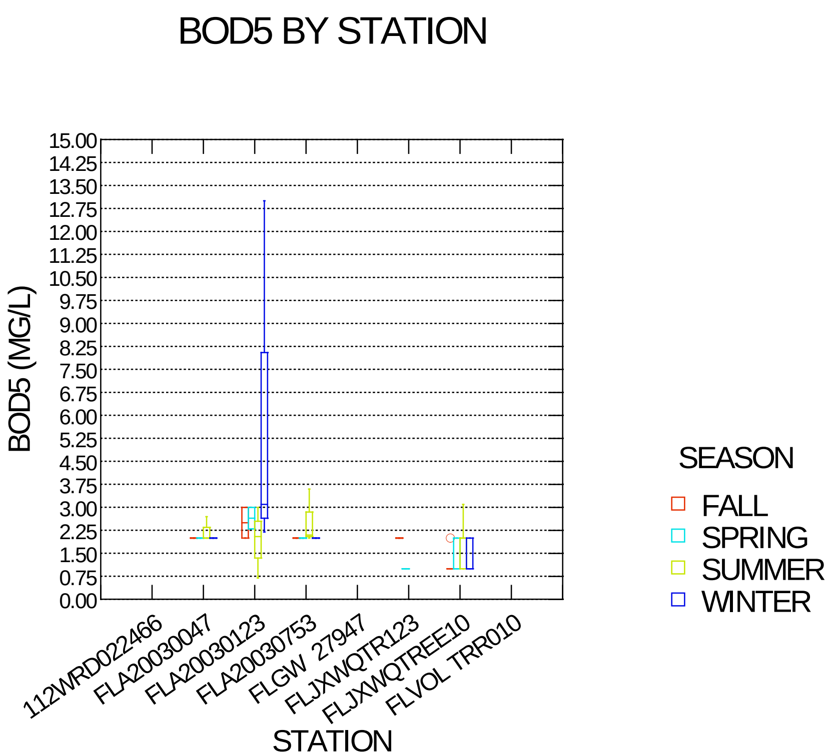


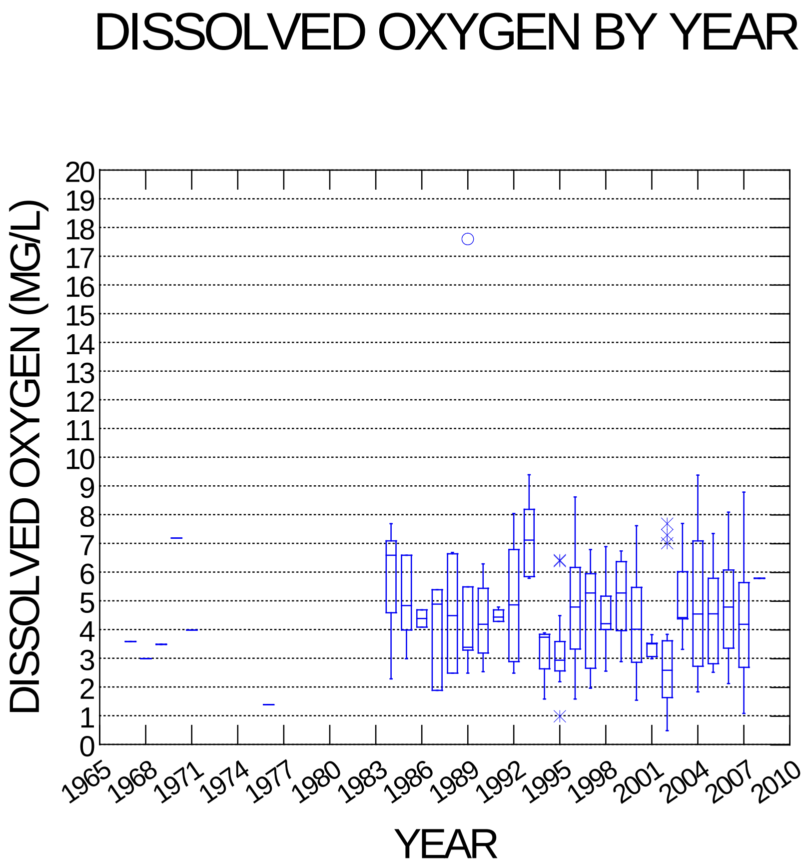

DOSAT BY STATION
DOSAT (%)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

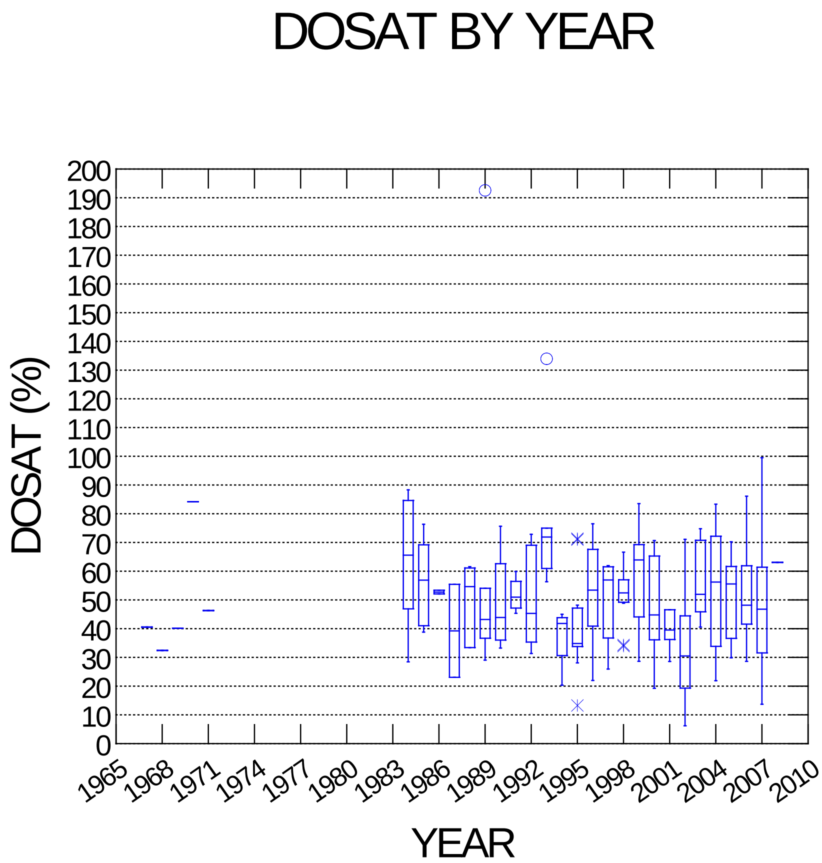

CHLAC BY STATION
CHLAC (UG/L)
30.0
28.5
27.0
25.5
24.0
22.5
21.0
19.5
18.0
16.5
15.0
13.5
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

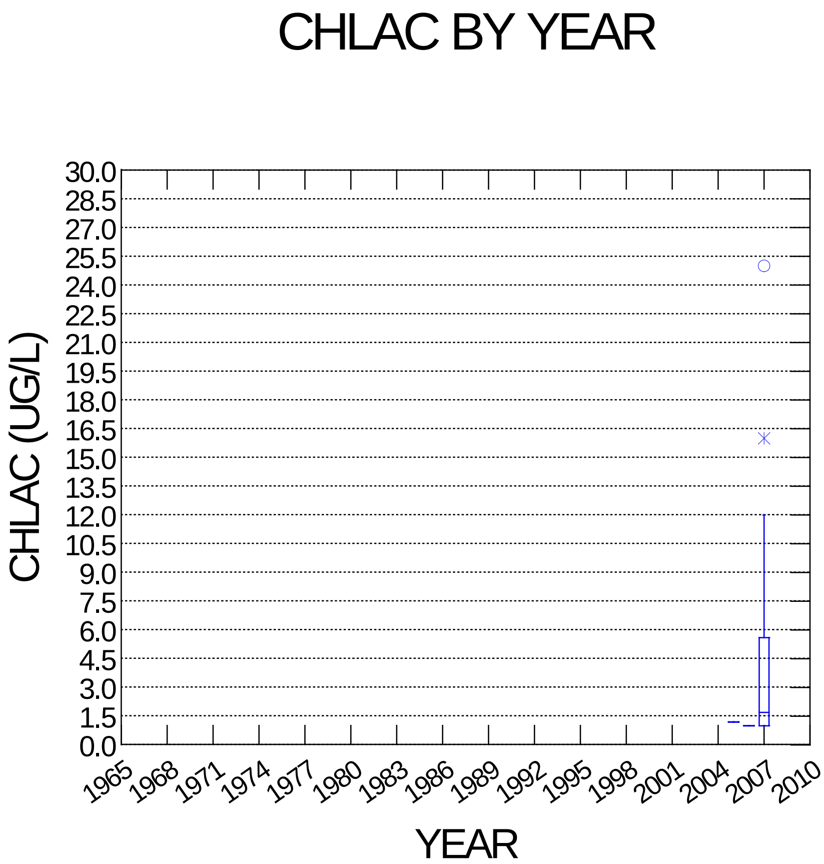

TOTAL NITROGEN BY STATION
TOTAL NITROGEN (MG/L)
3.60
3.45
3.30
3.15
3.00
2.85
2.70
2.55
2.40
2.25
2.10
1.95
1.80
1.65
1.50
1.35
1.20
1.05
0.90
0.75
0.60
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

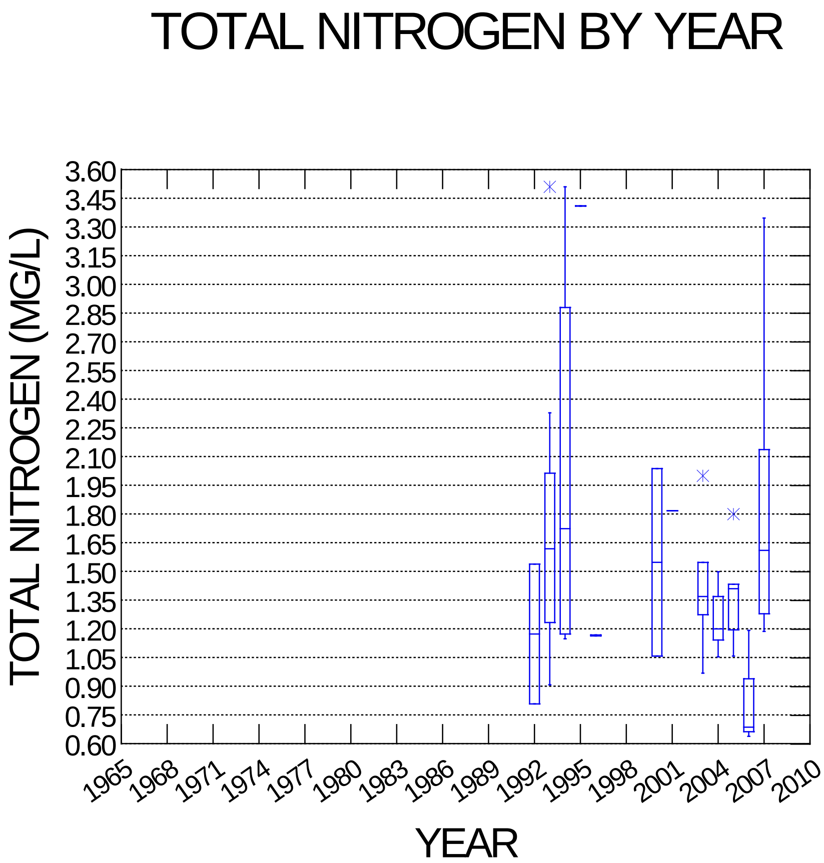

TOTAL PHOSPHORUS BY STATION
TOTAL PHOSPHORUS (MG/L)
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

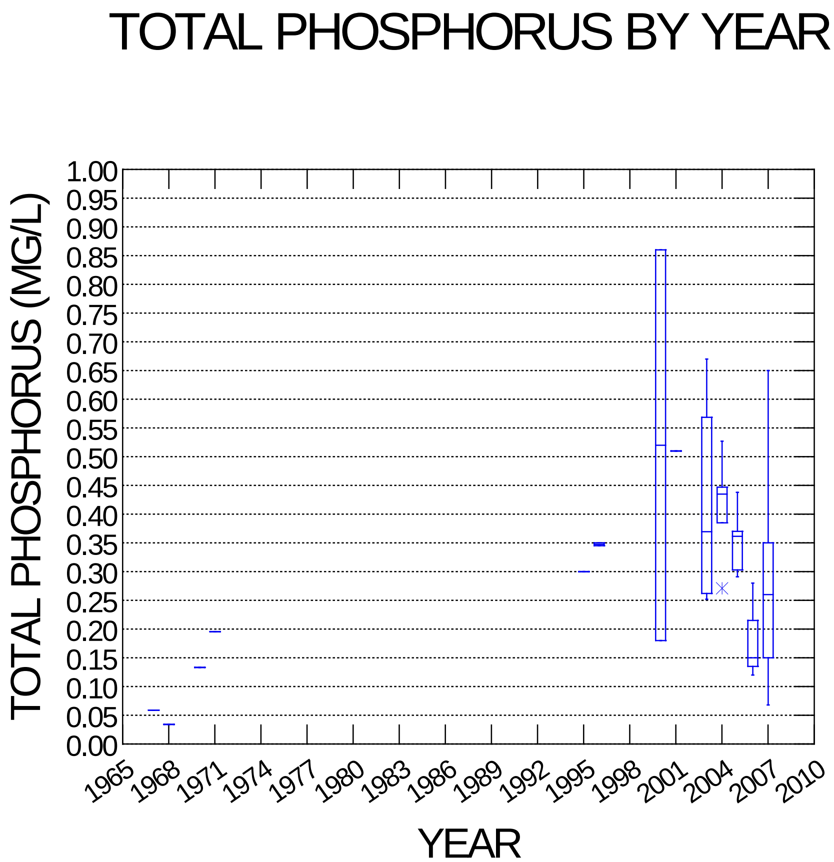

BOD5 BY STATION
BOD5 (MG/L)
15.00
14.25
13.50
12.75
12.00
11.25
10.50
9.75
9.00
8.25
7.50
6.75
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

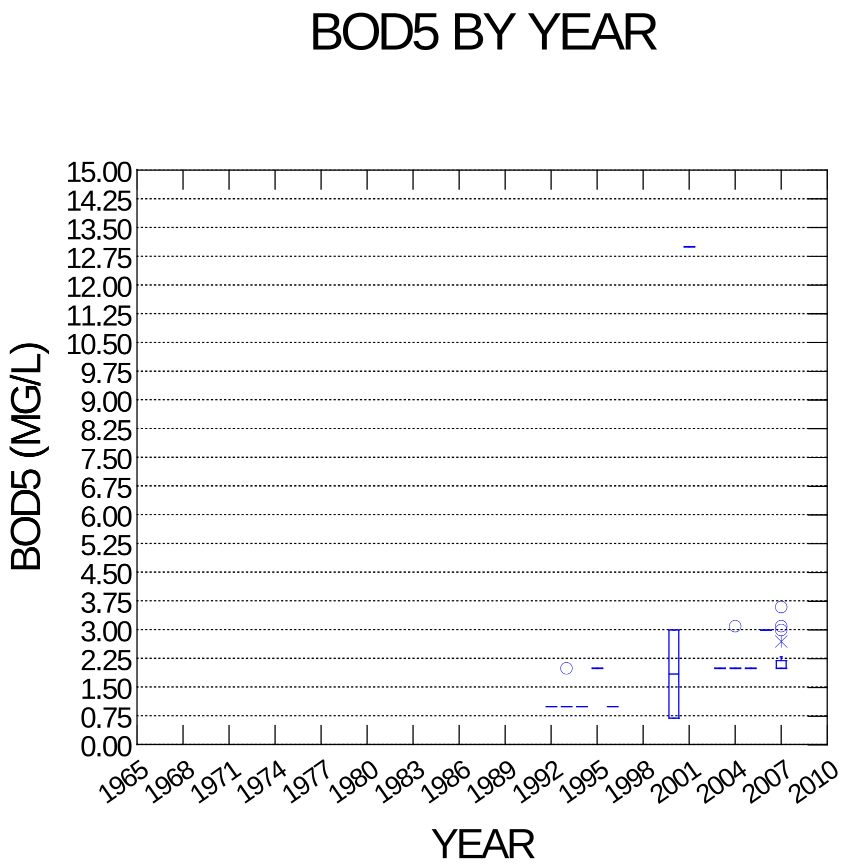

DISSOLVED OXYGEN BY YEAR
DISSOLVED OXYGEN (MG/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
YEAR

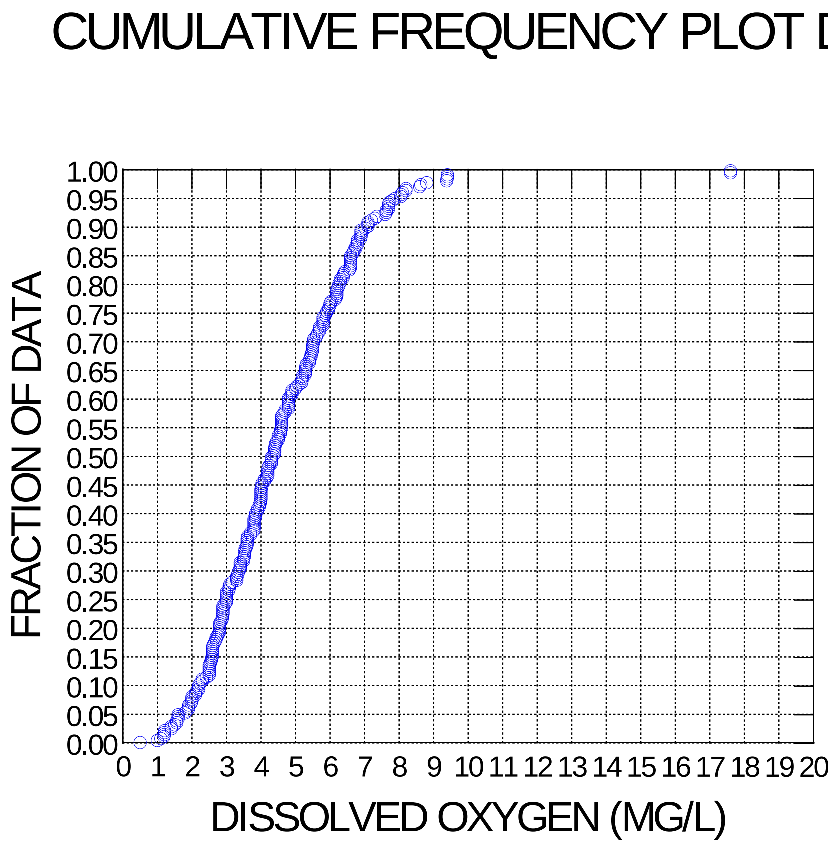

DOSAT BY YEAR
DOSAT (%)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
YEAR

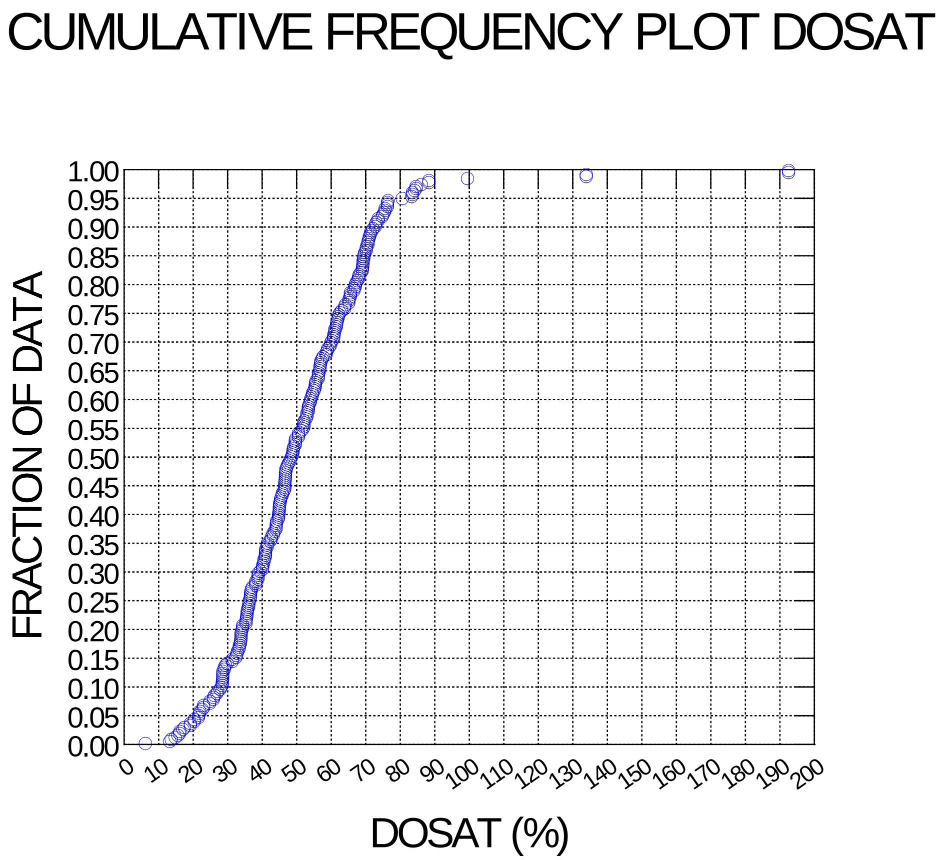

CHLAC BY YEAR
CHLAC (UG/L)
30.0
28.5
27.0
25.5
24.0
22.5
21.0
19.5
18.0
16.5
15.0
13.5
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
YEAR

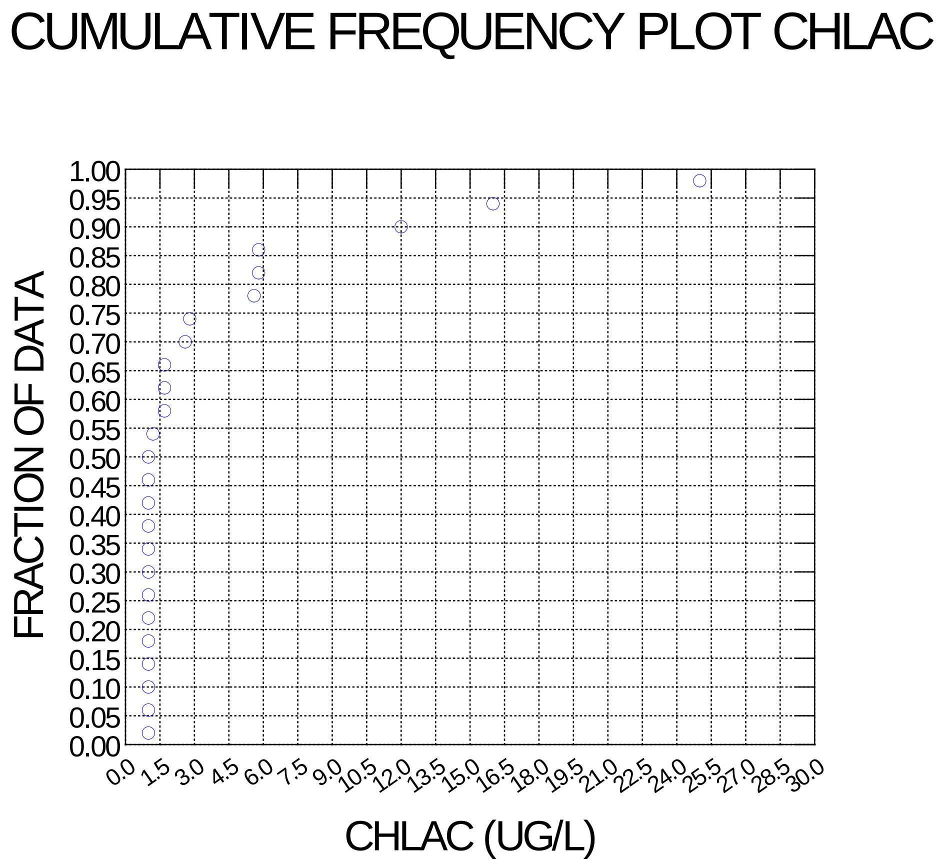

TOTAL NITROGEN BY YEAR
TOTAL NITROGEN (MG/L)
3.60
3.45
3.30
3.15
3.00
2.85
2.70
2.55
2.40
2.25
2.10
1.95
1.80
1.65
1.50
1.35
1.20
1.05
0.90
0.75
0.60
1965 1968 1971 1974 1977 1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010
YEAR


TOTAL PHOSPHORUS BY YEAR
TOTAL PHOSPHORUS (MG/L)
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
YEAR

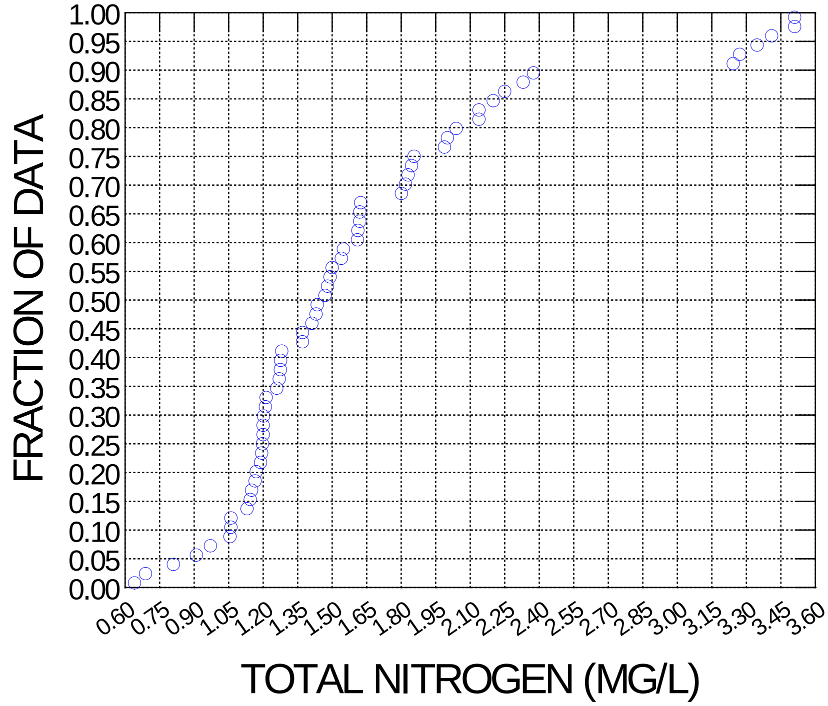

BOD5 BY YEAR
BOD5 (MG/L)
15.00
14.25
13.50
12.75
12.00
11.25
10.50
9.75
9.00
8.25
7.50
6.75
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
YEAR

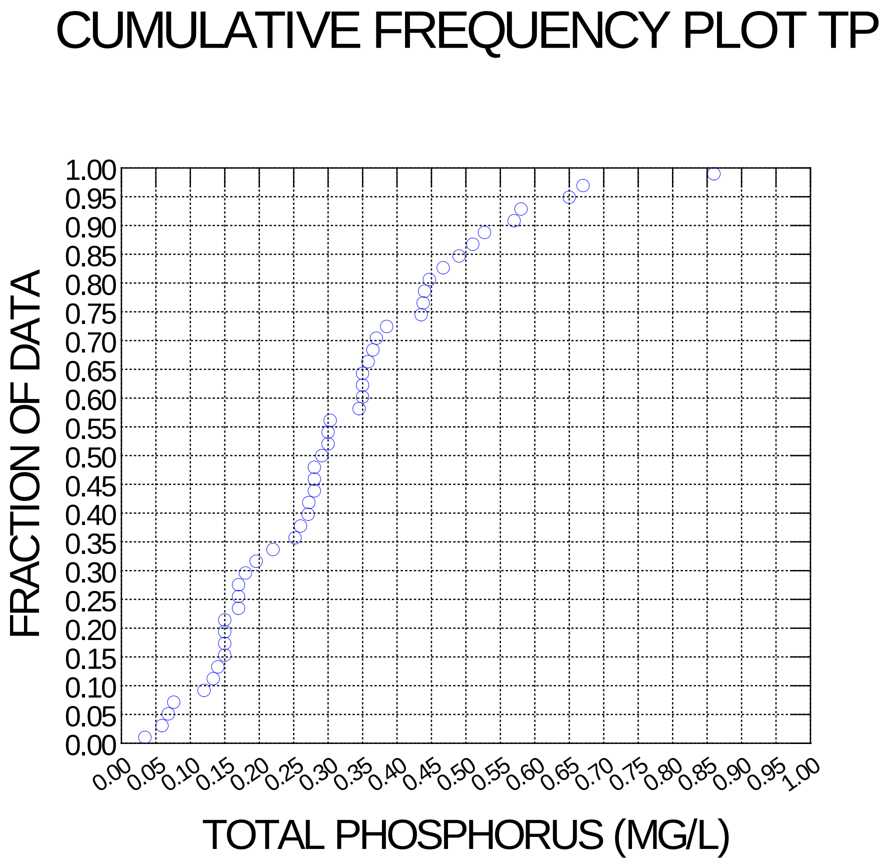

CUMULATIVE FREQUENCY PLOT DO
FRACTION OF DATA
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
DISSOLVED OXYGEN (MG/L)

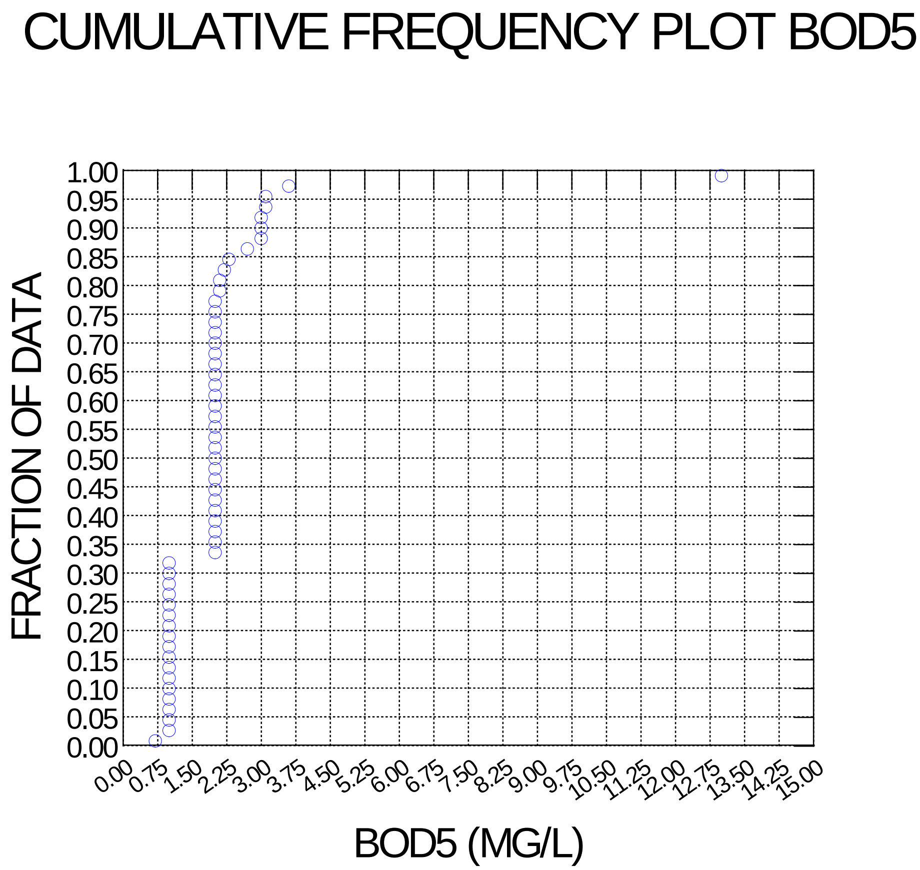

CUMULATIVE FREQUENCY PLOT DOSAT
FRACTION OF DATA
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
DOSAT (%)


CUMULATIVE FREQUENCY PLOT CHLAC
FRACTION OF DATA
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
1.5
3.0
4.5
6.0
7.5
9.0
10.5
12.0
13.5
15.0
16.5
18.0
19.5
21.0
22.5
24.0
25.5
27.0
28.5
30.0
CHLAC (UG/L)

CUMULATIVE FREQUENCY PLOT TN




CUMULATIVE FREQUENCY PLOT TP
FRACTION OF DATA
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95
1.00
TOTAL PHOSPHORUS (MG/L)


CUMULATIVE FREQUENCY PLOT BOD5
FRACTION OF DATA
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.75
1.50
2.25
3.00
3.75
4.50
5.25
6.00
6.75
7.50
8.25
9.00
9.75
10.50
11.25
12.00
12.75
13.50
14.25
15.00
BOD5 (MG/L)

Appendix D: Kruskal–Wallis Analysis of DO, DOSAT, CHLAC, TN, TP, and BOD5 Observations versus Season in the Trout River (WBID 2203)

Kruskal-Wallis One-Way Analysis of Variance for 290 cases
Dependent variable is DO
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	69	12164.000
SPRING	79	8850.500
SUMMER	77	7163.500
WINTER	65	14017.000

Kruskal-Wallis Test Statistic = 97.517
Probability is 0.000 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 287 cases
Dependent variable is DOSAT
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	69	10828.000
SPRING	79	9752.000
SUMMER	74	7798.000
WINTER	65	12950.000

Kruskal-Wallis Test Statistic = 51.333
Probability is 0.000 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 25 cases
Dependent variable is VCHLAC
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	6	51.000
SPRING	3	21.000
SUMMER	10	194.000
WINTER	6	59.000

Kruskal-Wallis Test Statistic = 15.045
Probability is 0.002 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 62 cases
Dependent variable is TN
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	13	384.000
SPRING	14	278.000
SUMMER	22	835.000
WINTER	13	456.000

Kruskal-Wallis Test Statistic = 9.312
Probability is 0.025 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 49 cases
Dependent variable is TP
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	8	134.000
SPRING	14	358.500
SUMMER	19	581.500
WINTER	8	151.000

Kruskal-Wallis Test Statistic = 7.094
Probability is 0.069 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 55 cases
Dependent variable is VBOD5
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	10	245.000
SPRING	12	281.000
SUMMER	20	634.500
WINTER	13	379.500

Kruskal-Wallis Test Statistic = 2.981
Probability is 0.395 assuming Chi-square distribution with 3 df

Appendix E: Kruskal–Wallis Analysis of DO, DOSAT, CHLAC, TN, TP, and BOD5 Observations versus Month in the Trout River (WBID 2203)

Kruskal-Wallis One-Way Analysis of Variance for 290 cases
Dependent variable is DO
Grouping variable is MONTH

Group	Count	Rank Sum
1	11	2458.000
2	19	4334.500
3	35	7224.500
4	16	1693.000
5	28	3784.000
6	35	3373.500
7	17	1479.500
8	31	2511.500
9	29	3172.500
10	16	2044.000
11	15	3076.500
12	38	7043.500

Kruskal-Wallis Test Statistic = 111.295
Probability is 0.000 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 287 cases
Dependent variable is DOSAT
Grouping variable is MONTH

Group	Count	Rank Sum
1	11	2182.000
2	19	3919.000
3	35	6849.000
4	16	1567.000
5	28	4204.000
6	35	3981.000
7	17	1787.000
8	30	2885.000
9	27	3126.000
10	16	2017.000
11	15	2783.000
12	38	6028.000

Kruskal-Wallis Test Statistic = 61.226
Probability is 0.000 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 25 cases
Dependent variable is VCHLAC
Grouping variable is MONTH

Group	Count	Rank Sum
2	3	21.000
3	3	38.000
4	3	21.000
7	3	62.000
8	3	53.500
9	4	78.500
11	6	51.000

Kruskal-Wallis Test Statistic = 16.347
Probability is 0.012 assuming Chi-square distribution with 6 df

Kruskal-Wallis One-Way Analysis of Variance for 62 cases
Dependent variable is TN
Grouping variable is MONTH

Group	Count	Rank Sum
1	2	55.000
2	6	186.000
3	5	215.000
4	7	139.000
5	3	79.000
6	4	60.000
7	6	239.500
8	7	326.500
9	9	269.000
10	3	113.500
11	8	227.000
12	2	43.500

Kruskal-Wallis Test Statistic = 16.146
Probability is 0.136 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 49 cases
Dependent variable is TP
Grouping variable is MONTH

Group	Count	Rank Sum
1	1	43.000
2	4	58.000
3	3	50.000
4	5	154.500
5	6	111.000
6	3	93.000
7	5	128.000
8	7	266.000
9	7	187.500
10	1	26.500
11	7	107.500

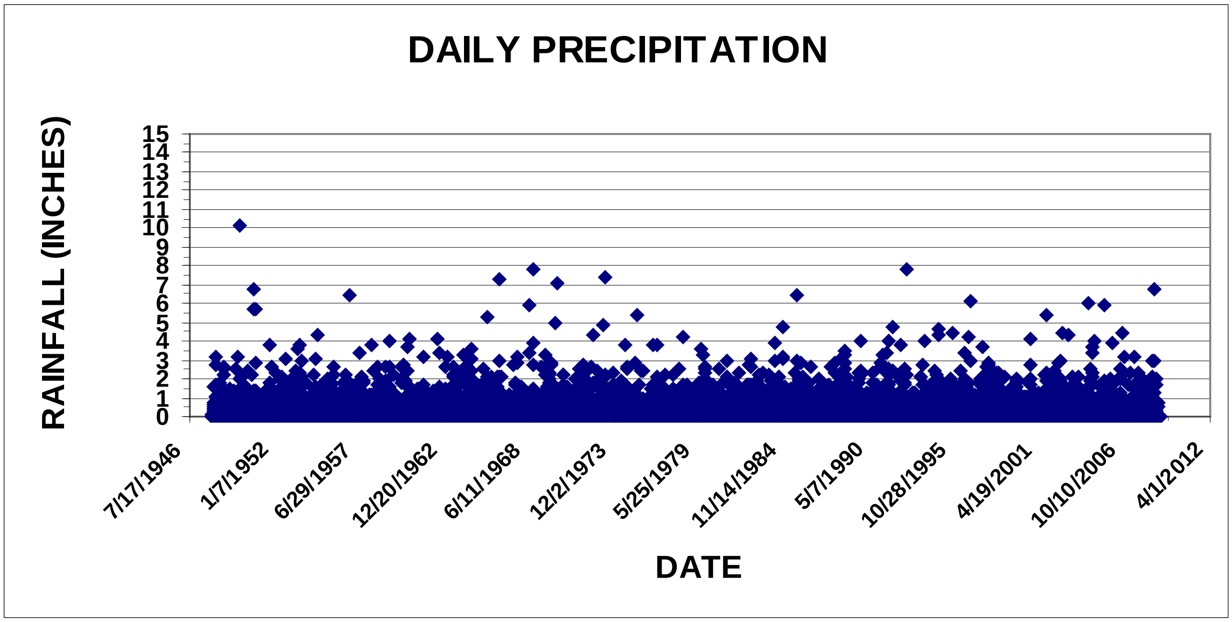
Kruskal-Wallis Test Statistic = 16.521
Probability is 0.086 assuming Chi-square distribution with 10 df

Kruskal-Wallis One-Way Analysis of Variance for 55 cases
Dependent variable is VBOD5
Grouping variable is MONTH

Group	Count	Rank Sum
1	2	65.000
2	6	180.000
3	5	134.500
4	6	160.000
5	3	91.000
6	3	30.000
7	5	147.500
8	7	238.000
9	8	249.000
10	3	51.000
11	6	184.000
12	1	10.000

Kruskal-Wallis Test Statistic = 9.515
Probability is 0.575 assuming Chi-square distribution with 11 df

Appendix F: Chart of Rainfall for JIA, 1948–2008



Appendix G: Spearman Correlation Matrix Analysis for Water Quality Parameters in the Trout River (WBID 2203)

Spearman correlation matrix

	PRECIP	PRECIP3DAY	PRECIP7DAY	PRECIP14DAY	JULIANDATE
PRECIP	1				
PRECIP3DAY	0.545	1			
PRECIP7DAY	0.343	0.623	1		
PRECIP14DAY	0.274	0.426	0.694	1	
JULIANDATE	-0.093	0.002	-0.111	-0.13	1
BOD5	-0.036	0.078	-0.079	-0.196	0.685
CHLORIDE	-0.037	0.054	-0.054	-0.111	0.55
CHLAC	0.417	0.272	0.405	0.449	0.448
COLOR	-0.006	-0.182	-0.178	0.027	0.15
COND	0.007	0.018	-0.065	-0.167	0.048
DO	-0.013	-0.046	-0.072	-0.136	-0.084
NO2NO3	0.091	0.217	0.3	0.21	0.015
AMMONIA	0.082	-0.016	0.014	-0.02	-0.288
TKN	-0.061	-0.228	-0.18	0.053	0.159
TN	-0.056	-0.197	-0.135	0.088	0.161
DOSAT	0.034	0.01	-0.034	-0.069	-0.097
PH	0.022	0.004	-0.102	-0.246	0.367
TOTALORTHOP	-0.205	-0.004	0.184	0.246	-0.039
TP	0.168	0.05	-0.046	0.054	-0.035
SULFATE	-0.081	0.31	0.228	-0.027	-0.141
TEMPC	0.174	0.139	0.095	0.218	0.035
TOC	-0.176	-0.648	-0.599	-0.358	0.508
TSS	0.023	0.153	0.045	-0.116	0.383
TURBIDITY	0.343	0.209	0.089	0.178	-0.241

Spearman correlation matrix (continued)

	BOD5	CHLORIDE	CHLAC	COLOR	COND
BOD5	1				
CHLORIDE	0.202	1			
CHLAC	0.621	0.114	1		
COLOR	-0.032	-0.617	0.113	1	
COND	0.323	0.409	0.285	-0.646	1
DO	-0.167	-0.069	-0.479	0.212	-0.315
NO2NO3	-0.047	-0.084	0.549	-0.066	0.139
AMMONIA	0.307	0.141	0.673	0.003	0.275
TKN	0.209	-0.124	0.307	0.435	-0.162
TN	0.2	-0.109	0.351	0.439	-0.167
DOSAT	-0.173	-0.114	-0.302	0.239	-0.283
PH	0.449	0.163	0.124	-0.634	0.207
TOTALORTHOP	0.674	-0.214	.	0.498	.
TP	0.364	-0.304	0.584	0.381	0.27
SULFATE	0.348	0.976	0.237	-0.644	0.978
TEMPC	0.102	-0.114	0.883	-0.071	0.349
TOC	-0.11	-0.66	-0.09	0.939	-0.74
TSS	0.357	0.423	0.469	-0.217	0.655
TURBIDITY	0.265	-0.371	0.484	0.173	0.353

	DO	NO2NO3	AMMONIA	TKN	TN
DO	1				
NO2NO3	-0.219	1			
AMMONIA	-0.161	0.204	1		
TKN	-0.22	-0.088	0.123	1	
TN	-0.23	0.005	0.143	0.989	1
DOSAT	0.962	-0.125	-0.156	-0.22	-0.225
PH	-0.037	0.509	-0.16	-0.323	-0.284
TOTALORTHOP	.	0.093	0.525	0.507	0.508
TP	-0.53	0.188	0.462	0.296	0.328
SULFATE	-0.19	0.302	0.457	-0.359	-0.339
TEMPC	-0.597	0.337	0.088	0.25	0.267
TOC	0.111	-0.354	-0.074	0.714	0.692
TSS	-0.404	0.197	0.527	0.141	0.159
TURBIDITY	-0.101	0.395	0.37	0.142	0.184

Spearman correlation matrix (continued)

	DOSAT	PH	TOTALORTHOP	TP	SULFATE
DOSAT	1				
PH	-0.014	1			
TOTALORTHOP	.	.	1		
TP	-0.442	-0.033	0.3	1	
SULFATE	-0.209	0.695	.	0.155	1
TEMPC	-0.385	0.127	.	0.525	0.082
TOC	0.091	-0.607	.	0.174	-0.712
TSS	-0.38	0.569	-0.097	0.219	0.585
TURBIDITY	-0.065	0.146	-0.075	0.537	0.331

	TEMPC	TOC	TSS	TURBIDITY
TEMPC	1			
TOC	-0.155	1		
TSS	0.399	-0.219	1	
TURBIDITY	0.277	-0.017	0.416	1

Pair-wise frequency table

	PRECIP	PRECIP3DAY	PRECIP7DAY	PRECIP14DAY	JULIANDATE
PRECIP	423				
PRECIP3DAY	423	423			
PRECIP7DAY	423	423	423		
PRECIP14DAY	423	423	423	423	
JULIANDATE	423	423	423	423	423
BOD5	55	55	55	55	55
CHLORIDE	142	142	142	142	142
CHLAC	25	25	25	25	25
COLOR	48	48	48	48	48
COND	186	186	186	186	186
DO	290	290	290	290	290
NO2NO3	62	62	62	62	62
AMMONIA	151	151	151	151	151
TKN	62	62	62	62	62
TN	62	62	62	62	62
DOSAT	287	287	287	287	287
PH	288	288	288	288	288
TOTALORTHOP	15	15	15	15	15
TP	49	49	49	49	49
SULFATE	29	29	29	29	29
TEMPC	296	296	296	296	296
TOC	27	27	27	27	27
TSS	59	59	59	59	59
TURBIDITY	45	45	45	45	45

Pair-wise frequency table (continued)

	BOD5	CHLORIDE	CHLAC	COLOR	COND
BOD5	55				
CHLORIDE	27	142			
CHLAC	13	8	25		
COLOR	35	36	15	48	
COND	31	47	15	33	186
DO	30	102	14	31	184
NO2NO3	54	33	15	42	35
AMMONIA	53	122	15	42	57
TKN	53	33	15	42	35
TN	54	33	15	42	35
DOSAT	30	101	14	31	184
PH	31	103	15	33	185
TOTALORTHOP	11	15	0	14	0
TP	37	36	15	45	35
SULFATE	21	21	14	29	29
TEMPC	31	102	15	32	185
TOC	24	16	14	27	27
TSS	51	34	14	39	31
TURBIDITY	38	33	15	42	31

	DO	NO2NO3	AMMONIA	TKN	TN
DO	290				
NO2NO3	34	62			
AMMONIA	100	61	151		
TKN	34	61	61	62	
TN	34	62	61	61	62
DOSAT	287	34	99	34	34
PH	286	35	100	35	35
TOTALORTHOP	0	14	14	15	14
TP	34	44	44	45	44
SULFATE	27	24	24	24	24
TEMPC	287	35	100	35	35
TOC	26	27	27	27	27
TSS	30	58	58	58	58
TURBIDITY	30	44	44	44	44

Pair-wise frequency table (continued)

	DOSAT	PH	TOTALORTHOP	TP	SULFATE
DOSAT	287				
PH	286	288			
TOTALORTHOP	0	0	15		
TP	34	34	15	49	
SULFATE	27	29	0	27	29
TEMPC	287	287	0	35	28
TOC	26	27	0	27	24
TSS	30	31	15	41	24
TURBIDITY	30	31	14	44	24

	TEMPC	TOC	TSS	TURBIDITY
TEMPC	296			
TOC	27	27		
TSS	31	24	59	
TURBIDITY	31	27	41	45

Appendix H: Linear Regression Analysis of DO and CHLAC Observations versus Nutrients and BOD in the Trout River (WBID 2203)

Dep Var: DO   N: 30   Multiple R: 0.179   Squared multiple R: 0.032

Adjusted squared multiple R: 0.000   Standard error of estimate: 2.049

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	5.092	0.576	0.000	.	8.837	0.000
VBOD5	-0.174	0.181	-0.179	1.000	-0.963	0.344

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	3.896	1	3.896	0.928	0.344
Residual	117.537	28	4.198		

*** WARNING ***
Case 256 has large leverage (Leverage = 0.902)

Durbin-Watson D Statistic 1.114
First Order Autocorrelation 0.417

Dep Var: DO   N: 34   Multiple R: 0.339   Squared multiple R: 0.115

Adjusted squared multiple R: 0.087   Standard error of estimate: 1.866

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	6.344	0.850	0.000	.	7.464	0.000
TN	0.985	0.483	-0.339	1.000	-2.039	0.050

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	14.481	1	14.481	4.157	0.050
Residual	111.467	32	3.483		

Durbin-Watson D Statistic 1.037
First Order Autocorrelation 0.442

Dep Var: DO N: 34 Multiple R: 0.732 Squared multiple R: 0.536

Adjusted squared multiple R: 0.490 Standard error of estimate: 1.395

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	10.406	2.239	0.000	.	4.647	0.000
TN	-1.136	1.410	-0.391	0.066	-0.806	0.427
VTEMPC	-0.261	0.101	-0.880	0.134	-2.588	0.015
VTEMPC*TN	0.036	0.058	0.407	0.036	0.618	0.541

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	67.538	3	22.513	11.563	0.000
Residual	58.410	30	1.947		

*** WARNING ***
Case 398 has large leverage (Leverage = 0.472)

Durbin-Watson D Statistic 2.336
First Order Autocorrelation -0.196

Dep Var: DO N: 287 Multiple R: 0.523 Squared multiple R: 0.273

Adjusted squared multiple R: 0.271 Standard error of estimate: 1.846

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	8.545	0.396	0.000	.	21.581	0.000
VTEMPC	-0.182	0.018	-0.523	1.000	-10.349	0.000

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	365.110	1	365.110	107.092	0.000
Residual	971.655	285	3.409		

*** WARNING ***
Case 53 is an outlier (Studentized Residual = 7.485)
Case 54 is an outlier (Studentized Residual = 7.485)
Case 130 is an outlier (Studentized Residual = 3.975)
Case 131 is an outlier (Studentized Residual = 3.975)

Durbin-Watson D Statistic 1.223
First Order Autocorrelation 0.388

Dep Var: DO   N: 34   Multiple R: 0.741   Squared multiple R: 0.550

Adjusted squared multiple R: 0.505   Standard error of estimate: 1.276

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	10.605	1.332	0.000	.	7.962	0.000
VTEMPC	-0.252	0.064	-0.876	0.304	-3.943	0.000
TP	-14.114	4.934	-1.421	0.061	-2.861	0.008
VTEMPC*TP	0.458	0.198	1.367	0.043	2.310	0.028

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	59.646	3	19.882	12.210	0.000
Residual	48.851	30	1.628		

*** WARNING ***

Case 245 has large leverage (Leverage = 0.441)

Case 256 has large leverage (Leverage = 0.443)

Durbin-Watson D Statistic 2.333

First Order Autocorrelation -0.203

Dep Var: DO N: 30 Multiple R: 0.846 Squared multiple R: 0.716

Adjusted squared multiple R: 0.642 Standard error of estimate: 1.100

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	8.471	2.058	0.000	.	4.117	0.000
VTEMPC	-0.098	0.127	-0.357	0.059	-0.776	0.446
TP	-23.699	6.637	-2.340	0.029	-3.571	0.002
TN	2.315	1.486	0.881	0.039	1.558	0.133
VTEMPC*TP	0.670	0.216	2.026	0.029	3.104	0.005
TP*TN	2.202	2.690	0.641	0.020	0.819	0.421
VTEMPC*TN	-0.131	0.082	-1.618	0.012	-1.587	0.126

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	70.081	6	11.680	9.655	0.000
Residual	27.824	23	1.210		

*** WARNING ***
Case 174 has large leverage (Leverage = 0.751)
Case 245 has large leverage (Leverage = 0.625)
Case 398 has large leverage (Leverage = 0.559)

Durbin-Watson D Statistic 2.313
First Order Autocorrelation -0.164

Dep Var: VCHLAC N: 15 Multiple R: 0.538 Squared multiple R: 0.289

Adjusted squared multiple R: 0.096 Standard error of estimate: 5.850

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	2.406	7.887	0.000	.	0.305	0.766
TP	-42.369	45.409	-1.369	0.030	-0.933	0.371
VTEMPC	0.105	0.419	0.130	0.244	0.252	0.806
VTEMPC*TP	1.644	1.642	1.685	0.023	1.001	0.338

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	153.308	3	51.103	1.493	0.270
Residual	376.390	11	34.217		

*** WARNING ***
Case 245 has large leverage (Leverage = 0.954)
Case 256 has large leverage (Leverage = 2.632)
Case 360 has large leverage (Leverage = 1.278)
Case 386 is an outlier (Studentized Residual = 25.753)

Durbin-Watson D Statistic 2.142
First Order Autocorrelation -0.087

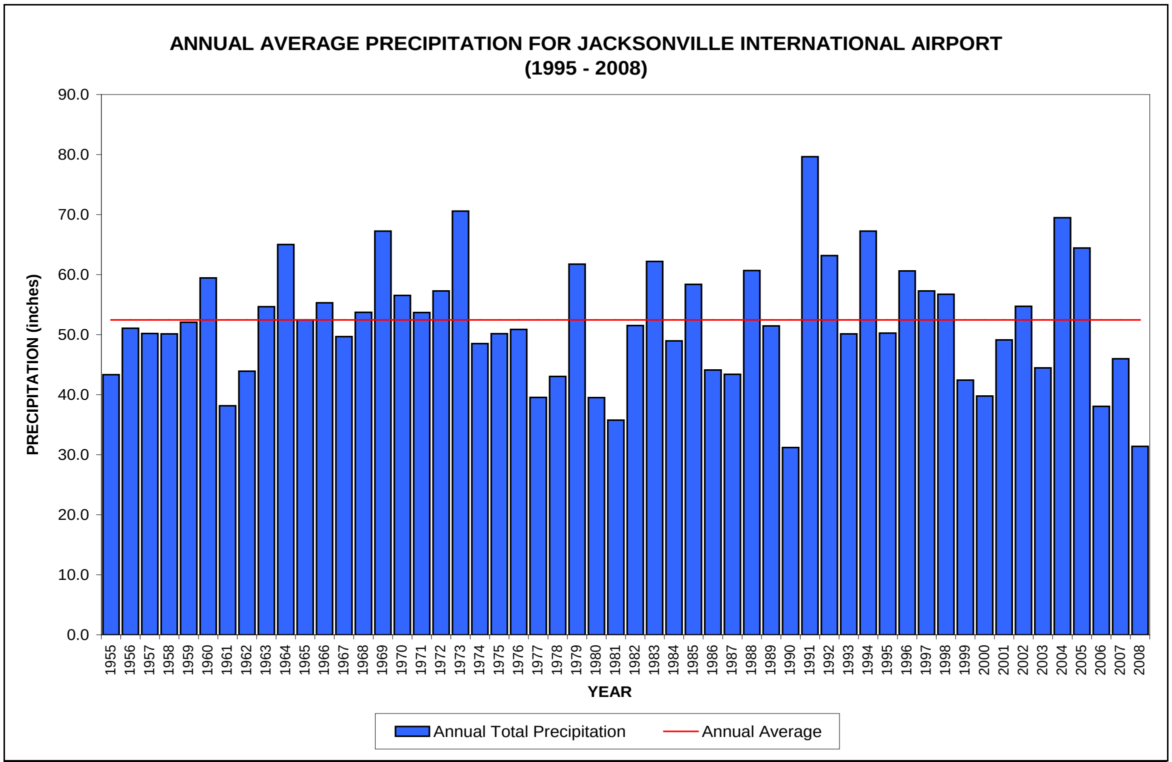
Appendix I: Monthly and Annual Precipitation at JIA, 1955–2008

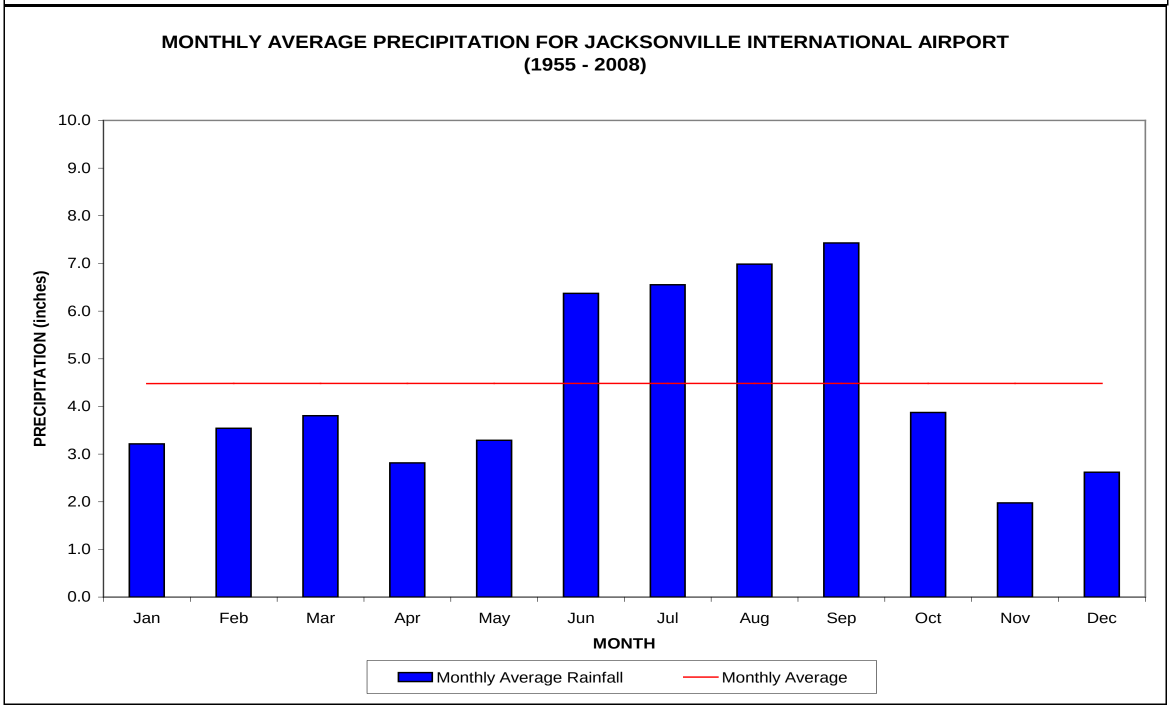
NOTE: Rainfall is in inches, and represents data from JIA.

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

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1997	2.9	1.28	1.84	4.56	3.43	6.33	7.69	8.24	3.97	4.84	2.4	9.8	**57.27**
1998	3.5	11.1	2.64	4.71	0.96	2.95	7.29	10.1	7.65	3.01	2.4	0.4	**56.72**
1999	4.6	1.7	0.4	1.92	1.02	7.75	3.56	3.51	13	3.24	0.8	0.9	**42.44**
2000	2.8	1.17	1.79	2.6	1.15	2.43	5.69	7.38	11.6	0.23	1.6	1.4	**39.77**
2001	0.9	0.68	5.48	0.62	2.56	5.59	8.31	3.58	16	0.81	1.4	3.1	**49.14**
2002	4.5	0.82	4.38	2.41	0.47	6.24	7.8	8.14	9.31	2.58	2.7	5.4	**54.72**
2003	0.1	4.66	10.7	2.63	2.54	6.75	7.33	1.83	3.04	2.98	0.7	1.2	**44.47**
2004	1.6	4.47	1.36	2.02	1.24	17.2	8.6	9.85	16.3	1.32	2.9	2.7	**69.47**
2005	1.9	3.56	3.67	4.53	3.51	14.8	7.37	4.43	5.76	6.49	1.1	7.4	**64.44**
2006	2.30	3.91	0.68	1.22	2.01	7.25	3.97	7.08	4.55	1.81	0.39	2.90	**38.07**
2007	2.29	2.40	2.22	1.02	1.12	6.68	9.48	3.57	5.44	8.85	0.17	2.74	**45.98**
2008	2.63	5.22	3.50	2.34	0.66	8.21	8.73	16.83	5.84	1.62	1.01	0.59	**46.01**
AVG:	**3.21**	**3.54**	**3.81**	**2.82**	**3.29**	**6.37**	**6.55**	**6.99**	**7.43**	**3.87**	**1.98**	**2.62**	**52.32**

Appendix J: Annual and Monthly Average Precipitation at JIA





Appendix K: Response to Comments

July 15, 2009

Mr. Jan Mandrup-Poulsen
Total Maximum Daily Load Program
2600 Blair Stone Road - Mail Station 3555
Tallahassee, FL, 32399-2400

Subject: Draft Total Maximum Daily Loads for the Ortega (WBID 2213P), Trout (WBID 2203), and Arlington (WBID 226SA) Rivers

Dear Mr. Mandrup-Poulsen:

The City of Jacksonville has reviewed the following Draft Total Maximum Daily Load Reports presented to stakeholder on July 9, 2009 at the Northeast District of the Florida Department of Environmental Protection.

Arlington River (WBID 2265A)
Ortega River (WBID 2213P)
Trout River (WBID 2203)

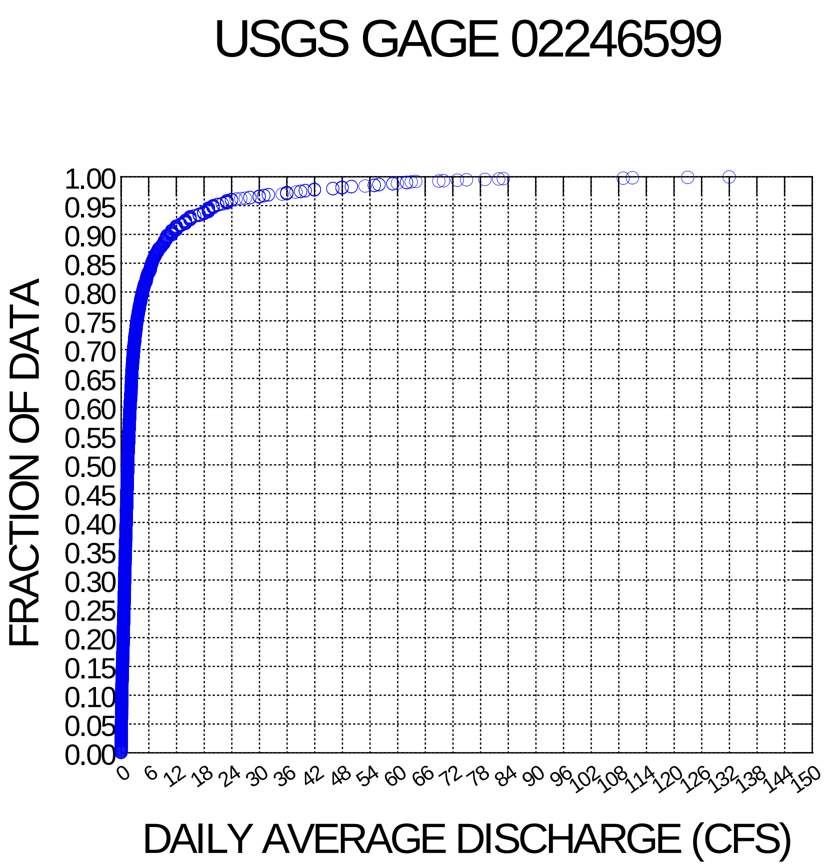
We would like to offer the following comments with regards to these TMDLs and their relationship to the previously established TMDL for the Mainstem of the Lower St Johns River Basin.

1) Explain why upstream tributary areas to the WBIDs appear to exclude some areas (see Figure 4.4 for Arlington River, Figure 4.6 for Ortega River, Figure 4.5 for Trout River). These figures exclude large sections of upstream tributary area.

Department Response: The intent of these figures and load estimates was to provide an overview of relative contributions of nitrogen and phosphorus from various sources to the impaired WBID from upstream areas. If the City could provide a GIS coverage of the upstream tributary drainage area for these WBIDs, the analysis could be revised. As noted in the documents, it was our understanding that the City has contracted with Camp Dresser & McKee, Inc. to model these sub-basins with the Watershed Management Model to develop discharge and pollutant load information as part of an update to the Master Stormwater Management Plan. Determination of the assimilative capacity described in Chapter 5 was based upon relationships between observed water quality parameters in the impaired WBID and the source assessment described in Chapter 4 was not a factor in the development of nutrient reductions.

2) The measured TN and TP concentrations for the Trout River appear to be higher than would be expected for a relatively undeveloped basin. The higher measured concentrations suggest that there is some load in the watershed that is not accounted for, and/ or the station is affected by high downstream TN and TP concentrations migrating upstream. A portion of this inconsistency could be due to tidal influences from the St Johns River.

Department Response: As noted in the document, there was a considerable increase in the median TN and TP medians in the Middle Trout River WBID (2203) compared to the upper Trout River WBID (2223). Based on data from the Impaired Waters Rule Run 35 database, the median TN and TP concentrations for WBID 2203 were 1.43 mg/L and 0.296 mg/L respectively, versus medians of 0.55 mg/L and 0.068 mg/L, respectively, in WBID 2223 over the same period. Over the same period, median TN and TP concentrations in the downstream Trout River WBID (2203A) were 0.93 mg/L and 0.13 mg/L, respectively. With respect to effects by high downstream TN and TP concentrations migrating upstream, flow records from the USGS site (02246599) located near the bottom of the middle Trout River WBID did not reflect any negative flows over the period of record (10/1/2002 – 8/10/2006). Daily flows ranged between 0.04 and 130 cubic feet per second (CFS) with a mean flow of 4.9 CFS. A cumulative frequency plot of flow is presented below. As part of the county stormwater program and phase 1 MS4 monitoring, has the county identified a possible source that would explain the elevation in TN and TP levels in this WBID?



3) For the Trout River, the relatively low estimated TP loads/ concentrations and the high measured TP concentrations indicate an inconsistency between the modeling and observed conditions. The TMDL for the Trout River should be revisited to account for the additional nutrient source.

Department Response: The load/concentration estimates described in Chapter 4 were provided to indicate the relative importance of various sources of nutrients in the watershed. It is our understanding that the City has contracted with Camp Dresser & McKee, Inc. to model the Trout River sub-basin with the Watershed Management Model to develop discharge and pollutant load information as part of an update to the Master Stormwater Management Plan. The TMDL reductions were not based on model estimated loads and/or concentrations. As discussed in Chapter 5, the assimilative capacity was based upon relationships developed between water quality measurements taken in the middle Trout River WBID.

4) In general, the draft TMDLs for the Arlington, Ortega, and Trout Rivers apply to WBIDs that border the LSJR and are highly tidally influenced. Measured water quality values within these tidally influenced WBIDs are most likely reflective of water quality within the LSJR itself. The reductions needed to protect these WBIDs from impairment will be addressed through the LSJR Mainstem Basin Management Action Plan (BMAP). The projects identified in the Mainstem BMAP will Fe protective of water quality in these WBIDs and will achieve the specific load reductions.

Department Response: Once relationships between dissolved oxygen, chlorophyll and nutrients were developed for these impaired waters, the percent reduction in nitrogen required under the Mainstem nutrient TMDL was the starting point to assess whether designated uses would be restored within these tributaries with implementation of nitrogen reductions. In the case of the middle Trout River WBID, the TMDL also requires a reduction in total phosphorus. We concur that implementation of projects that improve water quality in the mainstem of the St. Johns River should also benefit the Arlington and portions of the Ortega and Trout Rivers due to tidal exchange,

Please feel free to contact me at Pappas@coj.net or 904-255-8753 if you have any questions.

Very truly yours,

John P. Pappa,
Deputy Director Public Works
City of Jacksonville

cc: Bill Joyce, COJ
Vince Seibold, COJ
Lisa Sterling, CDM
Patrick Victor, CDM
August 10, 2009

Mr. Joshua Boan
Environmental Process/Natural Sciences Manager
Environmental Research Administrator
605 Suwannee Street MS 37
Tallahassee, FL 32399
Ph: 850-414-5266
Email: joshua.boan@dot.state.fl.us

Re: FDOT Comments on Newly Released Draft TMDLs

Dear Mr. Boan,

The Department appreciates the time and effort you and your staff put into reviewing these draft TMDLs. We have made necessary edits to some draft TMDL reports as a result of your comments. Because of your efforts, the final TMDL will be improved. To aid you in reviewing our responses, we have included your comments, followed by a response to each (in blue), in the order in which they were presented. Please contact me at Jan.Mandrup-Poulsen@dep.state.fl.us. if you have any further questions.

Sincerely

Jan Mandrup-Poulsen, Administrator
Watershed Evaluation and TMDL Section
Florida Department of Environmental Protection

DISTRICT 2 COMMENTS

GENERAL COMMENTS

The following comments relate to multiple TMDLs where specific comments are provided below for each of the TMDL documents.

1. It appears that the nutrient load assessments for the transportation category (Chapter 4) are based upon values presented in Harper (2007) (i.e., 1.64 mg/l TN and 0.22 mg/l TP). Harper's numbers are determined by averaging the average results from eleven different datasets from studies conducted between 1975 and 2005. Each study was given equal weight in the averaging procedure regardless of the number of events sampled and the methodologies used. Between December 2004 and October 2007 roadway runoff water quality data were collected by Johnson Engineering for FDOT District 1 at four locations within District 1. Ten events were sampled for each of the four locations, with samples collected at both the inflows and outflows of existing stormwater treatment ponds. All collection, transfer, and handling procedures were conducted in accordance with FDEP Standard Operating Procedures, and samples were analyzed by certified labs. Average values for TN and TP ***at the pond inflows*** were determined to be 1.17 mg/l and 0.158 mg/l, respectively. [It is perhaps noteworthy to observe that the highest average TN and TP values were measured at the first site sampled (i.e., samples collected between December 2004 and November 2005) which is also the site with the lowest percentage of impervious area.] Given the changes to roadway management practices that FDOT has undertaken over the past several years and the rigorous quality control used in these studies compared with the older studies, we believe that the numbers presented by Johnson Engineering are

more representative than Harper's numbers of present day TN and TP loading conditions. [This comment applies to all nutrient and DO TMDL documents reviewed. This included WBIDs 2410, 2389, 2203, 2213P,2265A, 2460, 2589, 2578.]

Department Response: A copy of the Johnson Engineering Study report was not included with the comments we received. If FDOT could provide the report to Mr. Eric Livingston (Bureau Chief for the Bureau of Watershed Restoration) it will be reviewed for incorporation into the stormwater database and used in estimating transportation event mean concentrations (EMCs).

1. The load reductions determined for the non-point sources, which include the WLA for the stormwater (under the MS4 permit) and the LA, have not been allocated but simply applied evenly between the WLA for Stormwater and the LA. Sufficient studies have not been completed to determine if an even distribution of the load reductions is justified, therefore some language acknowledging this (within the TMDL and ultimately within the Rule) should be put into both the TMDL documents and ultimately the rules to allow the ability to finalize (and therefore change the assigned reductions) under the BMAP. [This comment applies to all TMDLs reviewed in which there was an WLA-MS4 allocation specified.]

Department Response: In 2001, the Department submitted to the Governor and Legislature a document outlining the intended process for the allocation of loads under the TMDL Program. One key provision of the proposal was to level the "playing field," such that once stakeholders had the opportunity to meet and discuss what steps needed to be taken and to get appropriate credit for those initiatives already completed, the specific allocations would be set by the agreements reached under the Basin Management Action Plan (BMAP). This process has been successfully used in several adopted BMAPs and has demonstrated the flexibility that remains after setting the initial reductions for stormwater-related allocations (LA and WLA_{sw}) at identical levels.

The laws of Florida form the underlying basis for the initial equal allocations. In particular, Section 403.067(6)(b) of Florida Statutes, states in part that:

"Allocations may also be made to individual basins and sources or as a whole to all basins and sources or categories of sources of inflow to the water body or water body segments. An initial allocation of allowable pollutant loads among point and nonpoint sources may be developed as part of the total maximum daily load. However, in such cases, the detailed allocation to specific point sources and specific categories of nonpoint sources shall be established in the basin management action plan…"

Additionally, each of the draft TMDL reports contains language in the NPDES Stormwater Discharges section in Chapter 6 of the reports (repeated below) to address the issue of allocation between the WLA for stormwater and the LA portions of the TMDL.

"It should be noted that any MS4 permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction."

SPECIFIC COMMENTS

The following are specific comments referenced to the individual TMDL documents reviewed.

LOWER ST. JOHNS RIVER BASIN

Trout River (WBID 2203): DO/Nutrients

1. Predicted TN loadings presented in Chapter 4 agree fairly well with the available data. Predicted TP loadings (0.107 mg/l), however, are about one-third of the measured values. Failure to include groundwater cannot explain both of these conditions as groundwater seepage from septic tanks would increase both TN and TP, and probably TN to a greater degree than TP. Therefore, it seems that there is a significant source of TP that is not being accounted for in the model. Total P concentrations measured in area reference streams suggest that much of the measured phosphorus in Trout Creek could be from natural sources. In fact, one of the reference streams cited in Table 5.7, Alligator Creek, has an average phosphorus concentration of 0.234 mg/l compared with the measured average value of 0.314 mg/l in Trout River. Even at these higher TP levels, Alligator Creek had better DO values than another of the reference streams, Thomas Creek, which had an average TP of 0.049 mg/l. Application of a more reasonable 30 percent reduction to the TP values in Trout River will provide a target TP of 0.220 mg/l which is also within the range of values for the three reference streams.

   Department Response: As noted in the document, there was a considerable increase in the median TN and TP medians in the Middle Trout River WBID (2203) compared to the upper Trout River WBID (2223). Based on data from the Impaired Waters Rule Run 35 database, the median TN and TP concentrations for WBID 2203 were 1.43 mg/L and 0.296 mg/L, respectively, versus medians of 0.55 mg/L and 0.068 mg/L respectively, in WBID 2223 over the same period. Over the same period, median TN and TP concentrations in the downstream Trout River WBID (2203A) were 0.93 mg/L and 0.13 mg/L, respectively. Based upon the land use similarities between the upper and middle River WBIDs, it is unclear that the significant increase in phosphorus is due to natural sources.

Florida Department of Environmental Protection
Division of Environmental Assessment and Restoration
Bureau of Watershed Restoration
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