FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration,

Bureau of Watershed Restoration

NORTHEAST DISTRICT • LOWER ST. JOHNS BASIN

Draft TMDL Report

Dissolved Oxygen and Nutrient TMDLs for Trout River, WBID 2203

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June 2009

Acknowledgments

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TMDL Program

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Identification of Impaired Surface Waters Rule

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

STORET Program

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

2008 305(b) Report

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

Criteria for Surface Water Quality Classifications

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

Basin Assessment Report for the Lower St. Johns River Basin

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

U.S. Environmental Protection Agency, 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 River 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 River 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 River Basin verified list that was adopted by Secretarial Order in May 2009. This TMDL establishes the allowable loadings to Trout River that would restore the waterbody so that it meets its applicable water quality criterion 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 within the total 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 approximately 15.5 miles, 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 mi², which 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 creek's hydrology and geology are available in the Basin Status Report for the Lower St. Johns Basin (Florida Department of Environmental Protection [FDEP], 2004).

For assessment purposes, the Department has divided the 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 – 2203A, 2203, and 2223. This TMDL is addresses the middle segment, WBID 2203, as shown in **Figure 1.2** for dissolved oxygen 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 River 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 (WBID 2203) in Duval County

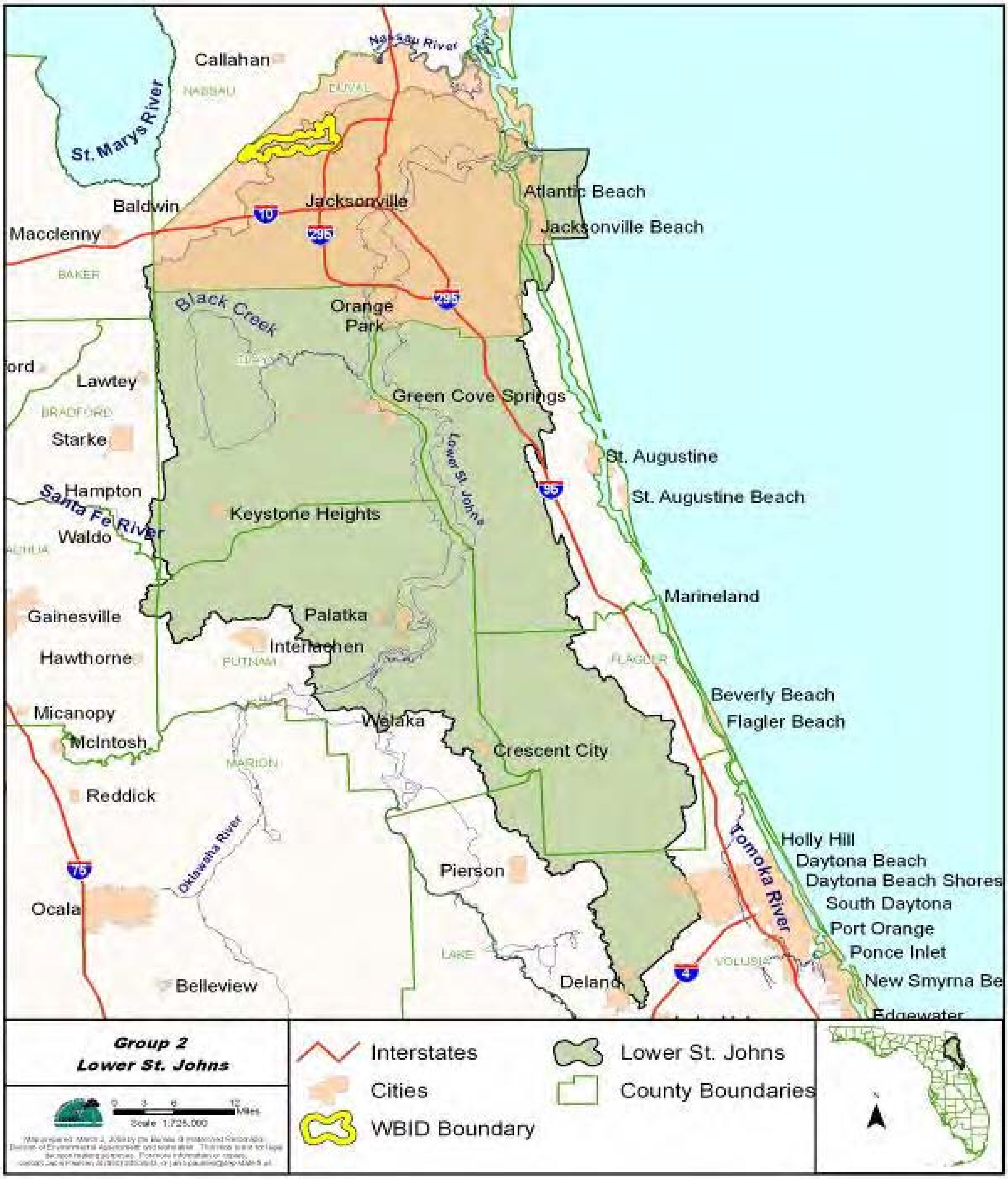


Figure 1.2. Location of the Trout River (WBID 2203) in Duval County and Major Hydrological Features in the Area

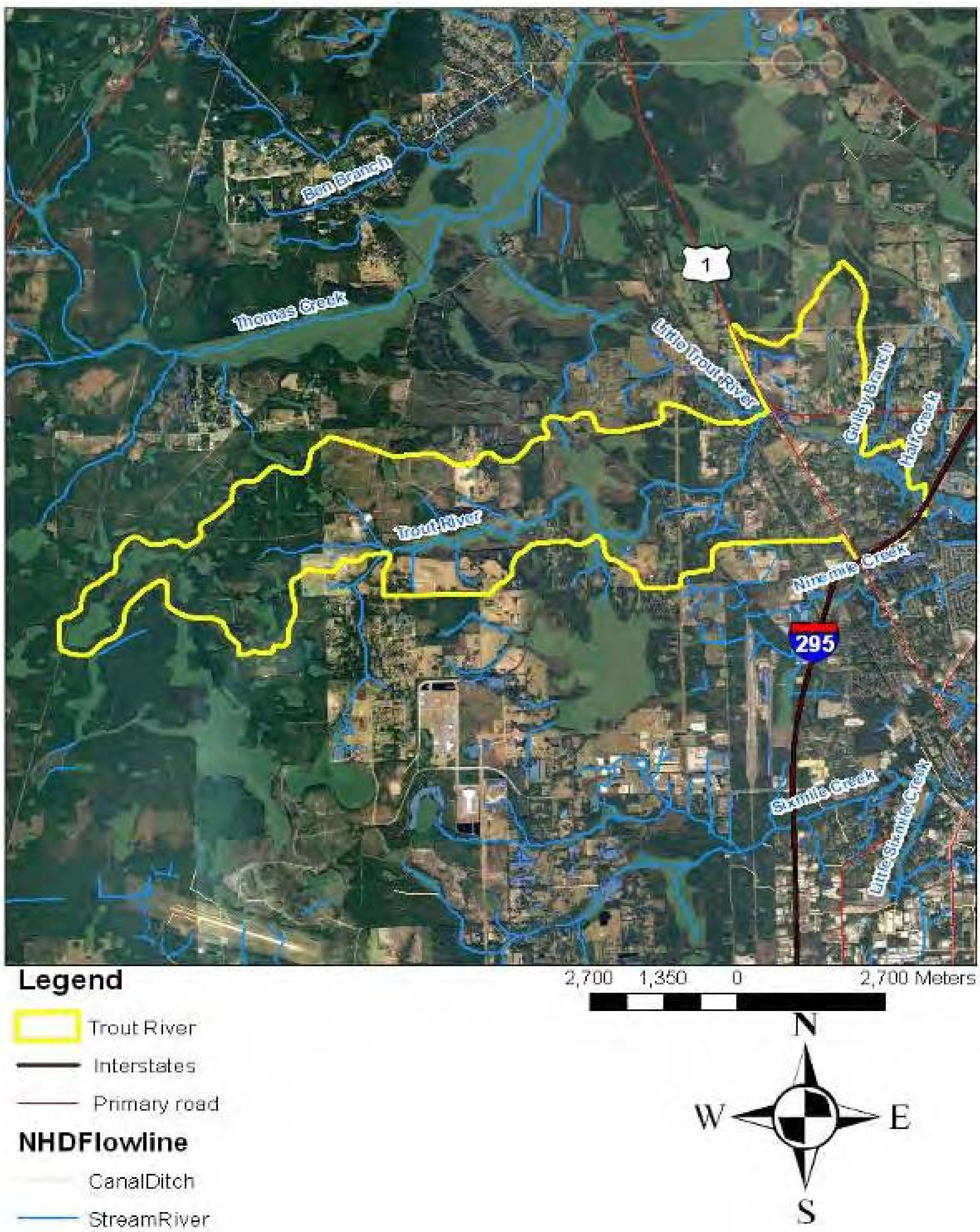
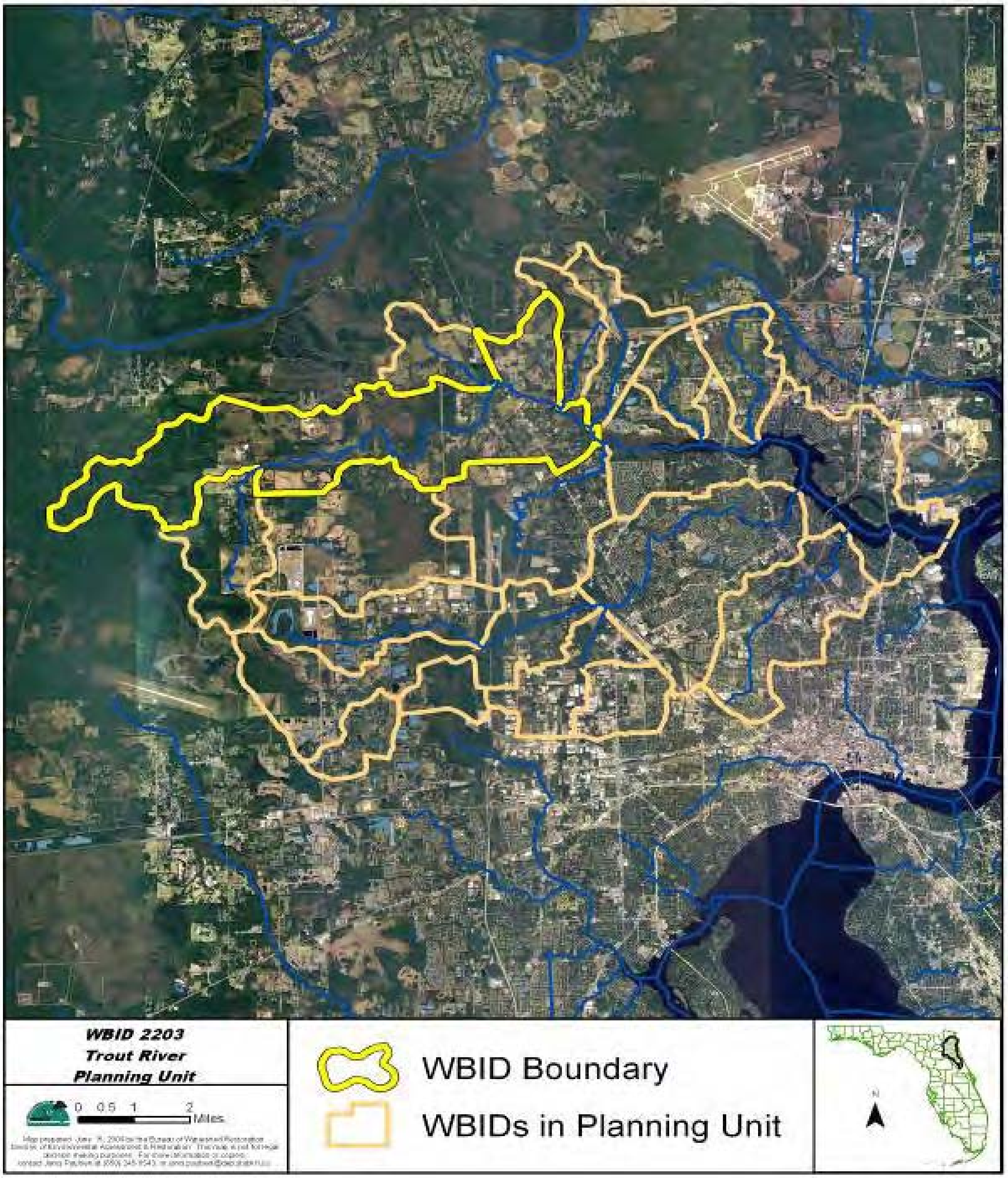


Figure 1.3. WBIDs in the Trout River Planning Unit



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 mainstem of the Lower St. Johns River that required between a 30 and 50 percent reduction in anthropogenic loadings of nitrogen to the marine portion of the Lower St. Johns River. 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 Lower St. Johns 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 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 River Basin. However, the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rulemaking process, the Environmental Regulation Commission adopted the new methodology as 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. **Tables 2.1** through **2.4** summarize the DO data for the cycle 1 verification period, which for Group 2 waters was January 1, 1996, through June 30, 2003, by overall, month, season, and year, respectively. The DO impairment was reaffirmed in the cycle 2 verification 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 were also evaluated. DO saturation ranged from 7.0 to 99.3 percent, averaging 47.1 percent. Fewer than 10 percent of the DO saturation 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 will be further assessed using the complete historical dataset in Chapter 5.

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)

Waterbody (WBID)	Parameter	Dissolved Oxygen
Trout River (2203)	Total number of samples	69
	IWR-required number of exceedances for the Verified List	11
	Number of observed exceedances	44 (63.8%)
	Number of observed nonexceedances	25
	Number of seasons during which samples were collected	4
	Highest observation (mg/L)	8.62
	Lowest observation (mg/L)	0.5
	Median observation (mg/L)	4.03
	Mean observation (mg/L)	4.26
	Median value for 34 BOD observations (mg/L)	2.0
	Median value for 40 TN observations (mg/L)	1.22
	Median value for 40 TP observations (mg/L)	0.51
	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)

Month	N	Minimum	Maximum	Median	Mean	No of Exceedances	% Exeedance	Mean Precipitation
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

DO units are mg/L.
Mean precipitation is for Jacksonville International Airport, in inches.

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

Season	N	Minimum	Maximum	Median	Mean	No of Exceedances	% Exeedance	Mean Total Precipitation
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

DO units are mg/L.
Mean total precipitation is for Jacksonville International Airport, in inches.

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

Year	N	Minimum	Maximum	Median	Mean	No of Exceedances	% Exeedance	Total Precipitation
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

DO units are mg/L.
Mean total precipitation is for Jacksonville International Airport, in inches.

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

Waterbody (WBID)	Parameter	Dissolved Oxygen
Trout River (2203)	Total number of samples	96
	IWR-required number of exceedances for the Verified List	14
	Number of observed exceedances	60 (62.5%)
	Number of observed nonexceedances	36
	Number of seasons during which samples were collected	4
	Highest observation (mg/L)	9.39
	Lowest observation (mg/L)	0.5
	Median observation (mg/L)	3.85

	Mean observation (mg/L)	4.30
	Median value for 34 BOD observations (mg/L)	2.0
	Median value for 40 TN observations (mg/L)	1.43
	Median value for 40 TP observations (mg/L)	0.296
	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 freshwater waterbody, with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to the impairment addressed by this TMDL is for 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 freshwater waters, as established by Rule 62-302, F.A.C., states the following:

> ***Dissolved Oxygen Criteria:***
> *Shall not be less than 5.0. Normal daily and seasonal fluctuations above these levels shall be maintained.*

DO concentrations in ambient waters can be controlled by many factors, including the DO solubility, which is controlled by temperature and salinity; DO enrichment processes influenced by reaeration, which is controlled by flow velocity; photosynthesis of phytoplankton, periphyton, and other aquatic plants; DO consumption from the decomposition of organic materials in the water column and 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 chla 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 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 chlorophyll a concentration did not exceed the IWR stream thresholds (2007 annual average = 3.2 ug/L), nutrients were considered impaired 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 to DO impairments.

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, including those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

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

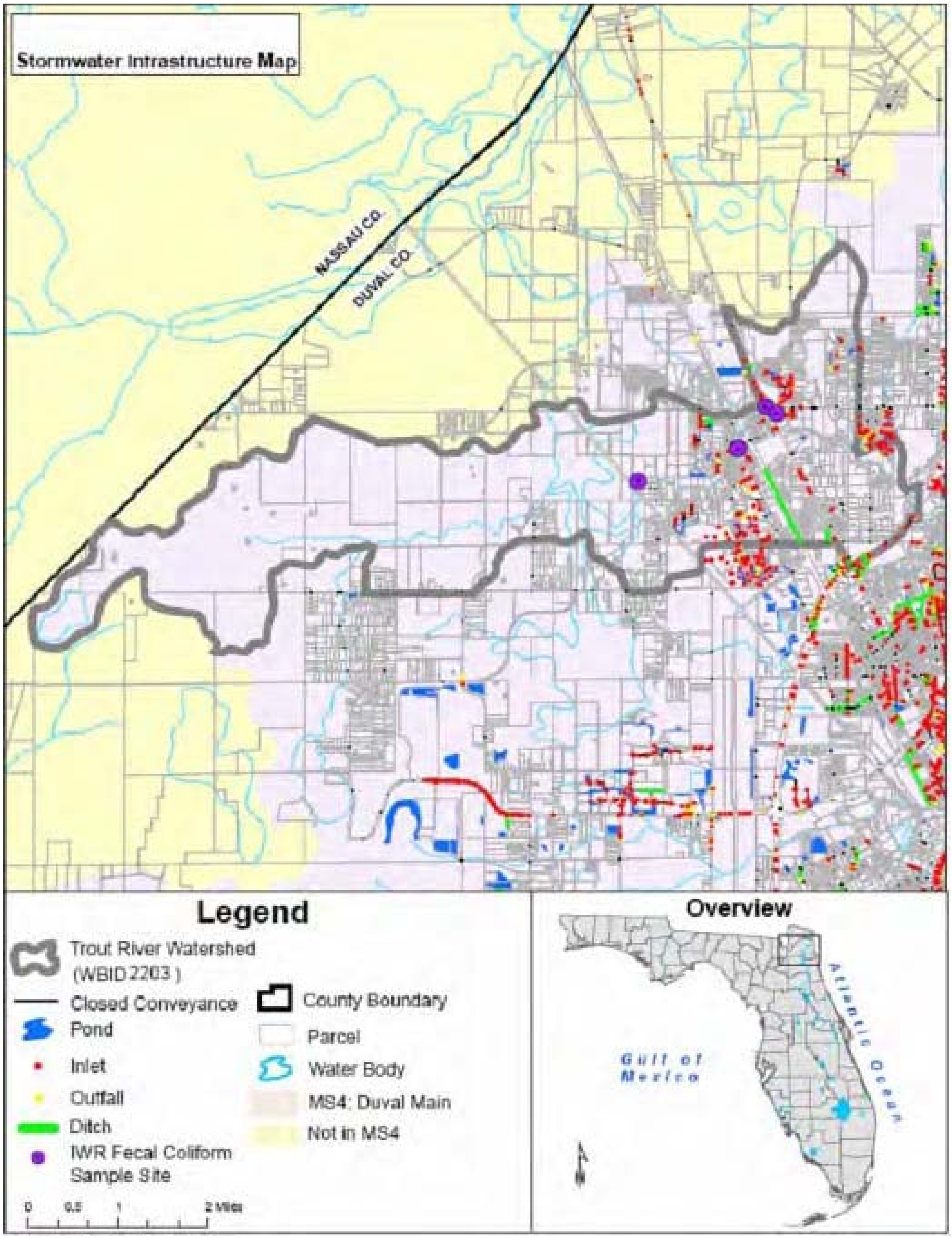
4.2 Potential Sources of Nutrients in the Trout River Watershed

4.2.1 Point Sources

There are currently no facilities with a NPDES Domestic or Industrial permit to discharge wastewater in WBID 2203 (**Figure 4.1**). The City of Jacksonville has developed a 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 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

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 areas of the Trout River watershed.

4.2.2 Land Uses and Nonpoint Sources

Nutrient loadings to 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 Geographic Information System (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.**

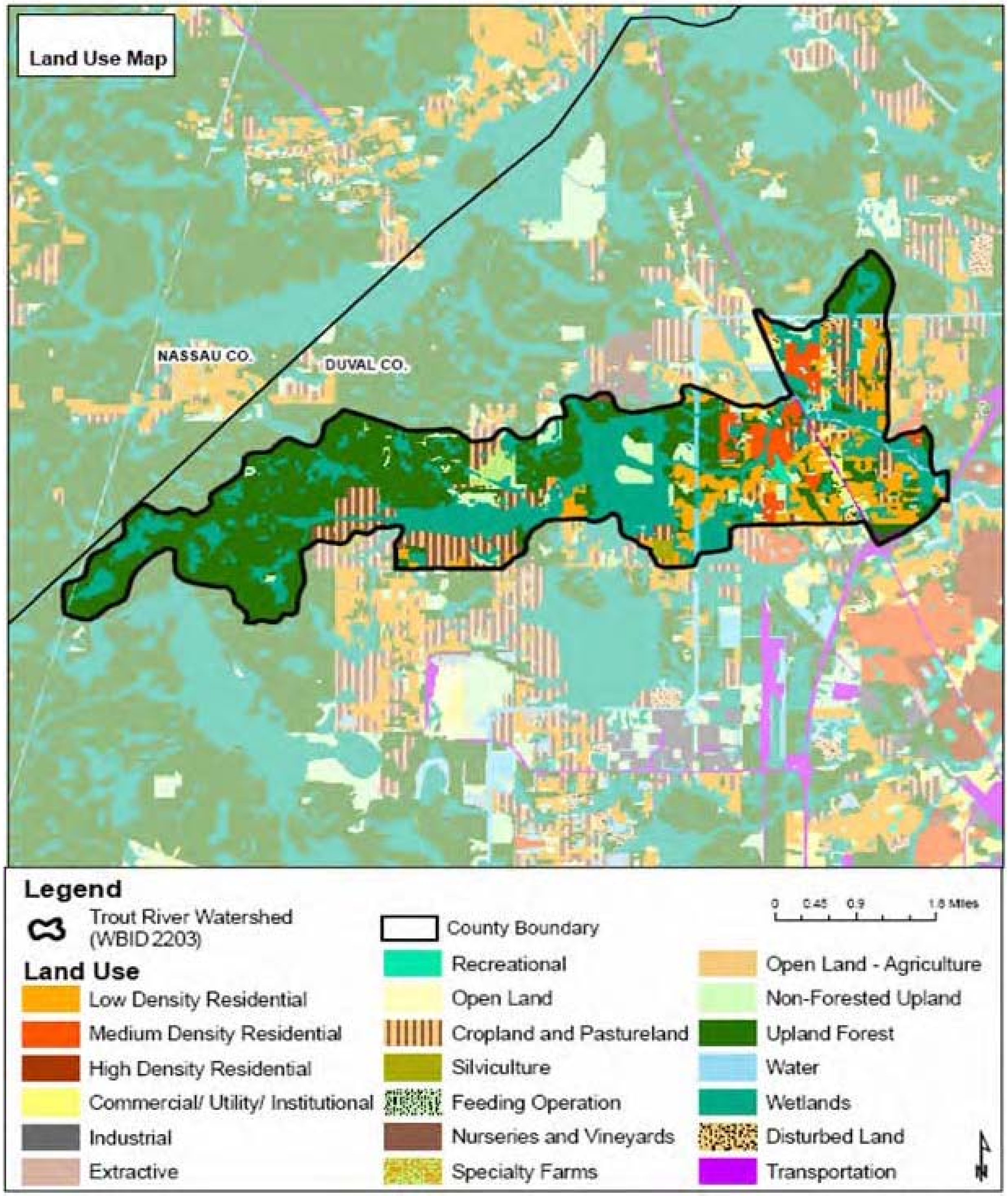
The principal land uses in WBID 2303 (**Figure 4.3**) are coniferous pine (21.7 percent), and wetland forested mixed (10.9 percent). Residential areas total only 14.1 percent (1,402.0 acres); there are no high-density residential areas, only medium- and low-density residential and rural (**Table 4.1**), 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, 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% of land use, in the eastern part of the watershed.

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

Level 2 Land Use Code	Attribute	Acres	% of Total
1100	Residential, low density - less than 2 dwelling units/acre	1024.58	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 conifierous forests	403.91	4.07
4200	Upland hardwood forests	2.55	0.03

Level 2 Land Use Code	Attribute	Acres	% of Total
4300	Upland hardwood forests cont.	283.58	2.86
4400	Tree plantations	2934.58	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	1081.75	10.91
6400	Vegetated non-forested wetlands	1183.9	11.94
7400	Disturbed land	49.95	0.50
8100	Transportation	66.73	0.67
8300	Utilities	91.12	0.92
	TOTAL	**9917.73**	**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.

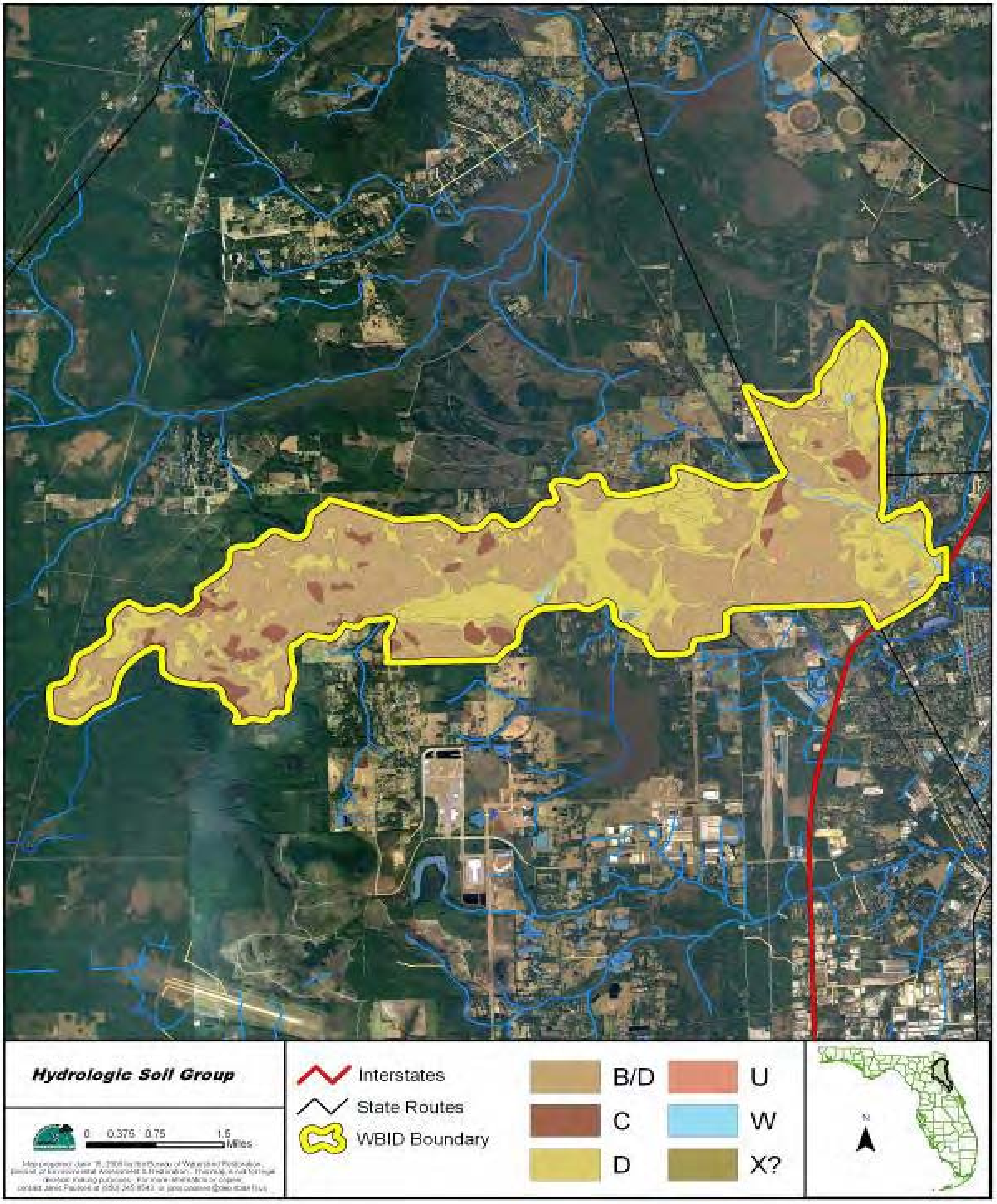
Table 4.2. Description of Hydrologic Soil Classes from the SSURGO Database

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



Septic Tanks

It is estimated that approximately 78 percent of the Duval County residences are connected to a wastewater treatment plant, while the rest are using septic tanks (WSEA Septic Files from PBS & J 2007, and DoH Website). Based on the 2000 census estimates, it was assumed that 137 residences in the Trout River watershed are using septic tanks. Using 70 gallons/day/person (EPA, 1999), and drainfield total nitrogen (TN) and total phosphorus (TP) concentrations of 36 mg/L 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 4.3. Estimated Average Household Size 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**

Data from U.S. Census Bureau Website, 2005, based on Duval County blocks that are present in the Trout River watershed.

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

Estimated No. Households on Septic	Estimated No. Persons Per Household[1]	Gallons/ Person/ Day[2]	TN in Drainfield (mg/L)	TP in Drainfield (mg/L)	Estimated Annual TN Load (lbs/yr)	Estimated Annual TP Load (lbs/yr)
137	2.52	70	36	15	2,650	1,104

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

4.3 Source Summary

4.3.1 Summary of Nutrient Loadings to Trout River from Various Sources

Screening level estimates of annual nitrogen and phosphorus loadings to the watershed were developed based on the 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 (Jacksonville International Airport, 1955-2007) 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, nine agricultural codes were identified in the Trout River watershed. Improved and unimproved pasture represented approximately 6.1% of the watershed area or 603 acres. Field crops represented approximately 3.2% of the watershed area 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.

Table 4.5. Estimated Annual Average TN and TP Loads from Agriculture in the Trout River Watershed

LAND USE CLASSIFICATION	SOIL GROUP	ACRES	ANNUAL RUNOFF COEFFICIENT	GROSS RUNOFF (ACREFT)	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	1173.83	181.33
	B/D	653.81	0.089	254.29	1930.44	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 scru	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**

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.

Table 4.6. Estimated Urban and Built-up Annual Nitrogen and Phosphorus Loading in the Trout River Watershed

LAND USE CLASSIFICATION	SOIL GROUP	ACRES	ANNUAL RUNOFF COEFFICIENT	GROSS RUNOFF (ACREFT)	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	1280.84	151.95
	B/D	681.76	0.083	247.28	1083.29	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**

Forest/Wetland/Water/Open Lands Areas

Estimates for nitrogen and phosphorus loadings from land uses in the forest, wetland, and water level 2 classifications are summarized in **Table 4.7**. Wetlands and upland forests represented 30 and 36 percent, respectively of the acreage in the watershed.

Table 4.7. Estimated Forest/Wetland/Water/Open Lands Annual Nitrogen and Phosphorus Loading in Trout River Watershed

LAND USE CLASSIFICATION	SOIL GROUP	ACRES	ANNUAL RUNOFF COEFFICIENT	GROSS RUNOFF (ACREFT)	ESTIMATED TN LOAD (LBS)	ESTIMATED TP LOAD (LBS)
Upland coniferous forests	D	82.28	0.226	81.2613736	254.2790272	12.16117087
	B/D	288.14	0.089	112.0662902	350.672232	16.77128066
	C	27.25	0.166	19.767695	61.85608281	2.958334395
	U	6.01	0.435	11.4247095	35.74962973	1.7097649
	W	0.2	0.435	0.38019	1.189671539	0.056897334
Upland hardwood forests	B/D	2.55	0.089	0.9917715	3.103401789	0.148423564
Upland hardword forests cont.	B/D	181.48	0.089	70.5830164	220.8648458	10.56310132
	W	0.33	0.435	0.6273135	1.962958039	0.093880602
	D	65.29	0.226	64.4817098	201.7729422	9.65001028
	C	33.46	0.166	24.2725532	75.95245985	3.632508949
	U	2.99	0.435	5.6838405	17.7855895	0.85061515
Tree plantations	B/D	2255.49	0.089	877.2277257	2744.977138	131.2815153
	C	255.76	0.166	185.5334192	580.5618987	27.76600385
	D	423.18	0.226	417.9410316	1307.800179	62.54696508
	U	0.07	0.435	0.1330665	0.416385038	0.019914067
Streams and waterways	D	10.24	0.435	19.465728	66.20780736	5.826287048
	B/D	0.13	0.435	0.2471235	0.840528804	0.073966535
	C	0.16	0.435	0.304152	1.03449699	0.091035735
	U	0.84	0.435	1.596798	5.431109198	0.477937609
	W	29.25	0.435	55.6027875	189.118981	16.64247033
Reservoirs - pits, retention ponds, dams	W	8.42	0.435	16.005999	54.4404041	4.790755561
	B/D	24.56	0.435	46.687332	158.795288	13.97398534
	D	11.34	0.435	21.556773	73.31997417	6.452157727
Wetland hardwood forests	D	362.22	0.435	688.562109	2997.723998	112.4146499
	C	0.6	0.435	1.14057	4.965585552	0.186209458
	B/D	175.21	0.435	333.0654495	1450.033741	54.37626529
	W	0.26	0.435	0.494247	2.151753739	0.080690765
Wetland coniferous forests	B/D	44.81	0.435	85.1815695	370.846481	13.90674304

	D	101.09	0.435	192.1670355	836.6184058	31.37319022
	C	0.54	0.435	1.026513	4.469026997	0.167588512
	W	0.44	0.435	0.836418	3.641429405	0.136553603
Wetland forested mixed	B/D	406.43	0.435	772.6031085	3363.604893	126.1351835
	D	663.08	0.435	1260.481926	5487.634113	205.7862792
	C	8.52	0.435	16.196094	70.51131484	2.644174306
	W	2.75	0.435	5.2276125	22.75893378	0.853460017
	U	0.2	0.435	0.38019	1.655195184	0.062069819
	X?	0.79	0.435	1.5017505	6.538020977	0.245175787
Vegetated non-forested wetlands	B/D	262.95	0.435	499.8548025	2176.167868	81.60629506
	D	896.6	0.435	1704.39177	7420.24001	278.2590004
	C	3.53	0.435	6.7103535	29.214195	1.095532312
	W	16.68	0.435	31.707846	138.0432783	5.176622938
	X?	4.13	0.435	7.8509235	34.17978055	1.281741771
	SUM	**6,660.25**		**7,643.22**	**30,829.13**	**1,244.33**

Upstream Drainage Area of Trout River

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 WBID was used to estimate annual TN and TP loading from the upper Trout and Gulley Branch watersheds (**Table 4.8**).

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

WBID	Land Use Category	Acres	Gross Runoff (ACREFT)	ESTIMATED TN LOAD (LBS)	ESTIMATED TP LOAD (LBS)
2223	Urban	422.71	183.01	792.95	94.31
2223	Agriculture	682.44	3,24.01	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

Source	Total Nitrogen (lbs/yr)	Total Phosphorus (lbs/yr)
Septic Tanks*	11,065	4,611
Urban and Built-up	18,562	4,578
Agriculture	7,931.0	1,195.3
Forest/Wetland/Water/Open Lands	1,962.5	82.0
Upper Trout (WBID 2223)	8,872.91	615.37
Gulley Branch (WBID 2201)	4,695.93	368.37

* potential contribution to ground water

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, middle Trout, 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 instream concentrations.

A USGS gaging station (02246599) was located in the upper Trout WBID near the confluence with the middle Trout River WBID from October 1, 2002 through August 10, 2006. The average total discharge for the years 2003 – 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 – 2005 period was 59.46 inches and ground water contributions were not included in the screening model.

Camp Dresser & McKee, Inc. is currently working with the City of Jacksonville on an update to the Master Stormwater Management Plan and are using the Watershed Management Model (WMM) to develop nutrient loads for subbasins. The Trout River Basin is one of the 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 historical DO, corrected chla (CHLAC), TN, TP, and BOD available 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 E** 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 E** contains additional plots by season, station, and year. A Statistical summary of major water quality parameters from the available data is presented in **Table 5.3**.

Table 5.1. Sampling Station Summary for the Trout River Watershed

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	FDEP	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	1995-1997	17
TROUT RIVER AT OLD KINGS RD	21FLA 20030753	FDEP	2002–2007	16
SJ2-SS-2046 TROUT RIVER	FLGW 27947	FDEP	2005	2
TROUT R @ END OF COLORADO SPRINGS RD	21FLA 20030047	FDEP	2006-2007	8

Table 5.2. Statistical Summary of Historical Data for Trout River

Station	N	Minimum	Maximum	Median	Mean	Exceedances	% Exceedance
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

DO concentrations are mg/L.

Table 5.3. Summary Statistics for Major Water Quality Parameters Measured in Trout River

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 5.1. Historical Sampling Sites in the Trout River Watershed

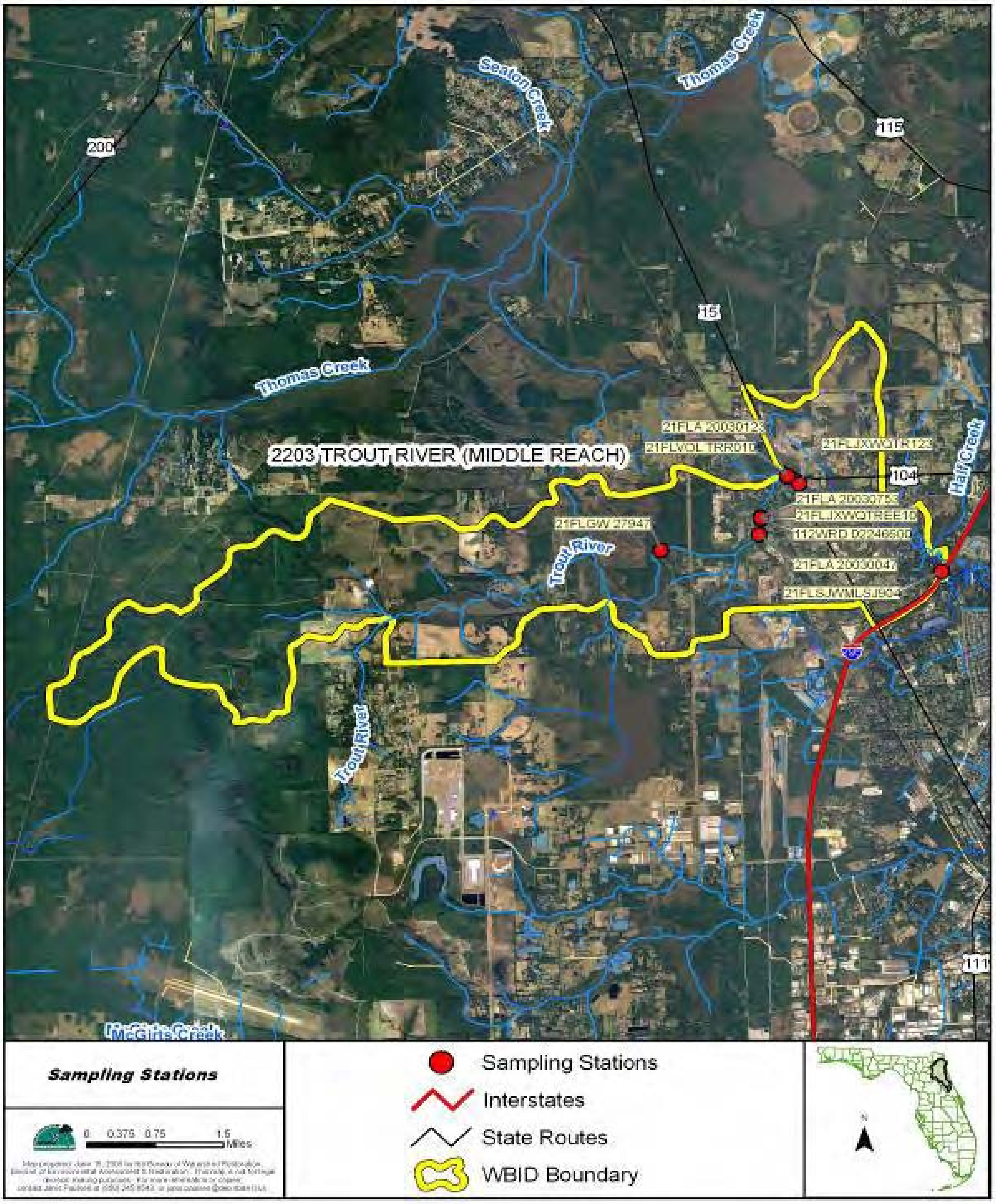


Figure 5.2. Historical DO Observations for Trout River

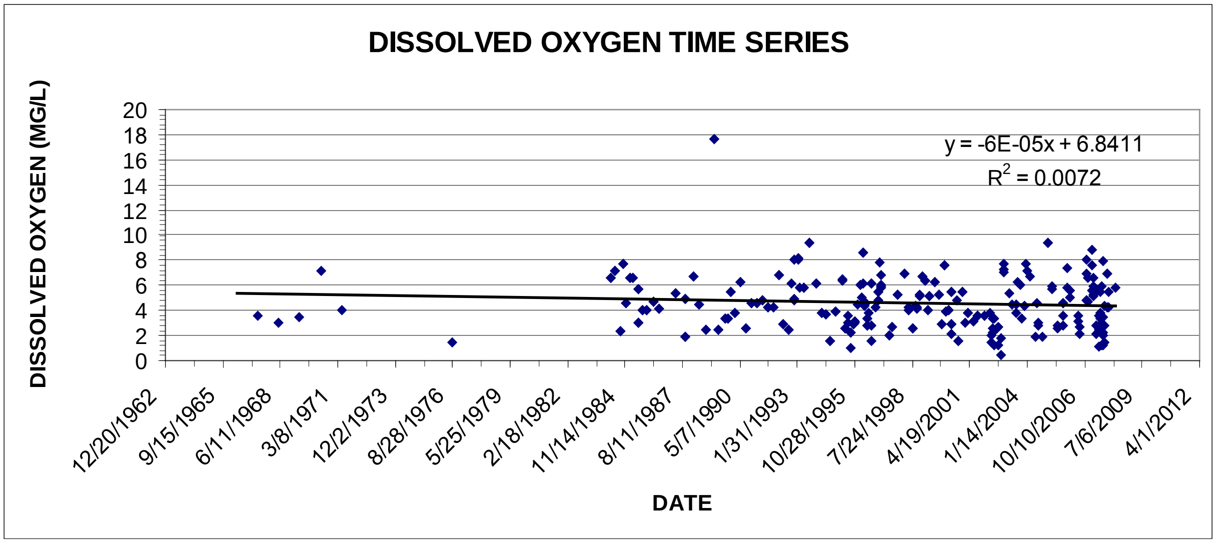


Figure 5.3. Historical Corrected Chla Observations for Trout River

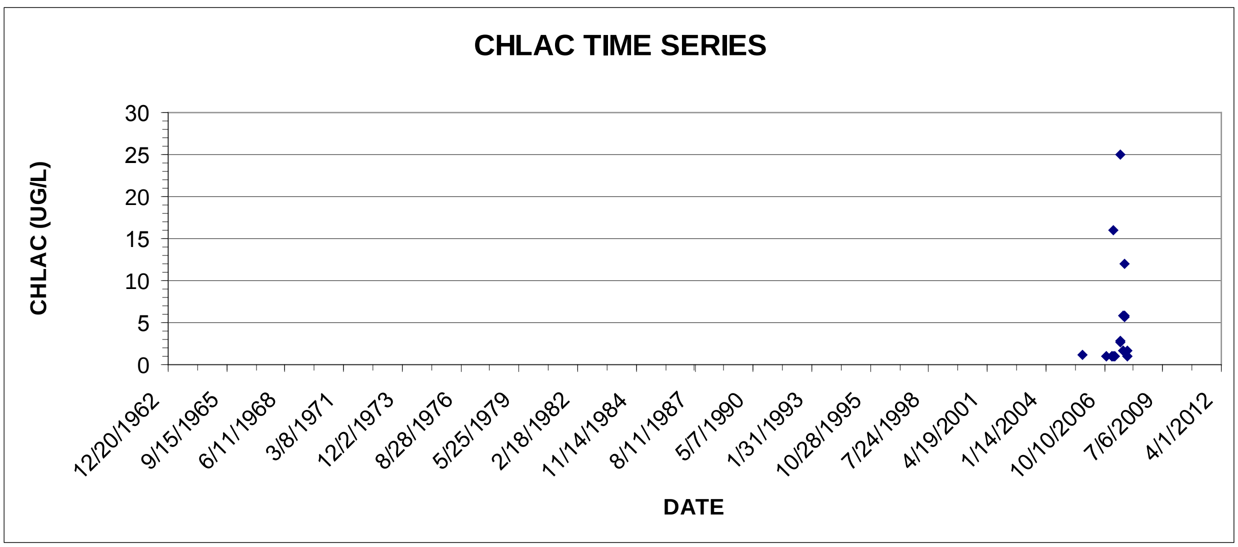


Figure 5.4. Historical TN Observations for Trout River

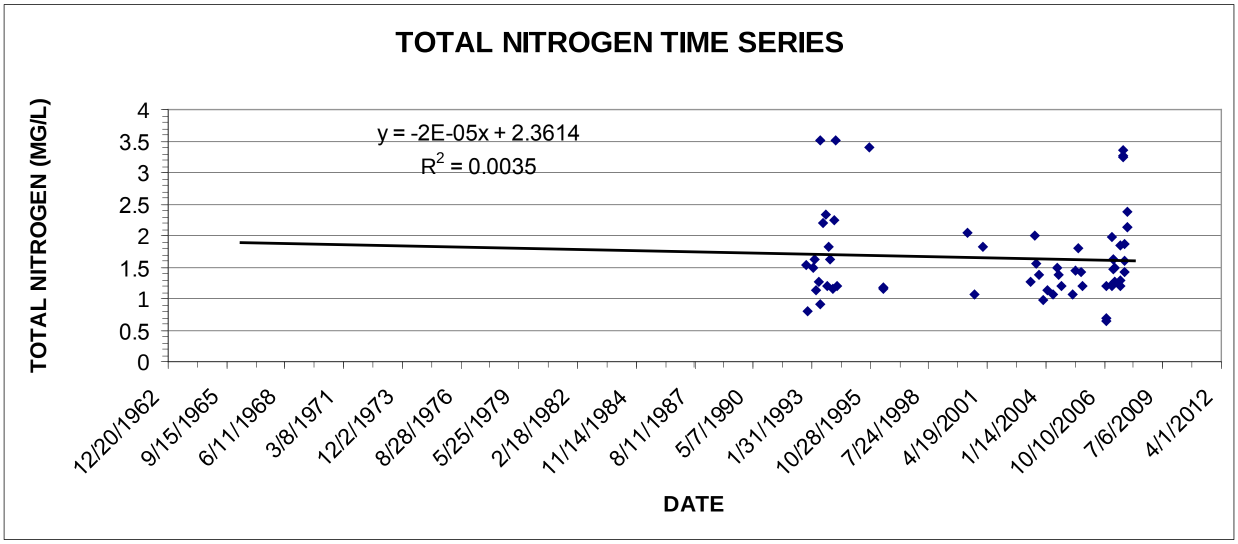


Figure 5.5. Historical TP Observations for Trout River

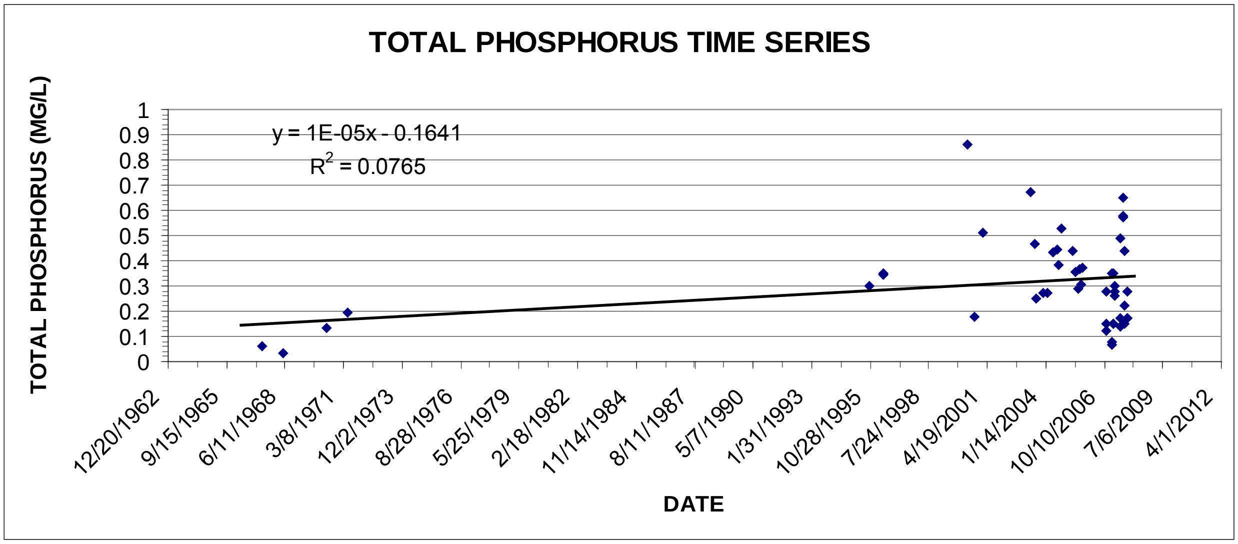
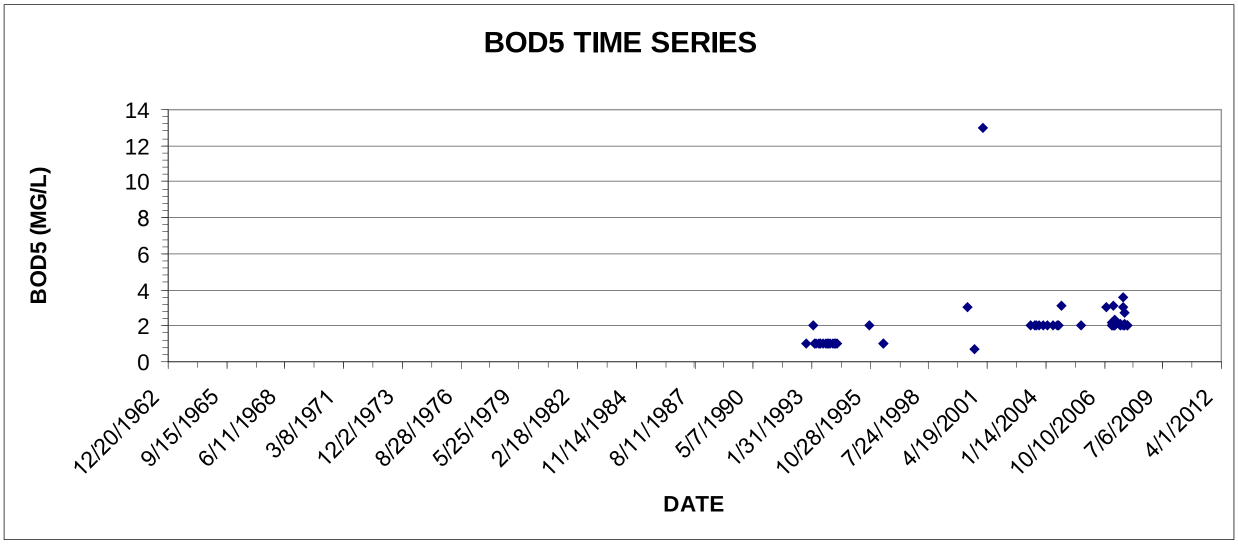


Figure 5.6. Historical BOD5 Observations for Trout River



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 C**). 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, CLAC, TN, TP, and BOD5 (**Appendix D**).

Table 5.4. Statistical Summary of Historical DO Data by Year for Trout River

Year	N	Minimum	Maximum	Median	Mean	Exceedances	% Exceedance
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 Trout River

Season	N	Minimum	Maximum	Median	Mean	Exceedances	% Exceedance
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%

DO concentrations are mg/L.

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 verification 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:

$$DO = 8.471 – 0.098*TEMP – 23.699*TP + 2.315*TN + 0.670*TP*TEMP + 2.202*TN*TP - 0.131*TN*TEMP$$

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

Table 5.6. Seasonal Summary Statistics for DO, TEMP, TN, TP, BOD5, and CHLAC for Trout River WBID 2203

SEASON		DISSOLVED OXYGEN (MG/L)					
	N	MIN	5%	25%	MEDIAN	MEAN	75%	MAX
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
SEASON		WATER TEMPERATURE (^{O} C)						
	N	MIN	5%	25%	MEDIAN	MEAN	75%	MAX
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
SEASON		TOTAL NITROGEN (MG/L)						
	N	MIN	5%	25%	MEDIAN	MEAN	75%	MAX
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
SEASON		TOTAL PHOSPHORUS (MG/L)						
	N	MIN	5%	25%	MEDIAN	MEAN	75%	MAX
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
SEASON		BOD5 (MG/L)						
	N	MIN	5%	25%	MEDIAN	MEAN	75%	MAX
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
SEASON		CHLAC (UG/L)						
	N	MIN	5%	25%	MEDIAN	MEAN	75%	MAX
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

In light of the adopted nutrient TMDL for the Lower St. Johns River requiring between a 30 and 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 historic data set temperature following a 30 percent reduction in TN and reductions in TP. The historic average TEMP was 21.56 ^{o}C and the historic 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 historic mean DO was 4.6 mg/L (**Table 5.3**).

The Upper Trout River segment (WBID 2223) exceeded the listing thresholds for DO in the Cycle 2 assessment, however a "natural condition" determination was made. The determination was based upon existing land uses, biological, and chemical characteristics of the segment. The median TN and TP concentrations for the Upper Trout River segment for the Cycle 2 verified period were 0.55 and 0.068 mg/L. In constrast, the median TN and TP concentrations for the same period in the Middle Trout River segment were 1.43 and 0.296 mg/L, respectively.

As part of a year-long statewide study of DO in Florida streams and lakes during the 2004 – 2005 period, datasondes were deployed quarterly for 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. **Table 5.7** summarizes DO and nutrient observations from these three sites. Both the Alligator Creek and Thomas Creek sites had DO measurements below 5 mg/L. The proposeed 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 5.7. Summary Statistics for DO, TN, and TP from Three Reference Stream Sites (Statewide DO Study 2004-2005)

Measurement*	STREAM SITE		
	NAS206GS Alligator Creek	NAS207LV Thomas Creek	NAS348LV Deep Creek
Dissolved Oxygen			
Ave of daily aves	5.27	4.14	5.62
Ave of daily min	4.91	3.82	5.15
Ave of daily max	5.65	4.41	6.02
Total Nitrogen			
Average	1.03	1.11	0.86
Minimum	0.93	0.69	0.72
Maximum	1.14	1.40	0.95
Total Phosphorus			
Average	0.234	0.049	0.027
Minimum	0.185	0.022	0.019
Maximum	0.307	0.079	0.032

* All measurements in mg/L

5.1.3 Critical Conditions/Seasonality

A nonparametric test (Kruskal-Wallis) was applied to the DO, DO saturation (DOSAT), corrected chla, 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 and DO, DOSAT, and CHLAC showed significant differences among months (**Appendices C** and **D**). 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 upon the long-term average TEMP, TN, and TP based upon the historic 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:

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

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

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

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

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

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. TMDLs for Trout River are 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 Trout River

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

[1] As the TMDL represents a percent reduction, it also complies with EPA requirements to express the TMDL on a daily basis.

6.2 Load Allocation

A TN reduction of 30 percent and a 70 percent reduction in TP 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 future discharge permits issued in the watershed 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 Florida Department of Transportation (FDOT) District 2 are co-permittees for a Phase I NPDES municipal separate storm sewer system (MS4) permit (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 upon long-term averages for TEMP, TN, and TP based upon the historic 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 upon 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. Basin Management Action Plans 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 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:

- 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 obligations of wastewater point source, MS4 and non-MS4 stakeholders in TMDL implementation, enhanced transparency in DEP decision-making, and built strong relationships between DEP and local stakeholders that have benefited other program areas.

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. Why? 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. There are a multitude of assessment tools that are 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 River 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 roadmap for restoration activities, while still meeting the requirements of Chapter 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 River, 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.

References

Florida Administrative Code. *Rule 62-302, Surface water quality standards.*

———. *Rule 62-303, Identification of impaired surface waters.*

Florida Department of Environmental Protection. February 2001. *A report to the Governor and the Legislature on the allocation of Total Maximum Daily Loads in Florida.* Tallahassee, Florida: Bureau of Watershed Management.

———. 2005. *Upper East Coast Basin status report.* Tallahassee, Florida. Available: http://www.dep.state.fl.us/water/basin411/uppereast/status.htm.

Florida Department of Health Website. 2008. Available: http://www.doh.state.fl.us/.

Florida Watershed Restoration Act. *Chapter 99-223, Laws of Florida.*

Gao, Xueqing. 2006 *Nutrient and Unionized Ammonia TMDLs for Lake Jesup WBIDs 2981 and 2981A*. FDEP, Tallahassee, Florida. Bureau of Watershed Management Available: http://www.dep.state.fl.us/water/tmdl/docs/tmdls/final/gp2/lake-jessup-nutr_ammonia-tmdl.pdf

Harper, H.H., and D.M. Baker. 2007. *Evaluation of current stormwater design criteria within the state of Florida.* Orlando, Florida: Environmental Research & Design, Inc.

Magley, W. and D. Joyner. 2008. *Total Maximum Daily Load for Nutrients for the Lower St. Johns River*. FDEP, Tallahassee, Florida. Bureau of Watershed Management Available: http://www.dep.state.fl.us/water/tmdl/docs/tmdls/final/gp2/lower-stjohns-nutrients.pdf

U. S. Census Bureau Website. 2000. Available: http://www.census.gov/.

U. S. Environmental Protection Agency. 1999. *Protocol for developing nutrient TMDLs.* First Edition. EPA 841–B–99–007.

U. S. Environmental Protection Agency Region 4. 2002. *Estimating water quality loadings from MS4 areas.*

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 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 Florida Department of Transportation 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, Corrected Chla, TN, TP, BOD5 Observations in Trout River, 1967–2008

Station	Sample Date	DO (mg/L)	Corr Chla (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				

Station	Sample Date	DO (mg/L)	Corr Chla (µg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
FLJXWQTR123	9/24/1987	1.9				
FLJXWQTR123	2/12/1988	6.65				
FLJXWQTR123	2/12/1988	6.7				
FLJXWQTR123	5/20/1988	4.5				
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				

Station	Sample Date	DO (mg/L)	Corr Chla (µg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
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				
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					

Station	Sample Date	DO (mg/L)	Corr Chla (µg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
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	
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				

Station	Sample Date	DO (mg/L)	Corr Chla (µg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
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				
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				

Station	Sample Date	DO (mg/L)	Corr Chla (µg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
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				
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					

Station	Sample Date	DO (mg/L)	Corr Chla (µg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
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					
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					

Station	Sample Date	DO (mg/L)	Corr Chla (µg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
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				
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				

Station	Sample Date	DO (mg/L)	Corr Chla (µg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
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				
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

Station	Sample Date	DO (mg/L)	Corr Chla (µg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
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
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

Station	Sample Date	DO (mg/L)	Corr Chla (μg/L)	BOD5 (mg/L	TN (mg/L)	TP (mg/L)
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: Kruskal–Wallis Analysis of DO, DOSAT, Corrected Chla, TN, TP, and BOD5 Observations versus Season in Trout River

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 D: Kruskal–Wallis Analysis of DO, DOSAT, Corrected Chla, TN, TP, and BOD5 Observations versus Month in Trout River

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

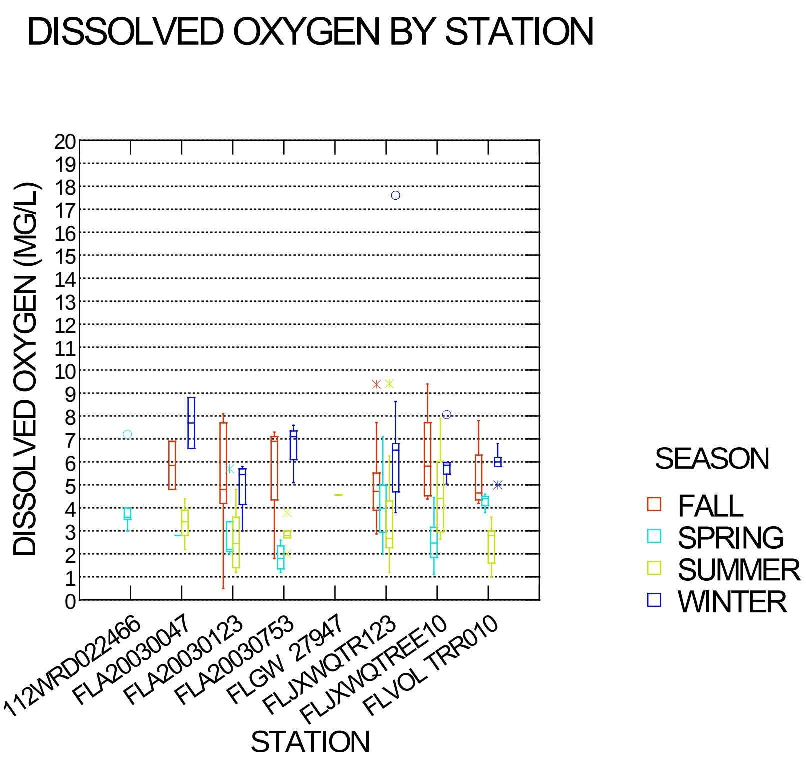
Kruskal-Wallis Test Statistic = 16.521
Probability is 0.086 assuming Chi-square distribution with 10 df

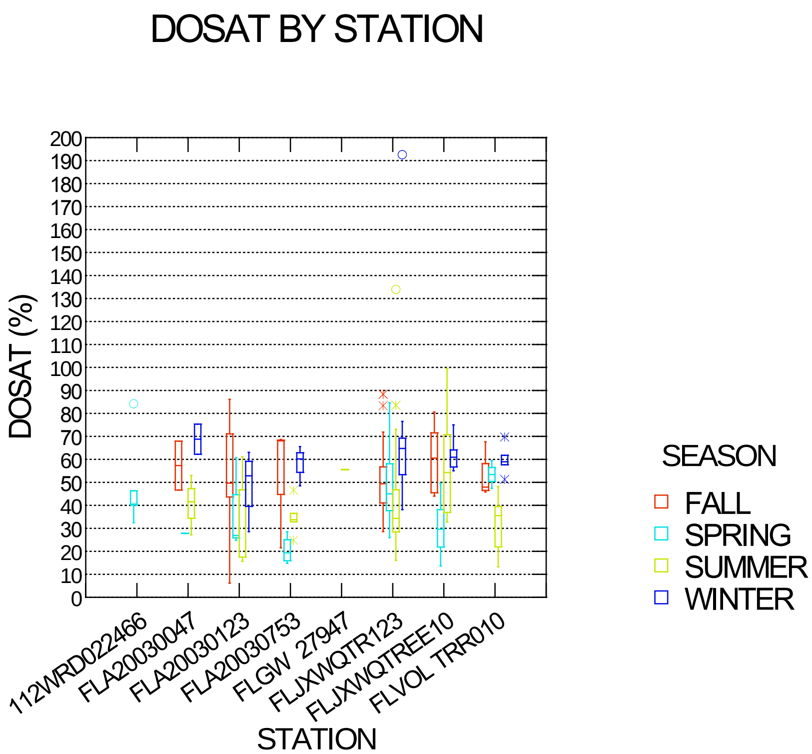
Kruskal-Wallis One-Way Analysis of Variance for 55 cases
Dependent variable is VBOD5
Grouping variable is MONTH

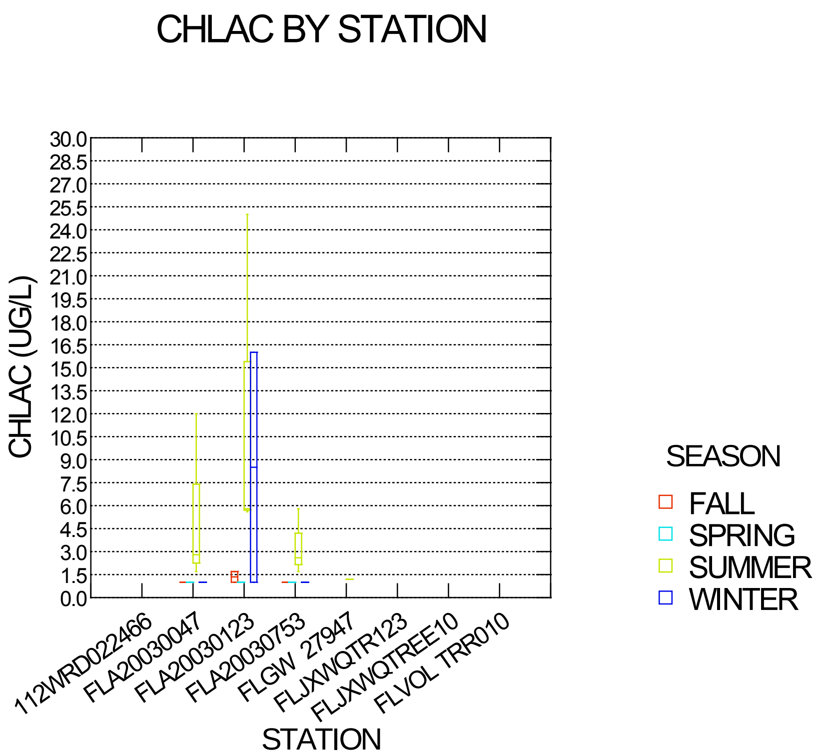
Group	Count	Rank Sum
1	2	65.000
2	6	180.000
3	5	134.500
4	6	160.000
5	3	91.000
6	3	30.000
7	5	147.500
8	7	238.000
9	8	249.000
10	3	51.000
11	6	184.000
12	1	10.000

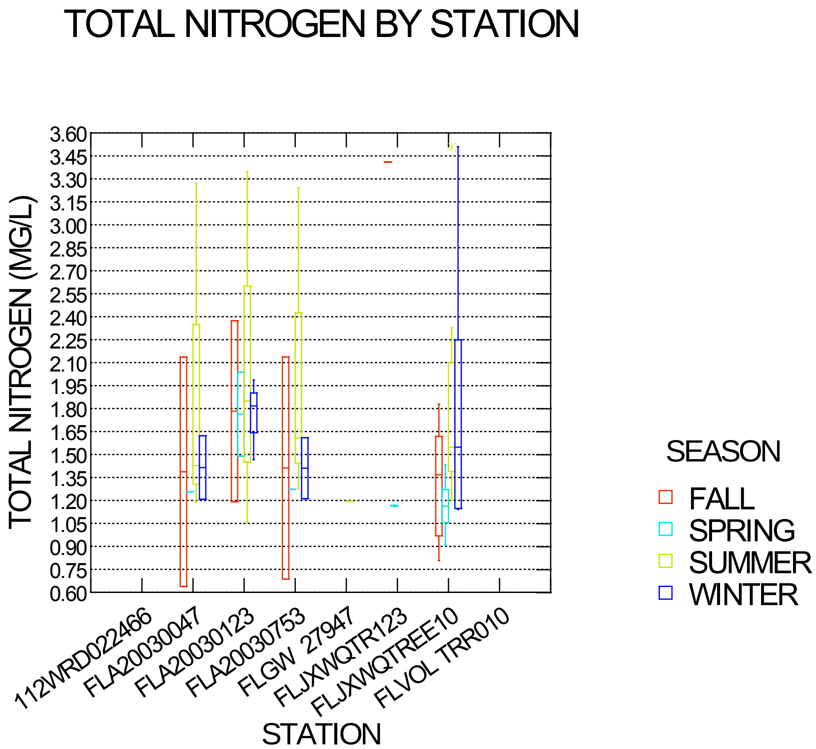
Kruskal-Wallis Test Statistic = 9.515
Probability is 0.575 assuming Chi-square distribution with 11 df

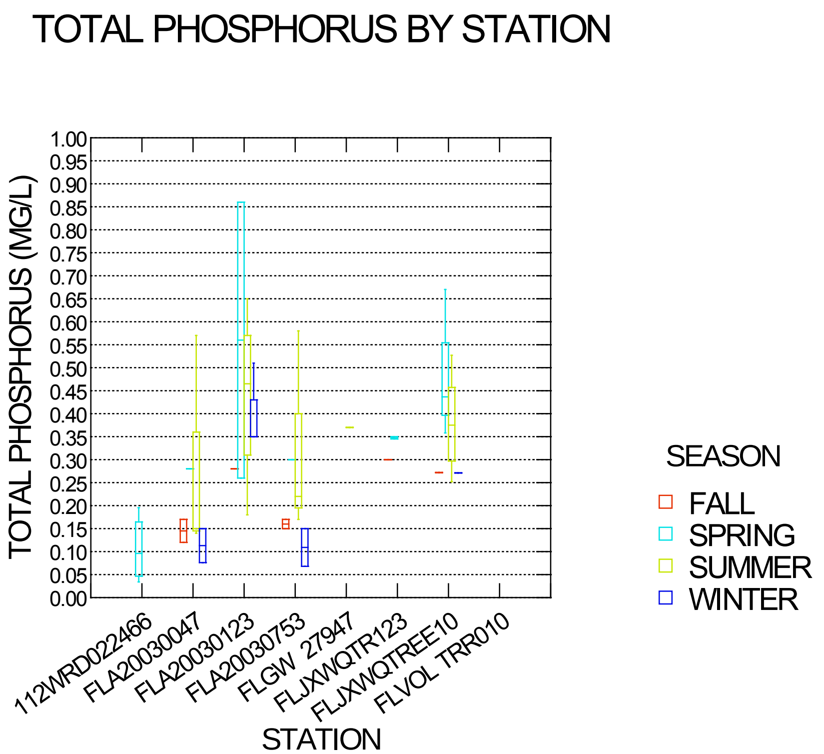
Appendix E: Chart of DO, DOSAT, Corrected Chla, TN, TP, and BOD5 Observations by Season, Station, and Year in Trout River

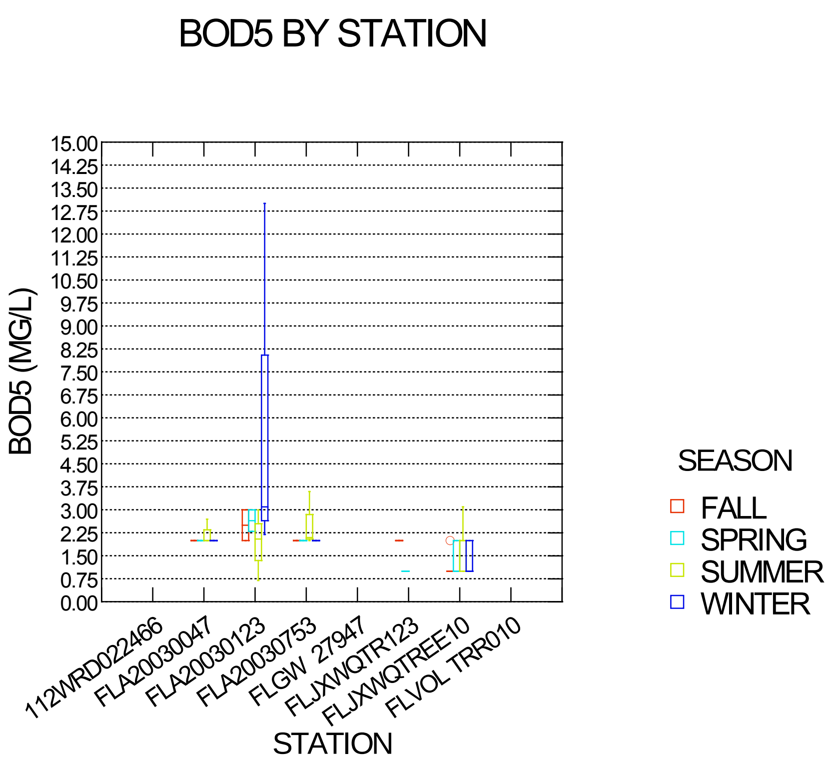


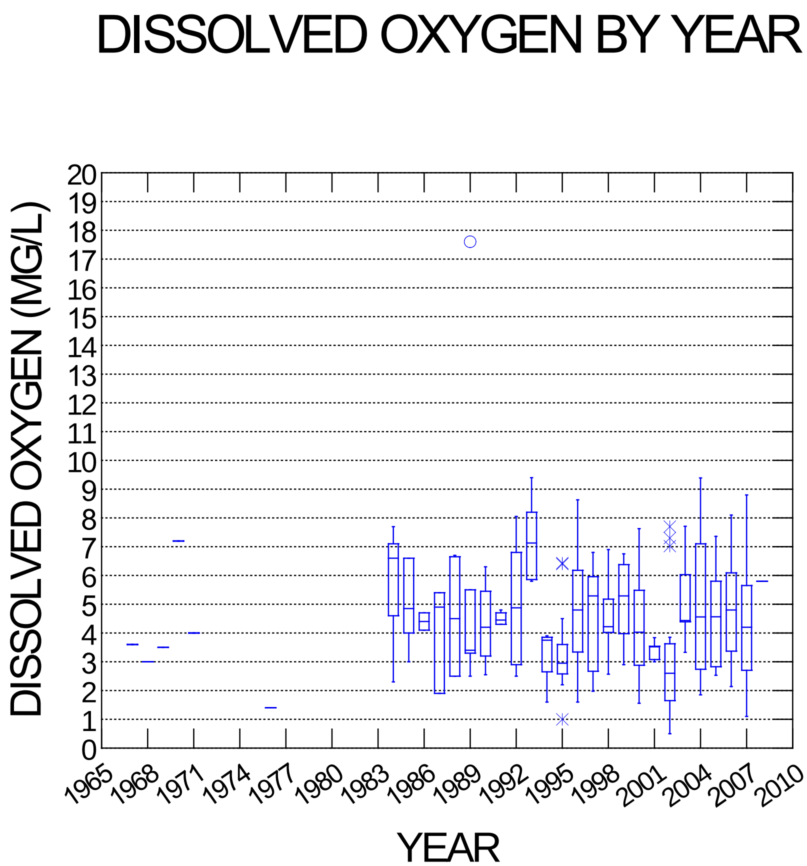

DOSAT BY STATION
DOSAT (%)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

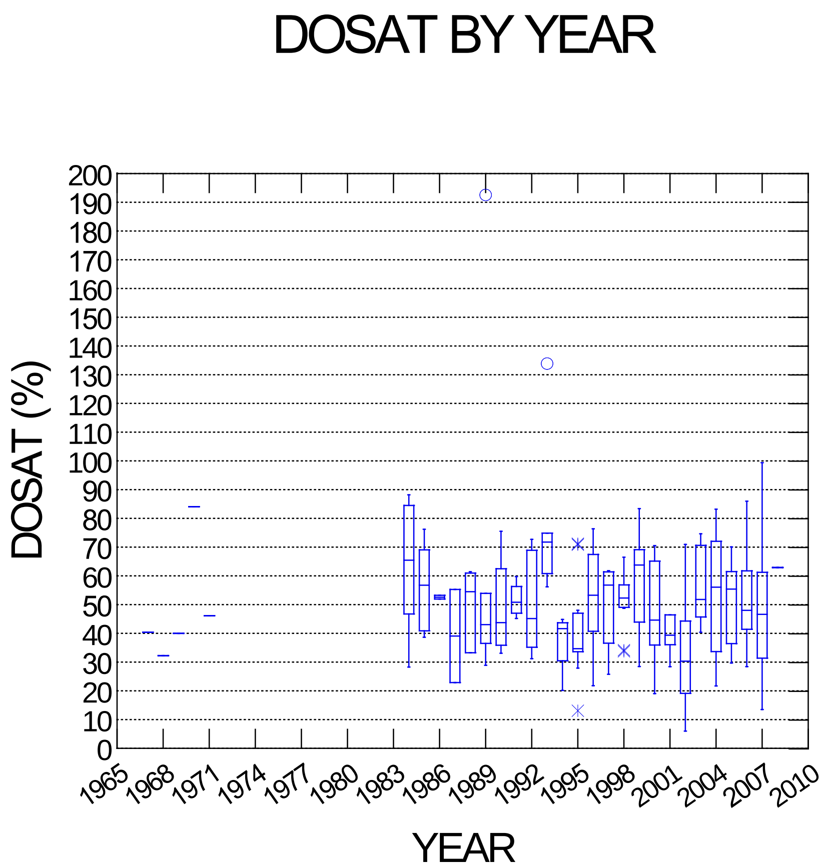

CHLAC BY STATION
CHLAC (UG/L)
30.0
28.5
27.0
25.5
24.0
22.5
21.0
19.5
18.0
16.5
15.0
13.5
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

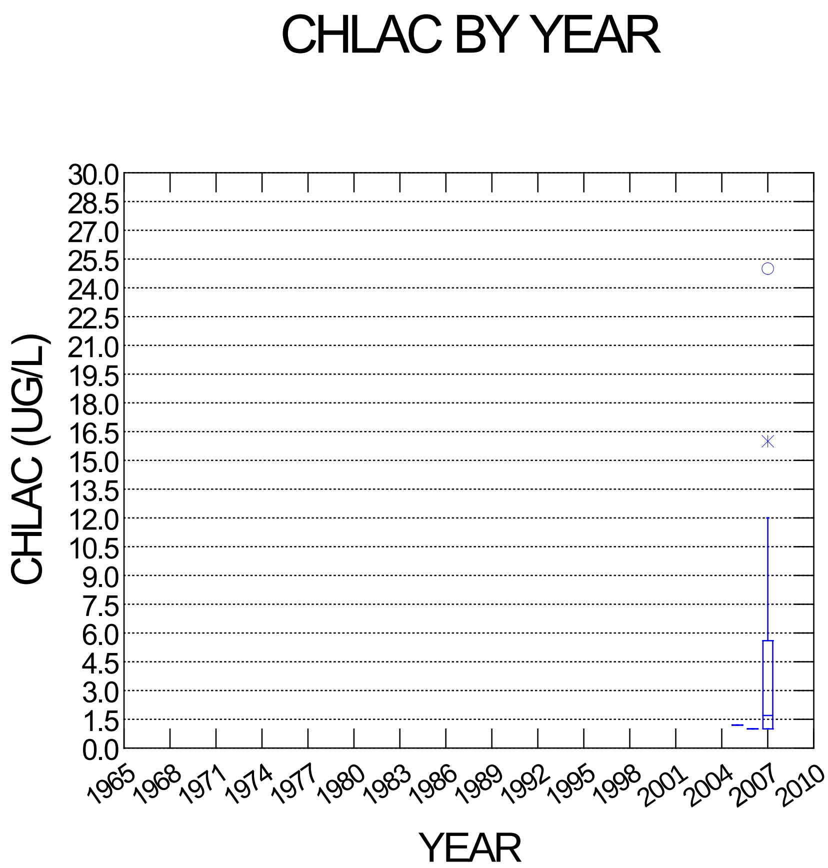

TOTAL NITROGEN BY STATION
TOTAL NITROGEN (MG/L)
3.60
3.45
3.30
3.15
3.00
2.85
2.70
2.55
2.40
2.25
2.10
1.95
1.80
1.65
1.50
1.35
1.20
1.05
0.90
0.75
0.60
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

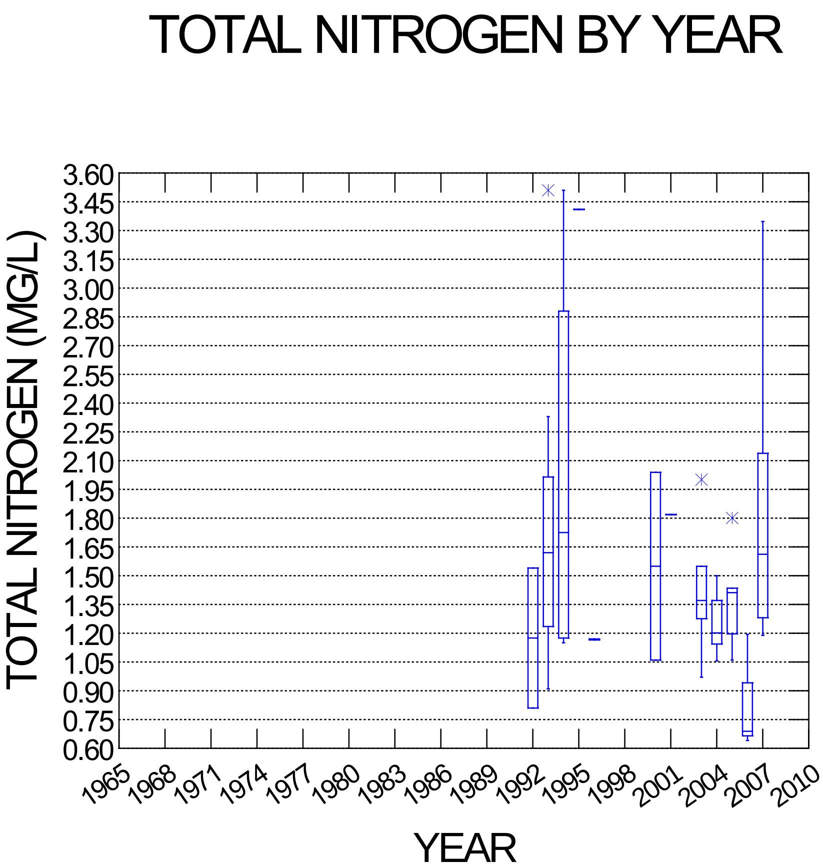

TOTAL PHOSPHORUS BY STATION
TOTAL PHOSPHORUS (MG/L)
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

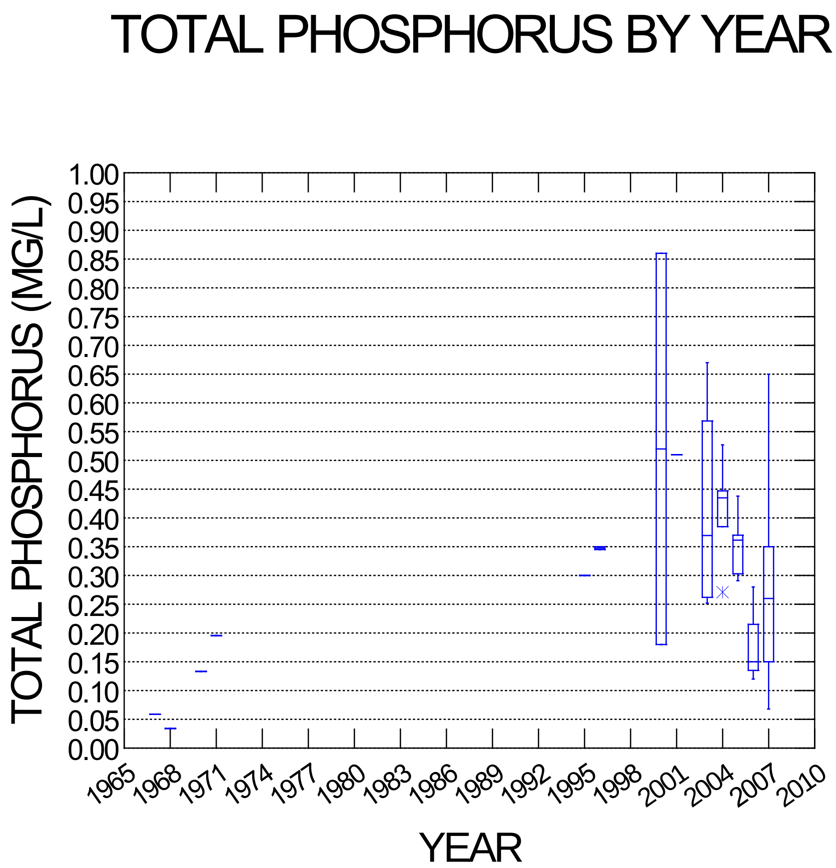

BOD5 BY STATION
BOD5 (MG/L)
15.00
14.25
13.50
12.75
12.00
11.25
10.50
9.75
9.00
8.25
7.50
6.75
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

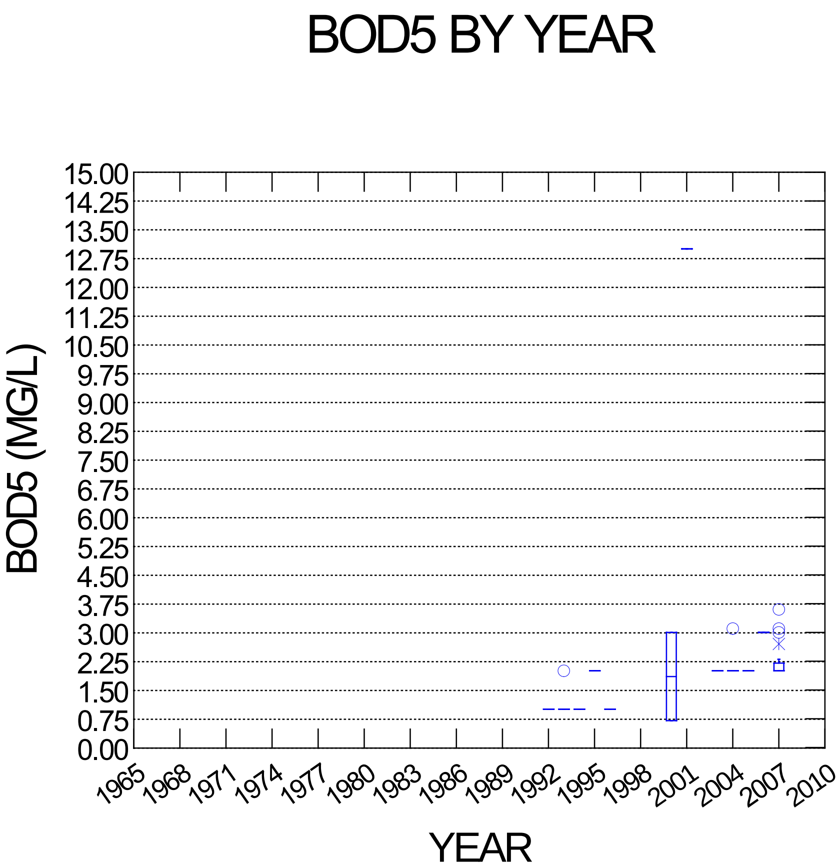

DISSOLVED OXYGEN BY YEAR
DISSOLVED OXYGEN (MG/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
YEAR

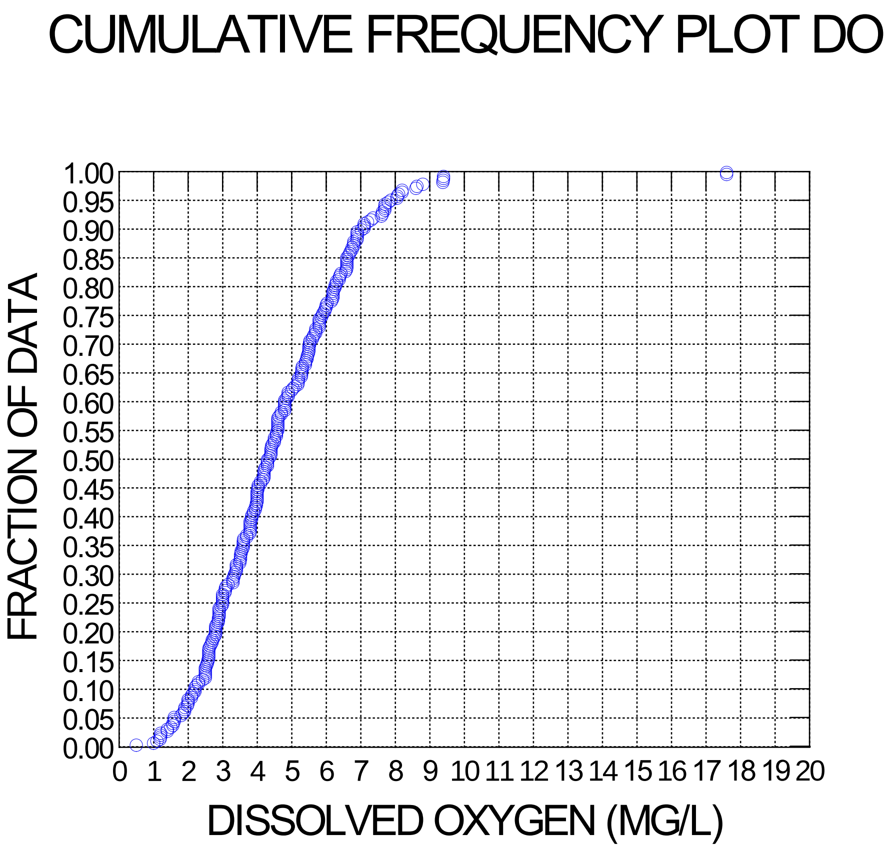

DOSAT BY YEAR
DOSAT (%)
YEAR
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010

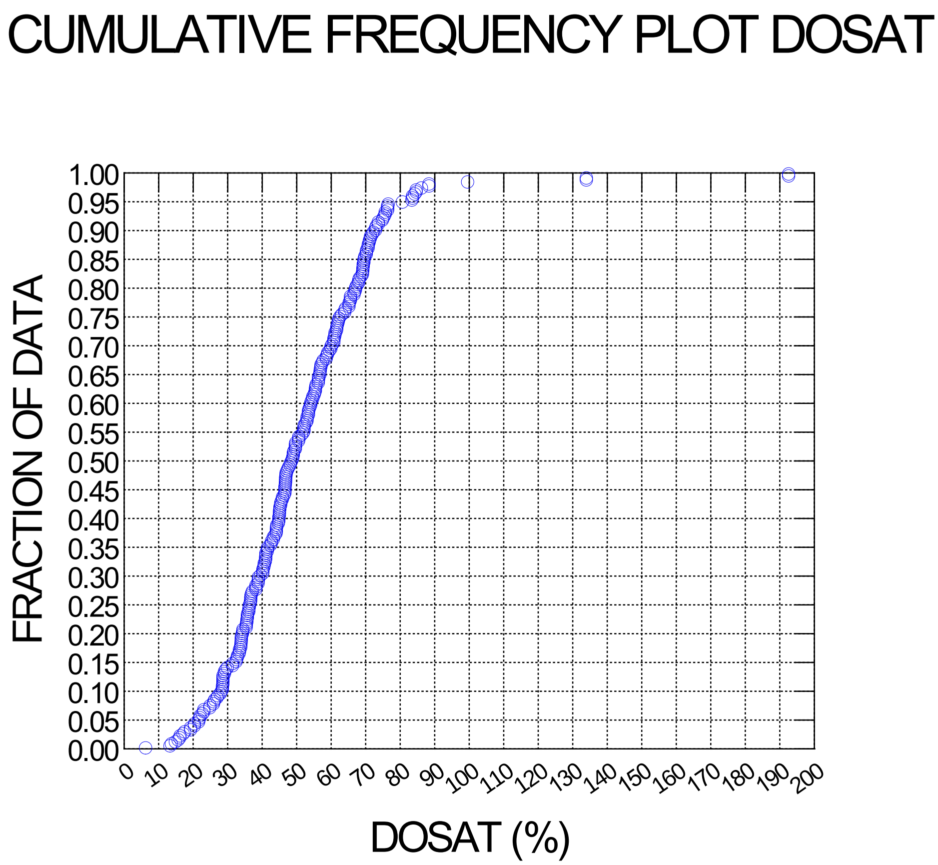

CHLAC BY YEAR
CHLAC (UG/L)
30.0
28.5
27.0
25.5
24.0
22.5
21.0
19.5
18.0
16.5
15.0
13.5
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
YEAR


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

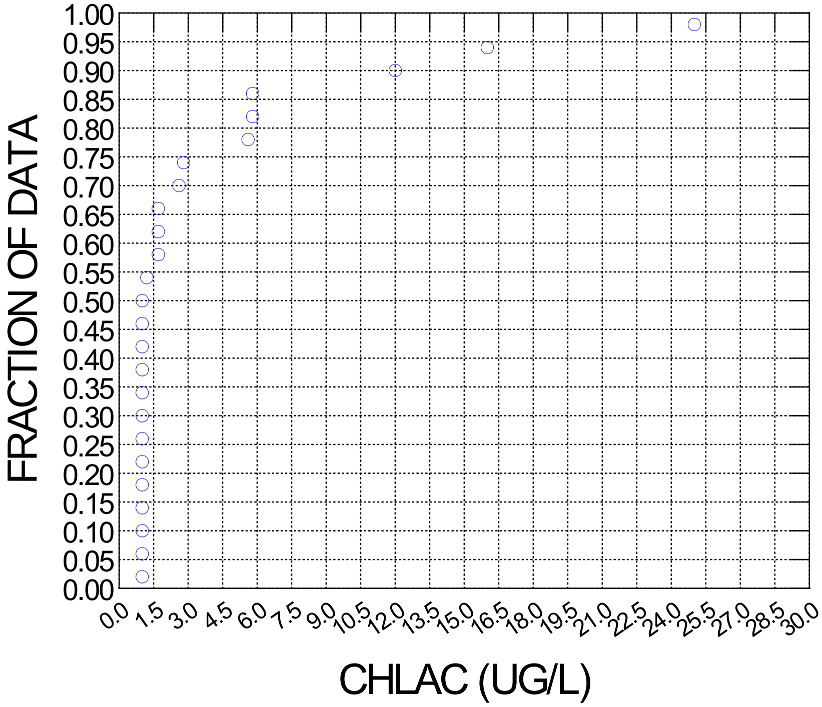

TOTAL PHOSPHORUS BY YEAR
TOTAL PHOSPHORUS (MG/L)
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
YEAR

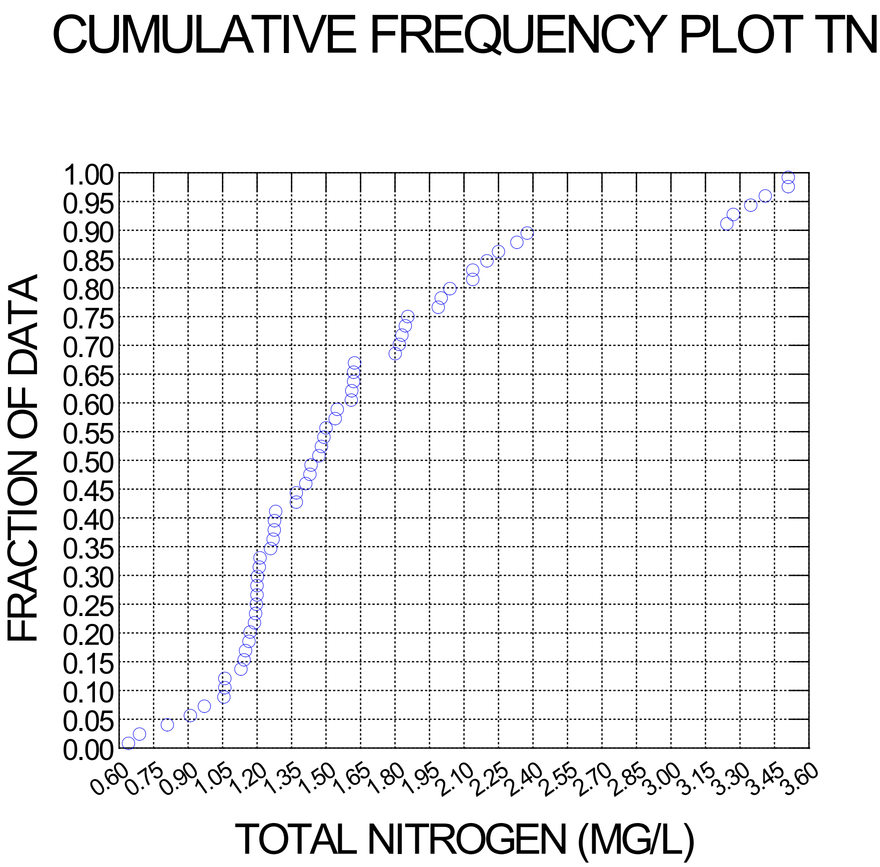

BOD5 BY YEAR
BOD5 (MG/L)
15.00
14.25
13.50
12.75
12.00
11.25
10.50
9.75
9.00
8.25
7.50
6.75
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
YEAR

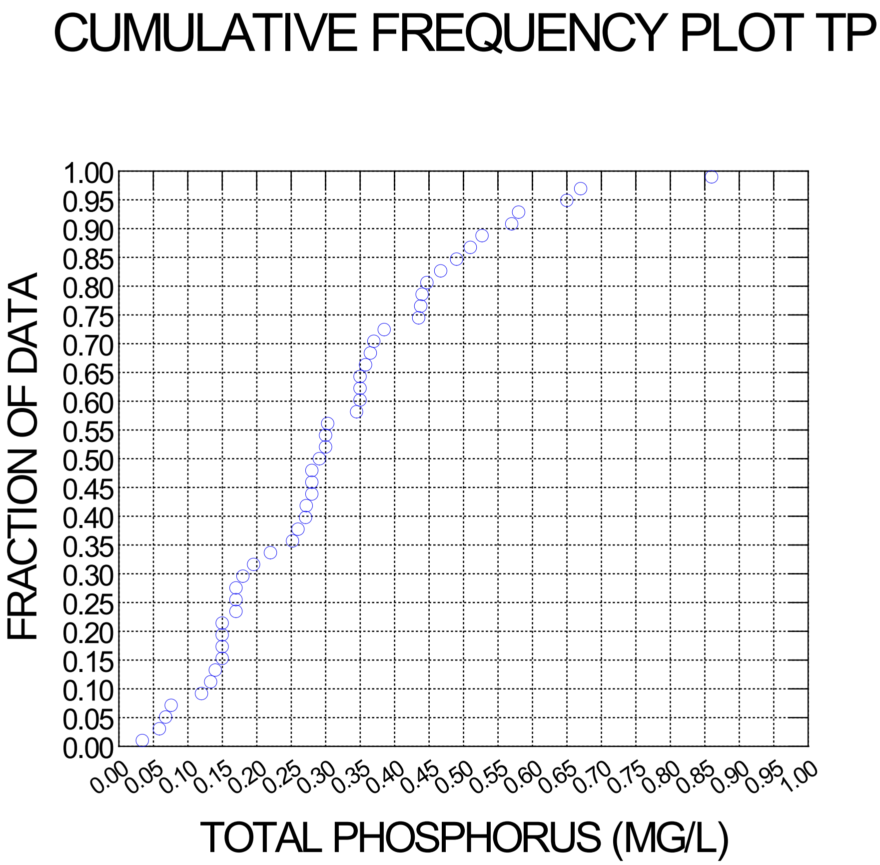

CUMULATIVE FREQUENCY PLOT DO
FRACTION OF DATA
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
DISSOLVED OXYGEN (MG/L)

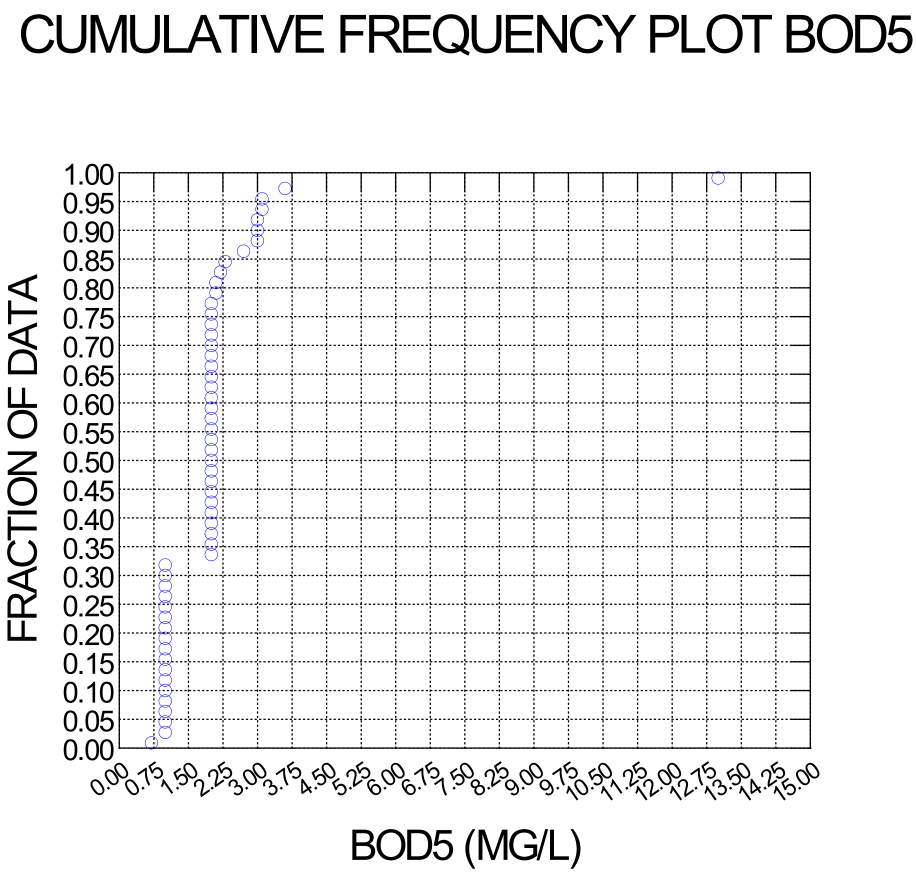

CUMULATIVE FREQUENCY PLOT DOSAT
FRACTION OF DATA
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
DOSAT (%)

CUMULATIVE FREQUENCY PLOT CHLAC

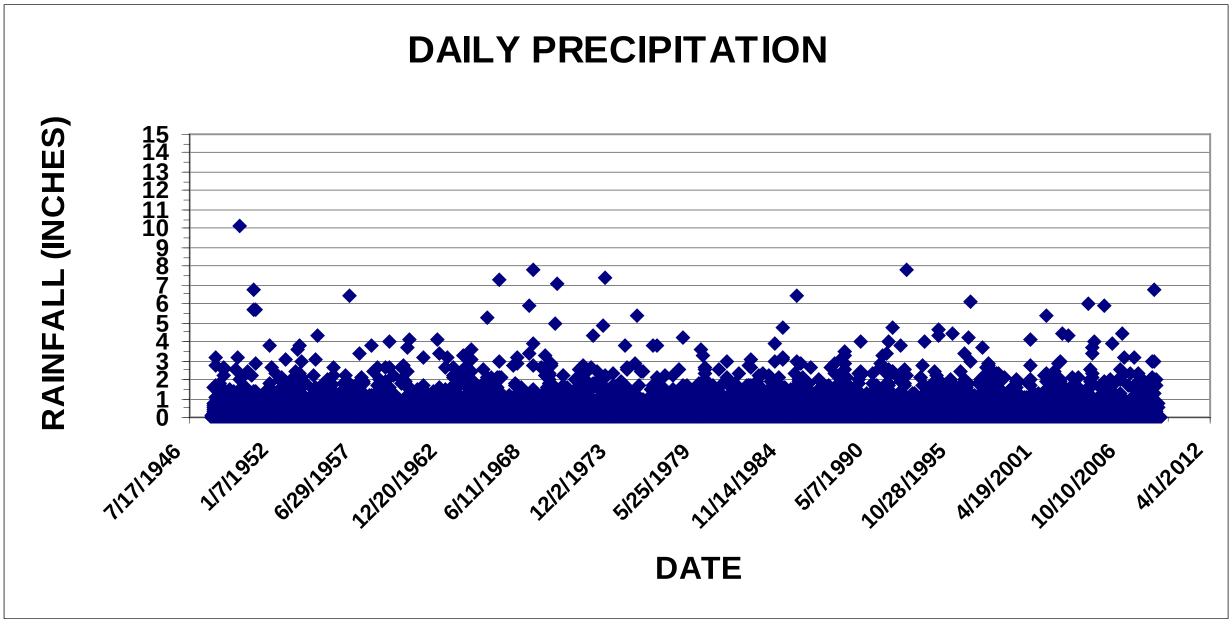



CUMULATIVE FREQUENCY PLOT TN
FRACTION OF DATA
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.60
0.75
0.90
1.05
1.20
1.35
1.50
1.65
1.80
1.95
2.10
2.25
2.40
2.55
2.70
2.85
3.00
3.15
3.30
3.45
3.60
TOTAL NITROGEN (MG/L)


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 F: Chart of Rainfall for Jacksonville International Airport, 1948–2008



Appendix G: Spearman Correlation Matrix Analysis for Water Quality Parameters in Trout River

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 Corrected Chla Observations versus Nutrients and BOD in Trout River

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
Firs t Order Autoc rrelation 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

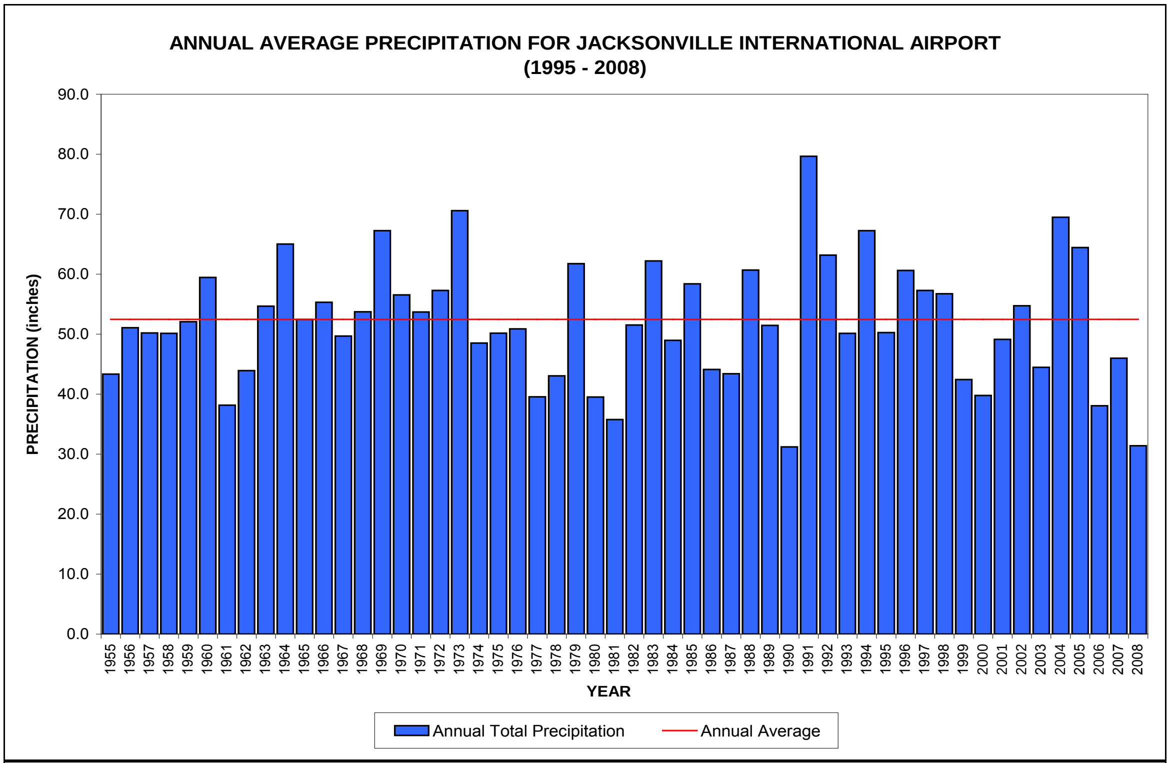
Appendix I: Monthly and Annual Precipitation at Jacksonville International Airport, 1955–2008

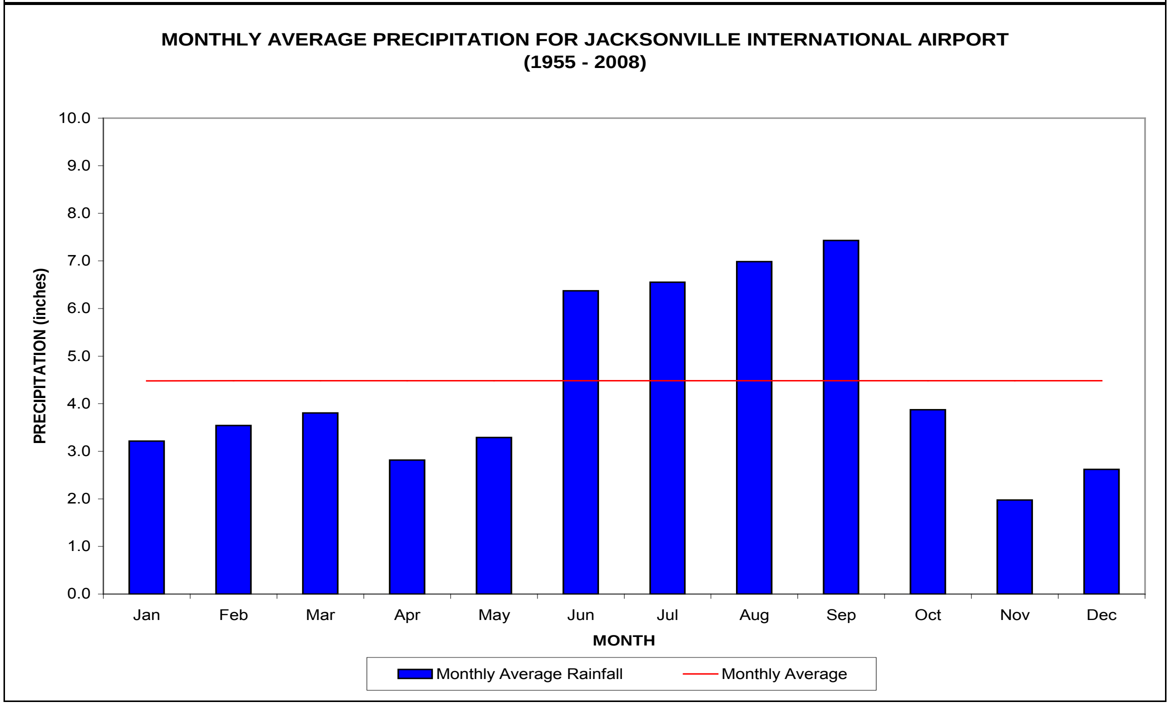
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1955	3.1	2.46	1.66	1.5	4.51	2.7	5.53	3.85	10.6	5.36	1.9	0.2	**43.33**
1956	2.9	2.94	0.81	2.33	3.98	7.87	8.25	5.24	2.89	13.4	0.4	0	**51.08**
1957	0.3	1.69	3.87	1.61	5.25	7.1	12.3	3.3	8.33	3.5	1.6	1.3	**50.18**
1958	3.4	3.74	3.38	8.24	3.79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

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1996	1.1	1.11	6.83	2.85	0.72	11.4	4.2	7.83	8.49	11.5	1.4	3.2	**60.63**
1997	2.9	1.28	1.84	4.56	3.43	6.33	7.69	8.24	3.97	4.84	2.4	9.8	**57.27**
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**

Rainfall is in inches, and represents data from JIA.

Appendix J: Annual and Monthly Average Precipitation Jacksonville International Airport





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