

WATER SEGMENT ASSESSMENT
BRUSHY CREEK (WBID 1498)
SWEETWATER CREEK (WBID 1516)

TAMPA BAY (GROUP 1)
COASTAL OLD TAMPA BAY TRIBUTARIES PLANNING UNIT
TAMPA BAY WATERSHED (HUC 03200106)
HILLSBOROUGH COUNTY, FLORIDA

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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 Sweetwater Creek water segment [Water Body ID (WBID) 1516] and Brushy Creek segment (WBID 1498) appeared on the 1998 303(d) List for DO, but not nutrients. In Cycle 1 (2000 to 2005), FDEP placed Brushy Creek on the Planning List as potentially impaired for DO. Sweetwater Creek was placed on the Verified List for DO, nutrients [based on chlorophyll a (Chl a), and nutrients (based on the historical Chl a trend). Nitrogen was identified as limiting in Sweetwater Creek. (FDEP, 2003)

In Cycle 2, Brushy Creek was verified for DO impairment based on 19 excursions of the Class III freshwater standard for DO [5.0 milligrams per liter (mg/L) of 60 measurements. The stream was listed as "not impaired" (Integrated Assessment Category 2) for Chl a and that there were insufficient data to assess the historical Chl a trend. FDEP noted that total phosphorus (TP) was the causative pollutant for the low DO observation based on regression analysis of the available data. Sweetwater Creek was also verified as impaired for DO based on 67 excursions of the standard of 107 measurements taken during the verification period. Nutrients were identified as the causative pollutant based on the Impaired Waters Rule (IWR) historical Chl a trend analysis. However, FDEP delisted Sweetwater Creek for nutrients based on Chl a because measurements showed that Chl a did not meet the listing thresholds of three consecutive years during the 2001 – 2006 verification period. However, FDEP verified the stream as impaired for nutrients based on historical Chl a because annual averages for Chl a during the verification period exceeded the annual average [3.84 micrograms per liter (µg/L)] for the historical period (1993 to 1997) by more than 50 percent for 2 years (2003 = 6.7 µg/L and 2006 = 12.0 µg/L). FDEP found that nitrogen and phosphorus are co-limiting in this stream based on a total nitrogen (TN)/TP ratio of 12.1 (FDEP, 2011).

FDEP proposed a TMDL for DO for Brushy Creek and Sweetwater Creek in June 2009 (Bailey et al., 2009). The TMDL determination used a reference approach to develop load reductions for these streams.

The most conservative and reasonable target has been determined to be the annual median TN concentration from sample stations in WBIDS that have been assessed by FDEP to be not impaired for Nutrients and Not Impaired for D.O. This concentration has been observed to be...0.75 mg/L for Brushy Creek and Sweetwater Creek. (Bailey et al., 2009)

However, FDEP also noted that:

DO can also be affected or lowered by in-stream modifications such as dredging and channelization. These processes slow down water velocity, reduce reaeration, and increase the settling of solids, thus increasing sediment oxygen demand (SOD) and lowering DO concentrations. Further analyses and monitoring must be completed to develop an appropriate, site-specific DO criterion.(Bailey et al., 2009)

Because FDEP found nitrogen to be limiting in these systems, load reductions were developed to reduce instream nitrogen concentrations to levels found in the reference streams (Table 1-1). However, recent data (2000 – 2009) for the lower portion of Sweetwater Creek agree more closely with FDEP's Cycle 1 assessment that nutrients may be co-limiting in Sweetwater Creek (median = 11.5) or limitation may vary between nitrogen (minimum ratio = 2.9) and phosphorus (maximum ratio = 36.9).

Table 1-1. Proposed Load Reductions in the 2009 FDEP TMDL Document for Brushy Creek and Sweetwater Creek

Water Segment	WBID	TN			TP
		TMDL (mg/L)	WLA	MS4s	
Brushy Creek	1498	0.75	54,794 lbs/yr	32.2%	N/A
Sweetwater Creek	1516	0.75	N/A	22.7%	N/A

Source: Bailey et al., 2009.

Written comments, and comments presented at a September 3, 2009 administrative hearing by various Stakeholders [Florida Department of Transportation (FDOT) and Hillsborough County] raised significant issues with the technical assumptions used to develop the TN TMDLs (Janicki Environmental, Inc., 2010b). Based upon those comments, FDEP postponed finalization of the TMDLs until February 2010. On September 30, 2009, EPA

proposed the FDEP TMDL (Bailey et al., 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.

FDEP revised the TMDL report for Brushy Creek and Sweetwater Creek in February 2010 (Bailey et al., 2010). This TMDL also utilized a target instream nutrient concentration approach but the targets were modified from the 2009 report. The proposed TMDLs also called for reductions in TN only. The instream TN target was changed from 0.75 mg/L to 0.87 mg/L, which lowered the load requirements to 16,000 pounds per year for the Dale Mabry wastewater treatment plant (WWTP) that discharges to Brushy Creek. The load reductions for stormwater dischargers were reduced to 16.3 percent for Brushy Creek and 19.4 percent Sweetwater Creek (Table 1-2).

Table 1-2. Proposed Load Reductions in the 2010 FDEP TMDL Document for Brushy Creek and Sweetwater Creek

Water Segment	WBID	TN			TP
		TMDL (mg/L)	WLA	MS4s	
Brushy Creek	1498	0.87	16,000 lbs/yr	16.3%	N/A
Sweetwater Creek	1516	0.87	N/A	19.4%	N/A

Source: Bailey et al., 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 biochemical oxygen demand (BOD) with potential for revised 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 Brushy Creek (WBID 1498) and Sweetwater Creek (WBID 1516), 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 against data from adjacent WBIDs with low DO that are currently not listed as impaired.
- Examine Stream Condition Index (SCI) data, where available, to determine level of biological health.
- Examine more recent data to see conditions in recent years.

1.2 CHARACTERIZATION OF WATER SEGMENT

1.2.1 BASIN AND STREAM ENVIRONMENT DESCRIPTION

The Brushy Creek and Sweetwater Creek water segments are located in the Tampa Bay (03100206) Watershed in Hillsborough County. FDEP placed both streams in the Coastal Old Tampa Bay Basins Planning Unit, which is part of the Tampa Bay Assessment Group. This group is assessed as part of FDEP's Group 1 and is currently in its third cycle (1/1/2005 – 6/30/2012). Figure 1-1 provides the location of these segments within the Coastal Old Tampa Bay Basins Planning Unit.

1.2.1.1 Brushy Creek (WBID 1498)

The Brushy Creek stream course is approximately 5.4 miles long and flows in a southwesterly direction until it reaches the upper portion of Rocky Creek. Rocky Creek continues in a southwesterly direction to Lower Rocky Creek (Channel A) and finally draining to Old Tampa Bay. There is evidence throughout the stream course of hydrologic modification and channelization (see Figure 1-2), although it appears that many areas have re-naturalized and there are significant vegetation buffers for much of the creek (see Figure 1-3). The stream contains relatively slow-moving clear tannic water flowing over a sandy bottom (see Figure 1-4 for a view of the stream where it crosses Ehrlich Road and Figure 1-5 where it crosses Gunn Highway).

The watershed that drains through WBID 1498 is 10,945 acres. The drainage area includes Brushy Creek (1498), Lake Charles Drain (1494), Brant Lake Drain (1494A), Round Lake Outlet (1478L), Drainage Canal (1478), Drainage Ditches (1509), Lake Le Clare Drain (1514) and many lake WBIDs wholly contained within the boundaries of these segments. While the IWR database (Run 42) contains data from 12 stations over the period of record, the recent period (2004 – 2009) comes from essentially three locations (called Lower, Middle, and Upper Creek in this report) and from only six stations. Of these data, the majority comes from the Lower Creek stations at the Gunn Highway crossing (see Figure 1-5 for view of stream at this location), and from 2006 to 2009, all the available stream data are from the Lower Creek from the Environmental Protection Commission of Hillsborough County (EPCHC) Station 161 (21FLHILL161).

1.2.1.2 Sweetwater Creek (WBID 1516)

The Sweetwater Creek stream course is approximately 9.1 miles long and begins at Lake Magdalene in the upper part of the WBID. The creek flows in a southwesterly direction, eventually flowing into the downstream portion of Rocky Creek. Rocky Creek continues south to Old Tampa Bay.

The stream course has been heavily modified through channelization (refer to Section 1.2.4.2 for a discussion of the hydrology and Figure 1-6 for an aerial photograph), with the lowest portion of the stream converted to a canal (Channel G and Channel H) (see Figure 1-7). While some of the course has re-naturalized and has significant vegetation buffers, most portions have little or no tree canopy or instream forested wetland.

The stream contains relatively slow-moving clear tannic water flowing over a sandy bottom. Figure 1-8 provides a view of the stream where it crosses Anderson Road, which is the site of the bulk of the Lower Creek sampling stations. Figure 1-9 shows where it crosses Gunn Highway. Figure 1-10 presents the Channel G portion of the water segment).

The Sweetwater Creek drainage area includes only the Sweetwater Creek WBID (1516). It is approximately 11,171 acres. While the IWR database (Run 42) contains data from nine stations over the period of record, these stations can be roughly grouped into four main sampling areas along the creek stream course (called Channel G/H, Lower Creek, Middle Creek, and Upper Creek in this report). Data from the Upper Creek station (112WRD 02306289) near Lake Magdalene are not available from the IWR database (Run 42) after 1982. The Middle Creek area is represented by three stations (112WRD 02306500; 21FLTPA 24040112, and 21FLWQSPHIL553US), but data from the recent period (2004 – present) are limited to 2005 and two samples from 2006. Data from the lower portion of the creek are available from 1989 to 2009 from three stations 21FLGW 22072, (21FLHILL142/21FLHILL24040102; and 21FLTPA 24030149). Of the measurements taken in the recent period (2004 – 2009), all but one were taken by EPCHC (21FLHILL142) on the upstream side of the Anderson Road crossing (see Figure 1-8 for view of stream at this location).

1.2.2 LAND USES

2009 land use data were retrieved from the shape file library of Southwest Florida Water Management District (SWFWMD) (SWFWMD, 2011) and used to prepare Figure 1-11 and Tables 1-3 through 1-5. 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 Brushy Creek (WBID 1498)

The watershed draining to Brushy Creek is over 10,900 acres and includes several water segments and lakes (see Figure 1-12). The predominant land uses are residential (56 percent) and wetlands/water (21 percent) (Table 1-3). There are no animal feeding operations or mining activities in the basin.

Table 1-3. Classification of Brushy Creek Drainage Area Land Uses in 2009

FLUCCS CODE	FLUCS DESC	Acres	% of Total
1100/1200/1300	RESIDENTIAL	6,118	55.9
1400/1500/1700	COMMERCIAL/INDUSTRIAL/INSTITUTIONAL	667	6.1
1600	MINING	0	0.0
1800	PARKS AND GOLF	393	3.6
1900/2600/3000	UNDEVELOPED AND OPEN LANDS	453	4.1
2100	CROPLAND AND PASTURELAND	82	0.8
2200	TREE CROPS	42	0.4
2300	FEEDLOTS	0	0.0
2400/2500	SPECIALTY FARMS	14	0.1
4000	UPLAND FOREST	421	3.8
5000	WATER	569	5.2
6000	WETLANDS	1,828	16.7
7000	DISTURBED LAND	0	0.0
8000	TRANSPORTATION AND UTILITIES	356	3.3
TOTAL		10,943	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.

The land uses specific to the Brushy Creek WBID (1498) itself are similarly proportioned to the larger drainage detailed in Table 1-3 except that there is an even higher proportion of

the land area devoted to residential and there is no agriculture within the segment boundaries (Table 1-4).

Table 1-4. Classification of Land Uses for the Brushy Creek WBID (only) in 2009

FLUCCS CODE	FLUCS DESC	Acres	% of Total
1100/1200/1300	RESIDENTIAL	2,367	64.6
1400/1500/1700	COMMERCIAL/INDUSTRIAL/INSTITUTIONAL	305	8.3
1600	MINING	0	0.0
1800	PARKS AND GOLF	161	4.4
1900/2600/3000	UNDEVELOPED AND OPEN LANDS	74	2.0
2100	CROPLAND AND PASTURELAND	0	0.0
2200	TREE CROPS	0	0.0
2300	FEEDLOTS	0	0.0
2400/2500	SPECIALTY FARMS	0	0.0
4000	UPLAND FOREST	3	0.1
5000	WATER	170	4.7
6000	WETLANDS	493	13.4
7000	DISTURBED LAND	0	0.0
8000	TRANSPORTATION AND UTILITIES	92	2.5
TOTAL		3,665	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 Sweetwater Creek (WBID 1516)

Unlike Brushy Creek, the Sweetwater Creek drainage area does not receive drainage from any other areas upgradient of the FDEP water segment boundary. Sweetwater Creek's watershed is approximately 11,171 acres. The predominant land uses are urban, including residential (52 percent) and commercial/industrial/ institutional (22 percent) (Table 1-5).

Wetlands and water (16.5 percent) make up the largest share of the balance of the uses.

There are no animal feeding operations or mining in the Sweetwater Creek watershed, and agricultural uses are limited to tree crops (21 acres) and some specialty farming (14 acres).

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

FLUCCS CODE	FLUCS DESC	Acres	% of Total
1100/1200/1300	RESIDENTIAL	5,804	52.0
1400/1500/1700	COMMERCIAL/INDUSTRIAL/INSTITUTIONAL	2,417	21.6
1600	MINING	0	0.0
1800	PARKS AND GOLF	181	1.6
1900/2600/3000	UNDEVELOPED AND OPEN LANDS	386	3.5
2100	CROPLAND AND PASTURELAND	0	0.0
2200	TREE CROPS	21	0.2
2300	FEEDLOTS	0	0.0
2400/2500	SPECIALTY FARMS	14	0.1
4000	UPLAND FOREST	72	0.6
5000	WATER	622	5.6
6000	WETLANDS	1,230	11.0
7000	DISTURBED LAND	8	0.1
8000	TRANSPORTATION AND UTILITIES	417	3.7
TOTAL		11,172	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 Brushy and Sweetwater Creek watersheds experience a humid, subtropical climate, with an annual rainfall of approximately 52 inches. The annual mean temperature for Hillsborough County is 72 degrees Fahrenheit (F°), and mean monthly temperatures range from a low of 60°F in January to 82°F in August. The average summer daytime high temperatures are in the 90s (°F), and the average daytime high winter temperatures are in the lower 70s. Summer humidity is often in the middle to upper 90 percent range. While winter low temperatures are typically above 40°F, the county does occasionally experience freezing temperatures that can drop into the low 20s. The wet season accounts for almost 60 percent of the rainfall total and is typically 4 months long (June – September), with high-intensity afternoon thunderstorms typical during this period. Winter rainfall comes from typically lower intensity events associated with weak cold fronts. However, some of the largest recorded rain events have occurred in the winter (e.g., 1997/1998) during El Niño years (Ayres Associates, 2007a).

The watersheds are located in the Hillsborough Valley portion of the Southwestern Florida Flatwoods ecoregion and have elevations ranging from 0 feet above sea level at the

discharge to Old Tampa Bay to 75 feet above sea level in the northern parts of these basins. 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 fine sands.

1.2.4 HYDROLOGY

1.2.4.1 Brushy Creek (WBID 1498)

Ayres Associates (2007a) completed an update to the 2001 Rocky/Brushy Creek Watershed Management Plan for Hillsborough County. That report indicates that the watershed is 55 square miles and encompasses portions in both Hillsborough and Pasco Counties. They divided the larger shed into five main drainages: Lake Ruth Drainage, Rocky Creek, Brushy Creek, Carrollwood, and Channel A. Of these, the 17.8 square mile Brushy Creek System corresponds to the drainage affecting the FDEP Brushy Creek water segment (WBID 1498) (see Section 1.2.2.1 for a discussion of the drainage and associated land uses). The FDEP water segment itself is approximately 6 square miles in area, but receives flow from several other drainages to the north and west (see Figure 1-13). The system is characterized by numerous lakes, wetlands, and depressional areas that were historically connected by groundwater and overflow through the wetlands and sloughs before draining to Old Tampa Bay through the Brushy Creek and Rocky Creek stream courses. The lakes are depressions formed by limestone dissolution sinkhole formation. Because of this, the smaller lakes and ponds tend to be round while the larger lakes were formed by the aggregation of several sinkholes. Flow is generally from north to south or southeast and then southwesterly once it reaches the Brushy Creek stream channel (Ayres Associates, 2007a).

The main channel of the Brushy Creek system originates above the FDEP water segment boundary in the Charles/Deer Lake system. This chain of lakes is approximately 5 square miles and includes eight named lakes. Flow from this subbasin historically flowed from Lake Charles to Bird Lake and thus away from Brushy Creek. However, flooding in the summer of 1979 resulted in the extension of the County Interceptor Canal to relocate this flow into Brushy Creek (WBID 1498). The canal joins the more natural Brushy Creek channel near Northdale Boulevard at the Northdale Golf & Tennis Club (Ayres Associates, 2007a).

The Brushy Creek water segment is contained in the Tampa Bay Hydrologic Unit (03100206). The U.S. Geological Survey (USGS) monitors stream flow and stage in this system in the lower portion of Sweetwater Creek, just upstream of the Gunn Highway crossing. As such, it receives flows from nearly the entire system (although USGS has not determined the drainage area for the gauge). This USGS Gauging Station 02306950 (Brushy Creek Near Citrus Park FL) is in Hillsborough County and is monitored in cooperation with the County. The period of record stretches from May 1946 to the present. From May 1946 to October 1981, only miscellaneous discharge measurements were recorded. Continuous discharge has been recorded since June 1993 together with stage.

Figure 1-14 presents a plot of daily flows from 1993 to the present. The flow signature on the chart is similar to measurements on Sweetwater Creek (see Figure 1-16). Median daily flow is also similar to Sweetwater Creek at 6.8 cubic feet per second (cfs) with flows ranging widely from no flow to almost 550 cfs in December 1997, with a standard deviation of 39 cfs. Also like Sweetwater Creek, high flow events skew the average flow (20 cfs) well above the median.

Also like several other area streams, there is considerable seasonal variation in stream discharge that follows local rainfall patterns with flows being reduced significantly in late spring. Since 1993, little or no flow (<2 cfs) was measured at the gauge in the stream for 21 percent of daily average values with the bulk of these no flow periods occurring in May and early June (Figure 1-15).

1.2.4.2 Sweetwater Creek (WBID 1516)

According to the most recent update of the watershed management plan (Ayres Associates, 2007b), the basin is “characterized by flat topography, high water tables, and many natural lakes, depressions and wetlands.” In its natural state, the lakes and streams were interconnected during storm or high water periods through overflowing lake and wetland systems to sloughs and ephemeral streams. Because this was incompatible with human development activities, the system has received significant hydrologic modification. The northern part of the watershed still contains most of the lakes, ponds, and depressions, but these are now connected by a series of channels, culverted road crossings, and control structures (Ayres Associates, 2007b).

The southern portion of the basin has also been extensively modified. The stream courses have been converted to an improved channel system with control structures that are fed by urban ditches and storm sewer systems. The drainage is primarily controlled by three major segments: Sweetwater Creek, Channel G, and Channel H. Sweetwater Creek drains over 60 percent of the watershed including the numerous lakes and wetland areas of the northern and western portions of the watershed. Major lakes include: Lake Lipsey, Lake Ellen, Bay Lake, Lake Magdalene, Lake George, Platt Lake, Bird Lake, Lake Chapman, and Lake Estes. SWFWMD conducted a stormwater study in 1983 in response to earlier flooding in the watershed (particularly in the summer of 1979). The result of the study was to expand and extend the U.S. Soil Conservation Service's (SCS) Upper Tampa Bay Watershed (UTBW) Project that began in the 1960s to include channel excavation in Sweetwater Creek, structural enhancements, and channel maintenance activities from the creek's confluence with Channel G in the south to Bird Lake in the north (Ayres Associates, 2007b).

A canal system was constructed along the southern portion of the basin in the mid-1960s as part of the UTBW Project. The canal that drains approximately 5.9 square miles (27 percent) of the basin in the southeast is called Channel H. It originates in the southwest portion of the basin at the confluence with Sweetwater Creek and Channel G and the excavation extends along a westerly and northwesterly course to Dale Mabry Highway, just north of Waters Avenue. The drainage to this canal extends further north to Lake Carroll, with stormwater flowing southward through a series of lakes including White Trout Lake and through a stormwater system that accepts this flow south of Busch Boulevard. The third primary drainage segment is a second canal constructed as part of the UTBW Project called Channel G, which receives drainage from approximately 13 percent of the basin and flows from Channel H and Sweetwater Creek before discharging to Rocky Creek west of Webb Road in the southwest of the basin (Ayres Associates, 2007b).

The Sweetwater Creek water segment is contained in the Tampa Bay Hydrologic Unit (03100206). USGS monitors stream flow and stage in this system in the lower portion of Sweetwater Creek just upstream of the G-1 control structure near the Veteran's Highway crossing. As such, it receives flows from the Sweetwater Creek and Channel H basins (87 percent of the basin). This USGS Gauging Station 02306647 (Sweetwater Creek Near Tampa FL) is in Hillsborough County and is monitored in cooperation with the SWFWMD. The period of record stretches from April 1964 to the present. From April 1964 to

September 1981, only discharge was measured. From October 1985 to the present, stage measurements are also recorded.

Figure 1-16 presents a plot of daily flows from 1985 to the present. The chart clearly shows the El Niño events in September 1997 through March 1998 that resulted in regional and local flooding. Median daily flow is approximately 6.7 cubic feet per second (cfs) since October 1985, but there is considerable variability, ranging from no flow to more than 800 cfs in 1998, with a standard deviation of 41 cfs. High flow events skew the average flow (20 cfs) well above the median.

Additionally, there is considerable seasonal variation in stream discharge that follows local rainfall patterns, with flows being reduced significantly in late spring. Since 1985, little or no flow (<2 cfs) was measured at the gauge in the stream for 17 percent of daily average values, with the bulk of these no flow periods occurring in May and early June (Figure 1-17).

1.2.5 SOURCE ASSESSMENT

The way nutrients and oxygen-demanding substances enter these stream courses 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.

Additional sources 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 National Pollutant Discharge Elimination System (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 Brushy Creek system are described by FDEP in the 2010 TMDL document (Bailey et al., 2010) and are summarized here. The Dale Mabry Advanced Wastewater Treatment Facility (AWWTP), a domestic wastewater treatment facility, is the only significant discharger of BOD or nutrients to Brushy Creek. The facility maintains an active NPDES permit with monitored discharge (FL 0036820), with a maximum flow of 6 million gallons per day (mgd). Most of the treated effluent is “either reused within the system or transferred to the Hillsborough County Master Reuse System” (Bailey et al., 2010). The permit indicates that the plant has an annual average daily flow of 4.22 mgd, with the limits presented in Table 1-6 (FDEP, 2003):

An addendum to the 2009 Reasonable Assurance document provides for agreed-to allocations for TN for consortium participants [Tampa Bay Nitrogen Management Consortium (TBNMC), 2009]. This document allocates Dale Mabry AWWTP a maximum of 7.4 tons of TN annually over a 5-year average. Table 1-7 lists the allocations to the other smaller dischargers to Brushy and Sweetwater Creeks (except stormwater outfalls). Only the Dale Mabry plant has a surface water discharge. Other allocations assume that the nitrogen will reach the Old Tampa Bay system through percolation to groundwater:

Table 1-6. Permit Limits for Reclaimed Water and Discharged Effluent for Dale Mabry AWWTP

Parameter	Limit, mg/L	Basis
CBOD ₅	5.0	Annual Average
	6.25	Monthly Average
	7.25	Weekly Average
	10.0	Single Sample Maximum
Total Nitrogen	3.0	Annual Average
	3.75	Monthly Average
	4.5	Weekly Average
	6.0	Single Sample Maximum
Total Phosphorus	1.0	Annual Average
	1.25	Monthly Average
	1.5	Weekly Average
	2.0	Single Sample Maximum

Source: FDEP, 2003.

Table 1-7. Permitted Dischargers to Brushy Creek (1498) and Sweetwater Creek (1516)

NPDES Permit No.	WBID	Facility Name	Facility Type	Capacity (mgd)	TN (tons/yr)
FLG110315	1516	CEMEX Construction Materials	Concrete Batch Plant	N/A	N/A
FLA012377	1516	Sparkling Waters Car Wash	Industrial Wastewater	N/A	N/A
FLA012164	1516	Bearss Park	Industrial Wastewater	0.015	0.23
FL0036820	1498	Dale Mabry AWWTP (surface water)	Domestic Wastewater	6	7.4
FL0036820	1498	Dale Mabry AWWTP (reuse water)	Domestic Wastewater	6	2.8
FLA573710	1498	Northdale Golf	Industrial Wastewater	N/A	N/A
FLA012193	1498	Ray Mar Mobile Home Park	Industrial Wastewater	0.0062	0.09

Sources: TBNMC, 2008; TBNMC, 2009.

The stormwater collection systems in the watershed are owned and operated by Hillsborough County (#FLS 000006) and its co-permittees. The responsible co-permittee for both water segments is Hillsborough County under the countywide Phase I Municipal Separate Storm Sewer Systems (MS4s) permit.

1.2.5.2 Non-Point & Legacy Sources

Non-point sources are expected to be the largest contributor of anthropogenic nutrients to the Brushy and Sweetwater Creek water courses and the surrounding wetlands. Nutrient enrichment can occur through direct and treated stormwater runoff to the creek from surrounding lands and roadways; the leaching of nutrients from residential, commercial, agricultural, and even natural forested systems to groundwater that will eventually reach the creek; and through atmospheric deposition. Atmospheric deposition is a major contributor of nutrients (especially nitrogen) to the watershed. FDEP (2005) estimated the average annual atmospheric load of TN and TP to the surface area of Tampa Bay is 1,094 tons of TN and 259 tons of TP or more than 17 percent of the TN load to the bay from all sources. Assuming that the Brushy Creek and Sweetwater Creek watersheds experience similar local depositional characteristics, atmospheric deposition can be expected to account for a load of 55 tons of TN and 13 tons of TP annually to the land and water area of the basin that drains through Brushy Creek; 18 tons of TN and 4 tons of TP on the Brushy Creek WBID itself; and 56 tons of TN and 13 tons of TP to the Sweetwater Creek watershed.

The diffuse loading from stormwater runoff is typically estimated by using a watershed model to simulate the loading to the stream from stormwater and groundwater sources as it moves from the point of precipitation to the stream course. The models are typically geographic information system (GIS) based programs that utilize many different factors (called coverages) developed as GIS layers. These include land uses, soils, climate, topography, and hydrology of the watershed. Each of the watershed land uses can be assigned a loading value typical of that land use. These values are often expressed as event mean concentrations (EMCs) that have been developed from measurements taken from past storm events. There is a growing literature of EMC values for various land uses that can be used for screening or estimation purposes as long as the researcher is careful to assess the appropriateness of the chosen literature value and ensure that it is comparable to the subject site. The U.S. Army Corps of Engineers (USACE) reviewed the available literature in 2004 (Lin, 2004). However, if the watershed model is intended to accurately assess loads to the stream (for example, to establish a TMDL), then it is important to use regionally or locally derived values through measurement. As Lin (2004) states, “[I]f accurate pollutant estimates are required, researchers should look into obtaining (or generating their own) local coefficients/concentrations for their area of interest.”

For the purposes of comparison between land use types and to assess potential sources of excess nutrients or oxygen-demanding substances in the Brushy Creek and Sweetwater Creek watersheds, typical ranges of EMC values derived literature are provided in Table 1-8 (Harper & Baker, 2007; Harper, 1998).

Table 1-8. Typical EMC Values for Trout Creek Land Uses Derived from the Literature (mg/L)

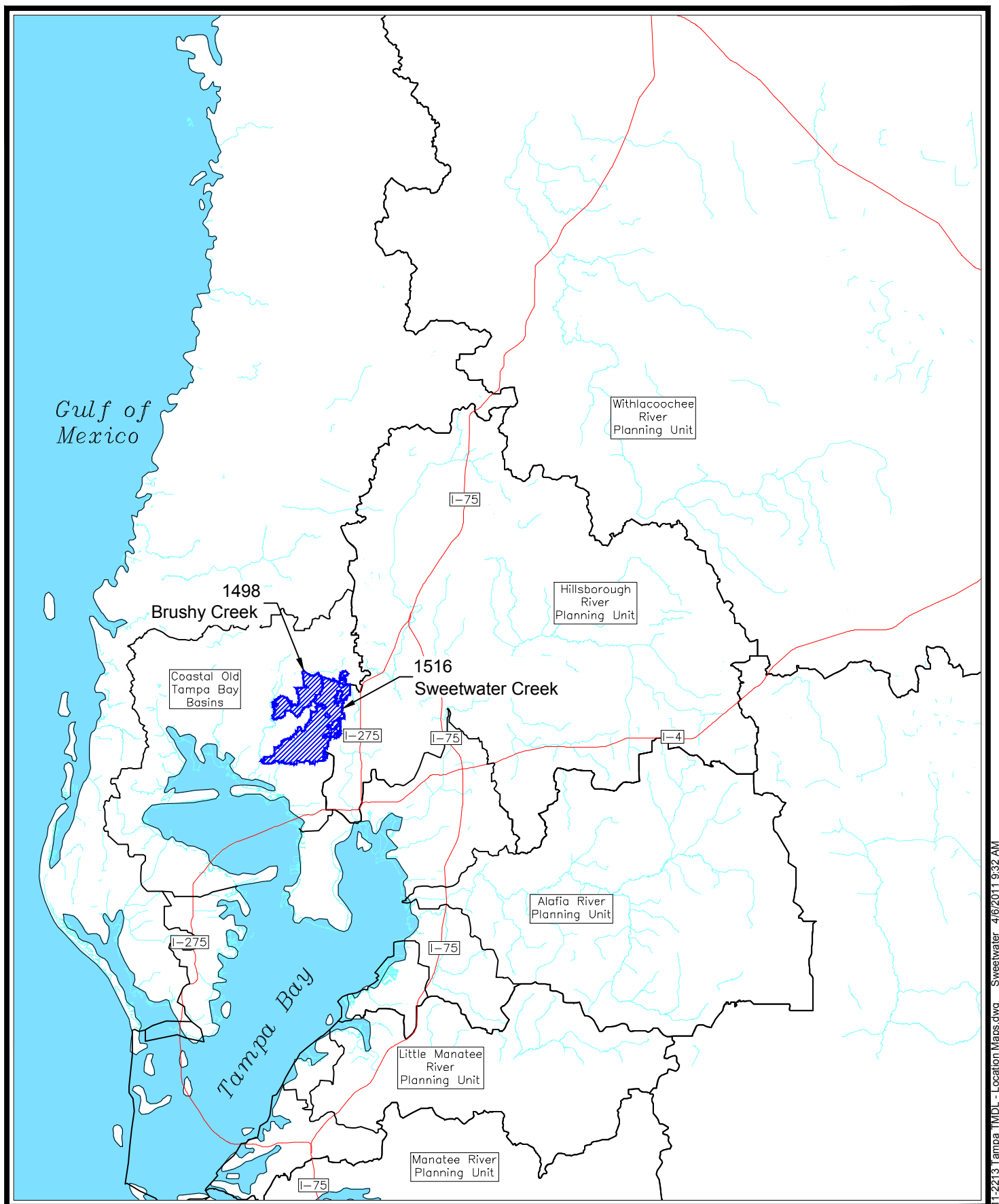
FLUCS DESC	TN	Ortho-P	TP	BOD
RESIDENTIAL	1.61 – 2.32	0.08 – 0.27	0.19 - 0.52	4.7 – 11.3
COMMERCIAL/INDUSTRIAL/INSTITUTIONAL	1.18 – 2.40	0.03 – 0.33	0.18 – 0.35	7.6 – 11.3
MINING	1.18	0.07	0.15	7.6
PARKS AND GOLF	1.25	0.05	0.11	1.6
UNDEVELOPED AND OPEN LANDS	1.15	0.05	0.06	1.4
CROPLAND AND PASTURELAND	2.65 – 3.47	0.09 0.40	0.59 – 0.62	5.1
TREE CROPS (citrus)	2.24	N/A	0.18	2.6
SPECIALTY FARMS	N/A	N/A	N/A	N/A
UPLAND FOREST	1.15	0.05	0.06	1.4
WATER	1.25	0.05	0.11	1.6
WETLANDS	1.60	0.13	0.19	4.63
DISTURBED LAND	N/A	N/A	N/A	N/A
TRANSPORTATION AND UTILITIES	1.64	0.14	0.22	5.2

Notes: Values are stormwater runoff EMCs and are provided in mg/L

Source: Harper & Baker, 2007; Harper, 1998.

A number of potential non-point sources exist within these watersheds, including residential runoff, agriculture, limited 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.

Ayres Associates (2007a; 2008b) presents a review of potential legacy sources of contaminants in the Brushy Creek and Sweetwater Creek basins. While sources of more toxic contaminants were identified (i.e., Superfund sites, closed landfills, and brownfields), no sources of significant nutrients were identified. Although there is little commercial agriculture currently in these basins, much of the land was previously under some form of cultivation of agricultural enterprise. However, the karstic nature of the geology and high infiltration covering soils would seem to preclude significant legacy nitrogen in these systems.



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Figure 1-1
Location Map - Brushy Creek (1498) and Sweetwater Creek (1516)



Figure 1-2
Upper Brushy Creek at the Northdale Golf & Tennis Club



Figure 1-3
Lower Middle Brushy Creek



Figure 1-4
Brushy Creek at Ehrlich Road



Figure 1-5
Brushy Creek at Gunn Highway

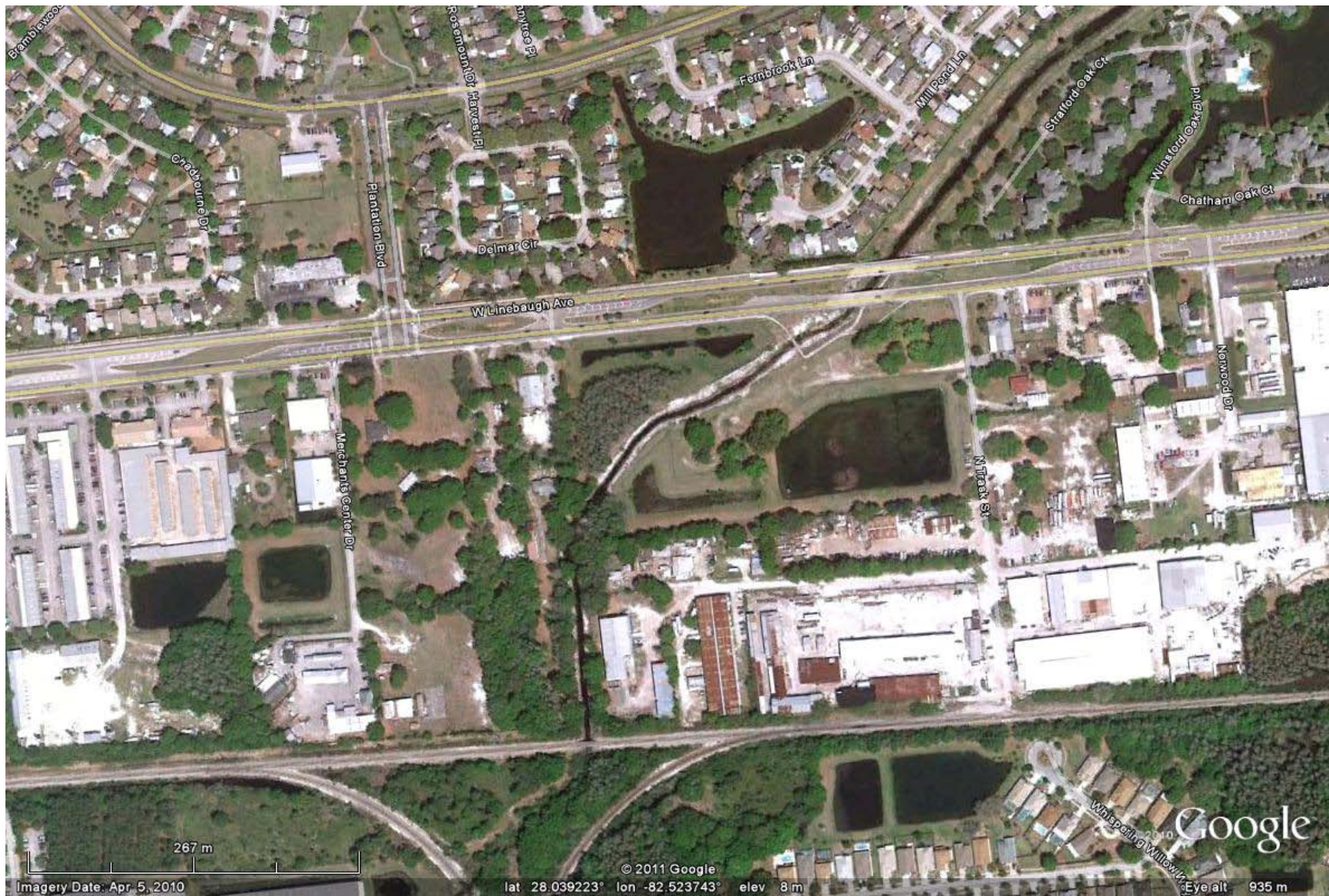


Figure 1-6
Sweetwater Creek near Linebaugh Avenue

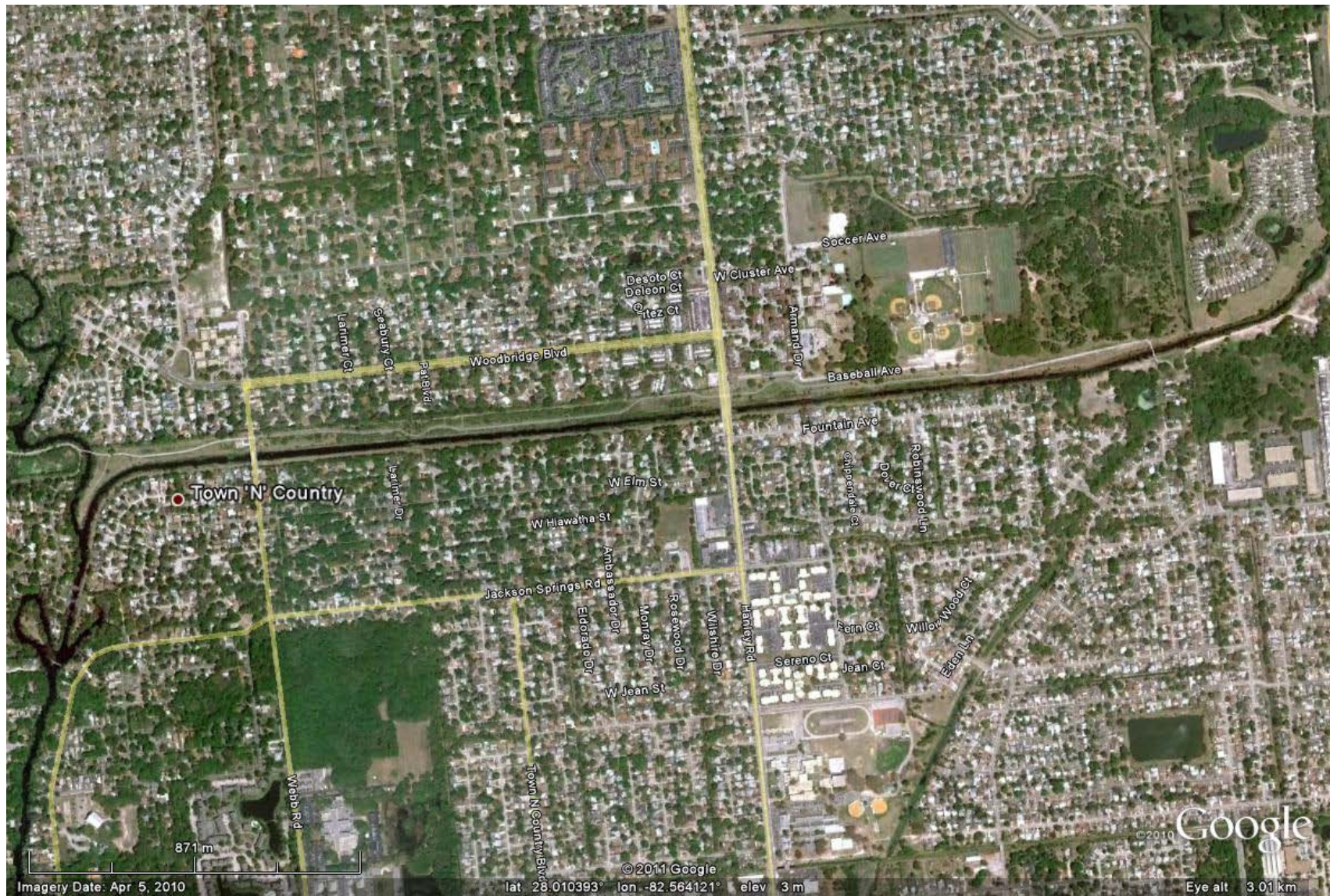


Figure 1-7
Canal Portion (Channel G) of Sweetwater Creek WBID



Figure 1-8
Sweetwater Creek at Anderson Road Crossing



Figure 1-9
Sweetwater Creek at Gunn Highway

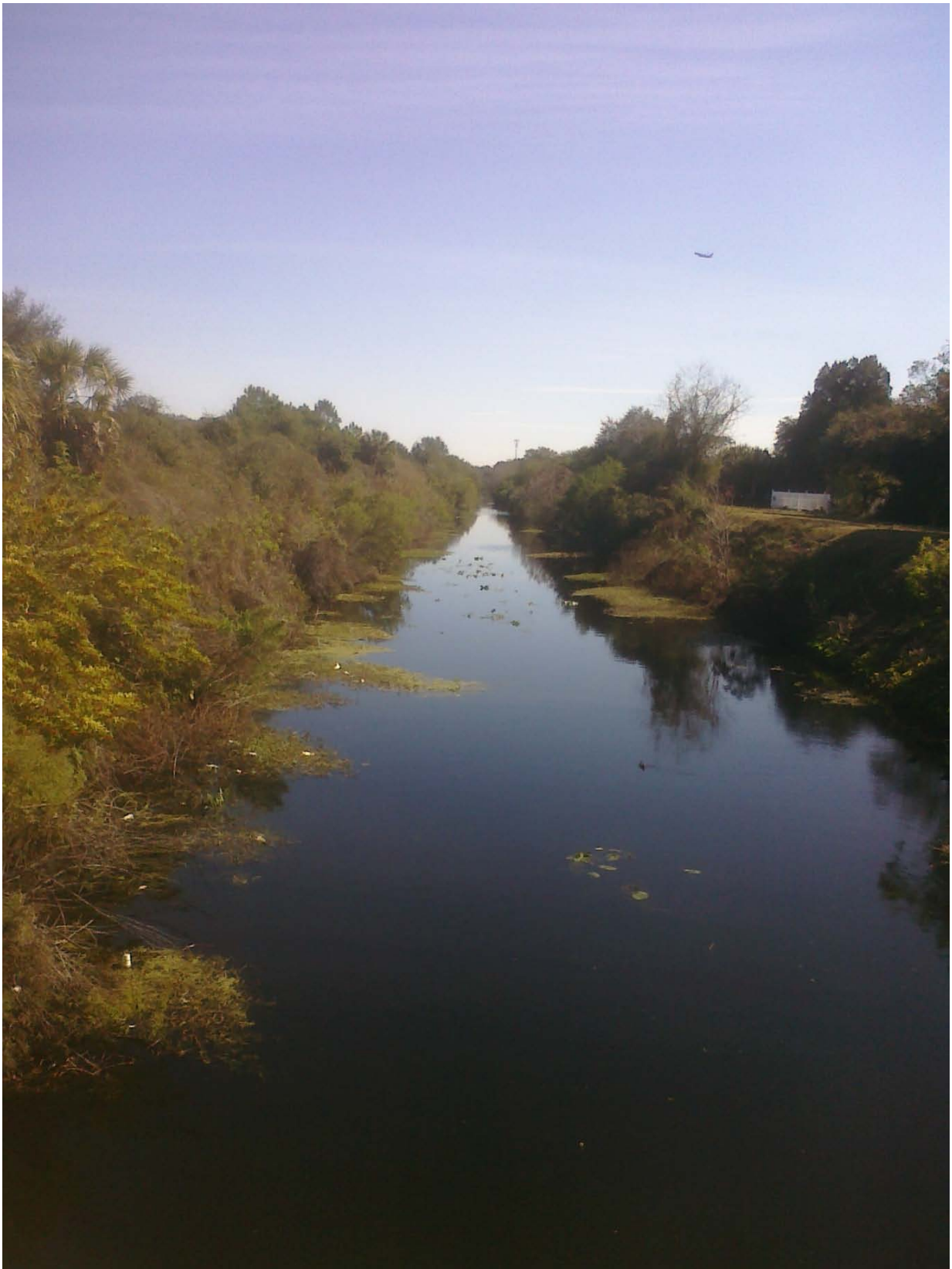


Figure 1-10
Sweetwater Creek (Channel G) at Hanley Road

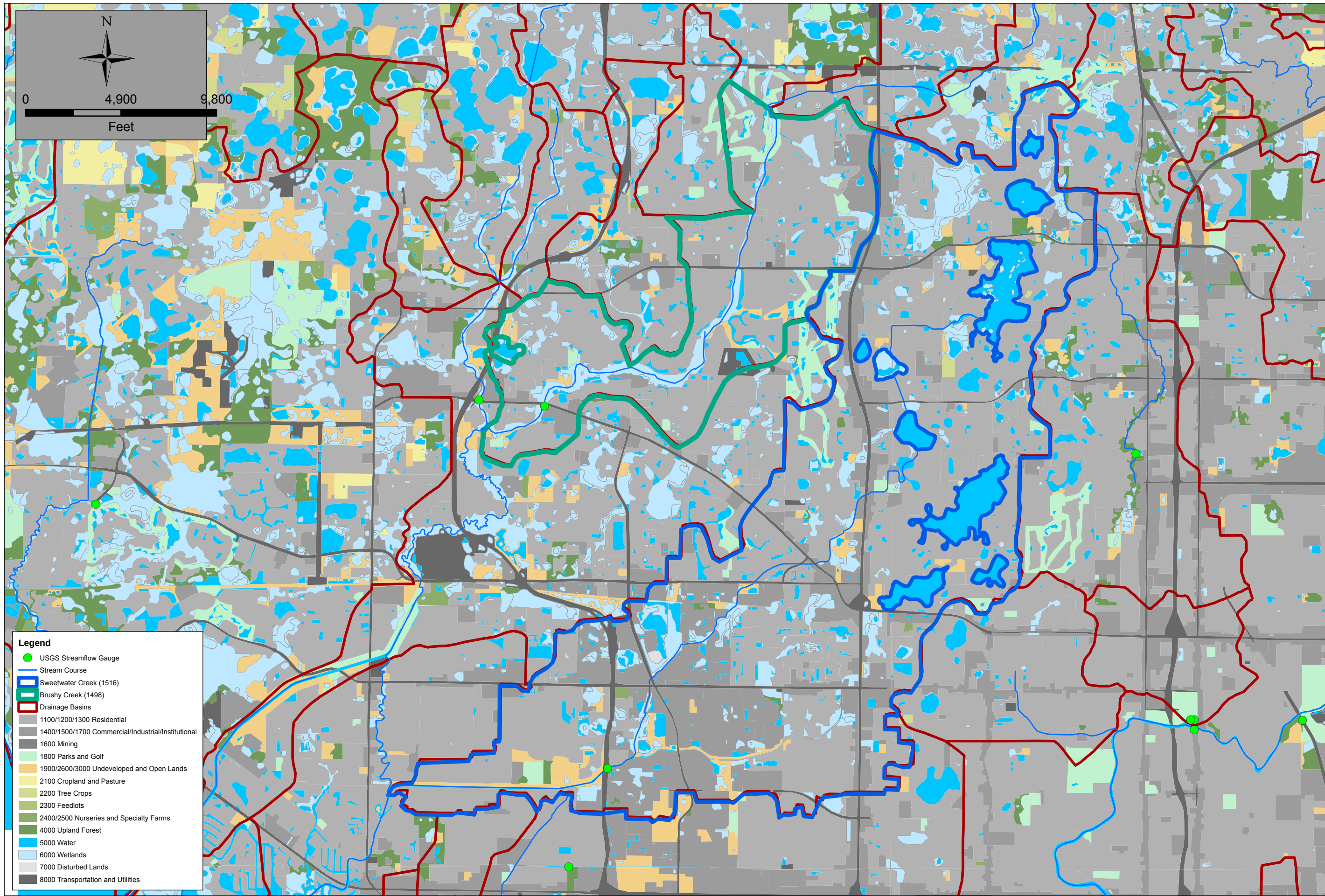


Figure 1-11
Land Uses - Sweetwater Creek (1516) and Brushy Creek (1498)

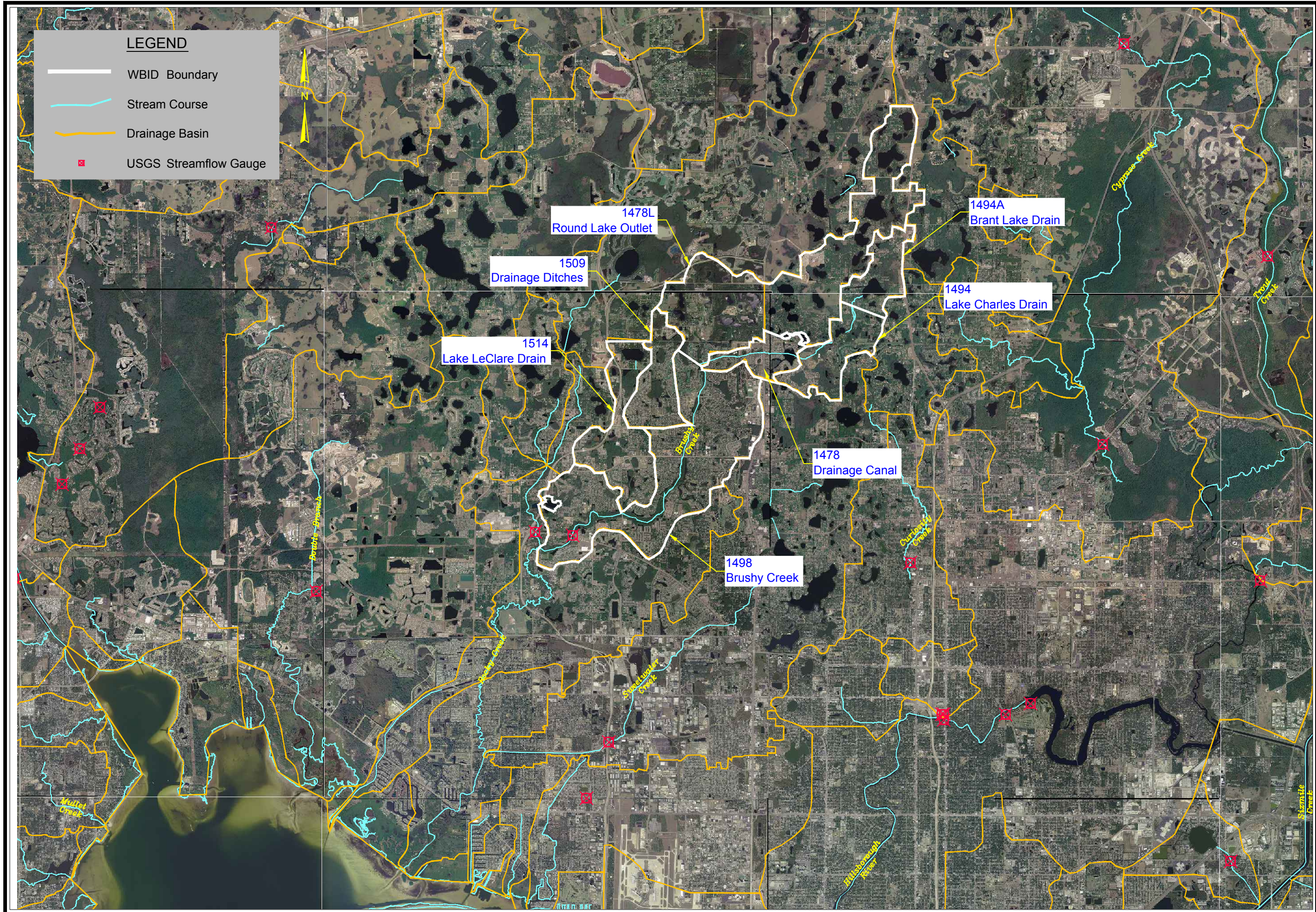


Figure 1-12
Hydrology and Basins - Brushy Creek (1498)

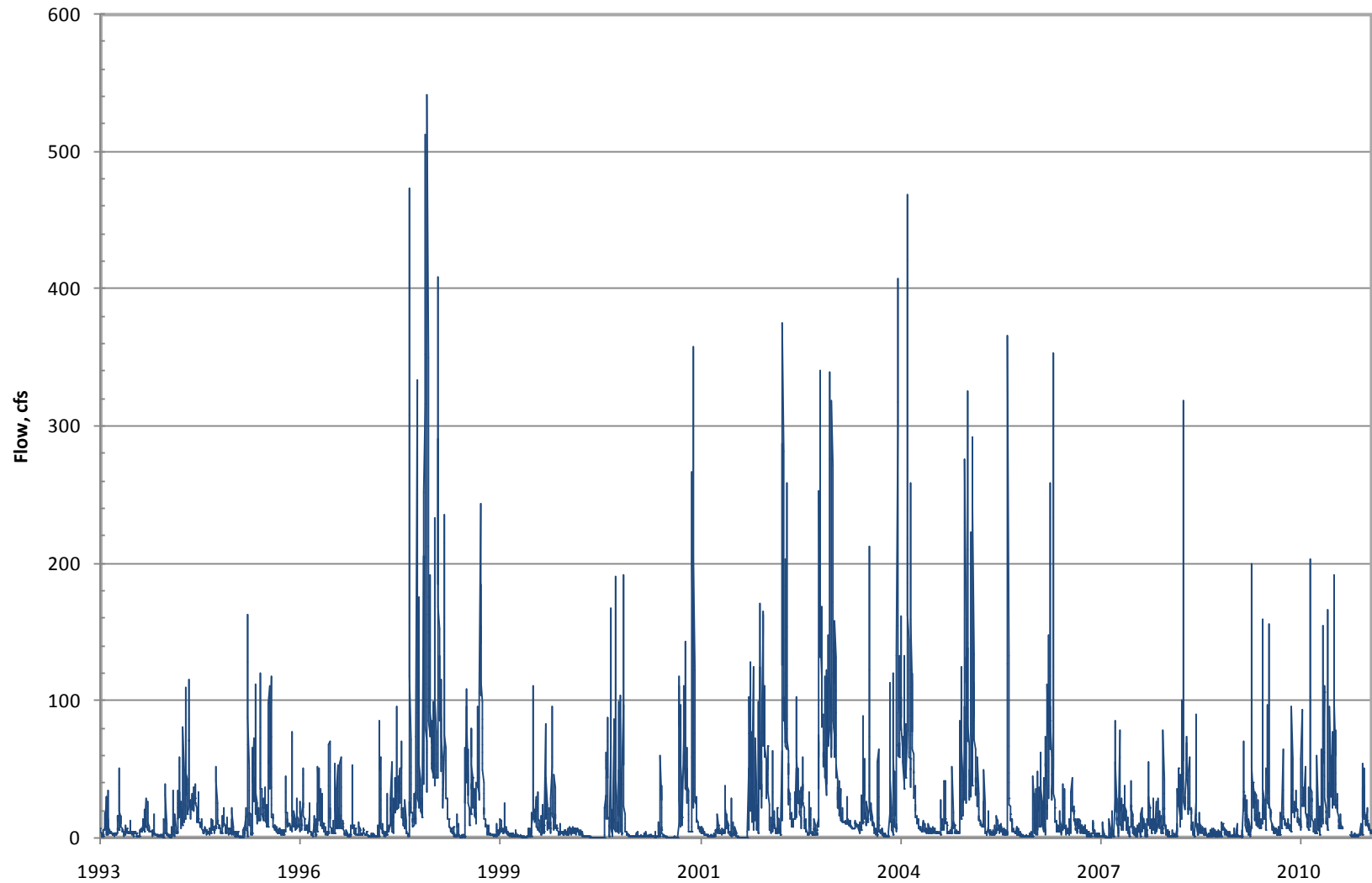


Figure 1-14
Daily Flow at Brushy Creek (1993 to present)

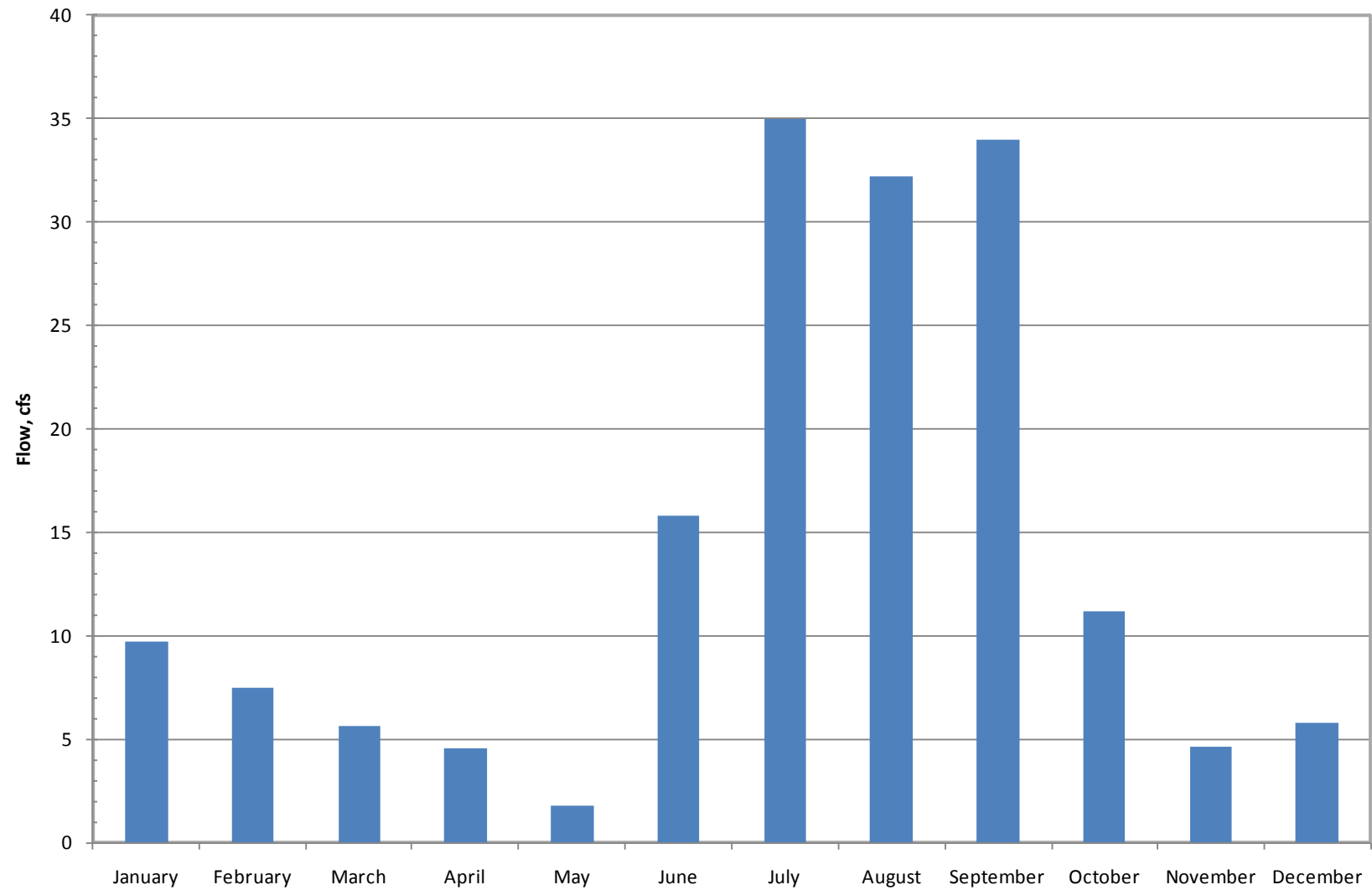


Figure 1-15
Average Daily Flow at Brushy Creek

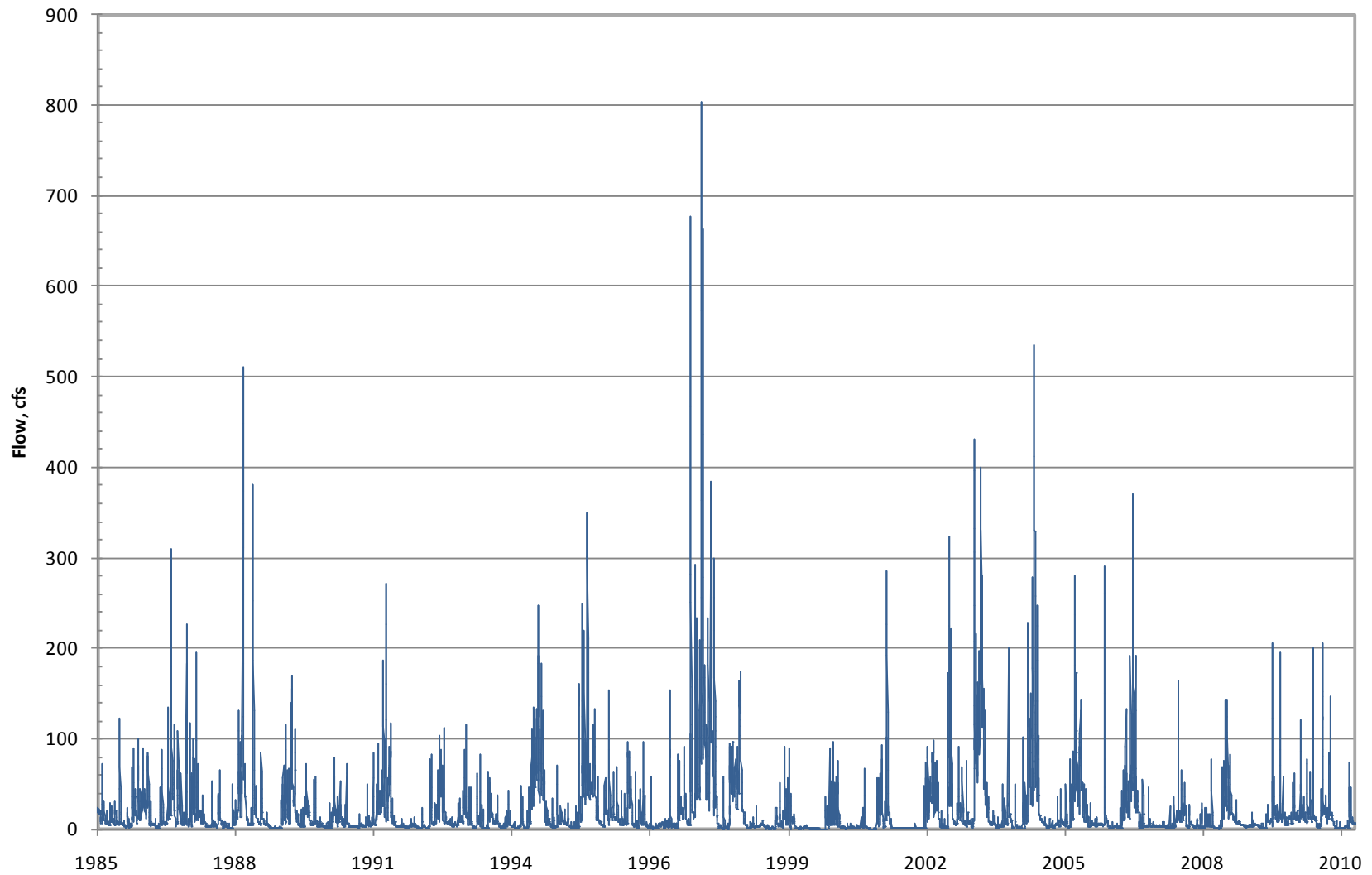


Figure 1-16
Daily Flow at Sweetwater Creek (1993 to present)

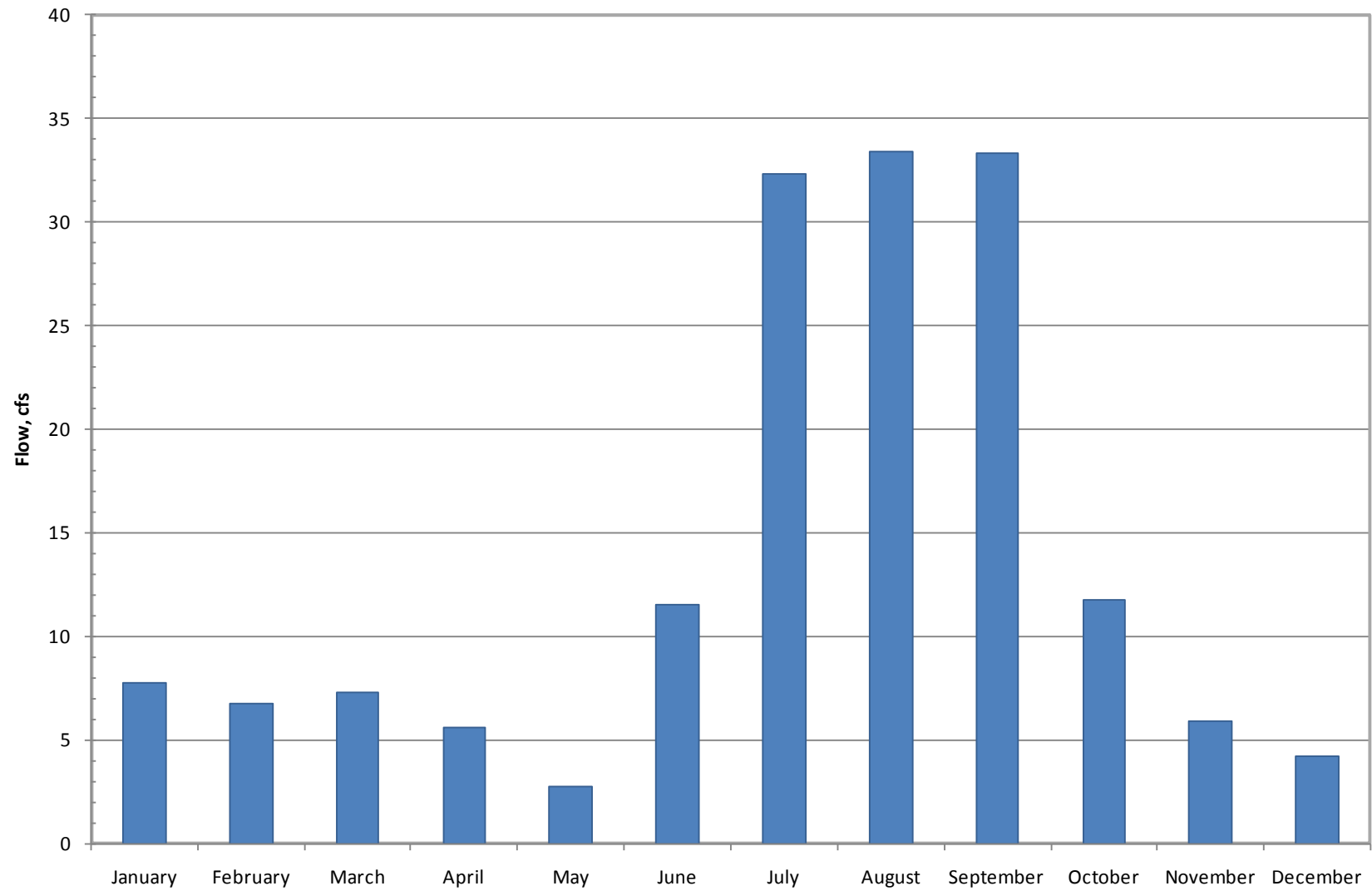


Figure 1-17
Average Daily Flow at Sweetwater Creek

2.0 WATER QUALITY DATA ASSESSMENT

2.1 REASON FOR IMPAIRMENT

This section presents the current available water quality data for Brushy Creek and Sweetwater Creek from Run 42 of the IWR database. In addition to these data, this analysis utilized more recent supplemental data available from EPCHC that is not in the IWR database. Figure 2-1 provides the locations of the stations associated with Brushy Creek (WBID 1498). Figure 2-2 provides the station locations for Sweetwater Creek (WBID 1516). Both segments are superimposed over recent aerial photography.

2.1.1 BRUSHY CREEK (WBID 1498)

For the Brushy Creek WBID, the IWR database (Run 42) contains DO concentration measurements from eight stations from 1991 to 2007. Additional data from one of these stations (21FLHILL161) were also available from EPCHC for 2007 – 2009. For the period from 2004 – 2009, observations ranged from a minimum of 1.6 mg/L to 9.5 mg/L, with a median concentration of 6.2 mg/L. Figure 2-3 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 existed throughout the measured period. However, DO concentrations in the stream in the upper reach have shown significant improvement over historical measurements.

2.1.2 SWEETWATER CREEK (WBID 1516)

The IWR database (Run 42) contains DO concentration measurements from 12 stations for the Sweetwater Creek water segment from 1968 to 2007. Additional data from one of these stations (21FLHILL142) were also available from EPCHC for 2007 – 2009. For the period from 2003 – 2009, observations ranged from a minimum of 0.1 mg/L to 9.6 mg/L, with a median concentration of 4.1 mg/L. Figure 2-4 plots the period of record measurements from all available stations. The graph illustrates the condition observed in Cycle 2 that resulted in verifying impairment for DO, and shows that it has been consistent through the measured period.

2.2 SUMMARY OF AVAILABLE WATER QUALITY DATA

2.2.1 BRUSHY CREEK (WBID 1498)

A summary of the key parameter statistics for Brushy Creek are provided in Table 2-1. The analyses represent conditions from 2004 to the present (the assessment period if conducted at the time of this writing). The system is typically nitrogen limited (TN/TP=11), but is often co-limited from an observation of paired measurements over the period of record. The nitrogen component is predominantly found in organic forms (70 percent), but the data clearly show some levels of inorganic nitrogen. Infrequent algal blooms occur, but the median condition is very balanced (geometric mean Chl *a* = 3.1 µg/L over this period). The system is also colored and is, at times, pulsed with organic material and high color.

Table 2-1. Selected Water Quality Observations for Brushy Creek (2004 to 2009)

Parameter	Observations	Minimum	Maximum	Median/Geomean
Dissolved Oxygen, mg/L	103	1.6	9.5	6.2
Temperature, °C	103	12.5	34	23
Total Nitrogen, mg/L	68	0.58	1.98	1.10
Total Phosphorus, mg/L	70	0.02	0.40	0.10
BOD, mg/L	41	0.4	2.2	0.9
Chlorophyll <i>a</i> , µg/L	64	<0.8	25.3	3.1
Organic Nitrogen, mg/L	70	0.39	1.05	0.76
Ammonia-Nitrogen, mg/L	68	0.02	0.54	0.07
Total Organic Carbon, mg/L	20	8	13	10
Color, PCU	46	20	100	48

Sources: IWR Database Run 42 and EPCHC.

2.2.2 SWEETWATER CREEK (WBID 1516)

A summary of the measured data from 2003 to 2009 for Sweetwater Creek is provided in Table 2-2. The data for the Channel G/H portion of the system come from four locations in the canal. One station (EPCHC Station 142) represents the lower part of the Sweetwater Creek segment (a single sampling event that was taken in lower part of Sweetwater Creek in August 2004 (21FLGW 22072). Two stations (21FLWQSPHIL553US & 21FLTPA 24040112) represent the middle portion of the Sweetwater Creek segment. Data are available for the middle portion of Sweetwater Creek only from 2005 and 2006. No data are available in the recent period for the upper part of the creek segment. However, the vast majority of the available data is from the EPCHC station (21FLHILL142) in the lower portion of the creek (at

Anderson Road) (see Figure 1-8) that has been sampled monthly during this period (2003-2009).

Aggregating these locations shows that the system's median DO concentration is less than the water quality standard but that the system can be observed to reflect concentrations from less than 1 to over 9.5 mg/L. The nutrient concentrations are similar to, but on average lower, than Brushy Creek. Nutrient limitation in the stream is highly variable, with TN/TP ratios varying from 2.9 to 96. The median ratio of 13 suggests that nitrogen is typically more limiting than phosphorus, but that the system should be considered co-limiting. Even when the data are disaggregated, the canal section, the lower creek, and the middle portion of the creek all have variable TN/TP ratios from less than 10 to more than 30. TN is composed primarily of organic nitrogen (long-term average organic nitrogen percentage of 80 percent). While algal blooms occur, they are infrequent (median condition represented by the geometric mean = 4.9 µg/L over record period). While the 328 µg/L concentration of Chl a was found as expected in the canal (Channel H, EPCHC Station 171 in May 2006), Chl a measurements over 20 µg/L have been observed in the lower creek segment (11 percent of the time). The system is also colored and is, at times, pulsed with organic material and high color.

Table 2-2. Selected Water Quality Observations for Sweetwater Creek (2003 to 2009)

Parameter	Observations	Minimum	Maximum	Median/Geomean
Dissolved Oxygen, mg/L	176	0.1	9.6	4.1
Temperature, °C	176	12	34	23.6
Total Nitrogen, mg/L	165	0.39	3.25	0.85
Total Phosphorus, mg/L	172	<0.01	1.11	0.06
BOD, mg/L	130	<0.2	6.7	1.1
Chlorophyll a, µg/L	158	<0.1	328	4.9
Organic Nitrogen, mg/L	161	0.35	2.90	0.66
Ammonia-Nitrogen, mg/L	159	<0.001	0.349	0.049
Total Organic Carbon, mg/L	7	9.6	16.3	12.3
Color, PCU	87	20	111	41

Source: IWR Database Run 42 and EPCHC.

2.3 TIME SERIES ANALYSIS

2.3.1 BRUSHY CREEK (WBID 1498)

Figures 2-5 through 2-7 present the time series measured nitrogen, phosphorus, and BOD for the period of record. Figure 2-5 shows an apparent increase in instream nitrogen concentrations in both the upper and lower parts of the stream between the measurements taken from 1991 to 1997 and those taken in the recent period (2004 – 2009). However, there does not appear to be a continuing trend upward in the recent period. Figure 2-8 shows that the nitrogen increases are attributable to both organic and inorganic nitrogen sources. The inorganic nitrogen source(s) are most likely anthropogenic and are consistent with discharges to a low flow stream from the Dale Mabry AWWTP. Figure 2-9 plots the nitrogen species for the same period for measurements taken from water collected at the upper creek stations. In both cases, the increase in TN is primarily the result of an increase in organic nitrogen, but in the lower creek, there appears to be an increase in the inorganic (especially nitrate-nitrite) components as well. This is perhaps better visualized in Figure 2-10, which plots the percentage of the TN that is associated with organic compounds.

The chlorophyll record is shorter in Brushy Creek, but sufficient measurements have been made since 2005 to evaluate the system in terms of algal imbalances. Figure 2-11 presents the Chl a concentrations in Brushy Creek over the period of record. Of the 64 measurements made, only one (25.3 µg/L) exceeded 20 µg/L. The time series plot also shows that phytoplankton levels have a seasonal pattern with higher concentrations of organisms in the summer months.

2.3.2 SWEETWATER CREEK (WBID 1516)

Figures 2-12 through 2-16a present the time series of measured data for Sweetwater Creek from 1990 through the present for TN, TP, BOD₅, and Chl a. Figures 2-12 and 2-13 show dramatic reductions of instream nutrients beginning in 1992. Like Brushy Creek, there are occasional pulses of nitrogen in the recent period (2003 – 2009). However, unlike Brushy Creek, Figure 2-16a shows that the observed higher TN in the recent period is primarily from organic sources, with inorganic nitrogen concentrations remaining fairly consistent (and low) since the reductions in 1992. This trend upwards of higher TN that is primarily from organic sources has also been observed in other systems in the region, even in areas with much

less land use impacts. This can be illustrated by plotting the time series nitrogen concentrations for Trout Creek for this same period (Figure 2-16b).

There is limited long-term BOD data (Figure 2-14) in all areas except the lower creek, but it appears that there was also a general lowering of the concentrations beginning in 1992 that remained at about the same level (<5 mg/L) since that time. All observations over the period of record are below 10 mg/L. Figure 2-15a suggests that there are signs of algal imbalance or even an increasing chlorophyll concentration over time. While the data are limited (except in the lower creek), all but one of the blooms (>20 µg/L) have occurred since 2000. While the highest concentration (328 µg/L) was measured in the canal section as expected, there have been far more frequent blooms measured in the lower creek over the period that the canal has been sampled. However, excursions above the 20 µg/L threshold are infrequent, with only 15 observations (8 percent of the time) greater than 20 µg/L in the record. As might be expected, the blooms appear to be correlated with some of the low flow periods (Figure 2-17) and follow a seasonal pattern (Figure 2-15b), not unlike Brushy Creek.

2.4 **CORRELATION ANALYSIS**

2.4.1 **BRUSHY CREEK (WBID 1498)**

An analysis was conducted to pair appropriate parameters to the 103 DO measurements in the recent period (2004 – 2009) to provide a means to test potential “dose/response” relationships by regression. Table 2-3 provides the number of paired measurements available from all stations to DO (expressed as a concentration).

Table 2-3. Number of Available Paired Measurements to Dissolved Oxygen from the IWR Database (Run 42) & EPCHC (2003-2009) for all Stations Assigned to Brushy Creek (1498)

Temp	TN	TP	BOD	Chl a	Org N	NH ₄	TOC	Color
103	68	70	41	64	70	68	20	46

Source: IWR Database Run 42.

In Cycle 1, the FDEP did not link the low DO observations in Brushy Creek to nutrients because average annual Chl a values did not exceed 20 µg/L during the verifying period. However, enough data were available to determine that Brushy Creek may not be meeting its designated uses because of low DO observations. Therefore, FDEP placed Brushy Creek on the Planning List and committed to collecting additional data in Cycle 2. In Cycle 2, FDEP changed the Integrated Assessment category from 3c (may be impaired -

collect more data) to 5 (impaired for DO and requires a TMDL) and cited TP as the causative pollutant “based on regression analysis of TP and DO.” However, when FDEP completed the draft TMDL proposal (Bailey et al., 2009), load reductions were only assigned for TN (because of the reference stream nutrient concentration target approach used to develop the load reductions).

In any case, ATM was unable to reproduce the TP/DO link that FDEP observed in the system or establish a link between TN and DO or Chl a in the system. Figure 2-18 plots paired DO and nutrient (TN and TP) concentrations for the current period (2004-2009). It is clear from the plot that there is no regressed relationship between DO and nutrients in the stream. Figure 2-19 plots the data for TP for the three stream segment sampling areas and the DO/TP relationship still is not evident.

As the typical conceptual model would expect nutrients to affect DO through generation of excess phytoplankton production, paired nutrient and Chl a concentrations were plotted (Figure 2-20 and Figure 2-21). Again, no relationship is apparent in the current period. Figure 2-22 plots nitrogen species against Chl a for the lower part of the creek (where the most measurements have been collected in the recent period) with no apparent dose/response relationship. Similarly, DO concentration does not appear to be responding to instream concentrations of BOD₅ (Figure 2-23).

While there is the expected correlation between decreasing DO with increased temperature (Figure 2-24), plotting DO deficit (the difference between the measured DO and 100 percent saturation), which removes the effect of temperature on oxygen solubility in the water column, removes the correlative effect. More lower concentrations are observed in the warmer summer months, however, median monthly DO deficits remain consistently around 2.2 mg/L except in May, when increasing temperatures combine with the lowest stream flows. When summer rains increase stream flows, DO deficit returns to the median condition even under the highest seasonal temperatures.

In summary, the correlation analysis performed using paired measured during the recent period does not suggest that nutrients or BOD are directly causative of the observed instream DO condition in Brushy Creek. While DO measurements are observed below 5.0 mg/L year-round, lower summertime measurements are primarily the result of lower

oxygen solubility in water at higher temperatures. By calculating and plotting the DO deficit below 100 percent saturation, DO is most depressed by factors other than solubility from April to June during the years' lowest flow periods. While winter flows are much lower than summertime ones, it is expected that the cooler water temperatures decrease biological activity during this season, keeping the DO deficit near the median for the system (2.2 mg/L). All of this lends support to FDEP's observation:

DO can also be affected or lowered by in-stream modifications such as dredging and channelization. These processes slow down water velocity, reduce reaeration, and increase the settling of solids, thus increasing sediment oxygen demand (SOD) and lowering DO concentrations. Further analyses and monitoring must be completed to develop an appropriate, site-specific DO criterion. (Bailey et al., 2009)

2.4.2 SWEETWATER CREEK (WBID 1516)

Similar to the analysis conducted for Brushy Creek, the available Sweetwater Creek data from the recent period (2003 – 2009) were paired to the 175 recent period 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) and EPCHC (2003-2009) for all Stations Assigned to Sweetwater Creek (1516)

Temp	TN	TP	BOD	Chl a	Organic N	NH ₄	TOC	Color
175	164	171	129	157	160	158	7	86

Source: IWR Database Run 42 and EPCHC.

In Cycle 1, the FDEP found that there were sufficient low DO observations to verify impairment of Sweetwater Creek for DO. The impairment was linked to nutrients. They also verified impairment for Chl a and historical Chl a and implied that nitrogen was causative because it is the limiting nutrient (FDEP, 2005).

In Cycle 2, FDEP affirmed the Integrated Assessment category of 5 (impaired and requires a TMDL) for instream DO concentrations; delisted (Category 2) the stream for Chl a and verified impairment for historical Chl a. Therefore, FDEP identified nutrients as the causative pollutant based on the historical Chl a. In this cycle, FDEP identified that the stream is co-limiting for nutrients (based on a TN/TP ratio of 12.1). However, when FDEP completed the

draft TMDL proposal (Bailey et al., 2009), load reductions were only assigned for TN (because of the reference stream nutrient concentration target approach used to develop the load reductions).

ATM was unable to reproduce the TP/DO link that FDEP observed in the system or establish a link between TN and DO or Chl a in the system. Figure 2-25 plots paired DO and TN concentrations for the current period (2004-2009), and Figure 2-26 plots the paired TP and DO observations for the current period. It is clear from the plot that there is no regressed relationship between DO and nutrients in the stream.

In the common conceptual model that links nutrients to lower DO, nutrients affect DO through generation of excess phytoplankton production. Figure 2-27 and Figure 2-28 plot paired nutrient and Chl a concentrations. Again, no relationship is apparent in the current period. Figure 2-29 plots nitrogen species against Chl a for the lower part of the creek (where the most measurements have been collected in the recent period), with no apparent dose/response relationship. Again, this plot shows that most of the nitrogen measured in the system is from organic sources, but no dose/response relationship is apparent for any of the nitrogen species and phytoplankton production. Similarly, BOD₅ concentrations in the stream do not appear to be high enough to elicit a DO response (Figure 2-30). However, a weak relationship ($r^2 = 0.21$, Channel G/H to 0.38, Lower Creek) is evident between paired Chl a and BOD₅ concentrations (Figure 2-31). However, it is unlikely that increases in BOD₅ cause Chl a to increase as was the assumption in a recent TMDL document for Rattlesnake Slough where the FDEP stated:

However, BOD could be significantly correlated to CHLA...Although, the TMDL considered BOD reductions necessary to achieve a DO concentration of 5.0 mg/L or greater, no compelling relationship could be established. However, when BOD levels are high, there is a probability the increased oxygen demand will have a negative influential affect on DO concentrations. Reductions in BOD to lower CHLA concentrations could also potentially increase DO levels (Burger, 2009).

Rather, as Heishary et al. (2001) observed, the relationship is not that the algae have a growth response to higher BOD, but that the periods of higher algal abundance create higher BOD:

We have also shown that BOD₅ is highly correlated with...chlorophyll and that the living cells (as expressed by chlorophyll a) and the dead or dying cells (as expressed by pheophytin a) both contribute to the BOD. The relationships among nutrients, algae and BOD also varied (between sites and years) as a function of watershed size, flow and residence time. Overall, these relationships should prove useful for nutrient criteria development and waste load allocations (where excess nutrients and dissolved oxygen are a primary concern) (Heishary et al., 2001).

In fact, in systems that fit the process envisioned by the conceptual model, excess nutrients stimulate the algal blooms (this biomass is surrogated by measuring the Chl a concentration in the water column) and the consumption of the dying algae by bacteria requires an increase in the oxygen demanded (expressed in the BOD₅ measurement), which lowers the instream DO concentrations observed in the stream. However, the paired data analyses do not show that this process is the major cause of the low DO values observed in Sweetwater Creek. While the observed blooms do weakly correlate to expected increases in BOD, BOD does not appear to be high enough to significantly contribute to DO deficit. Nutrient concentrations do not correlate with increases in Chl a, and increases in Chl a do not correlate well with DO deficit. The observed DO values in the system are resulting from other processes not well described by the conceptual model.

The expected correlation between increased temperature and decreasing DO due to lowered oxygen solubility at higher temperatures is not shown here as it is in Brushy Creek (Figure 2-32). Neither DO concentrations nor DO deficit shows any correlation to temperature. While increased temperatures do not correspond predictably to DO deficit, the temperatures in Sweetwater Creek follow the same seasonal and weather pattern as Brushy Creek, but are consistently higher (Figure 2-33) as measured over the same time period at the Lower Creek stations. This is likely due to the fact that Sweetwater Creek is more hydrologically modified than Brushy Creek and overall has less canopy, diversity of habitat, and riparian tree buffer.

While the higher DO deficits do occur in the warmer months, the highest deficits occur in late spring and early summer, when the warming temperatures combine with lower daily flows (Figure 2-34). However, the median DO deficit in Sweetwater Creek is twice that of Brushy Creek (4.4 mg/L versus 2.2 mg/L) as observed during the recent period at the lower creek stations.

In summary, the correlation analysis performed using paired data during the recent period does not suggest that nutrients or BOD are directly causative of the observed instream DO condition in Brushy Creek. By calculating and plotting the DO deficit below 100 percent saturation, DO is most depressed by factors other than solubility from April to June during the years' lowest flow periods. While winter flows are much lower than summertime ones, it is expected that the cooler water temperatures decrease biological activity during this season, keeping the DO deficit near the median for the system (4.4 mg/L). While DO concentrations below 5.0 mg/L might be a natural part of the Sweetwater Creek stream system, as with Brushy Creek, they are likely exacerbated by stream modifications like dredging, channeling, and culverting. In fact, Sweetwater Creek is far more modified than Brushy Creek, which may explain the lower DO concentrations observed in Sweetwater Creek compared to Brushy Creek in similar places along their stream courses and over the same time periods. As FDEP observed in the TMDL proposal, "These processes slow down water velocity, reduce reaeration, and increase the settling of solids, thus increasing sediment oxygen demand (SOD) and lowering DO concentrations" (Bailey et al., 2009) .

2.5 EPA NUMERIC NUTRIENT CRITERIA COMPARISON

This section presents a comparison of the present nutrient conditions within Brushy Creek and Sweetwater Creek 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 the 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 2-5). 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 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, so it is unlikely that nutrients are causing an algal imbalance in the system. No violations of the TN criteria were found in either WBID.

Sweetwater Creek would not be identified as impaired based upon the single violation of the TP criteria in 2002. Brushy Creek would be deemed impaired for TP based upon the two consecutive years of violation in 2006 and 2007.

Table 2-5. Comparison of EPA Numeric Nutrient Criteria for Florida Streams

Parameter	Criterion	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brushy Creek (1498)											
Chlorophyll a, µg/L	N/A	N/A	N/A	N/A	N/A	N/A	2.4	3.7	2.6	N/A	N/A
TN, mg/L	1.54	N/A	N/A	N/A	1.14	1.25	1.06	1.08	1.09	N/A	N/A
TP, mg/L	0.12	N/A	N/A	N/A	0.08	0.07	0.07	0.16	0.22	N/A	N/A
Sweetwater Creek (1516)											
Chlorophyll a, µg/L	N/A	11.1	2.9	5.8	4.5	3.0	6.1	10.6	4.1	N/A	N/A
TN, mg/L	1.54	0.94	0.75	0.70	0.84	1.00	0.88	0.90	0.69	N/A	N/A
TP, mg/L	0.12	0.08	0.07	0.13	0.10	0.07	0.05	0.07	0.05	N/A	N/A

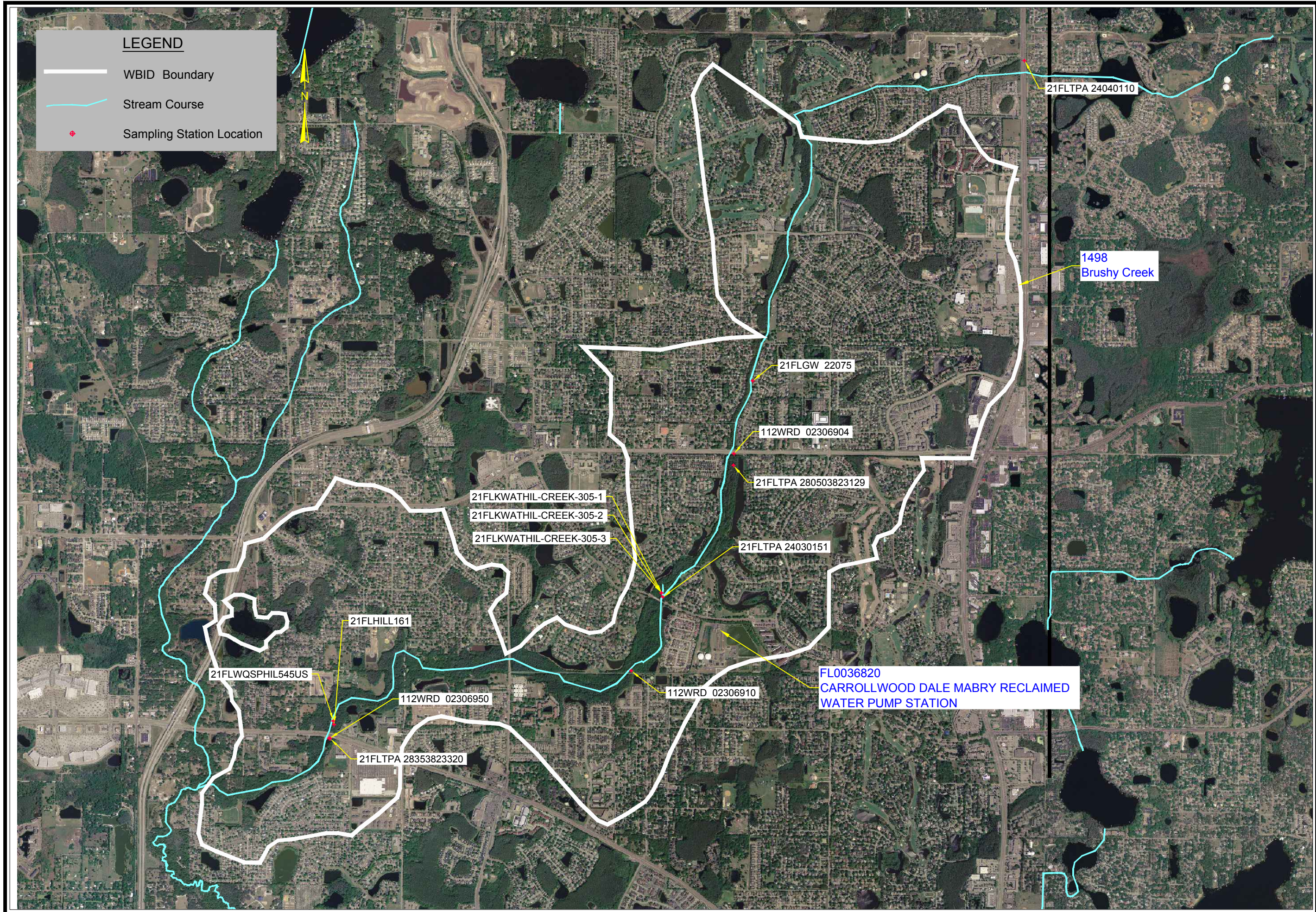


Figure 2-1
WBID Boundaries, Stream Reach, and Water Quality Stations - Brushy Creek (1498)

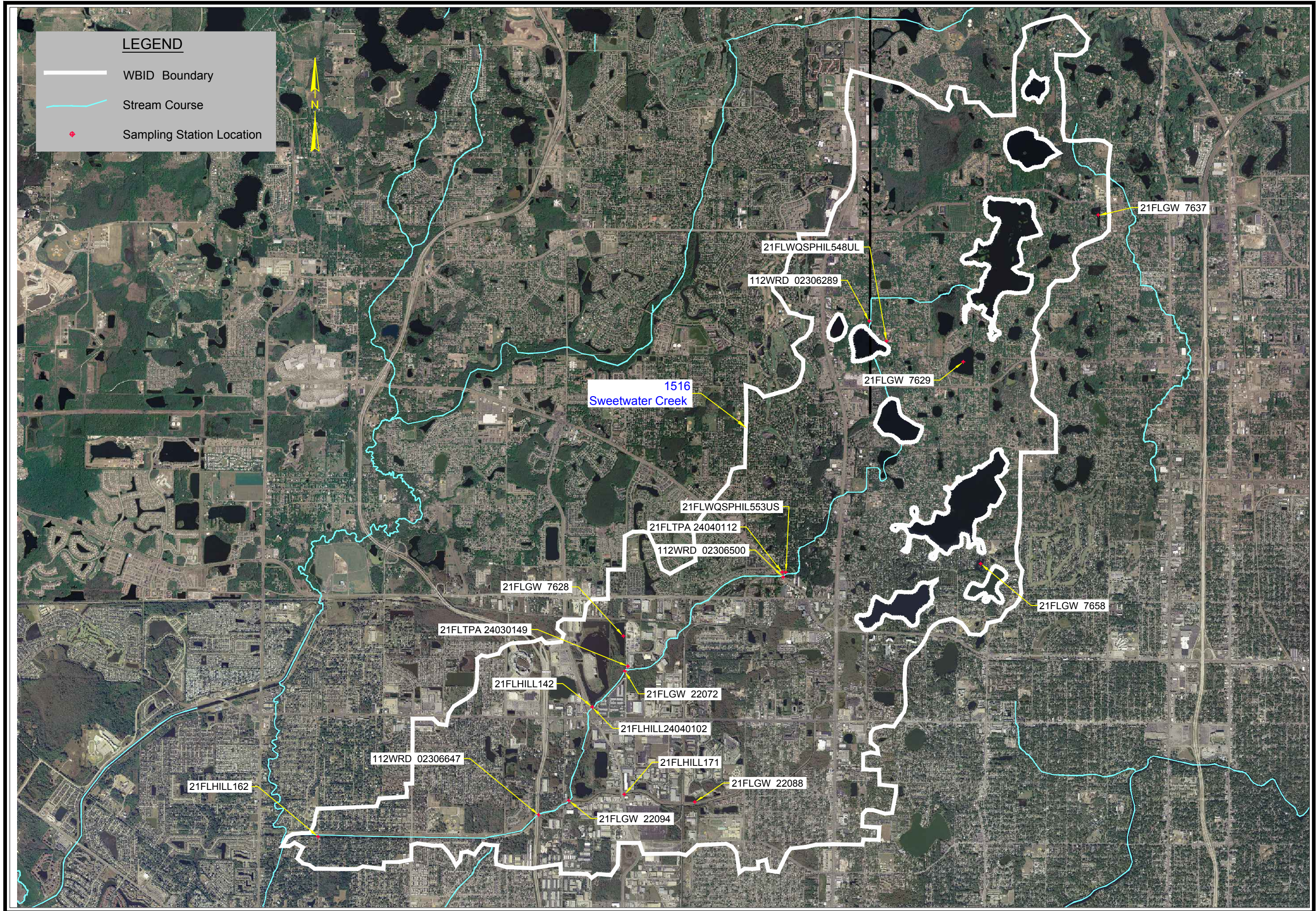


Figure 2-2
WBID Boundaries, Stream Reach, and Water Quality Stations - Sweetwater Creek (1516)

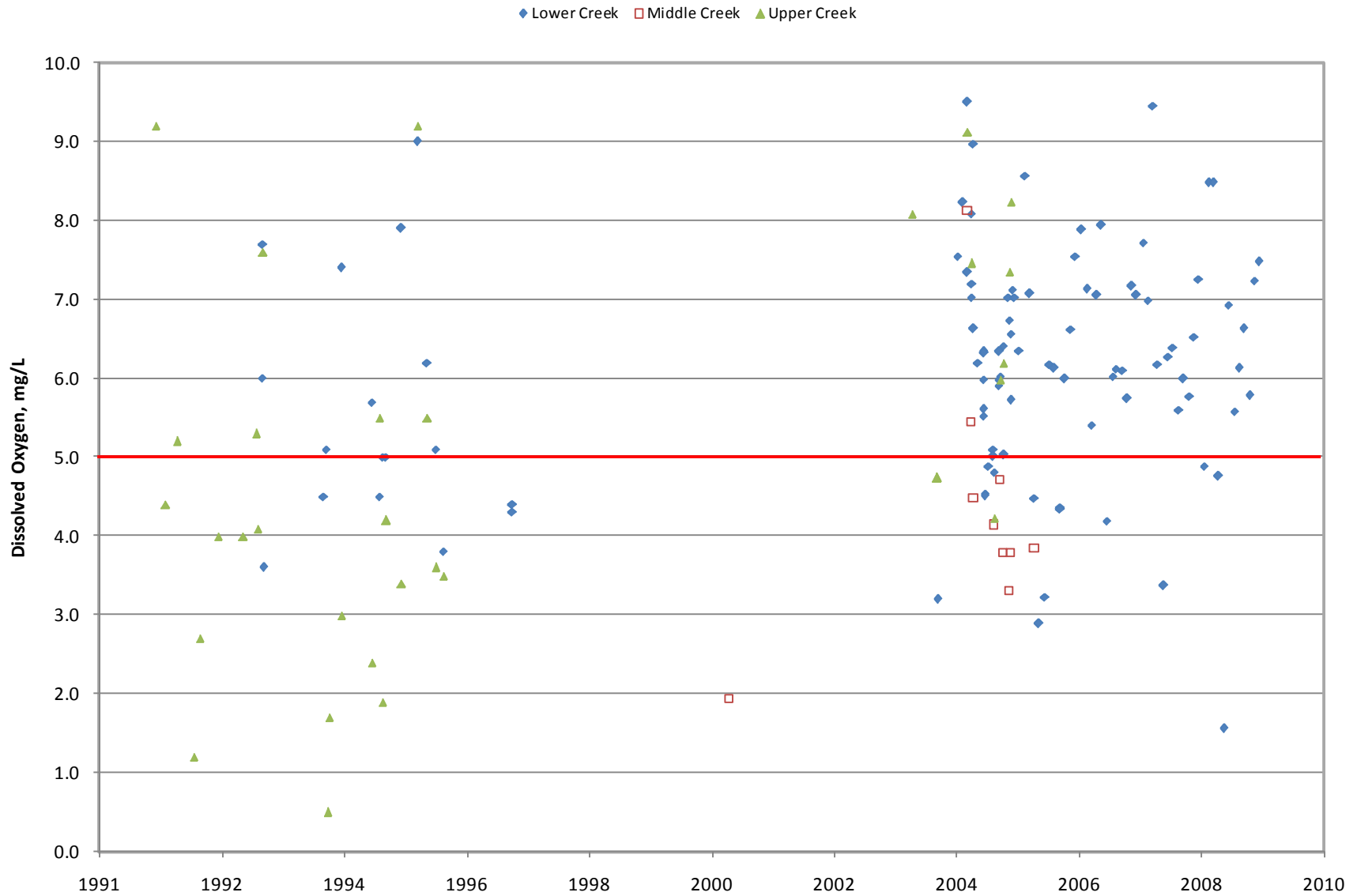


Figure 2-3
Dissolved Oxygen Observations assigned to the Brushy Creek WBID (All Stations)

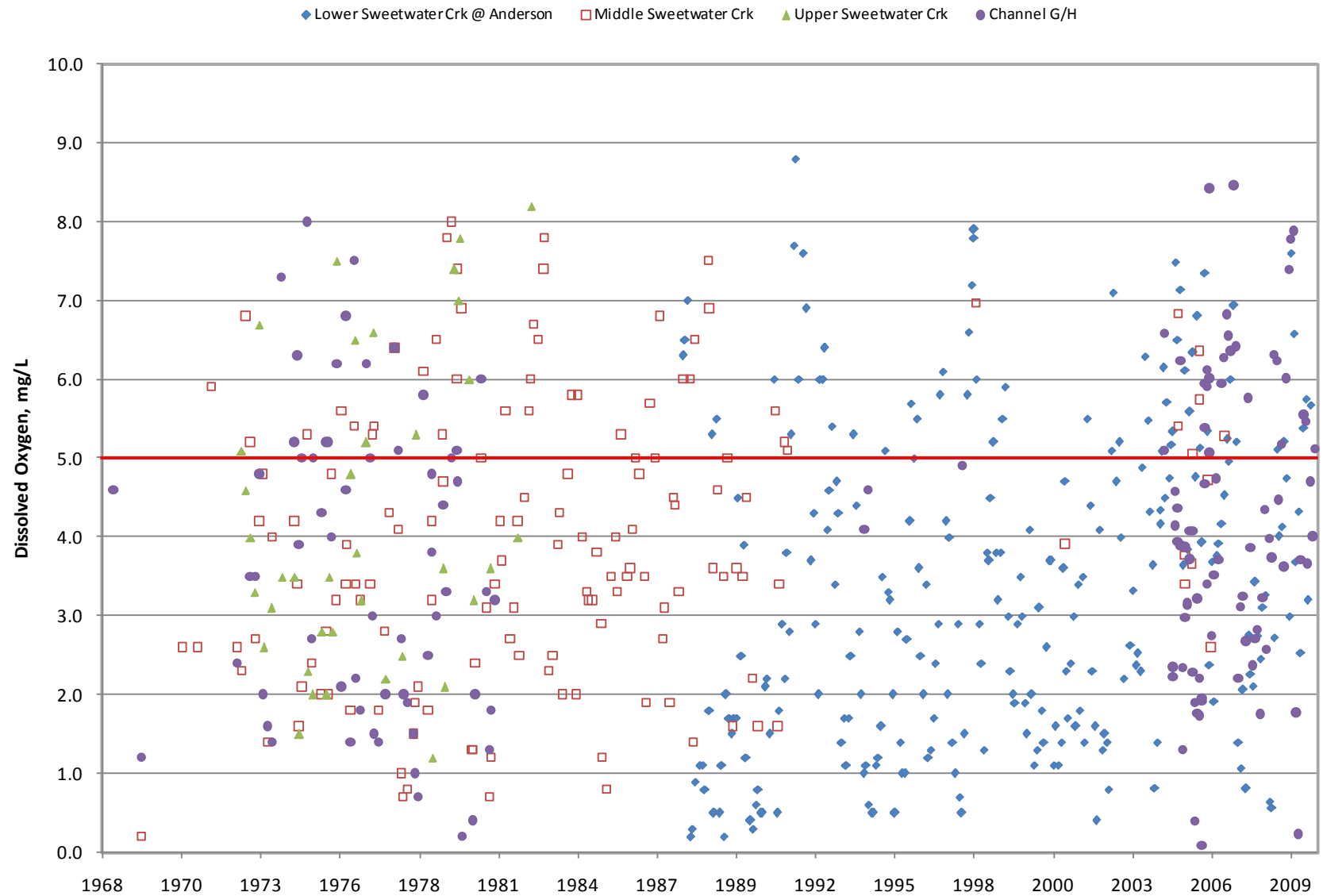


Figure 2-4
Dissolved Oxygen Observations assigned to the Sweetwater Creek WBID (All Stations)

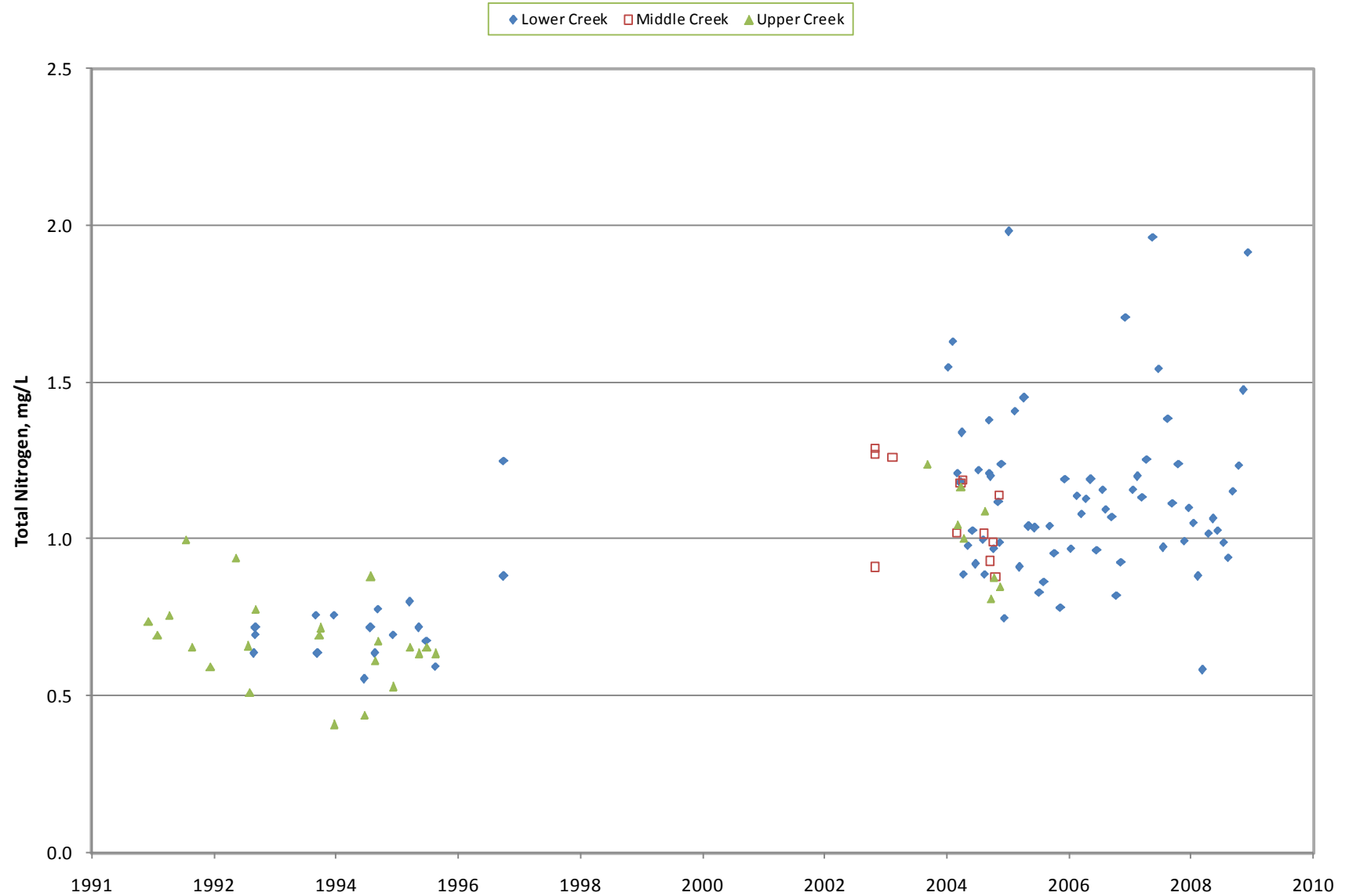


Figure 2-5
Total Nitrogen Observations assigned to the Brushy Creek WBID (All Stations)

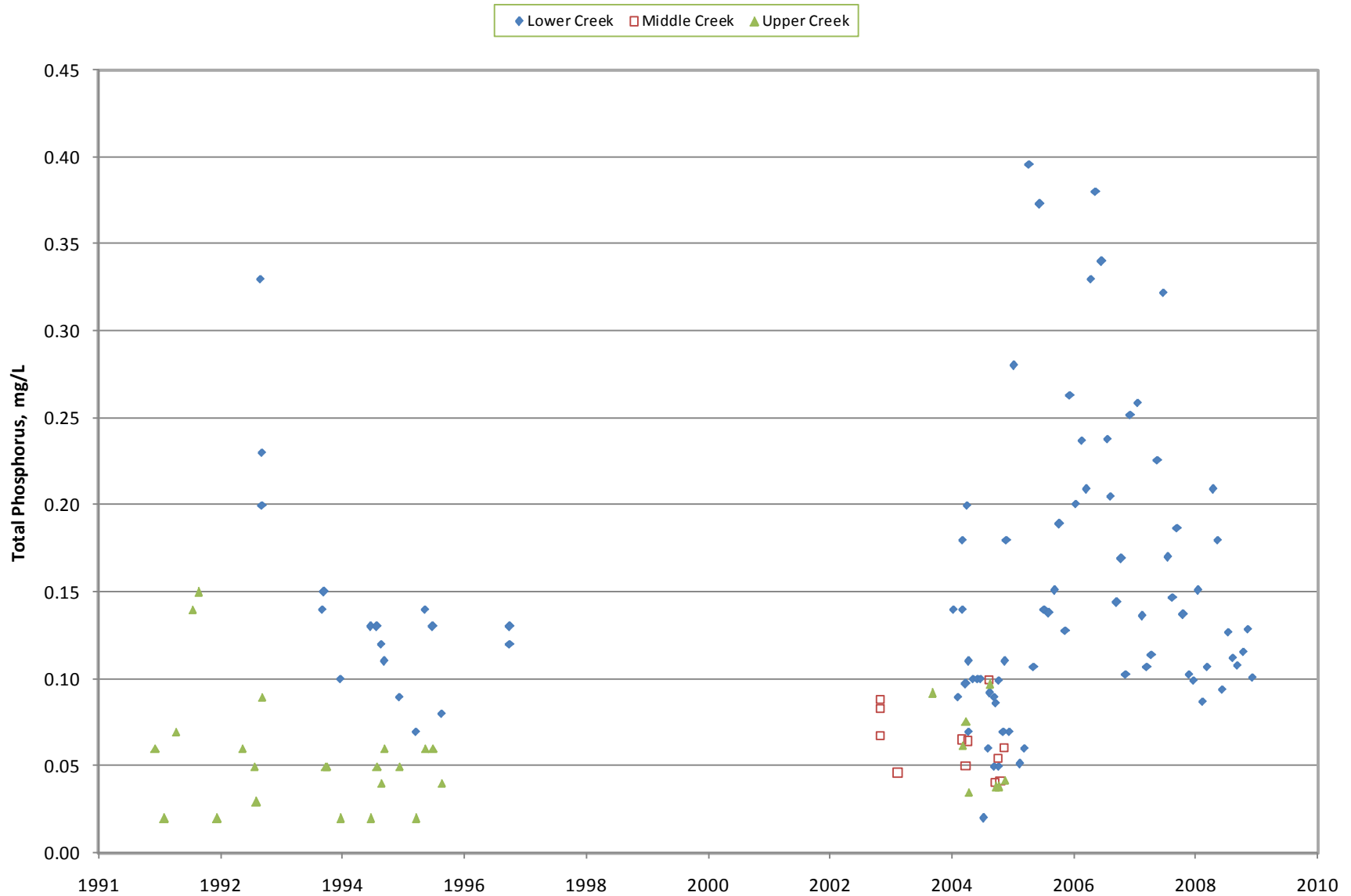


Figure 2-6

Total Phosphorus Observations assigned to the Brushy Creek WBID (All Stations)

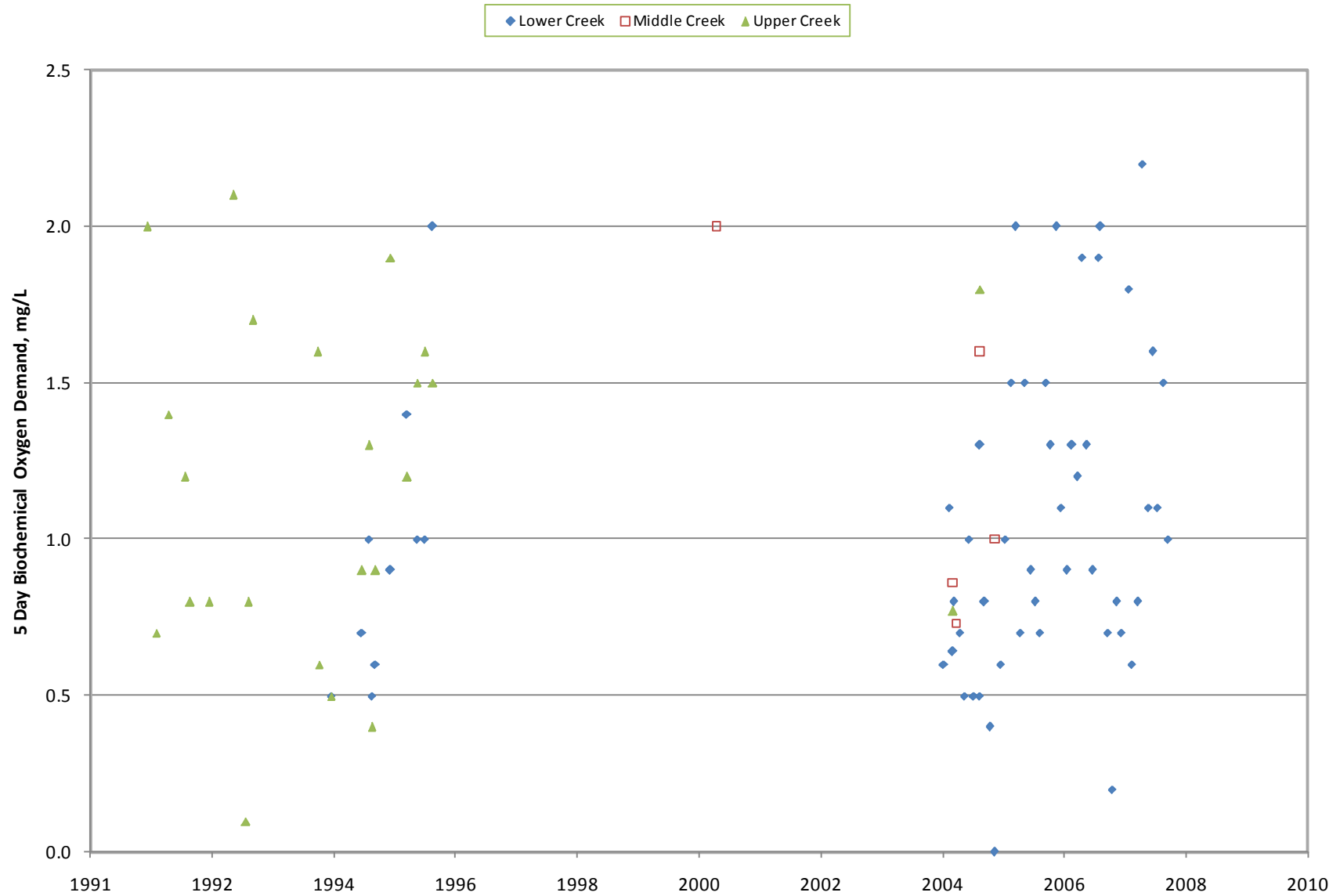


Figure 2-7
BOD₅ Observations assigned to the Brushy Creek WBID (All Stations)

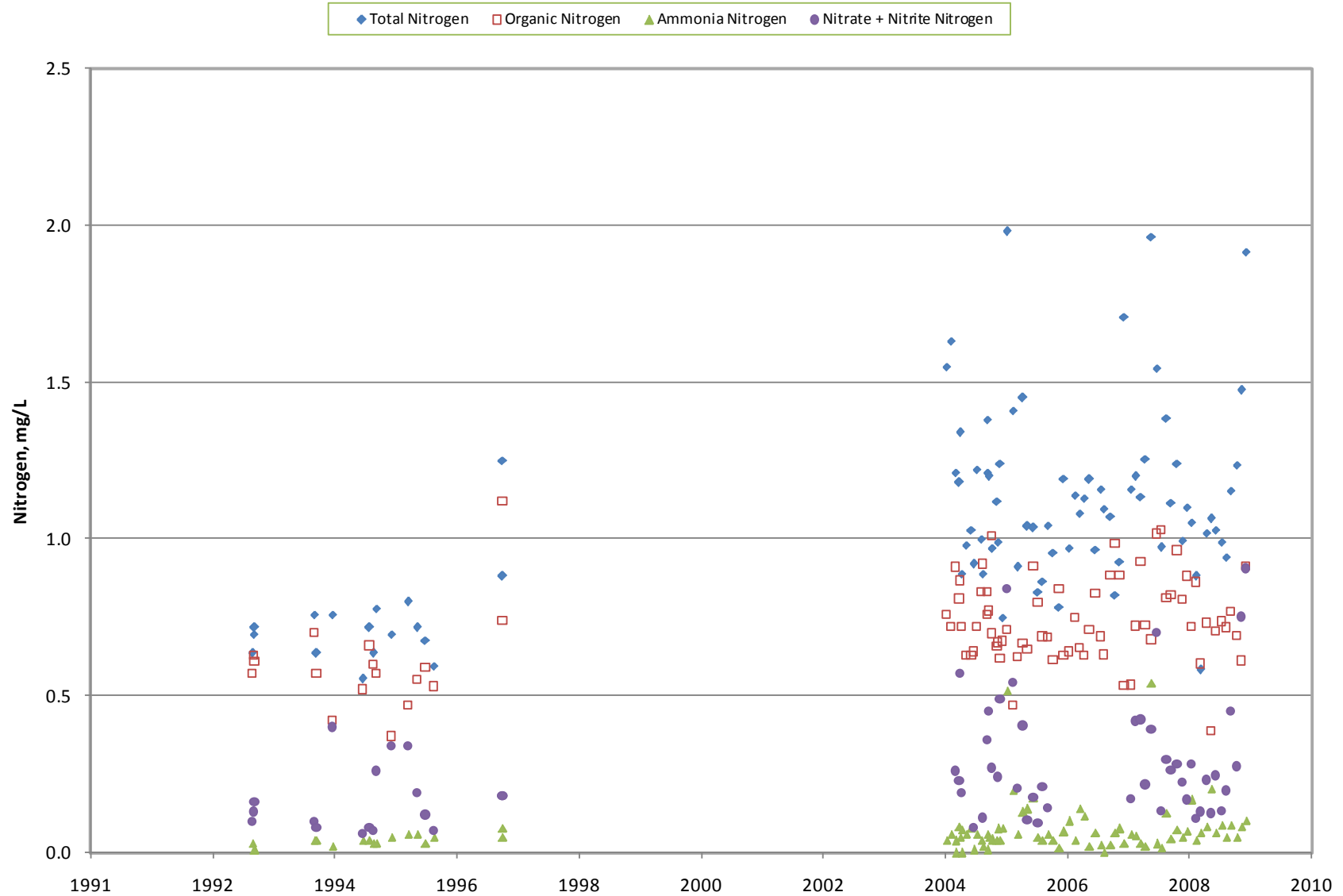


Figure 2-8
Nitrogen Species Observations assigned to the Brushy Creek WBID (All Stations)

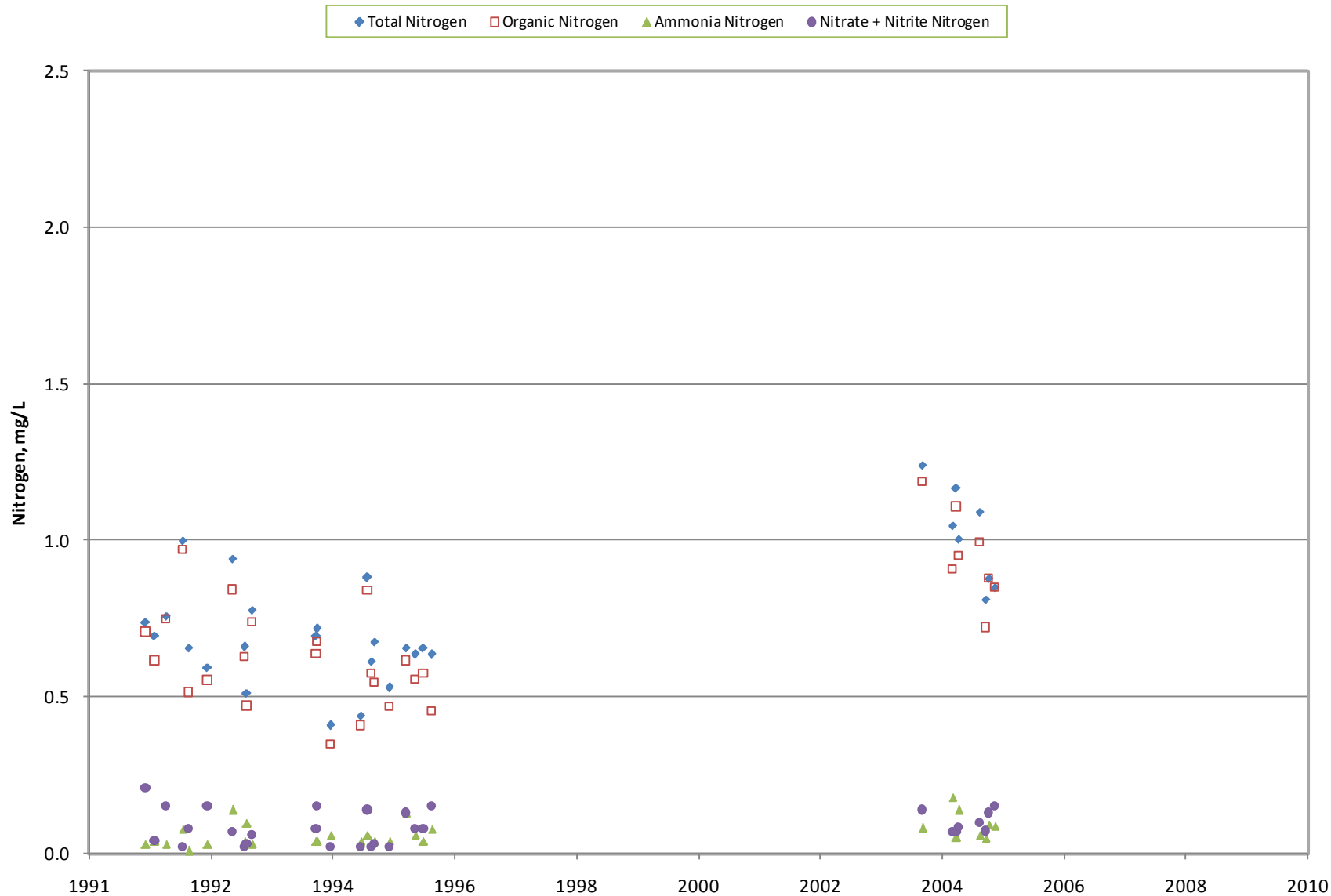


Figure 2-9
Nitrogen Species Observations for Upper Brushy Creek WBID

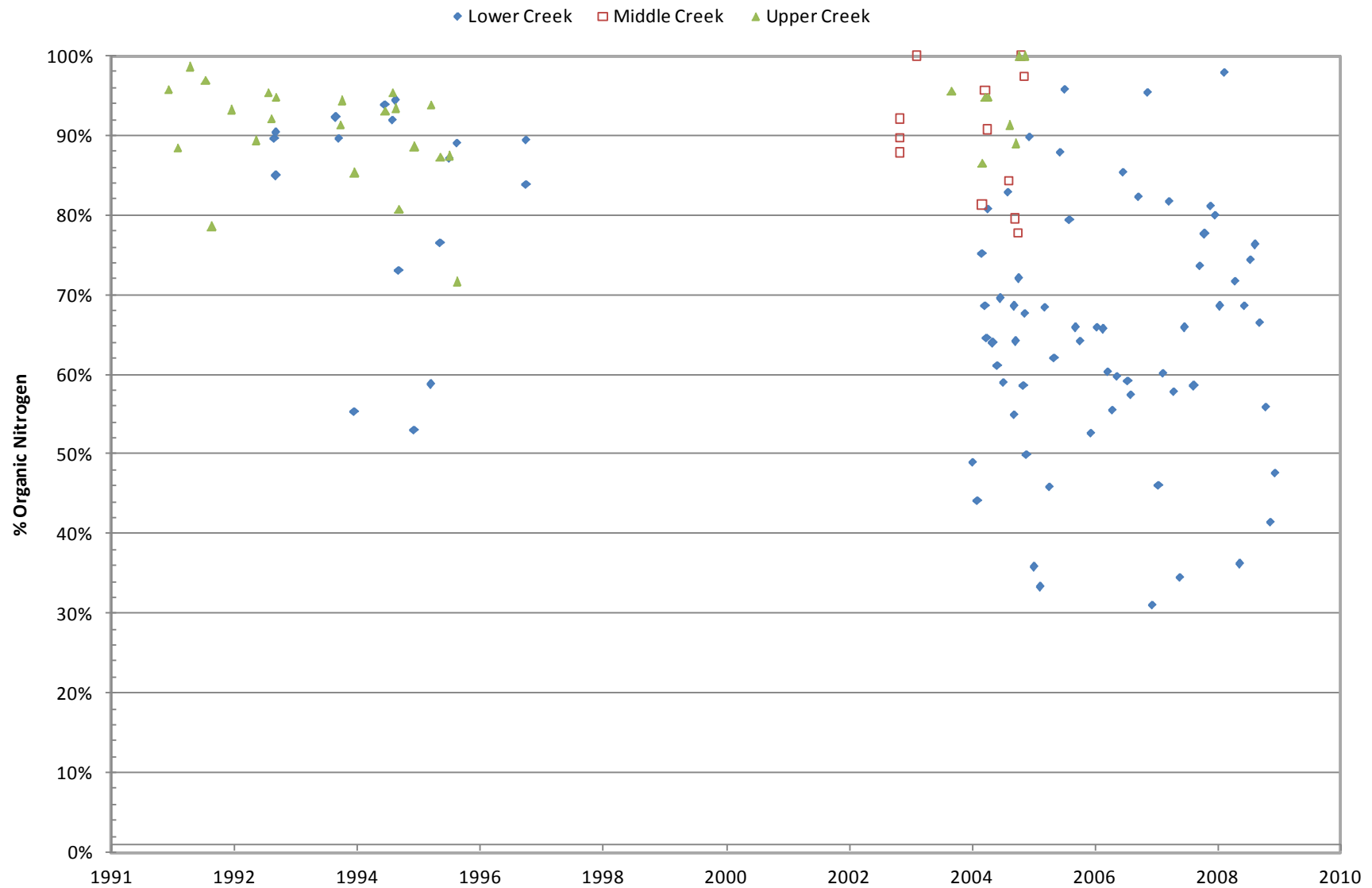


Figure 2-10
Percent Organic Nitrogen Observations in the Brushy Creek WBID (All Stations)

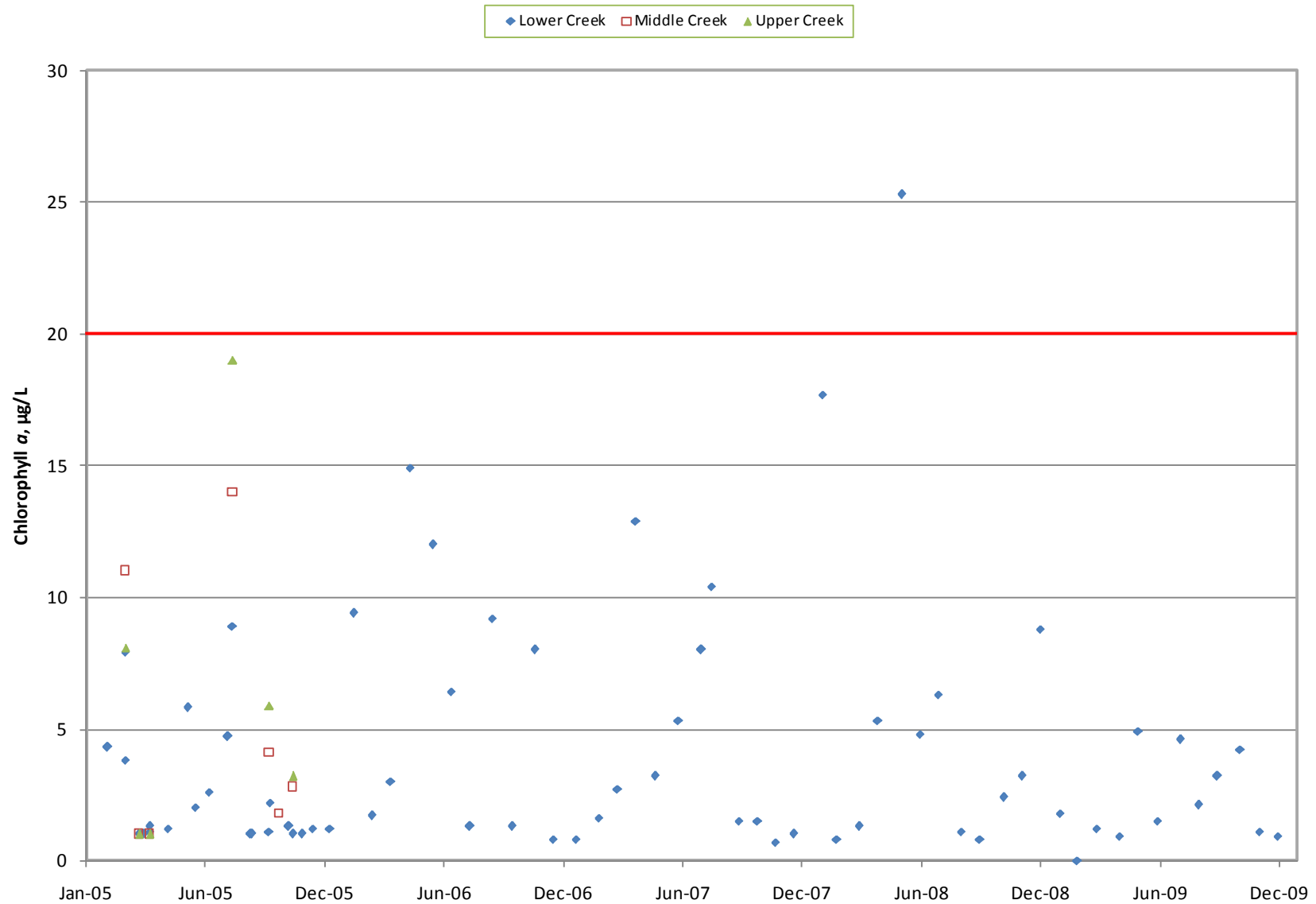


Figure 2-11
Chlorophyll a Observations assigned to the Brushy Creek WBID (Period of Record)

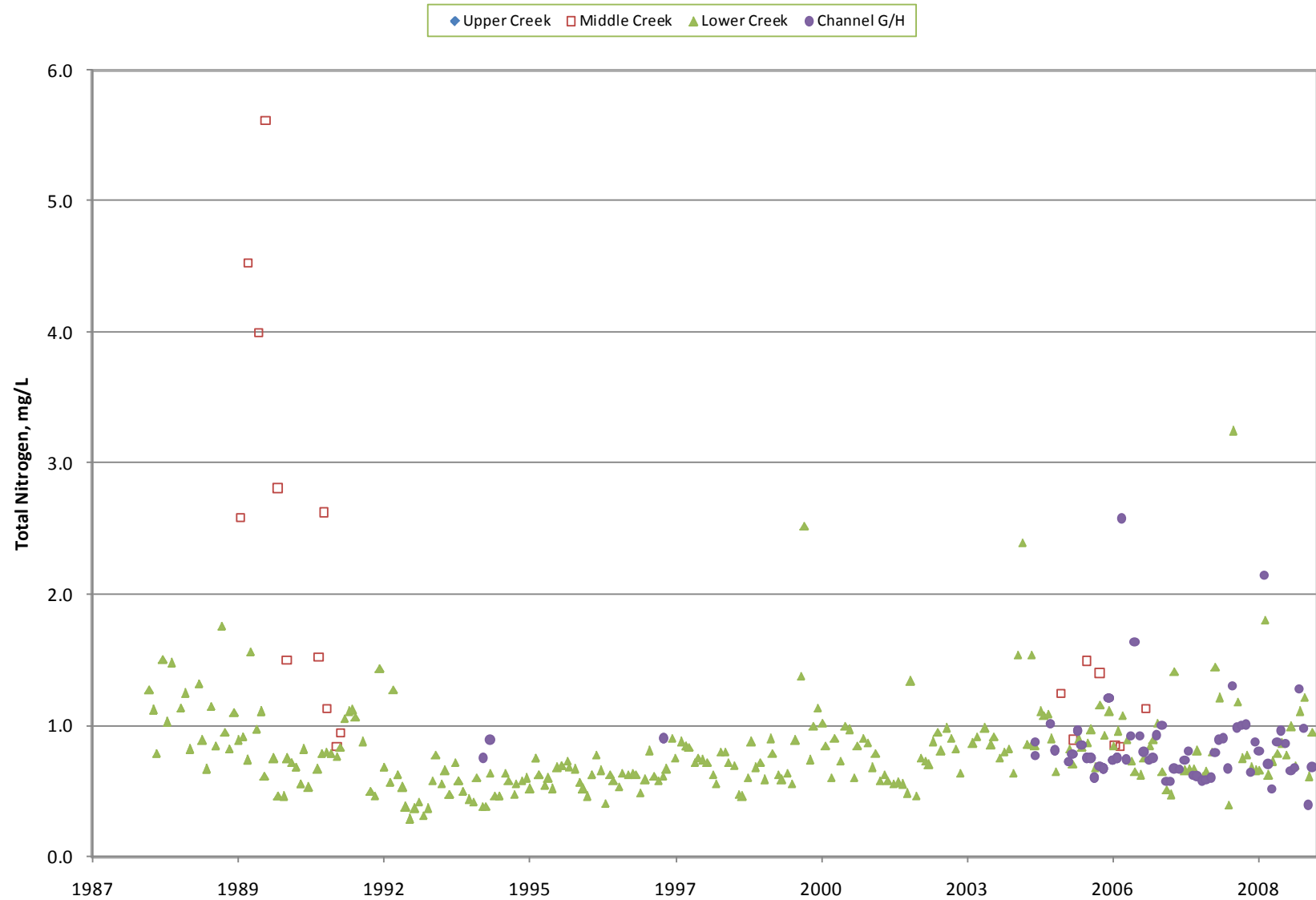


Figure 2-12

Total Nitrogen Observations assigned to the Sweetwater Creek WBID (All Stations)

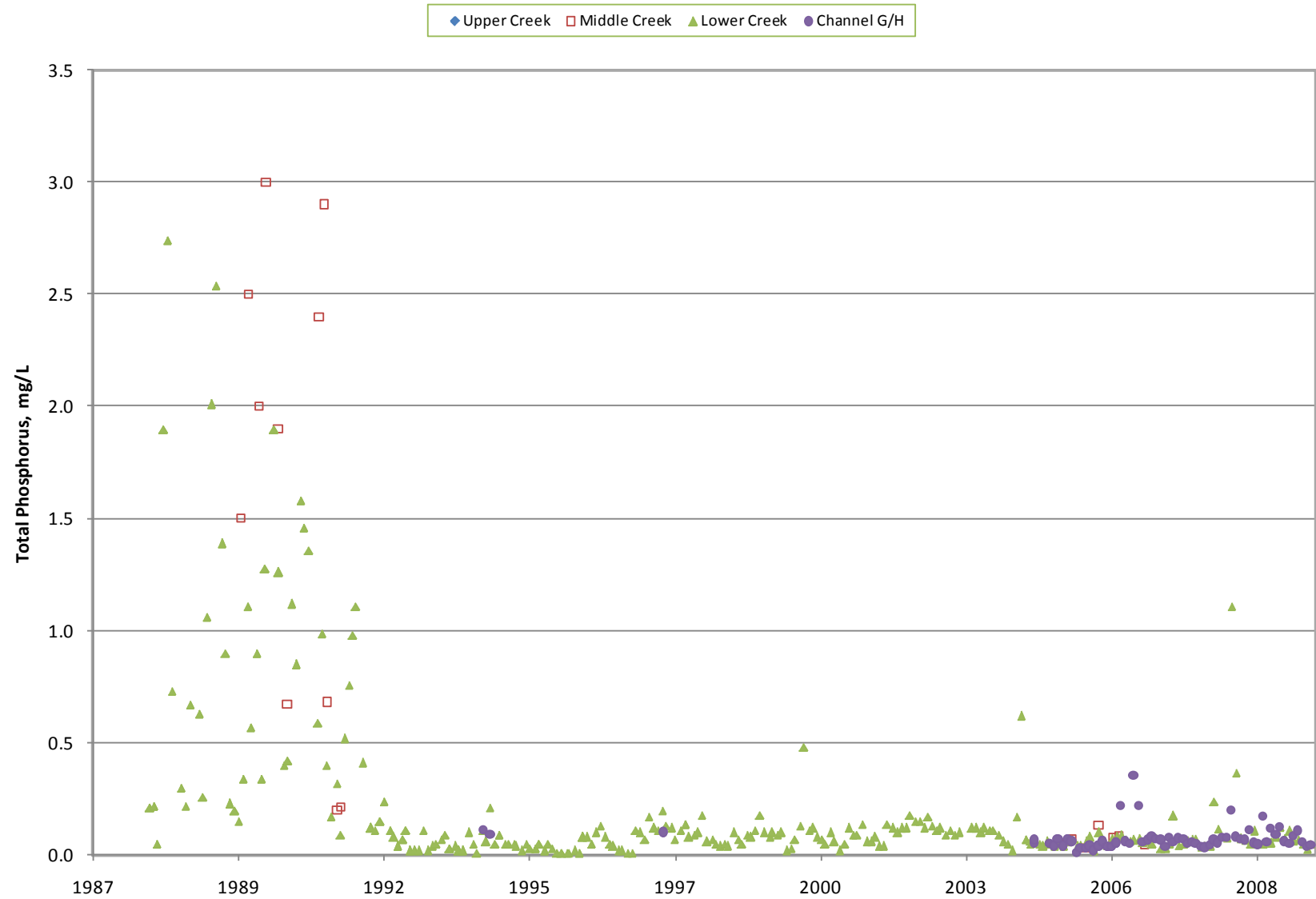


Figure 2-13

Total Phosphorus Observations assigned to the Sweetwater Creek WBID (All Stations)

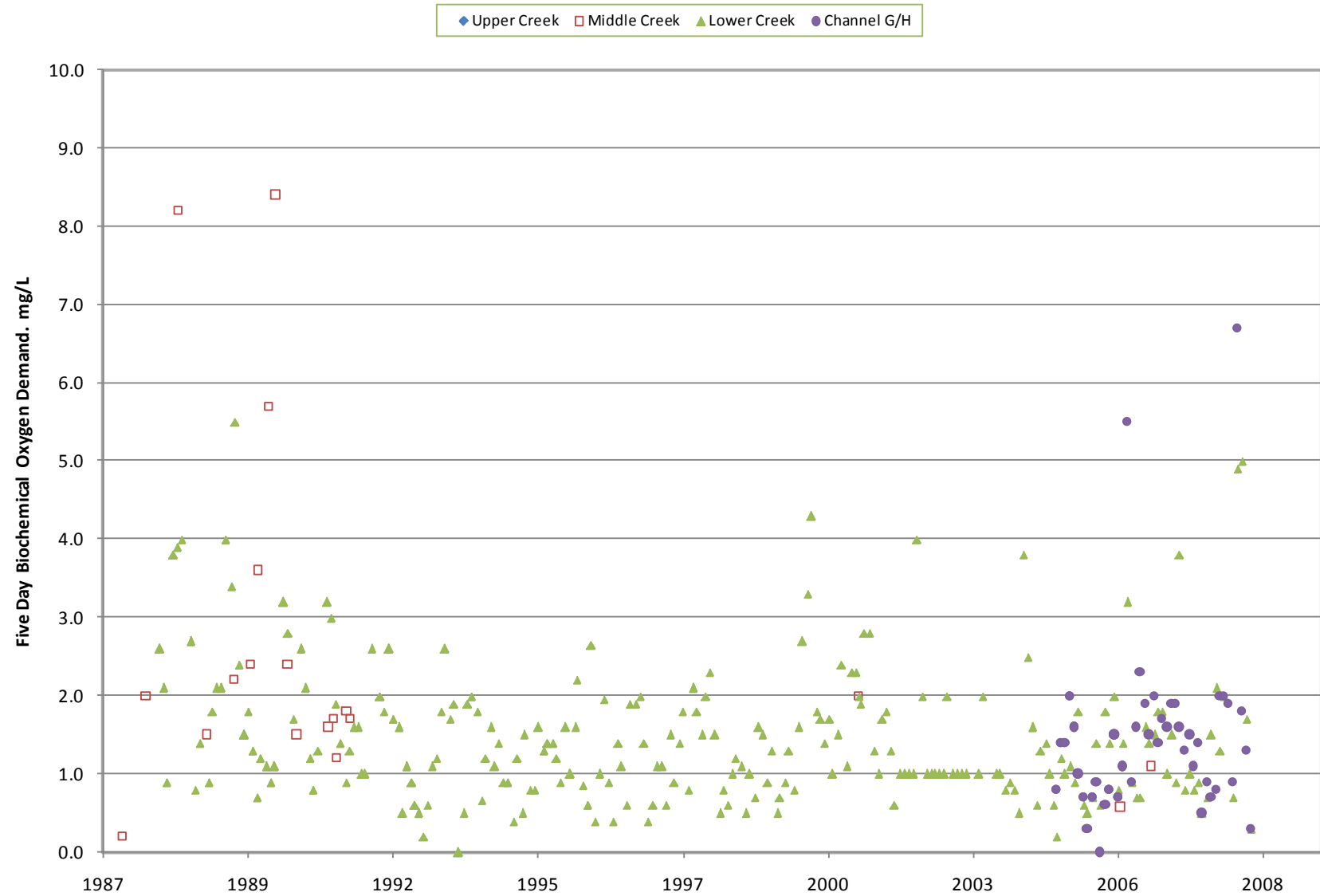


Figure 2-14
BOD₅ Observations assigned to the Sweetwater Creek WBID (All Stations)

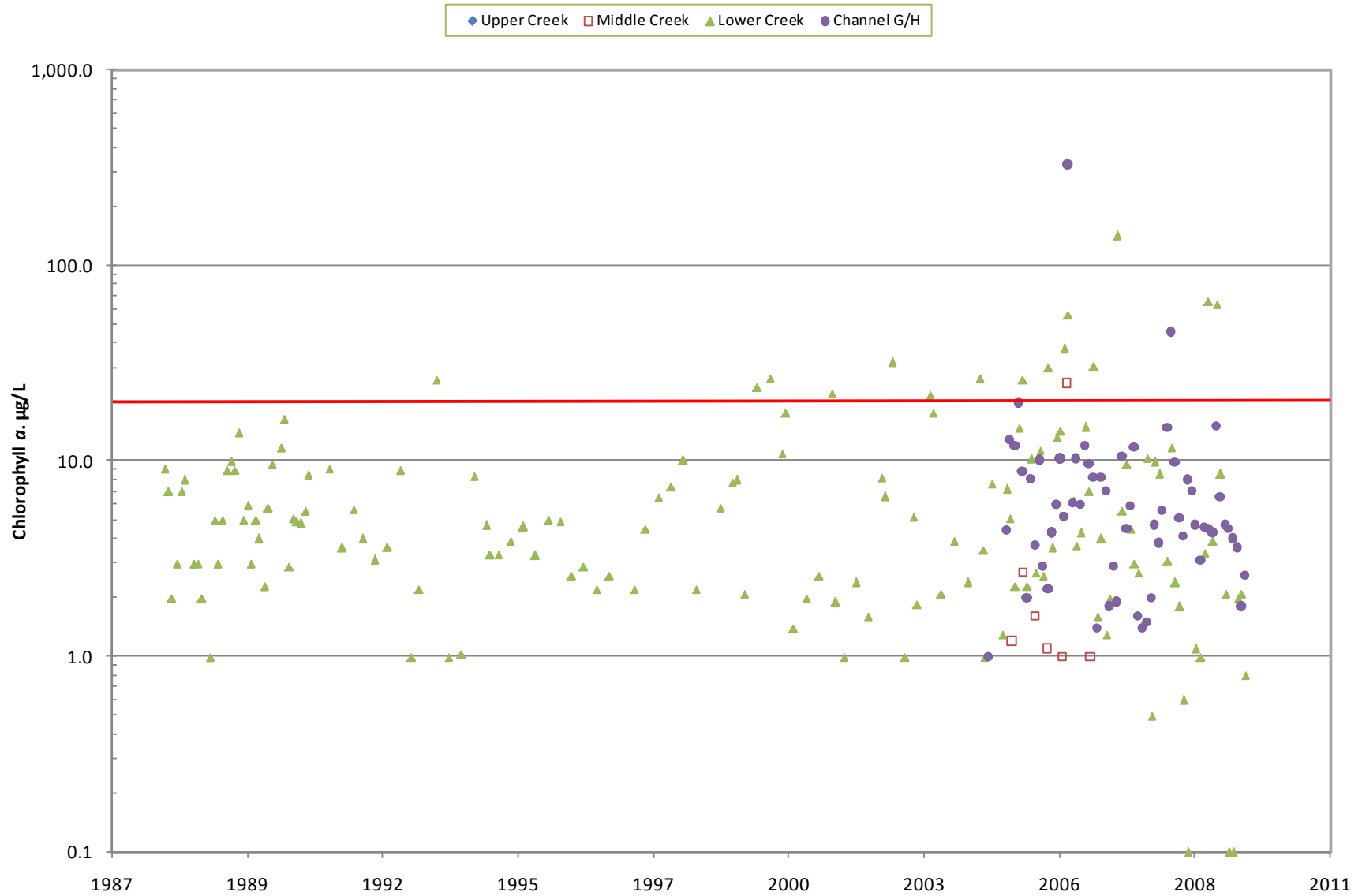


Figure 2-15a
Chlorophyll a Observations assigned to the Sweetwater Creek WBID (Period of Record)

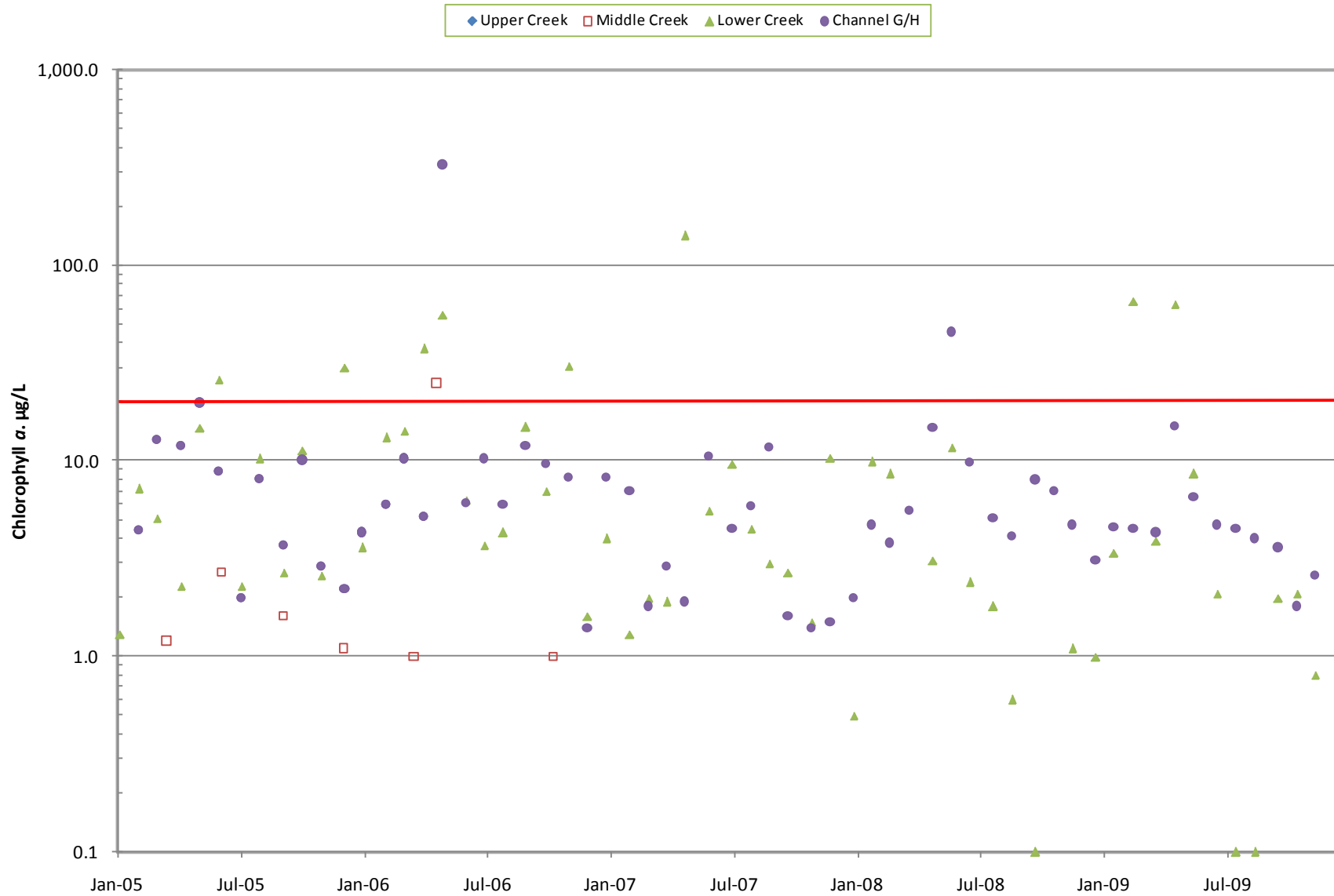


Figure 2-15b
Chlorophyll a Observations assigned to the Sweetwater Creek WBID (Current)

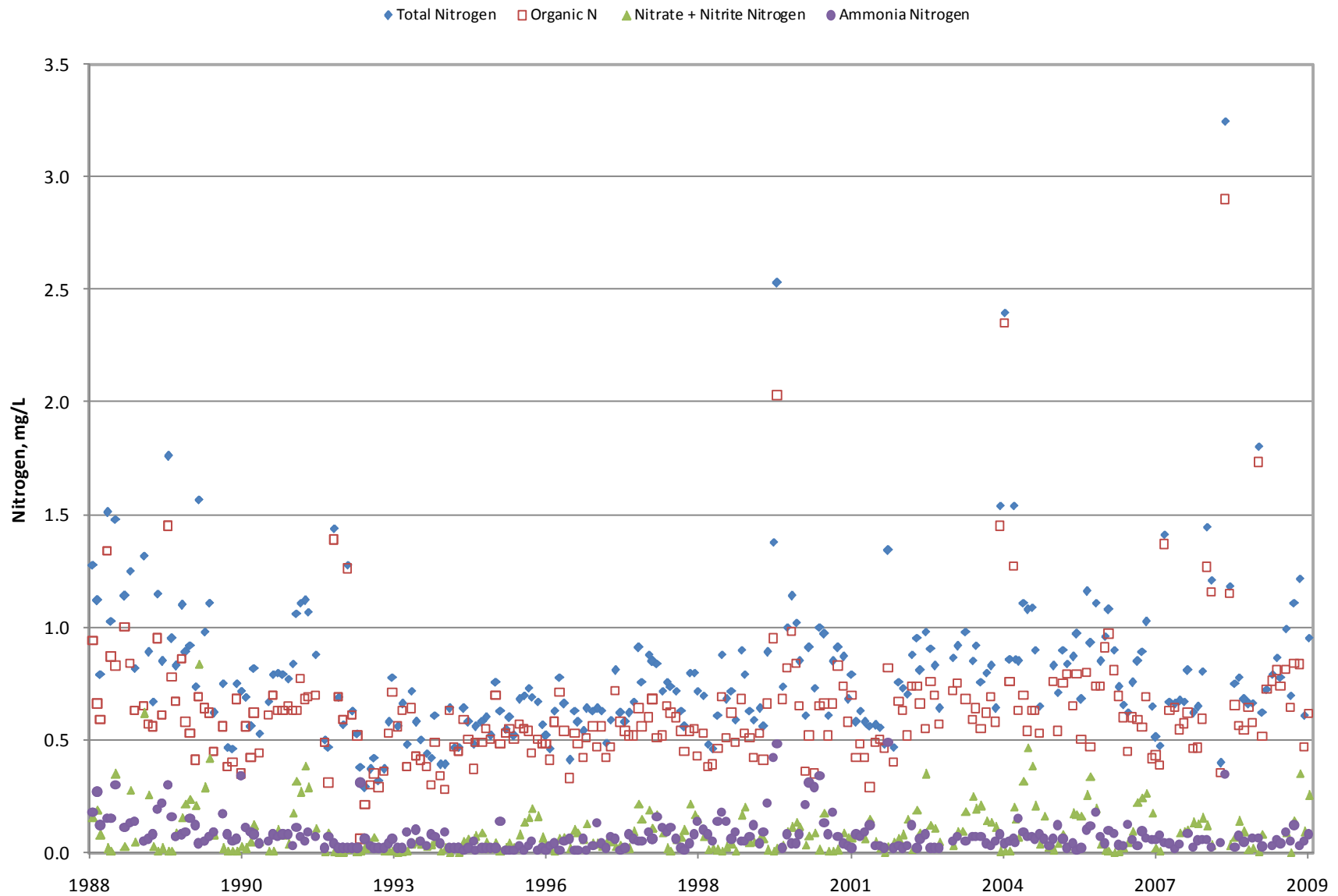


Figure 2-16a
Nitrogen Species Observations for Sweetwater Creek WBID

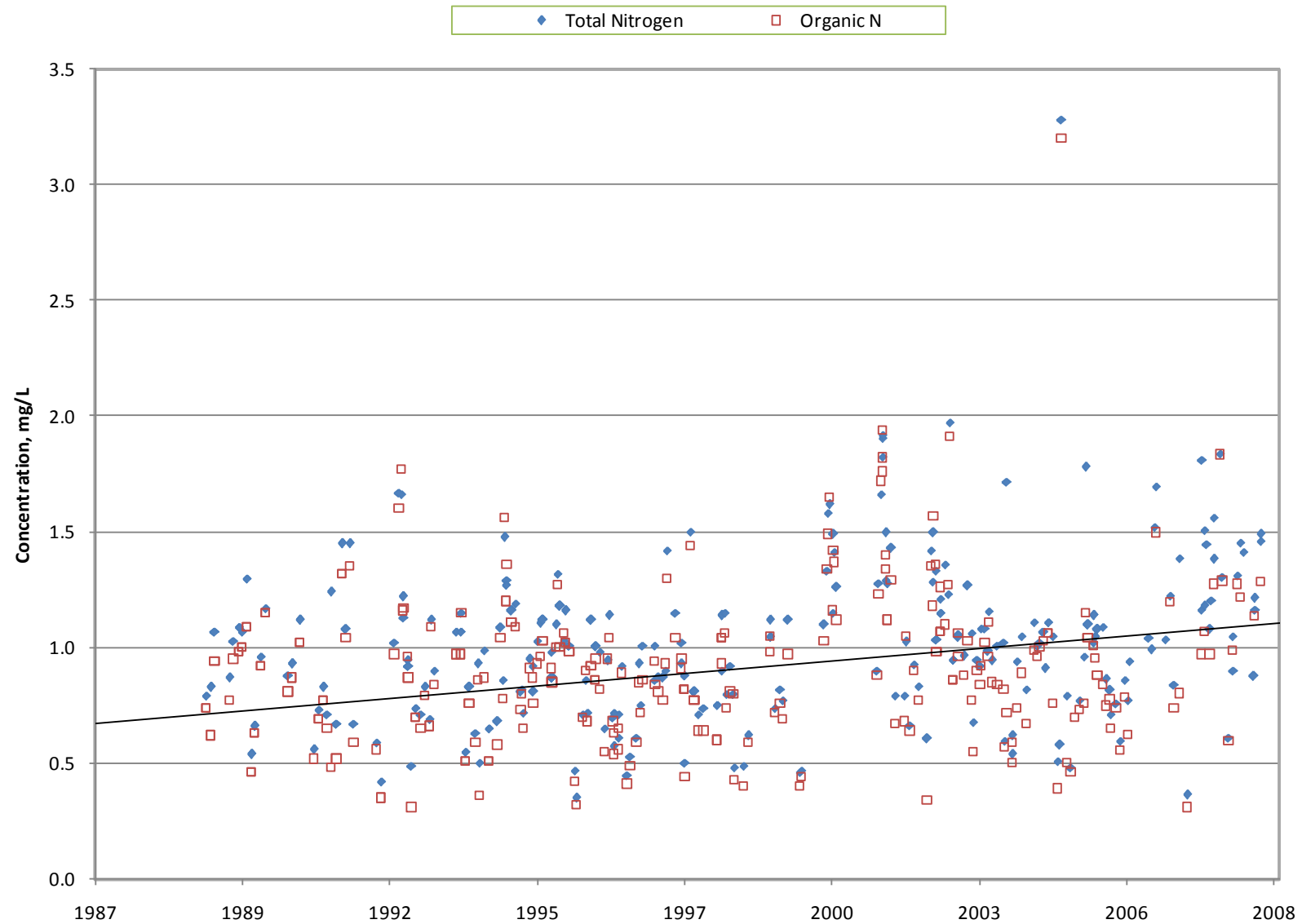


Figure 2-16b
Total and Organic Nitrogen Species for Trout Creek WBID (1455)

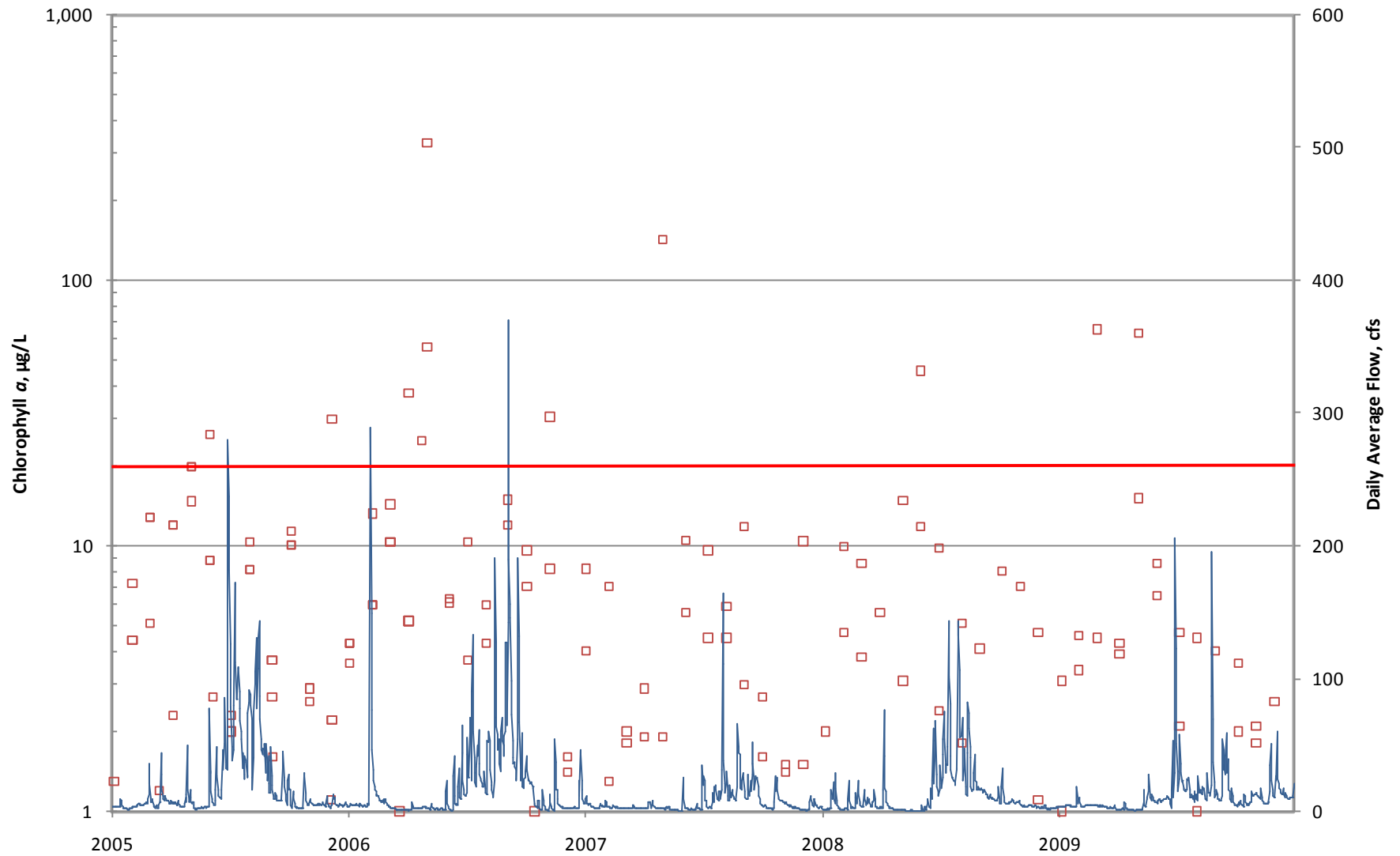


Figure 2-17
Daily Flows on Sweetwater Creek versus Chlorophyll *a* (All Stations)

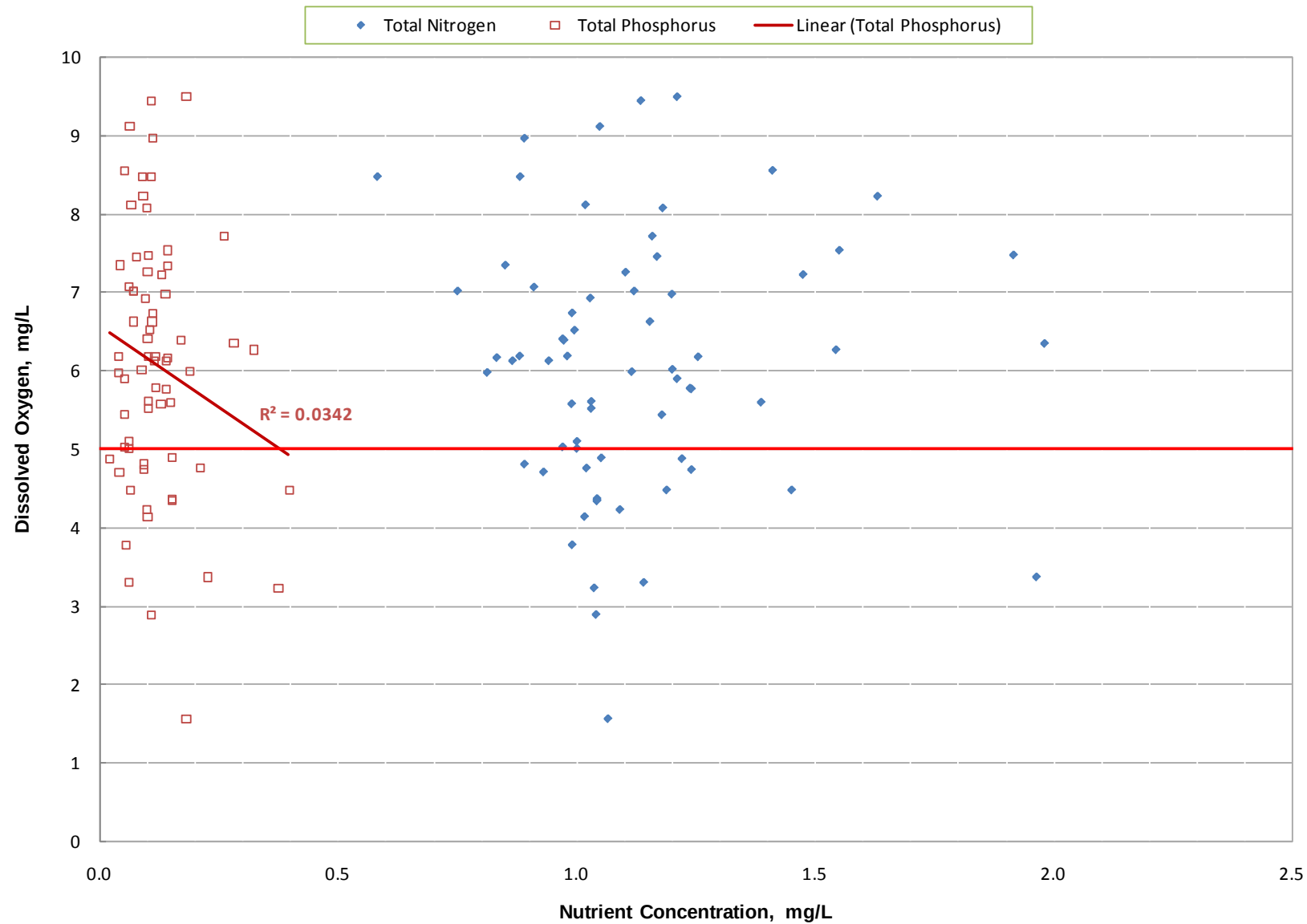


Figure 2-18

Paired Measurements for Nutrients versus Dissolved Oxygen in Brushy Creek (2004-2009)

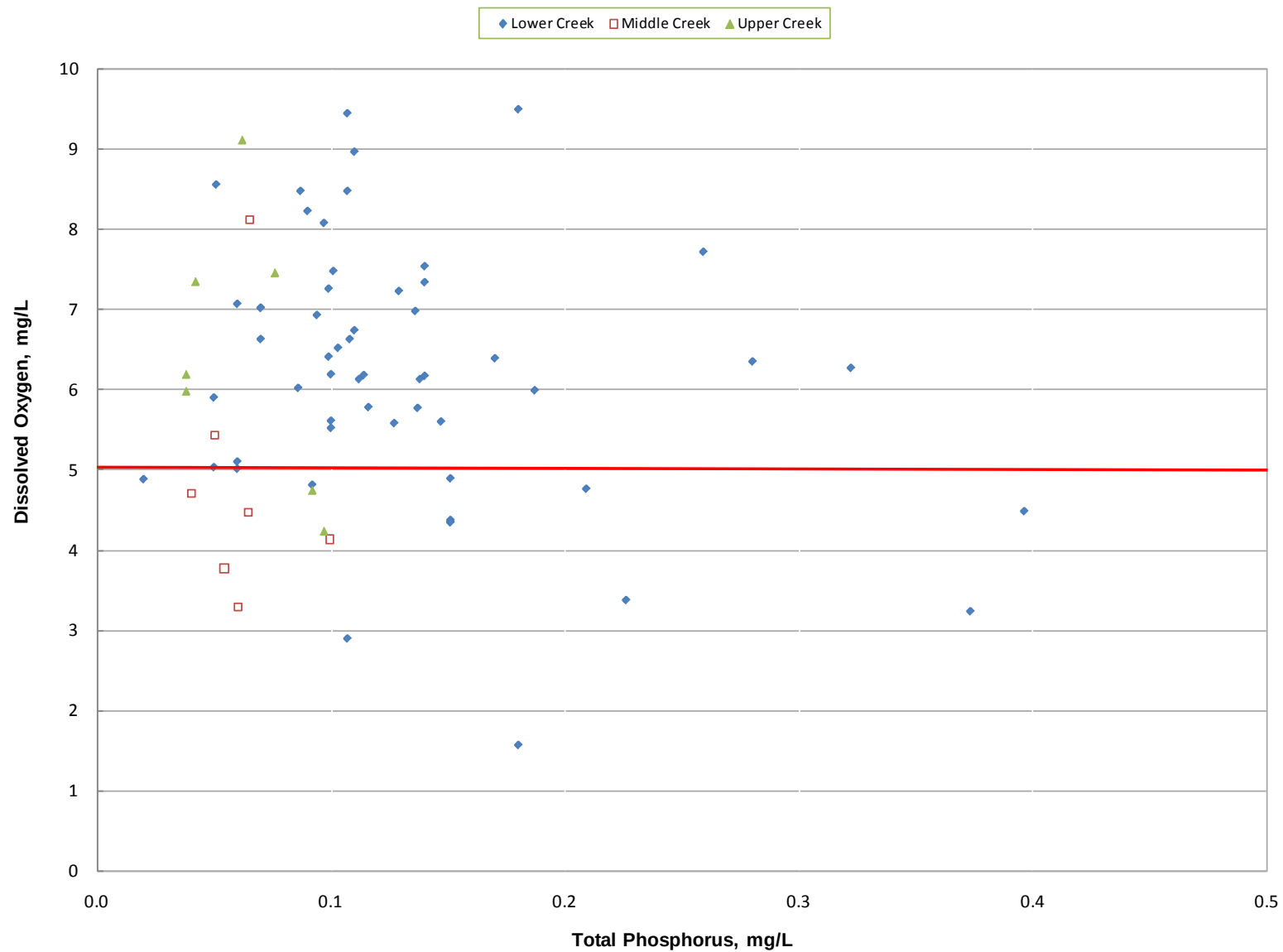


Figure 2-19

Paired Measurements for Total Phosphorus versus Dissolved Oxygen in Brushy Creek (2004-2009)

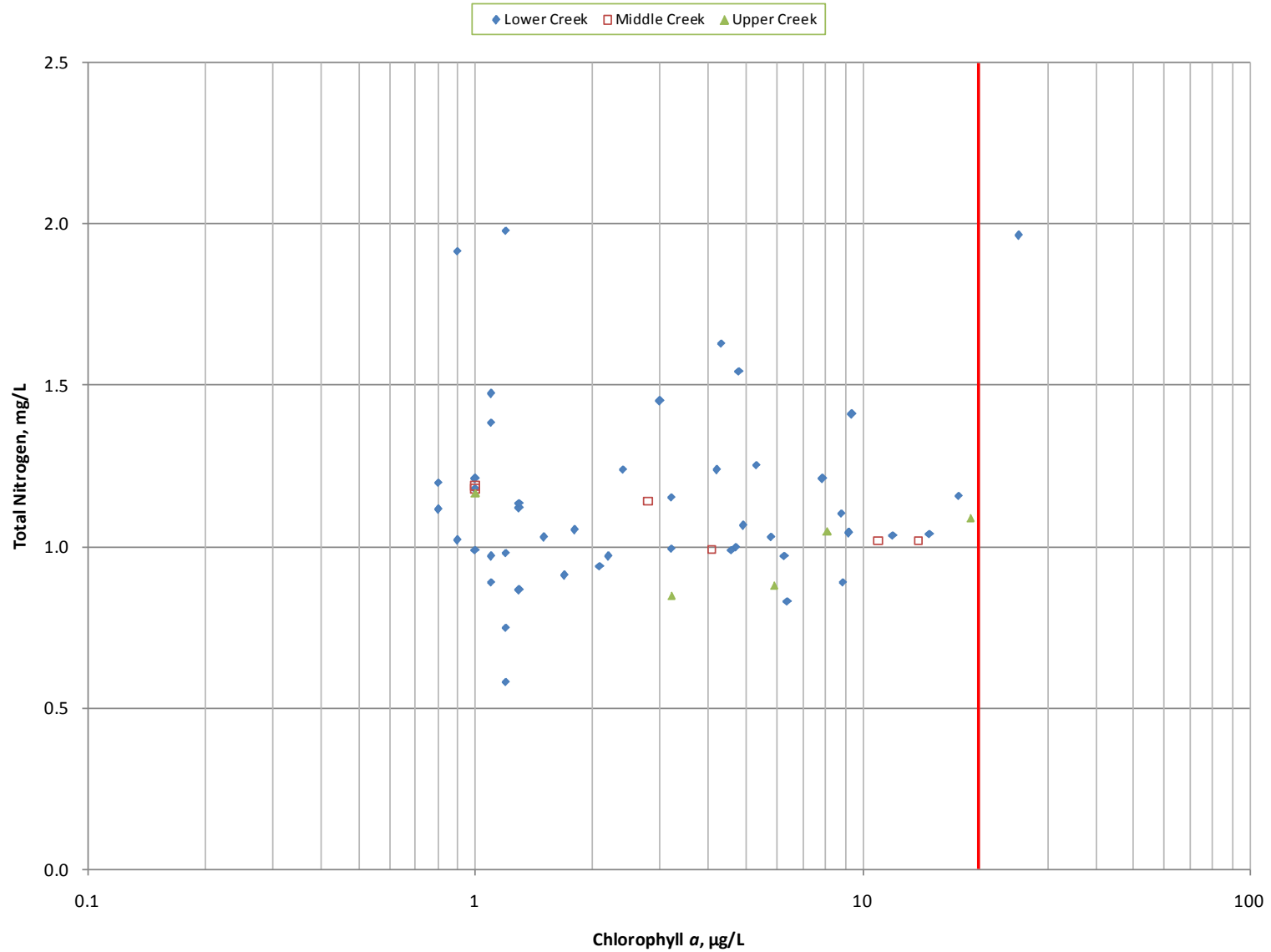


Figure 2-20

Paired Measurements for Total Nitrogen versus Chlorophyll *a* in Brushy Creek (2004-2009)

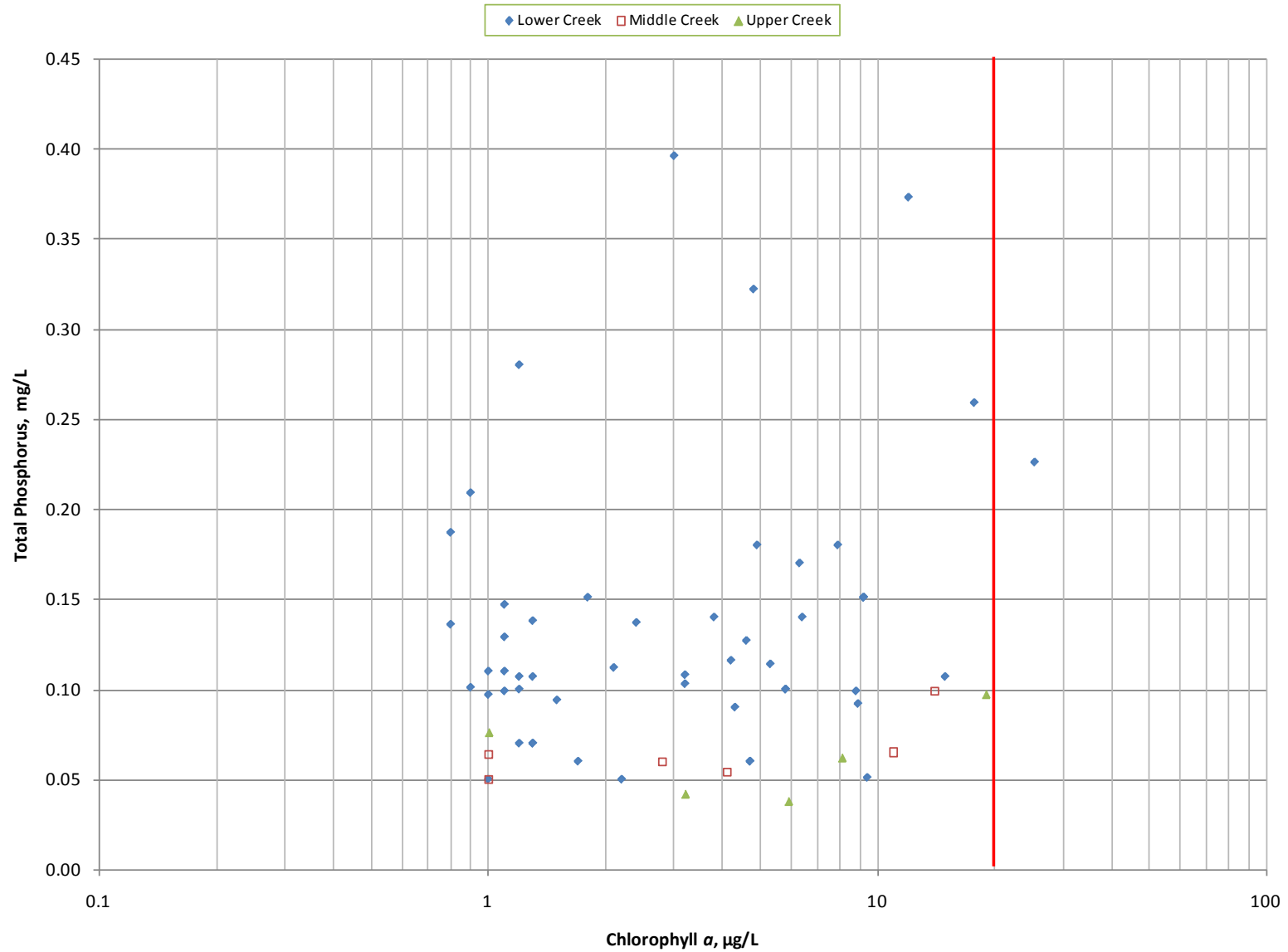


Figure 2-21

Paired Measurements for Total Phosphorus versus Chlorophyll *a* in Brushy Creek (2004-2009)

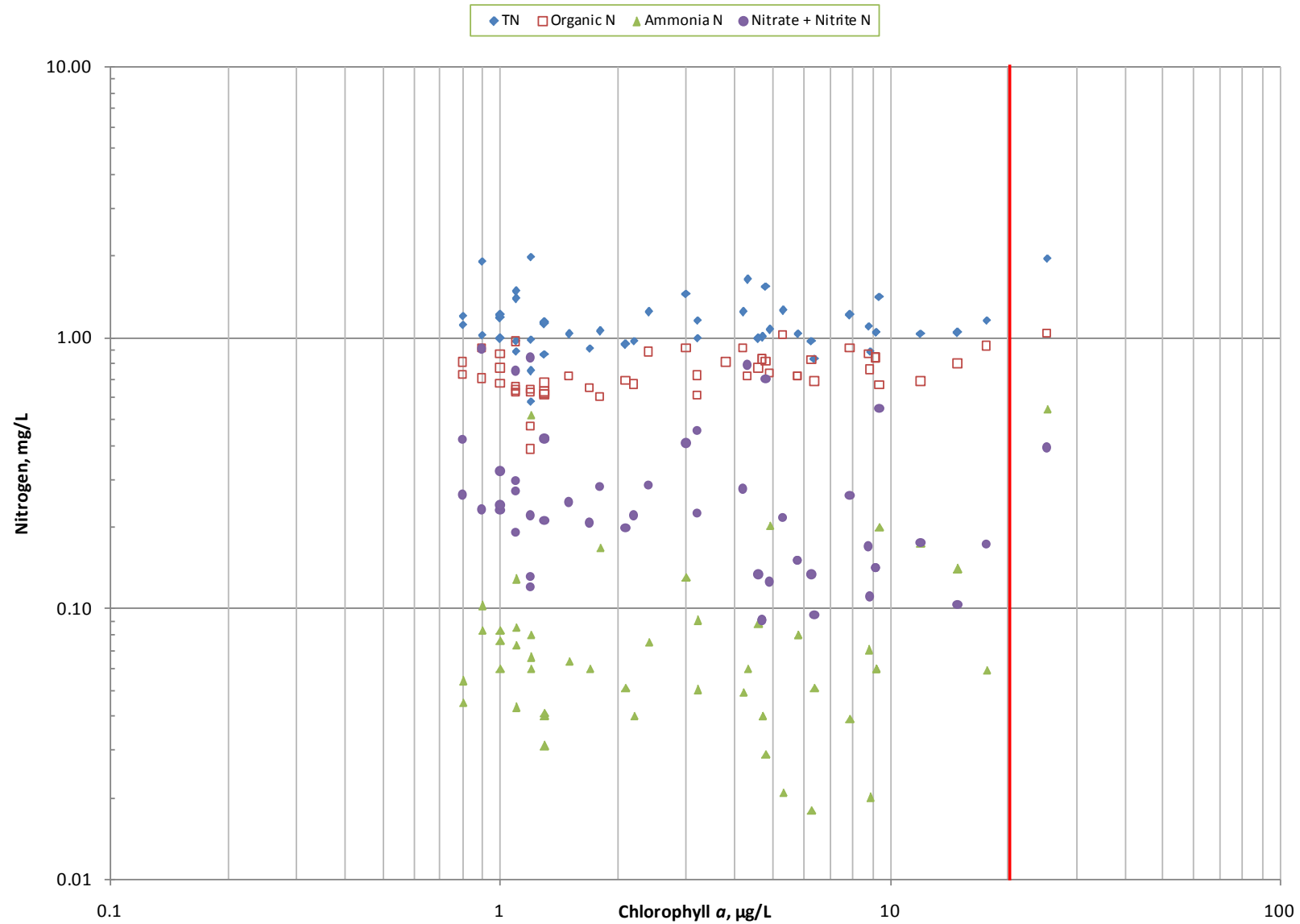


Figure 2-22

Paired Measurements for Nitrogen Species versus Chlorophyll *a* in Brushy Creek (2004-2009)

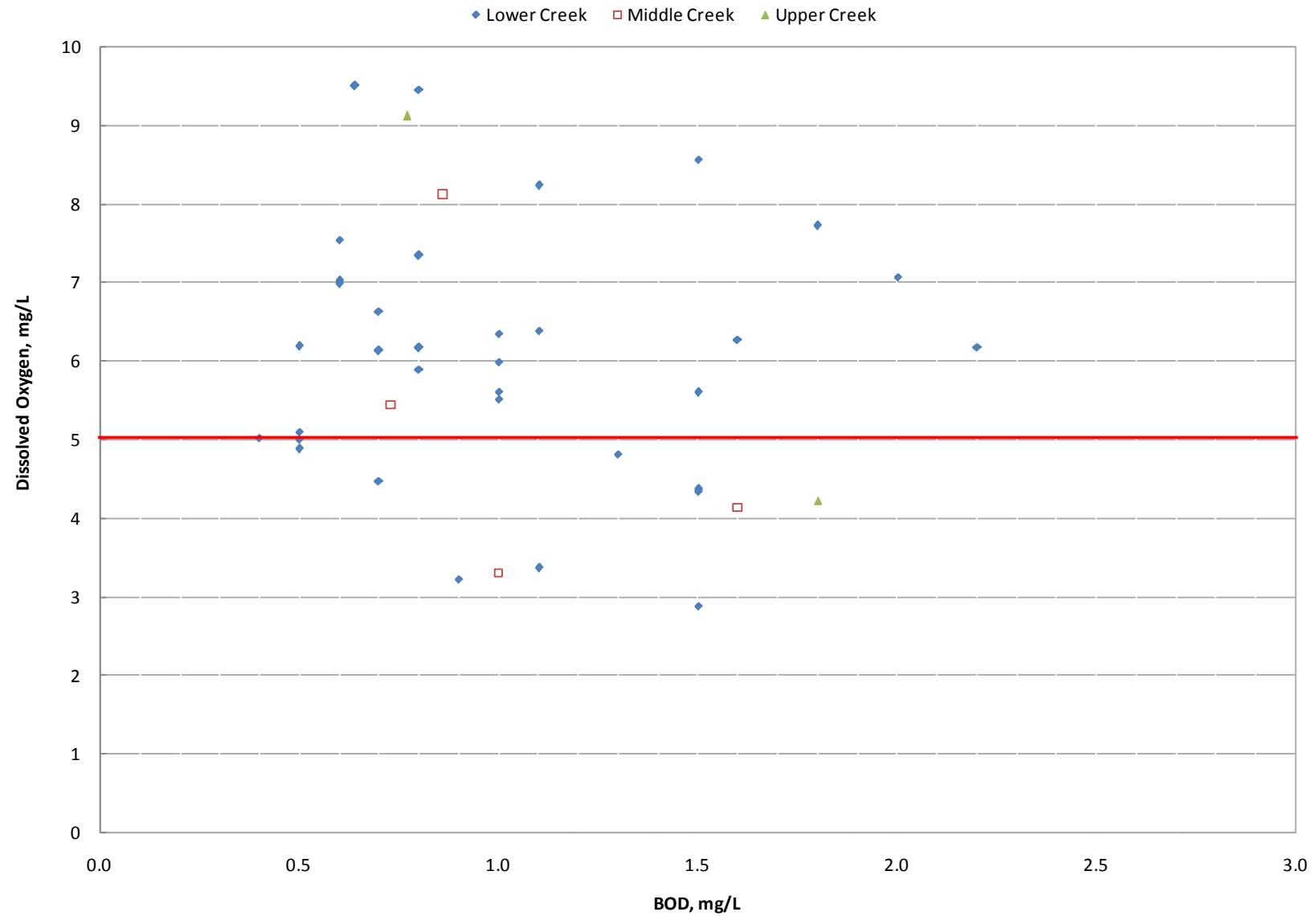


Figure 2-23

Paired Measurements for BOD₅ versus Dissolved Oxygen in Brushy Creek (2004-2009)

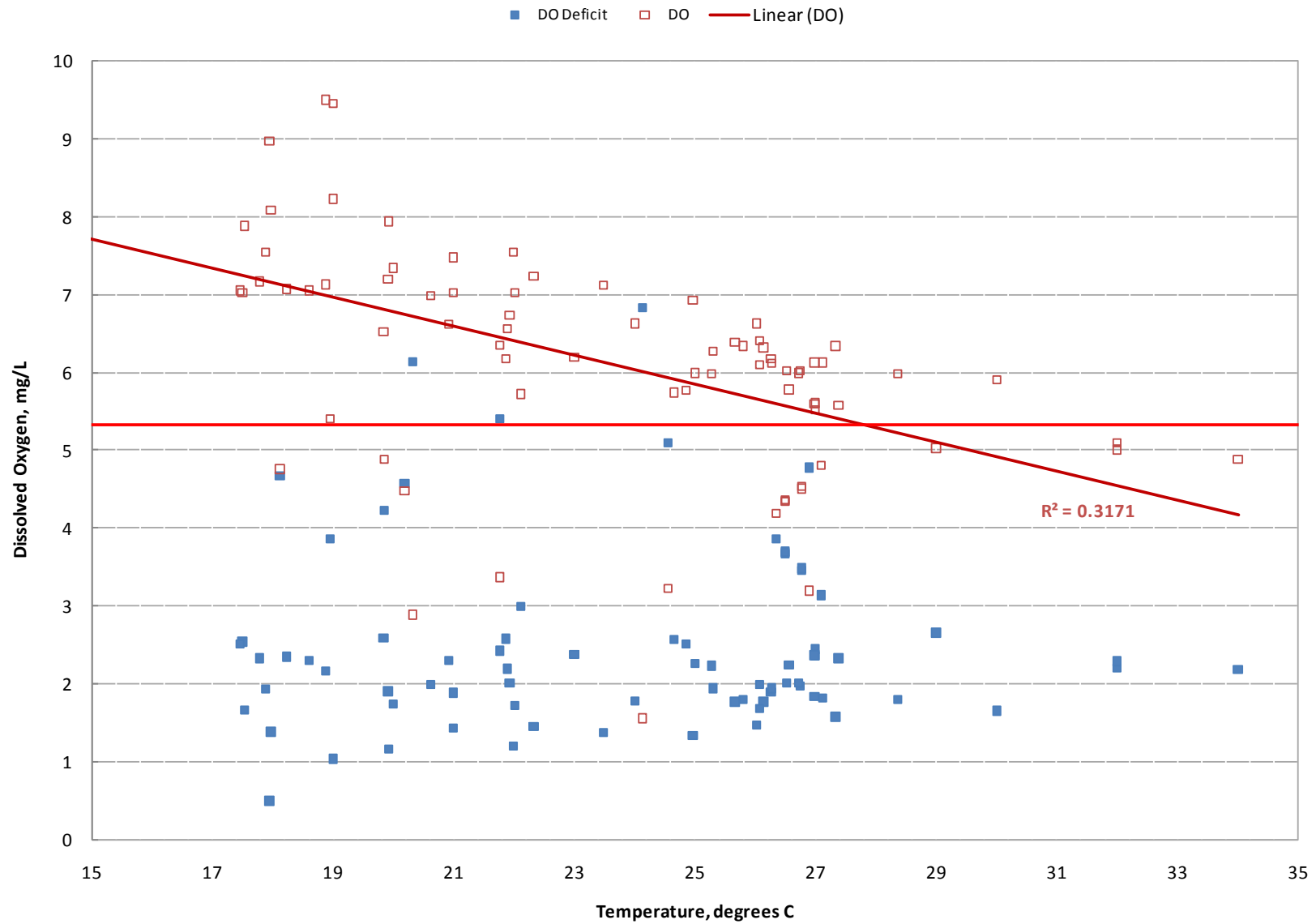


Figure 2-24

Paired Measurements for Temperature versus Dissolved Oxygen in Brushy Creek (2004-2009)

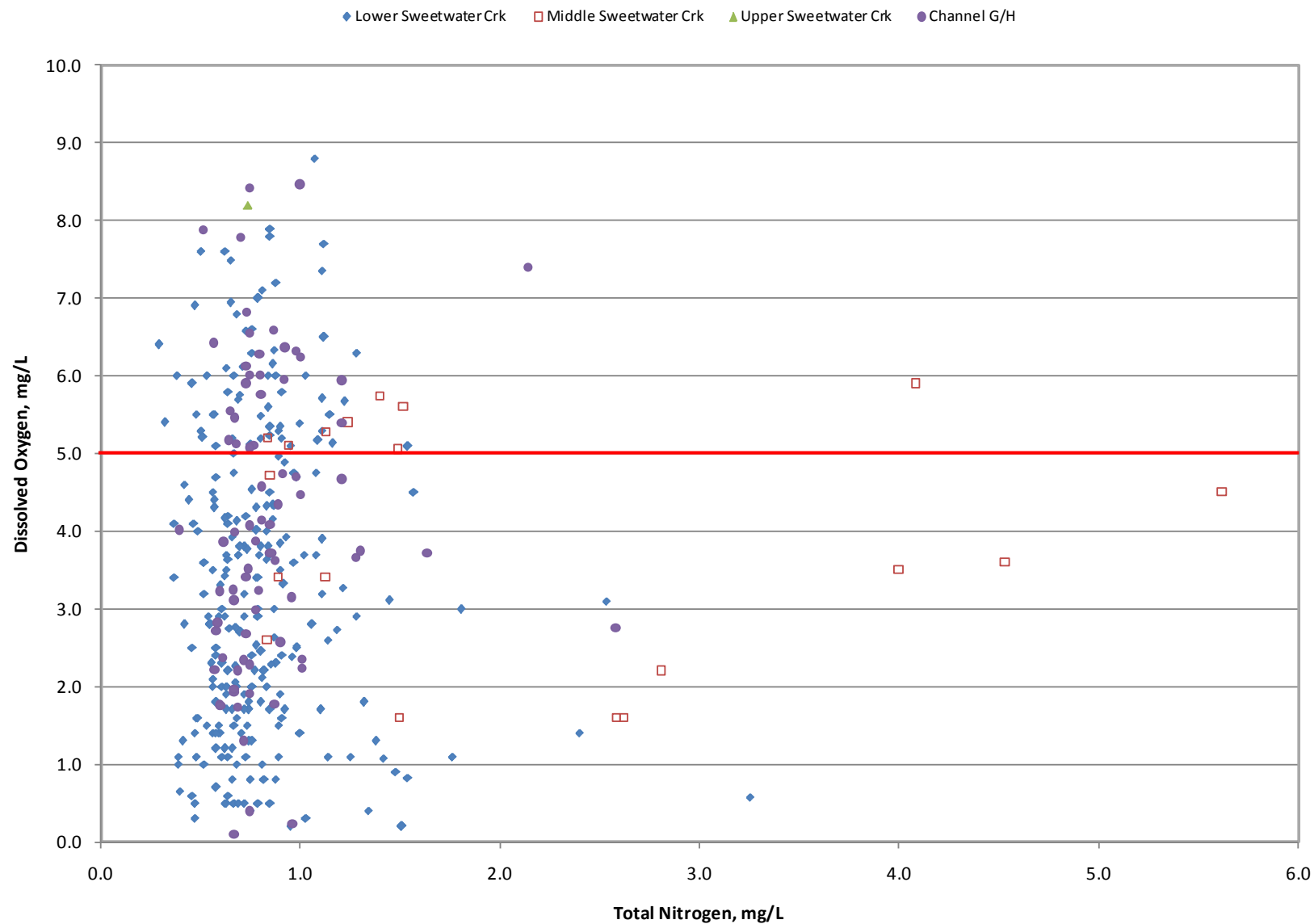


Figure 2-25

Paired Measurements for Total Nitrogen versus Dissolved Oxygen in Sweetwater Creek (2004-2009)

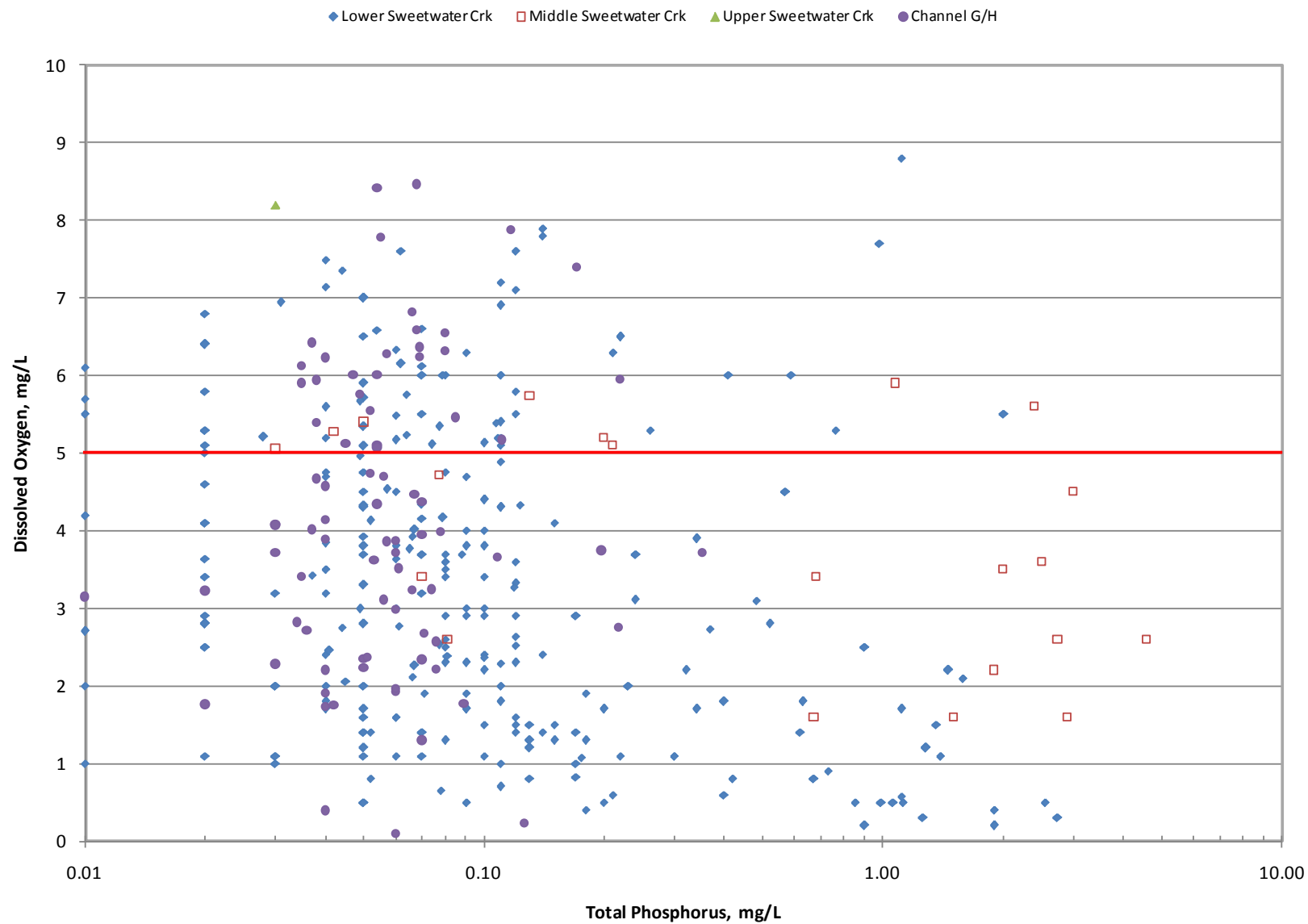


Figure 2-26

Paired Measurements for Total Phosphorus versus Dissolved Oxygen in Sweetwater Creek
(2004-2009)

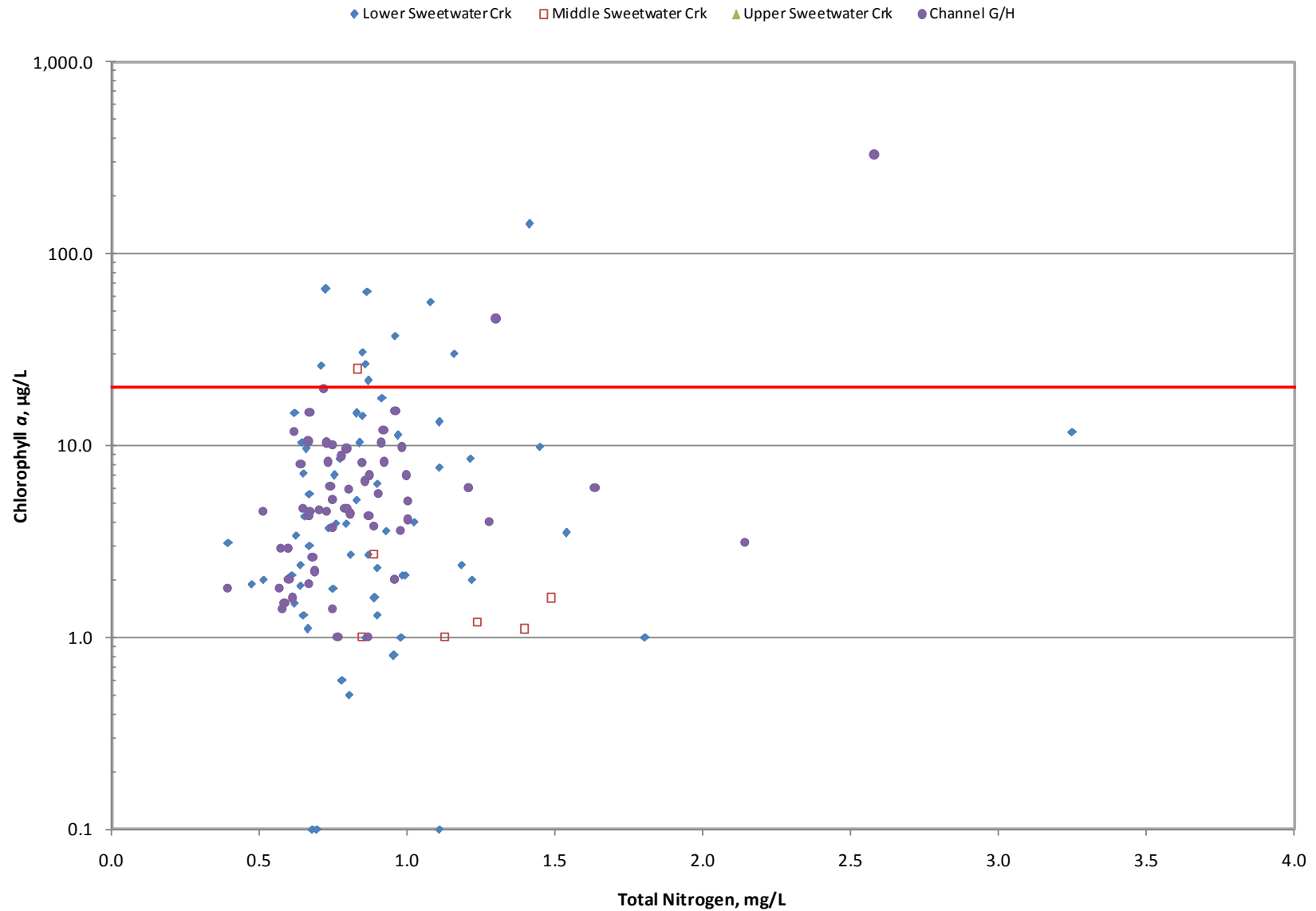
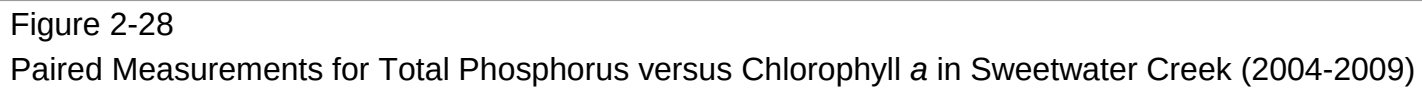


Figure 2-27

Paired Measurements for Total Nitrogen versus Chlorophyll *a* in Sweetwater Creek (2004-2009)



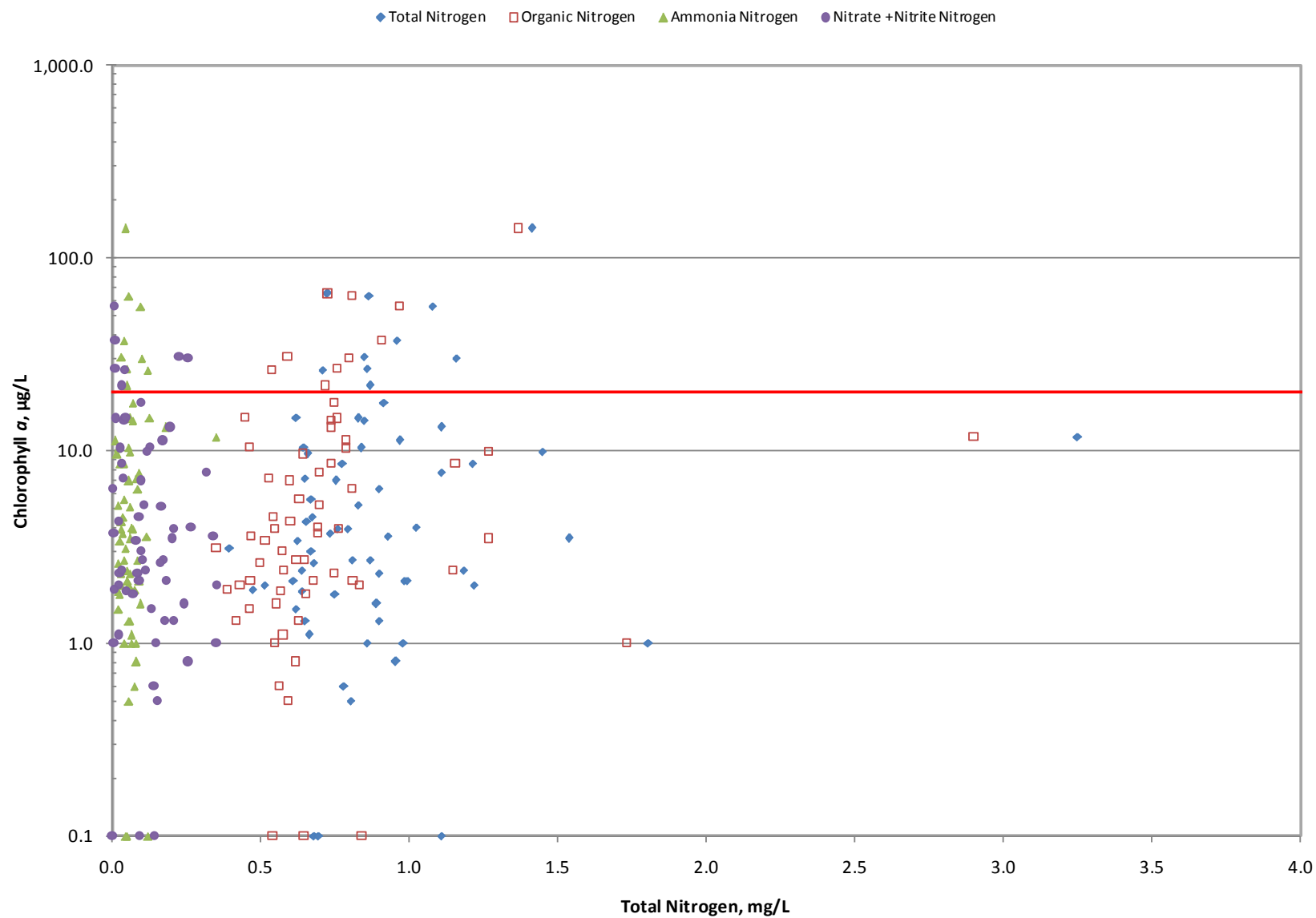


Figure 2-29

Paired Measurements for Nitrogen Species versus Chlorophyll *a* in Sweetwater Creek (2004-2009)

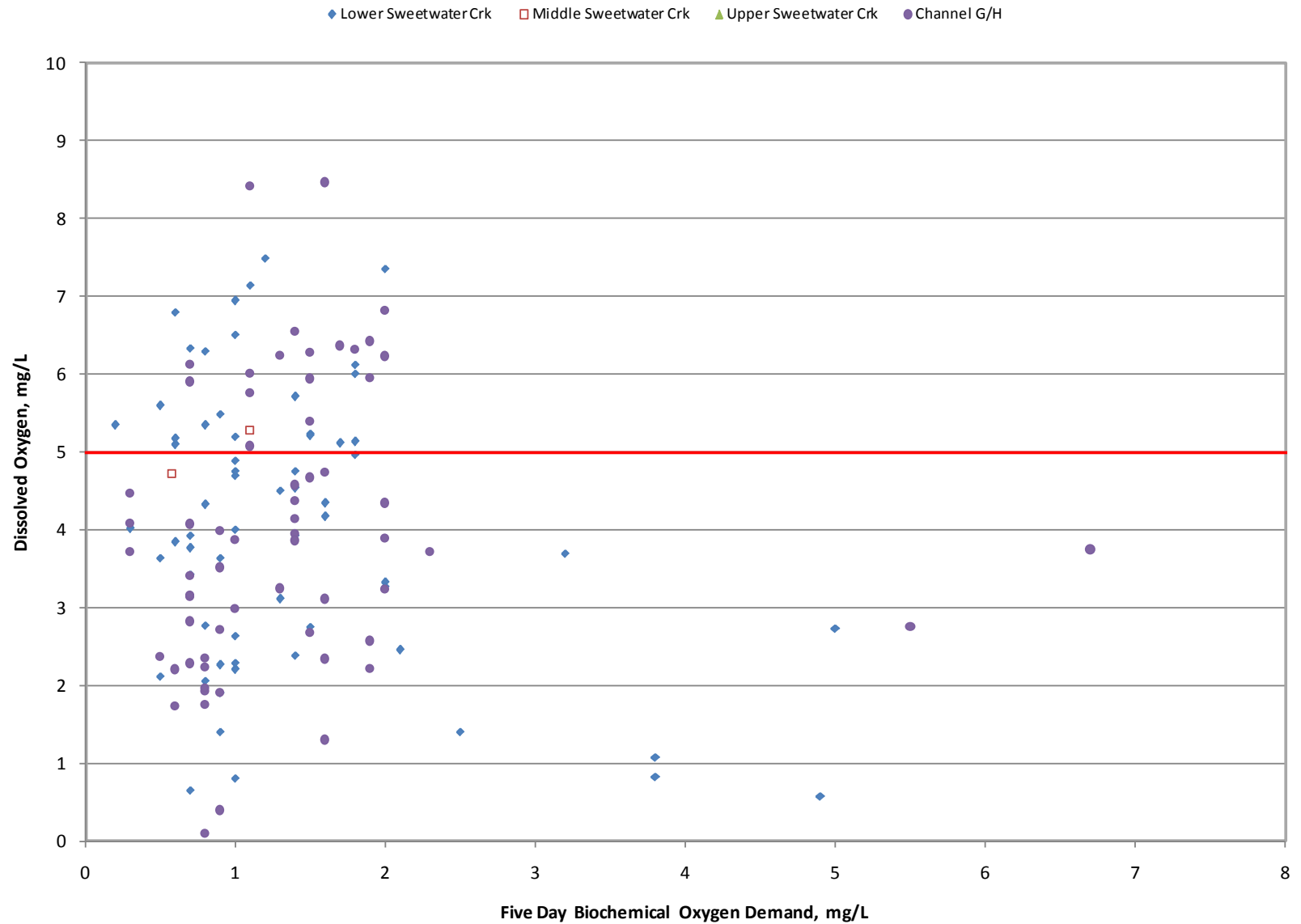


Figure 2-30

Paired Measurements for BOD₅ versus Dissolved Oxygen in Sweetwater Creek (2004-2009)

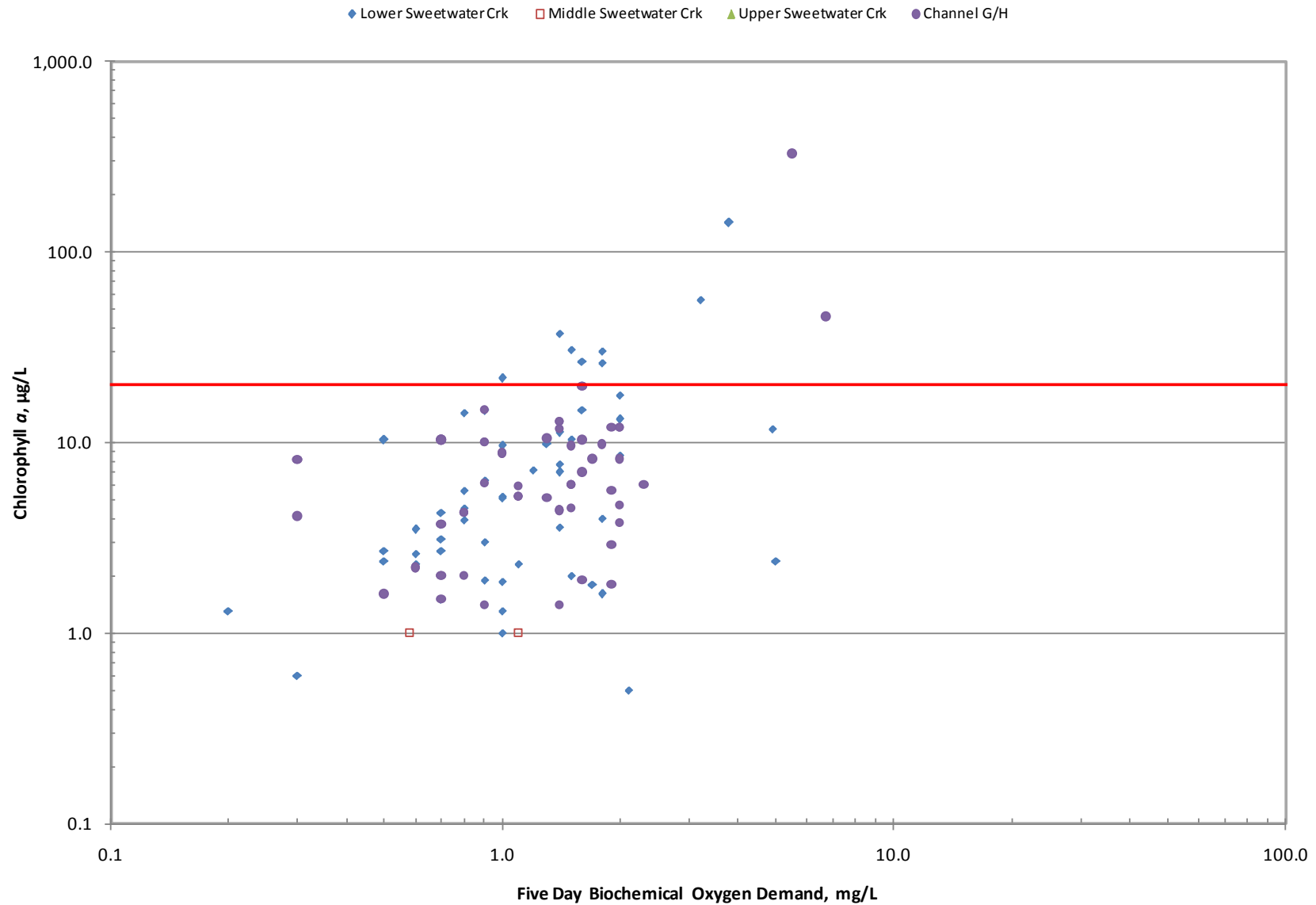


Figure 2-31

Paired Measurements for BOD₅ versus Chlorophyll *a* in Sweetwater Creek (2004-2009)

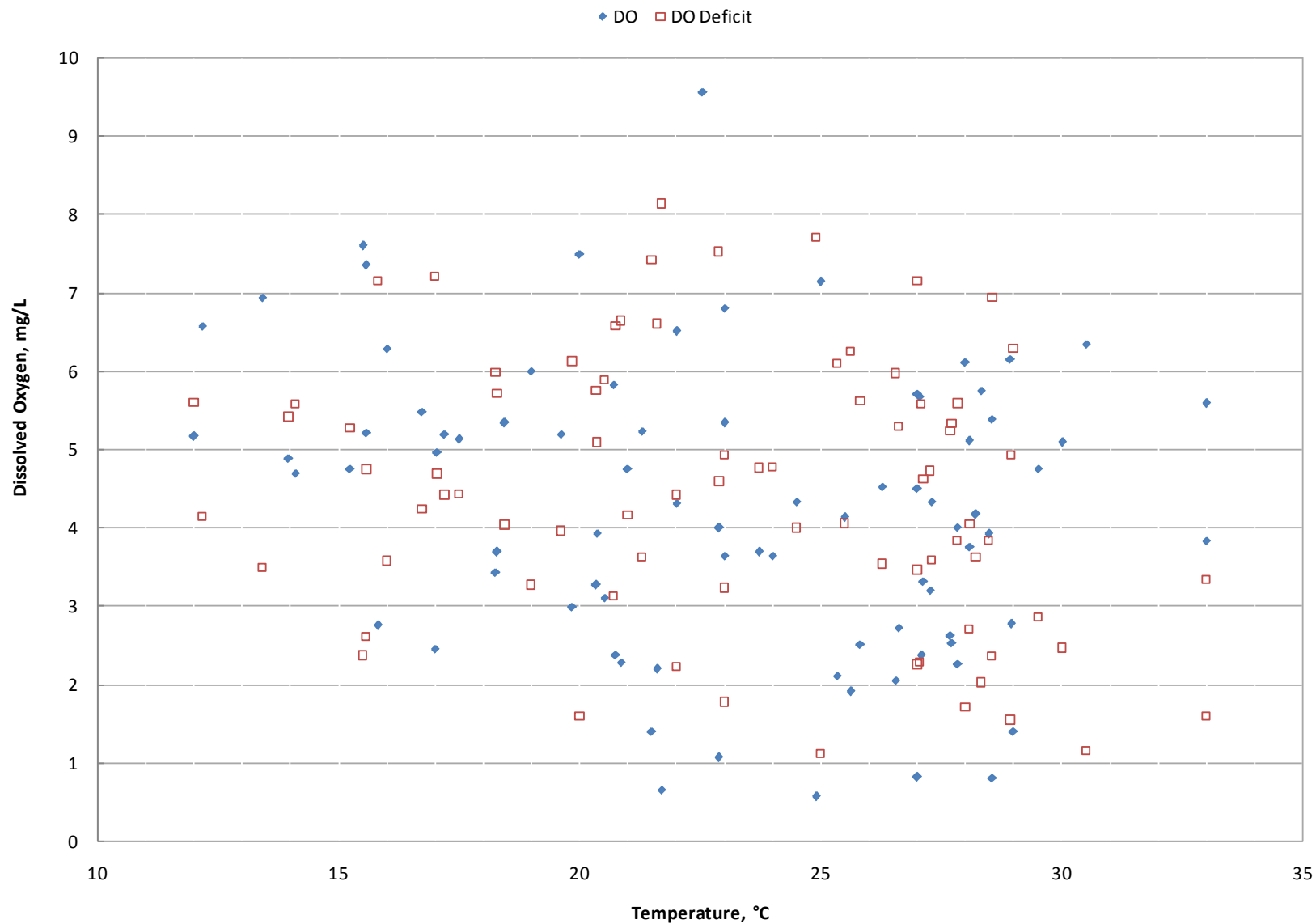


Figure 2-32

Paired Measurements for Temperature versus Dissolved Oxygen in Sweetwater Creek (2004-2009)

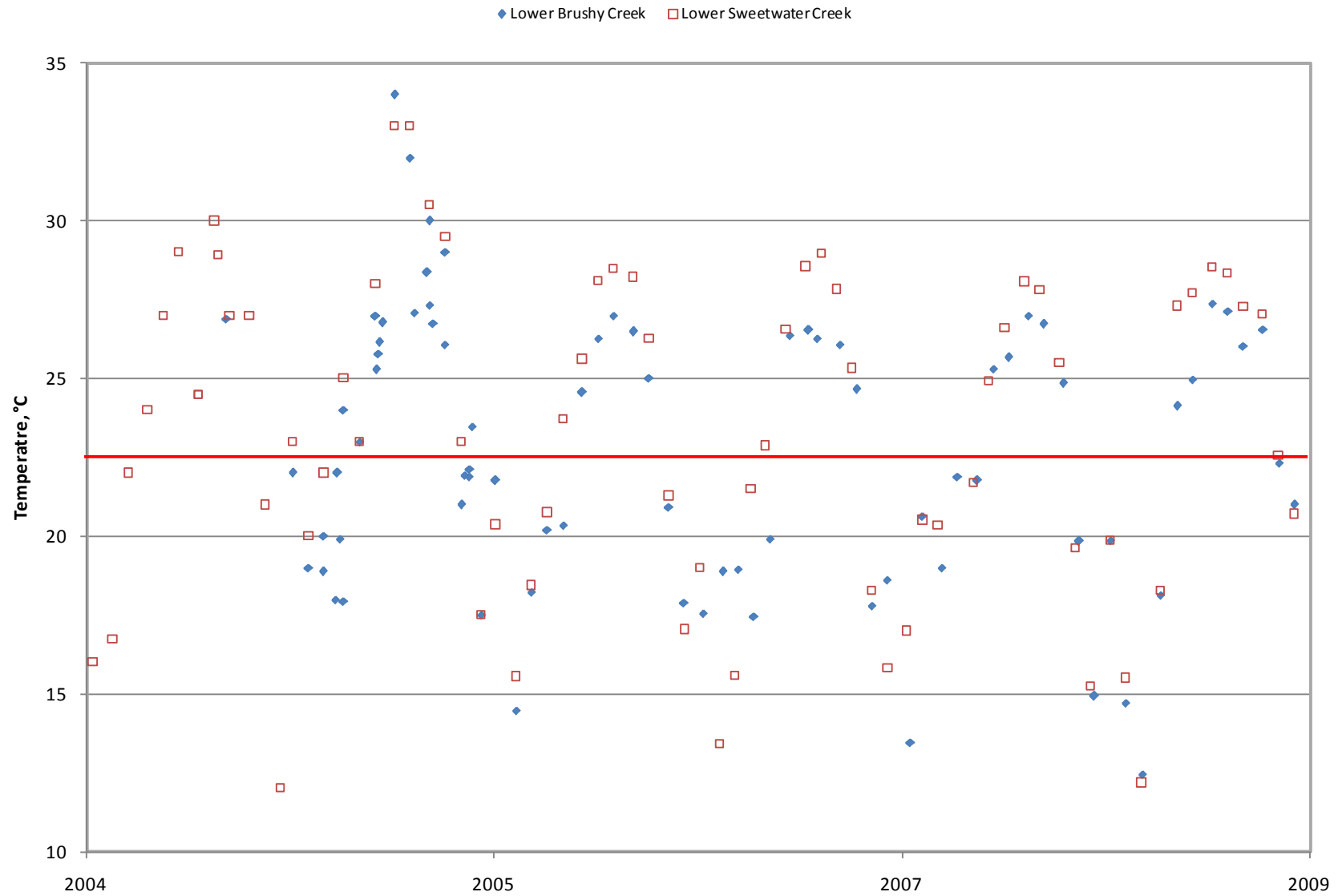


Figure 2-33

Comparison of Temperature Observations from Brushy Creek and Sweetwater Creek (2004-2009)

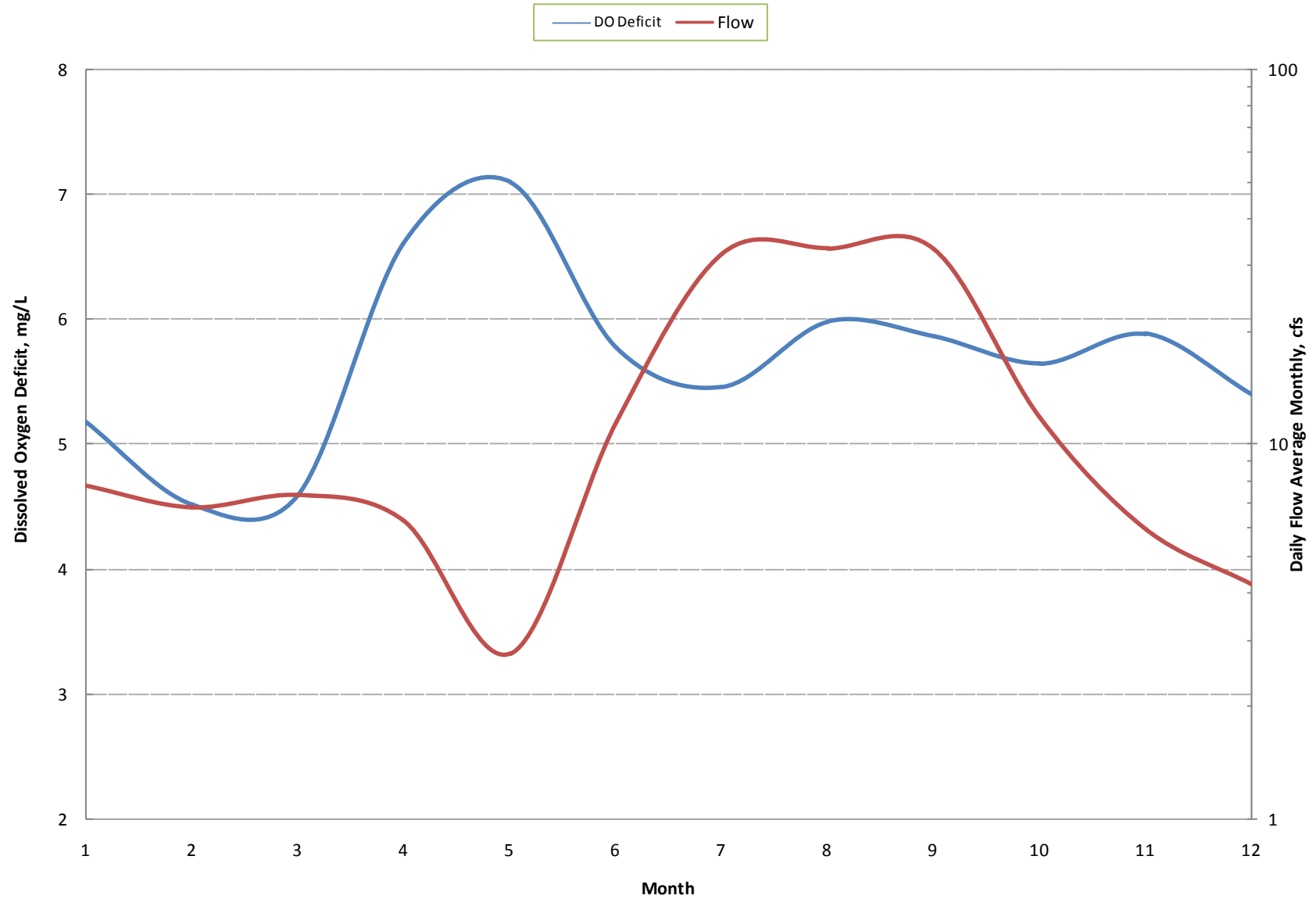


Figure 2-34

Average Daily Flows versus Average Dissolved Oxygen Deficit in Sweetwater Creek (2004-2009)

3.0 BIOLOGICAL DATA ASSESSMENT

Because discrete chemical or physical water quality measurements are, at best, only indicators or predictive variables for stream health, the biological integrity of streams is also assessed using several bioassessment methodologies. The FDEP utilizes several standard approaches for assessing streams for biological health. The three approaches that will be discussed here include: the Shannon-Weiner Diversity Index developed for artificial substrate (Hester-Dendys) sample collection, Biological Reconnaissance (BioRecon), and the SCI.

3.1 SHANNON-WEINER DIVERSITY INDEX

The Shannon-Weiner Diversity Index is a measure of macroinvertebrate community health and incorporates the levels of the total number of taxa present (taxa richness) with distribution of individuals among the present taxa to arrive at a diversity score. Low diversity scores are typically indicative of conditions where only a few species are present that may be excluding other taxa.

Shannon-Weiner Diversity Index scores are available for Brushy Creek only because this methodology is employed as part of the requirements for fifth-year inspections of domestic WWTPs. During these inspections, Hester-Dendys are deployed upstream of the treatment plant outfall to measure the background condition and at a “test” site to measure the potential effects of the discharge.

3.2 THE STREAM CONDITION INDEX (SCI)

FDEP uses two approaches for collecting and evaluating macroinvertebrate assemblages from *in situ* habitat, SCI and BioRecon. Both utilize the same gear (D-frame dipnet with a 0.25-meter opening and a 600-micrometer mesh net). In both cases, dipnet sweeps are collected among the best available substrates on an approximately equal basis. They differ in the number of sweeps collected, the location of sample sorting (field versus laboratory), and the final index used for assessment. BioRecon was developed to be a screening tool that utilizes a quick field assessment that could yield a same-day result. The SCI method is intended to be more precise and definitive. BioRecon is often used to rapidly assess a site to prioritize it for more intensive sampling.

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 one year to complete their lifecycle
- Number of Ephemeroptera (mayflies) taxa
- Number of Trichoptera (caddisflies) taxa
- Number of Florida sensitive taxa
- Number of clinger taxa
- Percent dominant taxon
- Percent Tanytarsini
- Percent very tolerant taxa
- Percent filterers.

The development and implementation of the SCI has been an iterative process. The original SCI for Florida (Barbour et al., 1996) tested various metrics for samples collected in Florida streams and compared the results from sites with minimal human disturbance (reference sites) with known disturbance sites (test sites) for three distinct Florida regions. These data were used to define metric expectations for each region. The index was updated to specifically consider the gradient of human disturbance in 2004 (Fore, 2004). The metrics were later revised in 2007 (Fore et al., 2007) to reflect EPA guidance from 2006 that promoted the Biological Condition Gradient approach as a national standard. Threshold values for evaluation were changed at that time. The routine application of the 2004 methodology scored many reference streams (formally evaluated as “excellent”) as either “fair” or “poor” under the new thresholds (Fore et al., 2007).

In the old SCI method (SCI 1992), taxonomic richness was represented by Ephemeroptera, Plecoptera, or Trichoptera, or their combination (EPT) taxa, total taxa, and *Chironomidae*. The feeding group was represented by percent filter feeders, community structure by percent dominance and percent *Diptera*, and sensitivity/tolerance by the Florida Index. Under the current methodology (SCI, 2007), the taxonomic richness metrics were changed to include *Trichoptera*, *Ephemeroptera*, and total taxa. Percent filterers were retained to represent the feeding group. Voltinism (the length of time between generations) was added, and the long-lived taxa metric used to represent it. Habit was added using the Clinger taxa

and percent *Tanytarsini* (*Chironomidae*) substituted for percent *Diptera* along with percent dominance to represent community structure. The Florida Index was dropped as a metric representing sensitivity/tolerance and the sensitive taxa and percent very-tolerant metrics added to represent this category.

Because of these changes, SCI scores over time are not directly comparable. The SCI 2007 now highly correlates with the human disturbance gradient and the thresholds have been corrected from the SCI 2004 methodology that resulted in false positives for stream condition impairment.

3.3 BIORECON

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 ten metrics used in the SCI). These include:

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

In the current approach, BioRecon results correlate well to both SCI and the human disturbance gradient. The new approach (Fore et al., 2007) incorporates the six metrics above while the older approach utilized only three (total taxa, EPT taxa, and the Florida Index). Instead of combining the three metrics into a single score, thresholds were developed for them separately. A stream was considered to be “healthy” if all three of the metrics were the thresholds, “suspect” if two are achieved, and “impaired” if only one of the metrics was above the threshold value.

3.4 **BIOLOGICAL EVALUATIONS OF BRUSHY CREEK & SWEETWATER CREEK**

3.4.1 **BRUSHY CREEK (WBID 1498)**

In Section 8.5.4 – Biological Indicators of Ecosystem Health in the Rocky/Brushy Creek Watershed Management Plan (Ayres Associates, 2007a), the authors state that the FDEP “BioRecon program has not collected macroinvertebrate data in the Rocky Creek – Brushy Creek watershed.” This is likely because the BioRecon results from a February 10, 1998, sampling event do not appear to be in the FDEP’s database. However, the data were published in an EcoSummary (Morgan, 1998a). The Watershed Management Plan does not discuss FDEP’s SCI or Hester-Dendy’s bioassessments.

This rapid assessment gave Brushy Creek a marginal habitat score “mainly due to [an] altered riparian zone and lack of instream habitat.” Table 3-1 presents the results of the BioRecon. While the results are not presented in tabular form in the EcoSummary, ATM scaled both the threshold values, which do not appear to be the typical ones used at that time, and the metric scores. This Brushy Creek location failed all three metrics.

Table 3-1. BioRecon Data from Samples Taken in Brushy Creek (WBID 1498)

STORET Station	Date	# of Taxa Score (healthy >18)	FL Index Score (healthy >10)	# of EPT Taxa Score (healthy >4)	Overall Evaluation
HIL545US	2/10/98	17 failed	5 failed	3 failed	Impaired

Notes: Tabular data interpreted from Figure 3 in Morgan, 1998.

Source: Morgan, 1998a.

This is likely due to hydrologic modification of the streambed and flanking riparian zones. Previous projects (discussed in Section 1.2.4) modified the stream to improve flows and to more rapidly discharge stormwater during extreme storm events. While there has been more re-naturalization since 1998, Morgan (1998a) described the habitat at the sampling site:

The sampling site was located upstream of the Gunn Highway bridge. The riparian zone is limited in the immediate area, and the streambed appears to have been dredged in the past. There is little instream habitat for macroinvertebrate colonization. The creek bed is a mixture of fine sand and silt, about 0.5 to 1 meter deep, with consistent rapid velocity.

Because this condition is common in many Florida streams and the sandy substrate provides few invertebrates when sampled, the sampling protocol describes the following method:

Florida streams typically have a sandy substrate that supports very few invertebrates. Therefore, the habitat sampled for macroinvertebrates includes logs, roots, and undercut banks; partially decayed leaf packs; aquatic vegetation; and rocks or large cobble. During SCI sampling, if 4 productive substrates are present (snags, roots, vegetation, and leaf packs), each substrate would be sampled 4 times, with sand being sampled 4 times, for a total of 20 sweeps (Fore et al., 2007).

Pesticides were also analyzed in samples collected during the February 1998 event. The event was scheduled in part to assess the impacts of Florida's Medfly Eradication program that year. The analysis found Atrazine in the water samples, but not at high enough concentrations to be toxic to invertebrates. As part of her conclusions, Morgan (1998a) stated, that "[h]abitat destruction may be solely responsible for the degraded invertebrate community...."

The NPDES permit for the Dale Mabry AWWTP discharge to Brushy Creek requires fifth-year inspections that include bioassessments at a "test" site affected by the discharge and at an upstream "background" site for comparison purposes. The rule requires the use of artificial substrate multi-plate samplers (such as Hester-Dendys) that are not reflective of native habitat stream conditions. The test is instead designed to limit microhabitat effects on the study results by removing substrate as a variable. In addition to the Hester-Dendys, SCI sampling was completed at Brushy Creek as part of the fifth-year inspections in 1997 and 2008.

The test and background stations are located in the middle portion of the creek, just upstream of a private dirt road crossing and about 0.3 mile downstream of the Village Drive crossing, where the bulk of the water quality samples for the middle part of the creek have been taken. The background (or reference) site is approximately 150 ft upstream of the test site.

According to of 62-302.530(11) F.A.C., a difference of more than 25 percent in the Shannon-Weiner diversity between results from Hester-Dendys incubated for 28 days at the

test and background sites would be a violation. While the Dale Mabry plant passed both of the fifth-year inspections, there is a noticeable difference in the colonization patterns only 150 ft downstream of the background site. For the 1997 event, the very tolerant species metric increased from 41 percent at the control to 78 percent at the test site. However, by 2008, the percentage of very tolerant species decreased significantly at both locations (4 percent at the control and 4.9 percent at the test site). Percent filterers at the control site were 29.7 percent and 26.1 percent at the control site in 1997 and 2008, respectively, but only 7.0 percent and 5.0 percent at the test site. While not strictly comparable to scores obtained using the standard SCI sampling protocol because the Hester-Dendys colonization test is short-term and on artificial substrates, SCI scores calculated for the control site improved from 43 in 1997 to 62 in 2008.

Bioassessments were also conducted in 1997 and 2008 at the Dale Mabry plant test and control sites using the SCI dipnet protocols. The SCIs for the test and control sites received a “excellent” (27) and “good” (21) rating based on the SCI 1992 methodology (the scoring basis has changed and so the values are not comparable to those under the present, SCI. 2007, system). Under the present scoring regime, both sites sampled in 1997 do not fare as well (both attaining a score of 28 under the present system). A score of 28 is currently designated as Category 3, the lowest of three categories and represents a “notable loss of taxonomic diversity...sensitive taxa [are] uncommon or rare...assemblage dominated by a tolerant taxon [and] very tolerant individuals represent a large proportion of the individuals collected” (Fore et al., 2007). However, the SCI sample collections at these same locations showed marked improvement at the upstream site that is more representative of the typical creek conditions. The upstream site received a score of 45, which places it in Category 2 where “diverse assemblage with 30 different species [are] found on average...6 sensitive taxa routinely found [but there is typically a] small increase in dominance by a single taxon relative to Category 1 [and] very tolerant taxa represent a small percentage of individuals, but noticeably increased from Category 1” (Fore et al., 2007). However, the score for the site affected by the treated effluent remained similar (24) to the 1997 score.

SCI collections were made in the creek in 2001, 2004, 2005, and 2006 that were unrelated to treatment plant inspections. Table 3-2 presents the results for the 10 SCI 2007 metrics and the final SCI 2007 score (so that the values are comparable). The HIL545US site is just

above the Gunn Highway crossing in the area where the lower creek water quality samples were taken. Station 24030151 was taken at the Village Drive crossing upstream of the treatment plant inspection sampling sites near where the middle creek water quality samples were collected. Station 22075 is located in the upper part of the creek above the County Road 582 crossing. This portion of the stream shows signs of channelization on recent aerial photography and has a more limited riparian buffer than the stations in the middle and lower parts of the creek.

Table 3-2. SCI Data from Samples Taken in Brushy Creek (WBID 1498)

STORET Stations	Collection Date	# of Taxa	# of Long-Lived Taxa	# of Clinger Taxa	# of Sensitive Taxa	EPT Taxa	# Trichoptera Taxa	%Tanytarsini	% Filterers	% Very Tolerant	% Dominant	SCI 2007	
24040087	9/19/97	25	3	3	1	1	3.8	1.9	3.3	9.5	52.4	28	Cat 3
24030151	4/11/01	33	1	0	0	0	0	31.9	26.7	31.5	21.8	35	Cat 2
22075	9/01/04	22	1	2	0	3	25.2	0.9	22.0	24.3	23.4	34	Cat 3
HIL545US	6/07/05	16	0	3	0	3	22.1	1.0	22.1	6.7	34.6	29	Cat 3
HIL545US	11/21/05	22	0	2	2	6	10	0.9	12.3	6.4	40	34	Cat 3
24030151	4/05/06	22	1	2	1	1	1	4	4.5	26	30	25	Cat 3
24040176	2/20/08	27	1	4	1	3	4.5	22.5	17	21	22	45	Cat 2

Notes: 1. Tabular data summarizes raw data obtained from FDEP.
2. Excludes data taken at the Dale Mabry "test" site that is affected by effluent discharges.
3. SCI 2007 calculations made by ATM from the raw metric results provided by FDEP.

Source: Raw data obtained from FDEP, 2011.

The period-of-record SCI scores were remarkably consistent over a range of seasons, 10 years of record, and over the upper, middle, and lower parts of the creek. The scores reflect an impaired state until the most recent evaluation conducted in 2008, which shows that the stream macroinvertebrate community is reflective of a "healthy" condition. The periods of low stream flow, effects of channelization, and habitat destruction are likely causes for few EPT taxa, sensitive taxa, and long lived taxa. The higher percentage of the dominant taxa and very tolerant taxa also reflect these conditions. However, lack of appropriate substrate may be adversely impacting the results. The median richness value of 22 scores a 2 out of a possible 10 points. The most recent control station using the Hester-Dendys artificial substrate had a richness value of 38, which would score a 9 (out of 10) in the SCI 2007 methodology. So, the low diversity of communities and the tendency toward dominant and tolerant species are likely more the result of stream hydrology, modifications, and lack of appropriate substrate.

3.4.2 SWEETWATER CREEK (WBID 1516)

The Sweetwater Creek Watershed Management Plan (Ayres Associates, 2007b) also fails to present any BioRecon or SCI data collected from the creek system by FDEP biologists. However, FDEP conducted a BioRecon in March 1998. The results are recorded in FDEP's database and discussed in an EcoSummary (Morgan, 1998b).

This rapid assessment was conducted upstream of Gunn Highway in the middle part of the Sweetwater Creek segment. While the stream has undergone significant hydrologic modification and habitat destruction, the EcoSummary suggests that there was sufficient substrate to support macroinvertebrates.

The riparian zone is limited in the immediate area, and the streambed appears to have been dredged in the past. However, there is a good amount of submerged vegetation, and some roots and snags present, providing instream habitat for macroinvertebrates" (Morgan, 1998b).

Table 3-3 presents the results of the BioRecon. While the results are not presented in tabular form in the EcoSummary, they are available in the FDEP database. ATM used the thresholds scaled from the Brushy Creek EcoSummary bar charts. This Sweetwater Creek location failed all three metrics.

Table 3-3. BioRecon Data from Samples Taken in Sweetwater Creek (WBID 1516)

STORET Station	Date	# of Taxa Score (healthy >18)	FL Index Score (healthy >10)	# of EPT Taxa Score (healthy >4)	Overall Evaluation
24040112	3/10/98	9 failed	3 failed	2 failed	Impaired

Notes: Tabular data from FDEP database information for 1998 BioRecon event

Source: Morgan, 1998b

While there have been significant disturbances to the streambed through channelization and removal of trees and wetlands, the presence of submerged vegetation, roots, and snags suggest that the stream should have scored higher than the Brushy Creek site discussed in the previous section. Morgan (1998b) summarizes the report as follows:

Adequate instream habitat capable of supporting a diverse macroinvertebrate community is present at this site. Therefore it is suspected that water chemistry contributes to the unbalanced community in addition to habitat destruction. It is recommended that a water chemistry investigation, including

heavy metals and pesticides, be executed. Accordingly, further recommendations for restoration could be made.

She also suggests that the ongoing management for the Mediterranean fruit fly through aerial spraying of Malathion could be responsible for the low richness observed.

Like Brushy Creek, SCI collections were made in the creek in 2001, 2004, and 2005. There are no permitted NPDES wastewater discharges to Sweetwater Creek, so no fifth-year inspection data are available. Table 3-4 presents the results for the 10 SCI 2007 metrics and the final SCI 2007 score (so that the values are comparable). Station HIL553US and 24041112 are located in the middle portion of the creek near the water sampling site, just above the Gunn Highway where the BioRecon was taken. The HIL553US station is the site of the most recent sample events completed in summer and winter 2005. The stream in this area is highly disturbed, shows signs of channeling, and has limited riparian buffer. Station 24030151 was taken at the Village Drive crossing upstream of the treatment plant inspection sampling sites near where the middle creek water quality samples were collected. Station 22072 and 2403149 are located in the lower part of the creek on either side of the Florida Mining Boulevard crossing. The stream here is very channeled and has little instream or riparian plant habitat. Station 22088 is located above the rail crossing in the Channel H canal. Station 22094 is located in the heavily channelized portion of the lower creek at the confluence with Channel H. HIL553US is located in the upper part of the creek above the County Road 582 crossing. This portion of the stream shows signs of channelization on recent aerial photography and has a more limited riparian buffer than the stations in the middle and lower parts of the creek.

If the canal station is removed, the period-of-record SCI scores, like Brushy Creek, are fairly consistent over a range of seasons, 5 years of record, and over the upper, middle, and lower parts of the creek. The scores reflect an impaired state except for the samples taken in the most recent year (2005) during the summer event. This event shows that the stream macroinvertebrate community is reflective of a “healthy” condition.

Table 3-4. SCI Data from Samples Taken in Sweetwater Creek (WBID 1516)

STORET Stations	Collection Date	# of Taxa	# of Long-Lived Taxa	# of Clinger Taxa	# of Sensitive Taxa	EPT Taxa	# Trichoptera Taxa	%Tanytarsini	% Filterers	% Very Tolerant	% Dominant	SCI 2007	
24030149	4/10/01	20	0	1	0	2	0.8	7.1	7.1	20.6	44.4	21	Cat 3
22088	9/22/04	14	0	0	0	2	1.0	3.0	1.5	13.9	41.6	15	Cat 3
22094	9/22/04	17	1	0	0	3	2.8	8.3	4.1	44.0	37.6	22	Cat 3
22072	8/24/04	22	0	2	0	3	3.7	7.4	8.3	25	38.9	28	Cat 3
HIL553US	6/06/05	28	1	3	0	3	2.9	20.4	10.2	23.3	11.7	43	Cat 2
HIL553US	12/05/05	23	0	2	1	2	1.0	21	13.3	37.1	21	33	Cat 3

Notes: 1. Tabular data summarizes raw data obtained from FDEP.

2. SCI 2007 calculations made by ATM from the raw metric results provided by FDEP.

Source: Raw data obtained from FDEP, 2011

Also, like Brushy Creek, the periods of low stream flow, effects of channelization, and habitat destruction are likely causes for few sensitive and long-lived taxa. The higher percentage of the dominant taxa and very tolerant taxa also reflect these conditions. However, notwithstanding the comments concerning available substrate in the 1998 EcoSummary (Morgan, 1998b), none of the other four locations sampled show any sign of a naturalized habitat, canopy, natural banks, or instream macrophytes. The lack of appropriate substrate may be adversely impacting the results. The median richness value of 21 scores a 2 (out of a possible 10 points). No sampling results using Hester-Dendys artificial substrate are available as in Brushy Creek, so it is difficult to determine with the available data how much of a role is played by substrate versus water chemistry. However, there is a significant period of record of water chemistry for the creek, and no impairments for toxic compounds have been recorded. The low diversity of communities and the tendency toward dominant and tolerant species reflect conditions that are likely more the result of stream hydrology, modifications, and lack of appropriate substrate.

3.5 **CONCLUSIONS FROM THE BIOLOGY**

The available biological assessment data for Brushy and Sweetwater Creeks are far more extensive than many other streams in Tampa area watersheds. Historically, both creeks have suffered low SCI 2007 scores but have shown some improvement in recent years (2005 is latest sampling event for Sweetwater Creek). The sampling using multi-plate artificial substrate samplers in Brushy Creek (to meet the permit requirements for the WWTP discharge) may provide a clue to the lack of richness and diversity found in these systems.

These are both sandy bottom creeks that have been extensively channeled and the banks and riparian zones modified to reduce flooding during extreme storm events. When the Hester-Dendys were installed in Brushy Creek above the treatment plant outfall, they quickly colonized with a rich and diverse assemblage of macroinvertebrates. The same processes that seem to be at least partially depressing DO in these systems may also be controlling the biological integrity. Hydrologic and habitat restoration coupled with generation of appropriate site-specific DO criteria are likely the best course of action.

4.0 RECOMMENDED PATH FORWARD

The purpose of the background presented in Section 1 and the analyses presented in Sections 2 and 3 is to identify the appropriate path forward for Brushy Creek (WBID 1498) and Sweetwater Creek (WBID 1516). 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 BRUSHY CREEK (WBID 1498)

The recommended path forward for Brushy Creek based on the analyses conducted in support of this investigation is that a TMDL is not needed (TNN) at this time;. The DO impairment should be reclassification to an appropriate Category 4 designation. Habitat and hydrologic restoration projects should be planned together with the development of an appropriate site-specific DO criterion that is protective of the stream ecosystem and uses but recognizes the variation in DO concentrations observed in systems of this type.

While more naturalized than Sweetwater Creek, Brushy Creek is a highly modified channelized drainage in a highly urbanized watershed. The Dale Mabry AWWTP has been primarily converted to a reuse facility. It is permitted to discharge nutrients and BOD to the middle portion of the Brushy Creek stream course. The data analyses performed and summarized in Section 2 show a clear anthropogenic nitrogen signal in the downstream water column. However, the additional anthropogenic nutrients cannot be linked to an algal imbalance or increased DO deficit through paired data correlation analysis.

Instead, the observed DO concentrations are more likely natural factors related to limited or intermittent flow and from factors that FDEP identified in the TMDL determination:

DO can also be affected or lowered by in-stream modifications such as dredging and channelization. These processes slow down water velocity, reduce reaeration, and increase the settling of solids, thus increasing sediment oxygen demand (SOD) and lowering DO concentrations. Further analyses and monitoring must be completed to develop an appropriate, site-specific DO criterion.(Bailey et al., 2009)

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

1. Brushy Creek is a highly intermittent stream that has limited flow.
2. The system is highly modified, highly urbanized, and serves the main drainage conduit for flood protection in the watershed.
3. Median DO deficit is low (2.2 mg/L), but is highest in the late spring / early summer period when low flow conditions and increasing temperatures are both present in the stream (Figure 2-25). Even during higher summer temperatures in July through September, DO deficit lowers due to increased stream flows from summer rains and groundwater storage.
4. There are significant FDEP bioassessment data available in Brushy Creek. While the historical data show that the creek has not supported abundant or diverse macroinvertebrate communities, this is likely due to the lack of appropriate substrate combined with stresses placed on the system during low or no flow periods.
5. Comparison of the data to the proposed EPA numeric nutrient criteria show that the primary limiting nutrient (nitrogen) is below the criteria. While phosphorus levels are occasionally above the criteria, this is not unexpected considering the methodology for the criteria development and the location of these streams on the edge of the Bone Valley.

4.2 SWEETWATER CREEK (WBID 1516)

The recommended path forward for Sweetwater Creek based upon these analyses is that TMDL for nutrients or BOD is not needed at this time because these parameters are apparently not causing of the observed DO deficits in the stream measurement record. Reclassification of this water segment to an appropriate Category 4 designation is recommended. The most appropriate path forward may be 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) and embark on a program of stream restoration that restores more of the natural stream banks and stream planform oscillation, canopy, and instream and buffer macrophytes. The analyses conducted and summarized here do not support any nutrient load reductions. The data indicate that nutrient reductions are unlikely to have any measurable impact upon the DO conditions and that the stream is assimilating any anthropogenic nutrient sources without causing an imbalance. The following provides a summary of key findings from Sections 2 and 3.

1. Sweetwater Creek is a highly intermittent stream that has limited flow.
2. The system is highly modified, highly urbanized, and serves the main drainage conduit for flood protection in the watershed.
3. Sweetwater Creek DO deficits are much higher than the adjacent Brushy Creek system even though Brushy Creek experiences higher nutrient loads. However, the system is far more impacted and hydraulically modified than the Brushy Creek one. Water temperatures during the same time periods are consistently higher, tree canopy lower, and riparian buffers narrower (or absent) than in that system. This implies that the root causes of any deficit below already variable natural conditions are likely due to hydraulic alteration and the destruction of instream and buffer habitat.
4. There are significant FDEP bioassessment data available in Sweetwater Creek. While the historical data shows that the creek has not supported abundant or diverse macroinvertebrate communities, this is likely due to the lack of appropriate substrate combined with stresses placed on the system during low or no flow periods.
5. Comparison of the data to the proposed EPA numeric nutrient criteria shows that the primary limiting nutrient (nitrogen) is below the criteria. While phosphorus levels are occasionally above the criteria, this is not unexpected considering the methodology for the criteria development and the location of these streams on the edge of the Bone Valley.

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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.