

WATER SEGMENT ASSESSMENT
BAKER CREEK (WBID 1522C)
MILL CREEK (WBID 1542A)
SPARKMAN BRANCH (WBID 1561)

TAMPA BAY TRIBUTARIES (GROUP 2)
HILLSBOROUGH RIVER PLANNING UNIT
HILLSBOROUGH RIVER WATERSHED
HILLSBOROUGH COUNTY, FLORIDA

TAMPA BAY STAKEHOLDERS

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1.0 INTRODUCTION

1.1 BACKGROUND AND PURPOSE OF REPORT

Several water segments in the Tampa Bay area appeared on Florida's 303(d) list in 1998 as impaired for dissolved oxygen (DO) or DO and nutrients. Since that time, the U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (FDEP) have developed total maximum daily loads (TMDLs) for the various water bodies, some of which are still in draft form and some finalized by EPA.

The Baker Creek water segment [Water Body ID (WBID) 1522C], Mill Creek segment (WBID 1542A) and Sparkman Branch segment (WBID 1561) all appeared on the 1998 303(d) List for DO and nutrients.

EPA proposed a TMDL for nutrients (DO) for Baker Creek and Sparkman Branch in December 2005 (EPA, 2005). Both water segments were verified for DO and nutrient impairment because more than 10 percent of the DO measurements were below the 5.0 milligram per liter (mg/L) standard, and more than 10 percent of the chlorophyll a (Chl a) measurements exceeded 20 micrograms per liter (µg/L). The TMDL proposal employed numerical simulation models (a combination of a watershed model to provide the loadings and hydrology, and a water quality model to simulate the water quality impacts of reduced loadings) to develop load reductions for these streams. Because the modeling exercise demonstrated that nutrient and biochemical oxygen demand (BOD) loads to the creeks "were not excessive enough to cause the chronically low DO found in...the system", EPA concluded: "The TMDL analysis demonstrated that neither nutrients, BOD, chlorophyll, or sediment oxygen demand caused the low DO in Baker Creek. Instead the low DO was the result of natural processes in the wetlands and groundwater flowing into these streams. Therefore the DO TMDL requires no reductions of BOD, SOD, or nutrients." Instead, EPA took a basinwide approach to the problem and established load reductions to be protective of Lake Thonotosassa. Because nitrogen is limiting in the whole of the Flint Creek Watershed, loads (Table 1-1) from these streams were established to target an inflowing concentration of 1.2 mg/L. The 1.2 mg/L target was what had been deemed as the protective in-lake concentration in Lake Thonotosassa. The 1.2 mg/L target was based upon the assumption that the lake concentration was equivalent to the inflowing concentration. This assumption was not supported by the original Storm Water

Management Model (SWMM) documents, which identified that an inflowing concentration of 2.4 mg/L would be protective of the lake concentration of 1.2 mg/L.

Table 1-1. Proposed Load Reductions in the 2005 EPA TMDL Document for Baker Creek and Sparkman Branch

Water Segment	WBID	TN			TP
		TMDL	LA	MS4s	
Baker Creek	1522C	73 kg/d	0.3 kg/d	18%	N/A
Sparkman Branch	1561	30 kg/d	N/A	21%	N/A

Source: (EPA, 2005)

FDEP proposed a TMDL for Baker Creek, Mill Creek, and Sparkman Branch in June 2009 (Kang, 2009). This TMDL identified the need for 80 percent reductions in both total nitrogen (TN) and total phosphorus (TP) in all three WBIDs (Table 1-2), based upon models that targeted meeting the 5.0 mg/L DO standard within Baker Creek. The instream TN targets identified through that effort were 0.29 mg/L, 0.24 mg/L, and 0.27 mg/L for Baker Creek, Mill Creek, and Sparkman Branch, respectively. The instream TP targets identified through that effort were 0.11 mg/L, 0.08 mg/L, and 0.09 mg/L for Baker Creek, Mill Creek and Sparkman Branch, respectively. Written comments and comments presented at a September 3, 2009 administrative hearing by various Stakeholders [Florida Department of Environmental Protection (FDEP), Pasco County, and Hillsborough County] raised significant issues with the technical assumptions used in the modeling (ATM 2009a, ATM 2009b, ATM 2009c). Based upon those comments, FDEP postponed finalization of the TMDLs until February 2010.

Table 1-2. Proposed Load Reductions in the 2009 FDEP TMDL Document for Baker Creek, Mill Creek, and Sparkman Branch

Water Segment	WBID	TN	TP
Baker Creek	1522C	80%	80%
Mill Creek	1542A	80%	80%
Sparkman Branch	1561	80%	80%

Source: (Kang, 2009)

On September 30, 2009, EPA proposed the FDEP TMDL (Kang, 2009) in compliance with its consent decree order. On November 30, 2009, comments similar to those provided to FDEP were sent to EPA. The EPA TMDL was not finalized in March 2010 but remained in draft form. In February 2010, FDEP proposed a revised TMDL based upon the use of local

reference stations to define TN and TP targets. The instream targets identified for TN and TP through this effort were 1.16 mg/L and 0.473 mg/L, respectively. Table 1-3 summarizes the proposed load reductions.

Table 1-3. Proposed Load Reductions in the 2010 FDEP TMDL Document for Baker Creek, Mill Creek, and Sparkman Branch

Water Segment	WBID	TN	TP
Baker Creek	1522C	26.1%	14.7%
Mill Creek	1542A	41.1%	6.2%
Sparkman Branch	1561	19.9%	N/A

Source: (Kang, 2010)

In February 2010, local Stakeholders filed a challenge on the TMDLs proposed by FDEP. Through negotiations, the challenge was put in abeyance while the local Stakeholders worked with FDEP to identify a resolution pathway. A Memorandum of Agreement (MOA) was developed in cooperation with FDEP and EPA that outlined a path forward for resolution. The MOA was developed through multiple coordination meetings and a site visit to the watershed by representatives of the local Stakeholder group, FDEP, and EPA. The MOA is included as Appendix A.

The first step under the MOA is the development of a WBID Assessment Report. The WBID Assessment Report provides an assessment of the water segment using available water quality, land use, hydrologic, and biological data to examine its impairment status, with special emphasis on DO and nutrients. It is intended to provide additional information to assist FDEP and local Stakeholders in determining an appropriate path forward relative to future management and/or restoration of this water body. The potential paths forward include the following or some combination of the following:

1. TMDL for nutrients and/or BOD with potential for revised the DO target using regional DO criteria
2. Class III Limited re-designation
3. Physical or habitat restoration
4. TMDL not needed (TNN)

For water bodies that have significant historical physical modifications, it may be determined that trying for a Class III Limited designation may be the appropriate path forward. In those cases, where the water body is impaired for the state's DO standard, but the water quality data do not show a strong connection of depressed DO to nutrients or BOD, the water body may be considered for TNN status or re-classification to an appropriate Category 4. In those cases where the depressed DO condition can be traced to past significant physical disturbances to the water body and it is expected that restoration activities will make the water body attain its designated use, physical restoration will be recommended. Finally, where data indicate that load reductions will achieve restoration of the designated use of the water body, then the path to an appropriate final TMDL will be defined.

This document presents the pathway forward for Baker Creek (WBID 1522C), Mill Creek (WBID 1542A), and Sparkman Branch (WBID 1561), based on the results of analyses performed specifically for reaching the recommended pathway. The MOA between the FDEP and the Stakeholders included specific work tasks to guide determination of the path forward. As outlined in the MOA, these analyses include the following:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors within Baker Creek, Mill Creek, and Sparkman Branch against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine how representative the Baker Creek station is of the inflowing waters versus being representative of conditions in Lake Thonotosassa.
- Examine Pemberton Creek DO values in relation to measurements in Baker Creek.
- Examine the local issues within Mill Creek to determine potential local and downstream impacts due to the discharge from the National Pollutant Discharge Elimination System (NPDES) permittee Crystals International.
- Examine potential for determining the downstream protective value (DPV) approach for Lake Thonotosassa as possible solution.
- Examine Stream Condition Index (SCI) data (if available) to determine level of biological health.
- Examine more recent data from Environmental Protection Commission of Hillsborough County (EPCHC) to see conditions in recent years.

- Review Mill Creek and Sparkman Branch separate from Baker Creek.

1.2 CHARACTERIZATION OF WATER SEGMENT

1.2.1 BASIN AND STREAM ENVIRONMENT DESCRIPTION

The Baker Creek, Mill Creek and Sparkman Branch water segments are located in the Hillsborough River Watershed in Hillsborough County, Florida. It has been placed in the Hillsborough River Planning Unit, which is part of the Tampa Bay Tributaries Assessment Group. This group is assessed as part of FDEP's Group 2 and is currently in its third cycle (1/1/2006 – 6/30/2013). Figure 1-1 provides the location of the three segments within the Hillsborough River Planning Unit.

1.2.1.1 Baker Creek (WBID 1522C)

The Baker Creek WBID flows directly into Lake Thonotosassa. The portion of Baker Creek listed as WBID 1522C is a highly modified dredged channel (see Figure 1-3). Moving upstream, the stream splits where the channelized portion changes direction from a southeast orientation to a southwest orientation. The branch to the west is the WBID Flint Creek (South) (1522D) (termed Upper Baker Creek at times in this document), which, moving upstream, becomes Pemberton Creek, a relatively natural stream channel. The branch to the south is Seffner Canal (WBID 1547), a highly modified dredged channel (see Figure 1-2). On Figure 1-3 Seffner Canal is visible at the split but the stream course to Upper Baker Creek and Pemberton Creek is hidden by tree canopy. The watershed that drains through WBID 1522C is 34,500 acres. The drainage area includes Baker Creek, Seffner Canal (1547), Baker Creek Tributary (1544), Flint Creek South (1522D), Pemberton Creek (1542), Moore Lake Drain (1565), Sparkman Branch (1561), and Mill Creek (1542A). The channelized portion of Baker Creek is approximately 1 mile in length. All of the Baker Creek (1522C) water quality measurements have been taken at the Thonotosassa Road bridge (pictured at the top of the photograph), just before the channel enters Lake Thonotosassa.

1.2.1.2 Mill Creek (WBID 1542A)

The Mill Creek water segment is part of the same Flint Creek watershed system as Baker Creek (Figure 1-2). Mill Creek is an intermittent stream that, when flowing, runs south to north. The stream is approximately 4.2 miles in length, and the stream course has been significantly modified over the years.

The channeling of the stream course is evident in Figure 1-4. Mill Creek discharges to the upper portions of Pemberton Creek (WBID 1542). The long-term water quality measurements are taken in the stream just north of Interstate 4. Some historic measurements are also available from a station just upstream of the pictured sewage treatment plant. Effluent from the treatment plant was routed away from Mill Creek in the late 1990s.

1.2.1.3 Sparkman Branch (WBID 1561)

Sparkman Branch is also an intermittent first-order stream that originates at a weir structure at Walden Lake in the southern portion of the WBID, and flows in a southeast to northwest direction into Pemberton Creek. The stream is approximately 2 miles long. EPA (2005) reports that the stream has received significant modification through channeling, but that much of the stream sinuosity and habitat has been restored or recovered. Figure 1-5 depicts the stream source in the eastern portion of Walden Lake.

1.2.2 LAND USES

Land use data for 2009 were retrieved from the shape file library of Southwest Florida Water Management District (SWFWMD) (SWFWMD, 2011) and used to prepare Figure 1-6 and Tables 1-1 through 1-3. SWFWMD derived the classifications using the Florida Land Use and Cover Classification System (FLUCCS). The features were photointerpreted by SWFWMD at 1:8,000 using 2009 1-foot color infrared (CIR) digital aerial photographs. The FLUCCS and SWFWMD's photo interpretation methodology are described in SWFWMD's Photo Interpretation Key (SWFWMD, 2010).

1.2.2.1 Baker Creek (WBID 1522C)

The watershed draining to Baker Creek is over 34,500 acres and includes the Baker Creek, Seffner Canal, Moore Lake Drain, Flint Creek South (Upper Baker Creek), Baker Creek Tributary, Mill Creek, Pemberton Creek, and Sparkman Branch water segments (see Figure 1-2). The Seffner Canal drainage area is approximately one-half of the total drainage, while the remaining sub-basins make up the rest. The predominant land uses are residential (42 percent), cropland and pasture land (14 percent), and wetlands (13 percent) (Table 1-4). There are 55 acres of animal feeding operations (predominantly chickens) that are primarily located in the Seffner Canal drainage area.

Table 1-4. Classification of Baker Creek Drainage Area Land Uses in 2009

FLUCCS CODE	FLUCS DESC	Acres	% of Total
1100/1200/1300	RESIDENTIAL	14,689	42.5
1400/1500/1700	COMMERCIAL/INDUSTRIAL/INSTITUTIONAL	2,669	7.7
1600	MINING	245	0.7
1800	PARKS AND GOLF	622	1.8
1900/2600/3000	UNDEVELOPED AND OPEN LANDS	1,791	5.2
2100	CROPLAND AND PASTURELAND	4,895	14.2
2200	TREE CROPS	902	2.6
2300	FEEDLOTS	55	0.2
2400/2500	SPECIALTY FARMS	526	1.5
4000	UPLAND FOREST	1,762	5.1
5000	WATER	828	2.4
6000	WETLANDS	4,514	13.1
7000	DISTURBED LAND	7	0.0
8000	TRANSPORTATION AND UTILITIES	1,037	3.0
TOTAL		34,542	100

Notes: FLUCCS determinations made by SWFWMD using 2009 1-ft color infrared photography. Combinations shown in the table were completed by ATM.

Source: SWFWMD, 2011

1.2.2.2 Mill Creek (WBID 1542A)

The Mill Creek drainage area is a subset of the larger Baker Creek drainage land uses described in Table 1-4. Mill Creek's watershed is approximately 3,456 acres. The predominant land uses are urban, including residential (39 percent) and commercial/industrial/ institutional (25 percent) (Table 1-5). Wetlands (19 percent) make up the largest share of the balance of the uses. There are no animal feeding operations or mining in the Mill Creek watershed.

1.2.2.3 Sparkman Branch (WBID 1561)

The Sparkman Branch drainage area is also a subset of the larger Baker Creek drainage (land uses described in Section 1.2.2.1). The Sparkman Branch watershed is approximately 4,927 acres. Urban lands make up more than half of the area including residential (35 percent) and commercial/industrial/institutional (17 percent) (Table 1-6). Wetlands (19 percent) make up the largest share of the balance of the uses. There are no animal feeding operations or mining in the Mill Creek watershed.

Table 1-5. Classification of Mill Creek Land Uses in 2009

FLUCCS CODE	FLUCS DESC	Acres	% of Total
1100/1200/1300	RESIDENTIAL	1,340	38.8
1400/1500/1700	COMMERCIAL/INDUSTRIAL/INSTITUTIONAL	870	25.2
1600	MINING	0	0
1800	PARKS AND GOLF	21	0.6
1900/2600/3000	UNDEVELOPED AND OPEN LANDS	165	4.8
2100	CROPLAND AND PASTURELAND	70	2.0
2200	TREE CROPS	10	0.3
2300	FEEDLOTS	0	0
2400/2500	SPECIALTY FARMS	23	0.7
4000	UPLAND FOREST	70	2.0
5000	WATER	29	0.8
6000	WETLANDS	647	18.7
7000	DISTURBED LAND	0	0
8000	TRANSPORTATION AND UTILITIES	213	6.1
TOTAL		3,458	100

Notes: FLUCCS determinations made by SWFWMD using 2009 1-ft color infrared photography. Combinations shown in the table were completed by ATM.

Source: SWFWMD, 2011

Table 1-6. Classification of Sparkman Branch Land Uses in 2009

FLUCCS CODE	FLUCS DESC	Acres	% of Total
1100/1200/1300	RESIDENTIAL	1,706	34.6
1400/1500/1700	COMMERCIAL/INDUSTRIAL/INSTITUTIONAL	839	17.0
1600	MINING	0	0
1800	PARKS AND GOLF	231	4.7
1900/2600/3000	UNDEVELOPED AND OPEN LANDS	218	4.4
2100	CROPLAND AND PASTURELAND	329	6.7
2200	TREE CROPS	60	1.2
2300	FEEDLOTS	0	0
2400/2500	SPECIALTY FARMS	70	1.4
4000	UPLAND FOREST	128	2.6
5000	WATER	168	3.4
6000	WETLANDS	953	19.4
7000	DISTURBED LAND	7	0.2
8000	TRANSPORTATION AND UTILITIES	217	4.4
TOTAL		4,926	100

Notes: FLUCCS determinations made by SWFWMD using 2009 1-ft color infrared photography. Combinations shown in the table were completed by ATM.

Source: SWFWMD, 2011

1.2.3 CLIMATE AND SOILS

The watershed draining to Baker Creek has a humid, sub-tropical climate, with an annual rainfall of 52.4 inches. The average summer temperature is 89.9 degrees Fahrenheit (°F) and the average winter temperature is 72.8°F. It is located in the Hillsborough Valley portion of the Southwestern Florida Flatwoods ecoregion and has elevations ranging from 30 feet above sea level at Lake Thonotosassa to 130 feet above sea level in the upstream areas of Mill Creek. The area is a plain of relatively low relief that results in slow surface drainage. Natural vegetation varies but includes longleaf pine/turkey oak forests, pine flatwoods, and considerable hardwood swamps. Soils are predominantly composed of medium fine sands and silts. Plant City is the major population center in the watershed.

Soils in the area are generally high in phosphates and have been classified within the Bone Valley under the EPA and FDEP numeric nutrient criteria development processes. This creates conditions where ambient phosphorus levels are high within the stream segments, creating nitrogen limited conditions.

1.2.4 HYDROLOGY

The Baker Creek system is contained in the Hillsborough Hydrologic Unit (03100205). The U.S. Geological Survey (USGS) monitors stream flow and stage in this system in the upper portion of Baker Creek / Lower Pemberton Creek at Station 02303205 (Baker Creek at McIntosh Road near Antioch) in Hillsborough County, which includes a drainage area of approximately 17,536 acres. This includes most of the watershed outside of the Seffner Canal WBID. The gauge is located at the McIntosh Road bridge crossing (see Figure 1-2) at approximately 43 ft above sea level. The gauge is monitored in cooperation with the City of Tampa. The period of record stretches from April 1992 to the present and includes daily discharge and stage measurements. Precipitation was also measured at this location from October 2002 to April 2005. There are no gauging stations in Mill Creek or Sparkman Branch. When comparing water quality data with stream flows in Section 2, the Baker Creek gauge measurements are used as a surrogate for these systems. However, because Mill Creek and Sparkman Branch are at the top of the drainage basin, they are far more intermittent than Baker Creek and experience longer durations without flow in the system. FDEP has been unable to collect biological data in Mill Creek because it has not been flowing when the site was visited for sampling (personal communication FDEP Tampa staff).

Figure 1-7 presents a plot of monthly average flows from 1992 to the present. Average annual daily flow is approximately 19 cubic feet per second (cfs) over the period of record, but there is considerable variability, ranging from 6.6 cfs in 2007 to 46.4 cfs in 1998, with a standard deviation of 10 cfs. The median flow value of 17.9 cfs suggests that there are more low flow years over the period of record than high ones.

Additionally, there is considerable seasonal variation in stream discharge that follows local rainfall patterns, with flows being reduced significantly in late spring. Over the more recent period of record (2000 to 2010), there is little or no flow (<2 cfs) in the stream for 14 percent of monthly daily average values, with the bulk of these no flow periods occurring in May and early June (Figure 1-8). The more recent data is appropriate because in 1998, the Plant City wastewater treatment plant (WWTP) discharge was moved out of the system, removing a significant level of base flow in the system. Looking at the data plotted in Figure 1-7, the base flow is evident going up to 1997, after which there are periods where flows are near or at zero.

1.2.5 SOURCE ASSESSMENT

The way nutrients and oxygen-demanding substances enter the Baker Creek watershed can be grouped as either point sources or non-point sources. As typically defined, point sources are discharges to surface or ground water that originate from discrete, well-defined areas such as a facility discharge from the end of a pipe, through a ditch or over a weir; but other discrete applications of known constituents like sprayfield applications are also considered point sources. Point sources are usually divided into two types: domestic wastewater (treatment plant discharge that originates from wastewater from homes, businesses, and institutions) and industrial wastewater (process water discharge, runoff, leachate, etc., from industrial processing, handling, or storage facilities). Although stormwater discharge from non-industrial sites can be classified as a point source, it is usually considered with non-point sources because of practical considerations involved in measuring loads and loading points.

Non-point sources generally originate from precipitation and runoff. Stormwater runoff contains nutrients and oxygen-demanding substances derived from atmospheric deposition and the entrainment of nutrients from human activities such as fertilizer application and land disturbance, but also from natural sources from the watershed's soils and organic

constituents. While nutrient loads from soils (particularly phosphorus) and organic matter (decaying plant and animal material, leaf litter, etc.) are not entering the watershed from outside its boundary, the nutrients entrained by the stormwater enter and affect the streams nonetheless.

An additional source of nutrients and oxygen-demanding substances that can enter the stream are called legacy sources. While properly a subset of non-point or even point-source loading, this category usually focuses on fertilizer or pollutants from past land uses or operations that would not be quantified in an analysis that only examined current point sources by reviewing NPDES permits or current land uses in the watershed. For example, long-term farming operations may have applied fertilizers that remain in the soil profile, but slowly leach to groundwater over time.

1.2.5.1 Point Sources

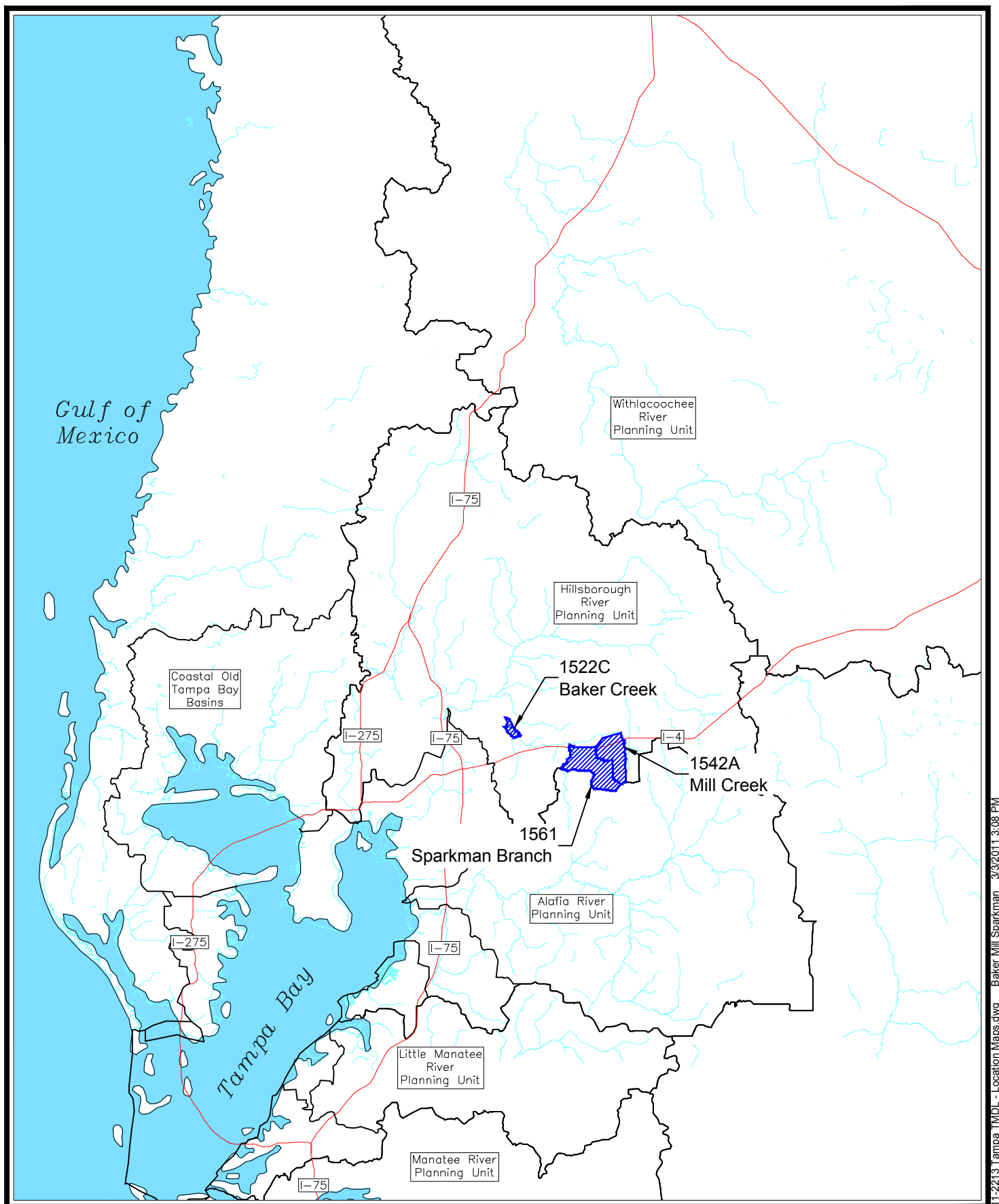
Permitted point sources to the Baker Creek system are described in detail by FDEP in the 2010 TMDL document (Kang, 2010) and are summarized here. The only significant discharger of nutrients to the system is Kerry I & F Contracting Company, an industrial WWTP. The facility maintains an active NPDES permit with monitored discharge (FL 0037389), with a maximum flow of 4.02 million gallons per day (mgd). The only nutrient that the facility is permitted to discharge is un-ionized ammonia, at a concentration of no more than 0.02 mg/L. The facility discharges to Westside Canal and thence to Pemberton Creek. The Westside Canal is another name for portions of Mill Creek, and the facility is located at the head of Mill Creek. Based upon visual assessment of the conditions at the discharge, the facility flows into a collection pond, which overflows across a weir structure into the creek.

The Plant City domestic WWTP (FL 0026557) effluent discharge was relocated from lower Mill Creek to East Canal in late 1997. East Canal discharges to Itchepackasassa Creek that flows to Blackwater Creek, avoiding the Baker Creek / Lake Thonotosassa system. Previous TMDL reports did not identify that the WWTP discharged to Mill Creek because the permit identified the discharge to Westside Canal (which is another name for Mill Creek).

The stormwater collection systems in the watershed are owned and operated by Hillsborough County (#FLS 000006), FDOT, and Plant City, under the Countywide Phase I Municipal Separate Storm Sewer Systems (MS4s) permit.

1.2.5.2 Non-Point Sources

A number of potential non-point sources exist within the Baker Creek watershed, including agriculture, residential runoff, septic systems, and other sources. Nutrients can also enter the watercourses from groundwater sources or baseflow. Both natural and anthropogenic sources of nutrients will leach through or from the soils over time and be carried to the stream with the surficial groundwater.



11-2213 Tampa TMDL - Location Maps.dwg Baker Mill Sparkman 3/3/2011 3:08 PM

Figure 1-1
Location Map - Baker Creek (1522C), Mill Creek (1542A), and Sparkman Branch (1561)



Figure 1-3
Aerial Photograph of Baker Creek

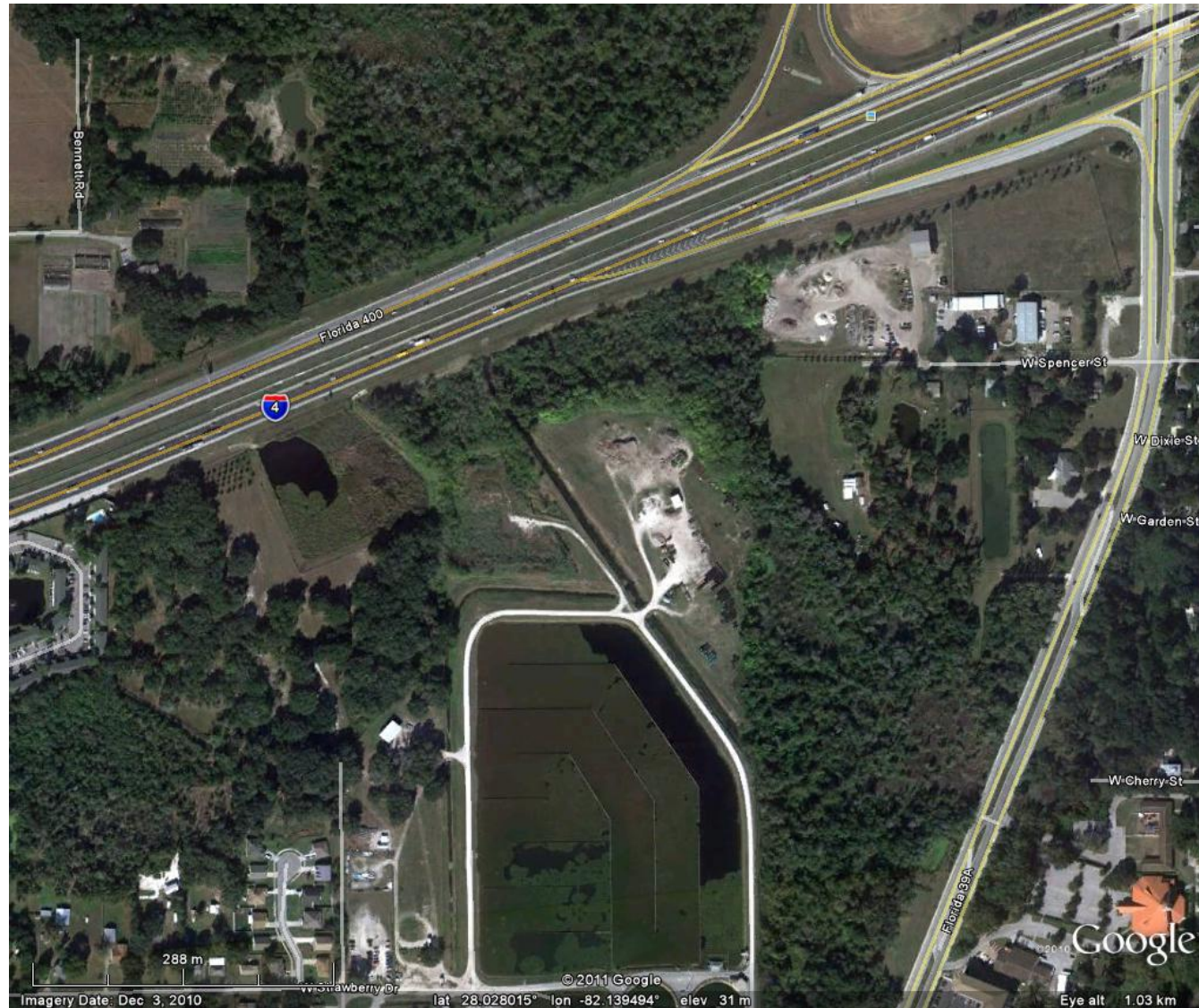


Figure 1-4
Aerial Photograph of Mill Creek

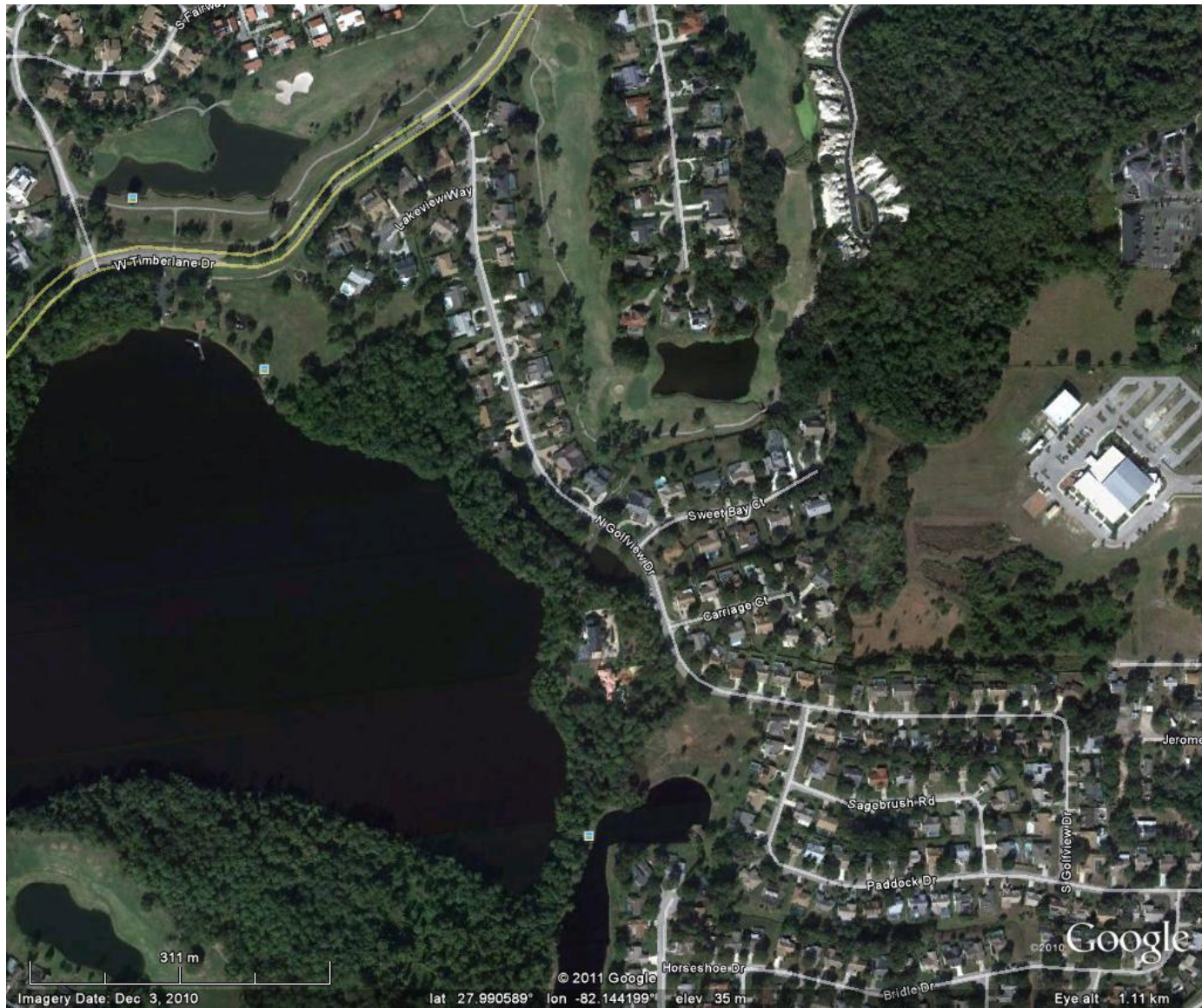


Figure 1-5
Aerial Photograph of Sparkman Branch

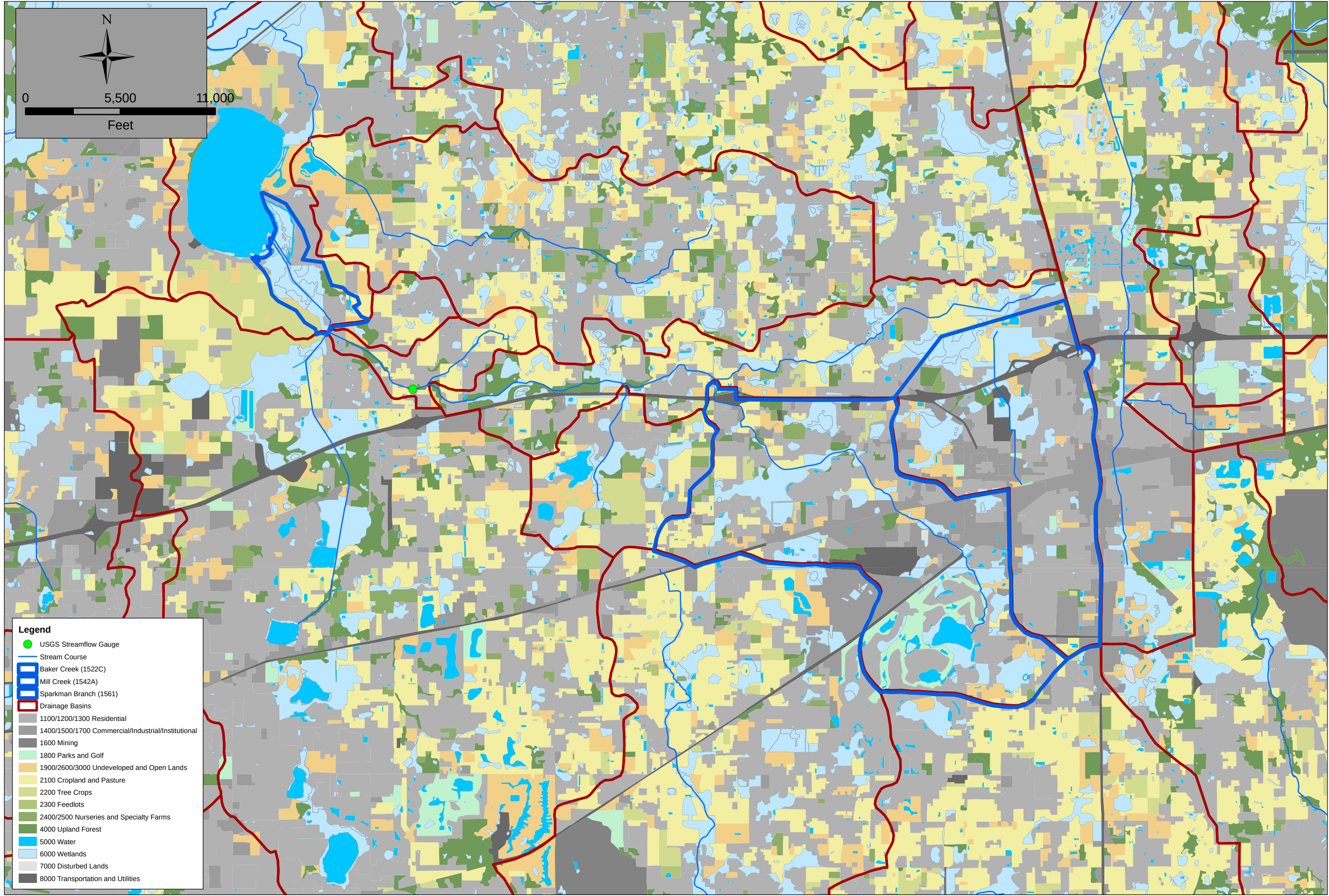


Figure 1-6
WBID Land Use - Baker Creek (1522C), Mill Creek (1542A), and Sparkman Branch (1561)

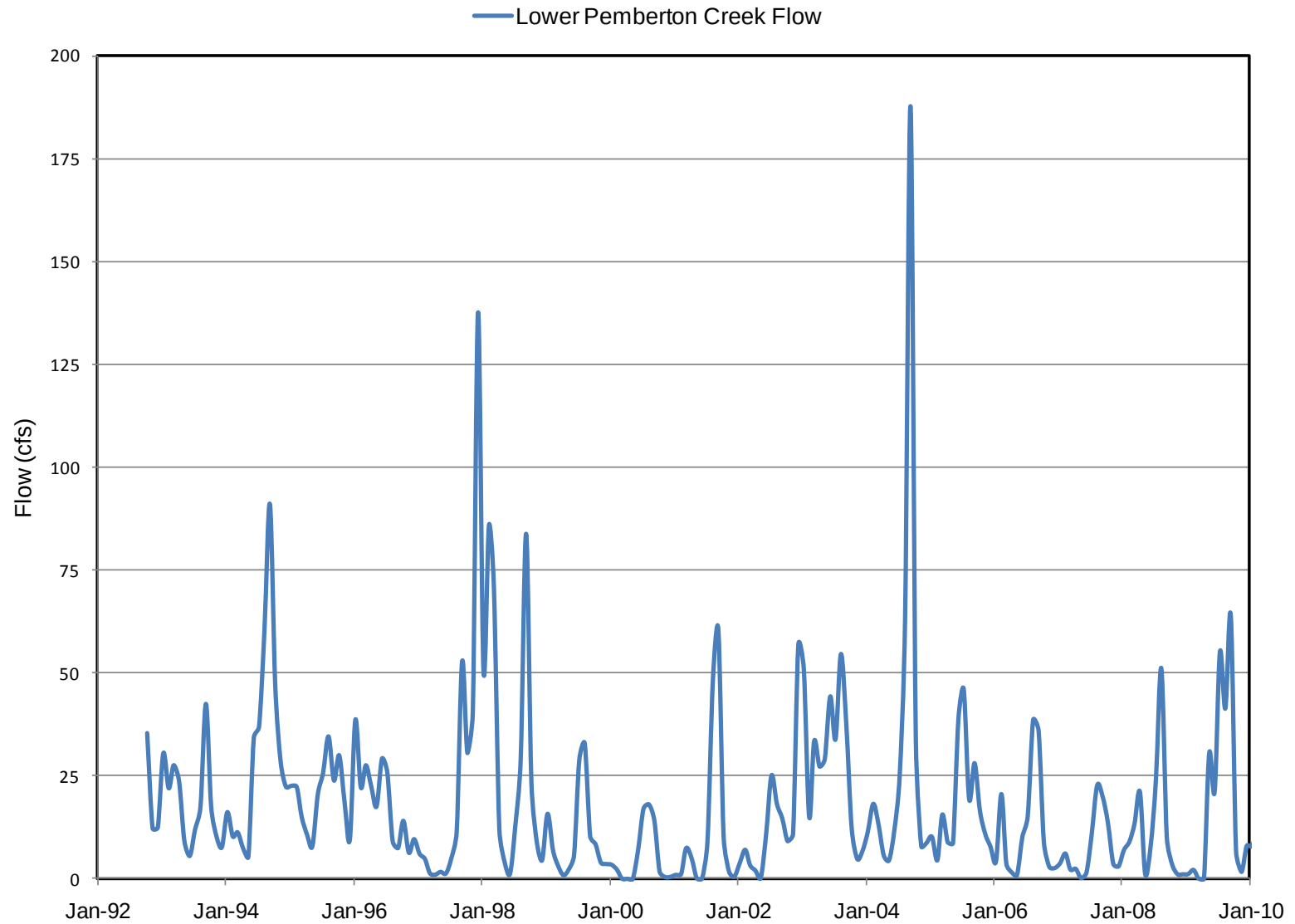


Figure 1-7
Measured Daily Flow at USGS Station on Pemberton Creek

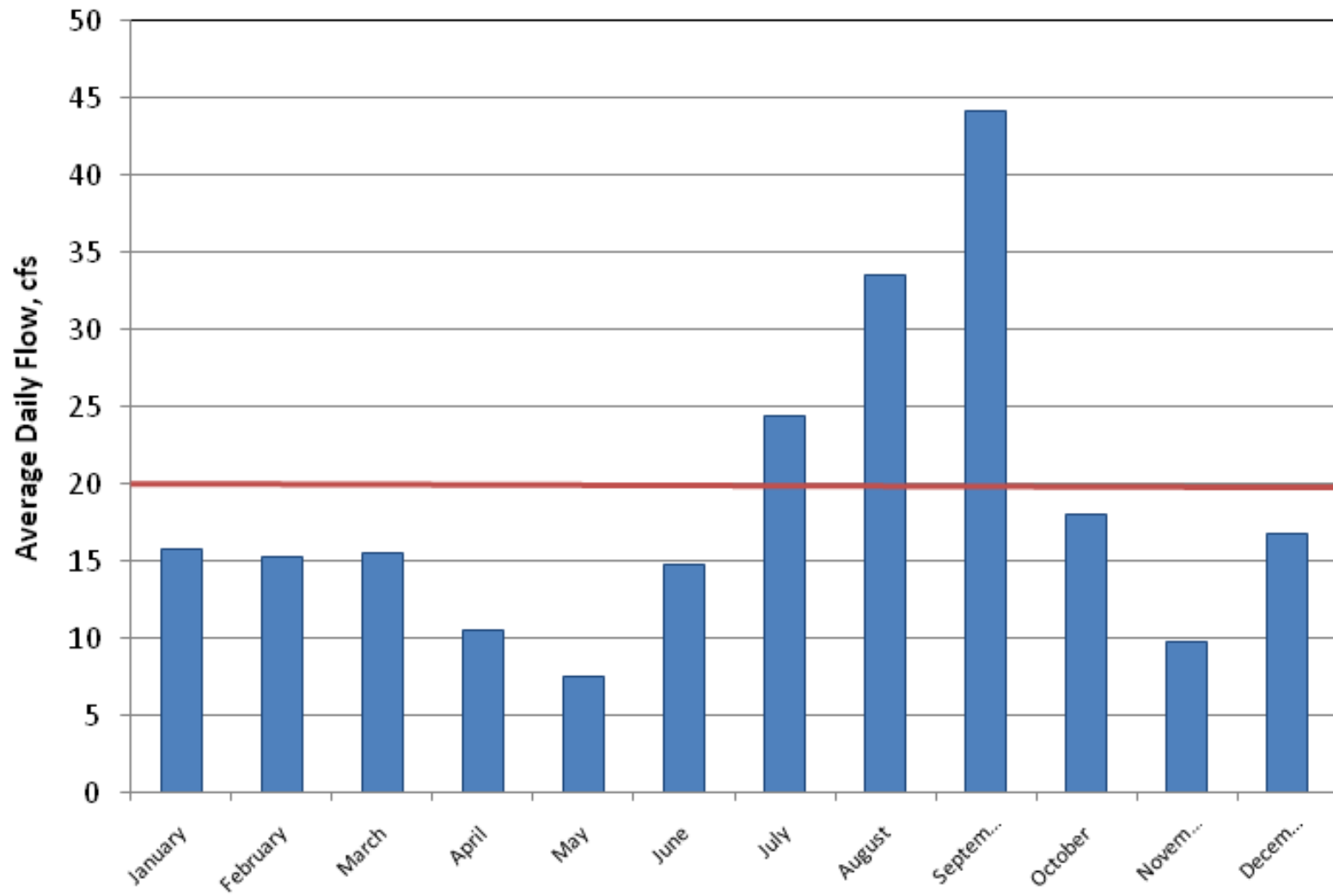


Figure 1-8
Average Daily Flow by Month at USGS Station on Pemberton Creek

2.0 WATER QUALITY DATA ASSESSMENT

2.1 REASON FOR IMPAIRMENT

This section presents the current available water quality data for Baker Creek, Mill Creek, and Sparkman Branch from Run 42 of the Impaired Waters Rule (IWR) database. In addition to these data, this analysis utilized some supplemental data available from EPCHC that is not in the IWR database. Data from other water segments in the Baker Creek drainage (e.g., Pemberton Creek and Flint Creek South) are presented in Section 2.4, where the data across the watershed are compared. Figure 2-1 provides the locations of the stations associated with Baker Creek (WBID 1522C), Mill Creek (WBID 1542A), and Sparkman Branch (WBID 1561) superimposed over recent aerial photography, including the station on Seffner Canal. Figure 2-2 provides the water quality station locations assigned to the Upper Baker Creek segment [Flint Creek (South) WBID 1522D], Baker Creek Tributary (WBID 1544), and Pemberton Creek (WBID 1542). These segments are all part of the Baker Creek system and provide the connection from Mill Creek and Sparkman Branch to lower Baker Creek.

2.1.1 BAKER CREEK (WBID 1522C)

The IWR database contains DO concentration measurements from six stations for the Baker Creek WBID from 1974 to 2010. Figure 2-3a plots the measured DO from 1990 to the present, and Figure 2-3b plots the percent saturation. For the DO measurements, the bottom, mid-depth, and surface values are plotted; for the percent saturations, only the mid-depth values are presented because the bottom and surface DO values do not show significant differences over the vertical. The percent saturation values are provided along with the DO measurements because it takes out some of the temperature affects in the data and allows a more direct assessment of the degree to which oxygen demand is occurring. For DO, for the period following the removal of the Plant City discharge in 1997, the measurements ranged from a minimum of 0.8 mg/L to 9.6 mg/L, with an average and median of 4.6 mg/L. The geometric mean is 4.3 mg/L. The analyses are looking at data from 2000 through 2010 and utilize mid-depth measurements where vertical profile data were taken. The graph indicates that the condition observed in Cycle 1 that resulted in verifying impairment for DO has been consistent through the measured period. It is interesting to note that following the removal of the WWTP discharge in 1997, the DO values within Baker Creek dropped very low for a period from March 1997 through October 1997.

In the 2004 listing cycle, FDEP identified approximately 50 percent of the DO at less than 5.0 mg/L. Additionally, a number of years were identified where the annual average Chl a levels exceeded 20 µg/L. The percent saturation data show that there is significant oxygen demand occurring within the water column, but no a significant amount of supersaturation.

2.1.2 MILL CREEK (WBID 1542A)

For the Mill Creek WBID, the IWR database (Run 42) contains DO concentration measurements from only three stations from 1990 to 2010. Observations ranged from a minimum of 0.8 mg/L to 14.3 mg/L, with an average of 5.6 mg/L. Figure 2-4 plots the measurements from all available stations from 1990 to the present. The graph indicates that the condition observed in Cycle 2 that resulted in verifying impairment for DO has been fairly consistent through the measured period. However, of the three stations in the database, only two have significant data record periods and, since 1999, only one station has been monitored. That station, 21FLHILL149, is the downstream-most monitoring station (north of Interstate 4) and is located in an area of heavily impacted hydrology. A station further upstream was monitored from 1990 to 1998 and returned generally higher DO concentrations during the same measurement period. The end result relative to DO of the removal of the WWTP discharge was a net lowering of the overall DO values as the data show.

2.1.3 SPARKMAN BRANCH (WBID 1561)

For the Sparkman Branch WBID, the IWR database (Run 42) contains DO concentration measurements from six stations sparsely from 1992 to 2007. Observations ranged from a minimum of 2.2 mg/L to 8.3 mg/L, with a median value of 4.8 mg/L. However, there are some additional data available for one of the stations in this group (Hillsborough County EPCHC Station FLHILL533) that are not yet available in the IWR database. These additional measurements (five measurements from 2008 and 2009) would still result in verification of the Sparkman Branch water segment as impaired for DO. Figure 2-5 plots the period-of-record measurements from all available stations. The graph indicates that the condition observed in Cycle 2 that resulted in verifying impairment for DO has been fairly consistent through the measured period.

2.2 SUMMARY OF AVAILABLE WATER QUALITY DATA

2.2.1 BAKER CREEK (WBID 1522C)

A summary of the key parameter statistics for Baker Creek are provided in Table 2-1. The analyses represent conditions from 2000 to the present due to the removal of the WWTP discharge in the late 1990s. The data, aggregating all stations in lower Baker Creek, shows that DO has wide swings but does not show significant supersaturation. The nutrient concentrations reflect the higher phosphorus levels often found in Bone Valley water bodies, but the concentrations observed here at the Lake Thonotosassa Road bridge are also reflective of the phosphorus levels found in Lake Thonotosassa that have been found to be anthropogenically enriched (FDEP, 2005). This is due to the nature of the station used within Baker Creek, which during low to zero flow periods, may reflect backwater conditions from Lake Thonotosassa. The system is highly nitrogen limited (TN/TP=2.1), and the nitrogen component is predominantly found in organic forms (especially in the last 10 years). Algal blooms occur, but the median condition is more balanced (geometric mean Chl *a* equals 4.4 µg/L over the record period). The system is also colored and is, at times, pulsed with organic material and very high color.

Table 2-1. Selected Water Quality Observations for Baker Creek Station at Lake Thonotosassa

Parameter	Observations	Minimum	Maximum	Mean
Dissolved Oxygen, mg/L	709	0.8	12.6	5.2
Temperature, °C	770	6.0	42	23.2
Total Nitrogen, mg/L	640	0.11	15.6	1.3
Total Phosphorus, mg/L	662	0.16	8.96	0.62
BOD, mg/L	490	<0.1	36	1.4
Chlorophyll <i>a</i> , µg/L	325	0.3	163.5	4.4
TKN, mg/L	516	0.04	14.5	0.73
Ammonia-Nitrogen, mg/L	522	0.004	14.5	0.24
Total Organic Carbon, mg/L	156	1.5	180	11.7
Color, PCU	505	4	300	74

Source: IWR Database Run 42

Of the six stations that provide DO measurements in the period of record, only three have sufficient long-term data to be useful for trends analysis. Two stations have only four measurements each and one has only a single measurement. All available data is located in the lowest reach of the channeled segment of Baker Creek, at the inflow point to Lake Thonotosassa.

2.2.2 MILL CREEK (WBID 1542A)

A summary of the measured data from 2000 to the present for Mill Creek is provided in Table 2-2. The data come from two locations in the lower part of the system. One site is represented by 21FLHILL24030035 and 21FLHILL149. These data are taken just north of the creek's intersection with Interstate 4. Data from this location (called 21FLHILL149 when referred to in this report) have been sampled continuously since 1990. The second location (21HILL24030040) is located farther upstream but still represents the lower and most hydrologically impacted reach of the creek. Sampling was initiated in 1990 but was discontinued in December 1998 (shortly after the adjacent WWTP rerouted its effluent to reuse and discharge to East Canal). This station was most likely established to provide upstream and downstream data for the Plant City WWTP discharge.

Aggregating these two locations shows that the system's average DO concentration meets the water quality standard but that the system can be observed at concentrations from 1 to more than 14 mg/L. The nutrient concentrations reflect the expected Bone Valley phosphorus concentrations. As is also typical in the Bone Valley, nitrogen is limiting in the stream (TN/TP=3.4). The nitrogen component is predominantly composed of inorganic forms (long-term average organic nitrogen percentage of only 36 percent). While algal blooms occur, they are infrequent (median condition represented by the geometric mean = 2.2 µg/L over the record period). The system is also colored and is, at times, pulsed with organic material and high color.

Table 2-2. Selected Water Quality Observations for Mill Creek from the IWR Database (Run 42) (period of record)

Parameter	Observations	Minimum	Maximum	Mean
Dissolved Oxygen, mg/L	354	0.81	14.3	5.6
Temperature, °C	381	12	37	27.7
Total Nitrogen, mg/L	328	0.05	26.53	0.96
Total Phosphorus, mg/L	331	<0.01	1.99	0.28
BOD, mg/L	326	<0.1	9	1.1
Chlorophyll a, µg/L	328	0.8	82.4	2.2
TKN, mg/L	331	<0.01	16.87	0.48
Ammonia-Nitrogen, mg/L	333	<0.01	19.2	0.13
Total Organic Carbon, mg/L	5	3	19	7.9
Color, PCU	329	<1	175	23

Source: IWR Database Run 42

2.2.3 SPARKMAN BRANCH (WBID 1561)

A summary of the period-of-record data are also provided for Sparkman Branch (Table 2-3). The period-of-record data (1992 to 2010) come from five stations in three locations in the Sparkman Branch stream. All of the more recent data is from one location at the lower part of the stream, just south of the Interstate 4 intersection, that is represented by two stations (21FLTPA 280132821113 and 21FLHILL533). Two additional locations are represented for the lower middle portion of the stream course, but data are very limited (20 DO observations from 1993 to 2002) and the bulk of these are from a single year (2002).

Aggregating the period-of-record data show that the system's measured instream DO concentrations are more often than not below the state water quality standard. Observations are quite variable, however, ranging from 1.5 to over 8 mg/L. The nutrient concentrations reflect expected Bone Valley phosphorus concentrations. Nitrogen is also limiting in this stream (TN/TP=2.9). Unlike Mill Creek, however, the nitrogen component has a long-term average inorganic nitrogen composition of less than 15 percent of the total nitrogen. While algal blooms occur, they are infrequent (median condition represented by the geometric mean = 3.7 µg/L over record period). The system is far more colored than Mill Creek, which is likely the result of its longer course through instream wetlands.

Table 2-3. Selected Water Quality Observations for Sparkman Branch from the IWR Database (Run 42) & Additional Data Obtained from Hillsborough County EPC (period of record)

Parameter	Observations	Minimum	Maximum	Mean
Dissolved Oxygen, mg/L	38	1.6	8.3	4.6
Temperature, °C	38	12.3	28.2	25.0
Total Nitrogen, mg/L	34	0.72	3.52	1.36
Total Phosphorus, mg/L	34	0.30	1.20	0.47
BOD, mg/L	32	0.6	4.5	1.7
Chlorophyll a, µg/L	27	0.4	140	3.7
TKN, mg/L	34	0.71	3.52	1.20
Ammonia-Nitrogen, mg/L	33	0.01	0.17	0.05
Total Organic Carbon, mg/L	22	7	37	22
Color, PCU	33	60	400	175

Source: IWR Database Run 42; Hillsborough County

2.3 CORRELATION ANALYSIS

2.3.1 BAKER CREEK (WBID 1522C)

An analysis was conducted to pair appropriate parameters to the 709 DO measurements to provide a means to test potential “dose/response” relationships by regression. Table 2-4 provides the number of paired measurements available from all stations to DO (expressed as a concentration).

Table 2-4. Number of Available Paired Measurements to Dissolved Oxygen from the IWR Database (Run 42) (period of record) for all Stations Assigned to Baker Creek (1522C)

Temp	TN	TP	BOD	Chl a	TKN	NH ₄	TOC	Color
698	611	648	618	440	637	614	149	612

Source: IWR Database Run 42

In Cycle 1, the FDEP found that the low DO observations in Baker Creek could be linked to nutrients because average annual Chl a values exceeded 20 µg/L in 2000 and 2001 and average annual Chl a values exceeded the historical average (1992-1996) by more than 50 percent in six of the years assessed. It is important to note that the historical condition used by FDEP reflected the discharge from the WWTP and the continuous flow in the system, this is a very different situation than exists today. Because nitrogen is the limiting nutrient, based on a TN/TP ratio median of 2.3, a TMDL was developed for Baker Creek in 2005 (EPA, 2005) where EPA determined that “neither nutrients, BOD, chlorophyll a, or sediment oxygen demand caused the low DO in Baker Creek. Instead the low DO is the result of natural processes in the wetlands and groundwater flowing into these streams.”

In Cycle 2, the DO depressions were again linked to nutrients based on average annual Chl a measurements in excess of 20 µg/L in 2001 and 2007. The assessment cites the EPA TMDL as addressing the nutrient impairment. However, FDEP developed two additional TMDL proposals in 2009 (Kang, 2009) and a revision in 2010 (Kang, 2010) that are discussed previously that require nutrient reductions of both TN and the non-limiting TP.

Figures 2-6a through 2-6c present the measured nitrogen, phosphorus, and BOD from 1990 to the present. While the nutrient data show a step rise in the values following the removal of the WWTP, overall the values are consistent before and after the removal, although the BOD shows higher values following removal. Figure 2-7a presents the measured Chl a at the Lake Thonotosassa Bridge from 1990 to the present. Evaluation of this data against the

flows identifies a key characteristic of the data from this station. Figure 1-7 presents the measured flow at the USGS Pemberton Creek gage (approximately one-half of the drainage area to Baker Creek). Looking at the data shows that prior to 1997, the system had a continuous base flow. This continuous base flow was based upon the Plant City WWTP discharge. Looking at Figure 1-7, the base flow conditions are evident prior to the 1997 time period, with values around 7 to 8 cfs. After 1997, the system had periods where the flow conditions go to near zero. Looking at the flow periods, there are low flows around 2000 and around 2008. During both of those periods, significant Chl a blooms occurred. Figure 2-11 presents the flows and Chl a values plotted on the same graph. A key aspect of the conditions in Baker Creek is that where the measurements are taken, it is a highly modified dredged canal, which is very different than the conditions in the more upstream reaches (1522D) where the stream is in a more natural state. The conditions within the upstream reach are discussed in Section 2.4. Finally, Figure 2-7b presents a plot of Chl a values in Lake Thonotosassa. Clearly, the lake has issues associated with overenrichment and, as the Baker Creek station represents a backwater area of the lake, it may not be the most appropriate station for determining instream protection needs.

The stream is impaired for DO and nutrients with TN identified as the causative pollutant (because the stream is nitrogen-limited). However, no relationship is apparent between TN, TP and Chl a (see Figure 2-8), and no significant relationship is found between TN, TP and percent saturation (see Figure 2-9).

Figure 2-10 presents a plot of the various nitrogen species versus the TN. While the data do show that the predominance of nitrogen is bound up within the organic form, there does appear to be some times where nitrate-nitrite is a larger percentage of the total.

2.3.2 MILL CREEK (WBID 1542A)

Similar to the analysis conducted for lower Baker Creek, the available Mill Creek data were paired to the 354 period-of-record DO measurements to provide a means to test potential “dose/response” relationships by regression. Table 2-5 provides the number of paired measurements available from all stations to DO (expressed as a concentration).

Table 2-5. Number of Available Paired Measurements to Dissolved Oxygen from the IWR Database (Run 42) (period of record) for all Stations assigned to Mill Creek (1542A)

Temp	TN	TP	BOD	Chl a	TKN	NH ₄	TOC	Color
122	121	119	120	121	120	121	0	121

Source: IWR Database Run 42

In Cycle 1, FDEP found that there were sufficient low DO observations to verify impairment of Mill Creek for DO. However, it was “unable to link low DO to a causative pollutant (BOD and nutrients)” (FDEP, 2005). Because Chl a measurements did not exceed an annual average of 20 µg/L during verification period, Mill Creek was delisted from the 1998 303(d) List for nutrients including un-ionized ammonia.

In Cycle 2, FDEP found “[l]ocated within the Bone Valley region there is a strong correlation between total phosphorus and DO during the verifying period”. Average annual Chl a measurements did not exceed 20 µg/L in the verifying period, but they did exceed the historic Chl a annual average (2.03 µg/L) by more than 50 percent during the verifying period. From this reasoning, Mill Creek was relisted for nutrients. Nitrogen was determined to be limiting (TN/TP ratio of 2.8), but phosphorus was found to be causative. Because it had been delisted in Cycle 1, a TMDL was not developed by EPA in 2005, but the relisting in Cycle 2 led to the development of the two TMDL proposals in 2009 (Kang, 2009) and a revision in 2010 (Kang, 2010). Load reductions were required for both TP and TN in the TMDL documents (refer to Section 1 for quantities).

Figures 2-12 through 2-16 present the time series of measured data for Mill Creek from 1990 through the present for total nitrogen, total phosphorus, BOD-5, Chl a, and ammonia. Figure 2-15 shows the Mill Creek system does not demonstrate significant signs of algal imbalance or even an increasing chlorophyll concentration over time. Excursions above the 20 µg/L threshold are infrequent, with only seven observations (6 percent of the time) greater than 20 µg/L in the record. As was found with Baker Creek, the blooms appear to be correlated with some of the low flow periods (based upon flows from downstream).

While the low DO observations cannot be tied to an algal imbalance, FDEP found a “strong correlation with total phosphorus and DO during the verifying period” even though nitrogen is limiting in the stream. Figure 2-17 charts the relationship between nutrients and Chl a. Figure 2-18 provides the relationship between total nutrients and DO. This analysis could

not recreate the finding that TP concentrations are related to observed instream DO, much less find “a strong correlation.”

However, since nitrogen is limiting in this and most Bone Valley systems, nitrogen speciation was studied for any potential links to observed DO depression. Figure 2-19 plots organic nitrogen and inorganic nitrogen against TN. In a typical natural stream course, with limited anthropogenic sources, one would expect that the majority of the nitrogen contribution would be tied in organic compounds. However, Mill Creek's organic nitrogen percentage varies widely from less than 10 percent of the total to more than 80 percent. The median value (35 percent) is much lower than expected. Figure 2-20 provides a similar graphic, but plots ammonia and nitrate-nitrite nitrogen against the total. While ammonia can, at times, make up nearly half of the TN, nitrate-nitrite is consistently making up the largest concentration of the inorganic nitrogen load in the system. While the source of this inorganic nitrogen is unknown, there still does not appear to be sufficient concentrations to create an imbalance (observable by frequent algal blooms). Figure 2-21 shows that there does not appear to be a direct relationship between either ammonia or nitrate-nitrite nitrogen and DO deficit.

Additional causes of the low DO observations were investigated, including flow, temperature, seasonality and color. There is a strong relationship with flow measured downstream in Upper Baker Creek and DO in Mill Creek, but it is puzzling. Figure 2-22a plots the annual average flow from the USGS gauge in Upper Baker Creek versus measured DO. Figure 2-22b provides the annual averages for DO versus flow. Both plots indicate that lower DO conditions appear to coincide with higher flow periods, which is generally not how DO behaves. Periods of low flow correspond to higher DO measurements and DO is depressed during higher flow periods. The DO response to temperature showed the typical relationship, and seasonal measurements are typically higher in winter and lower in the summer. However, this curve is skewed by the flow variable. Some of the highest DO measurements occur in April and May, when the creek is often not flowing, and some of the lowest measurements persist into October, when flows are higher. Lastly, there is a weak correlation ($R^2=0.23$) between DO and color (Figure 2-23). Less colored water is associated with the higher DO measurements. Additionally the high levels of inorganic nitrogen in the system may indicate some levels of anthropogenic sources to this system that may need to be investigated. It is important to note that this system has been significantly hydrologically modified and has highly intermittent flow, which

may not be fully represented by the flow data from Lower Pemberton Creek. In correspondence with staff from FDEP's local office who do biological work on the local systems, it was stated "I have tried to find Mill Creek and have never been able to find flowing water". In moving forward with Mill Creek, it will be important to work toward the identification of the source of low DO and inorganic nitrogen which may include investigating potential non-point and point sources.

2.3.3 SPARKMAN BRANCH (WBID 1561)

Figures 2-24 through 2-27 present the time series of nitrogen, phosphorus, BOD-5 and Chl a for Sparkman Branch. The available data are very limited and do not provide sufficient data for trends analysis and are limiting in terms of correlations.

Available data were paired to the 35 period-of-record DO measurements (there are only 30 available from the IWR database, Run 42) to test potential "dose/response" relationships by regression. Table 2-6 provides the number of paired measurements available from all stations to DO (expressed as a concentration).

Table 2-6. Number of Available Paired Measurements to Dissolved Oxygen from the IWR Database (Run 42) (period of record) for all Stations Assigned to Sparkman Branch (WBID 1561)

Temp	TN	TP	BOD	Chl a	TKN	NH ₄	TOC	Color
38	34	34	32	27	34	33	22	33

Source: IWR Database Run 42

In Cycle 1, FDEP found that there were sufficient low DO observations to verify impairment of Sparkman Branch for DO and linked the impairment to nutrients (FDEP, 2005). FDEP determined nitrogen was limiting. However, Chl a measurements did not exceed an annual average of 20 µg/L during the verification period. Sparkman Branch was delisted from the 1998 303(d) List for nutrients but placed on the planning list for un-ionized ammonia (by Rule) due to lack of available data.

A TMDL was developed for Sparkman Branch in 2005 (EPA, 2005) where the EPA determined that "low in-stream DO is a result of low DO water flowing from groundwater and wetlands, and not the result of instream algae, nutrient, and BOD oxygen consumption," so no load reductions were proposed to achieve the DO standard in the stream.

In Cycle 2, FDEP also determined that there was no algal imbalance in the system (no average annual Chl a measurements exceeding 20 µg/L). However, FDEP determined the stream to be impaired for nutrients, stating that nitrogen is limiting (TN/TP ratio of 3.3), but phosphorus was found to be causative. Relisting nutrients in Cycle 2 led to the development of the 2009 TMDL proposal (Kang, 2009) and the recent revision (Kang, 2010). Load reductions were required for both TP and TN in the TMDL documents (refer to Section 1 for quantities).

Figure 2-27 shows the period of record for Chl a measurements taken in Sparkman Branch. The system does not show signs of algal imbalance, and excursions above the 20 µg/L threshold are infrequent, with only two observations greater than 20 µg/L in the sparse record. This is consistent with the findings of FDEP's assessments and the EPA TMDL (EPA, 2005).

However, FDEP relisted Sparkman Branch for nutrients in Cycle 2 and cited total phosphorus as the causative pollutant. However, this listing does not appear to be justified. Figure 2-28 charts the relationship between nutrients and Chl a, and Figure 2-29 provides the relationship between total nutrients and DO. For phosphorus, there is clearly no significant relationship. For nitrogen, other than one outlying data point where high Chl a measurements occurred, no significant relationship appears to exist.

Because nitrogen is limiting in Sparkman Branch and a high proportional signature of inorganic nitrogen was observed in the Mill Creek data, nitrogen speciation was studied for any potential links to observed DO depression. Figure 2-30 plots organic nitrogen and inorganic nitrogen against TN. The pattern is more reflective of some of the natural system conditions observed and reported in Two-Hole Branch and Trout Creek WBID Assessment reports. Even the high TN value associated with the high Chl a measurement did not show any significant inorganic nitrogen signal.

Figure 2-24 showed that the nitrogen signature has been similar and consistent in Sparkman Branch over the period of record, with the organic component being responsible for the vast majority of the nitrogen in the total. When culled from the TN and plotted against DO in paired measurements, the organic nitrogen does not show a nutrient/oxygen consumption relationship (see Figure 2-31 where paired measurements of organic nitrogen

and the DO deficit are plotted) except perhaps for a single high organic nitrogen pulse observed in May of 2008. That measurement was over three times higher than the geometric mean of all observations and was associated with an instream DO concentration of only 1.64 mg/L (deficit of over 7 mg/L from 100 percent saturation). The source of the nitrogen appears to be from the wetland areas surrounding the stream course as 99.5 percent of the total nitrogen was from organic sources (TN=3.52 mg/L; TKN=3.517 mg/L; and ammonia-N=0.014 mg/L).

Similar to the previous analysis for Mill Creek, additional causes of the low DO observations were investigated, including flow, temperature, seasonality and color. Figure 2-32 depicts daily average flow from the USGS gauge in Upper Baker Creek versus measured DO. While DO measurements are limited in the record, the lowest concentrations do appear to occur during or just following low flow periods, although this is not a fully consistent finding. The DO response to temperature showed a weakly correlated relationship, but when the effects of temperature on saturation were removed, the DO deficit did not show a relationship to increasing temperatures. Figure 2-33 presents the DO versus color, which does not show a significant correlation.

Another line of evidence is to present plots of measured DO within a similar system that has been deemed healthy by FDEP. As part of its numeric nutrient criteria development process, FDEP identified a series of reference sites that were deemed healthy through biological assessments. Cypress Creek is a higher order tributary system similar to Sparkman Branch that flows into the Caloosahatchee River. In its overview of the reference station, FDEP states:

Experienced FDEP scientists conducted a series of observations and measurements (habitat assessment, hydrology, and local land use) at Cypress Branch. Based on our analyses, the Department concluded that the site was influenced only by very low levels of anthropogenic stressors and that it clearly maintained healthy biological assemblages. Thus, not only are the nutrient concentrations reflective of minimally disturbed conditions, they are associated with biota which demonstrate full support of the most sensitive designated use (propagation and maintenance of a healthy, well-balanced population of fish and wildlife).

Figure 2-34 presents the measured DO at Cypress Branch. As the data show, the levels are similar to those found within Sparkman Branch. It should be noted here that comparative analyses for DO are only useful to show general similarities. DO conditions

at any site are driven by many factors, and temperature and hydrology are the most critical. This analysis shows that low DO measurements, by themselves, are not indicators of anthropogenic impacts, but rather must be evaluated in terms of causative factors and the potential for natural sources.

2.4 ASSESSMENT OF WBIDS UPSTREAM OF BAKER CREEK WBID (1522C)

As described in Section 1 under hydrology, the Baker Creek WBID (1522C) receives drainage from three primary sub-basin areas. These sub-basins consist of the following WBIDs and are numbered for the purposes of the discussion:

- Sub-basin 1: Flint Creek South (1522D), Pemberton Creek (1542), Moore Lake Drain (1565), Sparkman Branch (1561), and Mill Creek (1542A)
- Sub-basin 2: Seffner Canal (1547)
- Sub-basin 3: Baker Creek Drain (1544)

The Baker Creek Drain is a small area and would be expected to contribute a small fraction of the flow to WBID 1522C. The Seffner Canal WBID is relatively large, but it appears to contain a significant amount of hydraulically disconnected area. Finally, Sub-basin 1 as outlined above, is a large hydraulically connected area that drains numerous WBIDs including Mill Creek and Sparkman Branch whose water quality conditions were discussed in previous sections.

Figure 2-2 shows three locations where water quality data were collected that would be representative of conditions coming out of Sub-basin 1 and Sub-basin 2 (Seffner Canal). Two of the stations are located near the base of Sub-basin 1, just before the creek merges with the dredged canal that represents the lower portion of Baker Creek. These stations are located on Pemberton Creek at North Gallagher Road, and Pemberton Creek at Pemberton Creek Drive. For the purposes of this section, these stations will be referenced by their EPCHC station numbers which are EPC-531 and EPC-529, respectively. These locations have data from a variety of sources. The third station is located on Seffner Canal where it crosses Muck Pond Road, upstream of the confluence with Upper Baker Creek. The data at this location comes from one source, Hillsborough County station EPC-168. It is important to note that within the IWR, the data from EPC-168 were identified as being in WBID 1522D

(Upper Baker Creek or Flint Creek South) but should have been associated with WBID 1547 (Seffner Canal).

The period of record for EPC-531 extends from 1970 to the end of 2009, providing a long record to assess the water quality history of flows coming out of Sub-basin 1. The period of record for EPC-168 extends from 2006 through the end of 2009, a much shorter record. No data were found for WBID 1544, Baker Creek Drain. The following provides a discussion of the nutrients, Chl a, and DO conditions from each sub-basin.

2.4.1 DISSOLVED OXYGEN AND PERCENT SATURATION

Figures 2-35a and 2-36a presents plots of the DO and percent saturation for the period from 1972 through 2009 at EPC-531 (the station on Pemberton Creek). Other than some of the period at the beginning of the record, the data show very similar DO values and percent saturation levels throughout the period of record. Statistical analyses shows that for no period in the recent time frame would this system be deemed impaired for DO relative to the State criteria of 5.0 mg/L. Additionally, the system does not show any significant periods of supersaturation (indicative of algal blooms) in more recent years, i.e., since 2000, although some were seen in the earlier years. Figures 2-35b and 2-36b present the DO values and percent saturation values for more recent years for EPC-531, EPC-529 (the station on Upper Baker Creek prior to the confluence with Lower Baker Creek and the Seffner Canal), and EPC-168 (the station on Seffner Canal). The data show that EPC-529 is very similar to EPC-531, but that the DO values and percent saturation values on Seffner Canal are much lower.

2.4.2 NUTRIENTS AND CHL A

Figures 2-37a and 2-38a presents plots of the TN and other nitrogen species, respectively, for the period from 1972 through 2009 at EPC-531. In contrast to the DO plots, the nitrogen plots show significant changes in the magnitude and composition of nitrogen in the system. The changes are the result of two primary causes, the first and most dramatic was the introduction of Grizzle Fig legislation in the late 1980s and early 1990s that significantly increased the treatment requirements for WWTPs discharging to surface waters. Up until 1998, the Plant City WWTP discharged to Pemberton Creek upstream of the monitoring station. The removal of the Plant City WWTP discharge in 1998 also had an impact but the changes were more subtle. Figures 2-37b and 2-38b present plots of the TN and other

nitrogen species, respectively, for the more recent period. On Figure 2-37b, the Seffner Canal results are also plotted for comparison, while for the nitrogen species, the Seffner Canal results are plotted separately in Figure 2-38c. In Pemberton Creek and Upper Baker Creek, the more recent nitrogen data show that the system has reached more normal levels for organic, inorganic and TN. In contrast, the inorganic nitrogen levels on Seffner Canal are higher and more variable than seen on Pemberton.

Figure 2-39a presents the measured TP for the period from 1972 through 2009 at EPC-531. The TP concentrations show similar trends to the TN. Figure 2-39b presents the TP data for more recent years at EPC-531, EPC-529 and EPC-168. Once again, the Seffner Canal shows elevated TP levels in relation to the Sub-basin 1 stations.

Figure 2-40 presents a comparison of the measured Chl a values from the Pemberton Creek and Upper Baker Creek stations versus the Seffner Canal station. Following what was found from the nutrient data, the Chl a levels on Seffner Creek are much higher than those in the Sub-basin 1 stations. The Chl a levels in Sub-basin 1 are all less than 5, with most around 2 to 3, indicating little to no primary productivity in the water column. Seffner Canal on the other hand does appear to show some exacerbated levels of primary productivity tied to nutrient levels and potentially hydrology. Longer term Chl a values are not provided for the Pemberton Creek station or others for comparison, only data available since 2005.

2.4.3 CONCLUSIONS FROM DATA

The results of this analysis shows that Pemberton Creek and Upper Baker Creek have good water quality and appear to be meeting their designated uses. This is in contrast with the data from Seffner Canal, which generally shows poorer water quality. It is important to note that the two systems are very different physically. Pemberton Creek and Upper Baker Creek are more natural systems, with some level of canopy and buffer areas. Seffner Canal, in contrast, is a highly modified dredged channel, similar to the conditions found in the Baker Creek WBID (1522C), which derived the stream listing. It is unlikely that the Sub-basin 1 drainage is a significant contributor to pollutants in the Baker Creek WBID or Lake Thonotosassa following the significant improvements that have been achieved through upgrades to, and the eventual removal of, the Plant City WWTP discharge. The water quality within Seffner Canal on the other hand appears more impacted, with higher levels of inorganic nitrogen and Chl a.

2.5 EPA NUMERIC NUTRIENT CRITERIA COMPARISON

This section presents a comparison of the present nutrient conditions within Baker Creek, Mill Creek, and Sparkman Branch to the EPA Numeric Nutrient Criteria for freshwater streams that was promulgated on December 6, 2010 in 40 CFR Part 131 (Water Quality Standards for the State of Florida's Lakes and Flowing Waters). Many of the Stakeholders involved with TMDLs in the Tampa Bay watershed have submitted extensive comments regarding the EPA criteria. The comparison of ambient nutrient data to the EPA criteria is presented in recognition of the existence of the criteria at present and that EPA will play a role in the review of these WBID assessments. The use of these criteria in no way indicates that the Tampa Stakeholders support their validity.

ATM utilized the available data for TN and TP and performed the calculations necessary to obtain the geometric means for TN and TP for the period from 2000 to 2010 (Table 2-7). The results of this analysis are provided, together with the associated EPA numeric criteria. Chl a is not assessed in the EPA criteria, but these data are provided here for comparison and interest. In no case did the average annual Chl a concentration (expressed as a geometric mean) exceed the 20 µg/L threshold. Additionally, none of the three stream segments exceed the EPA criterion for the limiting nutrient, nitrogen. As expected, there were several exceedances of the EPA's criterion for total phosphorus, but the observed values appear to be in the range of expected natural values in the Bone Valley, particularly from groundwater inputs in the channeled segments of the creek.

Table 2-7. Comparison of EPA Numeric Nutrient Criteria for Florida Streams

Parameter	Criterion	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Baker Creek (1522C)											
Chlorophyll a, µg/L	N/A	12.0	18.2	7.7	10.7	8.0	4.1	5.4	7.2	N/A	N/A
TN, mg/L	1.65	1.37	1.48	1.34	1.47	1.19	1.36	1.05	1.08	N/A	N/A
TP, mg/L	0.49	0.49	0.47	0.52	0.49	0.60	0.44	0.52	0.41	N/A	N/A
Mill Creek (1542A)											
Chlorophyll a, µg/L	N/A	1.6	3.4	1.2	2.6	2.9	2.5	4.6	2.2	N/A	N/A
TN, mg/L	1.65	0.70	0.98	0.76	1.41	1.20	1.05	0.84	0.47	N/A	N/A
TP, mg/L	0.49	0.22	0.37	0.26	0.43	0.46	0.40	0.34	0.18	N/A	N/A
Sparkman Branch (1561)											
Chlorophyll a, µg/L	N/A	N/A	N/A	3.5	N/A	N/A	N/A	2.9	N/A	N/A	N/A
TN, mg/L	1.65	N/A	N/A	1.31	N/A	N/A	N/A	1.36	N/A	N/A	N/A
TP, mg/L	0.49	N/A	N/A	0.45	N/A	N/A	N/A	0.53	N/A	N/A	N/A

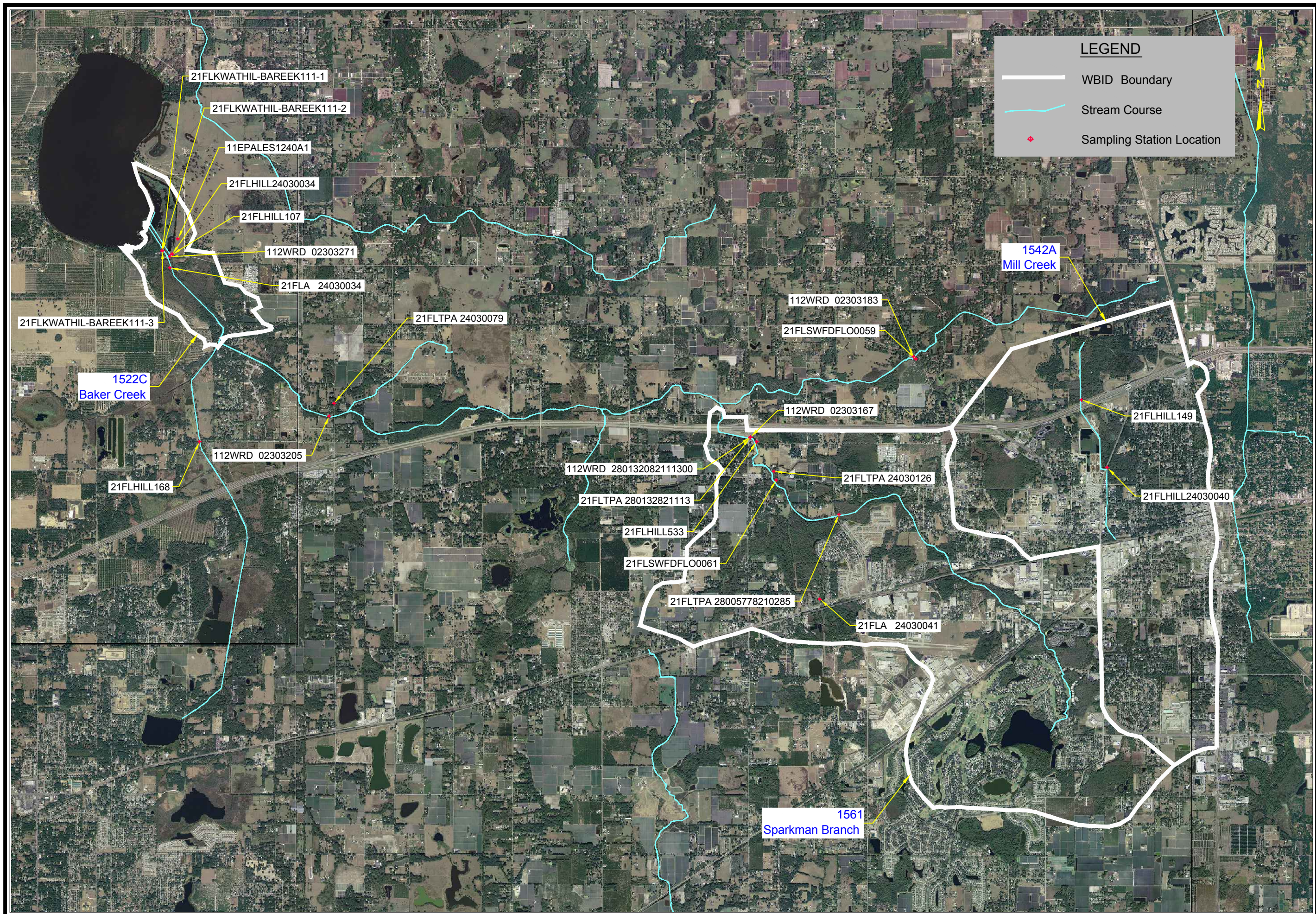


Figure 2-1
WBID Boundaries, Stream Reach, and Water Quality Stations - Baker Creek (1522C),
Mill Creek (1542A), and Sparkman Branch (1561)

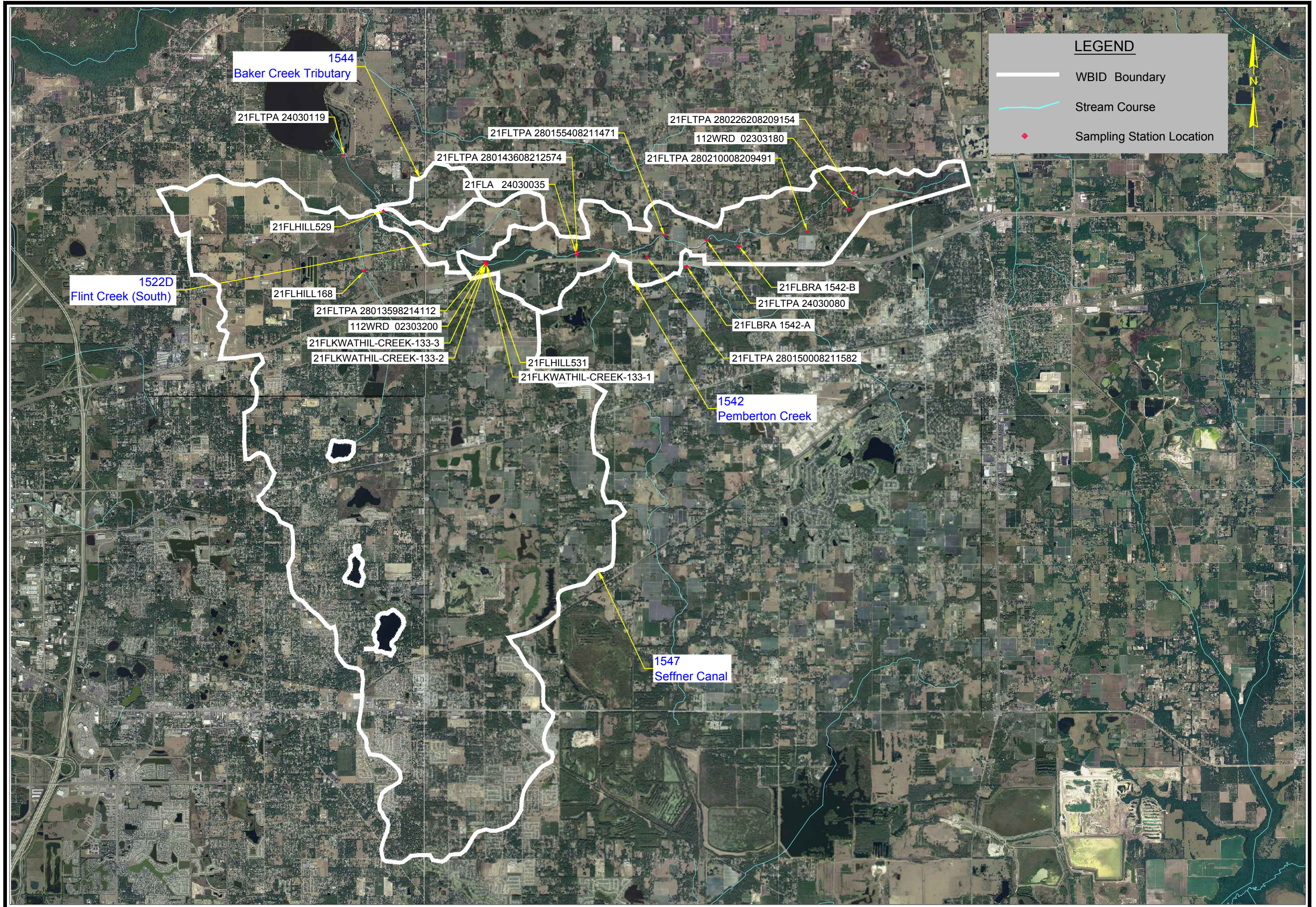


Figure 2-2
WBID Boundaries, Stream Reach, and Water Quality Stations - Flint Creek (South) (1522D), Baker Creek Tributary (1544), Pemberton Creek (1542), and Seffner Canal (1547)

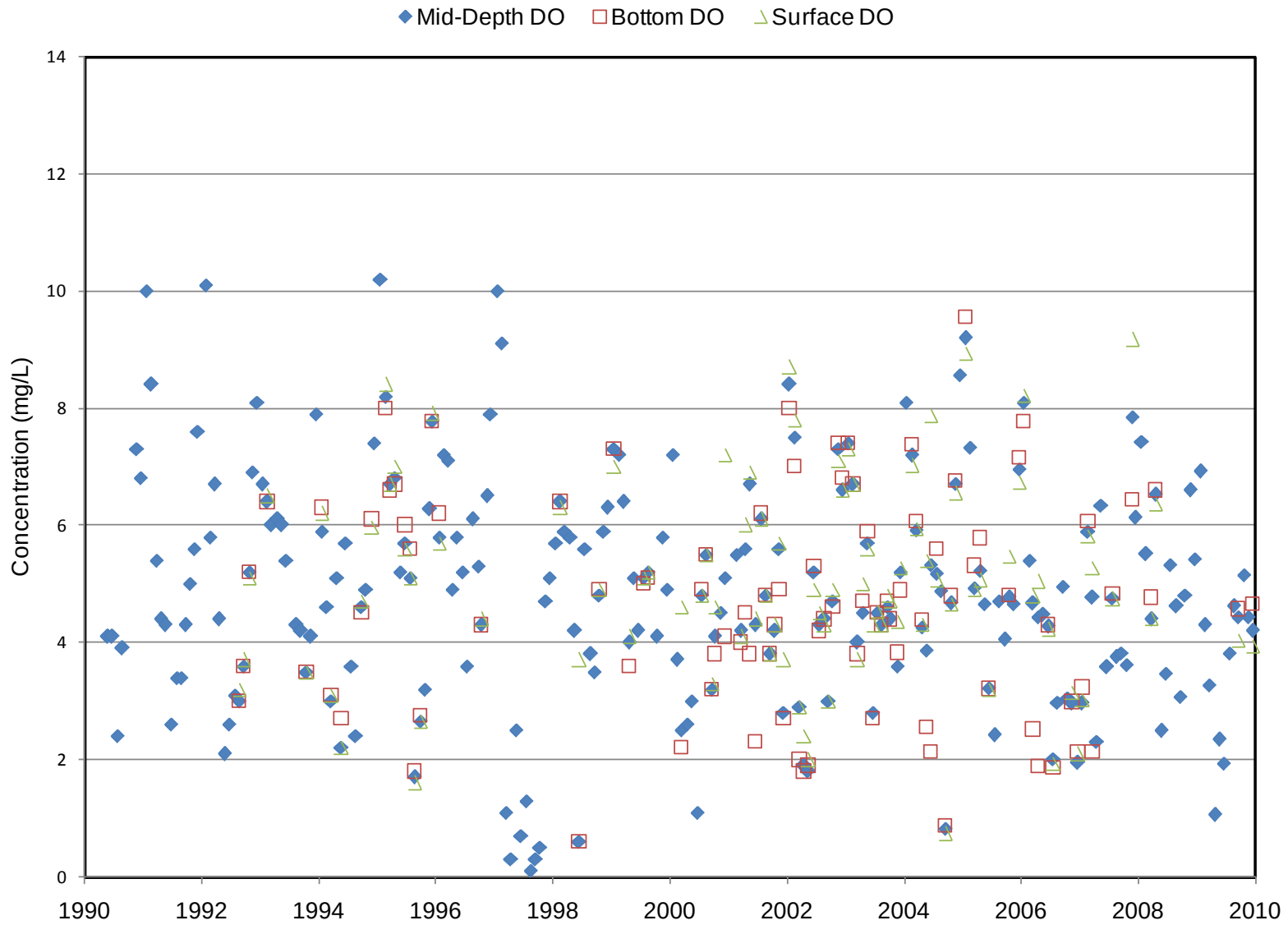


Figure 2-3a

Dissolved Oxygen Measurements in Baker Creek at Lake Thonotosassa Bridge (WBID 1522C)

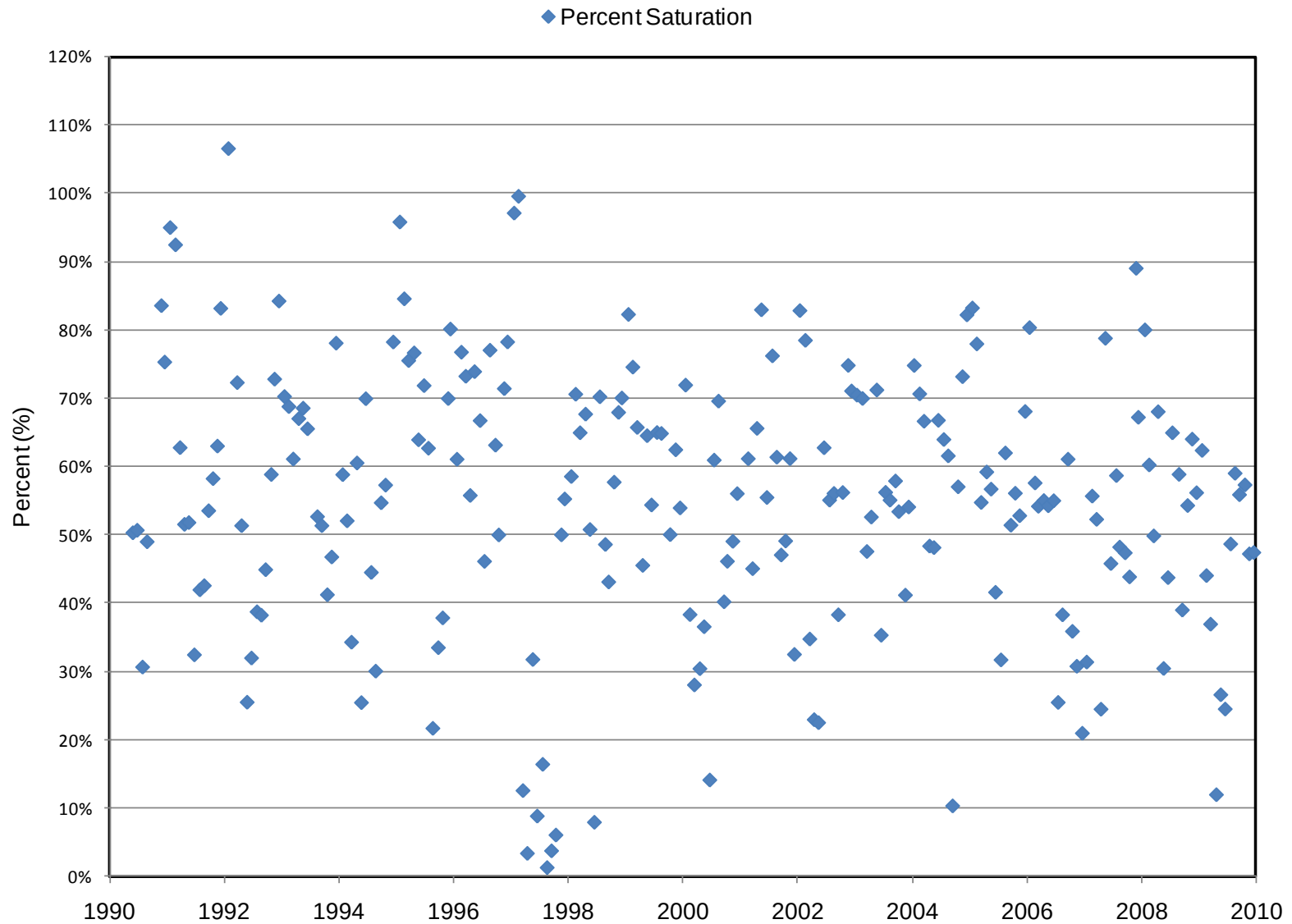


Figure 2-3b

Percent Saturation Measurements in Baker Creek at Lake Thonotosassa Bridge (WBID 1522C))

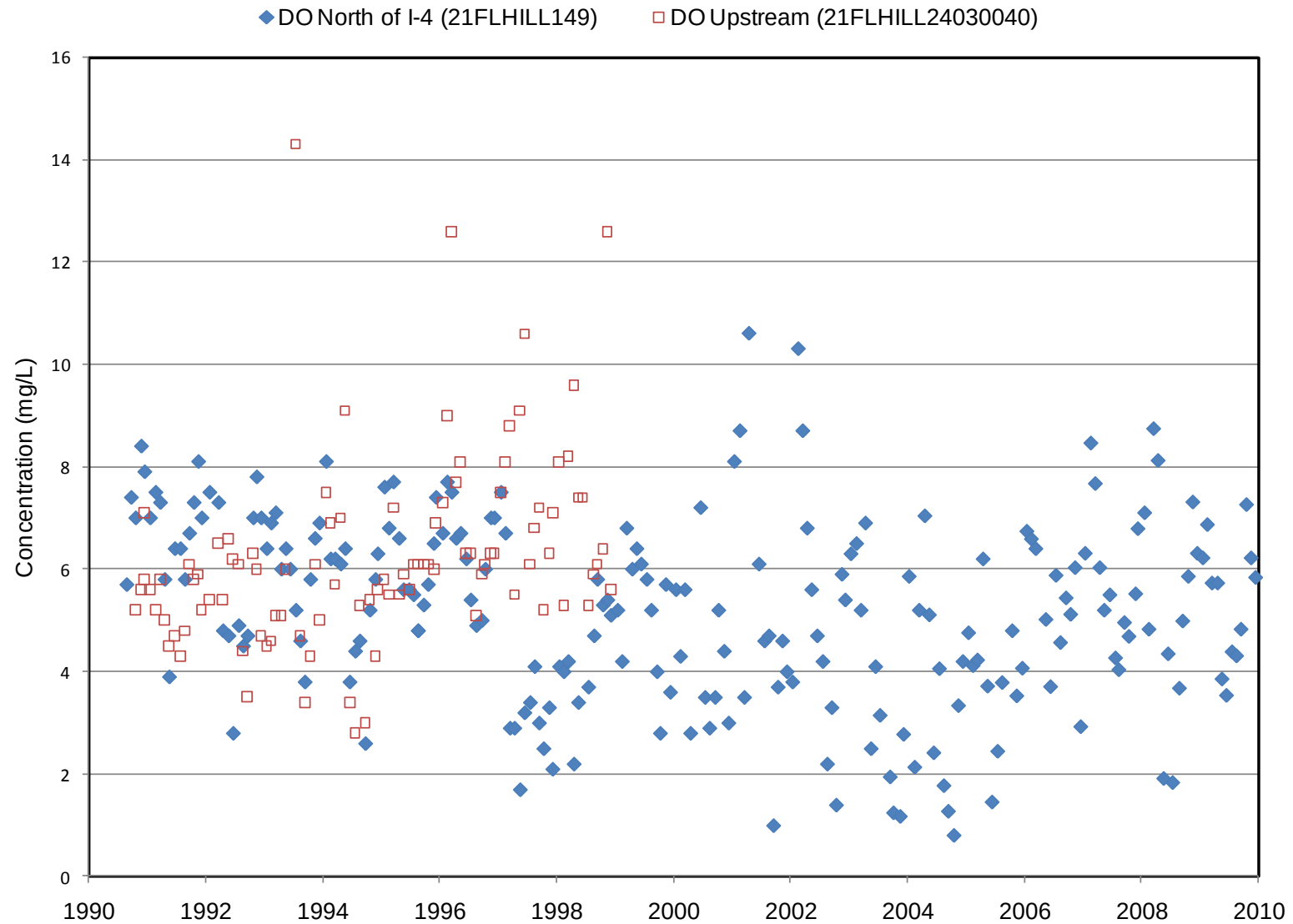


Figure 2-4
Dissolved Oxygen Measurements in Mill Creek (WBID 1542A)



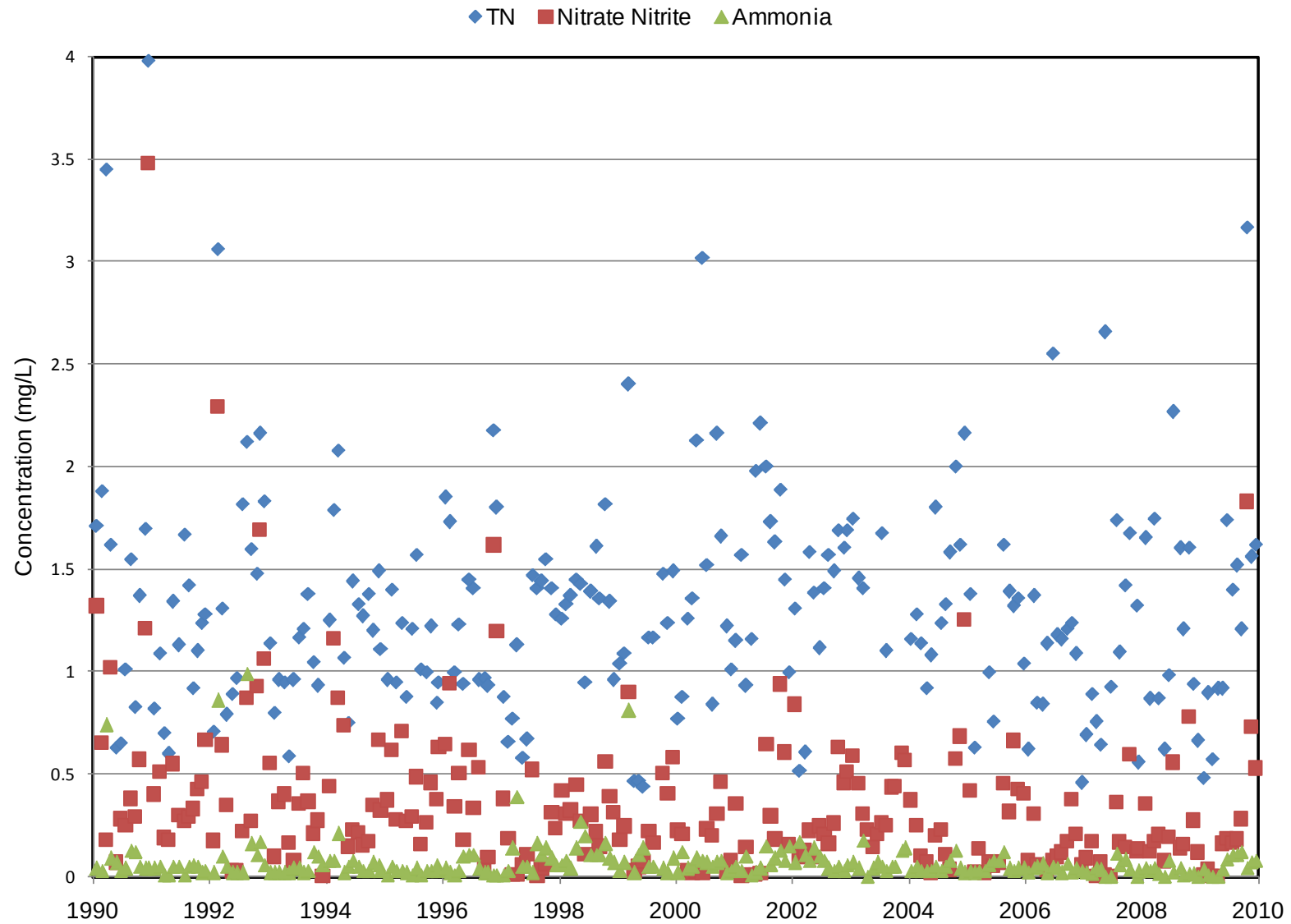


Figure 2-6a

Nitrogen Measurements in Baker Creek at Lake Thonotosassa Bridge (WBID 1522C)

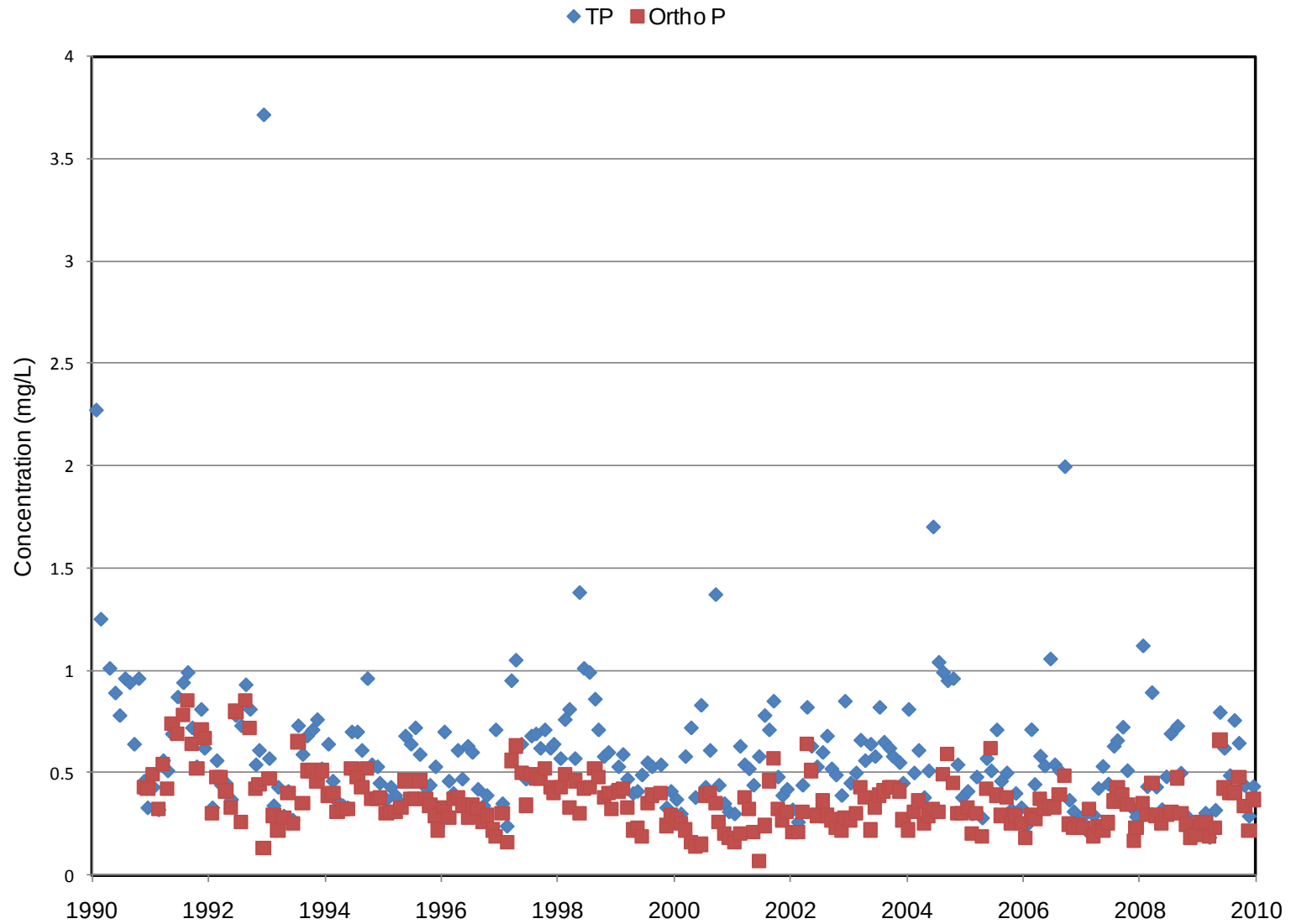


Figure 2-6b

Total Phosphorus Measurements in Baker Creek at Lake Thonotosassa Bridge (WBID 1522C)

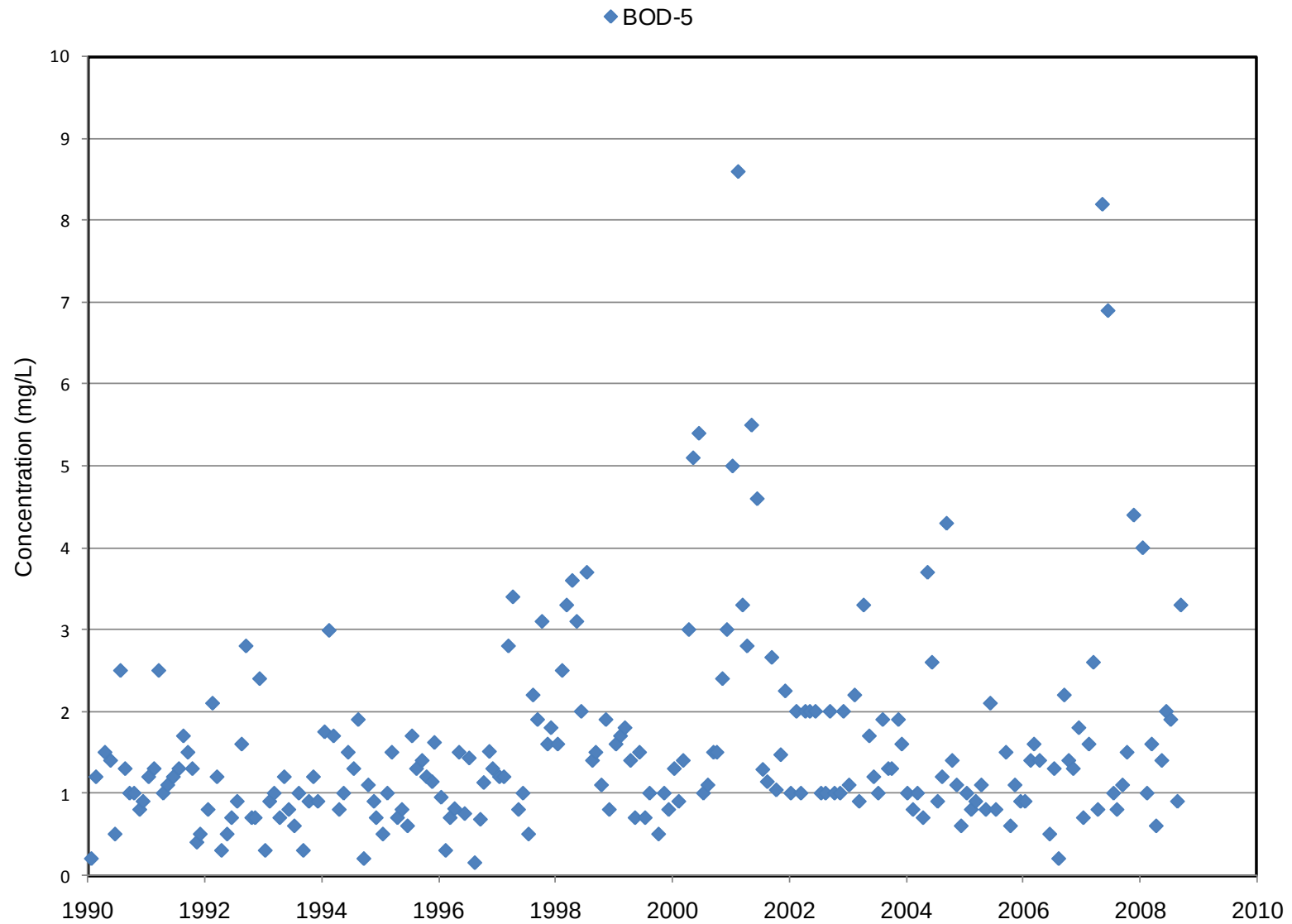


Figure 2-6c

BOD-5 Measurements in Baker Creek at Lake Thonotosassa Bridge (WBID 1522C)

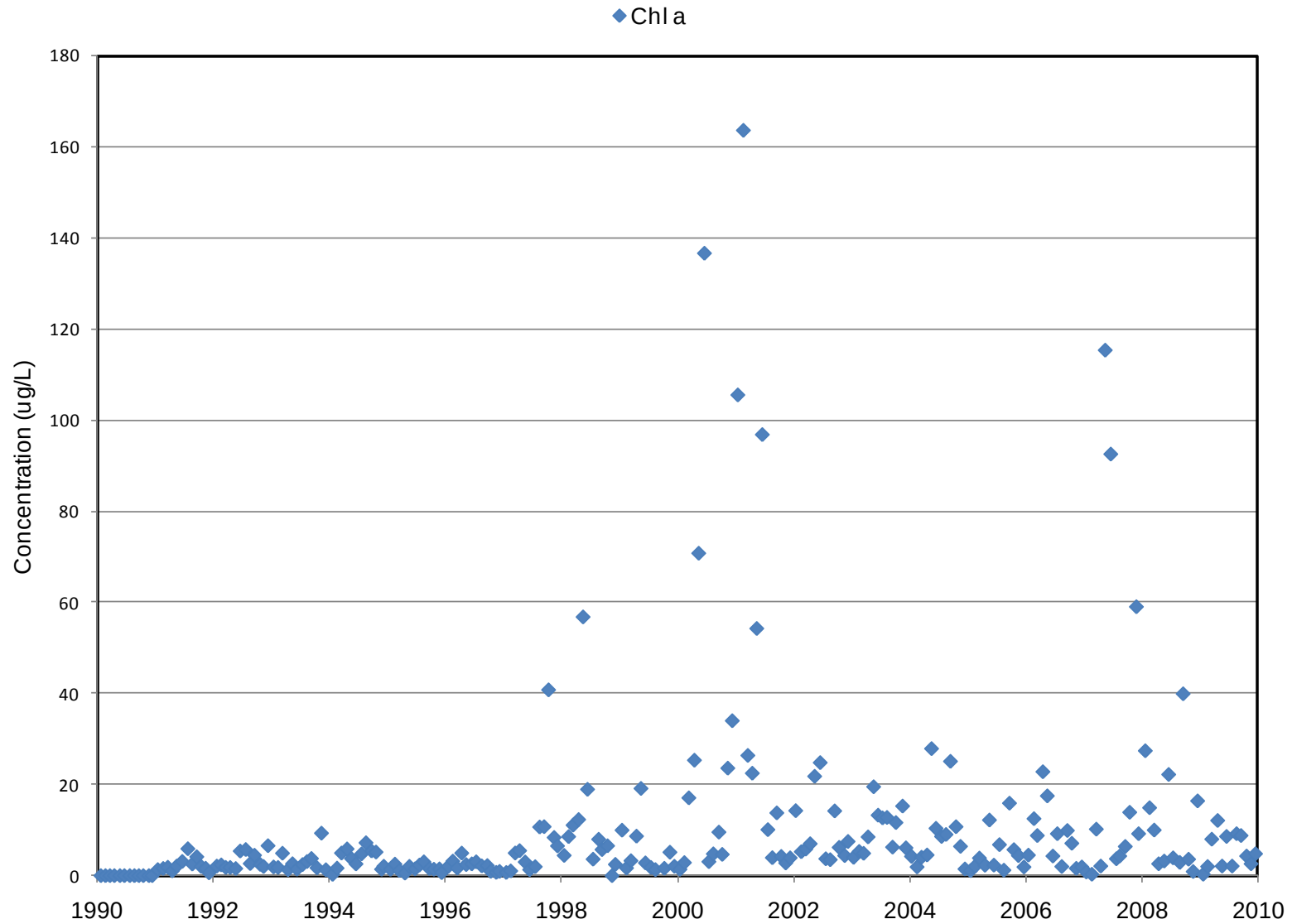


Figure 2-7a
Chlorophyll a Measurements in Baker Creek at Lake Thonotosassa Bridge (WBID 1522C)

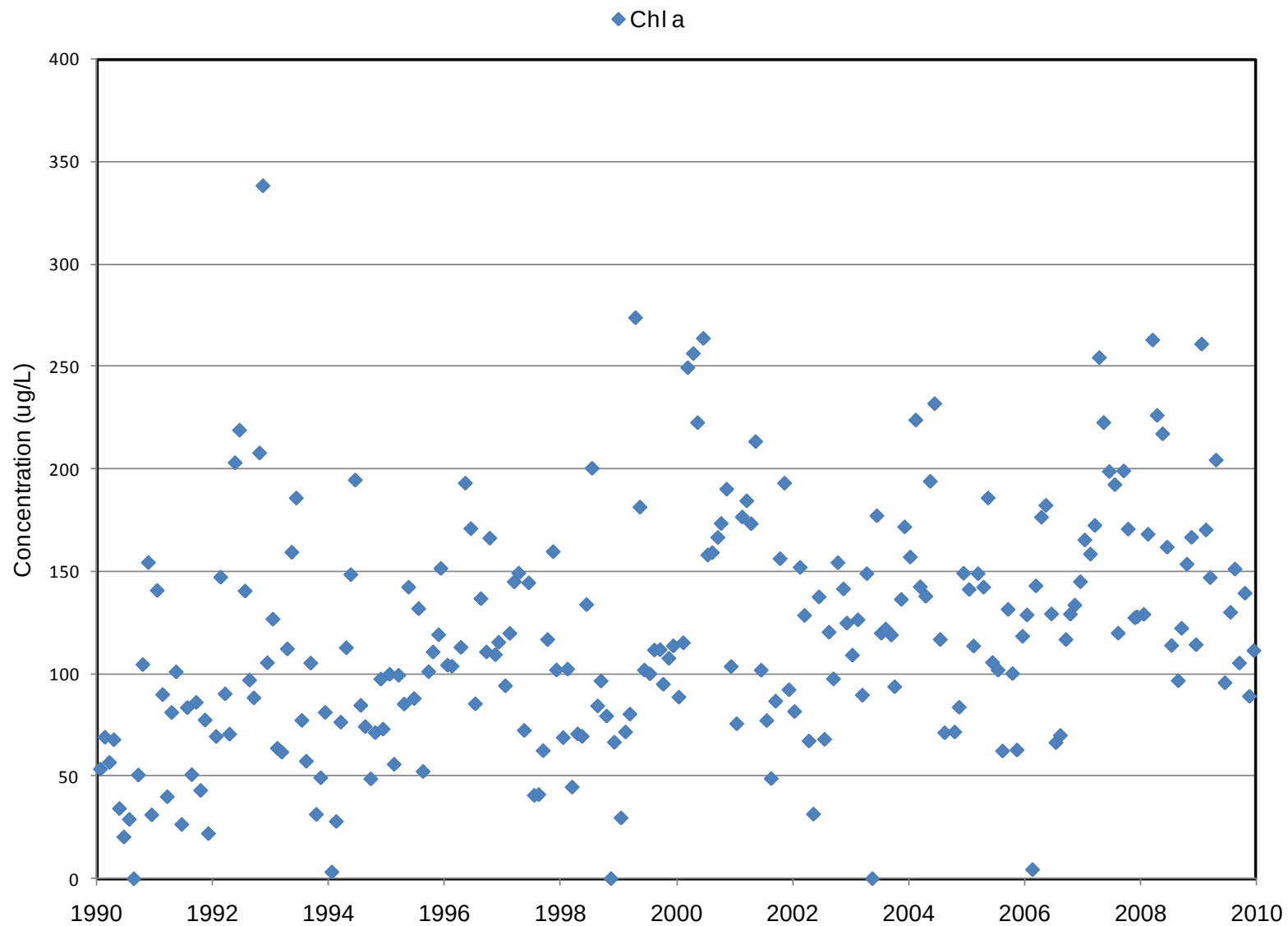


Figure 2-7b
Chlorophyll a Measurements in Lake Thonotossassa

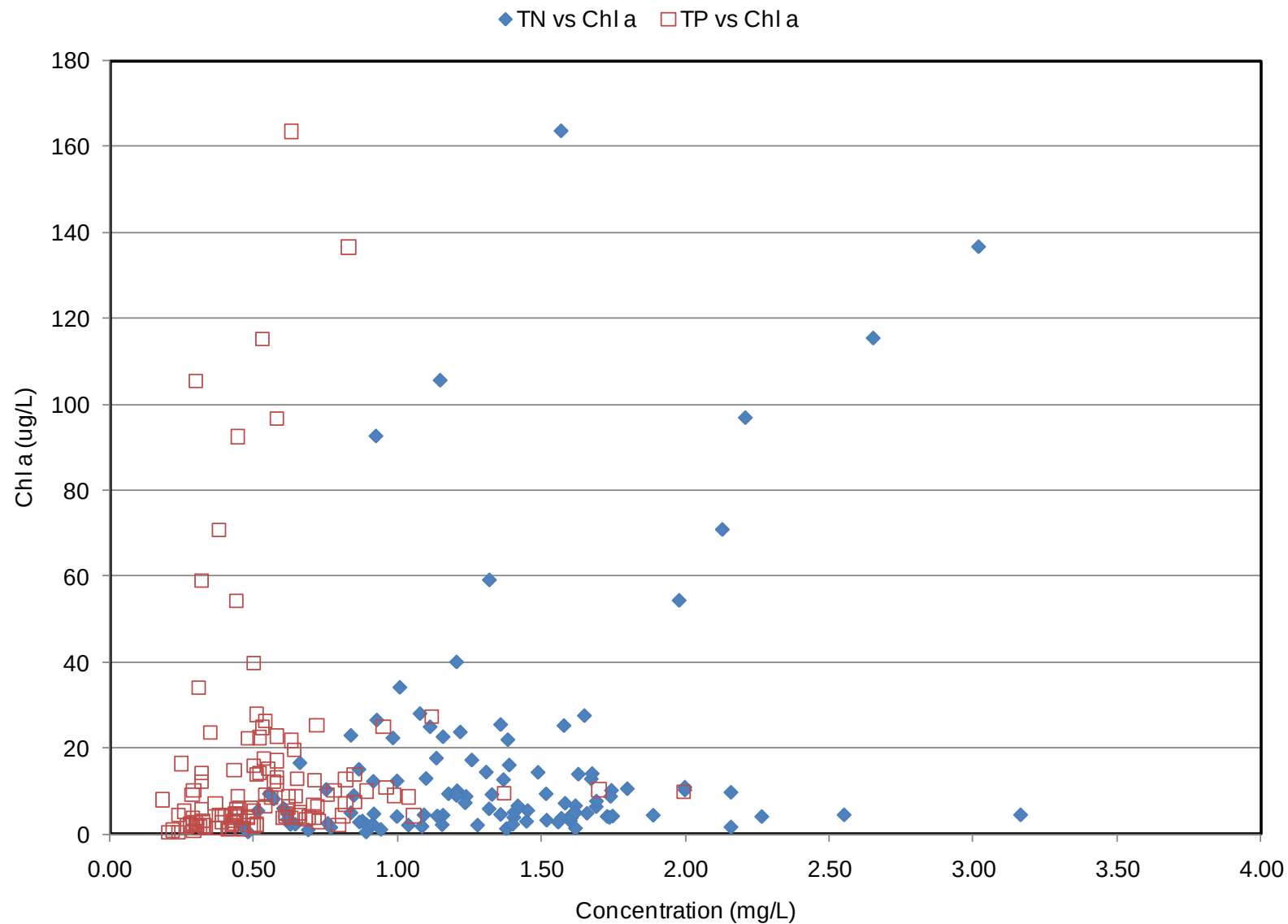


Figure 2-8

Paired Measurements for TN and TP versus Chlorophyll a in Baker Creek (2000 to 2010)

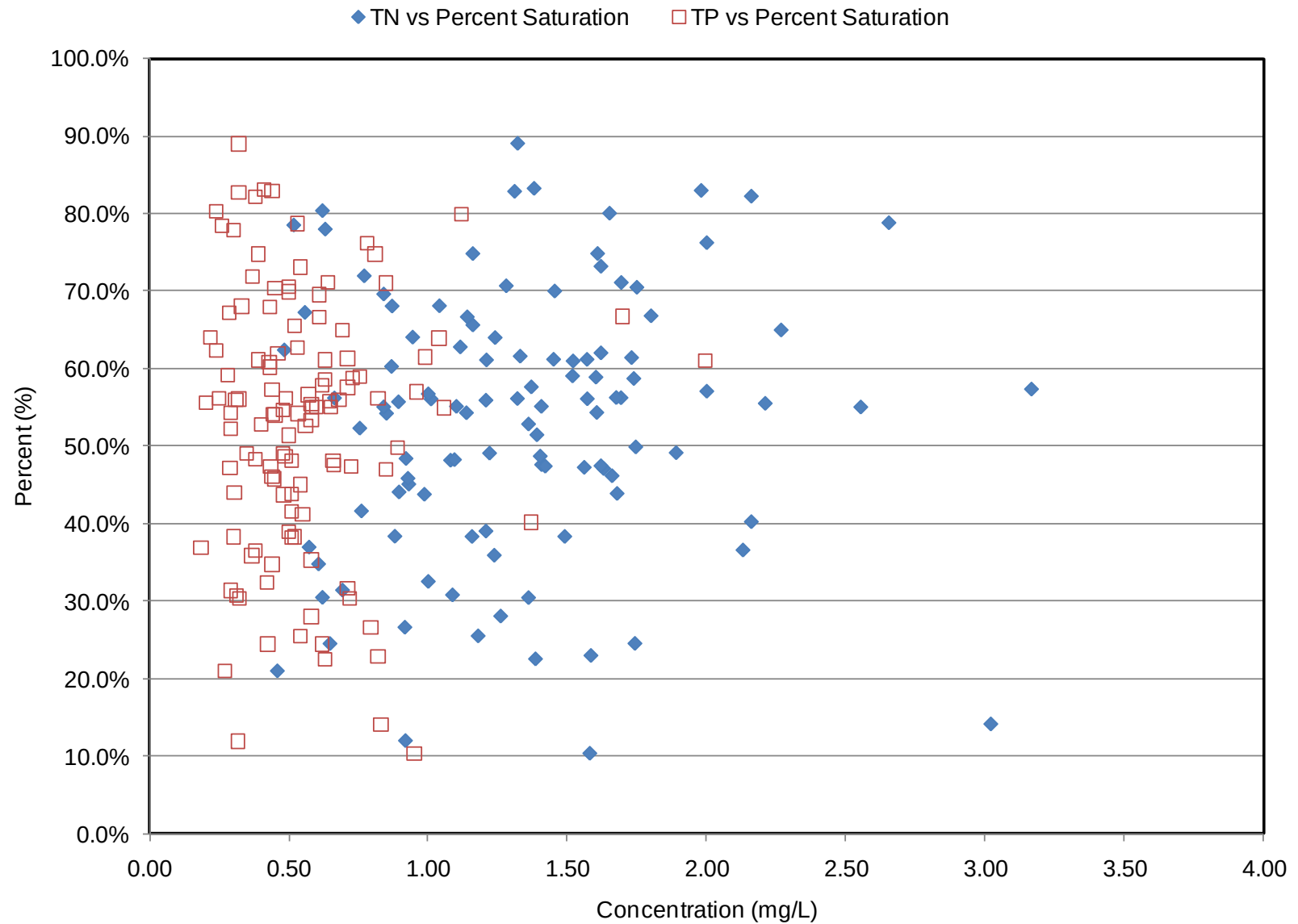


Figure 2-9

Paired Measurements for TN and TP versus Percent Saturation in Baker Creek (2000 to 2010)

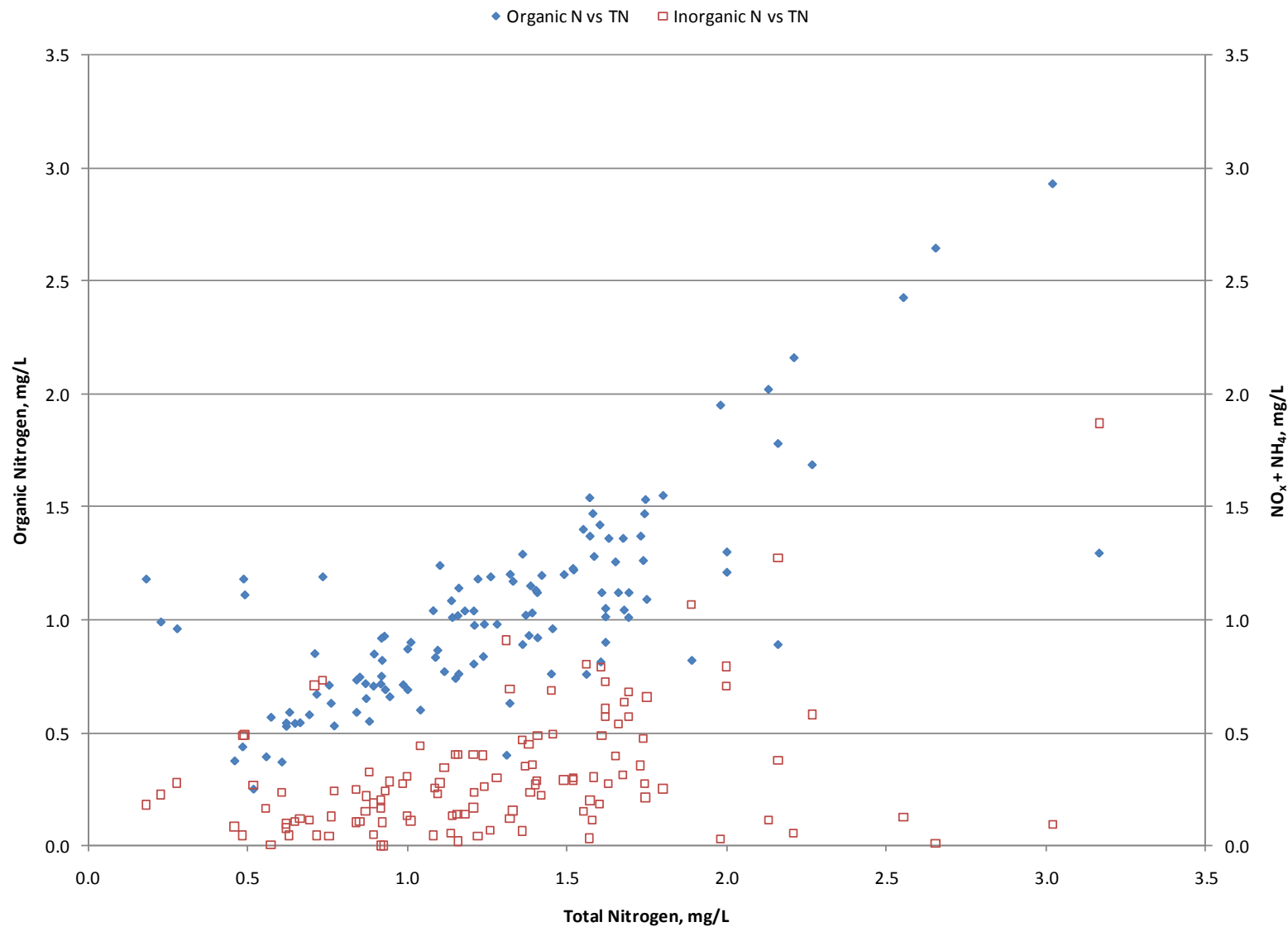


Figure 2-10
Paired Nitrogen Species vs Total Nitrogen at Lower Baker Creek (21FLHILL107) (2000-2009)

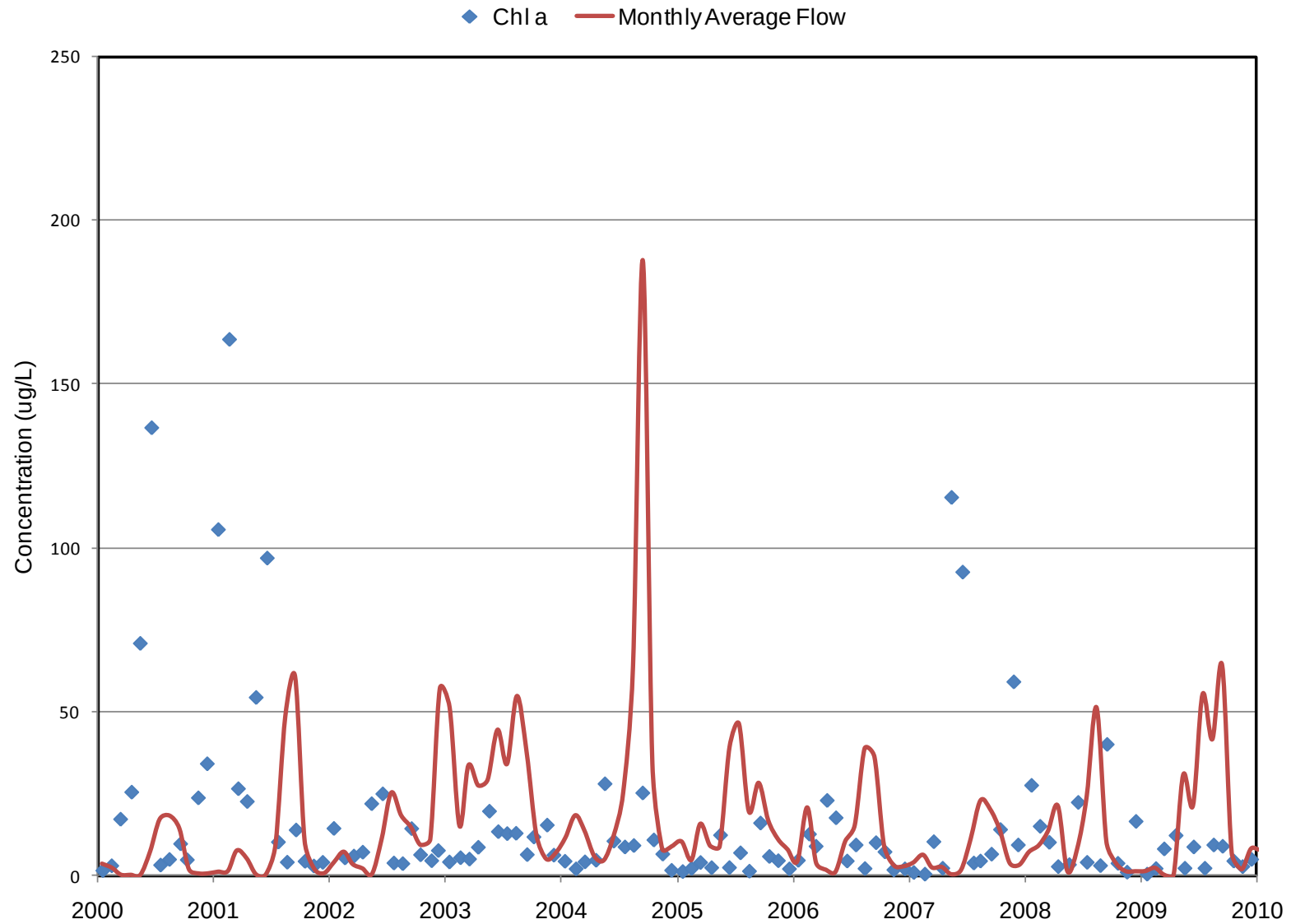


Figure 2-11
Flow versus Chlorophyll a in Baker Creek (2000 to 2010)

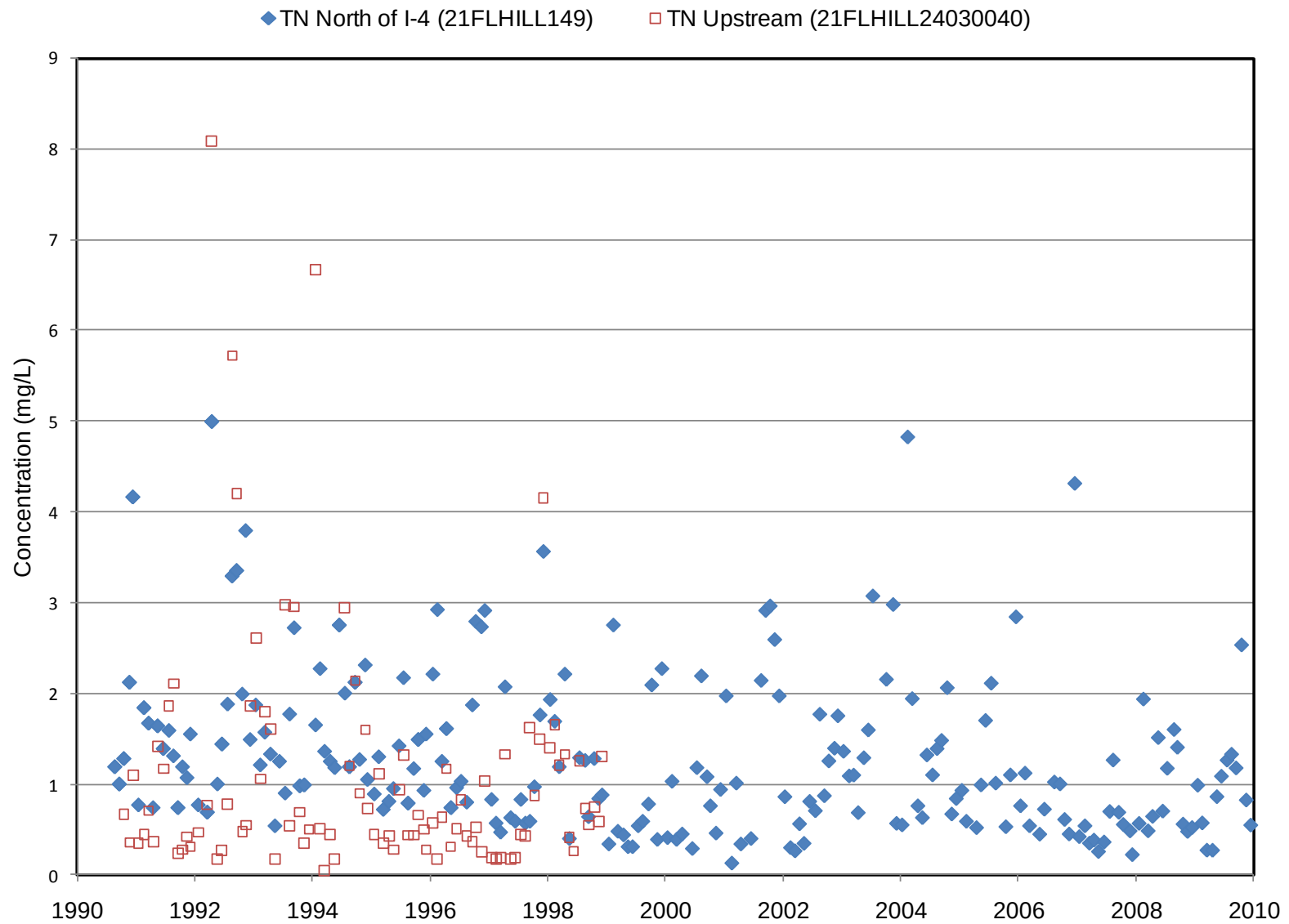


Figure 2-12
Measured Total Nitrogen in Mill Creek (WBID 1542A)

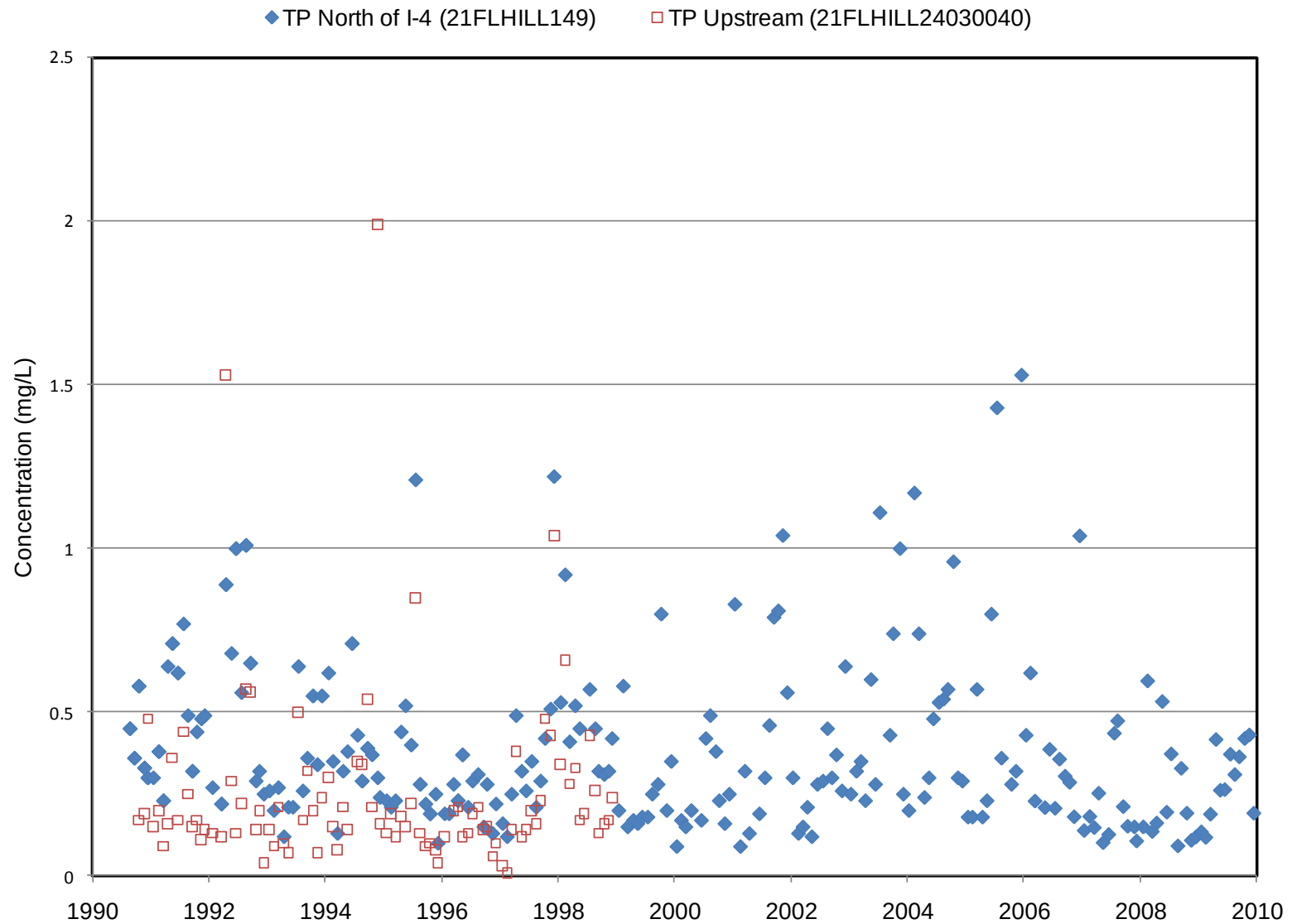


Figure 2-13
Measured Total Phosphorus in Mill Creek (WBID 1542A)

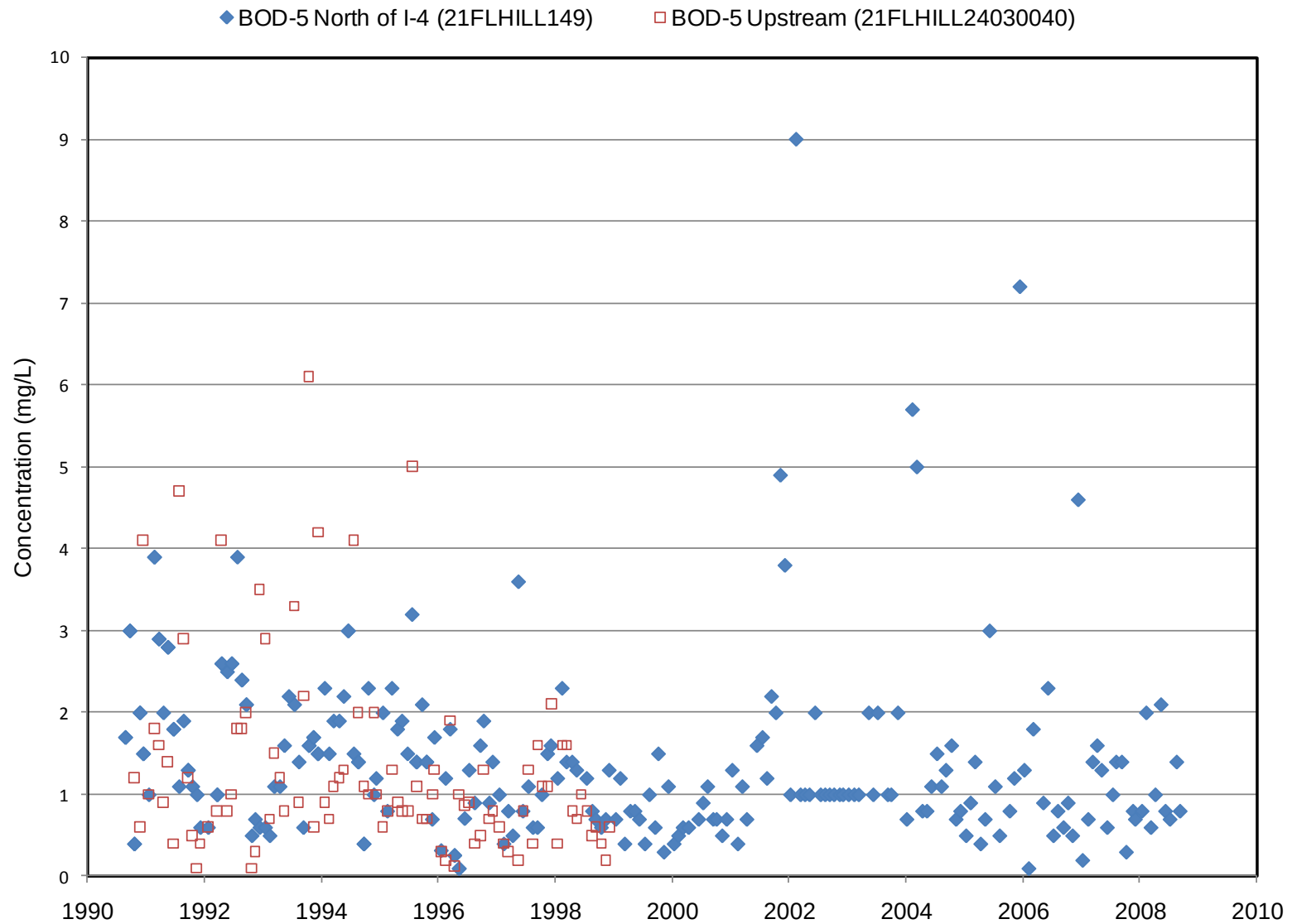


Figure 2-14
Measured BOD-5 in Mill Creek (WBID 1542A)

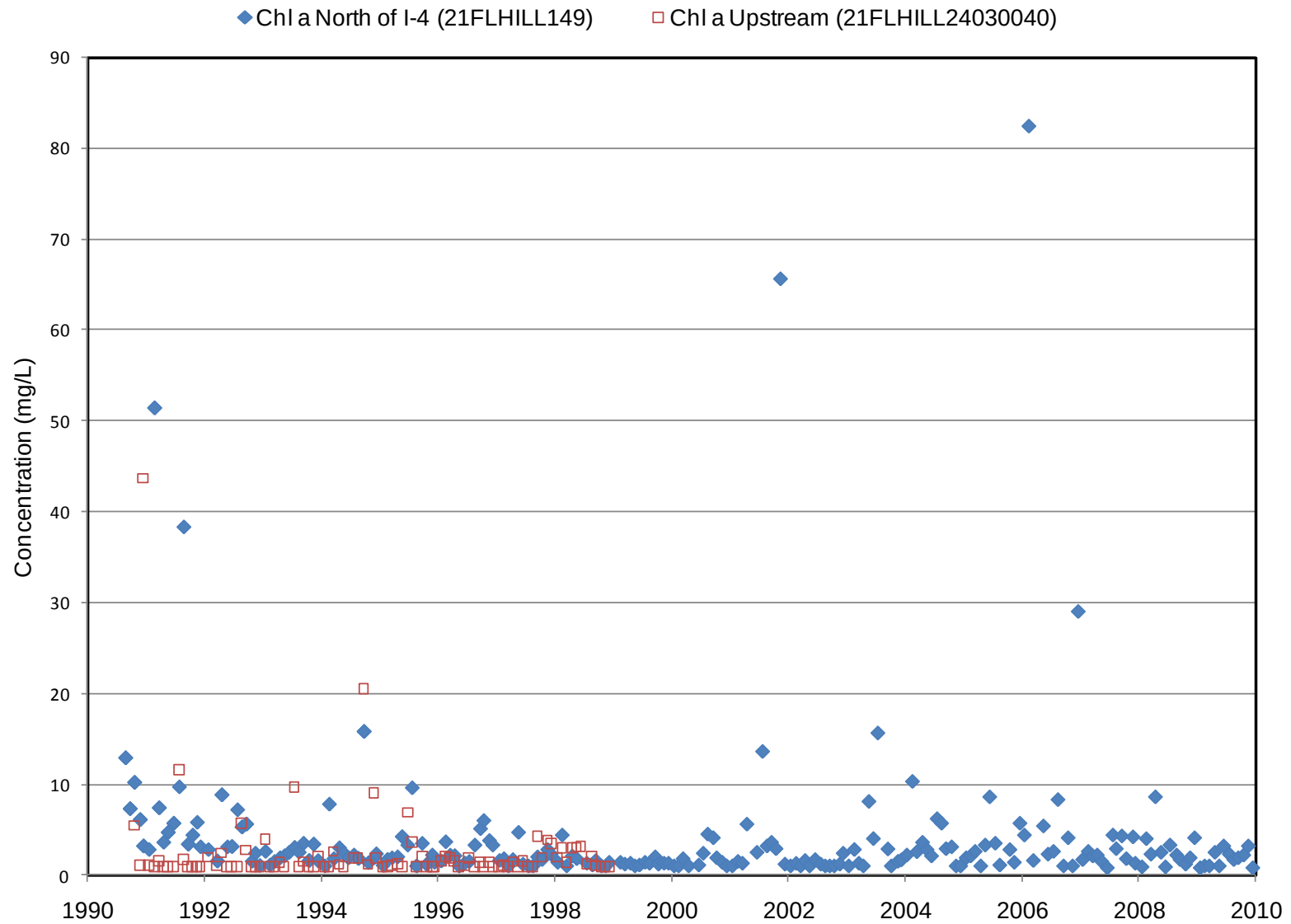


Figure 2-15
Measured Chlorophyll a in Mill Creek (WBID 1542A)

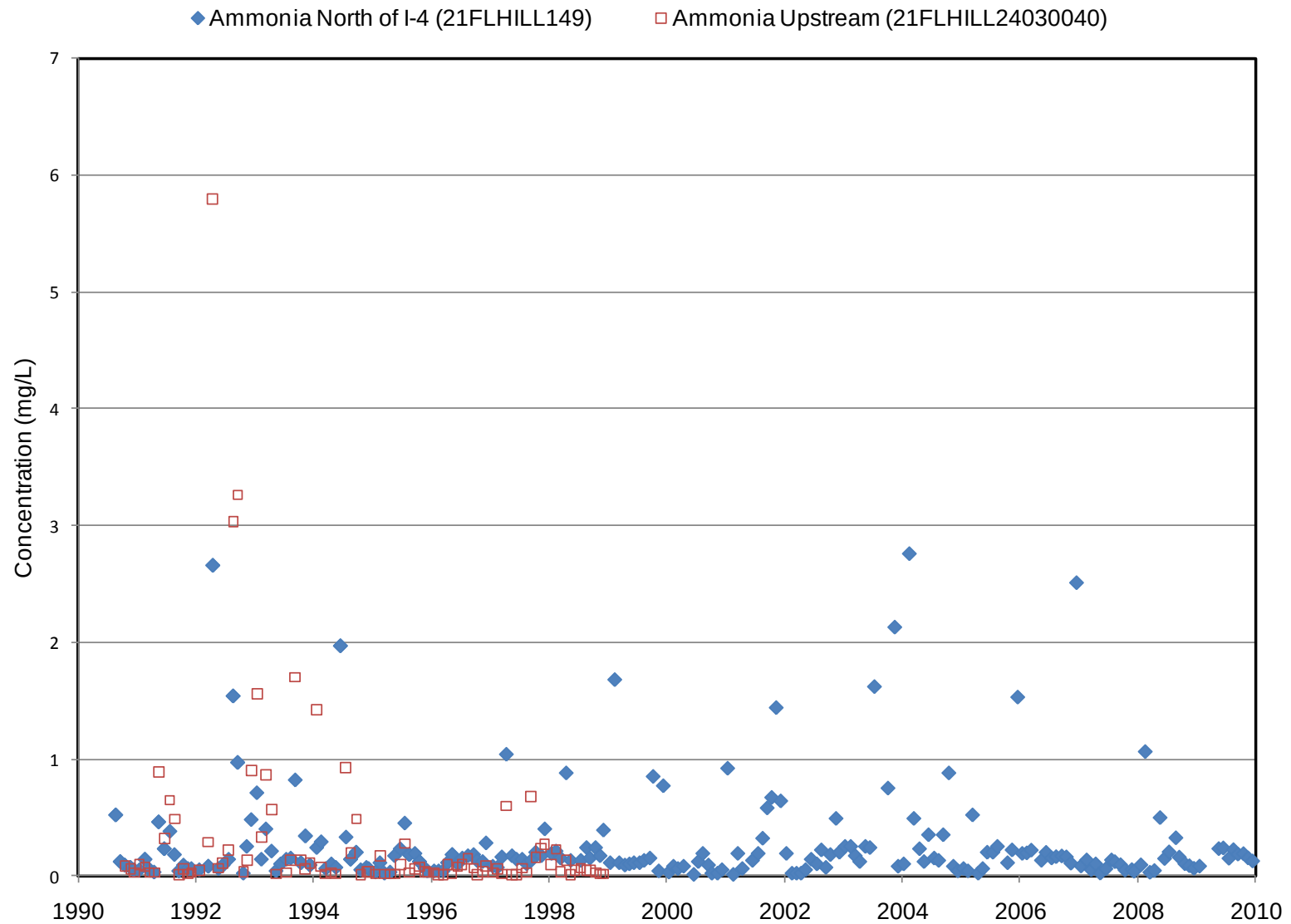


Figure 2-16
Measured Ammonia in Mill Creek (WBID 1542A)

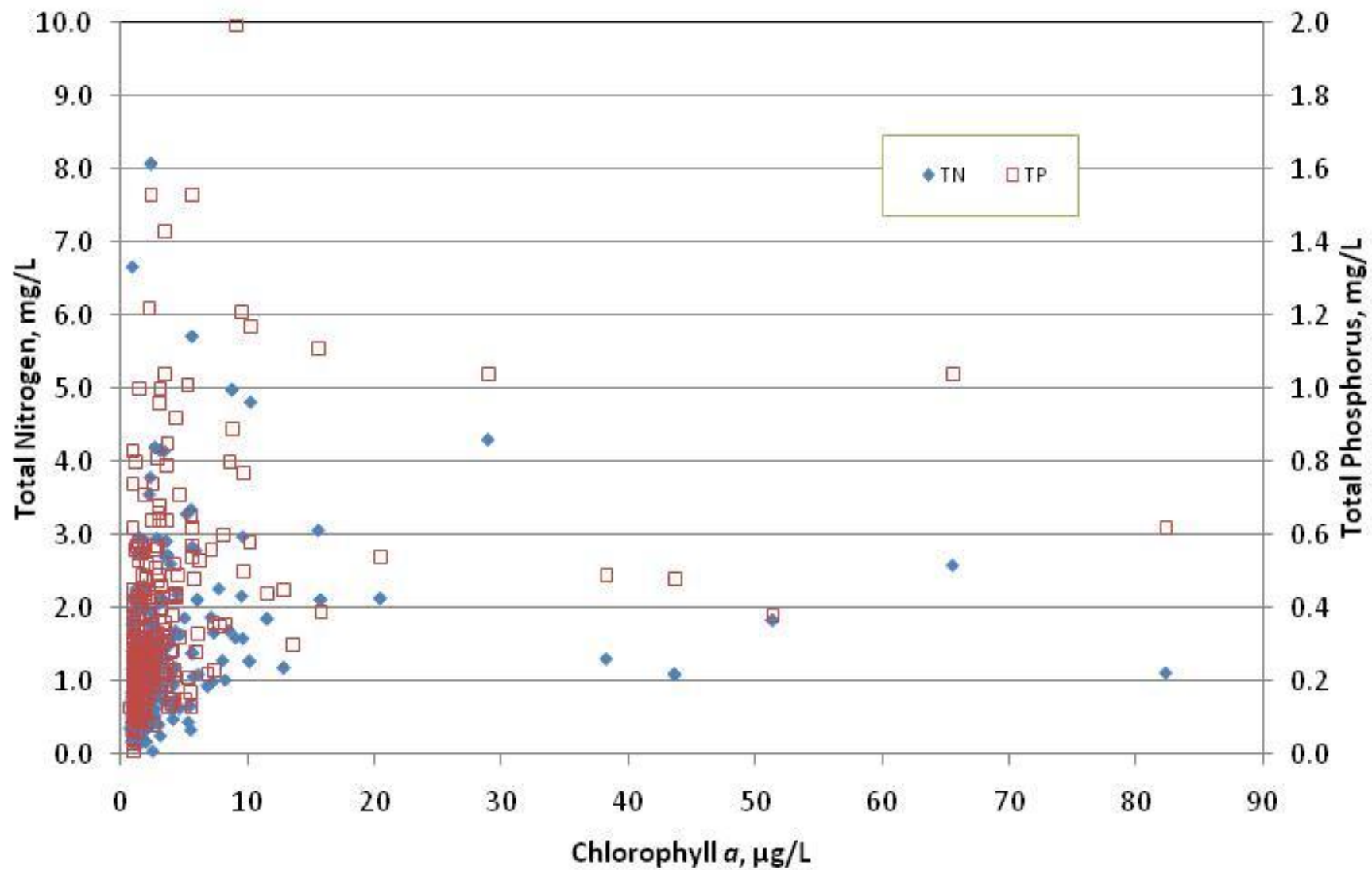


Figure 2-17
Paired Measurements for TN and TP versus Chlorophyll a at Mill Creek

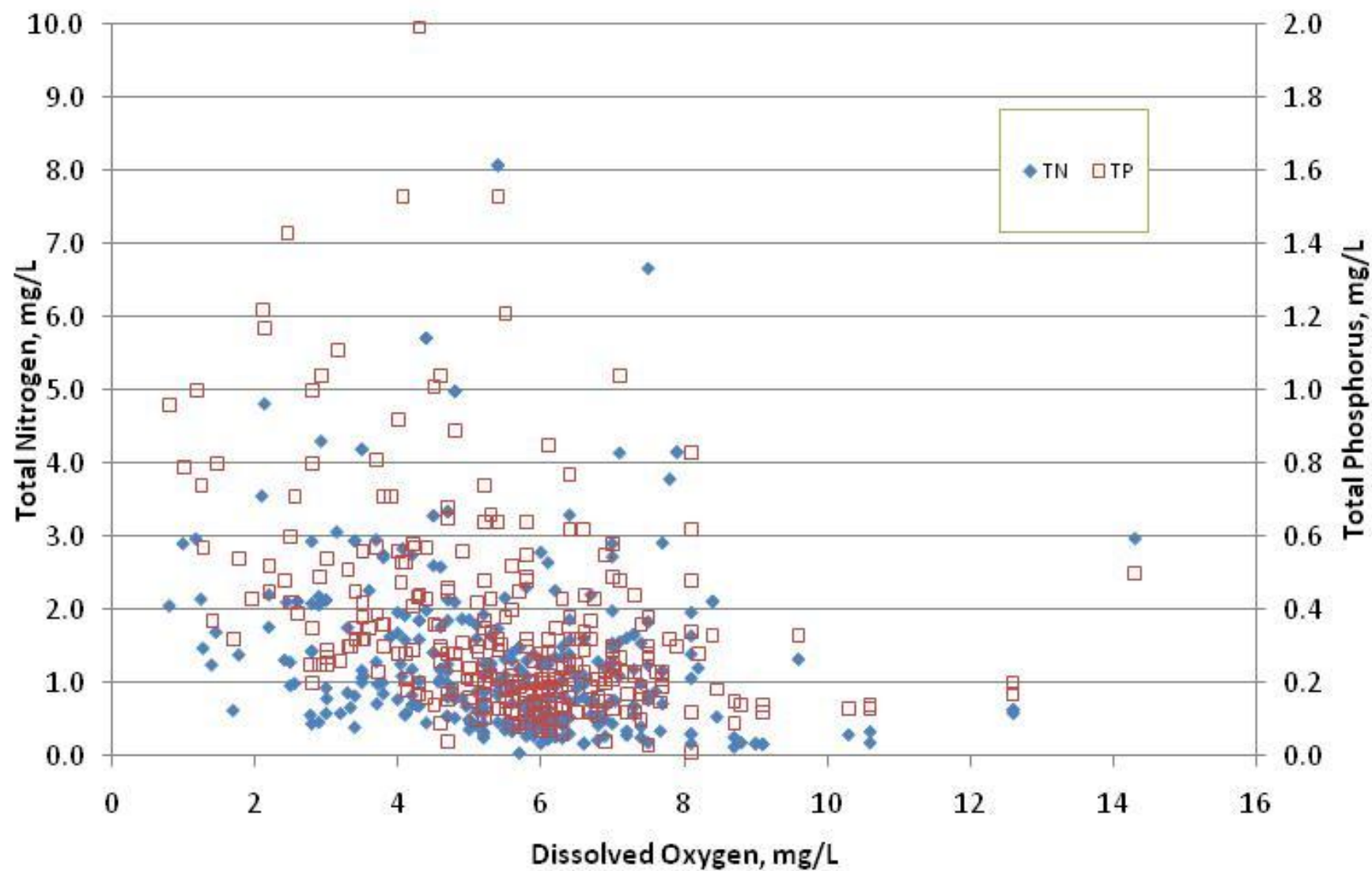


Figure 2-18
Paired Measurements for TN and TP versus Dissolved Oxygen at Mill Creek

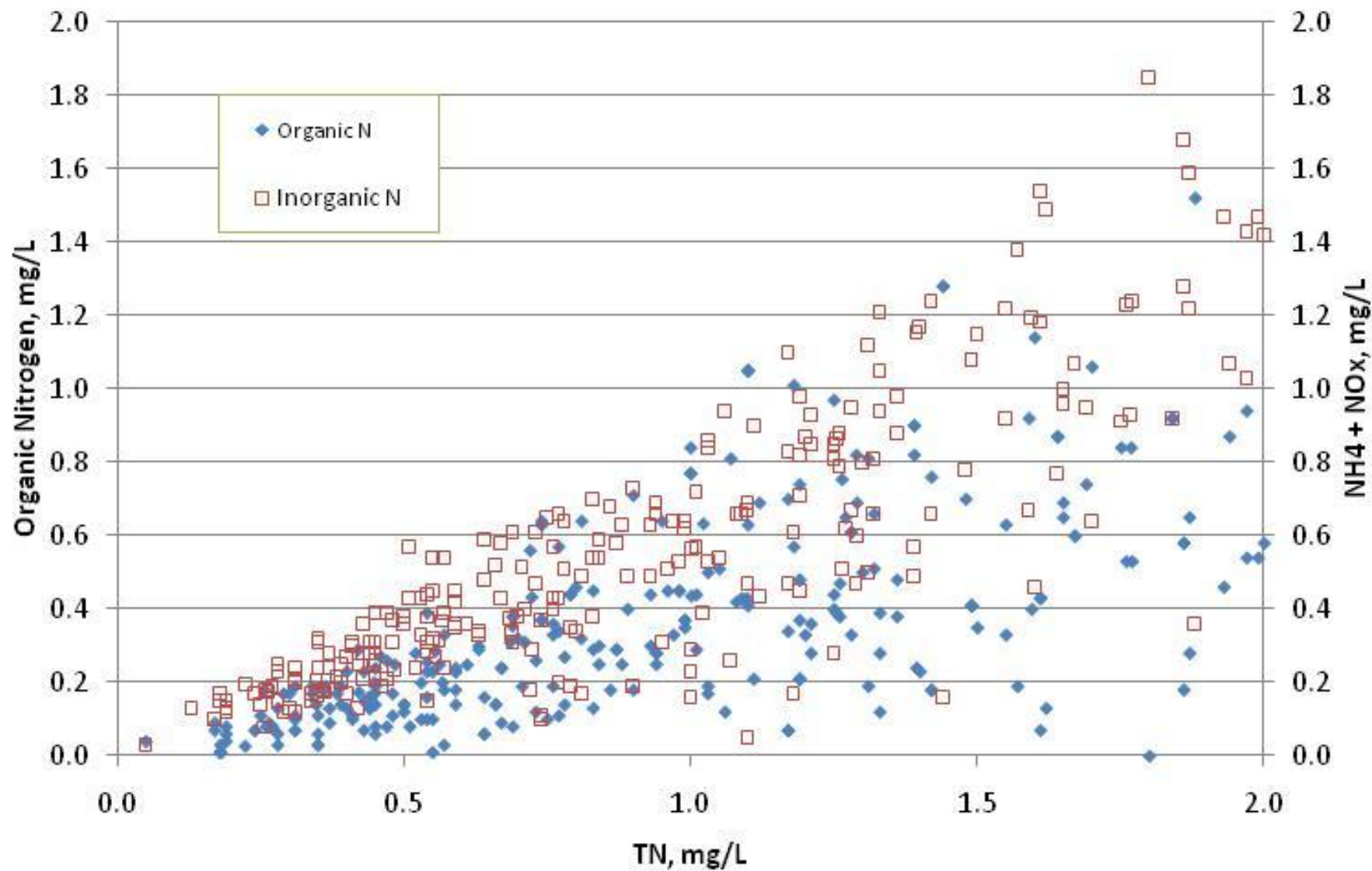


Figure 2-19

Paired Measurements for Organic and Inorganic Nitrogen versus Total Nitrogen at Mill Creek

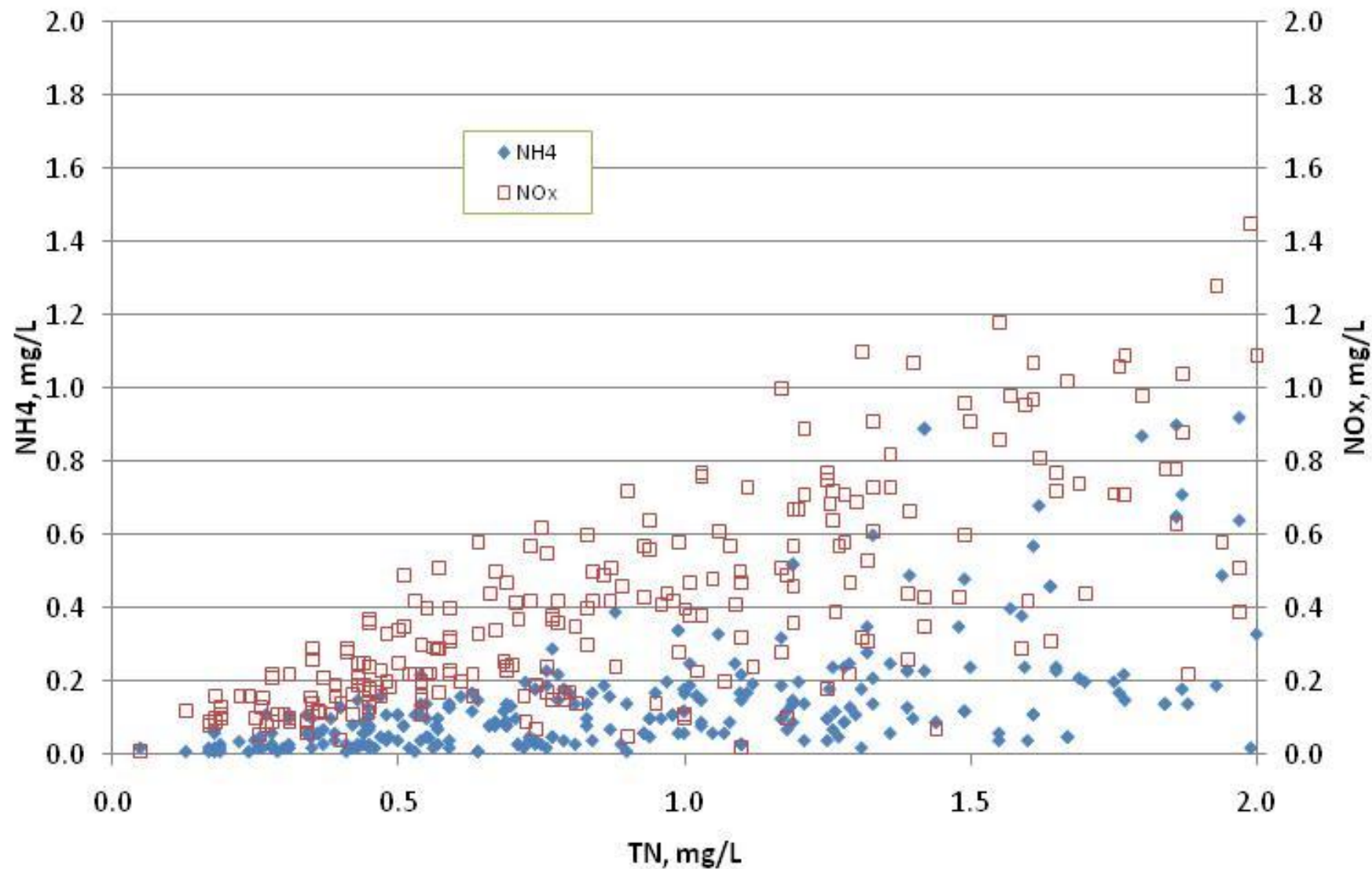


Figure 2-20

Paired Measurements for Ammonia and Nitrate-Nitrite Nitrogen versus Total Nitrogen at Mill Creek

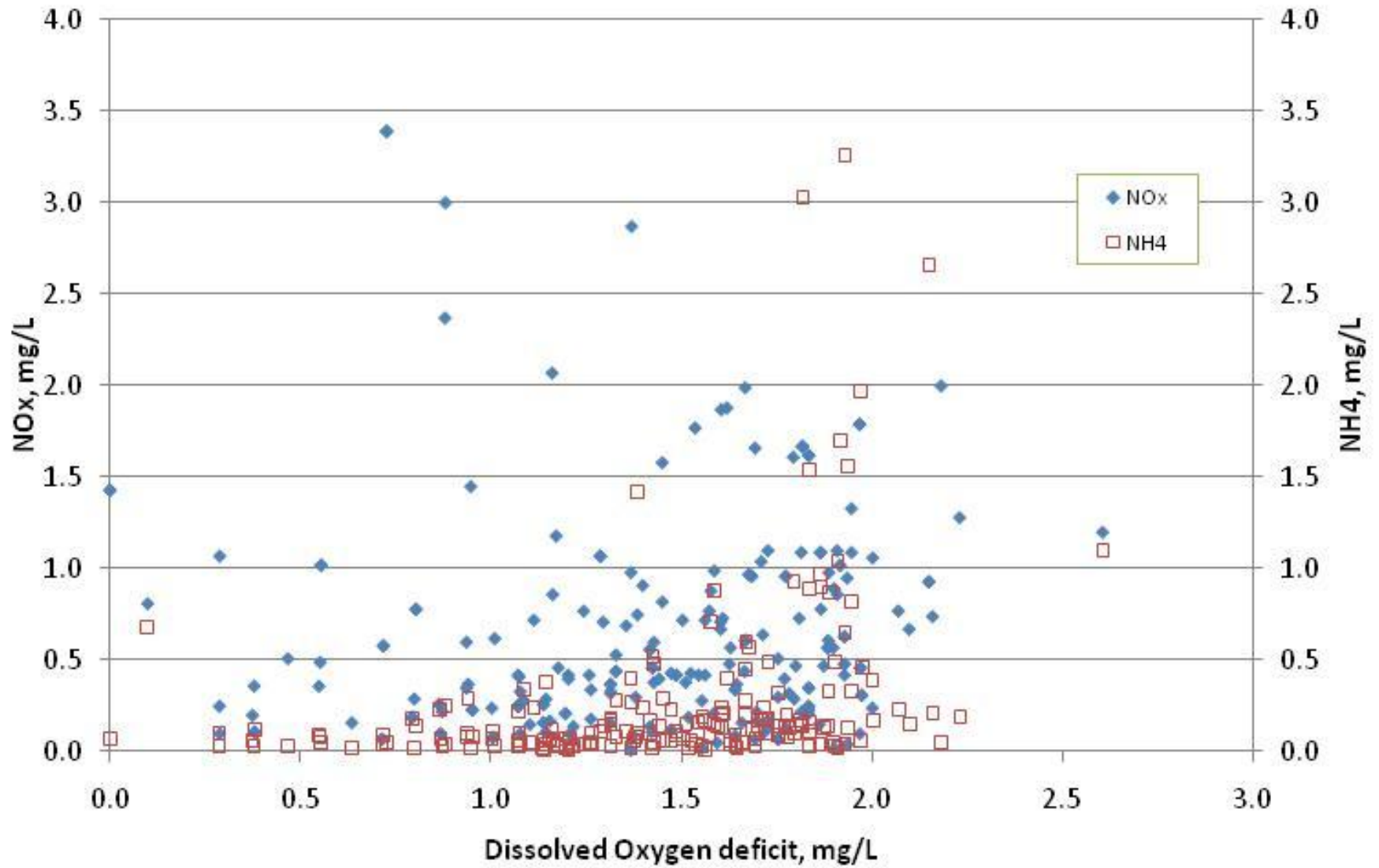


Figure 2-21

Paired Measurements for Ammonia and Nitrate-Nitrite Nitrogen versus Dissolved Oxygen at Mill Creek

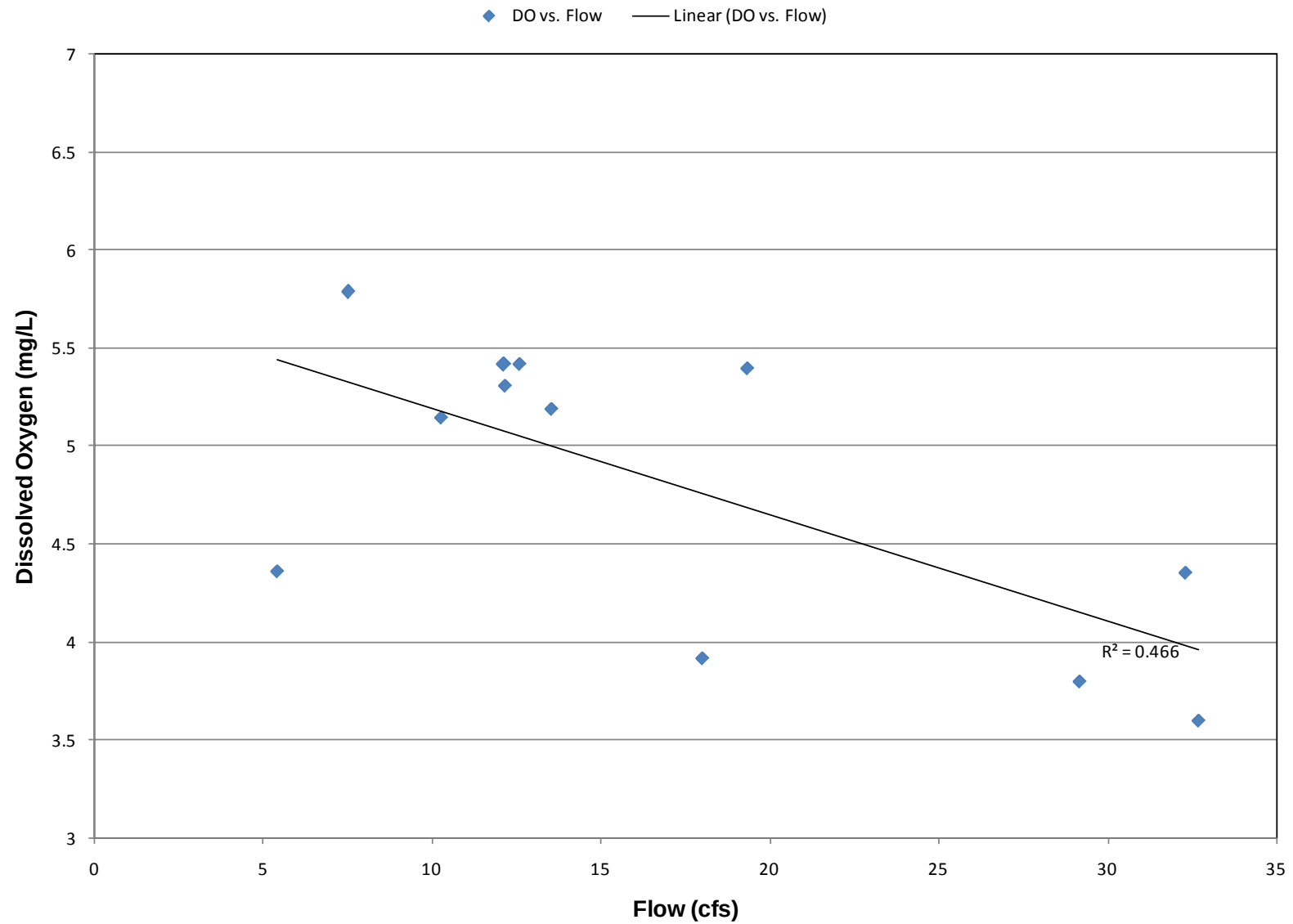


Figure 2-22a

Correlation of Annual Average Dissolved Oxygen versus Annual Average Flow at Mill Creek (1998-2009)

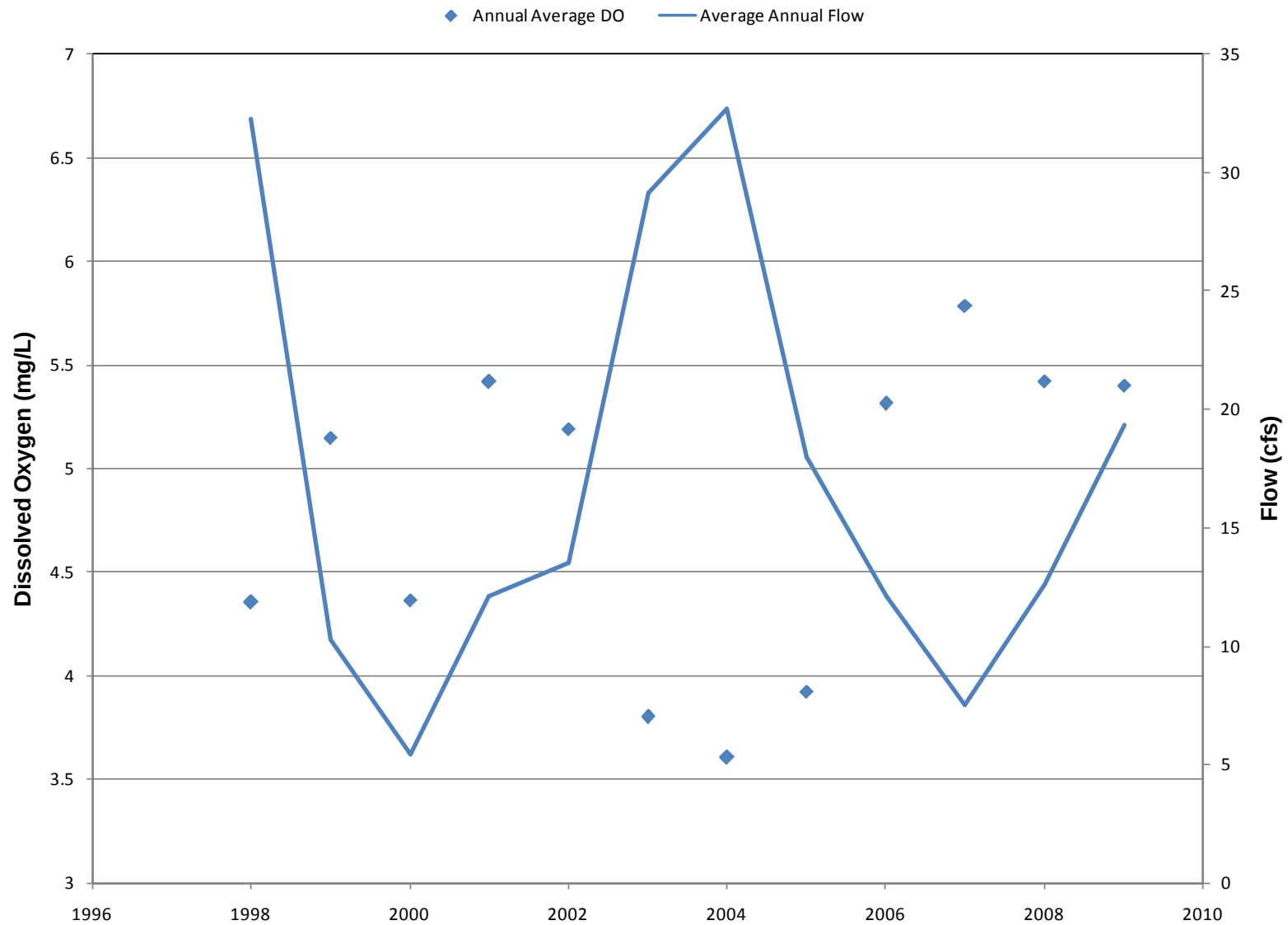


Figure 2-22b

Time Series Plot of Annual Average Dissolved Oxygen versus Annual Average Flow at Mill Creek (1998-2009)

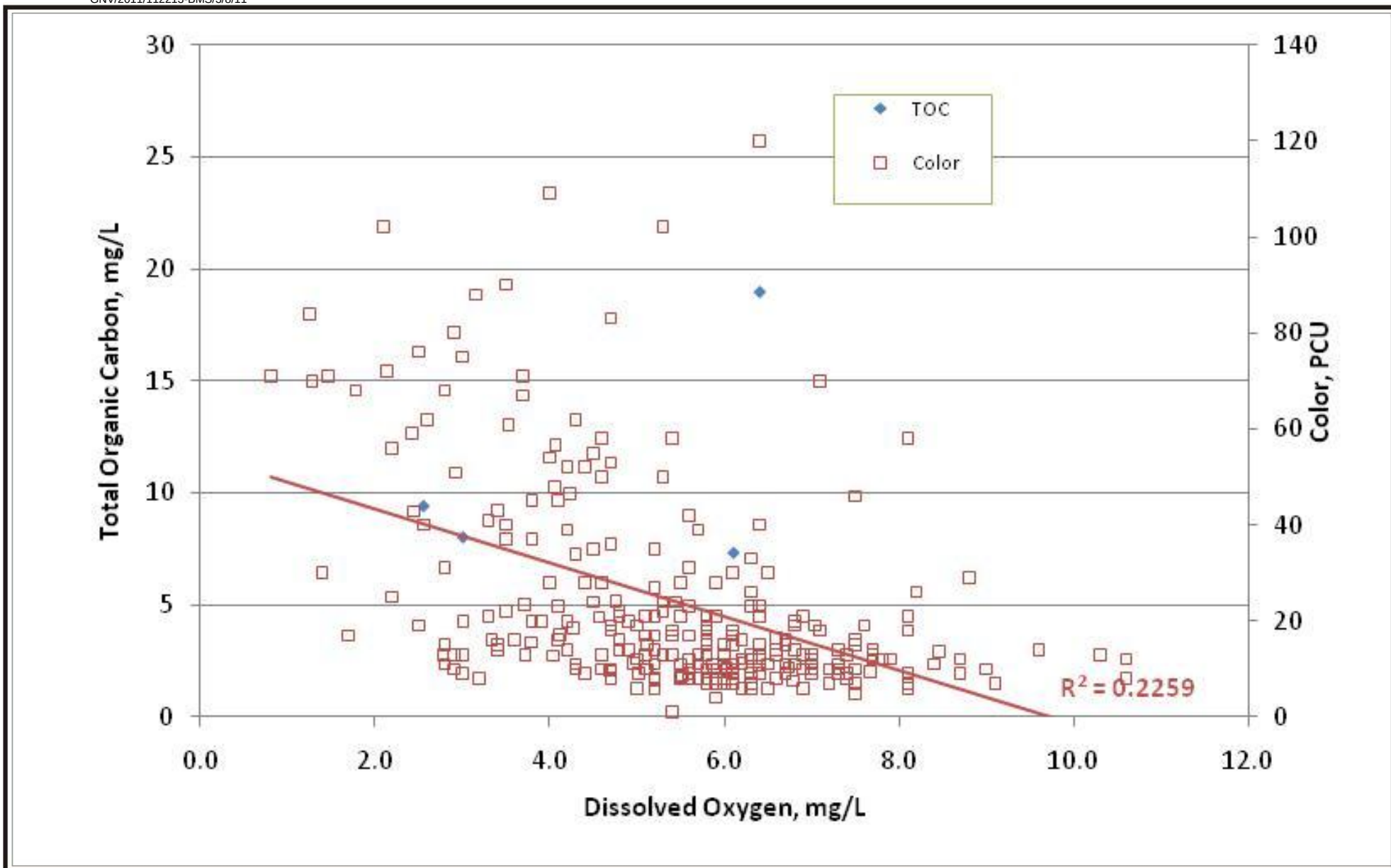


Figure 2-23

Paired Measurements of Total Organic Carbon and Color versus Dissolved Oxygen (Mill Creek)

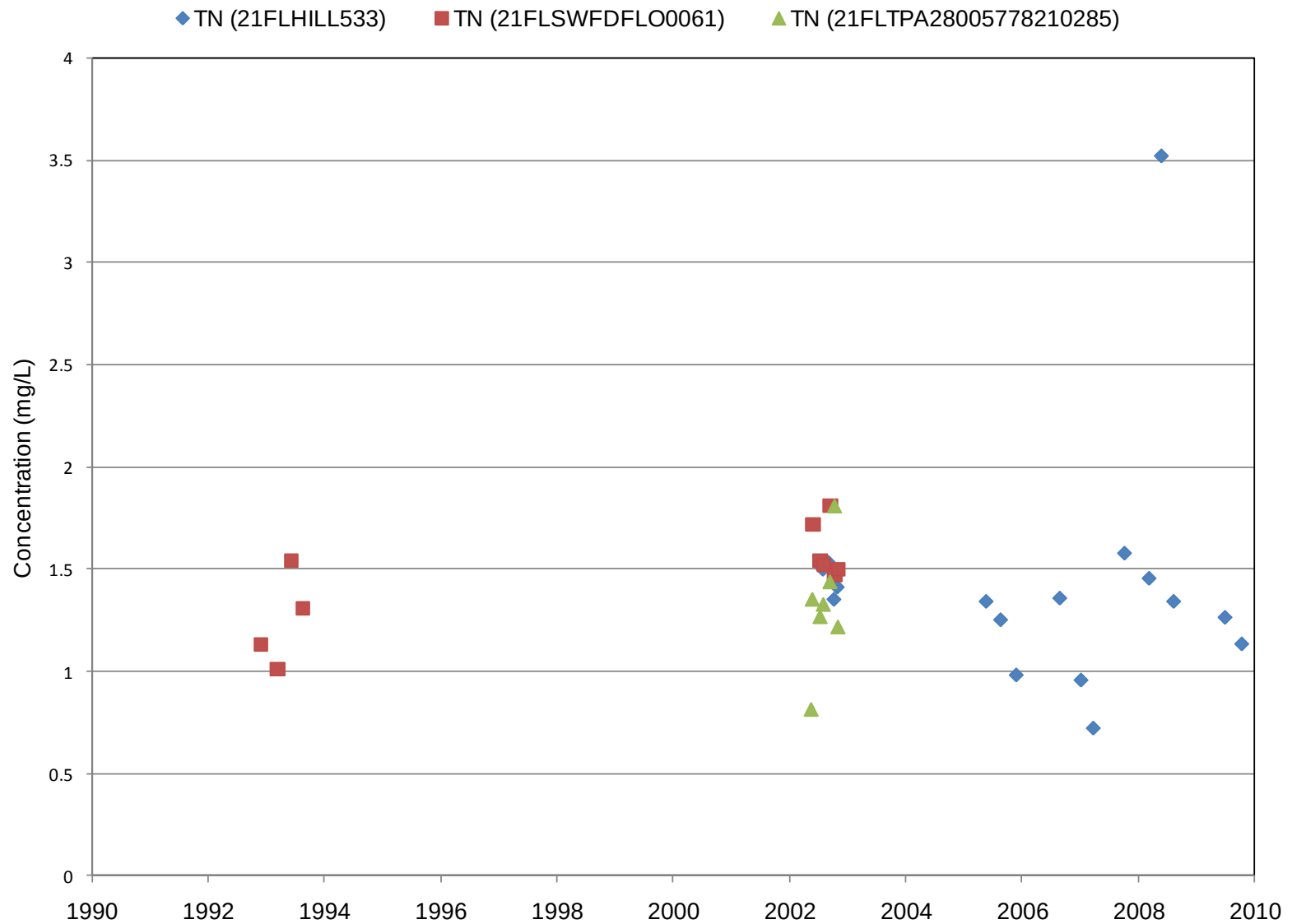
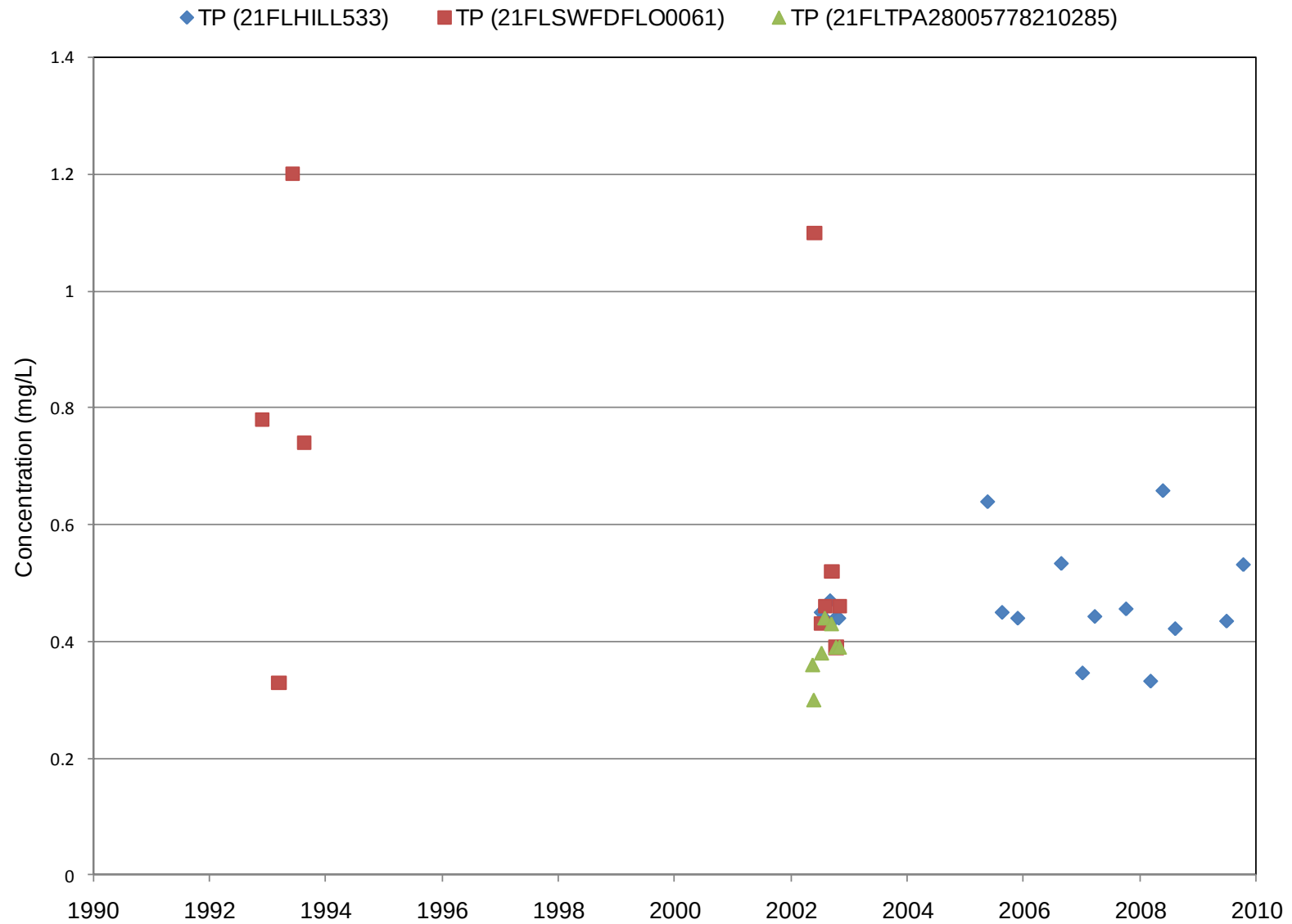


Figure 2-24
Measured Total Nitrogen in Sparkman Branch (WBID 1542A)



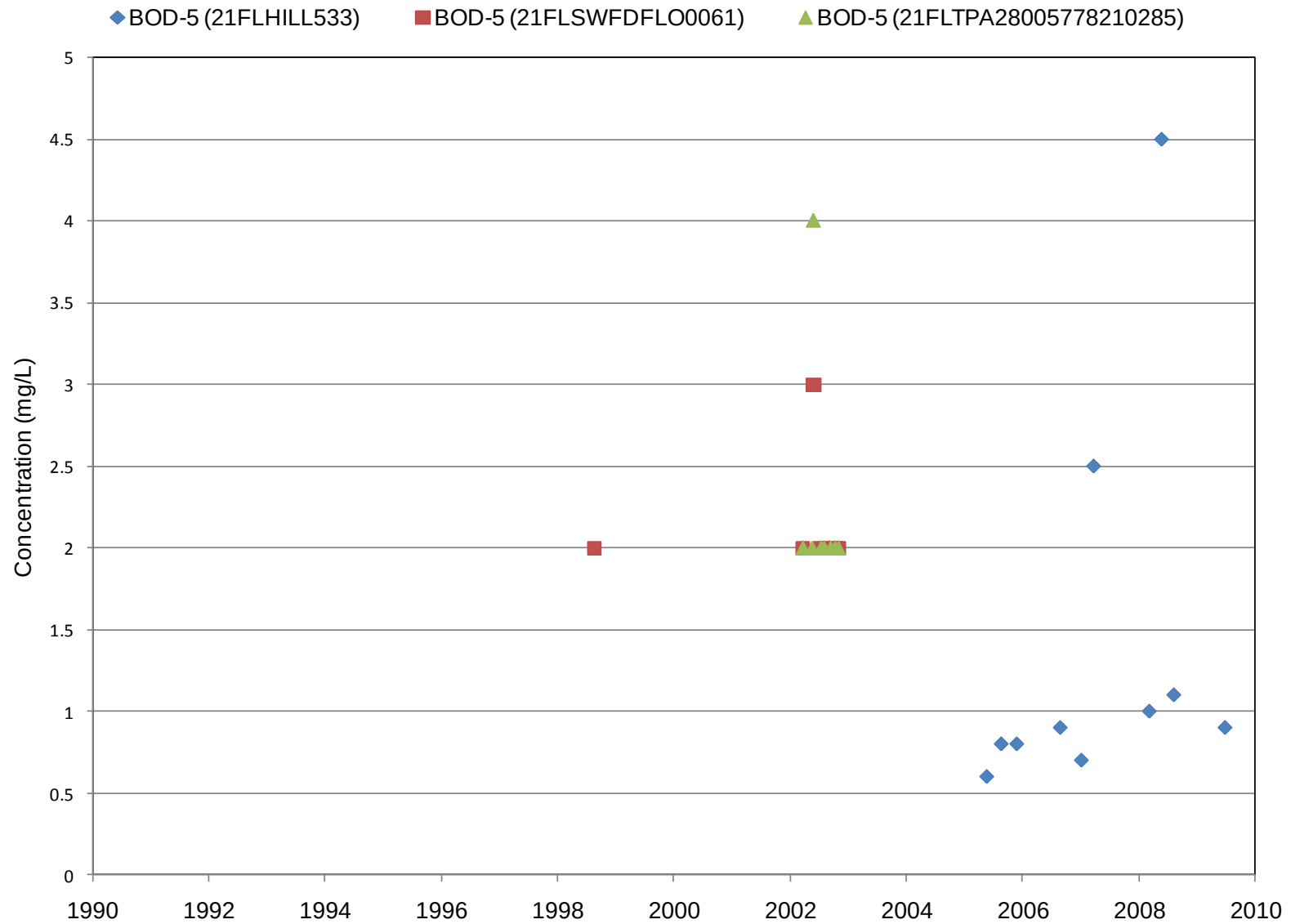


Figure 2-26
Measured BOD-5 in Sparkman Branch (WBID 1542A)

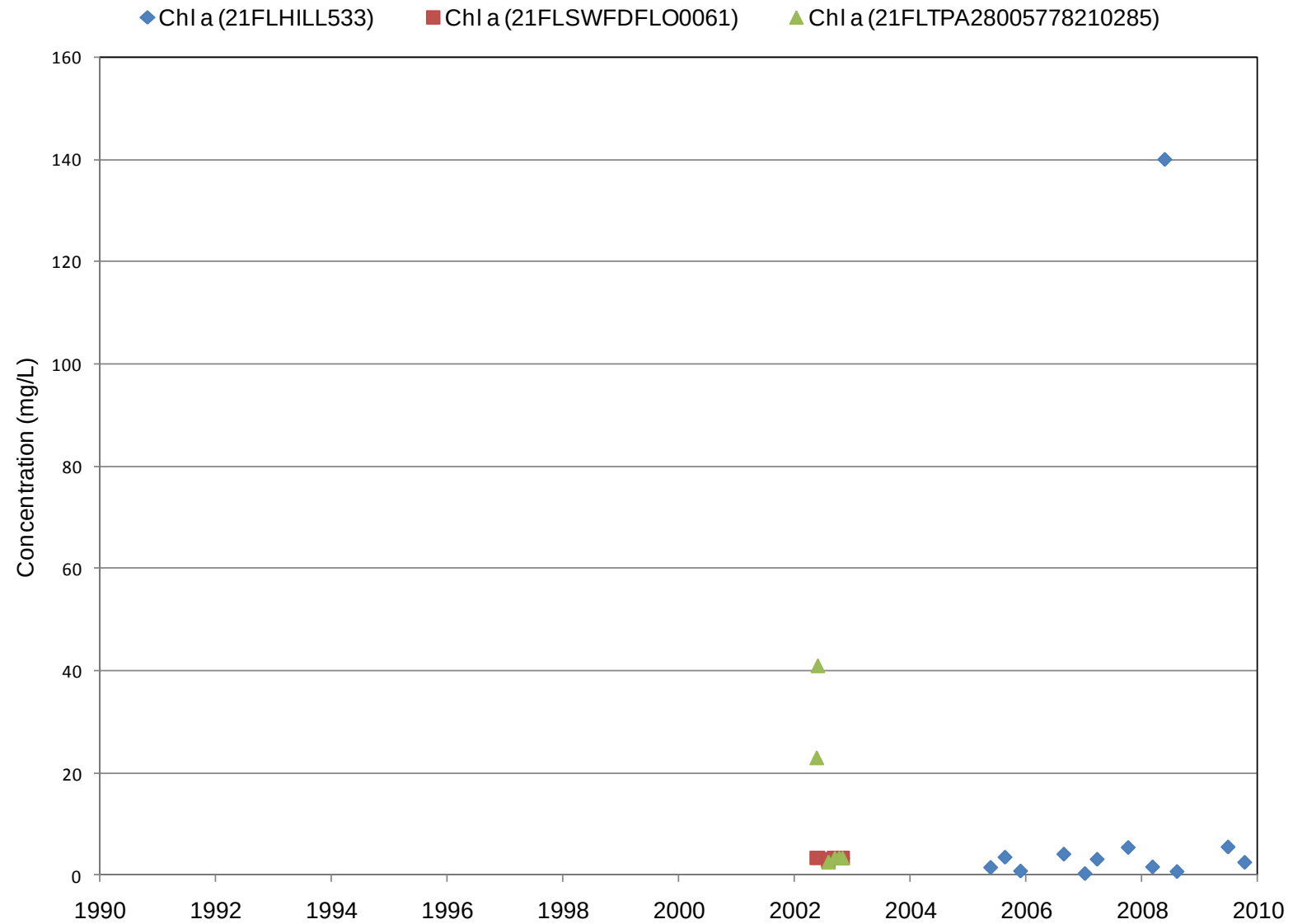


Figure 2-27
Measured Chlorophyll a in Sparkman Branch (WBID 1542A)

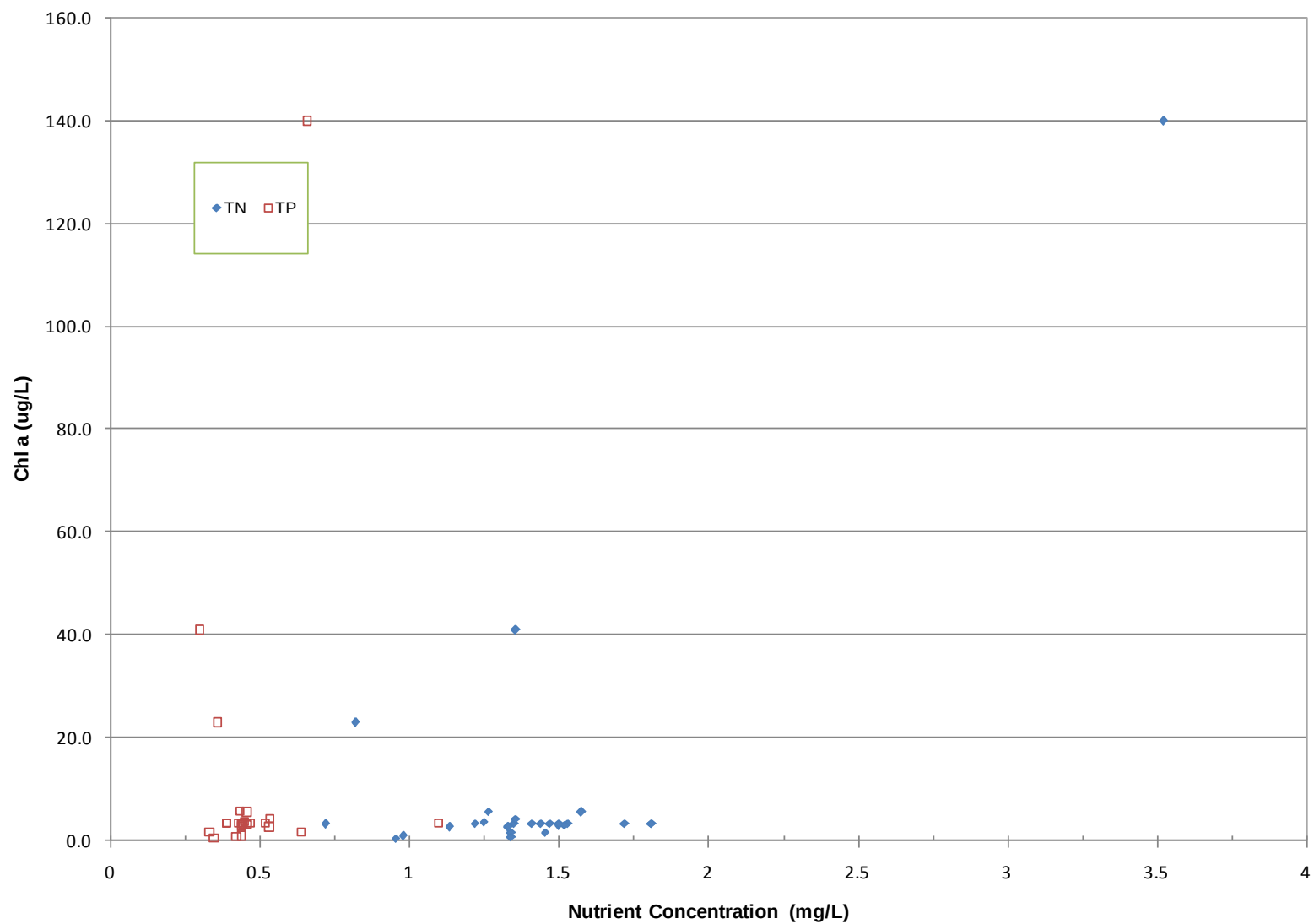


Figure 2-28

Paired Measurements for TN and TP versus Chlorophyll a at Sparkman Branch (All Stations)

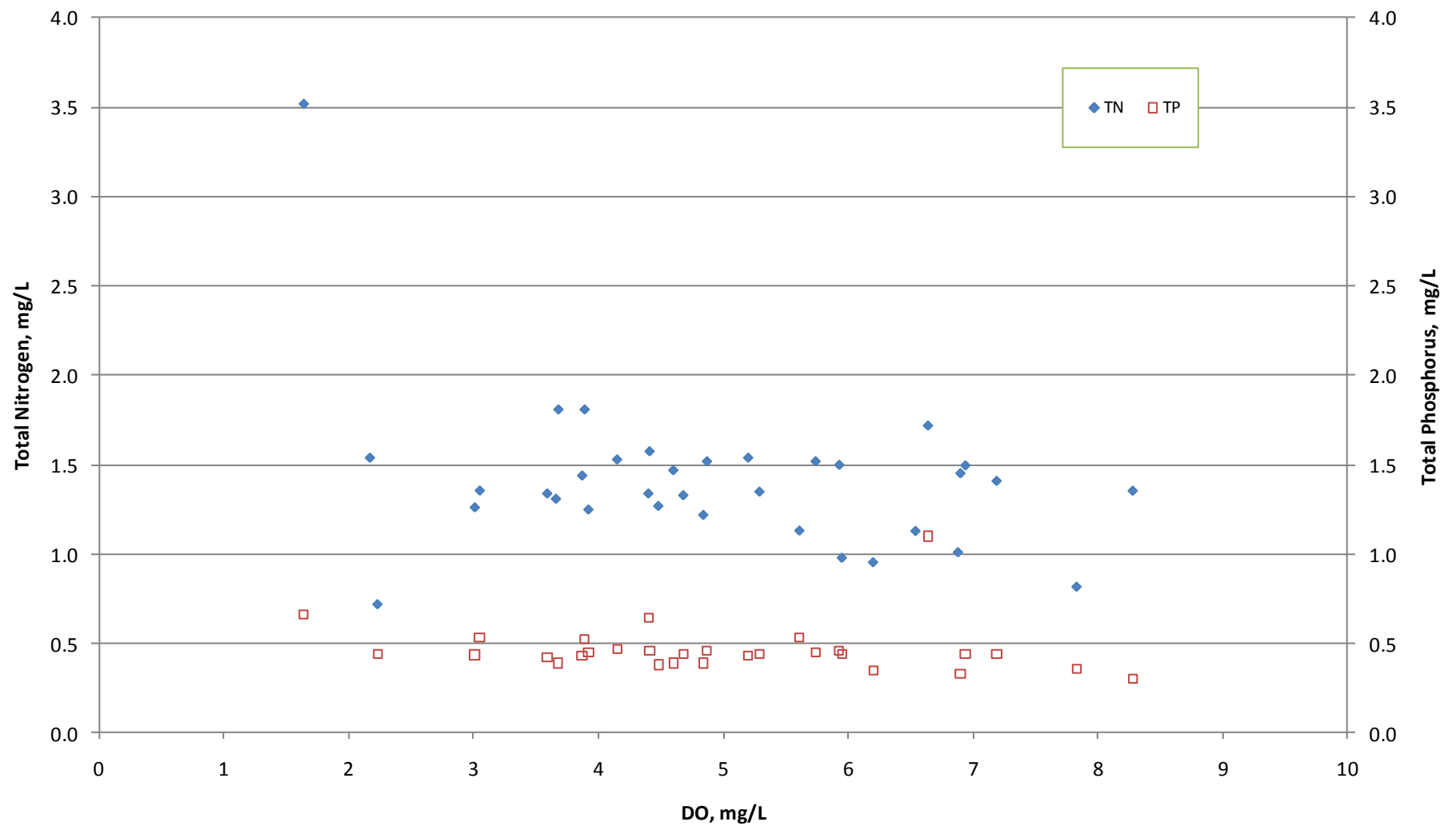


Figure 2-29

Paired Measurements for TN and TP versus Dissolved Oxygen at Sparkman Branch (All Stations)

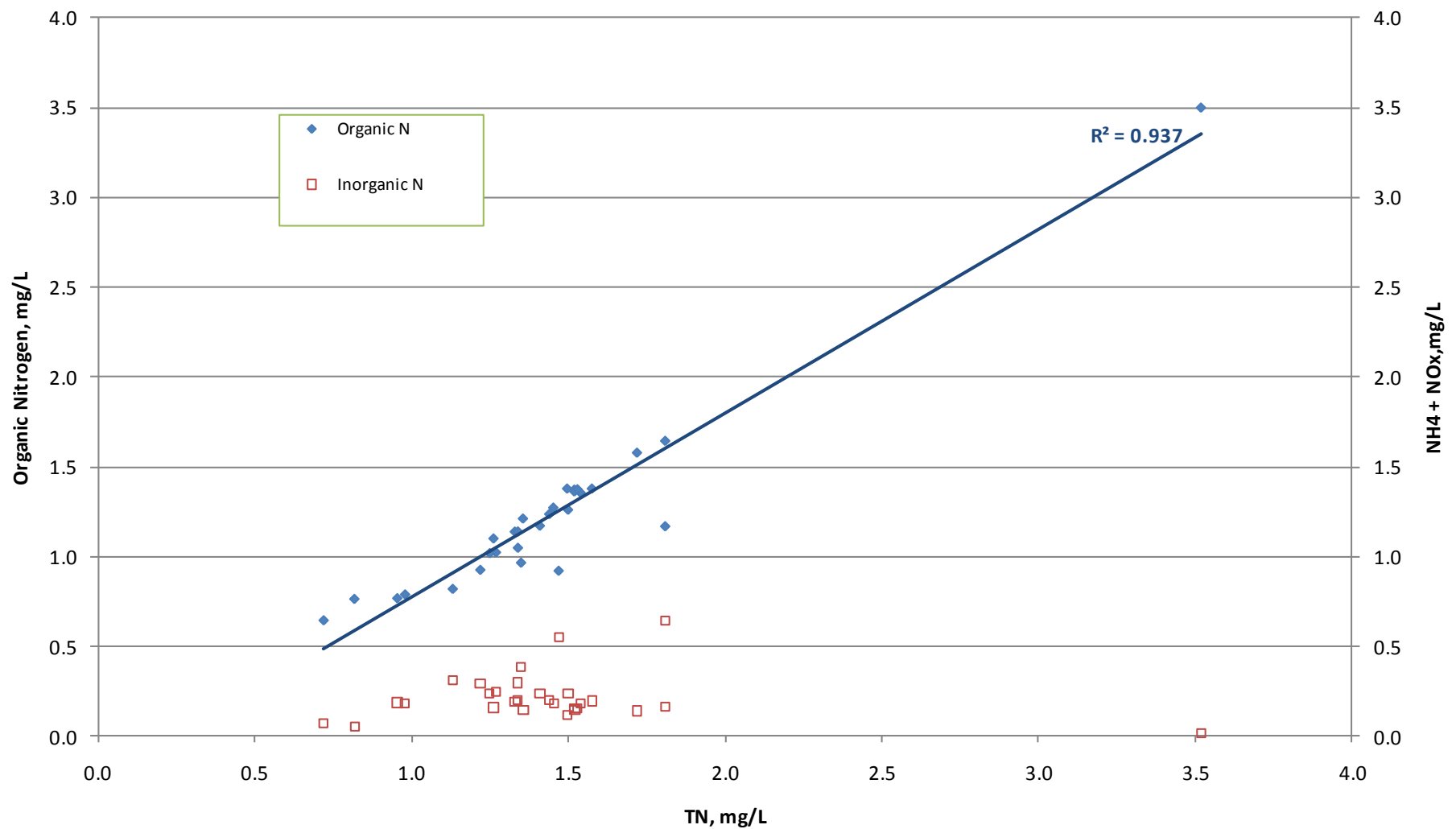


Figure 2-30
Paired Measurements for Organic and Inorganic Nitrogen versus Total Nitrogen at Sparkman Branch
(All Stations)

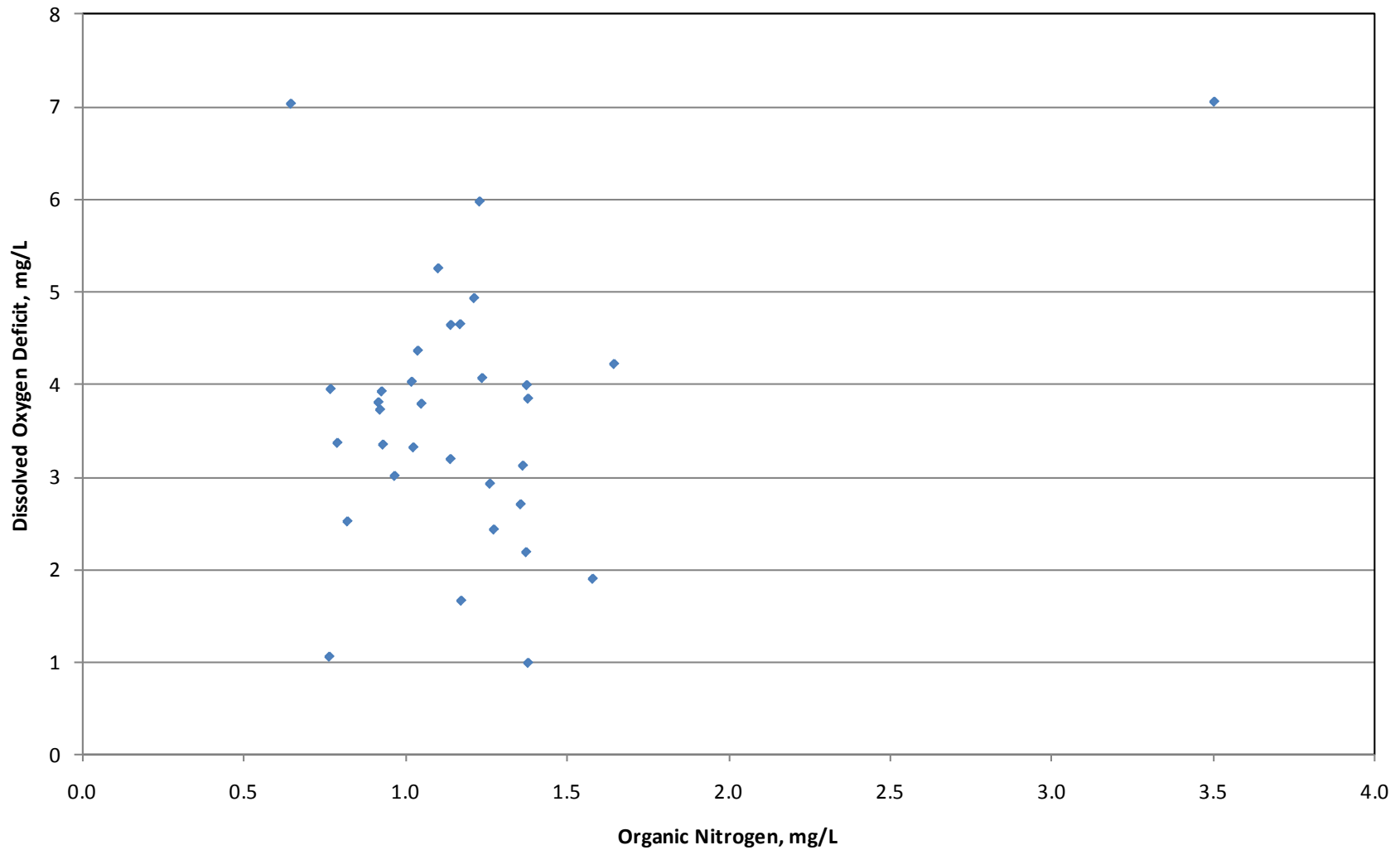


Figure 2-31

Paired Measurements for Organic Nitrogen versus Dissolved Oxygen at Sparkman Branch
(All Stations)

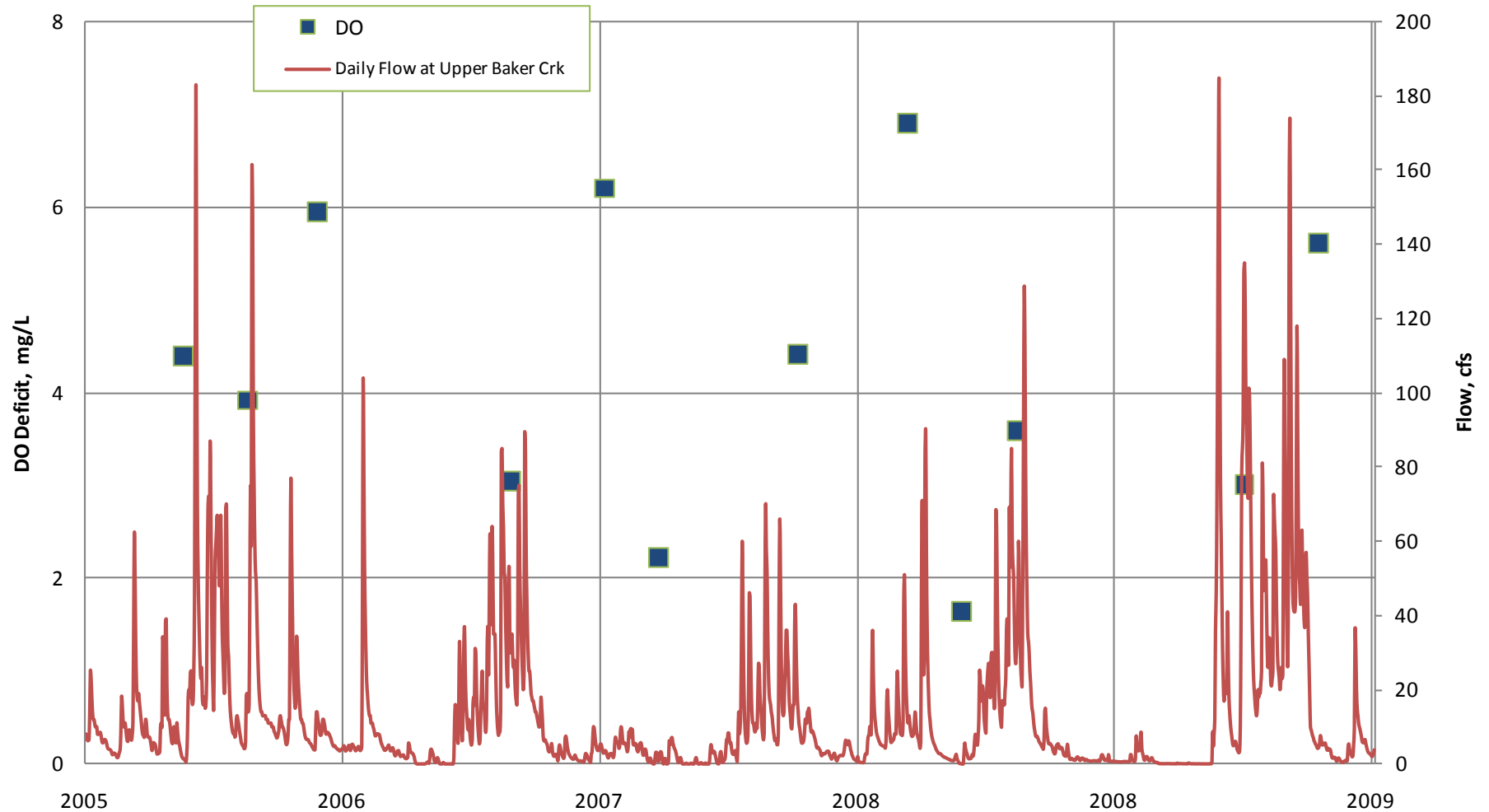


Figure 2-32

Flow at Upper Baker Creek versus Dissolved Oxygen at Sparkman Branch (all stations)

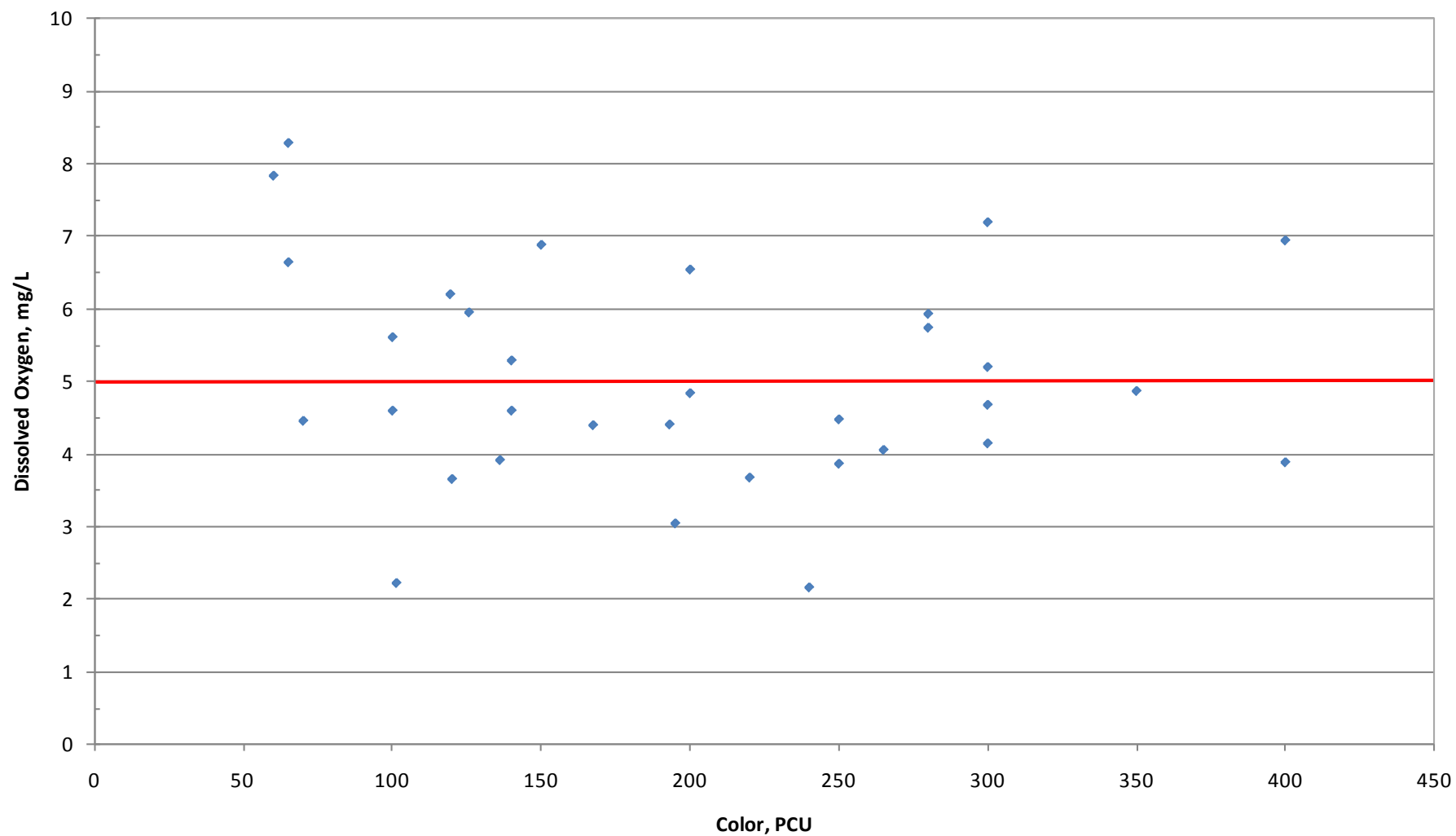


Figure 2-33

Paired Measurements for Dissolved Oxygen versus Color at Sparkman Branch (All Stations)

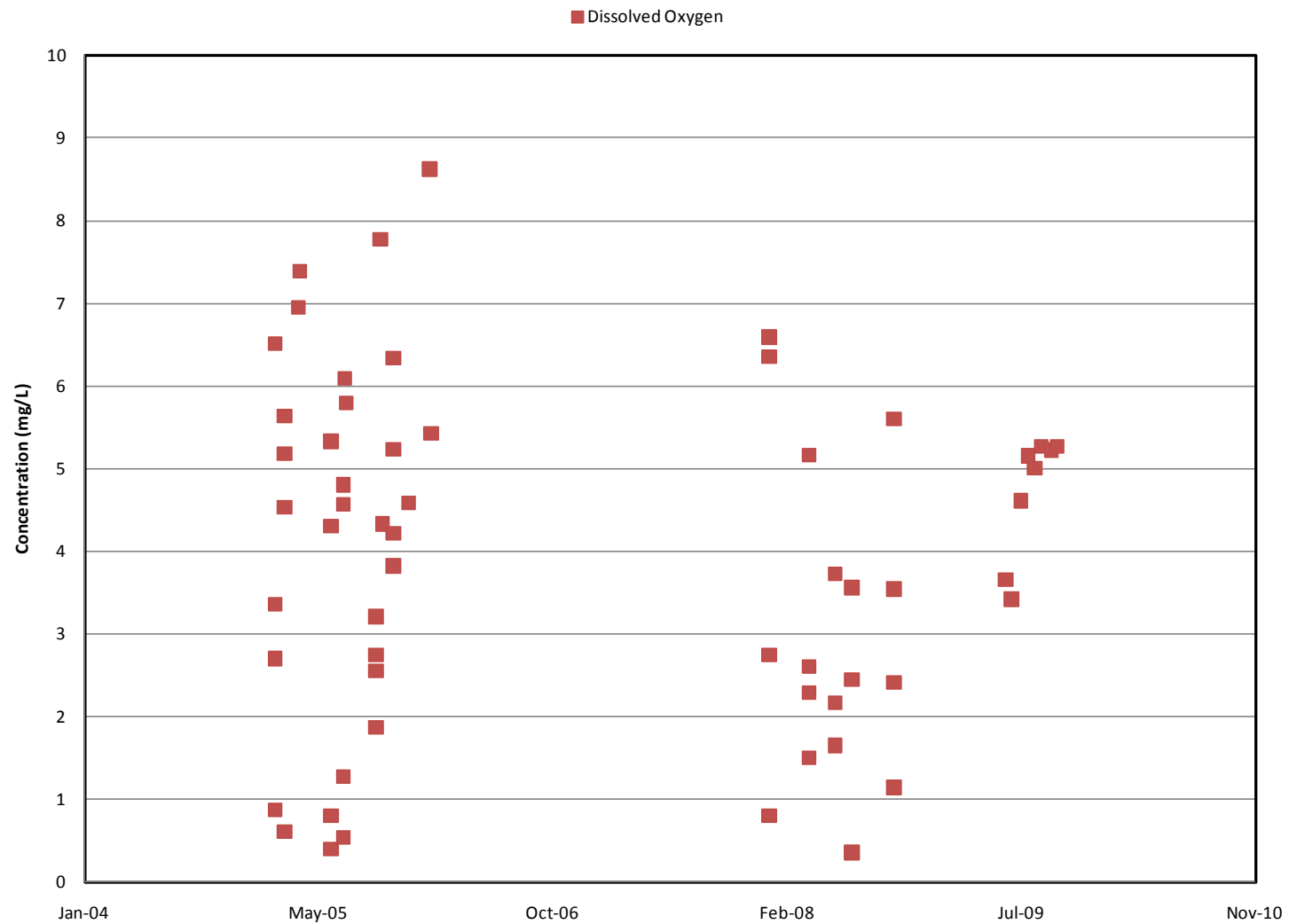


Figure 2-34
Plot of Dissolved Oxygen at FDEP Reference Station (Cypress Branch)

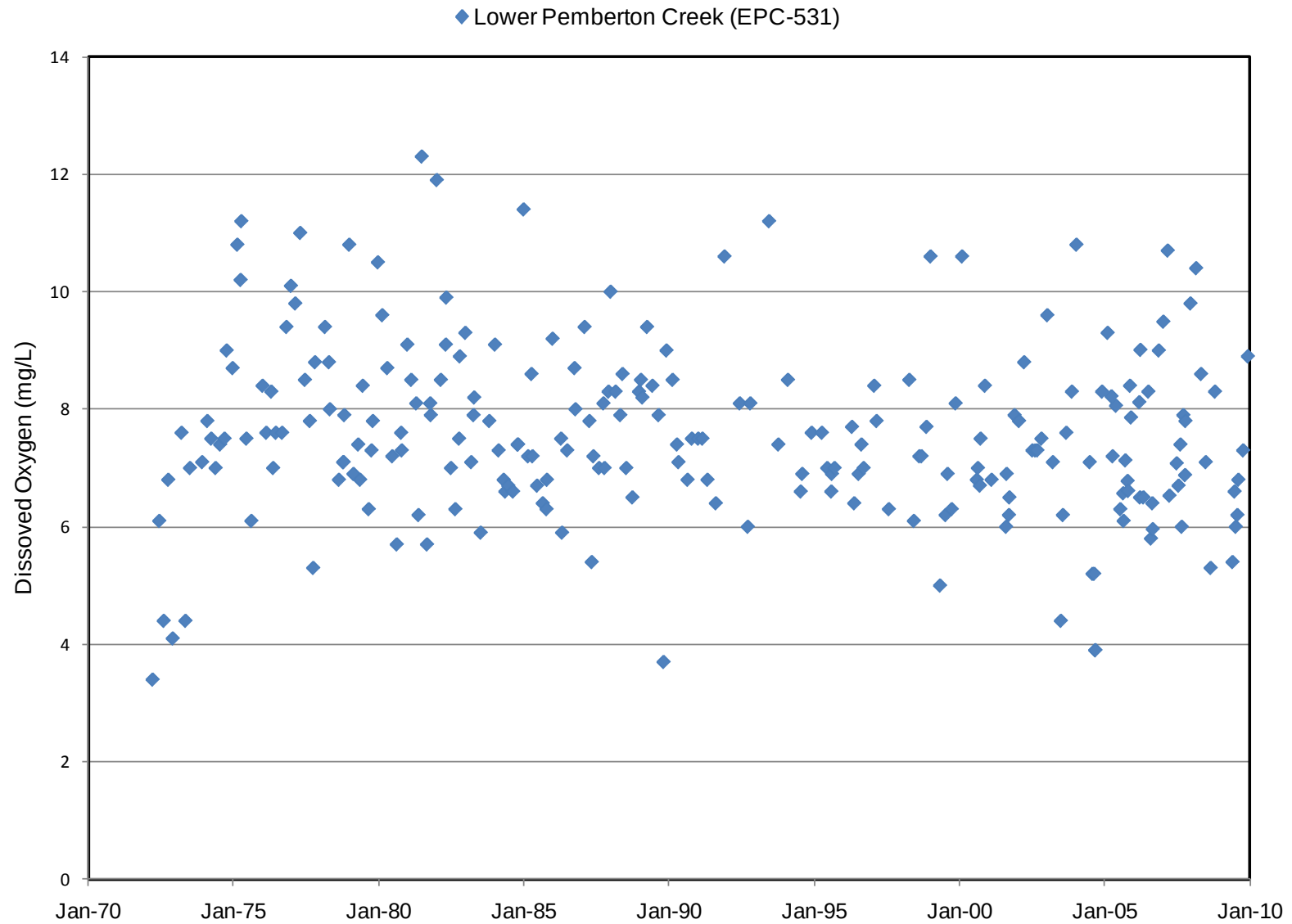


Figure 2-35a
Plot of Dissolved Oxygen at Lower Pemberton Creek Station (1970 to 2010)

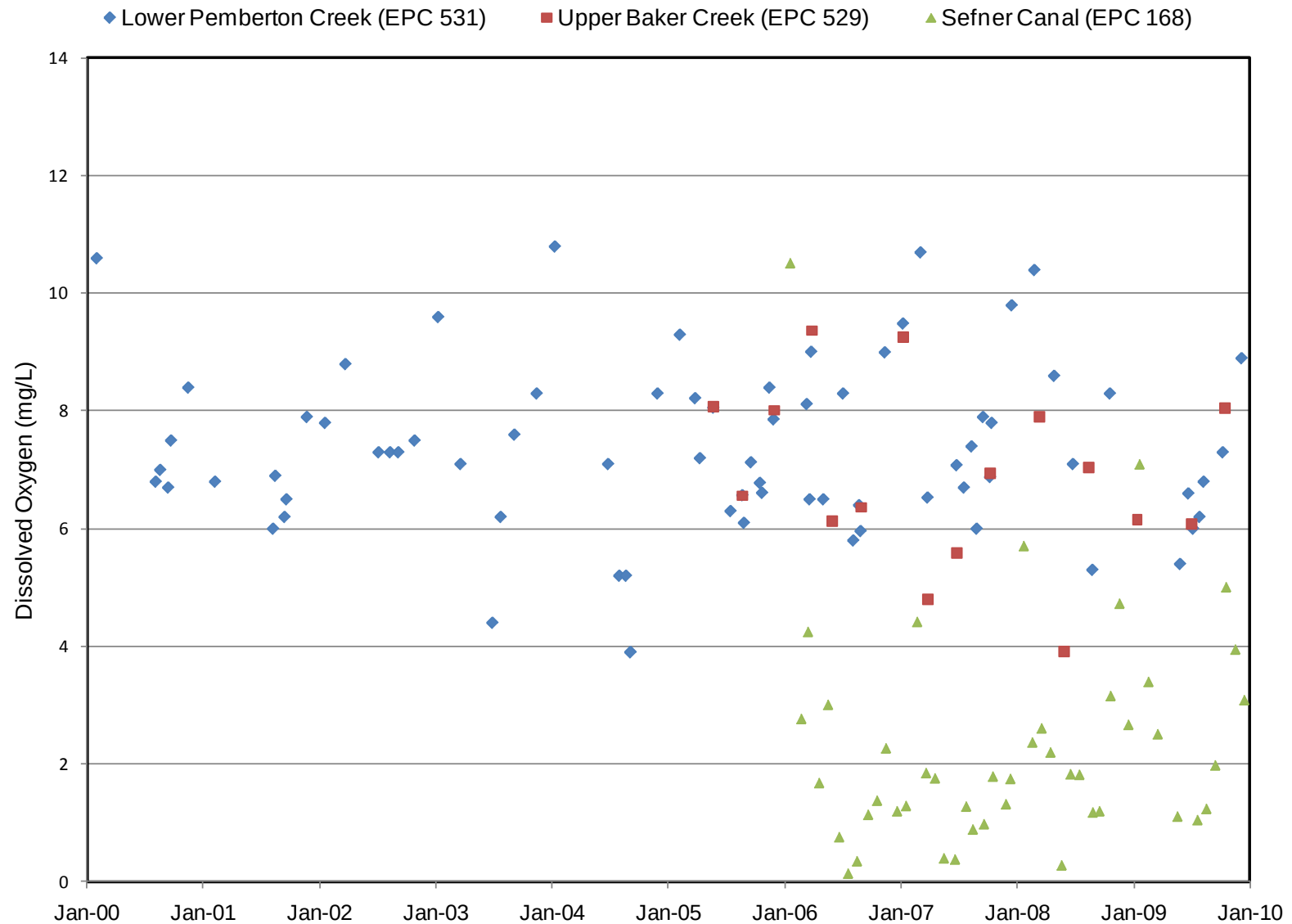


Figure 2-35b

Plot of Dissolved Oxygen at Lower Pemberton Creek Station, Upper Baker/Flint Creek Station and the Sefner Canal (2000 to 2010)

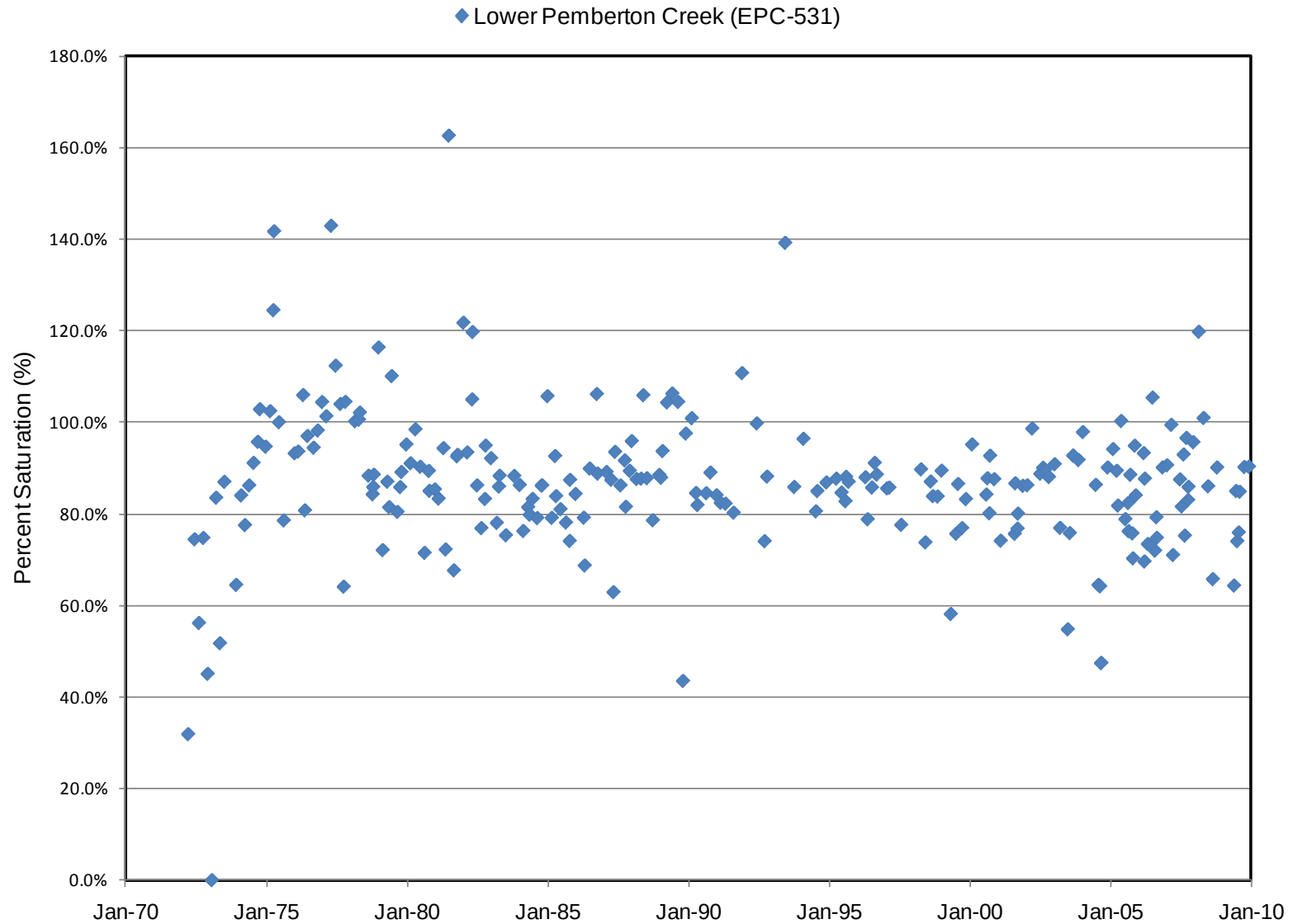


Figure 2-36a
Plot of Percent Saturation at Lower Pemberton Creek Station (1970 to 2010)

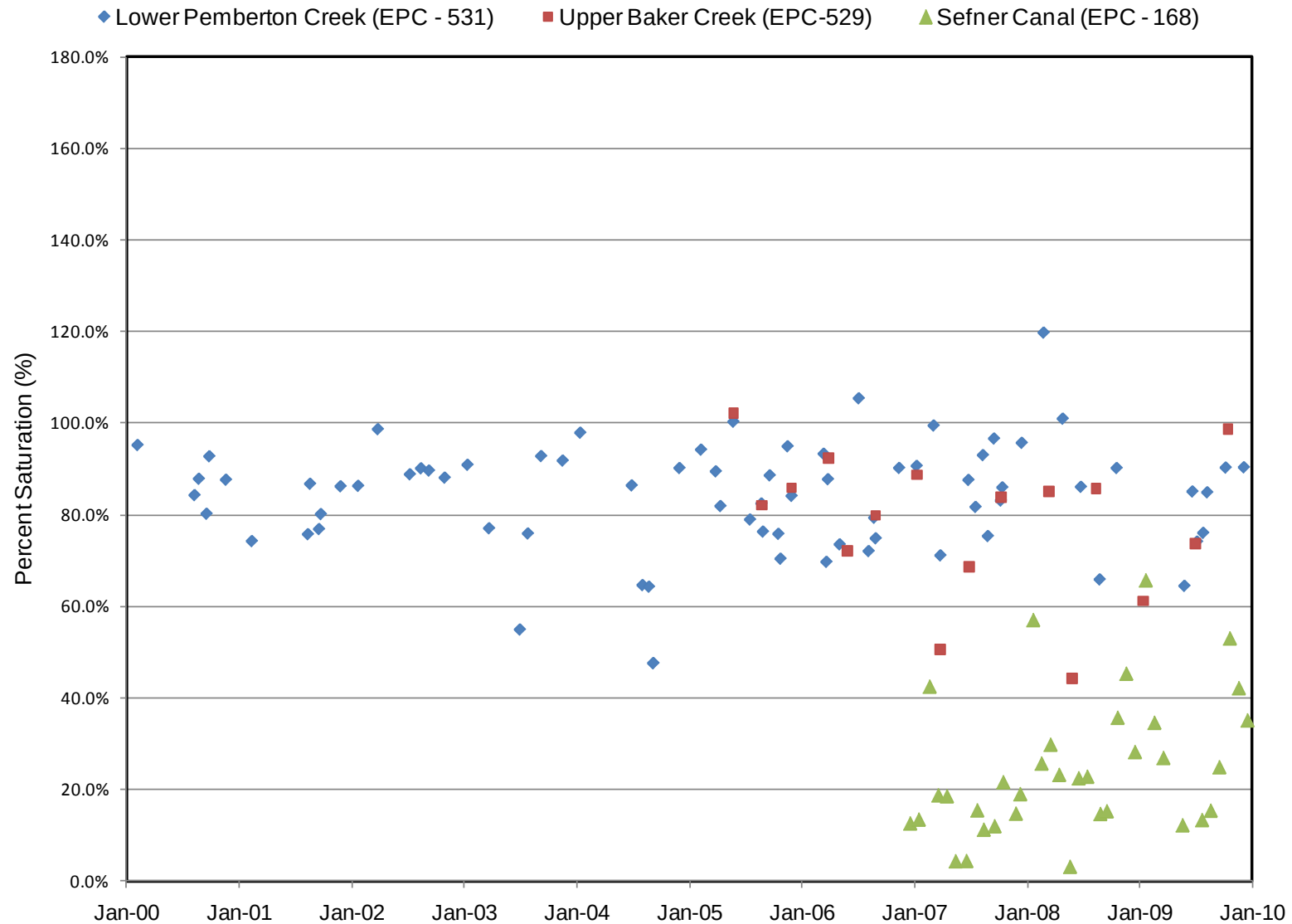


Figure 2-36b

Plot of Percent Saturation at Lower Pemberton Creek Station, Upper Baker/Flint Creek Station and the Sefner Canal (2000 to 2010)

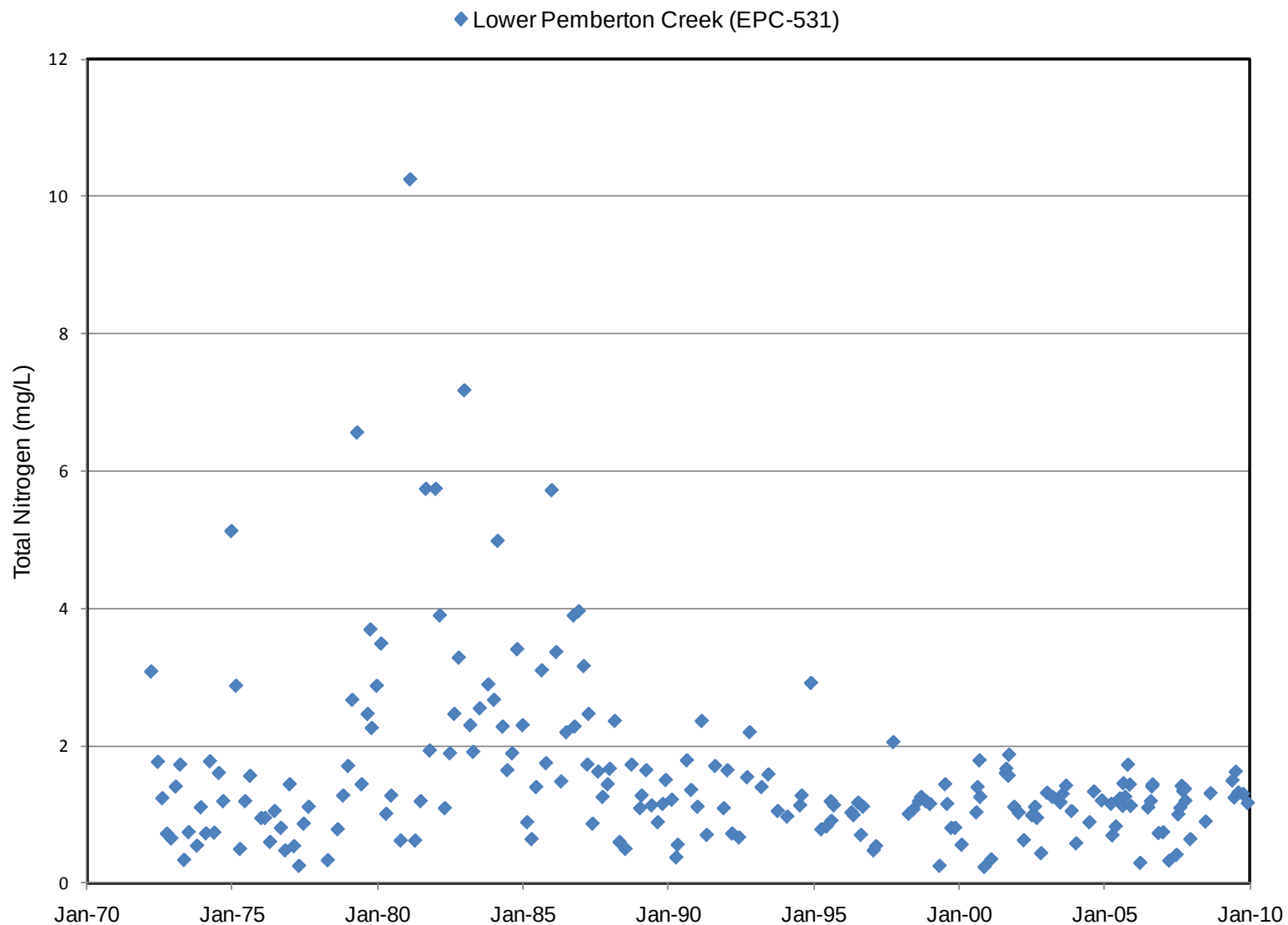


Figure 2-37a
Plot of Total Nitrogen at Lower Pemberton Creek Station (1970 to 2010)

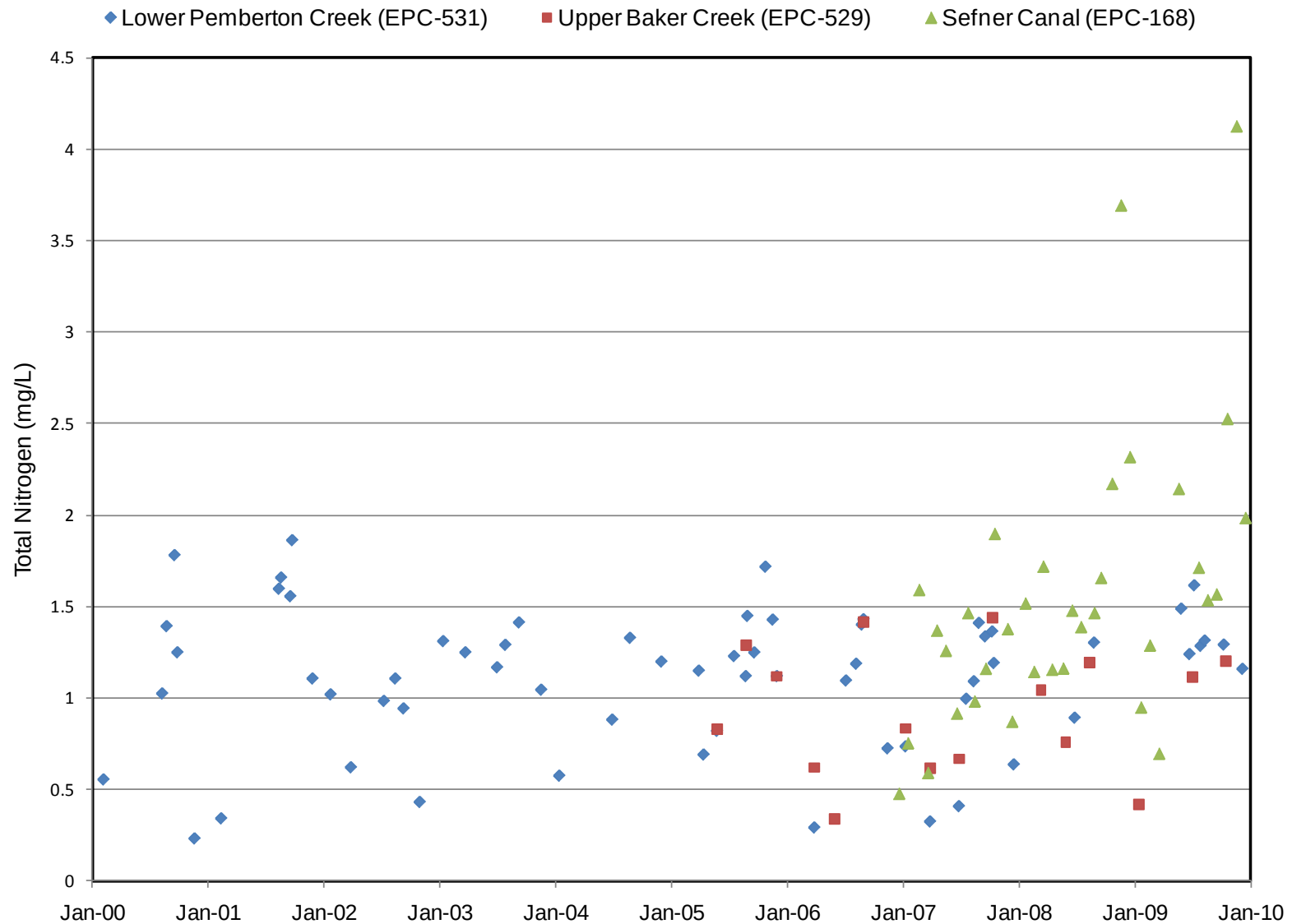


Figure 2-37b

Plot of Total Nitrogen at Lower Pemberton Creek Station, Upper Baker/Flint Creek Station and the Sefner Canal (2000 to 2010)

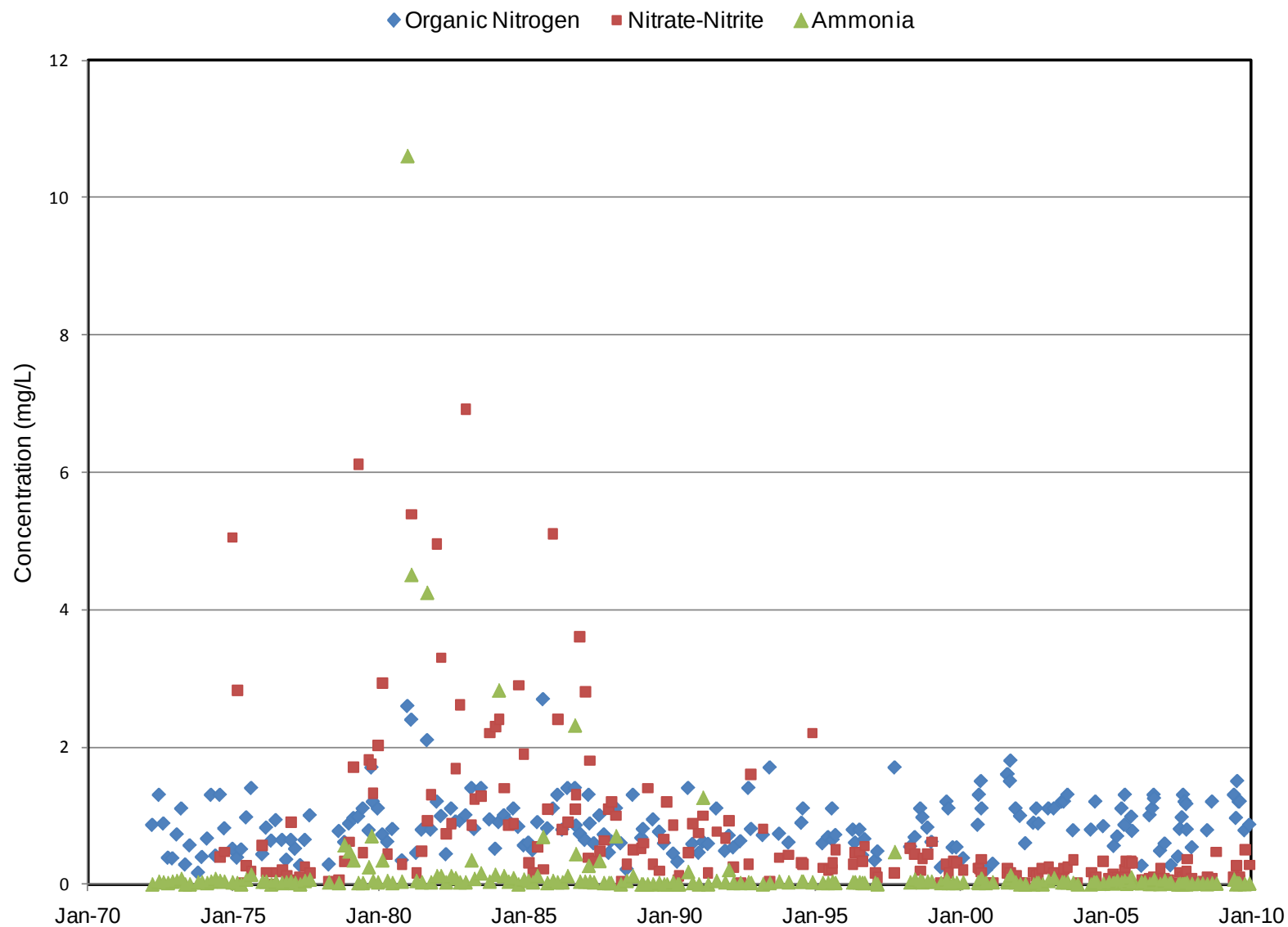


Figure 2-38a
Plot of Nitrogen Species at Lower Pemberton Creek Station (1970 to 2010)

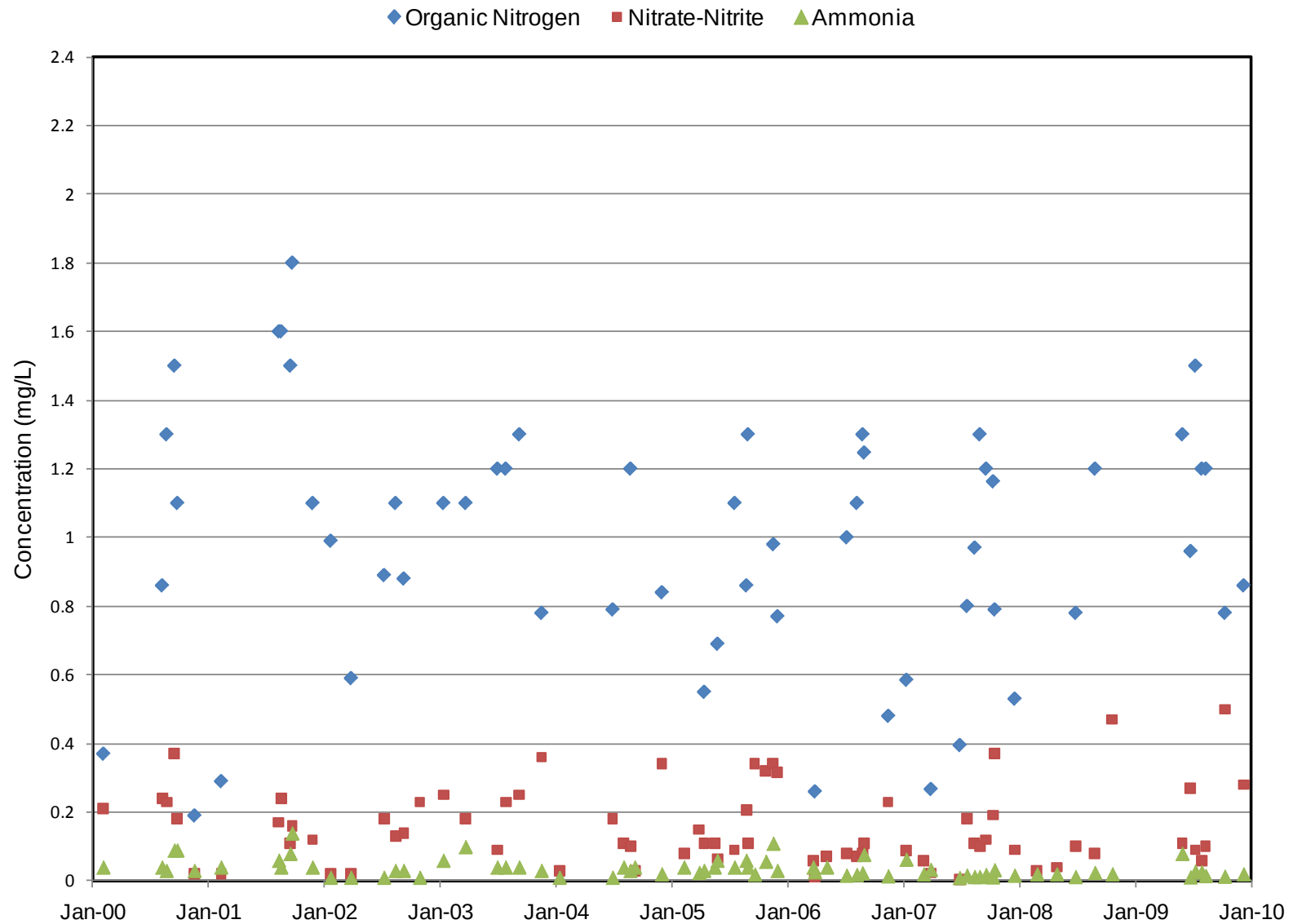


Figure 2-38b
Plot of Nitrogen Species at Lower Pemberton Creek Station (2000 to 2010)

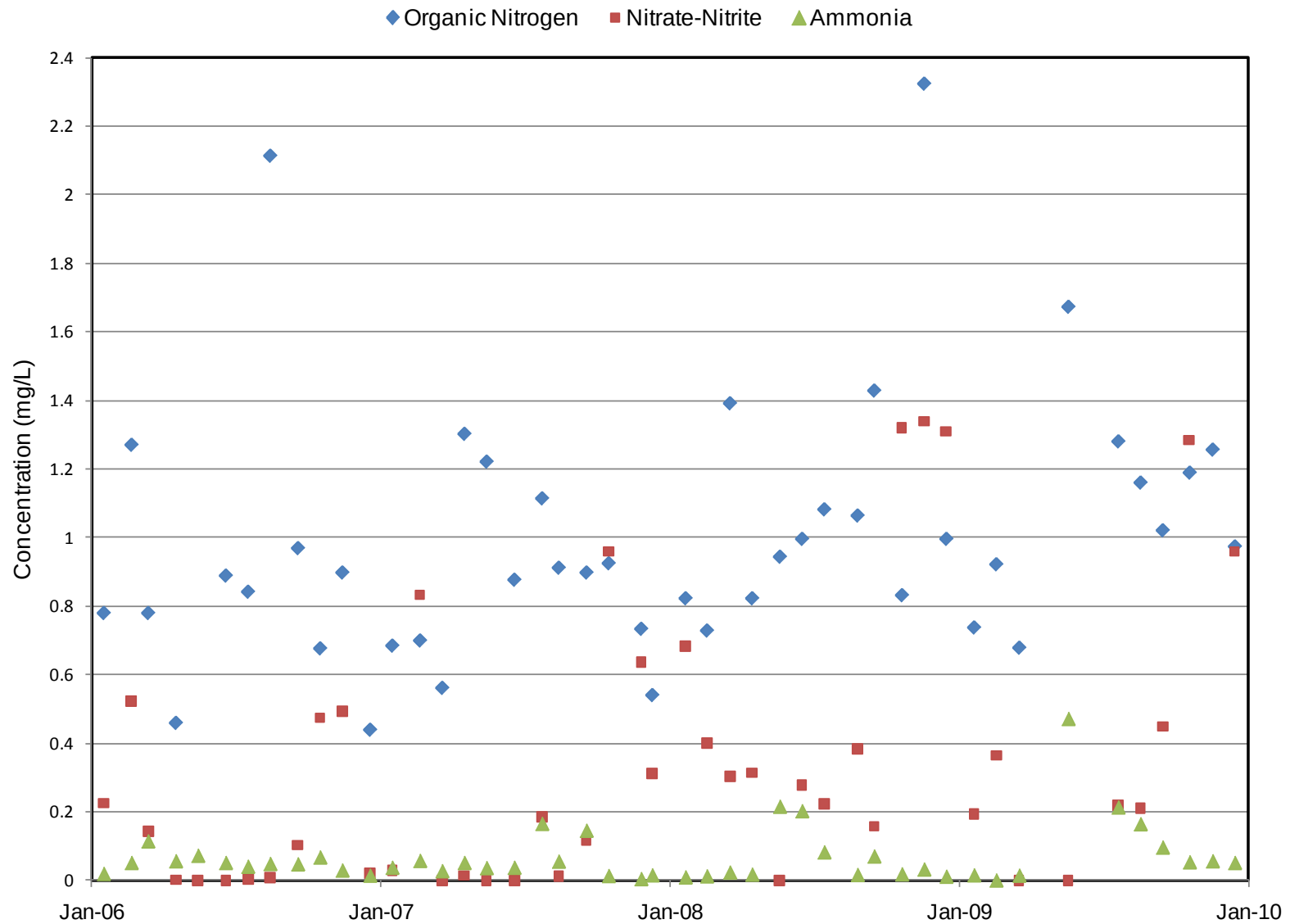


Figure 2-38c
Plot of Nitrogen Species at Seffner Canal Station (2000 to 2010)

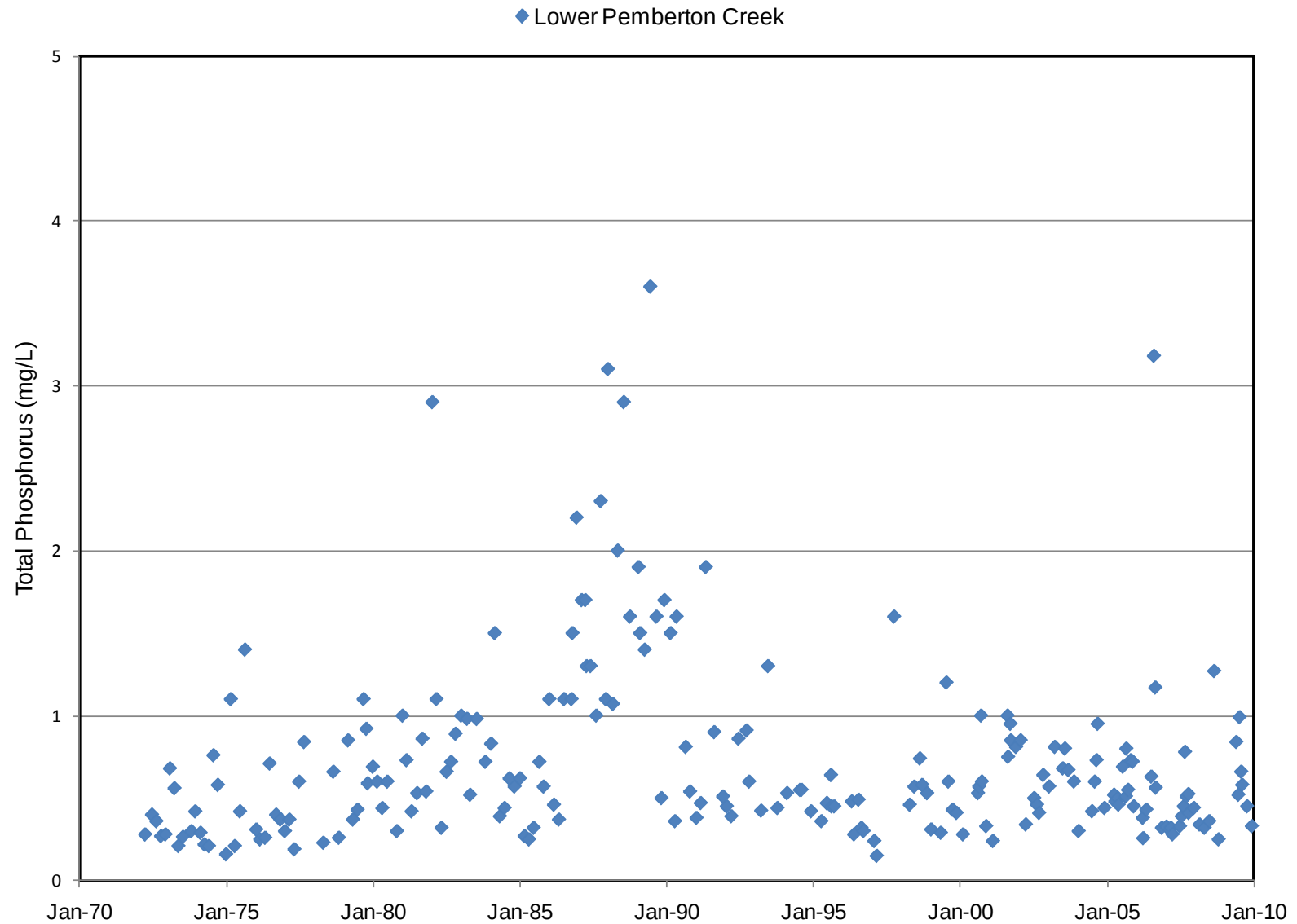


Figure 2-39a
Plot of Total Phosphorus at Lower Pemberton Creek Station (1970 to 2010)

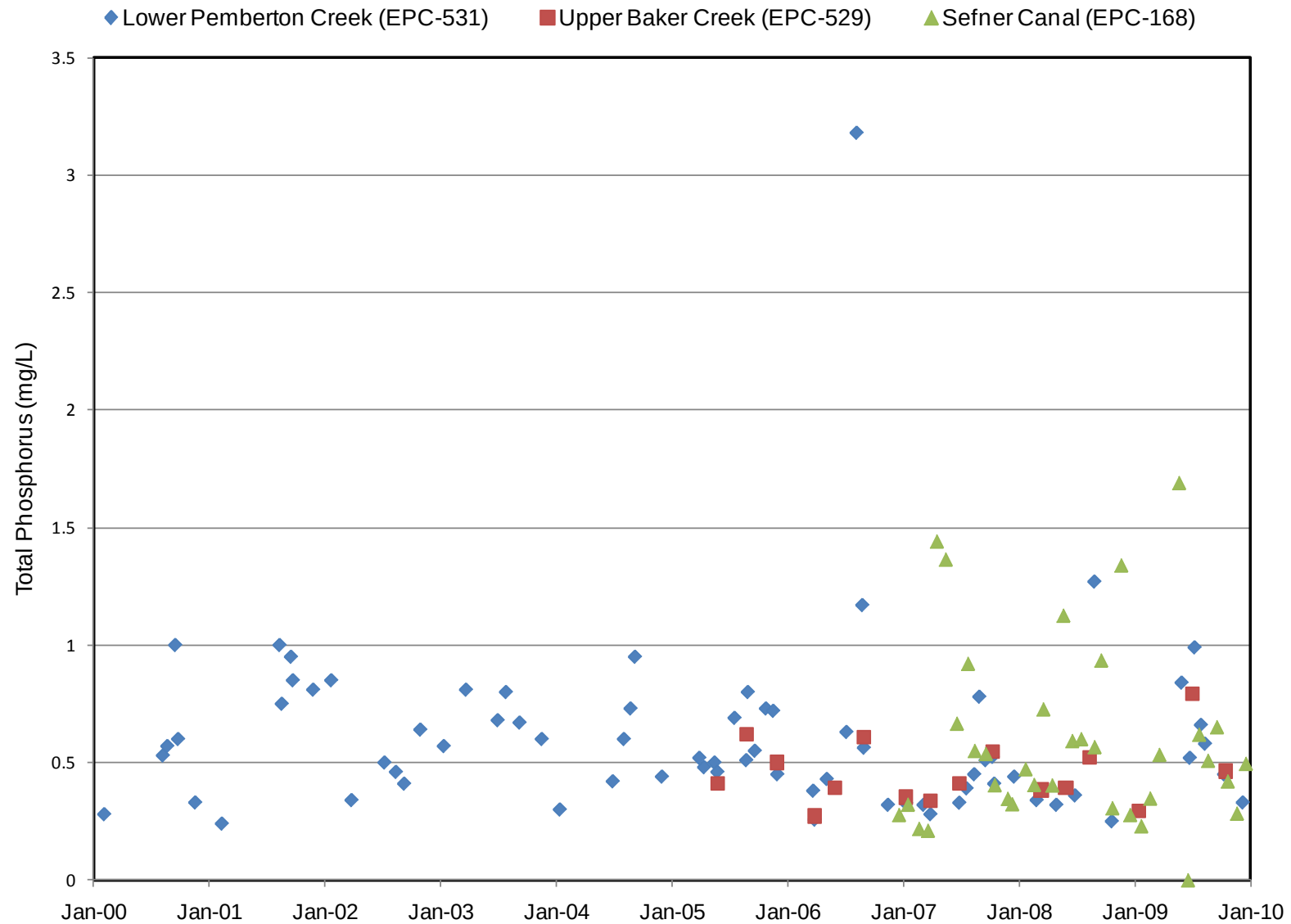


Figure 2-39b

Plot of Total Phosphorus at Lower Pemberton Creek Station, Upper Baker/Flint Creek Station and the Sefner Canal (2000 to 2010)

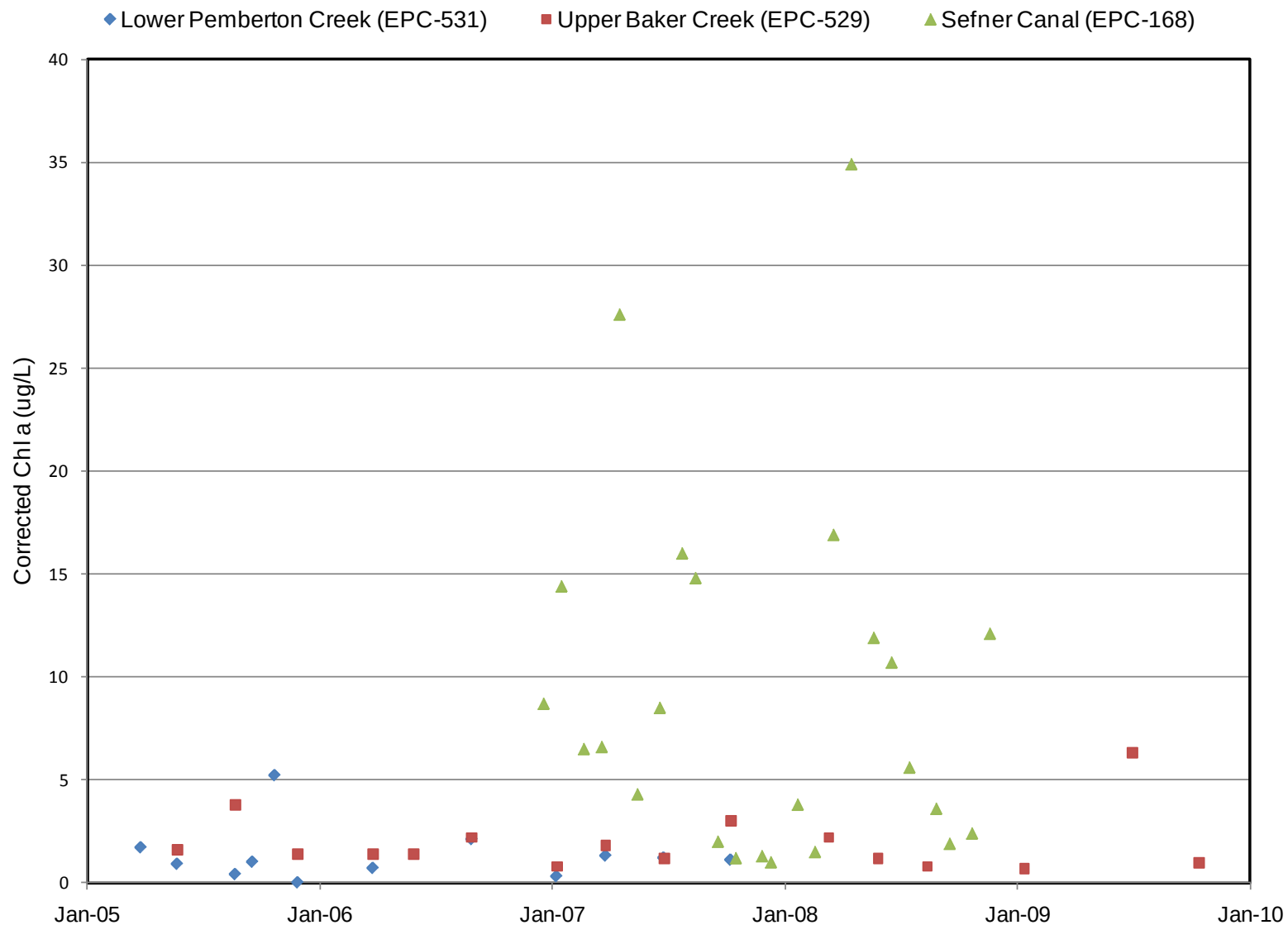


Figure 2-40

Plots of Chlorophyll a on Pemberton Creek, Upper Baker/Flint Creek Station and Sefner Canal

3.0 BIOLOGICAL DATA ASSESSMENT

The FDEP utilizes two standard approaches for assessing streams for biological health. These include the SCI, a composite macroinvertebrate index, and a screening tool or rapid assessment called BioRecon.

3.1 THE STREAM CONDITION INDEX (SCI)

To develop the SCI score, 20 dipnet sweeps are conducted from the most productive habitats in a 100-meter reach of the stream. Organisms collected in these sweeps are preserved and placed in containers according to standard procedures and transported to the laboratory for processing and analysis. The species identified, the counts and the abundance of these organisms are then used to calculate 10 biological metrics that have been shown to respond predictably to human disturbance. The metrics are:

- Number of total taxa
- Number of long lived taxa, those that require more than 1 year to complete their lifecycle,
- Number of Ephemeroptera (mayflies) taxa,
- Number of Tricoptera (caddisflies) taxa,
- Number of Florida sensitive taxa
- Number of clinger taxa
- Percent dominant taxon
- Percent Tanytarsini
- Percent very tolerant taxa,
- Percent filterers.

3.2 BIORECON

BioRecon is the screening tool version of the SCI that is intended to rapidly assess a site to prioritize it for more intensive sampling. For BioRecon, only four dipnet sweeps are performed of the most productive habitats. BioRecon also differs from an SCI sampling effort in that the organisms are sorted in the field and relative species abundance is recorded on the BioRecon Field Sheet. While the protocol is intended to bypass the laboratory procedure, samples are typically taken of each taxa found and are verified in the laboratory.

The FDEP has established thresholds specific to this method for each region for each of six calculated metrics (a subset of the 10 metrics used in the SCI). These include:

- Number of total macroinvertebrate species (taxa)
- Number of long lived taxa, those that require more than 1 year to complete their life cycle
- Number of sensitive taxa
- Number of clinger taxa
- Number of Ephemeroptera (mayflies) taxa
- Number of Trichoptera (caddisflies) taxa.

3.3 BIOLOGICAL EVALUATIONS OF BAKER CREEK, MILL CREEK, AND SPARKMAN BRANCH

3.3.1 BAKER CREEK (WBID 1522C)

The only biological evaluation found for the lower channelized reach of Baker Creek was conducted on February 18, 1998. FDEP described the site as follows, *“The riparian zone is limited in the immediate area, and the streambed appears to have been dredged in the past. The streambed consists of fine sand and silt, and there is very little instream habitat for Macroinvertebrates.”* The results of the BioRecon were as follows: *“This site on Baker Creek failed all three measurements of the Biorecon. This indicates that the stream did not support a healthy macroinvertebrate community and did not meet its designated use at the time of sampling.”*

During the same time period as the BioRecon on lower Baker Creek, a BioRecon was conducted on Pemberton Creek near its confluence with Baker Creek. FDEP staff described the site as follows: *“There is abundant instream habitat for macroinvertebrate colonization. The stream flows rapidly, and there are rock riffles in which water velocity is 1 m/s or more.”* The results of the BioRecon were as follows: *“This site on Pemberton Creek passed two of the measurements of the BioRecon. This indicates that the stream supported a fairly healthy macroinvertebrate community and met its designated use at the time of sampling.”*

In recent years, three SCI evaluations were conducted in the lower reaches of Pemberton Creek prior to where the more natural stream had its confluence with the channelized area

of Lower Baker Creek. The system had a diversity of species and received two “excellent” rankings and one “good” ranking under the SCI 1992 system (Table 3-1). The taxa identified in Baker Creek during the SCI efforts are listed in Appendix B.

Table 3-1. SCI Data from Samples Taken in Baker Creek (Flint Creek South WBID 1522D)

		# of Taxa	# of EPA Taxa	# of Chir Taxa	% Diptera	FL Index Score	% Filter Feeders	% Dom Taxon	SCI
24030079	7/31/96	25	10	4	17.7	15	30	26	27 Excellent
24030079	11/20/2002	20	3	3	13.6	8	29	17	23 Good
24030079	1/9/2003	21	4	7	42.3	9	19	4	27 Excellent

Notes: Tabular data summarizes raw data obtained from FDEP

Source: FDEP, 2005 and raw data obtained from FDEP, 2011

3.3.2 MILL CREEK (WBID 1542A)

FDEP biologists have attempted to conduct BioRecons at Mill Creek, but have been unable to find flowing water in the system since the WWTP discharge was routed away from the creek in 1997. During the time of plant operation, inspections were conducted in 1984 and 1991. The species list is provided in Appendix B.

3.3.3 SPARKMAN BRANCH (WBID 1561)

ATM obtained FDEP raw data for biological investigations of Sparkman Branch that show that a BioRecon was conducted on Sparkman Branch in August 1998 that was later followed up with an SCI in December 2002. Appendix G of the Cycle 1 Water Quality Assessment Report (FDEP, 2005) also reports the results of a 1998 SCI for Sparkman Branch. Table 3-2 summarizes the BioRecon results and Table 3-3 summarize the SCI events. The macroinvertebrate taxa lists from these sampling events show a good diversity of organisms, especially considering the intermittent flow regime of the creek. The site was identified as healthy for the 1998 sampling as well as the 2002 sampling.

Table 3-2. BioRecon Data from Samples Taken in Sparkman Branch (WBID 1561)

STORET Station	Date	# of Taxa Score (healthy >12)	FL Index Score (healthy >8)	# of EPT Taxa Score (healthy >4)	Overall Evaluation
24030041	8/27/98	20 passed	10 passed	4 passed	Healthy

Notes: Tabular data summarizes raw data obtained from FDEP

Source: FDEP, 2005 and raw data obtained from FDEP, 2011

Table 3-3. SCI Data from Samples Taken in Sparkman Branch (WBID 1561)

STORET Station	Date	# of Taxa	# of EPA Taxa	# of Chir Taxa	% Diptera	FL Index Score	% Filter Feeders	% Dom Taxon	SCI
24030041	8/27/98	21	5	4	8.8	11	6.4	45.6	23 Good
24030041	12/2/02	27	4	7	18.9	9	14.6	6.6	29 Excellent

Notes: Tabular data summarizes raw data obtained from FDEP

Source: FDEP, 2005 and raw data obtained from FDEP, 2011

3.4 **CONCLUSIONS FROM THE BIOLOGY**

The biological data identifies that Baker Creek (the channelized portions prior to entering Lake Thonotosassa) was not meeting its designated use in 1998, which may have been a result of physical modifications or water quality issues. On the more natural portions of the creek upstream (Pemberton Creek) the system is healthy. No data are available for Mill Creek due to limited periods of flow, while Sparkman Branch was deemed healthy.

4.0 RECOMMENDED PATH FORWARD

The purpose of the analyses presented in Sections 2 and 3 was to help identify the appropriate path forward for Baker Creek (WBID 1522C), Mill Creek (WBID 1542A), and Sparkman Branch (WBID 1561). As stated in Section 1, The MOA between FDEP and the Tampa Stakeholders included specific work tasks to guide determination of the category for the path forward. This section will outline the recommended path forward and summarize the findings from the analyses for each WBID.

4.1 BAKER CREEK (WBID 1522C)

As the analyses showed, the Baker Creek WBID is a highly modified channelized drainage to Lake Thonotosassa. The conditions where the samples were taken may be more representative of backwater conditions of Lake Thonotosassa versus a natural stream segment. The water quality within the more upstream natural reaches is good, and locally these waters are meeting their designated uses. Conditions in Seffner Canal indicate that this portion of the drainage to Baker Creek may have water quality issues that need to be addressed. Additionally, the data show that Lake Thonotosassa is currently impaired, and a TMDL should be developed that accurately identifies if load reductions are needed within the upstream reaches and where the sources appear to be coming from. This analysis should address what is coming into Baker Creek and Lake Thonotosassa from Seffner Canal. Therefore, the recommendation is to develop a TMDL for Lake Thonotosassa dealing with the upstream reaches to assure downstream protection.

The following provides a summary of key findings from Sections 2 and 3.

1. The station location does not represent natural stream flow conditions but rather a channelized backwater area of Lake Thonotosassa.
2. Correlation analyses did not identify any statistically significant relationship between nutrients and DO or nutrients and Chl *a*.
3. Algal productivity is driven primarily by local hydrology with algal blooms occurring during periods of near zero flow.
4. The system has undergone extensive physical modification and is channelized and dredged.

5. There is only limited biological data. But the available data indicates that the system may be impaired biologically.
6. The upstream more natural segments, i.e., Lower Pemberton Creek, show healthy biology.
7. The water quality within the natural segments upstream was good with more natural levels of organic and inorganic nitrogen.
8. Seffner Canal appears to have some potential water quality issues associated with its hydrologic modification or other sources.
9. Comparison of the data to the proposed EPA numeric nutrient criteria show that the nitrogen levels within Baker Creek are below the criteria, while the phosphorus levels violate the criteria. The phosphorus levels most likely reflect typical Bone Valley concentrations.

4.2 MILL CREEK (WBID 1542A)

The Mill Creek WBID is a highly modified channelized drainage for Plant City. There is an upstream NPDES discharge at the headwaters. Based upon the analyses, there does appear to be some level of local anthropogenic impact upon the system. The data from downstream identifies that there do not appear to be downstream impacts from the drainage out of Mill Creek. The highly intermittent modified nature of the system would indicate that a TMDL may not be needed to be locally protective, but a assessment should be performed to determine the source of the low DO and inorganic nitrogen and a determination made of what can be done to reduce the levels of discharge to the creek. A specific focus of the study should be the characteristics of the NPDES discharge at the headwaters of the creek.

The following provides a summary of key findings from Sections 2 and 3.

1. Mill Creek is a highly intermittent stream that has limited flow.
2. The system is highly modified and serves as drainage for Plant City.
3. Correlation analyses identified a relationship between high flow and low DO, indicating some wet weather source that is creating oxygen demand within the stream or is a source of low DO water.
4. No biological assessment data were available due to local FDEP staff being unable to find flowing conditions.
5. Locally elevated inorganic nitrogen levels are found in the data.

6. Comparison of the data to the proposed EPA numeric nutrient criteria show that the nitrogen and phosphorus levels are below the criteria.
7. A NPDES-permitted point source discharge is located at the headwaters of the creek.

4.3 SPARKMAN BRANCH (WBID 1561)

The recommended path forward for Sparkman Branch based upon the analyses is a TNN at this time per EPA, and a reclassification of this waterbody to an appropriate Category 4 designation. While much of the analyses presented in Sections 2 and 3 indicate that a 4c category may be appropriate, with the limited water quality and biological data, a conclusive determination that there are no anthropogenic impacts within the system cannot be made at this time. Therefore, it may be more appropriate to move to a reclassification of the water body as Class 4d, i.e., that the system is impaired based upon the present DO standard, but that no causative pollutant can be identified. The information presented herein does not support that any nutrient load reduction will have an appreciable impact upon the dissolved oxygen conditions, and that it appears that the nutrient levels within the system are from natural sources. The following provides a summary of key findings from Sections 2 and 3.

1. The available data within the system is highly limited and, for a proper assessment of the system, multiple years of data are needed.
2. There are only limited recent biological data. But the available data indicates that the system is biologically healthy.
3. Correlation analyses did not identify any statistically significant relationship between nutrients and DO, either using nutrient concentrations or loads.
4. Assessment of the nitrogen species points toward nitrogen within the system being from natural sources such as wetlands due to the high levels of organic nitrogen, the low levels of inorganic nitrogen, and the correlations between organic nitrogen and color.
5. Comparison of the measured DO within Sparkman Branch and a comparable higher order intermittent blackwater stream deemed healthy by FDEP showed similar levels of DO, identifying that the low DO values, on their own, do not necessarily point to the system being impaired by anthropogenic sources.

5.0 WORKS CITED

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APPENDIX A

Memorandum of Agreement

EXHIBIT A

MEMORANDUM OF AGREEMENT

The purpose of this memorandum is to outline agreements made between the Florida Department of Environmental Protection (FDEP) and the Parties working on the Tampa Bay Tributary Total Maximum Daily Load (TMDL) challenge. This memo outlines agreements made on a waterbody identification (WBID) basis on the pathways forward to resolution of the TMDLs under challenge and currently in abeyance.

For each WBID, the following outlines the determination made between the Parties and FDEP in relation to the path forward. Additionally, the timelines for completion of deliverables (where applicable) and the specific work tasks to complete the deliverables are provided. The potential outcomes for each WBID include the following:

- I. TMDL for nutrients and/or biochemical oxygen demand (BOD) with potential for revised dissolved oxygen (DO) target using regional DO criteria
- II. Class III Limited re-designation
- III. Physical or habitat restoration
- IV. TMDL not needed (TNN)

Specific work tasks outlined below will lead to the determination of the category for the path forward. For waterbodies that have significant historical physical modifications, it may be determined that trying for a Class III Limited designation may be the appropriate path forward. Additionally, where it is determined that the WBID is showing low DO values, but no direct impact from nutrient enrichment can be found either through assessment of primary productivity or other mechanisms, then the waterbody may be considered for TNN status. Finally, where data indicate that load reductions will achieve restoration of the designated use of the WBID, then the path to a final TMDL will be defined.

The deliverables outlined below will either define the final outcome, or will outline steps to reach the final outcome. If the determination is Option II, III, or IV, the report will outline and support the finding. The timeline for completion of the Class III Limited re-designation or the habitat restoration cannot be identified under this process and will be identified at a later time. If it is determined that Option I is the pathway (a revised TMDL needs to be developed), the report will outline the work to be done to complete the TMDL. The timeline for the development of the TMDLs will be at latest December 31, 2011 for all waterbodies where a determination is made to move forward with a revised TMDL.

Trout Creek (1455)

Determination:

- This WBIDs will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors within Trout Creek against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine the high chlorophyll a (Chl a) measurement to try to determine the potential cause of the apparent anomalous measurement.
- Look at other data that may be available upstream to determine if there are distinct differences in the upstream and downstream conditions to decide if splitting the WBID makes sense.
- Examine Stream Condition Index (SCI) data to determine level of biological health.
- Examine more recent data from the Environmental Protection Commission of Hillsborough County (EPCHC) to see conditions in recent years. Specifically, examine if there are three consecutive years after 2007 that are below the impairment threshold to support a delisting for nutrients.
- Provide WBID Assessment Report outlining path forward with any future timelines.

Baker Creek (1522C), Mill Creek (1542A), and Spartman Branch (1561)

Determination:

- These WBIDs will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for each WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors within Baker Creek, Mill Creek, and Spartman Branch against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine how representative the Baker Creek station is of the inflowing waters versus being representative of conditions in Lake Thonotosassa.
- Examine Pemberton Creek DO values in relation to measurements in Baker Creek.
- Examine the local issues within Mill Creek to determine potential local and downstream impacts due to the discharge from the National Pollutant Discharge Elimination System (NPDES) permittee Crystals International.
- Examine potential for determining the downstream protective value (DPV) approach for Lake Thonotosassa as possible solution.
- Examine SCI data (if available) to determine level of biological health.
- Examine more recent data from EPCHC to see conditions in recent years.
- Review Mill Creek and Spartman Branch separate from Baker Creek.
- Provide WBID Assessment Report outlining path forward with any future timelines.

Two-Hole Branch (1489)

Determination:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for each WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks

- Examine more closely the available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors within Two-Hole Branch against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine SCI data if available to assess biological health.
- Provide WBID Assessment Report outlining path forward with any future timelines.

Channelized Stream (1483)

Determination:

- As no Parties participating within the group have specific interests within this WBID, it will be removed from the challenge
- FDEP will deal with other Parties on the TMDL.
- FDEP will examine the TMDL report to remove the reference to Hillsborough County and Florida Department of Transportation (FDOT) from the list of municipal separate storm water sewer system (MS4) permittees because there are no MS4 responsibilities within this WBID.
- Hillsborough County will withdraw the challenge for Channelized Stream by February 28, 2011.

Tampa Bypass Canal Tributary (1536C)

Determination:

- This WBID will undergo a localized evaluation of conditions at the site to determine potential for Class III Limited designation. Also, a more detailed assessment of potential sources will be evaluated to define if a TMDL is needed to address specific known sources. This more localized work will be completed in conjunction with an evaluation of potential causes of low DO. Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely the available data on DO relative to hydrology and other potential factors causing the low DO values.

- Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine SCI data if available to assess biological health.
- Review sampling field sheets to determine hydrologic conditions during sampling.
- Conduct assessment of sources within the WBID and examine sources against local data to assess nutrient species.
- Meet with Hillsborough County to do a detailed infield assessment.
- Examine need for additional monitoring.
- Provide WBID Assessment Report outlining path forward with any future timelines.

Sweetwater Creek (1516) and Brushy Creek (1498)

Determination:

- FDEP discussed the potential for withdrawing these TMDLs with EPA at their regularly scheduled conference call on October 12, 2010. EPA responded that at this time they will not withdrawal the TMDLs for Sweetwater Creek and Brushy Creek.
- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks: (if TMDLs not withdrawn)

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine SCI data to determine level of biological health.
- Examine more recent data to see conditions in recent years.
- Provide WBID Assessment Report outlining path forward with any future timelines.

Lake Tarpon Canal (Freshwater) (1541B)

Determinations:

- Pinellas County will identify if it is interested in pursuing a Class III Limited designation.
- If Pinellas County decides not to pursue reclassification, then this WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- Pinellas County Recommendation (based upon completion of Class III Limited feasibility assessment) – 02/15/11
- WBID Assessment Report (optional)– 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine SCI data to determine level of biological health.
- Examine more recent data to see conditions in recent years.
- Review Lake Tarpon pollutant load reduction goals (PLRG) for use in TMDL development
- Examine data on DO within Brooker Creek, which was recently identified as TNN, to determine if similar condition exists for Lake Tarpon Canal.

Alligator Lake (1574A) and Alligator Creek (1574B)

Determinations:

- Alligator Lake
 - o Complete data analyses.
 - o FDEP and Pinellas County will make determination on desired path forward for Alligator Lake designation following analysis of data.
- Alligator Creek
 - o WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- Alligator Lake Determination – 02/15/11
- Alligator Creek WBID Assessment Report – 02/28/11

Work Tasks:

- Alligator Lake
 - o Complete analysis of recent data collected in August and September.
 - o Determine appropriateness of weir data to represent the lake as a whole.
 - o Examine recent data in relation to total nitrogen (TN) target to determine if TNN designation appropriate based upon recent data.
 - o Meet with FDEP and make determination on path forward.
- Alligator Creek
 - o Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
 - o Compare low DO values and other key water quality factors, against data from adjacent WBIDs with low DO that are currently not listed as impaired.
 - o Examine SCI data to determine level of biological health.
 - o Examine more recent data to see conditions in recent years.
 - o Provide WBID Assessment Report outlining path forward with any future timelines.

Bellows Lake (1579A) and Bellows Lake Outlet (1579)

Determinations:

- Bellows Lake
 - o DEP will provide Scope of Work for Paleolimnologic Study to Hillsborough County for review.
 - o Following completion of the Paleolimnologic Study, a path forward will be developed by FDEP and Hillsborough County based upon analysis of new data. An approach document will be developed with schedule and detailed approach to complete the TMDL once paleolimnologic data is received.
- Bellows Lake Outlet
 - o Bellows Lake Outlet will be determined to be in compliance upon completion of the Bellows Lake TMDL.

Timeline/Deliverable:

- Paleolimnologic Study Report – 6/30/11
- Bellows Lake TMDL – 9/30/11

Work Tasks:

- Work tasks to be developed between FDEP and Hillsborough County

Allen Creek Tidal (1604)

Determinations:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Examine available biological data/information to identify biological health of system
- Examine more recent data to see conditions in recent years.
- Look at nitrogen species compared to salinity levels to help isolate potential sources.
- Document timeframes for septic tank removal and restoration projects to see if they align with recent water quality improvements
- Examine the measured DO values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.

Bishop Creek Tidal (1569)

Determination:

- This WBID will undergo an evaluation of the data to determine if the high nutrient levels measured are a local condition, i.e., not coming from upstream sources. The evaluation

will lead to the determination of the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Initial Assessment
 - o Examine data to determine if the higher nutrient levels are local and not coming from upstream sources.
 - o Potentially do some coordinated sampling in the upstream (freshwater) and downstream (estuarine) areas to see if the upstream watershed is the source or is it a more local issue, i.e., associated with mangroves in old sampling location.
- Further Assessment (if Initial Assessment does not identify path forward).
 - o Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
 - o Examine available biological data/information to identify biological health of system
 - o Examine more recent data to see conditions in recent years.
 - o Examine the measured DO values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.

Mullet Creek Tidal (1575)

Determinations:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine the one year (2002) where Chl a values were high to determine any issues with data.
- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Examine available biological data/information to identify biological health of system
- Examine more recent data to see conditions in recent years.
- Evaluate the upstream freshwater area measurements against historical downstream estuarine measurements by Pinellas County.
- Examine the measured DO values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.

Lake Tarpon Canal (marine) (1541A)

Determinations:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
- Examine available biological data/information to identify biological health of system
- Examine more recent data to see conditions in recent years.
- Evaluate the potential upstream freshwater sources to determine potential for impacts on marine section (i.e., Lake Tarpon freshwater resolution solving issue).
- Examine the measured DO and Chl a values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.

Double Branch Tidal (1513)

Determination:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values. Examine potential local wetland contributions.
- Examine potential contributions from local point sources in watershed.
- Examine available biological data/information to identify biological health of system
- Examine more recent data to see conditions in recent years.
- Evaluate the upstream freshwater area measurements against downstream measurements if available.
- Examine the measured DO values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.

Moccasin Creek Tidal (1530),

Determination:

- This WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBID.

Timeline/Deliverable:

- WBID Assessment Report – 02/28/11

Work Tasks:

- Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values. Examine potential local wetland contributions.
- Examine potential contributions from local point sources in watershed.
- Examine available biological data/information to identify biological health of system
- Examine more recent data to see conditions in recent years.
- Evaluate the upstream freshwater area measurements against downstream measurements if available.
- Examine the measured DO values against other tidal tributaries that are within more pristine areas. Look at TN concentration comparisons.
- Examine possible link between when the ponds are discharging and the data results. Also need to parse data for times of fresh versus marine conditions.

Cross Canal (1625)

Determination:

- This WBID will be examined to determine if it will be utilized as a pilot study for the Class III Limited designation.
- Pinellas County will make determination on working for Class III Limited status.
- Possibly utilize data coming from Watershed Study.

Timeline/Deliverable:

- Pinellas County Recommendation (based upon completion of Class III Limited feasibility assessment) – 02/15/11

Work Tasks:

- None at this time

Bullfrog Creek (1666A)

Determination:

- FDEP will utilize new data and examine the relationships previously developed to see if relationships hold. FDEP will also provide explanation for the lack of relationship using data from the entire period of record.
- If the relationships hold, then investigations will be done for the development of alternative Chl a target for the tidal creek segment.

- If relationships do not hold, this WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report will be provided that outlines the findings for the WBIDs.

Timeline/Deliverable:

- Revised analysis completed by FDEP - 12/15/10
- Evaluation of FDEP Methodology – 2/15/11
- Chl a Target Determination Report (if relationships hold) – To be determined
- WBID Assessment Report (if relationships do not hold) – 02/28/11

Work Tasks:

- Chl a Target Determination
 - Examine tidal creek data to identify potential Chl a targets as they relate to the biotic health of these systems
- WBID Assessment Report
 - Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
 - Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
 - Examine available biological data to assess biological health.
 - Examine more recent data to see conditions in recent years.
 - Given the appropriateness of the empirical relationships derived by FDEP and the proposed Chl a targets, estimate critical loads to meet the Chl a targets.

Cockroach Bay (1778)

Determination:

- FDEP will utilize new data and examine the relationships previously developed to see if relationships hold. FDEP will also provide explanation for the lack of relationship using data from the entire period of record.
- If the relationships hold, then investigations will be done for the development of alternative Chl a target for the tidal creek segment.
- If relationships do not hold, this WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report outlining the findings for the WBIDs will be provided.

Timeline/Deliverable:

- Revised analysis completed by FDEP - 12/15/10
- Evaluation of FDEP Methodology – 2/15/11
- Chl a Target Determination Report (if relationships hold) – To be determined
- WBID Assessment Report (if relationships do not hold) – 02/28/11

Work Tasks:

- Chl a Target Determination
 - Examine tidal creek data to identify potential Chl a targets as they relate to the biotic health of these systems

- WBID Assessment Report
 - o Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
 - o Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
 - o Examine available biological data to assess biological health.
 - o Examine more recent data to see conditions in recent years.
 - o Given the appropriateness of the empirical relationships derived by FDEP and the proposed Chl a targets, estimate critical loads to meet the Chl a targets.

Lower Rocky Creek (1563)

Determination:

- FDEP will utilize new data and examine the relationships previously developed to see if relationships hold. FDEP will also provide explanation for the lack of relationship using data from the entire period of record.
- If the relationships hold, then investigations will be done for the development of alternative Chl a target for the tidal creek segment.
- If relationships do not hold, this WBID will undergo a full evaluation to determine the path forward (see path forward options listed above). Following completion of the evaluation, a report outlining the findings for the WBIDs will be provided.

Timeline/Deliverable:

- Revised analysis completed by FDEP - 12/15/10
- Evaluation of FDEP Methodology – 2/15/11
- Chl a Target Determination Report (if relationships hold) – To be determined
- WBID Assessment Report (if relationships do not hold) – 02/28/11

Work Tasks:

- Chl a Target Determination
 - o Examine tidal creek data to identify potential Chl a targets as they relate to the biotic health of these systems
- WBID Assessment Report
 - o Examine more closely all available data on DO relative to hydrology and other potential factors causing the low DO values.
 - o Compare low DO values and other key water quality factors against data from adjacent WBIDs with low DO that are currently not listed as impaired.
 - o Examine available biological data to assess biological health.
 - o Examine more recent data to see conditions in recent years.
 - o Given the appropriateness of the empirical relationships derived by FDEP and the proposed Chl a targets, estimate critical loads to meet the Chl a targets.

Coffee Pot Bayou (1700), Smacks Bayou (1683)

Determination:

- Will examine the potential for these two WBIDs to be taken off the list (i.e., TNN) based upon recent TN and DO data and trends, historic restoration activities within these two WBIDs, and the use of inappropriate canal data (Smacks Bayou) to identify impairment.

Timeline/Deliverable:

- Smacks Bayou and Coffee Pot Bayou Determination - 2/28/11

Work Tasks:

- Smacks Bayou and Coffee Pot Bayou
 - o Examination of data within Smacks Bayou and Coffee Pot Bayou to determine if those waterbodies should be taken off the impaired list for DO based on use of canal data and due to watershed restoration activities that have taken place previously.
 - o A determination report will be developed that will outline the findings for these two WBIDs.

APPENDIX B

Taxa Information from Biological Sampling

APPENDIX B-1 – TAXA LIST FROM BAKER CREEK SCI EVENTS

<i>Amnicola</i>	<i>Lymnaeidae</i>
<i>Ancylidae</i>	<i>Microcylloepus pusillus</i>
<i>Argia</i>	<i>Nais communis complex</i>
<i>Argia sedula</i>	<i>Nectopsyche</i>
<i>Atrichopogon</i>	<i>Nectopsyche exquisita</i>
<i>Baetis intercalaris</i>	<i>Oecetis</i>
<i>Bivalvia</i>	<i>Oecetis persimilis</i>
<i>Caenis</i>	<i>Oniscidae</i>
<i>Cheumatopsyche</i>	<i>Parachironomus</i>
<i>Chironomidae</i>	<i>Paratanytarsus</i>
<i>Corbicula fluminea</i>	<i>Pentaneura inconspicua</i>
<i>Dipsocoridae</i>	<i>Phaenopsectra punctipes grp.</i>
<i>Dubiraphia vittata</i>	<i>Sphaeriidae(mollusca)</i>
<i>Dugesia tigrina</i>	<i>Polypedilum flavum</i>
<i>Eclipidrilus palustris</i>	<i>Polypedilum flavum</i>
<i>Enallagma</i>	<i>Polypedilum illinoense grp.</i>
<i>Erythemis</i>	<i>Polypedilum scalaenum grp.</i>
<i>Gastropoda</i>	<i>Pseudocloeon</i>
<i>Heptageniidae</i>	<i>Pyrgophorus platyrachis</i>
<i>Heteroptera</i>	<i>Rheotanytarsus exiguus grp.</i>
<i>Hipponicidae</i>	<i>Rheotanytarsus pellucidus</i>
<i>Hyaella azteca</i>	<i>Simulium</i>
<i>Hydrobiidae</i>	<i>Stenelmis</i>
<i>Hydropsyche</i>	<i>Stenochironomus</i>
<i>Hydroptila</i>	<i>Maccaffertium exiguum</i>
<i>Limnodrilus hoffmeisteri</i>	<i>Triaenodes</i>
<i>Lumbriculus variegatus</i>	<i>Trichoptera</i>
	<i>Tricorythodes albilineatus</i>

APPENDIX B-2 – TAXA LIST FROM MILL CREEK INSPECTIONS

<i>Ablabesmyia mallochi</i>	<i>Goeldichironomus</i>	<i>Physa</i>
<i>Ablabesmyia rhamphe</i> grp.	<i>holoprasinus</i>	<i>Placobdella papillifera</i>
<i>Argia moesta</i>	<i>Graphoderus liberus</i>	<i>Polycentropus cinereus</i>
<i>Argia sedula</i>	<i>Hagenius brevistylus</i>	<i>Polypedilum flavum</i>
<i>Pseudocloeon propinquum</i>	<i>Hesperocorixa</i>	<i>Polypedilum fallax</i>
<i>Acerpenna pygmaea</i>	<i>Hetaerina titia</i>	<i>Polypedilum illinoense</i> grp.
<i>Belostoma</i>	<i>Hydropsyche</i>	<i>Procambarus alleni</i>
<i>Belostoma testaceum</i>	<i>Ischnura</i>	<i>Prostoma graecense</i>
<i>Boyeria vinosa</i>	<i>Ischnura posita</i>	<i>Ranatra</i>
<i>Caenis</i>	<i>Ischnura ramburi</i>	<i>Rheocricotopus robacki</i>
<i>Cheumatopsyche</i>	<i>Limnodrilus hoffmeisteri</i>	<i>Rheotanytarsus exiguus</i>
<i>Chimarra</i>	<i>Macromia taeniolata</i>	grp.
<i>Chironomidae</i>	<i>Melanoides tuberculata</i>	<i>Stenacron interpunctatum</i>
<i>Chironomus decorus</i>	<i>Micromenetus floridensis</i>	<i>Stenelmis</i>
<i>Corydalis cornutus</i>	<i>Mooreobdella tetragon</i>	<i>Stenochironomus hilaris</i>
<i>Cricotopus bicinctus</i>	<i>Nectopsyche exquisita</i>	<i>Maccaffertium exiguum</i>
<i>Cricotopus or orthocladius</i>	<i>Nectopsyche pavida</i>	<i>Stylurus plagiatus</i>
<i>Dineutus</i>	<i>Neoperla clymene</i>	<i>Tanytarsus</i>
<i>Dromogomphus spinosus</i>	<i>Neurocordulia</i>	<i>Thienemanniella xena</i>
<i>Dubiraphia</i>	<i>alabamensis</i>	<i>Triaenodes</i>
<i>Empididae</i>	<i>Nyctiophylax</i>	<i>Tribelos fuscicornis</i>
<i>Enallagma</i>	<i>Oecetis</i>	<i>Tropisternus</i>
<i>Enallagma coecum</i>	<i>Oecetis inconspicua</i>	<i>Tropisternus lateralis</i>
<i>Enallagma weewa</i>	<i>Orthemis ferruginea</i>	<i>nimbatus</i>
<i>Endochironomus nigricans</i>	<i>Orthoclaadiinae</i>	<i>Zygoptera</i>
<i>Enochrus blatchleyi</i>	<i>Palaemonetes paludosus</i>	

APPENDIX B-3 – TAXA LIST FROM SPARKMAN BRANCH SCI

Ablabesmyia mallochi

Ancylidae

Argia

Bivalvia

Caenis

Ceratopogonidae

Cheumatopsyche

Chironomidae

Dero

Dero digitata complex

Dero pectinata

Enallagma

Enallagma coecum

Gastropoda

Glossiphoniidae

Hyalella azteca

Microcylloepus pusillus

Micromenetus dilatatus

Neotrichia

Physa

Platyhelminthes

Polypedilum illinoense grp.

Procladius

Prostoma

Rheotanytarsus exiguus grp.

Rheotanytarsus pellucidus

Slavina appendiculata

Stenelmis

Tanytarsus

Triaenodes perna

Tribelos jucundum

Trichoptera