FINAL TMDL Report

**SOUTHWEST DISTRICT • SPRINGS COAST BASIN •
ANCLOTE RIVER/COASTAL PINELLAS COUNTY PLANNING UNIT**

Dissolved Oxygen and Nutrient TMDL for Stevenson Creek Tidal Segment, WBID 1567

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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Loads for nutrients and dissolved oxygen (DO) for the tidal portion of Stevenson Creek, located in the Anclote River/Coastal Pinellas County Planning Unit, which in turn is part of the larger Springs Coast Group 5 Basin. The waterbody segment was verified as impaired for DO and nutrients, and was included on the Verified List of impaired waters for the Springs Coast Basin that was adopted by Secretarial Order in December 2007.

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and provides water quality targets needed to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality. The TMDLs establish the allowable loadings to the tidal segment of Stevenson Creek that would restore the waterbody so that it meets its applicable water quality criteria for DO and nutrients.

1.2 Identification of Waterbody

The Stevenson Creek watershed encompasses 9.8 square miles (6,288 acres) in west-central Pinellas County (**Figure 1.1**). The watershed area spans several jurisdictions, including the city of Clearwater (4,057 acres, or 65%), the city of Dunedin (1,287 acres, or 20%), unincorporated parts of Pinellas County (859 acres, or 14%), and the city of Largo (83 acres, or 1%). Land uses within the watershed are predominantly medium- and high-density residential, commercial, and open space. **Chapter 4** of this report provides further discussion of land uses. Approximately 90% of the watershed is urbanized, with a significant portion of the development occurring prior to the implementation of regulatory requirements for floodplain preservation, environmental protection, stormwater treatment, and peak runoff attenuation. Several developments constructed within the creek's floodplain have experienced severe flooding. In addition, the creek and its tributaries have moderate to severe erosion problems due to steep embankments, improper maintenance, highly erodible soils, and inadequate rights-of-way.

For assessment purposes, the Florida Department of Environmental Protection divided the Springs Coast Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. **Figure 1.1** shows the location of the three waterbody segments (WBIDs 1567, 1567B, and 1567C) that comprise the Stevenson Creek watershed. Stevenson Creek Tidal Segment is WBID 1567. The tidal segment receives drainage from the free-flowing freshwater segment of Stevenson

Creek designated as WBID 1567C, as well as two freshwater tributaries; Spring Branch (WBID 1567B) and Hammond Branch, a smaller tributary that is part of WBID 1567. The tidal segment is approximately 1.6 miles long and empties directly into Clearwater Harbor. **Figure 1.2** shows the locations of water quality monitoring locations and major roads in the vicinity of the tidal creek**.**

Additional information about the region's hydrology and geology are available in the Water Quality Status Report for the Springs Coast Basin (Department 2006a).

1.3 Background

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

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

This TMDL report will be followed by the development and implementation of a restoration plan to reduce the amount of pollutants that caused the verified impairment of Stevenson Creek Tidal Segment. These activities will depend heavily on the active participation of the Southwest Florida Water Management District (SWFWMD), local governments, businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for the impaired waterbody.

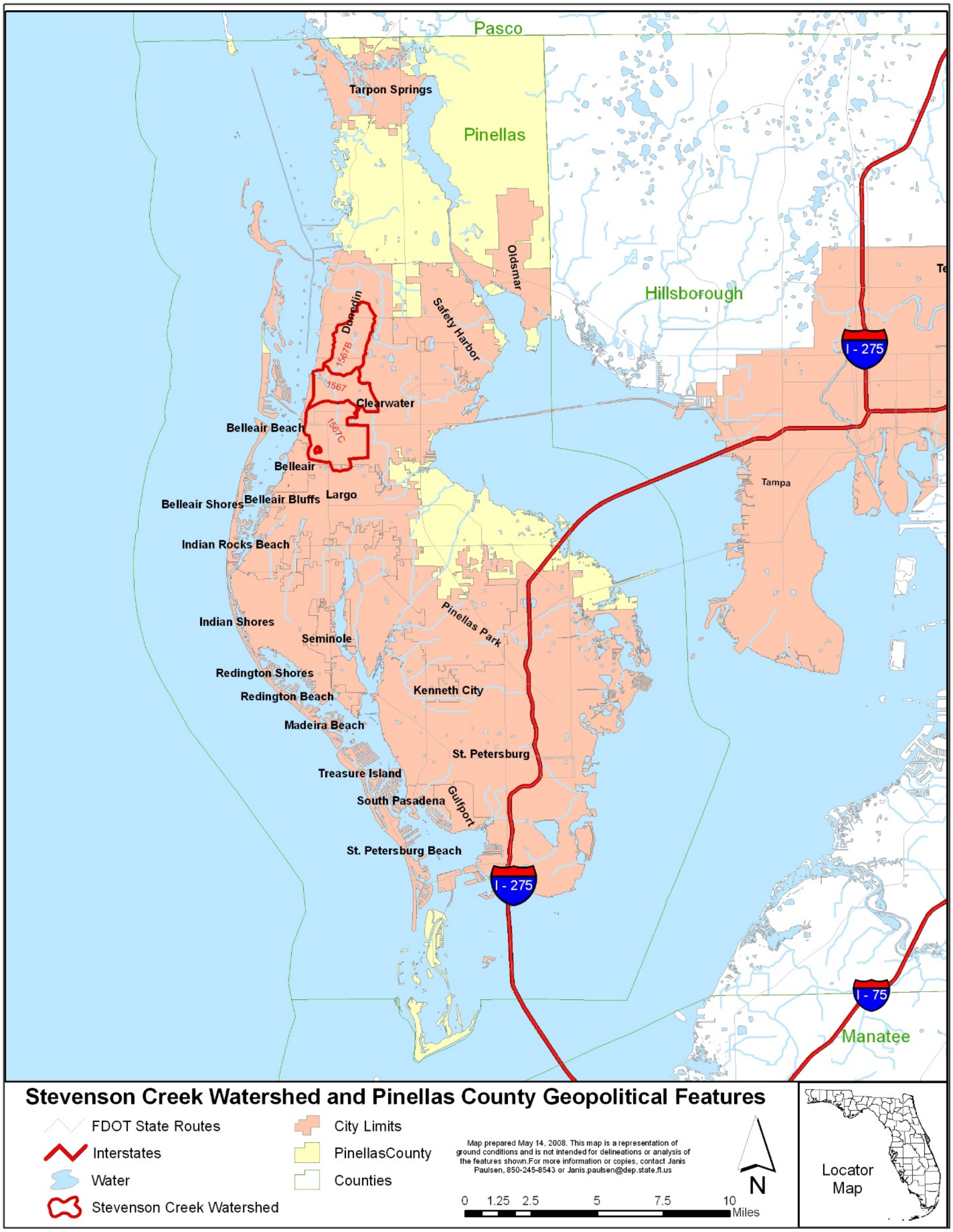

Figure 1.1. Location of the Stevenson Creek Watershed (WBIDs 1567, 1567B, and 1567C) and Major Geopolitical Features in Pinellas County

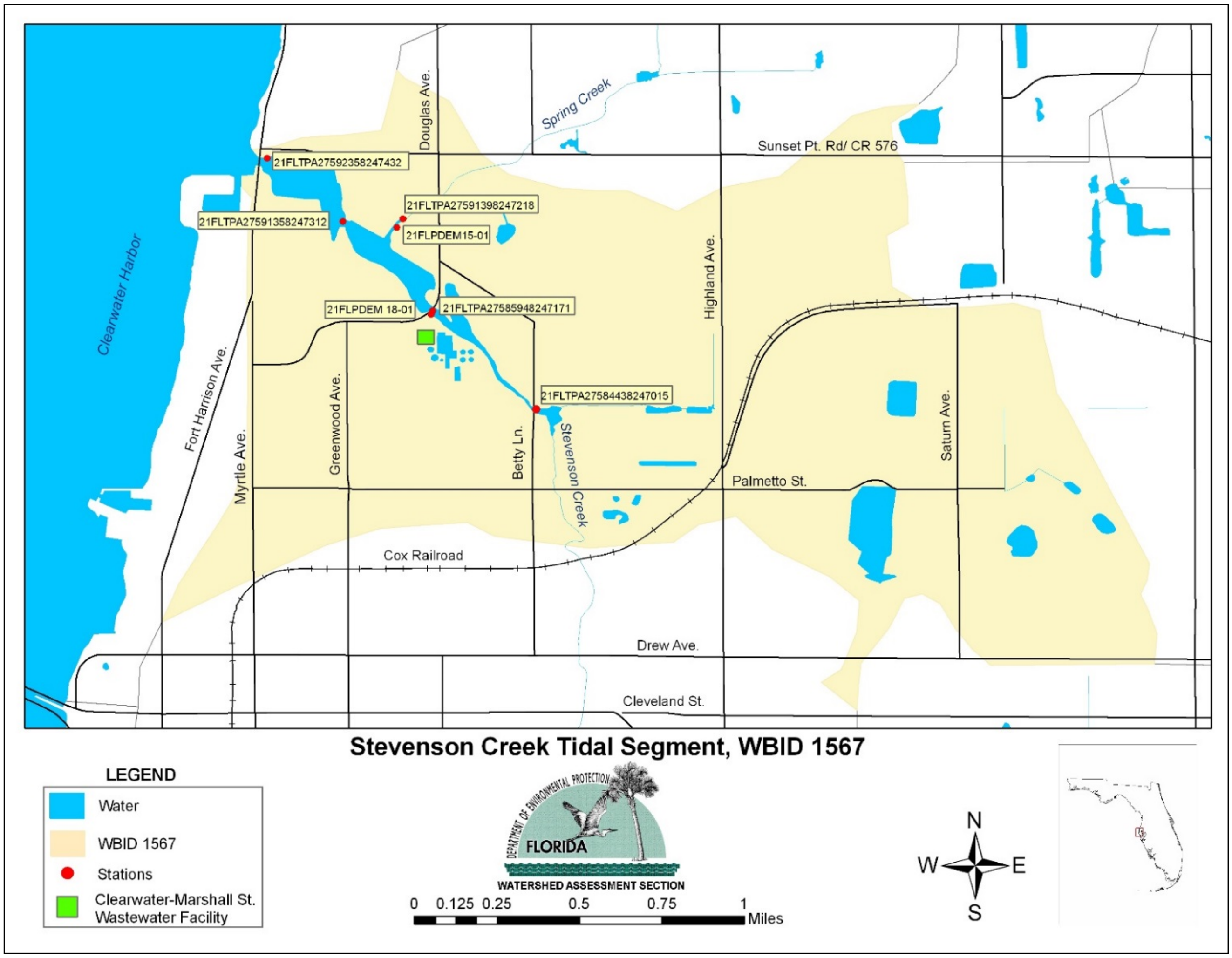

Figure 1.2. Monitoring Locations in Stevenson Creek Tidal Segment, WBID 1567

Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

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

Florida's 1998 303(d) list included 22 waterbodies in the Springs Coast Basin. However, the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. The Environmental Regulation Commission adopted the new methodology as Chapter 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001; the rule was amended in 2006 and 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Stevenson Creek Tidal Segment and verified the impairment for DO and nutrients (**Table 2.1**). **Table 2.2** summarizes the DO data collected during the verified period (January 1, 1999–June 30, 2006). The WBID was verified as impaired for DO because more than 10% of the values were below the Class III marine criterion of 4 milligrams/liter (mg/L) over the course of the verified period. In performing estuary nutrient evaluations following the IWR methodology, annual average chlorophyll *a* values serve as the primary measurement for assessing nutrient impairment. Chlorophyll *a* is typically used as the primary indicator of nutrient enrichment because its concentrations are a good measure of the biomass of phytoplankton (microscopic algae suspended in the water column) that utilize nutrients for growth. During the verified period, the annual average chlorophyll *a* values for the tidal segment (WBID 1567) were above the estuarine threshold of 11 micrograms per liter (µg/L), averaging between 16.1 and 59.4 µg/L (**Table 2.3** and **Figure 2.3**). According to the IWR, if the annual mean chlorophyll *a* for any one year is over the chlorophyll *a* threshold, the water is verified as impaired for nutrients.

The sources of data for the IWR assessment came from stations sampled by the Pinellas County Department of Environmental Management (21FLPDEM…) and the Department's Southwest District (21FLTPA…). Sampling conducted by Pinellas County at Stations 21FLPDEMAMB 15-1 and 21FLPDEMAMB 18-1 comprised the majority of the data. The Department also collected data from the following stations: 21FLTPA27584438247015, 21FLTPA585948247171, 21FLTPA27591358247312, 21FLTPA27591398247218, and 21FLTPA27592358247432. **Figure 1.2** shows the locations of these sampling sites. **Figure 2.1** displays the DO data collected from 1999 through 2006 for each of these stations, while **Figure 2.2** shows the chlorophyll *a* data from the same period. The individual water quality measurements used in this analysis are in the IWR database and are available on request.

Monitoring results collected after 2006 were also evaluated, and the results show that water quality in the tidal segment does not exhibit a trend over time and has remained fairly constant since the beginning of the Cycle 1 verified period. The graphs in **Appendix C** display water quality results for relevant variables, contained in the IWR Run 44 database, that were collected from 1999 to the present.

Table 2.1. Verified Impairment in Stevenson Creek Tidal Segment, WBID 1567

Parameter Causing Impairment	Priority for TMDL Development	Projected Year For TMDL Development
DO	High	2007
Nutrients	High	2007

Table 2.2. Summary of DO Data for Stevenson Creek Tidal Segment, WBID 1567 (1999–2004)

Number of Samples	Minimum (mg/L)	Mean (mg/L)	Median (mg/L)	Maximum (mg/L)	Number of Exceedances
121	0.25	3.35	3.14	20.03	77

Table 2.3. Summary of Chlorophyll a Data for Stevenson Creek Tidal Segment, WBID 1567 (1999–2004)

Year	Annual Mean Chlorophyll *a* (µg/L)
1999	16.08
2000	32.74
2001	59.37
2002	24.75
2004	42.81

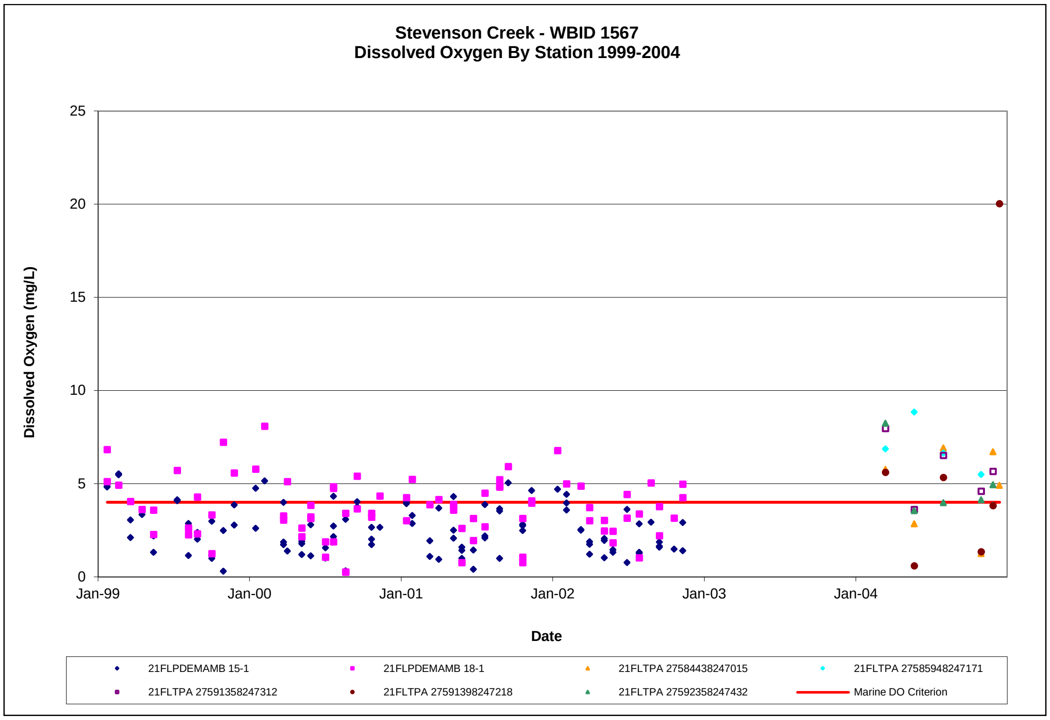

Figure 2.1. DO Measurements in Stevenson Creek Tidal Segment, WBID 1567, During the Verified Period

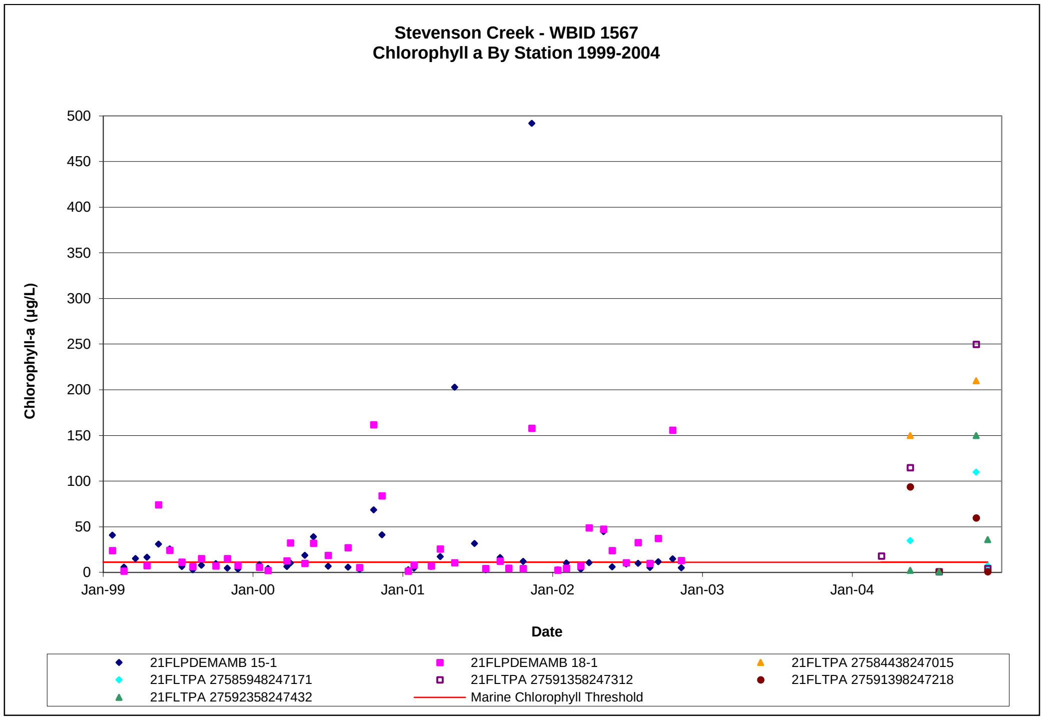

Figure 2.2. Chlorophyll a Measurements in Stevenson Creek Tidal Segment, WBID 1567, During the Verified Period

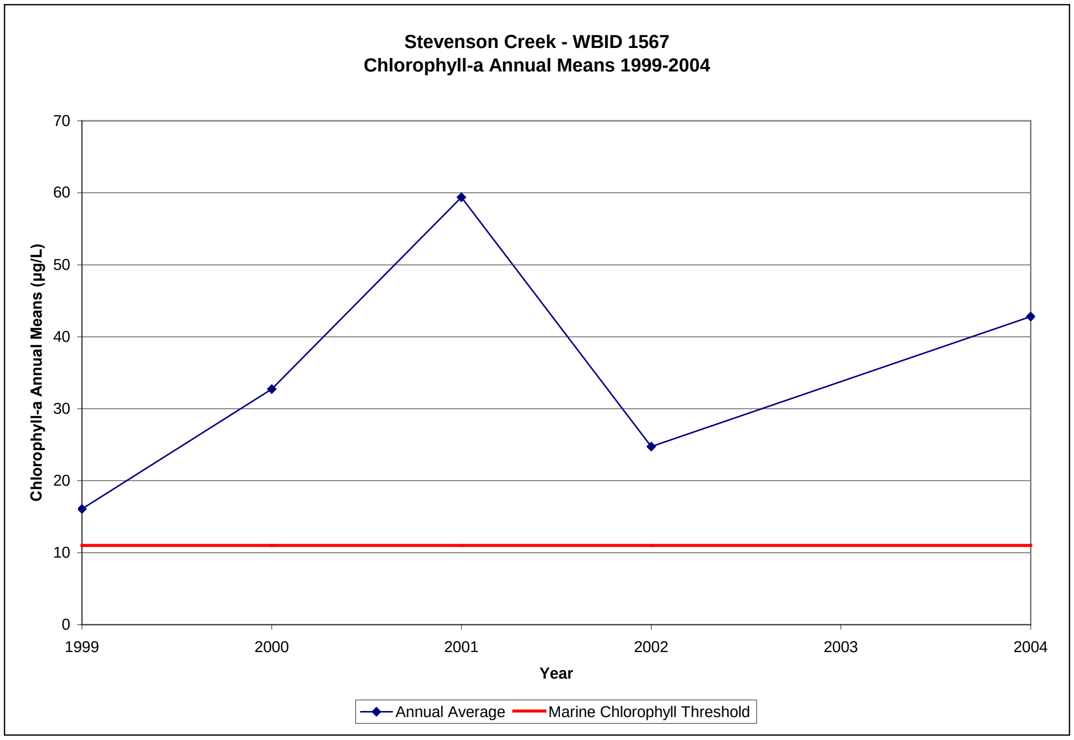

Figure 2.3. Chlorophyll a Annual Averages in Stevenson Creek Tidal Segment, WBID 1567, During the Verified Period

As part of the verified listing process, the Department attempts to identify the limiting nutrient or nutrients for the impaired waterbody. The limiting nutrient, generally nitrogen or phosphorus, is defined as the nutrient that limits plant growth (both macrophytes and algae) when it is not available in sufficient quantities. A limiting nutrient is a chemical that is necessary for plant growth, but available in quantities smaller than those needed for algae, represented by chlorophyll *a*, and macrophytes to grow. Once the limiting nutrient in a waterbody is exhausted, algae stop growing. If more of the limiting nutrient is added, larger algal populations will result until nutrients or other environmental factors again limit their growth.

In Florida waterbodies, nitrogen and phosphorus are most often the limiting nutrients, and nitrogen is typically the limiting nutrient in most Florida estuaries. There is a general understanding in the marine scientific community that nitrogen is the principal cause of nutrient overenrichment in coastal systems (National Research Council 1993 and 2000), and an analysis of the data from the Stevenson Creek Tidal Segment supports this conclusion.

Determining the limiting nutrient in a waterbody can be accomplished by calculating the ratio of nitrogen to phosphorus in the waterbody, with water column ratios of total nitrogen (TN) to total phosphorus (TP) of less than 10 indicating that nitrogen is limiting. The median TN to TP ratio is 5.8 (computed from n=117 values), indicating that nitrogen is the limiting nutrient in Stevenson Creek Tidal Segment.

Since nitrogen is the limiting nutrient, reductions in TN loadings would be expected to result in decreases in algal growth, and are measured as decreases in chlorophyll *a* levels. Reductions in TN loading are also expected to result in additional benefits of concern, including DO and biochemical oxygen demand (BOD). BOD is defined as the amount of oxygen required by bacteria while stabilizing decomposable organic matter under aerobic conditions (Sawyer and McCarty 1967). Reductions in nutrients will result in lower algal biomass levels in the water column, and lower algal biomass levels will result in smaller diurnal fluctuations in DO, fewer algal-based total suspended solids (TSS), and reduced BOD.

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS

3.1 Classification of the Waterbody and Criteria Applicable to the TMDL

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

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

The tidal portion of Stevenson Creek is a Class III estuarine waterbody, with designated uses of recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criteria applicable to the impairment addressed by this TMDL are for DO and the narrative nutrient criterion.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

3.2.1 DO Criterion

The Class III marine criterion for DO, as established by Subsection 62-302.530(30), F.A.C., states that DO shall not average less than 5.0 mg/L in a 24-hour period, and shall not be less than 4 mg/L, and that normal daily and seasonal fluctuations above these levels shall be maintained.

3.2.2 Interpretation of Narrative Nutrient Criterion

Florida's nutrient criterion is narrative only—*i.e.*, nutrient concentrations of a body of water shall not be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. Accordingly, a nutrient-related target is needed to represent levels at which an imbalance in flora or fauna is expected to occur. While the IWR provides a threshold for nutrient impairment for estuaries based on annual average chlorophyll *a* levels, these thresholds are not standards and need not be used as the nutrient-related water quality target for TMDLs. In fact, in recognition that the IWR thresholds were developed using statewide average conditions, the IWR (Section 62-303.450, F.A.C.) specifically allows the use of alternative, site-specific thresholds that more accurately reflect conditions beyond which an imbalance in flora or fauna occurs in a waterbody.

In translating the narrative nutrient criterion for this TMDL, the Department selected estuarine segments not impaired for nutrients to identify a target chlorophyll *a* concentration for establishing the TMDL. **Table 3.1** summarizes the results for the estuarine segments where average chlorophyll *a* concentrations are less than the 11 µg/L impairment threshold for estuaries. These waters include both open water estuarine segments and tidal stream segments in the area of Stevenson Creek. Given the uncertainty of nutrient reactions within estuaries, the Department applied a chlorophyll *a* target of 8 µg/L for establishing the TMDL, which falls within the range of average chlorophyll a concentrations in the estuarine waters not impaired for nutrients. Using this target value for establishing the TMDL should result in annual average chlorophyll *a* values below the impairment threshold for estuaries of 11 µg/L. This approach minimizes the potential for listing the water as impaired in the future.

Table 3.1. Summary of Chlorophyll a Results for Estuarine Segments Not Impaired for Nutrients

[1] Averages calculated from results collected during the 1994 to 2006 period as contained in IWR Database Run 28.

Waterbody Segment	WBID	Average Chlorophyll *a* (µg/L)[1]
Clearwater Harbor South	1528	7.6
The Narrows	1528A	8.3
Direct Runoff to Intracoastal Waterway	1528B	7.8
Clearwater Harbor North	1528C	6.4
Boca Ciega Bay Central	1694A	6.5
Boca Ciega Bay North	1694B	7.2
Boca Ciega Bay	1694C	8.2
St. Joseph Sound	8045D	4.9
Direct Runoff to Gulf (Minnow Creek)	1535	5.1
Anclote River Tidal Segment	1440	4.3

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

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

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

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

4.2 Point Sources

4.2.1 NPDES-Permitted Wastewater Facilities

One permitted domestic WWTF in the watershed has a surface water discharge: the city of Clearwater-Marshall Street Advanced Wastewater Treatment Plant (AWWTP), NPDES FL0021857. The Marshall Street plant is a domestic WWTF with a design flow of 10 million gallons per day (MGD) (Department 2007a). A portion of the treated effluent from this facility is reused for irrigation on public access areas under the city of Clearwater Master Reuse System permit (FL186261). The reclaimed water may provide an indirect source of nutrients impacting Stevenson Creek. The remaining treated effluent is discharged directly into the tidal portion of Stevenson Creek, via Outfall D-001, which is located approximately 0.8 miles upstream of the creek's mouth. The point of discharge in Stevenson Creek is 20 feet from shore at a depth of 4 feet, at Latitude 27° 58' 58"N and Longitude 82° 47' 15"W. **Figure 4.1** displays the location of the surface water outfall and reuse system application points in the watershed.

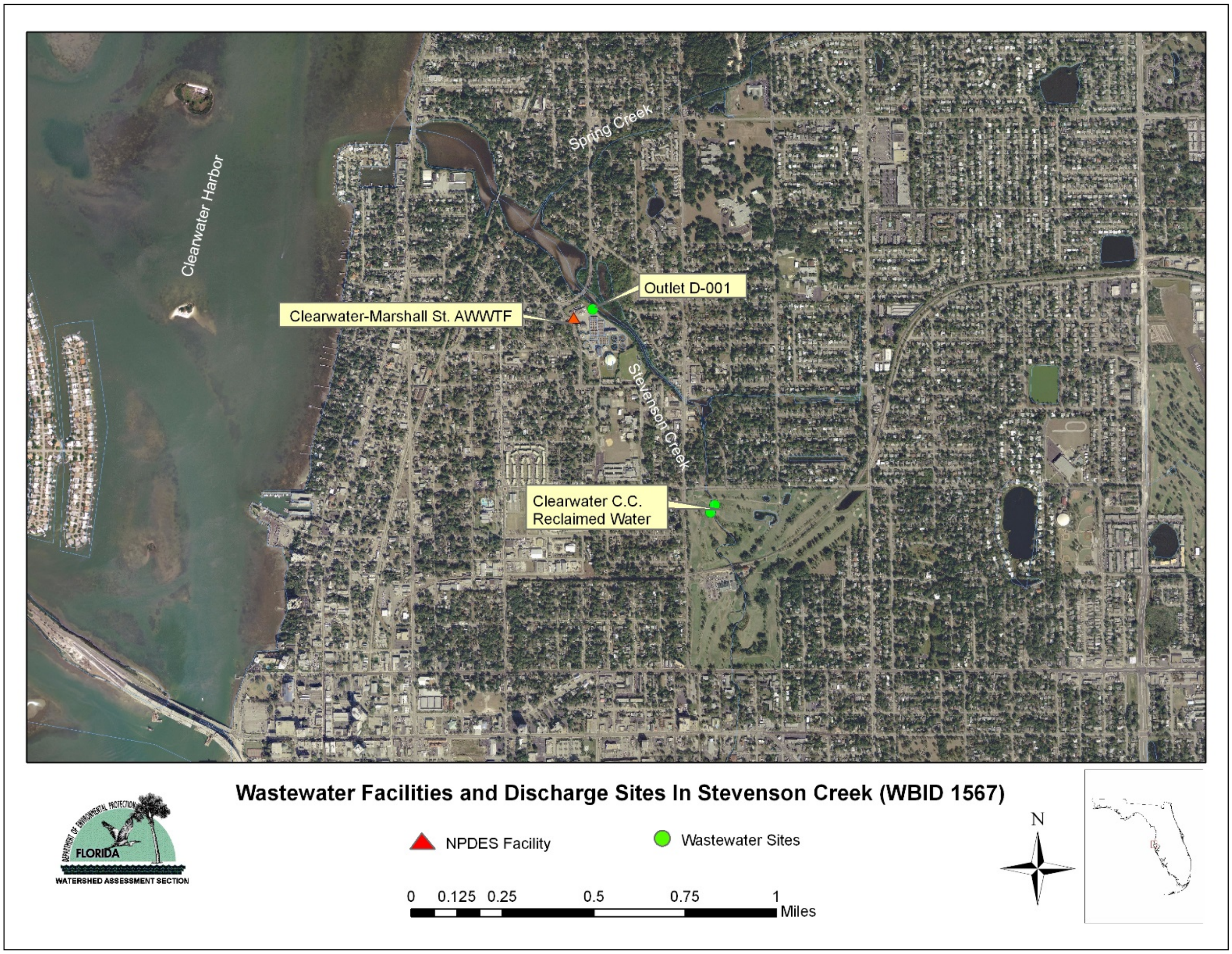

Figure 4.1. Wastewater Facilities and Discharge Sites in the Stevenson Creek Watershed

During the 1999 to 2006 period, which is used in the modeling assessment to develop the TMDLs, the amount of effluent discharged to Stevenson Creek is considerably lower than the WWTF permitted capacity of 10 MGD. The WWTF annual average daily flow volumes and total annual nutrient and biochemical oxygen demand loads discharged to Stevenson Creek, calculated from results reported in the state Permit Compliance System database, are presented in **Table 4.1**.

Table 4.1. Clearwater-Marshall Street AWWTP Average Daily Flow and Total Loads Discharged to Stevenson Creek Tidal Segment

Year	Flow (MGD)	TP Load (lbs/yr)	TN Load (lbs/yr)	$CBOD_5$ Load (lbs/yr)
1999	7.32	7,315	37,200	52,064
2000	6.15	18,689	31,086	30,653
2001	4.72	5,475	33,260	44,614
2002	4.49	3,074	33,510	30,937
2003	5.63	2,568	36,826	28,358
2004	3.86	2,614	29,393	20,905
2005	3.03	1,011	21,095	15,950
2006	2.87	1,321	21,269	18,916
Average	**4.76**	**5,258**	**30,455**	**30,300**

4.2.2 Municipal Separate Storm Sewer System Permittees

Municipal separate storm sewer systems (MS4s) may also discharge pollutants to waterbodies in response to storm events. To address stormwater discharges, the EPA developed the NPDES stormwater permitting program in two phases. Phase 1, promulgated in 1990, addresses large and medium-size MS4s located in incorporated areas and counties with populations of 100,000 or more. Phase 2 permitting began in 2003. Regulated Phase 2 MS4s are defined in Section 62-624.800, F.A.C., and typically cover urbanized areas serving jurisdictions with a population of at least 10,000 or discharging into Class I or Class II waters, or into Outstanding Florida Waters (OFWs).

The stormwater collection systems in the Stevenson Creek watershed, which are owned and operated by Pinellas County in conjunction with the Florida Department of Transportation (FDOT) District 7, are covered by a Phase 1 MS4 permit (FLS000005) (Department 2006b). The cities of Clearwater, Dunedin, and Largo, which have land areas within the Stevenson Creek watershed, are co-permittees. Currently, no local governments in the watershed have applied for coverage under the Phase 2 NPDES MS4 permit.

4.3 Land Uses and Nonpoint Sources

Nutrient loading from urban areas is most often attributable to multiple sources, including stormwater runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from the improper disposal of waste materials, leaking septic systems, and domestic animals. Because the Stevenson Creek watershed is primarily urban, agricultural fertilizing or nutrients from wildlife and agricultural livestock wastes are not expected to contribute significantly to the TN load.

4.3.1. Land Uses

The spatial distribution and acreage of different land use categories were identified using the SWFWMD 2004 land use coverage (scale 1:40,000) contained in the Department's Geographic Information System (GIS) library. According to the Florida Land Use and Cover Classification System (FLUCCS), there are 26 land use categories (Level 4) in the Stevenson Creek watershed. For the purpose of this report, and considering the most predominant land use categories in the Stevenson Creek watershed, the FLUCCS land use categories were aggregated into nine groups for modeling purposes and are presented in **Table 4.2** with their respective distribution within each of the model subwatersheds (Camp, Dresser & McKee [CDM] and Dynamic Solutions [DS] 2009). Land use categories in the watershed were aggregated using the simplified Level 1 codes (**Table 4.2**).

Figure 4.2 shows the acreage of the principal land uses in the watershed. Land use is predominately urban and residential, with over 75% of the land area developed into residential areas. The next largest land use is commercial and industrial at 10.4% of the combined watershed land area, and over 7% is recreational area, comprising mostly golf courses. Natural land uses (water and wetlands) represent some 4.9% of the area, and transportation/communications/utilities take up about 2%.

Table 4.2. Land Use Category Classification and Area (in Acres) in the Stevenson Creek Watershed in 2004

Land Use	Hammond Branch	Lower Stevenson	Spring Branch	Upper Stevenson	Total	% of Watershed
Commercial/Industrial	40.2	70.8	129.8	415.9	656.6	10.4%
Cropland/Upland Forest	5.7		38.2	4.8	48.7	0.8%
Recreational/Open Land	123.3	91.7	59.7	174.4	449.0	7.1%
Residential High Density/Institutional	38.4	30.5	143.5	83.2	295.6	4.7%
Residential Low Density: < 2 dwelling units per acre (DU/ac)			58.5	8.8	67.3	1.1%
Residential Medium Density: 2 to 5 DU/ac	647.1	393.3	1,551.9	1,786.4	4,378.6	69.6%
Transportation/Utilities	23.8	19.2	54.4	37.6	134.9	2.1%
Water	26.5	35.2	60.1	64.9	186.6	3.0%
Wetlands	0.8	6.3	55.5	8.4	70.9	1.1%
Total	**905.8**	**647.0**	**2151.6**	**2,584.4**	**6,288.2**	**100%**

4.3.2 Estimating Nonpoint Source Loadings

The nonpoint source loadings of BOD, expressed as ultimate carbonaceous biochemical oxygen demand ($CBOD_u$) and nutrients (TN and TP) generated in the Stevenson Creek watershed for the 1999 to 2006 period, were estimated for stream baseflow, septic systems, and surface water runoff using the *Hydrological Simulation Program - FORTRAN* (HSPF) model. A detailed description of the HSPF model applied to the watershed is available in the TMDL model development report (CDM and DS 2009). **Table 4.3** provides the model-simulated annual average nonpoint source pollutant loadings The following briefly describes the methods used to develop the loading estimates.

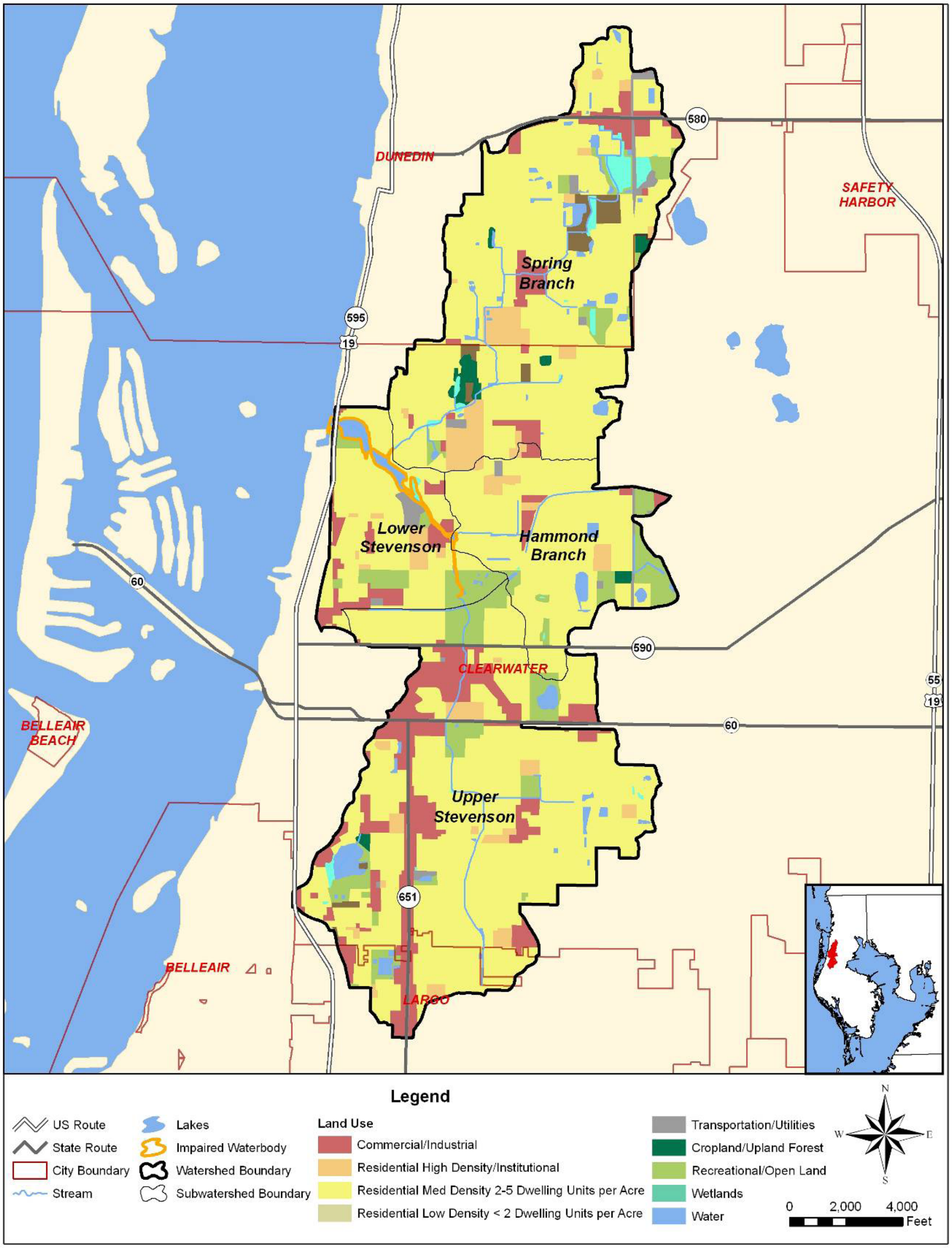

Figure 4.2. Principal Land Uses in the Stevenson Creek Watershed in 2004

Table 4.3. Annual Average Watershed Nonpoint Source Loads to Stevenson Creek Tidal Segment

Year	TP (lbs/yr)	TN (lbs/yr)	$CBOD_u$ (lbs/yr)
1999	3,262	36,092	91,162
2000	2,405	27,110	59,871
2001	3,725	37,469	127,333
2002	4,795	46,625	170,619
2003	6,199	57,035	259,748
2004	8,844	62,394	469,895
2005	3,232	36,593	79,893
2006	4,078	38,343	152,224
Average	**4,568**	**42,708**	**176,343**

Ground Water

Baseflow

Baseflow represents ground water discharge to streams. The annual baseflow discharge and load were computed for each of the subbasins draining to Stevenson Creek. Estimated annual baseflows, including interflows, for all subwatersheds are included in *Tables 4-7* through *4-10*, in acre-ft per year, in the model development report (CDM and DS 2009). Interflow is defined as that ground water flow from the soil zone above the ground water table.

Ground water quality data were obtained from wells in the upper parts of Stevenson Creek watershed or from wells located just outside the watershed boundary (see *Figure 2-6* in the model development report). Samples from these wells were analyzed for a large set of constituents, including nutrients that are 303(d) listed in surface waterbodies. Most of the available data from Pinellas County for these wells were collected between 1990 through 1999, with one sample in 2003 (CDM and DS 2009).

Average annual pollutant loadings from baseflows, as simulated with the HSPF model, were estimated in pounds per year. These loads are included for all subwatersheds in *Section 4* of the TMDL model development report (CDM and DS 2009).

Septic Systems

Figure 4.3 shows the locations of septic tanks in the Stevenson Creek watershed, as shown in GIS data published by the Florida Department of Health (FDOH). The number of septic tanks in the watershed

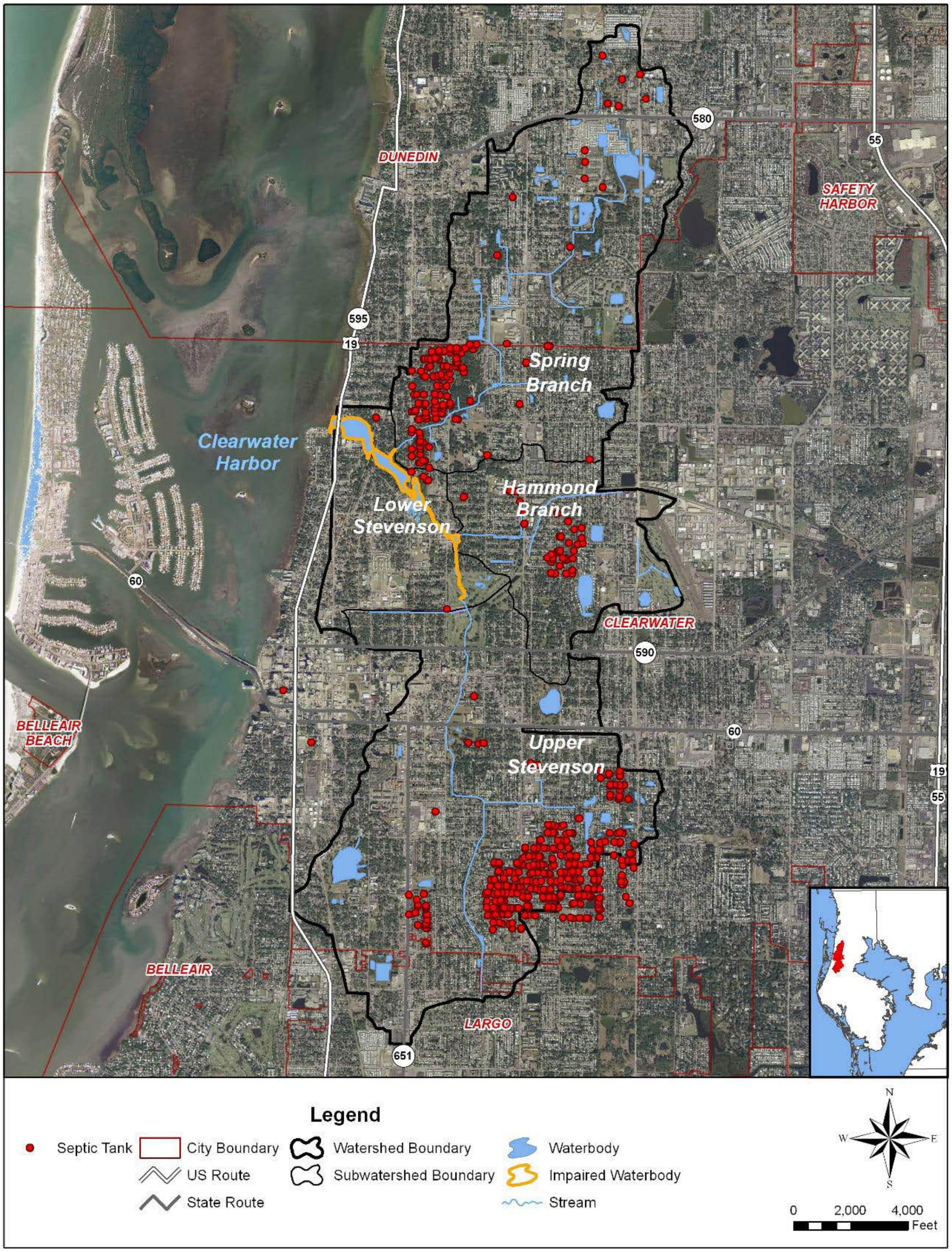

Figure 4.3. Septic Tank Locations in the Stevenson Creek Watershed

based on this information is 487. The loading impacts of failing septic tanks are addressed by increasing the surface runoff loading calculated by the HSPF model. The failing septic tank loading rate of 10% was used per the Department's protocol (Department 2006). To account for septic system loadings, the HSPF model was adjusted to match the estimated annual loadings through the use of accumulation/washoff, interflow, and baseflow parameters. Values used in the septic tank load calculations may be found in the TMDL model development report (CDM and DS 2009).

Surface Water Runoff

The HSPF model was used to estimate the watershed surface water runoff loads associated with rainfall. The model is designed to simulate the annual hydrologic (stream flows) and associated water quality (pollutant loads) from pervious and impervious land surfaces based on land use.

A discussion of the HSPF's model development, parameters, and input data is included in *Section 4* of the model development report (CDM and DS 2009). The HSPF-simulated surface water runoff flows for all subwatersheds may be found in *Tables 4-7* through *4-10* in the model development report. Additionally, the annual and average annual simulated watershed loading rates (in lbs/acre/year); and the simulated total loads for each pollutant for all subwatersheds are included.

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The goal of this TMDL development effort is to identify the maximum allowable TN and carbonaceous biochemical oxygen demand (CBOD) loadings from point and nonpoint sources in the watershed, so that Stevenson Creek Tidal Segment (WBID 1567) will meet the DO water quality criterion and the narrative nutrient water quality criterion, thus maintaining its function and designated use as a Class III marine water. The Department contracted with CDM and DS to develop a watershed pollutant loading model and a surface water hydrodynamic and water quality model. The *Hydrological Simulation Program - FORTRAN* (HSPF) model was selected as the watershed-scale loading model, and the *Environmental Fluid Dynamics Code* (EFDC) model was selected as the receiving water hydrodynamic and water quality model. Details on the setup, calibration, and validation of each model are documented in the TMDL model development report (CDM and DS 2009). After the models were completed for the Stevenson Creek system, the Department applied them in assessing pollutant load reductions required for the tidal reach of the creek to meet the applicable criteria for DO and nutrients.

The HSPF model was used to conduct the watershed hydrodynamic modeling to generate watershed flows associated with each of the aggregated land use categories from each of the freshwater tributaries. HSPF flows and selected pollutant loading rates, as mentioned in **Chapter 4**, were used to conduct watershed loading calculations. The output from the HSPF model provided the hydrodynamic and water quality constituent input needed for the EFDC model to simulate the hydrology and water quality of Stevenson Creek Tidal Segment.

In the setup of the EFDC model for the tidal creek, Clearwater Harbor served as the downstream boundary condition. Inflow boundaries to the EFDC model domain were provided by the HSPF model output of flow volumes and water quality concentrations developed for the subwatersheds, representing the nonpoint source loadings, and the effluent discharge monitoring data for the Clearwater-Marshall St. AWWTP facility, representing the point source loading. *Appendix A* of the TMDL model development report summarizes the development of the St. Joseph Sound/Clearwater Harbor hydrodynamic model that was used to generate boundary conditions for the downstream end of the EFDC model (CDM and DS 2009).

The hydrodynamic and water quality time series results for each model boundary component were linked as input to the EFDC model to simulate hourly DO and chlorophyll *a* responses in the tidal creek. Each model was calibrated and validated using the available hydrologic data and water quality results collected in the Stevenson Creek watershed and in nearby Clearwater Harbor. The comparisons of model simulated results to observed data are provided in the TMDL model development report (CDM and DS 2009). The water quality models were calibrated and validated using surface water quality data contained in the IWR Database that were collected between 1999 and 2006. Monitoring results collected after 2006 were also evaluated and the results show that water quality in both the tidal and freshwater segments do not exhibit trends over time and has remained fairly constant since 1999. Water quality results for chlorophyll *a*, DO, TN, and five-day BOD (BOD_5), contained in the IWR Run 44 database, that were collected from 1999 to the present are displayed in the graphs in **Appendix C**.

Other models implemented in this project included an "AdlCPR" model that was developed as part of the Stevenson Creek Watershed Management Plan, to characterize stage, discharge, and cross-sectional area relationships for select cross-sections of stream reaches in the model. Channel section geometry data were imported into a *Hydraulic Engineering Center River Analysis System"* (HEC-RAS) model to simulate water depth and cross-sectional area at different downstream flow rates. Other supporting models, not mentioned in this report, are documented and referenced in the TMDL model development report (CDM and DS 2009).

Although the focus of this TMDL is reductions in BOD and nutrient loadings to address the DO and nutrient impairments, other factors can affect DO in surface waters. These factors include reaeration, temperature, salinity, color, light transmission, total suspended solids (TSS), and sediment parameters such as sediment oxygen demand (SOD) and nutrient flux rates.

5.2 Overview of the HSPF Model

The HSPF model was used to simulate both hydrologic and water quality loads in the watershed and freshwater tributaries. The EPA and United States Geological Survey (USGS) jointly developed the modifications to the original model for water quality purposes in the 1980s. Information about the model may be found at the USGS website provided in the reference section. Detailed information about the setup, input data, and application of the HSPF model to the Stevenson Creek watershed is documented in the TMDL model development report (CDM and DS 2009). The data used to develop this dynamic model include information on rainfall, solar radiation, temperature (air and dewpoint), evapotranspiration, ground elevation, stream reach channel characteristics (cross-sections, lengths, and volumes), stream flows and stages, watershed inflows and withdrawals, land use classifications, hydrologic soil groups, pollutant loading coefficients, baseflow concentrations, and water quality concentrations.

5.3 Overview of the EFDC Model

The EFDC model is a general purpose modeling package designed to simulate one-, two-, and three-dimensional flow, transport, and biogeochemical processes in surface water systems, including rivers, lakes, estuaries, reservoirs, wetlands, and nearshore to shelf-scale coastal regions. The public domain EFDC model, originally developed at the Virginia Institute of Marine Science for estuarine and coastal applications, is supported by the EPA.

The EFDC Explorer program was used to set up and apply the EFDC model to Stevenson Creek Tidal Segment to simulate the three-dimensional hydrodynamic and water quality characteristics of the system (CDM and DS 2009). To efficiently test, set up, and calibrate EFDC models, DS developed the EPA-licensed EFDC_Explorer pre- and post-processor. EFDC_Explorer, developed to support the EFDC submodels for hydrodynamics, sediment transport, toxic chemicals, water quality, and sediment diagenesis, is a public domain, Windows-based graphical user interface (GUI) available from DS. EFDC_Explorer is designed to support EFDC model setup and configuration, grid generation (cartesian or curvilinear), model testing, calibration, and validation. EFDC_Explorer provides the capability for data visualization, including display of the computational grid, map overlays, spatial results, time series, and vertical profile plots. Information on EFDC_Explorer is available in the user's manual (Craig 2008) and at the DS website listed in the reference section.

Stevenson Creek Tidal Segment was segmented into curvilinear computational grid cells representing three dimensions, using bathymetric data, for the hydrodynamic and water quality model. A discussion of the grid development, bathymetry, and model boundary conditions is contained in the TMDL model development report (CDM and DS 2009).

5.4 HSPF Model Calibration and Validation

The HSPF model was set up, refined, calibrated, and validated. The HSPF model was developed to simulate Stevenson Creek watershed stream flows and water quality constituent loads for the period from January 1, 1999, to December 31, 2006. Simulated results were compared with observed ambient water quality monitoring data collected between 1999 and 2006.

The period from August 2006 through December 2006 was chosen as the HSPF stream flow calibration period, and the period from February 2004 through March 2005 was chosen as the HSPF stream flow validation period. Simulated stream flow was calibrated against instantaneous flow measurements collected by Pinellas County during routine monitoring at Stations 21FLPDEM18-03 and 21FLPDEM15-04 for Upper Stevenson Creek and Spring Branch, respectively. Results indicated that the flow calibration was quite good for both streams. *Chapter 4* of the TMDL model development report (CDM and DS 2009) discusses the calibration/validation process and results.

Based on available ambient water quality data, the period from January 1, 2003, through December 31, 2004, was chosen as the HSPF model water quality calibration period, and the period from January 1, 2005, through December 31, 2006, was chosen as the HSPF model validation period.

Upper Stevenson Creek and Spring Branch were calibrated for the following water quality parameters:

- *Water Temperature - ^{o}F.*
- *DO – mg/L.*
- *Chlorophyll a – µg/L.*
- *TP – mg/L.*
- *Orthophosphate – mg/L.*
- *TN – mg/L.*
- *Total Kjeldahl Nitrogen (TKN) – mg/L.*
- *Nitrite plus Nitrate Nitrogen – mg/L.*
- *Ammonia Nitrogen (NH_4) – mg/L.*
- *CBOD ultimate ($CBOD_u$) – mg/L.*

In the case of $CBOD_u$, there are no direct measures of $CBOD_u$ in surface waters. To evaluate model performance for BOD, the BOD_5 ambient monitoring results were converted to $CBOD_u$ using a multiplier of 2.47, as recommended in EPA guidance (1997), in the absence of site-specific data.

Figures and tables providing the simulated (modeled) and/or observed data for all waterbody segments may be found in *Sections 4.3.3* through *4.3.6* of the TMDL model development report (CDM and DS 2009).

5.5 HSPF Model Sensitivity

A model sensitivity analysis was performed to identify the model parameters that have or do not have a significant influence on model simulations. Various parameter changes were made to test the sensitivity of the model. The results of the sensitivity analysis included the fact that stream flow rate was sensitive to the percent impervious cover. Model water quality parameters were determined to be sensitive to watershed loadings, SOD, and algal growth rate. HSPF model sensitivity is discussed in *Section 4.5* of the TMDL model development report (CDM and DS 2009).

5.6 EFDC Model Calibration

The primary period selected for water quality model calibration was January 1, 2004, to December 26, 2004. This period had an adequate set of salinity, temperature, meteorological, and water quality data for setting boundary conditions and calibrating the model.

The source of the data for the calibration period of 2004 was sampling performed by the Department's Southwest District office. The stations with their full station names and STORET ID numbers are as follows:

— *TP283-Stevenson Creek, 27592358247432.*

— *TP284-Stevenson Creek, 27591358247312.*

— *TP282-Stevenson Creek, 27585948247171.*

— *TP285-Stevenson Creek, 27584438247015.*

Figure 1.2 shows the locations of the stations.

Since there were no tidal or water-level gages within the tidally influenced region of Stevenson Creek, a short record of relative water depths, collected by the United States Army Corps of Engineers (USACOE) from June 25 to 26, 2002, was used to calibrate the tidal fluctuations.

The model initial conditions and boundary conditions are discussed in *Section 4.7.1*; the EFDC hydrodynamic and water quality model calibration results are presented in *Sections 4.7.2* through *4.7.4*. (including calibration plots and supporting tables) of the final TMDL model development report (CDM and DS 2009). *Appendix B* of the report contains a complete set of calibration plots.

In accordance with the Department's TMDL protocol, a statistical methods analysis using the "root mean squared" (RMS) was performed. As per the protocol, "the RMS error should ideally be no greater than potential gaging, sampling, and laboratory errors inherent in the measured data." RMS is also called the "standard deviation" and is in the same units as the evaluated data. The summary tables (*Tables 4-33* through *4-35*) in the final TMDL model development report (CDM and DS 2009) for the calibration runs show that the model results were all within the estimated error ranges for water elevation, temperature, and salinity. *Table 4-41* of the report shows the calibrated and RMS results for the water quality parameters.

5.7 EFDC Model Validation

The four-year period from January 1, 1999, to December 31, 2002, was selected for model validation. The observed data used for validation were from the Pinellas County water quality monitoring program. The two stations chosen were 21FLPDEM AMB 18-1 and 21FLPDEM AMB 15-1. **Figure 1.2** identifies the station locations.

Section 4.8 of the final TMDL model development report outlines the changes in the boundary conditions for validation, hydrodynamics, and water quality (CDM and DS 2009). Time series validation plots for flow, salinity, water temperature, DO, and chlorophyll *a* for both the water surface and bottom layers are included in this report. A complete set of validation plots may be found in *Appendix C* of the TMDL model development report (CDM and DS 2009).

5.8 EFDC Model Sensitivity

A sensitivity analysis of the EFDC model was performed. The base model for this analysis was the calibrated model for 2004. Sixteen model runs with different parameter values were run to investigate the model sensitivity.

Section 4.9 of the TMDL development report (CDM and DS 2009) includes a discussion of the sensitivity analysis model run descriptions and results. The conclusions were that the model was not very sensitive to the range of parameter variation analyzed; however, raising the algal growth rate improved the chlorophyll *a* RMS but negatively impacted the DO and nutrient RMS's. SOD also had a significant effect on DO concentrations in surface water and to a lesser degree the related benthic nutrient fluxes and nutrient concentrations in surface water.

5.9 The TMDL Development Process

The calibrated and validated HSPF and EFDC models developed for Stevenson Creek are designed to assist in predicting future water quality responses, as a result of reductions in existing pollutant loads, in order to determine the waterbody's assimilative capacity to meet the applicable DO and nutrient surface water quality criteria and establish the TMDLs. The models simulate the eutrophication processes in the freshwater tributaries and the tidal segment of Stevenson Creek.

The contractors provided the models set up to simulate conditions during the 1999 to 2006 period. The Department applied the models in assessing pollutant load reductions required for the tidal reach of the creek to meet the applicable criteria for DO and nutrients. The loading capacity for the tidal segment was determined by performing multiple model design runs where the point source and nonpoint source loads were adjusted until the applicable water quality targets were met.

Reductions in both point source loads, from the Clearwater-Marshall St. AWWTP, and watershed nonpoint source loads were evaluated with the EFDC model of Stevenson Creek to determine a load reduction alternative for meeting the water quality targets and setting TMDLs for BOD and TN loadings.

As a result of reductions in point and nonpoint loadings, the SOD and benthic nutrient flux rates are expected to decrease due to reduced inputs of organic matter, primarily in the form of algal biomass, deposited to watersbody sediments. Therefore, the SOD and benthic nutrient flux rates were modified to account for this mechanism.[1] The approach chosen for adjusting SOD and benthic nutrient flux rates was to assume a linear relationship between the rates and the organic carbon content of sediment related to water column primary productivity. The formula for the linear assumption that reductions in SOD and benthic nutrient flux rates are directly related to reductions in algal (phytoplankton) primary productivity is as follows:

$$(\text{SOD})_{rev} = \frac{(\text{Chl } a)_{out}}{(\text{Chl } a)_{cal}} \times (\text{SOD})_{cal}$$

[1] The Chl *a* annual averages used in these SOD and benthic nutrient flux rate revisions were calculated following the IWR methodology.

Where:

- *$(SOD)_{rev}$ is the revised SOD (or benthic ammonia and/or phosphorus flux) rate under the reduction scenario under evaluation.*

- *$(Chl\ a)_{out}$ is the chlorophyll a annual average value from the reduction scenario model run.*

- *$(Chl\ a)_{cal}$ is the chlorophyll a annual average value from the calibrated model run.*

$(SOD)_{cal}$ is the SOD (or benthic ammonia and/or phosphorus flux) rate from the calibrated model run.After each load reduction scenario was completed, the same EFDC model was rerun with the revised SOD and benthic nutrient flux rates. The DO and chlorophyll *a* results from the model runs with the adjusted sediment rates were then evaluated against the appropriate water quality targets. The simulated results from the EFDC model that were compared with the water quality targets were obtained from the model grids where the ambient monitoring stations used for model calibration and validation were located. **Figure 5.1** shows the sampling stations along with the EFDC model grid domain.

The objective of the evaluation for establishing the TMDLs was to identify a model scenario where the predicted average chlorophyll *a* value would not exceed the selected target of 8 µg/L and result in DO conditions that would allow the tidal creek to meet the minimum DO criterion of 4 mg/L.

During the evaluation of alternative load reductions, model design scenarios were run with the Clearwater-Marshall St. AWWTP discharging at the current permitted flow of 10 million gallons per day (MGD) and at a flow of 5 MGD, which is approximately the average flow observed during the 1999 to 2006 period. Additionally, the model was run at effluent concentrations equal to the Advanced Wastewater Treatment (AWT) concentration limits in the existing permit. As the facility AWT limits are beyond technology-based effluent treatment levels for TN and BOD, some design runs were evaluated that maintained the maximum permitted limits for the AWWTP, while focusing the load reduction on the nonpoint sources. Additionally, TP load reductions were not included in the evaluation for establishing the TMDL, as the chlorophyll *a* response to AWWTP TP load reductions was determined to be negligible.

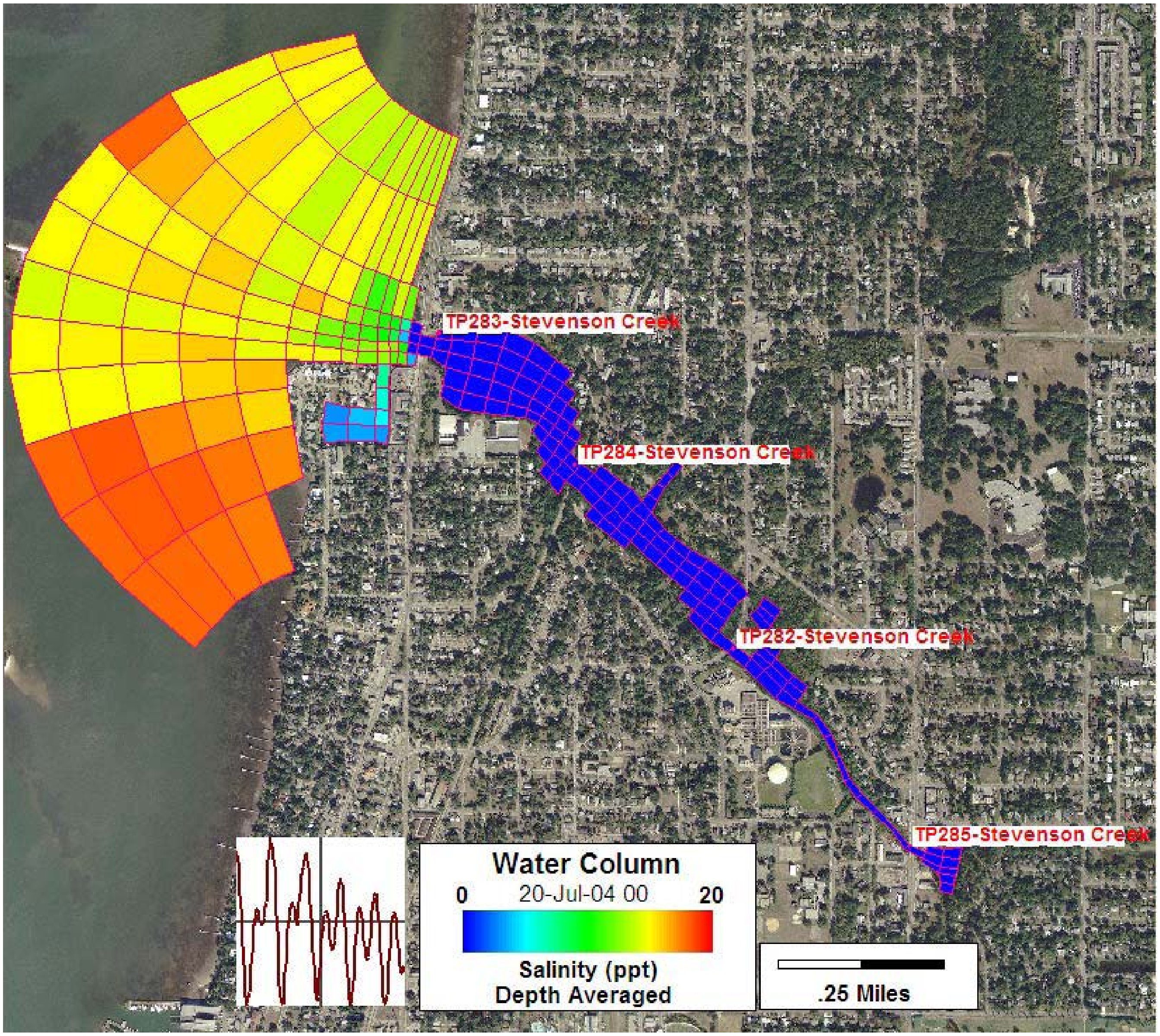

Figure 5.1. EFDC Model Domain with Monitoring Stations Used for Calibration

After each design scenario was completed, the percent DO exceedances (< 4 mg/L), and average chlorophyll *a* value were determined. Annual average chlorophyll *a* values were calculated following the IWR methodology for each model grid location with a sampling station. The average of the annual average concentrations at each sampling location was calculated for comparison with the chlorophyll *a* target.

The model results indicate that Stevenson Creek water quality is responsive to the discharge flow volumes applied in the design scenarios. For the model design run using the existing permit effluent limits for the

Clearwater-Marshall St. facility (permitted flow of 10 MGD), the percent DO exceedance rate and average chlorophyll *a* concentrations are much lower than the values for the model scenario with the facility discharge flow rate at 5 MGD (**Table 5.1**). This can be partially attributed to higher discharge flow volumes from the AWWTP resulting in shorter water residence times, which aids in flushing of the tidal creek.

The selection process for identifying the load reduction scenario for establishing the TMDL took into consideration what the AWWTP discharge flow volumes are reasonably expected to be. As a large quantity of the treated effluent goes to reuse and the plant inflow is considerably less than the permitted capacity of 10 MGD, an AWWTP flow volume of 5 MGD was used in the model design runs for determining the assimilative capacity of the tidal segment. During the 1999 to 2006 period, the Clearwater-Marshall St. facility annual average flow volume was slightly less than 5 MGD. In general, during recent years the effluent flow volumes discharged to the creek have been decreasing, while in the same period flow volumes going to reuse have increased (**Figure 5.2**). In this circumstance, the current discharge volume is a more realistic flow to apply in the model scenarios for evaluating the impacts of the point source discharge along with load reductions from nonpoint sources.

Table 5.1 presents a summary of the model-predicted DO and chlorophyll *a* results for the existing loading conditions (baseline) and the alternative load reduction scenarios evaluated are presented in **Table 5.1**. The load reduction scenario selected for establishing the TMDLs includes an 85% nonpoint source reduction in BOD and TN along with the Clearwater-Marshall St AWWTP discharging at an average flow rate of 5 MGD and at the following average effluent concentrations: $CBOD_5$ = 5 mg/L; TN = 2.2 mg/L; and DO = 7 mg/L. The AWWTP facility effluent flow rate and concentrations used in the model represent long-term averages, as they were applied throughout the eight-year model simulation period. Under this loading scenario, the DO exceedance rate is 9.4%, and the average chlorophyll *a* concentration is 7.1 µg/L.

A model scenario was performed to predict tidal creek water quality at loadings that represent undeveloped natural conditions. Watershed loadings of TN for the undeveloped condition were derived by using the estimated annual mass loads from undeveloped/natural areas for each hydrologic soil group presented in Harper and Baker (2007), and the area of each hydrologic soil group in the watershed presented in the TMDL model development report (CDM and DS 2009). The natural background TN load is estimated to be 5,594 pounds per year (lbs/yr), which is 13% of the existing watershed TN load. The undeveloped natural condition model scenario was simulated by reducing the existing TN and BOD watershed loads by 87% and removing the Clearwater-Marshall St. AWWTP effluent discharge to the creek. The model results for this scenario predict additional reductions in chlorophyll *a* concentrations (average of 3.3 µg/L) but with a greater percent exceedance (12.7%) of the minimum DO criterion of 4 mg/L (**Table 5.1**). These results indicate that at watershed loads representative of natural background conditions, the DO regime in the tidal creek would still not meet the marine minimum DO criterion.

Table 5.1. Summary of Model-Predicted DO and Chlorophyll a Results (1999–2006 Simulation Period)

* An asterisk, boldface type, and shading indicate the model run scenario selected for establishing the TMDL.
NPS = Nonpoint source

Model Run	Total Number of Model Observations	Number of DO Values Less Than 4 mg/L	% of DO Values Less Than 4 mg/L	Average Chlorophyll *a* (µg/L)
Baseline - Current Conditions (1999–2006)	58,400	22,515	38.6%	11.7
Design Run - 85% NPS Load Reduction; WWTF at 10 MGD Permitted Flow and $CBOD_5$ = 5.0 mg/L, TP = 1.0 mg/L, TN = 3.0 mg/L, DO = 5 mg/L	58,400	2,676	4.6%	4.0
Design Run - 85% NPS Load Reduction; WWTF at 50% of Permitted Flow and $CBOD_5$ = 5.0 mg/L, TP = 1.0 mg/L, TN = 3.0 mg/L, DO = 5 mg/L	58,400	7,059	12.1%	7.9
Design Run - 85% NPS Load Reduction; WWTF at 50% of Permitted Flow and $CBOD_5$ = 5.0 mg/L, TP = 1.0 mg/L, TN = 2.5 mg/L, DO = 7 mg/L	58,400	5,812	10.0%	7.4
Design Run - 85% NPS Load Reduction; WWTF at 50% of Permitted Flow and $CBOD_5$ = 5.0 mg/L, TP = 1.0 mg/L, TN = 2.2 mg/L, DO = 7 mg/L	**58,400***	**5,473***	**9.4***	**7.1***
Design Run - 85% NPS Load Reduction; WWTF at 50% of Permitted Flow and $CBOD_5$ = 5.0 mg/L, TP = 1.0 mg/L, TN = 2.0 mg/L, DO = 7 mg/L	58,400	5,331	9.1%	6.8
Design Run - 87% NPS Reduction, No WWTF Discharge (Natural Background Approximation)	58,400	7,417	12.7%	3.3

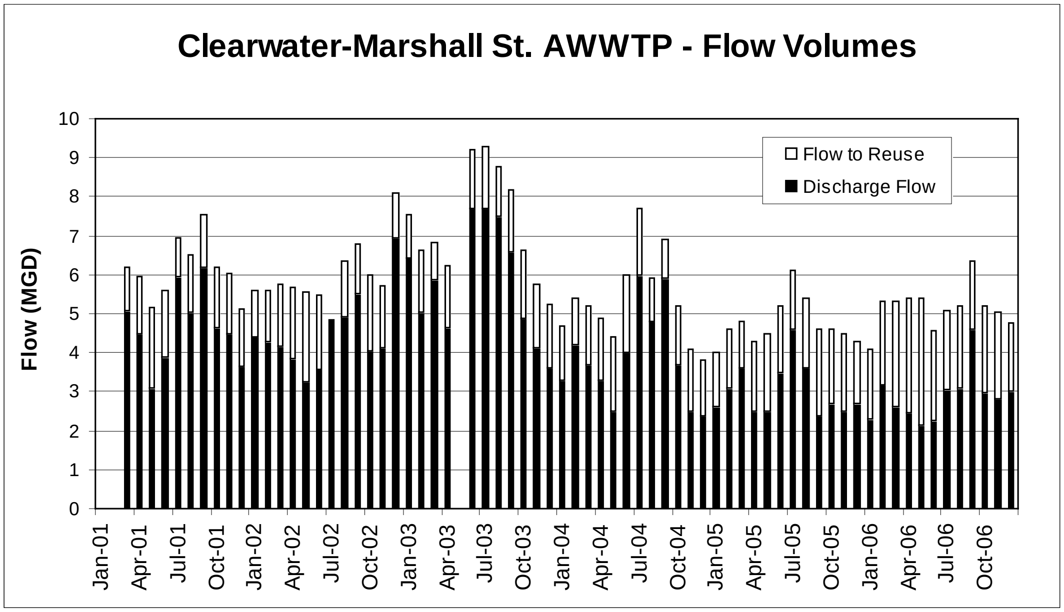

Figure 5.2. Clearwater-Marshall Street AWWTP Facility Flows to Reuse and Discharge to Stevenson Creek (2001–06)

Figures 5.3 and **5.4** show the predicted chlorophyll *a* annual averages used to calculate the overall chlorophyll *a* value for the current baseline condition and the selected load reduction scenario, respectively.

Based on the EFDC modeling results, the load reduction scenario selected for establishing the TMDLs is expected to result in an average chlorophyll *a* less than the target of 8 µg/L, thus achieving the narrative nutrient criterion, and result in an occurrence frequency of low DO that is similar to that of undeveloped natural conditions.

5.10 Critical Conditions

The TMDLs were based on conditions observed throughout the eight-year model simulation period which includes the period used to determine the DO and nutrient impairment. Therefore the model simulation period addresses the critical/seasonal conditions observed in the time frame used to place the Stevenson Creek Tidal Segment on the state’s 303(d) list.

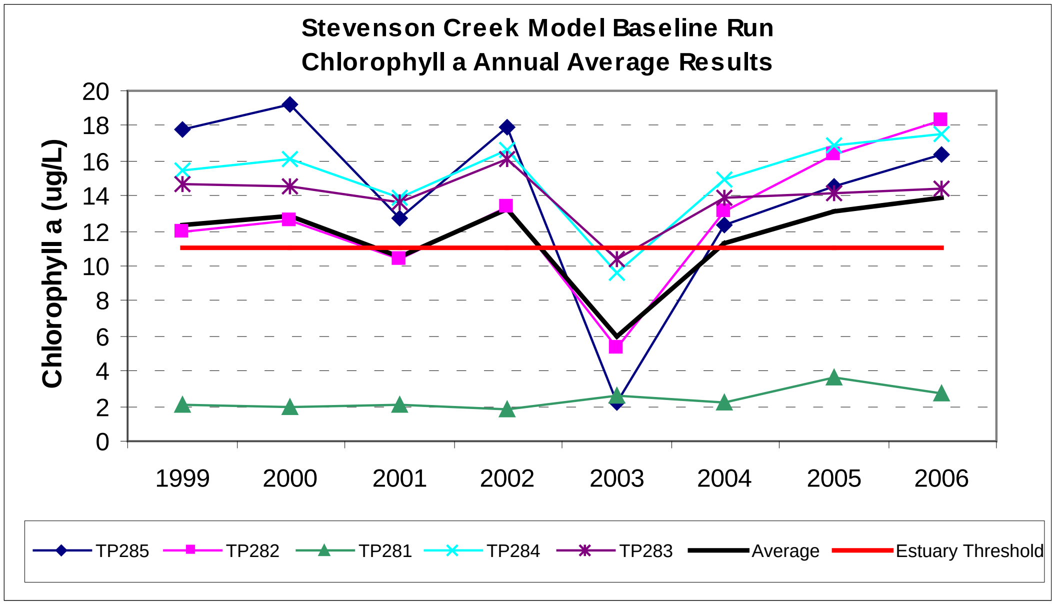

Figure 5.3. Predicted Annual Average Chlorophyll a Values for the Baseline Condition

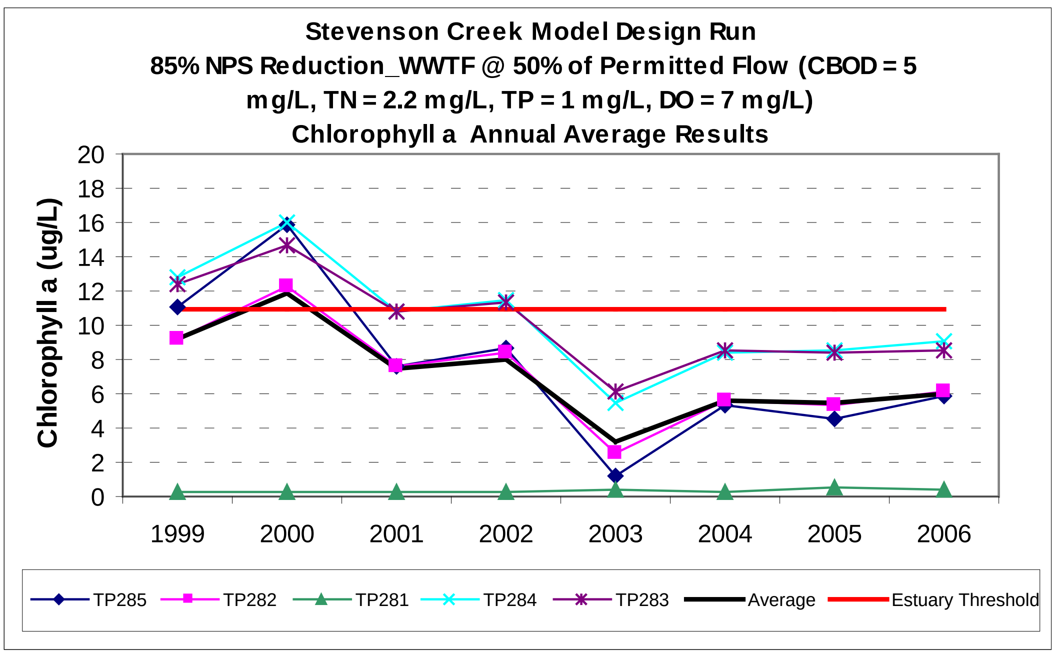

Figure 5.4. Predicted Annual Average Chlorophyll a Values for the Load Reduction Scenario Selected for the TMDL

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

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

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

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

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

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (1) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for within the LA, and (2) TMDL components can be expressed in different terms (for example, the WLA for stormwater is typically expressed as a percent reduction, and the WLA for wastewater is typically expressed as mass per day).

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

This approach is consistent with federal regulation 40 CFR § 130.2[I] (EPA 2003), which states that TMDLs can be expressed in terms of mass per time (*e.g.*, pounds per day), toxicity, or other appropriate measure. The TMDLs for Stevenson Creek Tidal Segment (WBID 1567) are expressed in terms of pounds per year and pounds per day (**Tables 6.1a** and **6.1b**, respectively). The TMDLs represent the maximum annual and daily load the tidal segment can assimilate to maintain the marine DO water quality criterion and the narrative nutrient criterion. The TMDLs to be implemented are those expressed on a mass per year basis, and the expression of the TMDL on a mass per day basis is for informational purposes only.

Table 6.1a. TMDL Components Expressed as an Annual Load for Stevenson Creek Tidal Segment (WBID 1567)

Parameter	WLA for Wastewater (lbs/yr)	WLA for NPDES Stormwater (% reduction)	LA (lbs/yr)	MOS	TMDL (lbs/yr)
$CBOD_5$	76,157[a]	85%	9,314	Implicit	85,471
TN	33,509[a]	85%	6,406	Implicit	39,915

[a] Clearwater-Marshall St. AWWTP loads are based on long-term average discharge conditions: discharge flow rate of 5 MGD, $CBOD_5$ concentration of 5 mg/L, TN concentration of 2.2 mg/L, and DO concentration of 7 mg/L.

Table 6.1b. TMDL Components Expressed as a Daily Load for Stevenson Creek Tidal Segment (WBID 1567)

Parameter	WLA for Wastewater (lbs/day)	WLA for NPDES Stormwater (% reduction)	LA (lbs/day)	MOS	TMDL (lbs/day)
$CBOD_5$	209[a]	85%	26	Implicit	235
TN	92[a]	85%	18	Implicit	110

[a] Clearwater-Marshall St. AWWTP loads are based on long-term average discharge conditions: discharge flow rate of 5 MGD, $CBOD_5$ concentration of 5 mg/L, TN concentration of 2.2 mg/L, and DO concentration of 7 mg/L.

6.2 Load Allocation

The LAs were determined by reducing the estimated total nonpoint source loadings in conjunction with the loadings from the Clearwater-Marshall St. facility by the amount required to meet the assimilative capacity of the waterbody so that the water quality criteria for DO and nutrients are met. The assimilative capacity under the load reduction scenario selected was estimated to be an 85% reduction in the existing annual average $CBOD_5$ and TN nonpoint source loads during the 1999 to 2006 period, which are presented in **Section 4.3.2**. The LA for $CBOD_5$ and TN are 9,314 and 6,406 lbs/yr, respectively. The loads are based on long-term average conditions that were simulated in the tidal creek surface water model. Note that the $CBOD_u$ loads predicted by the HSPF model were converted to a $CBOD_5$ load using a ratio of $CBOD_u$ to $CBOD_5$ of 2.84, as recommended in EPA guidance (1997), in the absence of site-specific data. A $CBOD_5$ result is more commonly used for establishing BOD limits, particularly for point source dischargers, and is consistent with the expression of the BOD limit as $CBOD_5$ in the existing Clearwater-Marshall St. AWWTP NPDES permit.

It should be noted that the LAs include loading from stormwater discharges regulated by the Department and the SWFWMD that are not part of the NPDES stormwater program (see **Appendix A**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

The Clearwater-Marshall St. AWWTP WLA for $CBOD_5$ and TN are 76,157 lbs/yearand 33,509 lbs/year, respectively. The loads are based on long-term average discharge conditions that were simulated in the tidal creek surface water model. These loads are established in conjunction with the LA for nonpoint sources and the facility flow volumes reasonably expected to be discharged under existing conditions.

6.3.2 NPDES Stormwater Discharges

Pinellas County and co-permittees (FDOT District 7, city of Clearwater, city of Dunedin, and city of Largo) are covered by a Phase I NPDES MS4 permit (FLS000005), and areas within their jurisdiction contributing loads to the Stevenson Creek watershed may be responsible for an 85% reduction in current anthropogenic TN and $CBOD_5$ loadings. There are no Phase II MS4 permits identified in the watershed. It should be noted that any MS4 permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

As noted in **Chapter 4**, loadings from stormwater discharges permitted under the NPDES stormwater program (*i.e.*, MS4 areas) are placed in the WLA, rather than the LA. The WLA is expressed as a percent reduction and was set at the same percent reduction needed for nonpoint sources to meet the LA. The actual loads from NPDES-permitted stormwater discharges are included in the LA, and the LA will be portioned between all parties responsible for nonpoint source loadings when the specific source information becomes available.

6.4 Margin of Safety (MOS)

TMDLs must address uncertainty issues by incorporating an MOS into the analysis. The MOS is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving waterbody (Clean Water Act, Section 303[d][1][c]). Considerable uncertainty is usually inherent in estimating pollutant loading from nonpoint sources, as well as predicting water quality response. The effectiveness of management activities (*e.g.*, stormwater management plans) in reducing loading is also subject to uncertainty. The MOS can either be implicitly accounted for by choosing conservative assumptions about loading or water quality response, or explicitly accounted for during the allocation of loadings.

In the TMDL development for the tidal reach of Stevenson Creek, an implicit MOS was accounted for by selecting a load reduction scenario that results in an overall average chlorophyll *a* value below the target of 8 µg/L, and that maintains a frequency in occurrences of low DO similar to that predicted under natural background loading conditions.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Basin Management Action Plan

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

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

- *Water quality goals (based directly on the TMDLs).*
- *Refined source identification.*
- *Load reduction requirements for stakeholders (quantitative detailed allocations, if technically feasible).*
- *A description of the load reduction activities to be undertaken, including structural projects, nonstructural BMPs, and public education and outreach.*
- *A description of further research, data collection, or source identification needed in order to achieve the TMDLs.*
- *Timetables for implementation.*
- *Implementation funding mechanisms.*

— *An evaluation of future increases in pollutant loading due to population growth.*

— *Implementation milestones, project tracking, water quality monitoring, and adaptive management procedures.*

— *Stakeholder statements of commitment (typically a local government resolution).*

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

7.2 Other TMDL Implementation Tools

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

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

7.3 Implementation Considerations for Stevenson Creek

In addition to addressing reductions in watershed pollutant contributions to impaired waters during the implementation phase, it may also be necessary to consider the impacts of internal sources (*e.g.,* sediment nutrient fluxes or the presence of nitrogen-fixing cyanobacteria) and the results of any associated remediation projects on surface water quality. In the case of Stevenson Creek, there is an ongoing project to dredge "muck sediments" from an area of the tidal portion of the creek. Specifically, the Stevenson Creek Estuary Restoration Project is currently being implemented by the city of Clearwater and USACOE, with project completion expected in 2014. The project includes the removal of approximately 10,000 cubic yards of material from Fort Harrison to the Pinellas Trail and 80,000 cubic yards of organic muck deposits from the Pinellas Trail to Douglas Avenue. Two mangrove wetland shelves, totaling 3.2 acres, will also be created and planted with red and black mangrove. Dredging the estuary will remove a concentrated deposit of muck sediments that is expected to result in water quality benefits due to increased water velocity and circulation as well as reduced nutrient sediment flux and SOD on the overlying water column. To evaluate the outcome of this project on the tidal segment, it will be critical to develop and initiate water quality monitoring in the early stages of the implementation phase.

Additionally, the city of Clearwater is initiating a project to provide sanitary sewer service to a neighborhood that is currently using septic systems, located in the lower reach of the Spring Branch watershed. This project will result in the abandonment of 450 septic tanks, with an expected completion date of December 2014. Due to the timing, it will also be important to consider this project in the development of a water quality monitoring plan.

One issue raised by stakeholders during the comment period is the use of a chlorophyll *a* restoration target of 8 µg/L to address the nutrient impairment. The selection of this target was based on the best available information for estuarine segments in the area of Stevenson Creek that are not impaired for nutrients. During the implementation phase, the Department plans to work with stakeholders to further evaluate this restoration target and revise the target based on further investigation, if necessary.

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APPENDICES

Appendix A: Background Information on Federal and State Stormwater Programs

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

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

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES stormwater permitting program to designate certain stormwater discharges as "point sources" of pollution. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific standard industrial classification (SIC) codes, construction sites disturbing five or more acres of land, and the master drainage systems of local governments with a population above 100,000, which are better known as MS4s. However, because the master drainage systems of most local governments in Florida are interconnected, the EPA has implemented Phase 1 of the MS4 permitting program on a countywide basis, which brings in all cities (incorporated areas), Chapter 298 urban water control districts, and FDOT throughout the 15 counties meeting the population criteria.

An important difference between the federal and state stormwater permitting programs is that the federal program covers both new and existing discharges, while the state program focuses on new discharges.

Additionally, Phase 2 of the NPDES Program, implemented in 2003, expands the need for these permits to construction sites between one and five acres, and to local governments with as few as 1,000 people. While these urban stormwater discharges are now technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution such as domestic and industrial wastewater discharges. It should be noted that most MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs once they are formally adopted by rule.

Appendix B: Public Comments on Draft TMDL Report and Department Responses to Comments

Comments and Department Responses for the 2008 Public Comment Period

CITY OF DUNEDIN
"Dedicated to Quality Service"
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December 8, 2008

Jan Mandrup-Poulsen, Program Administrator
Total Maximum Daily Load Program
Florida Dept. of Environmental Protection
Mail Station 3510
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Re: Draft Dissolved Oxygen and Nutrient TMDL for Stevenson Creek Tidal Segment, WBID 1567, City of Dunedin, FL

Thank you for considering Pinellas County's request for a limited time extension to the public comment period for Stevenson Creek TMDLs (Kelli Hammer Levy, Pinellas County Dept. of Environmental Management, dated Nov. 13, 2008.) The City of Dunedin wishes to respectfully express an objection to the draft TMDL for Stevenson Creek. We have several concerns regarding assumptions including, but not limited, to the following:

1. Sampling stations for water quality were located in the tidal segments of the tributaries. Although the collected samples may reflect conditions existing at the point of sampling, they are not necessarily indicative of the nutrient loads potentially originating upstream in those tributaries;

2. The sites chosen to represent unimpaired chlorophyll A concentrations for some very close to passes - and all very well mixed. Mixing is less prominent in tidal streams and is controlled by the tidal prism movement in that segment. For more realistic background measurements, such sampling should occur in relatively unimpaired tidal streams and not open an unfairly higher standard for chlorophyll and nutrients attainment.

3. We believe the Department has grossly underestimated the number of septic tanks - particularly in the downstream portion of Spring Branch - and their nitrogen contribution to surface waters;

4. The choice to aggregate septic tank impacts with non-point sources (i.e., of Dunedin to expectations for removing nitrogen which the City did not generate. All of those septic tanks are located in an area downstream of the City, and should not be the City's responsibility.

Our review of the report continues. In the meantime, we will be glad to further discuss with the Department the details of our objections. The City of Dunedin believes that this draft TMDL report should not be used as the basis for allocation of load reductions or the development of a Basin Management Action Plan.

Respectfully,

Jon Everett, PE
Public Works Engineer

cc: Tom Burke, City Engineer
Keith Fogarty
Kelli Levy, Pinellas County
Melanie Weed, Pinellas County
Elie Araj, Applied Sciences

November 17, 2009

Jon Everett, P.E.
Public Works Engineer
City of Dunedin
P.O. Box 1348
Dunedin, Florida 34697-1348

Subject: Response to Comments on the Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek (WBID 1567)

Dear Mr. Everett:

The Department has reviewed the City of Dunedin's comments submitted in the December 8, 2008 letter, on the October 2008 Stevenson Creek Dissolved Oxygen and Nutrient Total Maximum Daily Load (TMDL) report and modeling report. After evaluating these and other comments received by stakeholders on each report, we believe that the TMDLs proposed by the Department do not have to be revised. However, some of the comments are relevant to the development of Basin Management Action Plans (BMAPs) and can be further taken into consideration during the BMAP process. The Department greatly appreciates the review of these reports and looks forward to working with stakeholders as we move towards identifying and implementing projects to improve water quality in Stevenson Creek. All of the comments were carefully considered and the following are our responses to the City's comments.

1. The City indicates that water quality sampling stations were located in the tidal segments of the tributaries and are not necessarily indicative of the nutrient loads potentially originating upstream in those tributaries. This comment is acknowledged. Please note that the locations of the sampling stations used in the modeling effort were carefully evaluated and data collected in the freshwater segments and the tidal segment of the Stevenson Creek watershed were used, as appropriate, in model development. Two separate models were developed for this study; the Hydrologic Simulation Program - FORTRAN (HSPF) model was used to simulate the watershed loadings and freshwater stream water quality entering the creek's tidal segment, and the Environmental Fluid Dynamics Code (EFDC) model was used to simulate the hydrodynamics and surface water quality of the tidal segment. Data collected at Pinellas County freshwater stations designated as 21FLPDEM 15-04 and 21FLPDEM 18-03 were used in developing the HSPF model and data collected at Pinellas County estuary stations designated as 21FLPDEM AMB 15-1, and Station 21FLPDEM AMB 18-1 were used in developing the EFDC model. The data used in the calibration and validation of each model are documented in the Stevenson Creek modeling report.

Response to Comments on the Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek (WBID 1567)
November 17, 2009, Page Three

2. The City indicates that the sites selected to represent chlorophyll a concentrations for tidal streams, (Table 3.1 of the TMDL report), were all located in open bay waters. However, chlorophyll a results collected from two tidal stream segments, the Anclote River (WBID 1440) and Minnow Creek (WBID 1535), are included in Table 3.1 to represent estuarine waters not impaired for nutrients in the area of Stevenson Creek. The average chlorophyll a values for the tidal stream segments, (4.3 µg/L in the Anclote River and 5.1 µg/L in Minnow Creek), are at the lower end in the range of chlorophyll a values.

3. The chlorophyll a value of 8 µg/L was used as a target for TMDL development because it falls within the range of existing conditions in estuarine segments not impaired for nutrients in the area around Stevenson Creek. This target was considered appropriate to apply in Stevenson Creek since estuaries in this area with good water quality, including open bay waters and tidal streams, have annual average chlorophyll a values at or below 8 µg/L. Establishing a TMDL to meet this target also provides for a necessary margin of safety in the TMDL development process, ensuring that annual average chlorophyll a values remain below the Impaired Waters Rule estuary impairment threshold of 11 µg/L.

4. The City believes that the Department grossly underestimated the number of septic tanks and their nitrogen contribution to surface waters, although no specifics were provided for why this may be the case. Based on a phone conversation concerning this issue, that Kevin Petrus had with you earlier this year, the comment was based on the apparent disconnect in the number of septic tanks displayed on the map and the report text description.

   The Department believes that the best available information was used to evaluate the impact of septic tanks in the creek's watershed. The septic tank locations presented in Figure 2.7 of the modeling report were used in the HSPF watershed model. The septic tanks coverage is that published by the Florida Department of Health. The TMDL report text referring to the low incidence of septic tanks will be removed. Additionally, the modeling report has been revised to provide additional explanation for estimating the pollutant loadings from septic tanks.

Response to Comments on the Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek (WBID 1567)
November 17, 2009, Page Three

Data displayed in Figure 2-7 of the revised modeling report were used to determine the number of septic tanks (487) located in each model subbasin. Values in Table 4-5 of the report were used to calculate the mass loading (pounds per year) that may be expected in each subbasin due to failing septic tanks (assumed to be 10% of the septic tanks). Presuming that septic tank "failure" means that the septic tank discharge travels through several feet of soil and then travels by overland flow to the watershed transport system, the concentrations shown in that table are representative of septic tank discharge concentrations after traveling through several feet of soil. When calculations are done using the values in Table 4-5, the load attributed to failing septic tanks is at most 1 to 2 percent of the overall total watershed load. For each subbasin, the range of estimated subbasin loading rates (for example, Table 4-11 in the model development report for Upper Stevenson Creek) was adjusted upward, to account for the calculated failing septic tank contribution.

5. The City expressed concern about the aggregation of septic tank loads with stormwater runoff and that the septic tank loads are located in an area downstream of the City and should not be the City's responsibility. The TMDL report expresses the nonpoint source load as an aggregate allocation for the entire watershed draining to the tidal segment. Detailed allocations of loads to individual entities are developed in the BMAP process and takes into consideration the drainage area loads that each entity is responsible for. Language has been added to Chapter 6 of the TMDL report (repeated below) to address the issue of the load allocation to MS4 permittees.

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

Again the Department truly appreciates the City's review of the TMDL documents and their involvement in the TMDL program. If you have any questions concerning our responses, please contact me or Kevin Petrus at (850) 245-8449.

Sincerely,

Jan Mandrup-Poulsen, Environmental Administrator
Watershed Evaluation and TMDL Section

ec: Jeff Greenwell
Charles Kovach
Terry Hansen

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December 9, 2008

Mr. Jan Mandrup-Poulsen
Watershed Assessment Section
Florida Department of Environmental Protection
Mail Station 3555
2600 Blair Stone Road
Tallahassee. Florida 32399-2400

Re: TMDL Report
Stevenson Creek Tidal WBlD 1567

Dear Mr. Mandrup-Poulsen:

Please accept these comments on behalf of the City of Clearwater (City) for the above referenced subject. Comments are based on the review of the November 10, 2008, "Stevenson Creek Watershed TMDL Model Development" Report prepared by CDM & Dynamic Solutions. The City is concerned about the future of its Stormwater and Wastewater Infrastructure (point & non-point sources), based on the recommendations offered in this report. We have attached a Technical Memorandum (TM) prepared for us by City Engineers of Record, Jones Edmunds.

As detailed in the TM, the proposed point and non-point reduction goals are technically unfeasible. To propose an impossible 85% non-point sources load reduction without clear expectation of meeting it is troubling. For our point sources, the solution is not merely limiting capacity. The City has already upgraded facilities using the best technology currently available.

Specifically, the City requests additional consideration of the following issues:

- Reconsider the Chlorophyll-A (Chl-A) maximum limit of 8.0 µg/L for establishing the required nutrient removal. This limit is considerably less than the Impaired Surface Waters Rule (IWR) Chl-A threshold of 11.0 µg/L.

- Model a scenario with zero discharge from the Marshall Street APCF to determine the resulting water quality for dissolved oxygen and nutrient impairment prior to setting a discharge limit on the plant.
- Provide an analysis as to whether the reverse (incoming) tide is strong enough to carry its influence upstream and the potential effect on data.
- Re-examine the impact of septic tanks in the area and their potential impact to the TMDL.
- All comments provided by Pinellas County Department Environmental Management on the sources and use of input data used in the hydrodynamic modeling.

In addition, and as noted in earlier correspondence, a US Army Corps of Engineers (ACOE) Stevenson Creek Estuary Restoration project has been permitted and ready for implementation. This project will greatly improve the water quality of the estuary and its discharge to Clearwater Harbor. The City believes that the benefits of this project will follow too late, after a TMDL has already been established for the creek.

The City is committed to improving water quality, and our capitol improvement projects of the past, present and future are testament to that. We are committed and ready to work with the Department and our neighbors Pinellas County, Dunedin and Largo on this TMDL process. At this time, the City believes the TMDL for Stevensons Creek is flawed and needs further development.

Sincerely,
Ed Chesney. P.E.
Environmental Manager. City of Clearwater
Attachments: Jones Edmunds Technical Memorandum

Cc: Kevin Petrus, FDEP
Kelli Levi, Pinellas County
Mike Quillen, P.E. City Engineer. City of Clearwater

Jones Edmunds
Technical Memorandum

FROM: Tom Friedrich, P.E., Vice President
DATE: December 8, 2008
TO: Nan Bennett, P.E., City of Clearwater
XC: Brett Goodman, P.E.; Rick Roberts, P.E., Jim McLellan, P.E. - Jones Edmunds
RE: Preliminary Peer Review of FDEP TMDL Report – Dissolved Oxygen and Nutrient TMDL for the Stevenson Creek Tidal Segment, WBID 1567

Jones Edmunds conducted a preliminary peer review of the process and data used by the Florida Department of Environmental Protection (FDEP), Southwest District in preparation of the above referenced TMDL report. Our initial findings and concerns with the TMDL report recommendations are presented herein.

Our overall recommendation to the City, as a major stake holder, is that the City oppose this TMDL report and its recommendations. There are concerns with the draft TMDL for Stevenson Creek and FDEP should address these concerns prior to final adoption of the report. Our primary concerns are regarding the feasibility of implementing the proposed TMDL, the justifications for determining the TMDL, and the technical merit of the collected data and modeling used as the basis for establishing the TMDL.

We understand the importance of the TMDLprocess and protecting Stevenson Creek. In order to ensure that the TMDL is created based on the best information and sound science, we would request FDEP working collaboratively with the City to review the TMDL and establish realistic goals and limits.

This collaborative process would involve addressing the data gaps and assumptions in the models, as well as conducting alternative modeling run scenarios to assist in the development of a TMDL report that adequately identifies the critical conditions/events for Stevenson Creek, and development of final waste load allocations that are technically and economically feasible for the City and other stake holders.

<u>Detailed Comments on TMDL Report</u>

A review of the draft FDEP TMDL report and its modeling support document: *Stevenson Creek Watershed TMDL Model Development* (CDM, November 2008) prompted numerous concerns warranting questions or comments summarized herein. These pertain only to the HSPF model portion of the report. The EFDC model portion was not reviewed.

> 1) In Table 2.2 of the draft report, the maximum DO is reported as 20 mg/L which is beyond the possible saturation limit at any temperature. We suggest FDEP do a quality assurance (QA) check of the data set.

2) Stream Flow Data - The CDM report states that flow data was very limited (Sections 2.2.4 and 4.2.2.4) and did not calibrate well (Section 4.3.1). It appears flow rates were over predicted by the model particularly for the storm peaks (Figure 4-5). Figures 4-6 and 4-7 show significant disagreement between modeled and observed stream flow, particularly for Upper Stevenson Creek for some 2004 dates. These disagreements are hidden by the logarithmic scales used in the graphs.

3) Model Calibration - Sections 4.3.3 and 4.3.4 discuss the predicted water quality for Upper Stevenson Creek and Spring Branch respectively (apparently no observed data were available for the other branches). Much of the calibration appears unsatisfactory. Predicted DO in Stevenson Creek does not match the observed values to any significant degree. Predicted Chl-A is generally too low, but with seasonal spikes that are too high.

The observed CBODu (ultimate) has too many identical values for both Stevenson Creek and Spring Branch, and are stated as "flaged"·for Spring Branch. Measuring CBOD5 (5-day) in surface waters is often problematic due to the reporting threshold of 2.0 mg/L for the laboratory method since this threshold is often higher than the levels experienced in the water body. Measuring a CBOD series (up to 30 days) usually gives better CBODu values for the model.

Other model parameters also had poor agreement between predicted and observed. The conclusions of the report suggest ways to improve the model including collecting more data. The model in its existing form appears to be insufficient for establishing a TMDL and should be updated with additional data as discussed herein.

4) The location of the Marshall Street Advanced Pollution Control Facility (APCF) discharge is stated to be at the mouth of Stevenson Creek in Section 4.2.2.8 of the CDM report. Does this have particular implications for its influence on areas of the water body downstream versus upstream; i.e., is the reverse tide strong enough to carry its influence considerably upstream? How were tidal velocities measured in Stevenson Creek, or what assumptions were used in the models?

5) CBOD - In Section 6.2 of the draft report, it states that a ratio of CBODu to CBOD5 of 2.84 was applied per EPA guidelines, but in Section 4.3.3 of the CDM report, it states a conversion factor of 2.47 was used. Shouldn't a consistent value be applied? Also Table 4.2 of the draft report shows substantial variation in CBOD loading with a particularly high value in 2004. Is there a satisfactory explanation for this? Could there have been an acute event skewing the data?

6) Septic Tanks - Septic tanks are mentioned in both reports (draft report Section 4.3.2) as not being a significant source of load since the watershed is 90% built out. Yet, in Figure 4.3, the septic tanks appear dense in some areas. There appears to be inadequate discussion or data presented regarding their potential impact to the TMDL.

7) In Section 4.5.2 it states that an increase in the sediment oxygen demand (SOD) rate resulted in increases in DO concentrations. SOD increases would normally result in a decreased DO concentration. Please check model and assumptions.

8) In Table 4-6 of the CDM report, the stormwater removal efficiencies are inconsistent with those stated in the Glen Oaks report (Parsons, 2003), and are considerably higher. The Glen Oaks facility went online in 2007, and the actual removal efficiencies for this facility should be based on actual data.

9) Tables 4-11 and 4- 16 of the CDM report have identical data for the last three categories. Please check for accuracy, and explain reason for similarity.

10) Identify the modeled concentrations for the total nitrogen components in the Marshall Street APCF effluent (ammonia, organic and nitrate) for the baseline and design runs.

11) Provide observed stream flow and water quality data sets used for establishing the TMDL models.

TMDL Feasibility

The proposed 85% nonpoint source (NPS) load reduction for nutrients is not a feasible goal. The cost and availability of land, and the cost of design and construction for stormwater management systems would be prohibitive within the City of C1earwater for such a task. Consider that the recently completed Glen Oaks stormwater management project has a total area of 31.5 acres with over 21 acres of stormwater management facilities and cost approximately S7,000,000. Based on the existing TN load of 42,708 pounds (from Table 4.2 of the report), the proposed TMDL requires a removal of 85% of that, or 36,300 pounds TN. This would require numerous similar stormwater management projects in a highly urbanized area. The capital cost of these stormwater measures could exceed $150,000,000 using a conservative estimate of $5000/lb-N removed.

Additionally, the proposed reductions to the Marshall Street APCF will equate to approximately $50,000,000 in lost treatment capacity assuming $10/gallon to develop new advanced treatment altematives to eliminate nitrogen from the discharge. Alternatively, the development of 5.0-MGD of additional reclaimed water users, transmission and storage capacity is estimated on the order of $75,000,000 in capital expenses . It is important to note that the APCF was upgraded in the late 1980's to an advanced wastewater treatment plant using the best available technology for advance biological nutrient removal (5-stage Bardenpho), for which the City's tax payers funded.

Given the costs that are likely to be associated with the proposed TMDL and its impacts to your rate payers, considerable effort must be dedicated to ensuring that the allocations are based on the best information and science possible.

Basis and Justification of TMDL

The draft TMDL used a goal of achieving an ambient chlorophyll-A (Chl-A) of 8.0 µg/L for establishing the required nutrient removal which is considerably less than the Impaired Surface Waters Rule (IWR) Chl-A threshold of 11.0 µg/L. This means that a water body is not considered impaired if Chl-A remains at or below 11 µg/L. The report provides limited justification for developing a site specific interpretation of the narrative nutrient criteria in the IWR. We suggest using a Chl-A value of 11.0 µg/L to establish a TMDL for the Stevenson Creek WBID 1567.

We question the justification for the proposed WWTF discharge limit of 5-MGD. The City has a current permit limit of 10-MGD which is needed to allow for expected infill growth over the next 30-ycars and for future conversion of septic tanks to the municipal collection system. In order for the City to discharge less than 5-MGD, a considerably larger reclaimed water program would be required. It is unclear, why an arbitrary limit of 5-MGD was placed on the WWTF when the report states that a modeled effluent discharge of 10-MGD predicted lower Chl-A concentrations and better dissolved oxygen (DO) levels in the stream since it aids in flushing (Section 5.8), and reduces residence time in the stream, which will aid in reducing Chl-A concentrations. The FDEP should model a scenario with zero discharge from the Marshall Street APCF and resulting water quality for dissolved oxygen and nutrient impairment.

Based on review of Table 5.1, it appears that a Chl-A concentration below 11.0 µg/L could be readily achieved at loadings between the baseline condition and the first design run (85% NPS load reduction, WWTF at 50% and AWT of 3 mg/L-TN). The TMDL goal of 10 percent of D0 concentrations < 4.0 mg/L is achieved (as is the proposed goal for Chl-A to be <8.0 µg/L) for the second design run (same as first but with additional WWTF requirements of TN = 2.5 mg/L and effluent DO = 7.0 mg/L). We believe more design runs arc needed to explore additional scenarios that could achieve a realistic TMDL. We suggest a design run to achieve a Chl-A of 11 µg/L and the 10% D0 < 4.0 mg/L with current WWTF discharge of 10-MGD and AWT limit of TN = 3.0 mg/L, but with a higher effluent DO (between 5 to 7 mg/L). The ammonia component should have a sublimit within the TN = 3.0 mg/L since it is the only nutrient that directly impacts DO. It should be noted that ammonia from Marshall Street APCF is typically 0.1 mg/L. The NPS loadings could then be adjusted as needed to achieve the TMDL.

Another approach that should be considered as part of the TMDL development process is how critical flow conditions influence the waste load allocations. The analysis would separate dry conditions from normal or wet conditions with various loading conditions. This may suggest that different allocations under differing hydrologic conditions are appropriate.

October 6, 2009

Ed Chesney, P.E.
Environmental Manager
City of Clearwater
Post Office Box 4748
Clearwater, Florida 33758-4748

Subject: Response to Comments on the Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek (WBID 1567)

Dear Mr. Chesney:

The Department has reviewed the City of Clearwater comments including the Technical Memorandum from Jones Edmunds, submitted in the December 9, 2008 letter, on the October 2008 Stevenson Creek Dissolved Oxygen and Nutrient Total Maximum Daily Load (TMDL) report and modeling report. After evaluating these and other comments received by stakeholders on each report, we believe that the TMDLs proposed by the Department do not have to be revised. However, some of the comments are relevant to the development of Basin Management Action Plans (BMAPs) and can be further taken into consideration during the BMAP process. The Department greatly appreciates the review of these reports and looks forward to working with stakeholders as we move towards identifying and implementing projects to improve water quality in Stevenson Creek. All of the comments were carefully considered and the following are our responses to the itemized comments by the City in the December 9, 2008 letter and by Jones Edmunds in the December 8, 2008 Technical Memorandum.

Response to City of Clearwater Comments

1. The chlorophyll a value of 8 µg/L was used as a target for TMDL development because it represents existing conditions in estuarine segments not impaired for nutrients in the area of Stevenson Creek. This target was considered appropriate to apply in Stevenson Creek since estuaries in this area with good water quality have annual average chlorophyll a values at or below 8 µg/L. Establishing a TMDL to meet this target also provides for a necessary margin of safety in the TMDL development process, ensuring that annual average chlorophyll a values remain below the Impaired Waters Rule estuary impairment threshold of 11 µg/L.

2. The City of Clearwater Marshall Street facility is already a permitted surface water discharge to Stevenson Creek and it was demonstrated through TMDL development that the discharge is allowable. The Department believes it is not necessary to simulate a model with zero discharge since a wasteload allocation in the TMDL can be set at the existing effluent discharge conditions.

3. The EFDC model used to model the tidal segment of Stevenson Creek, simulates reversing tides and therefore already accounts for pollutant loadings being carried upstream.

Response to Comments on the Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek (WBID 1567)
October 6, 2009, Page Two

4. The Department believes that the best available information was used to evaluate the impact of septic tanks in the creek's watershed. The Stevenson Creek modeling report has been revised to provide additional explanation for estimating the pollutant loadings from septic tanks.

   Data displayed in Figure 2-7 of the revised report were used to determine the number of septic tanks (487) located in each model subbasin. Values in Table 4-5 of the report were used to calculate the mass loading (pounds per year) that may be expected in each subbasin due to failing septic tanks (assumed to be 10% of the septic tanks). Presuming that septic tank "failure" means that the septic tank discharge travels through several feet of soil and then travels by overland flow to the watershed transport system, the concentrations shown in that table are representative of septic tank discharge concentrations after traveling through several feet of soil. When calculations are done using the values in Table 4-5, the load attributed to failing septic tanks is at most 1 to 2 percent of the overall total watershed load. For each subbasin, the range of estimated subbasin loading rates (for example, Table 4-11 in the model development report for Upper Stevenson Creek) was adjusted upward to account for the calculated failing septic tank contribution.

5. The Department submitted responses, in a July 29, 2009 letter, to the Pinellas County Department of Environmental Management comments on the Stevenson Creek TMDL report and modeling report. The responses to Pinellas County's comments are provided as an attachment to this letter.

<u>Responses to Jones Edmunds Comments</u>

1. We recognize that the DO value reported as 20 mg/L is an anomaly and this value was not used in the TMDL development for Stevenson Creek. The data provider was notified of this high DO value. The other DO measurements used for TMDL development are within an acceptable range.

2. In Section 4.3.1 of the modeling report, it is recognized that HSPF did not simulate peak flows well for the limited calibration period. However, we believe that the model provided a good fit to the instantaneous flow measurements performed by Pinellas County. It should be noted that the watershed flow volumes and loads generated by the HSPF model were not used directly in the TMDL development process. The HSPF generated watershed flow volumes and loads were used as input to the tidal Stevenson Creek EFDC model, and provided for an adequate calibration of the EFDC model, that was subsequently used to simulate design scenarios for the development of the TMDLs.

Response to Comments on the Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek (WBID 1567)
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3. The HSPF model was used to simulate watershed runoff flows and loads for input to the EFDC model of the Stevenson Creek tidal segment. We recognize that some of the HSPF model results did not fit the observed data well and that there are limited data available for the tributaries and some of the water quality model variables; however, we believe that the model is sufficient for use. The modeling report does identify additional data collection efforts that could be performed as part of the BMAP process. We believe it is in the best interest of addressing water quality problems to adopt the TMDL using the available data and models and then work with stakeholders on identifying additional data collection and projects that would improve water quality. The HSPF generated watershed flow volumes and loads were used as input to the tidal Stevenson Creek EFDC model, and provided for an adequate calibration of the EFDC model that was subsequently used to simulate design scenarios for the development of the TMDLs.

4. The location of the Marshall Street Advanced Wastewater Treatment Plant outfall is described in the modeling report as being located near the mouth of Stevenson Creek, not at the mouth as stated in the comments. As described in the TMDL report, the outfall is located about 0.8 miles upstream of the mouth. The EFDC model used for the tidal segment of Stevenson Creek simulates reversing tides and therefore already accounts for pollutant loadings being carried upstream. The hydrodynamic component of the EFDC model was setup using available data for tide stage, flow, temperature, and salinity, as described in the modeling report. There were no velocity data available for use in the model. The calibration of the hydrodynamic model is described in Section 4.7.3 of the modeling report.

5. In Section 6.2 of the TMDL report, the CBODu loads were converted to a CBOD5 load using a CBODu to CBOD5 ratio of 2.84. In Section 4.3.3 of the modeling report, measured BOD5 values were converted to CBODu using a CBODu to BOD5 ratio of 2.47. The ratios used in each case are appropriate, and both conversion factors are provided in the 1997 EPA Technical Guidance Manual that is referenced in the TMDL report.

   The year 2004 was the wettest year in the eight-year simulation period. On an annual basis, the annual rainfall in 2004 was 35 percent greater than the 8-year average (1999-2006), and included a period of July through October with rainfall that was 74 percent higher than the average for that 3-year period. Significantly higher loads for that year can be attributed to two factors: (1) the freshwater flow from the watershed was roughly 70 percent higher than the average flow for the simulation period, and (2) a higher percentage of flow was surface runoff, which has higher concentrations than baseflow.

Response to Comments on the Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek (WBID 1567)
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6. The Stevenson Creek modeling report has been revised to provide additional explanation for estimating the pollutant loadings from septic tanks. Please see our earlier response to the City of Clearwater's comment No. 4 for additional information.

7. The statement in Section 4.5.2 of the modeling report is a typographical error, and the text has been revised to state that an increase in SOD results in a decrease in DO concentration.

8. The BMP removal efficiency values in Table 4-6, and the values in the Parsons report, are both estimates, as stated in the comment. The values in Table 4-6 were used to adjust the range of estimated sub-basin loading rates (for example, Table 4-11 for Upper Stevenson Creek sub-basin). In the absence of measured storm event data in the watershed and BMP performance data, model input parameters such as pollutant buildup and washoff coefficients were refined to generate the appropriate loads by land use type, and ultimately based on a comparison between measured and modeled instream concentrations. The overall objective was modeled loads within the expected range of values and modeled instream concentrations consistent with the observed data. As more data become available, the model could be refined to better reflect measured stormwater concentrations and BMP removal rates.

9. The ranges of estimated loads in Tables 4-11 and 4-16 are based on land use-specific runoff coefficients and runoff event mean concentrations (EMCs). It was assumed that the forest, open, and wetland land use categories would generate similar runoff (assumed runoff coefficient = 0.05, based on the "Simple Method" proposed by the Center for Watershed Protection) and similar EMCs. Consequently, the expected loads for those land uses are similar. These land use types make up a small fraction of the watershed (14%) and because of the low EMC and runoff values relative to the other urban land uses, make up a small fraction of the total watershed load.

10. The concentrations of the nitrogen components used in the model simulations were based on facility discharge monitoring report results available in the Permit Compliance System database. Based on data available from 1989 to 1992, the average percentages of effluent total nitrogen consisting of ammonia, nitrate, and organic nitrogen are approximately 10 percent, 60 percent, and 30 percent, respectively. These percentages were used to arrive at individual nitrogen constituent concentrations used in the model runs. For the model baseline condition, the 1999 to 2006 measured total nitrogen effluent data were multiplied by these factors. For the model design runs, the effluent total nitrogen concentrations selected for the simulations were multiplied by these factors. The nitrogen data used in the modeling effort are provided on the attached disk.

Response to Comments on the Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek (WBID 1567)
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11. The requested stream flow and water quality data sets used in the modeling are also provided on the attached disk.

If you have any questions concerning our responses, please contact me or Kevin Petrus at (850) 245-8449.

Sincerely,

Jan Mandrup-Poulsen, Environmental Administrator
Watershed Evaluation and TMDL Section

Attachments

ec: Jeff Greenwell
Charles Kovach
Terry Hansen

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December 9, 2008

Jan Mandrup-Poulsen, Program Administrator
Total Maximum Daily Load Program
Florida Dept. of Environmental Protection
Mail Station 3510
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Subject: Comments on the Dissolved Oxygen and Nutrient TMDLs for Klosterman Bayou (WBID 1508) and Stevenson's Creek (WBID 1567).

Dear Mr. Mandrup-Poulsen:

County staff has reviewed the TMDLs referenced above and has the following comments:

Stevensons Creek (WBID 1567) Final TMDL Report Comments:
1. Pages 7-8: Table 2.2 shows a summary of DO for 1999-2006 yet Figure 2.1 shows no data collected beyond 2004. The data collected for this TMDL assessment contains 2 heavy rainfall years (2002 and 2004) which could have negatively impacted the overall analysis. Pinellas County staff believes that while there was enough data to satisfy the verified period criterion, more data is needed to unbias the unusually wet years experienced in 2002 and 2004.

2. Section 4.3.2, page 19, states that the incidence of septic tank coverage within the Stevenson Creek watershed is relatively low; however, figure 2-7 on page 2-14 of the modeling report shows a heavy coverage of septic tanks within the WBID and its contributing tributaries.

3. Page 8: Figure 2.2 shows Chl-a values of 492 µg/L at site 15-1 and a >150 µg/L at site 18-1 in November 2001. Field notes entered into STORET indicated there was a very strong incoming tide and that the water was very turbid. Based on the state's red tide database, a red tide was occurring during November 2001. This data should be removed and all other outliers verified per IWR rules (item also addressed in 07/07108 letter.)

4. Throughout the TMDL document BOD, BODS, BODu, CBOD, CBOD5 and CBODu are used interchangeably. Please use correct terminology when applicable. What is the value of using CBODu in an ambient water quality environment? (item also addressed in 07/07/08 letter)

Stevenson's Creek Modeling Report Comments:

1. Figure 4-3: The simulated versus measured Stevenson's Creek flow r^2 =0.042 indicates no relationship. How was this information used? (item also addressed in 07/07/08 letter.)

2. Page 4-7: Section 4.2.2.9 indicates that reclaimed water was not considered a potential water quality issue. Why? This is inconsistent with the calculations used by the Tampa Bay Estuary Program. (item also addressed in 07/07/08 letter.)

3. Figure 4-104: DO=3.12mg/L Data Point on 10/23/02 should be removed from the IWR run- DO failed post calibration.

4. Figure 4-105: Chl-A=162µg/L Data Point on 11/14/2001 should be removed from the IWR run. This was sampled during an incoming tide and a high turbidity (red tide) event.

5. Page 4-125: The calibration period used was 2004, which was a very wet year (10 inches above normal rainfall). The validation period differs and uses 1999-2002, 2002 also being a very wet year. How did this factor in to the modeling and how was the resultant data used?

6. Same comment as #9 above concerning the use of calculated and modeled values to calculate TMDL loads.

Appendix A Hydrodynamic Model Comments

1. Bathymetric data from 1960 was used for inshore and 1972-1980 offshore (10 miles) data was used for the model. The inshore data does not take into account significant changes within the area including the 1961 dredging of Clearwater Channel and the construction of the Intracoastal waterway in 1963. Additionally, Dunedin Pass closed permanently in 1988. How was satellite imagery integrated to reflect the more recent changes?

2. Table A-1; Runoff coefficient calculations were calculated based on various stream" gages. Gage 0230889 is the lake level gage for Lake Seminole. There is no discharge data associated with this gage.

3. Why do the grid sizes vary throughout the length of the creek? When calculating the RMS should it be N-1 degrees of freedom instead of just N? If not why?

4. The majority of the water quality model calibrations were completed using only five data points. There are multiple instances where two-three out of five data points are not in agreement with the model out put. What is the analysis of variance? (item also addressed in 07/07/08 letter.)

5. Model output for Nitrogen series does not fit actual data collected. There a numerous spikes in the model output unseen in the field data.

6. Model validation includes output for Total Organic Nitrogen, Total Organic Phosphorous, and Total Organic Carbon (TOC) at site 18-1. Pinellas County does not collect for these parameters. What data was used or calculations performed to estimates these values? Additionally, especially for TOC, there appears to be no fit between the data used and the model output. How was this information used? (item also addressed in 07/07/08 letter.)

7. It appears that values at the method detection limits were used in the model validation. Why? (item also addressed in 07/07/08 letter.)

Klosterman Bayou Tidal (WBID 1508) Final TMDL Report

1. Page 5 states that 'Of the Pinellas County STORET stations, all data from the verified period were collected from STORET station 21 FLPDEM02-07'. This is incorrect, as shown in Figure 2-1. Stations 21 FLPDEM02-01 and 21 FLPDEM02-02 were in existence through the end of 2002 and 2003 respectively. 21 FLPDEM02-07 was not sampled until 2004. Additionally, data are available for 21FLPDEM02-02 for 2003 but are not showing in figure 2-1.

2. 21 FLPDEM02-01 Chl-a reading of 17.9ug/L on 6/1BI2001 was J coded for precision above designated parameter and should be removed from the IWR.

3. Page 17: Reclaimed water (RW) loading contributions originating from the Dunn treatment facility were included in the nonpoint source watershed loading estimates. RW contributions to the system are pumped via multiple pump stations and discharged through a pipe. By definition this is a point source not a non-point source and should be assigned accordingly.

4. Page 17, section 4.3.2, refers to BOD loadings being calculated, yet table 4.2 shows CBODu loads? And again on page 23, CBODu and BOD are used interchangeably. What is the value of using CBODu versus BOD since CBODu are calculated using a 2.4 7 multiplier as described on page 22?

5. Page 20, how were the HSPF model characteristics modified to simulate the discharge characteristics observed at Weir A-B?

6. Page 25 states that the model was not very sensitive to the range of parameter variation analyzed. How is the sensitivity rated? Section 4.2.6 of the modeling report states that sensitivity studies were not conducted during this study.

7. Page 26, the report states the Chl-a target is 8 µg/L. Why is this value used? This is much lower than the State water quality standard of 11 µg/L.

9. Finally, as stated in our letter to Mr. Daryll Joyner, dated 10/19/2007, stations 21 FLPDEM02-02 and 21 FLPDEM02-07 are predominantly fresh. During the verified period, 75% of the salinity readings at these two stations were lower than the regulatory 2.7ppt. The estuarine criterion for Chl-a of 11 µg/L and the associated 80% load reduction are too stringent for the conditions at that location and presents an undue burden to the County beyond the implicit margin of safety. The WBID lines should be re-evaluated to accurately establish the tidal limits.

Klosterman Bayou Modeling Report Comments:

1. Figure 1-2 on page 1-4 and figure 3-1 on page 3-15: A small portion of the Innisbrook Golf Course on the east side is not within the basin boundary, yet the water is being pumped from those ponds into the system for irrigation purposes. The pumping station is shown in figure 4-3.

2. Page 2-10 "The Westin-Innisbrook Gulf Resort obtains irrigation water from the facility, and under the current configuration· of its drainage system, only eliminates discharges during extreme rainfall events." This is incorrect. There is flow coming out of the Innisbrook system on a daily basis.

3. Also page 2-10 and figure 2-6, the flapper valves located at the northwestern end of the Innisbrook system are not mentioned. How does this affect the overall hydrology in this system?

4. Page 2-13: “The contoured elevations do not extend into the Klosterman Bayou watershed, but the general gradient towards the Gulf of Mexico is evident." This is incorrect. The Pinellas Ridge, which is clearly represented in figure 2-3 on page 2-5, will cause some of the groundwater to flow eastward. At least a portion of the northern reach of the Peninsula flows east towards Lake Tarpon and eventually Tampa Bay, not west towards the Gulf. Past studies conducted by Pinellas County show a portion of the groundwater near Lake Tarpon flows eastward. Also, the report states that no groundwater monitoring data were available. There are nine sites located within or very near the Klosterman Bayou, monitored by Dunn Facility staff. Data and locations can be made available upon request.

5. Page 2-22. Actual fertilizer application rates need to be obtained from Innisbrook, we cannot assume that state recommended BMPs are being followed. During monitoring activities, staff has observed fertilizer pellets scattered along concrete golf cart paths, pond banks, and along the main Klosterman channel.

6. Page 2-22 and 3-3: More EMC studies are available, such as Dames and Moore, 1990 and Rushton and Dye, 1993.

7. Figure 2-16: How are current Construction Generic Permits relevant to nutrient problems in the verified period?

8. Page 3-2: The Dunn Waste Water Treatment Facility provides in average 3MGD, but up to 5MGD to Innisbrook per day by contract, as noted on pages 4-21 and 4-22.

9. Pages 4-29 through 4-34: Simulated readings show numerous spikes unlike actual measurements for TP, OP, NOX, TAM, TKN, BOD and Chl-a time series, for both the calibration and the validation periods.

10. Page 4-55: Tide data for St Joseph Sound are available online for the calibration period.

11. Page 4-77: were the cell bottom type assigned arbitrarily to sand or mud?

Please inform me if there is any additional information the County can provide to assist the Department in the development or reassessment of TMDLs. Pinellas County staff has worked hard and will continue to work hard to maintain communications with Department staff during the TMDL process. Nevertheless, there are numerous concerns with the modeling reports used as a basis for determining load reduction requirements for both Stevenson's Creek and Klosterman Bayou which place undue burden onto the MS4 and domestic treatment plant permittees. Pinellas County's position is that the TMDLs for Stevenson's Creek and Klosterman Bayou are not valid and should be reassessed before moving forward.

Respectfully,

Kelli Hammer Levy
Division Director
Watershed Management Division

cc: Kevin Petrus, FDEP
Mark E. Schroeder, City of Tarpon Springs
Sue Moore, FDOT
Ed Chesney , City of Clearwater
John Everett, City of Dunedin
Don Crowell, Assistant County Attorney

July 29, 2009

Ms. Kelli Hammer Levy
Division Director
Watershed Management Division
Pinellas County Department of Environmental Management
300 S. Garden Ave.
Clearwater, FL 33756

Subject: Response to Comments on the Dissolved Oxygen and Nutrient TMDLs for Klosterman Bayou (WBID 1508) and Stevenson Creek (WBID 1567)

Dear Ms. Levy:

The Department has reviewed the County's comments, in the December 9, 2008 letter, on the October 2008 Stevenson Creek and Klosterman Bayou DO and Nutrient Total Maximum Daily Load (TMDL) reports and modeling reports. After evaluating these and other comments received by stakeholders on each report, we believe that the TMDLs proposed by the Department do not have to be revised. However, some of the comments are relevant to the development of Basin Management Action Plans (BMAPs) and can be further taken into consideration during the BMAP process. The Department greatly appreciates the review of these reports and looks forward to working with the stakeholders as we move towards identifying and implementing projects to improve water quality in these impaired surface waters. All of the comments were carefully considered and the following are our responses to the County's comments.

Stevenson Creek (WBID 1567) Final TMDL Report Comments:

1. The County believes that more data are needed to unbias the unusually wet years experienced in 2002 and 2004. The DO and nutrient impairments for the Stevenson Creek tidal segment adopted by the Department Secretary included the assessment of data from a five year period. The Department believes that there are a sufficient amount of data in the verified period (1999-2006) to have performed the surface water assessment and develop the TMDLs using the available data, as the data sufficiency requirements of the Impaired Waters Rule (IWR) were met. Additionally, in establishing the TMDLs, an eight-year model simulation period was used, which places less emphasis on the conditions in the wet years and represents a large range of annual rainfall conditions.

2. The septic tank locations presented in Figure 2.7 of the modeling report were used in the HSPF watershed model. The TMDL report text referring to the low incidence of septic tanks will be removed.

Response to Comments on the Dissolved Oxygen and Nutrient TMDLs for Klosterman Bayou (WBID 1508) and Stevenson Creek (WBID 1567)
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3. The Department believes that the information provided to explain the elevated chlorophyll a values reported in November 2001 is not sufficient to exclude these data from the surface water assessment using the IWR methodology. There were about 9 chlorophyll a values of 150 µg/L or greater reported in the verified period, so the elevated values are not considered an unusual occurrence. Even if the chlorophyll a values reported in November 2001 are excluded from the assessment, the tidal segment of Stevenson Creek is impaired for nutrients. The proposed TMDLs were established based on conditions observed throughout the eight-year model simulation period rather than on any one critical/seasonal condition because the methodology used to determine impairment was based on water quality results collected throughout each year in the verified period.

4. The TMDL report was revised to properly explain the types of biochemical oxygen demand (BOD) results being discussed. The HSPF model used to simulate the watershed loadings for this project models the biochemical oxygen demand (BOD) as ultimate carbonaceous biochemical oxygen demand (CBODu). In order to evaluate the model performance with respect to BOD simulation, it was necessary to convert the BOD5 results collected at the monitoring stations to CBODu values because there are no CBODu data available. A CBODu to BOD5 ratio of 2.47 was used to convert the observed data to CBODu in order to compare the data. The ratios for converting one form of BOD to another are provided in a U.S. Environmental Protection Agency technical guidance manual for developing TMDLs and which is further explained in the TMDL and modeling reports.

Stevenson Creek Modeling Report Comments:

1. The report shows several comparisons of flow, including the following:
   - Figure 4-3: Comparison of daily modeled flows and “synthetic” flows (5 months of measured flows, and other 79 months of estimated flows based on relationship between daily measured flows at Alligator Creek.
   - Figure 4-4: Comparison of daily modeled flows and measured flows (5-month period).

The values in Figure 4-3 were generated as an attempt to lengthen the period of record for comparison, as 5 months is a limited period for model calibration. Please note that the R^2 of 0.042 included in the comment, is not the same as the R^2 of 0.43 presented in Figure 4-3 of the report. However, it is recognized that the resulting correlation was not very good ($R^2 = 0.43$) and one potential source of error was that the relationship between Alligator Creek and Stevenson Creek daily flows was not very good at higher flows (e.g., above 20 cubic feet per second (cfs). The conclusion was that the limited 5-month comparison of measured and modeled flows in Stevenson Creek ($R^2 = 0.75$), presented in Figure 4-4, was a better indication of how well the model was replicating conditions in the study area.

Response to Comments on the Dissolved Oxygen and Nutrient TMDLs for Klosterman Bayou (WBID 1508) and Stevenson Creek (WBID 1567)
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2. In section 4.2.2.9, the report indicates that reclaimed water was not considered a potential water quality issue because discussion with the golf course personnel at the Clearwater Country Club Golf Course and subsequent calculations indicated that the contributions of the applied reclaimed water to the overall flow and load from the Stevenson Creek watershed would be negligible. As indicated in the modeling report, the reclaimed water is applied throughout the golf course at a slow rate via a spray irrigation system, and due to its proper administration, it is not anticipated to contribute to ambient water quality degradation. Additionally, the watershed flow volumes and loads used in the modeling provided for an adequate calibration of the tidal Stevenson Creek EFDC model, further supporting that the reclaimed water application rates are not a significant contribution.

3. It is acknowledged that the DO result of 3.12 mg/L, measured on 10/23/02, failed post calibration. Please make the appropriate corrections in the county's data upload to the STORET database so that the revisions will be reflected in future IWR database assessments.

4. The Department does not believe that the chlorophyll a value of 162 µg/L should be removed from the IWR assessment. There were about 9 chlorophyll a values of 150 µg/L or greater reported in the verified period, so the elevated values are not considered an unusual occurrence.

5. During the model development process, different time periods are selected for model calibration and validation. Model calibration consists of adjusting model rate and constant parameters within acceptable ranges to achieve a model that adequately simulates observed conditions. Model validation consists of running the calibrated model in a different time period to evaluate model performance under a different set of observed conditions. The model which was calibrated for the year 2004 was determined to have adequately simulated water quality under the conditions observed in the 1999-2002 period. The 1999 - 2002 period included years with above average and below average rainfall. Since the model adequately simulated water quality in years with below and above average rainfall it was deemed appropriate to use the model in simulating water quality for the 1999 to 2006 period and performing load reduction model scenarios for TMDL development.

Appendix A Hydrodynamic Model Comments

1. Bathymetry data for Clearwater Harbor were collected before 1960. These data were later processed (smoothing and interpolation) by NOAA and published in 1979. These reprocessed data were then laid over the recent satellite photos and adjusted for recent changes in shoreline. This final data set was then used to generate the model grid bathymetry.

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The scale of the Clearwater Harbor-St. Joseph Sound (CWHSJ) model, with finest cell size of 400X120m and domain of 17X87 km, eliminates the impact of small scale variations of bathymetry and has only minimal impact on calculation of water level.

With respect to Dunedin Pass, the model grid reflected the recent satellite photos showing the pass has closed. Therefore, the model cells in that region were inactive, forming a no flow barrier along the shoreline and linking to the islands to the north and south.

The Clearwater Channel and any dredging work on the channel had little impact on the CWHSJ model due to the scale of the model grids, as mentioned earlier. A number of tidal calibration runs were conducted by making minor adjustments in bed elevations around the passes and bridge openings. Given that the goal of this large scale model was to provide boundary conditions for the open boundaries for the Stevenson Creek and Klosterman Bayou models, the approximations used were appropriate.

1. Table A-1. Discharge volumes of Lake Seminole Outlet can be found at the following web site: http://waterdata.usgs.gov/nwis/monthly?referred_module=sw&search_site_no=02308889&format=sites_selection_links. The data set used was derived from the monthly statistics for the period 08/01/1950 to 09/30/1971.

2. Concerning the first question, a certain minimum number of grid cells must be achieved over the model domain in order to have reasonable computer simulation time of calibration, validation and prediction runs;

- Finer grid cells must be in the area of most interest, i.e., from Pinellas Trail Bridge through the creek up to the upstream end of the model domain; coarser cells are in the open bay area where more moderate hydrodynamic and water quality regimes exist;
- The sizes and shapes of the cells were made such that they best fit the creek plan shape;
- There are N pairs of data: Model data (*X*) and observed data (*O*), so the standard method to compute RMS is:

$$RMS = \sqrt{\frac{\sum_{i=1}^{N}(O_i - X_i)^2}{N}}$$

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Concerning the second question, if it is considered that the observed data follow a normal distribution, then the maximum likelihood estimate(s) of population standard deviation (σ) is:

$$s = \hat{\sigma} = \sqrt{\frac{\sum_{i=1}^{N}(O_i - \overline{O})^2}{N-1}}$$

Where $\overline{O}$ is the estimate of population mean. Therefore, the estimate of standard deviation of a normal distribution data series of N members is of N-1 degree of freedom, not the RMS.

1. The model metrics were reported in Tables 4-33, 4-34, 4-35, and 4-41 for the calibration period. In water quality modeling, it is not possible for model simulations to pass through every data point. The objective is to pick up seasonal trends and major flow events and we believe that the model achieves these goals. The time series graphs and the statistics provided in the aforementioned tables are routinely used to assess model calibration which in our opinion is adequate information for this purpose.

2. As we understand it, this comment is regarding validation station AMB15-1 and addressed to Nitrate Nitrogen (Figure C-9) and Total Nitrogen (Figure C-11) (Appendix C). The observed Nitrate Nitrogen and Total Nitrogen concentrations are low in general, Nitrate Nitrogen average is 0.18 mg/l, Total Nitrogen average is 1.1 mg/l. The timing of these data collection events correspond to times when the model also predicts lower concentrations. The spikes that occur in the hydrodynamic water quality model results directly reflect the source loadings by HSPF during high flow events. The close proximity of the AMB15-1 measurement station, relative to the boundary condition at "Spring Branch", means that this station is largely a reflection of loading from Spring Branch.

3. Water quality data from station 21FLPDEM AMB 18-1 were downloaded from the Florida DEP STORET webpage. Results for TKN, NHx, BOD5, Total Phosphorus (TP) and Orthophosphate (PO4) were directly available in the database. Using these parameters the Total Organic Nitrogen (TORN), Total Organic Phosphorous (TORP) and Total Organic Carbon (TOC) were derived as shown in the following table:

Derived Data
TORN = TKN-NHx
BODu = 2.3*BOD5; TOC=4.13*BODu
TORP = TP-PO4

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It is acknowledged that TOC appears to have a poor fit between the data used and the model output, having one of the highest RMS. It is worthwhile to note that for Stevenson Creek the water residence time is relatively short which results in insignificant effects on TOC change, and TOC is largely determined by the model boundary loadings. Furthermore, DO and algae play a more important role impacting BOD values, which are the primary variables used to develop the TMDLs.

1. The values used in model calibration were directly derived from results obtained from the FDEP STORET database. Results at the method detection limit are useful for evaluating model performance at the lower range of observed water quality.

Klosterman Bayou Tidal (WBID 1508) Final TMDL Report:
1. Comment acknowledged. The TMDL report text and Figure 2-1 will be revised accordingly.

2. Data marked with a "J" remark code are not automatically excluded from the IWR assessment. A justification should be provided if the county believes specific results marked with a "J" code should not be used in the IWR assessment.

3. The William Dunn Water Reclamation Facility (NPDES No. FL0128775) effluent goes to a reuse system and the facility does not have a permitted surface water outfall. The management of effluent at this facility is not considered a traditional point source discharge to surface waters for purposes of TMDL development.

4. The reference to BOD in the text is a generic term, whereas the actual form of BOD loadings calculated by the HSPF model are ultimate carbonaceous BOD (CBODu) concentrations and loads, as presented in Table 4.2. The text in Section 4.3.2 of the TMDL report will be revised to clarify this. As there were no direct measurements of CBODu in the water column, observed BOD 5-day results were converted to CBODu using the EPA recommended multiplier of 2.47, for purposes of HSPF model calibration and validation.

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5. Details of the modifications are provided in Section 4.1.4 of the Klosterman Bayou TMDL Model Development Report. The surface area of the HSPF RCHRES segments was increased to include the areas of the ponds in sub-basin 8 to allow for evaporation.

6. Although formal sensitivity analysis was not carried out in this project, an informal sensitivity analysis was carried out during the calibration process and presented in Section 4.2.6 of the Klosterman Bayou TMDL Model Development Report. The list of the water quality parameters for which the values were varied to analyze the sensitivity and the magnitude of the change are given in Table 4-35. The sensitivity was rated based on a magnitude of change of ±50%, but most of the computed water quality parameters changed less than 12% (area-average) (Table 4-36) and most of the RMS's at the calibration stations (Basin02Site01 and Basin02Site02) are near the base case (Reference Run00) (Table 4-39).

7. The chlorophyll a value of 8 ug/L was used as a target for TMDL development because it represents conditions of estuarine segments not impaired for nutrients in the area of Klosterman Bayou. This target was considered appropriate to apply in Klosterman Bayou since estuaries in this area already have annual average chlorophyll a values at or below 8 ug/L. Establishing a TMDL to meet this target also provides for a necessary margin of safety in the TMDL process.

8. The Department had previously reviewed the data at stations 21FLPDEMAMB 02-02 and 21FLPDEMAMB 02-07 and determined that these sampling locations are located in the tidal segment of Klosterman Bayou. The Department provided a response on this issue in the November 8, 2007 letter to Pinellas County explaining why the locations are not considered part of the freshwater segment. Please note that the Department received comments provided by Pinellas County staff, in an email dated March 14, 2007, requesting that the two county stations in question be located in the tidal segment (WBID 1508) and based on our review we concurred with this request.

Both sampling locations have a sufficient number of salinity results that indicate these areas are predominantly marine waters (salinity values above 2.7 ppt). Also, the chloride data collected by the Department's Southwest District Office at these locations were often greater than the 1500 mg/L chloride value used as the cut-off between marine and fresh waters as defined in Chapter 62-302.200, F.A.C. We believe there are a sufficient number of higher salinity and chloride results at the sampling locations to include them in the tidal segment of Klosterman Bayou.

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Klosterman Bayou Modeling Report Comments:

1. The basin boundary originally used for configuring the model was obtained from Pinellas County. Minor refinements to the boundaries were made, based on a brief field reconnaissance, but otherwise the boundaries were accepted as accurate. In addition to the boundary refinement suggested by Pinellas County in the comments, the City of Tarpon Springs also suggested refinements to the basin boundaries based on their knowledge of the area. The refinements suggested by the City of Tarpon Springs consist of removing approximately 290 acres from the basin definition and that of Pinellas County is the addition of approximately 120 acres. The impact on flows were quantified in order to assess their significance by the Department's contractor. Using the data in Table 4-8 of the modeling report, which provides the sub-basin water budgets, the total annual acre-feet of discharge with the original basin delineation and with the requested revisions were calculated. For the original basin delineation, the total annual discharge from the model is 2503 acre-feet. With all of the requested revisions, the total annual discharge is 2552 acre-feet. This change amounts to approximately 2% of the annual discharge and does not warrant any revision to the existing model results.

2. Comment acknowledged. This statement will be removed from the text.

3. During the contractor's field reconnaissance, the flapper gates were found to be 'stuck' open. Discussion with the Golf Course personnel indicated that the gates had been in this condition for a long time. In the modeling analysis they were assumed to be open and not affect the flow.

4. The data referenced in this comment were obtained and support the claim that there is probably flow to the east from the Pinellas Ridge, as stated in the comment. The average elevations for the 2006 through 2008 period are plotted in Attachment A. Well NP-143 is on the ridge and in the surficial aquifer showing the gradient is to the east. However, this region is south of Klosterman Bayou. Wells NS-07 and NP-128, which are east of the Klosterman Bayou basin boundary, indicate a general westerly flow when compared to elevations for wells within the Klosterman Bayou basin. These findings are consistent with the inferences derived from Figure 2-8 in the Klosterman Bayou Model Report. Note these inferences only applied to the area of the Klosterman Bayou basin, and not to the south. The data are consistent with the existing model configuration and no modifications are required.

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5. Fertilizer data are not directly used in the modeling analysis, but are implicitly represented in the run-off concentration algorithm model coefficients. Since these coefficients were calibrated to measured data, there is not a need for this information in the modeling analysis. However, the fertilizer applications and their relationship to the BMPs will be important in the BMAP development process.

6. The Department's contractor obtained the referenced data and compared it to the EMC values adopted for the modeling analysis. The Rushton and Dye study provides inflow and outflow nutrient levels for a stormwater detention pond in the Tampa area. Twelve events were recorded in 1989 and 29 events were recorded in 1990. The mean TN for inflow and outflow concentrations were 1.5 mg/L and 1.47 mg/L for the 1989 events, and 1.17 mg/L and 1.05 mg/L for the 1990 events. The minimum and maximum TN were 0 (i.e. ND) and 3.05 mg/L, respectively. For TP the inflow and outflow concentrations were 0.34 mg/L and 0.18 mg/L for the 1989 events, and 0.39 mg/L and 0.17 mg/L for the 1990 events. The minimum and maximum TP values for all events were 0 (ND) and 1.12 mg/L, respectively. The Dames and Moore studies provided data for single family homes and derived an EMC for TN of 1.85 mg/L and 0.525 mg/L for TP. A BOD_5 value was also provided and when converted to CBODu (per 2.47 factor) is 27.17 mg/L. There were no data for forest or wetlands reported in either study. The EMC data in those studies are consistent with the values adopted in the modeling analysis (2.18 mg/L TN, 0.33 mg/L TP and 18.3 mg/L CBODu), given the general variability in the measured EMC data.
7. The Construction Generic Permits information was not used in the modeling analysis. The Construction Generic Permits information was bundled with other information considered for the modeling analysis in the data layer, and therefore were plotted automatically with the other data.

8. Comment acknowledged. The text in the report has been updated with this information.

9. The measured data do not represent every day during the comparison period, and therefore often the measured data do not represent the full range of values in the system. Thus, it is likely that modeling results will exceed the range represented in the measured data.

10. Tidal data at station Clearwater Beach (ID: 8726724) were used for the open sea boundary condition. To our knowledge, there are no other tidal data available for the modeling period. Given that the goal of this large scale model was to provide boundary conditions for the open boundaries for the Stevenson Creek and Klosterman Bayou models, the information used were deemed appropriate for the application.

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11. The model cells in St. Joseph Sound were assigned to mostly sandy bottoms. The cells interior to the bayou were assigned with mostly mud bottoms. Table 4-7 in the model report provides a summary of the fluxes assigned to the mud and sand zones.

If you have any questions concerning our responses, please contact me or Kevin Petrus at (850) 245-8449.

Sincerely,

Jan Mandrup-Poulsen, Environmental Administrator
Watershed Evaluation and TMDL Section

ec: Jeff Greenwell
Charles Kovach
Terry Hansen

Attachment

Comments and Department Responses for the 2011 Public Comment Period

February 29, 2012

Mr. Steven Peene, Vice President
Applied Technology and Management, Inc.
1435 East Piedmont Drive, Suite 210
Tallahassee, FL 32308

SUBJECT: Response to Comments on the Proposed State Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek Tidal Segment (WBID 1567)

Dear Mr. Peene:

The Department has reviewed your comments provided on the proposed Dissolved Oxygen and Nutrient TMDL for the Stevenson Creek Tidal Segment, (WBID 1567) submitted on December 23, 2011 on behalf of the Florida Department of Transportation. We appreciated the opportunity to have a discussion about your comments and exchange additional information about the TMDL development process at the meeting on February 13. We have prepared responses to each of your comments as itemized below.

In the order in which they were presented, what follows are the comments and our responses (shown in blue).

Response to Comments in SUMMARY OF FINDINGS

1. Based upon evaluation of the available data within the two primary watersheds draining to the tidal segment of Stevenson Creek, the identified reduction brings the TN concentrations in the freshwater streams draining the watershed to levels that are unrealistic, and well below reasonable natural levels. Application of the 85% reduction would bring the TN concentrations to levels below 0.3 mg/L (on average). This is based upon the fact that the assumptions of the modeling do not reduce the associated flows as part of the TMDL, but simply reduce the loads while maintaining the pre-TMDL hydrologic load.

Department Response: The water quality constituent concentrations in the sub-basin runoff and the domestic wastewater facility effluent discharge were systematically reduced to then estimate the load reductions that were applied in the model scenarios. Concentrations were reduced as it is not certain to what extent the hydrologic loadings would be affected by management actions designed to reduce nutrients entering the surface waters throughout the watershed. The implementation of some management practices (such as fertilizer application controls and street sweeping) would not influence the runoff volumes in the watershed. At this time, it is not known to what extent watershed runoff

Response to Comments on the Proposed State Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek Tidal Segment (WBID 1567)
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volumes would be affected by nutrient control projects. There is a large variety of potential management actions that can be considered for implementation throughout the watershed to reduce pollutant loads. The evaluation of the potential hydrologic effects is best addressed during the development of a restoration plan, such as a Basin Management Action Plan, after rule adoption of the TMDLs. The TMDLs are solely expressed as loads to provide an approximation of the load reductions necessary to meet the water quality targets. It is not the intent of the TMDL to reduce the nitrogen and biochemical oxygen demand concentrations in the receiving waters to a specific value.

2. A calculation of the proposed TMDL load for TN against the total acreage of the watersheds showed that the proposed load represents a per acre TN load of 1 lb/acre/yr. This level is well below the lowest loadings for natural areas such as wetlands. This loading is inherently unrealistic.

Department Response: Before identifying the load reductions necessary to establish TMDLs, the watershed loading for total nitrogen (TN) was approximated for an undeveloped natural condition using estimated annual mass loads for natural areas for each hydrologic soil group that are presented in the document entitled, Evaluation of Current Stormwater Design Criteria within the State of Florida, prepared for the Florida Department of Environmental Protection by Environmental Research & Design, Inc. This load approximation was performed so that the TMDL was not set at a load at or below estimated natural condition loads. The natural condition TN load is estimated to be 5,594 lbs/year; which is less than the TN TMDL of 6,406 lbs/year. These loadings equate to unit area total nitrogen loads of 0.89 lbs/acre/year for the natural condition and 1.02 lbs/acre/year for the TMDL.

With consideration of other loading rates provided in a Charlotte Harbor watershed pollutant loading report and in a Pinellas County ambient monitoring program report, we do not believe the TN TMDL loading rate is unrealistic. In the Charlotte Harbor NEP Pollutant Loading Estimates report prepared by Janicki Environmental, Inc. in 2010, the unit area TN load for natural areas ranged from 0.56 lbs/acre/year for upland forests to 3.72 lbs/acre/year for forested freshwater wetlands. The Pinellas County Ambient Monitoring Program Annual Report for the period of 2003-2009, shows that the Stevenson Creek watershed existing annual TN loading rates, estimated from measured data, ranged from approximately 2 lbs/acre/year to 17 lbs/acre/year. These published results noted show that there is large variability and overlap in TN loading rates for natural land cover areas and for existing conditions in highly urbanized watersheds like Stevenson Creek.

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3. While there are a number of issues associated with the modeling, the most significant is the over prediction of the nitrate-nitrite loads from the HSPF model. In the Spring Branch and Upper Stevenson Creek watersheds the data show nitrate-nitrite levels averaging around 0.2 mg/L with maximum measured values at near or below 0.4 mg/L. Examination of the model results presented in the report show that in the Spring Branch watershed the levels average near the 0.2 mg/L level but have values as high as 3.0 mg/L. Upper Stevenson Creek levels average generally over 0.5 mg/L with levels for extended periods near 1.5 mg/L. While no data are available to compare the Hammond Branch concentrations, the model results show similar high levels. In addition to the issue of over predicting the concentrations, the modeling report identifies that the model over predicts the flows, this exacerbates the over prediction of the loads.

Department Response: It is acknowledged that the HSPF model over-predicts nitrate concentrations or loads entering the tidal segment from watershed runoff. To address this comment, two additional model simulations were performed. A baseline model simulation was performed by replacing the HSPF predicted nitrate concentrations with the average nitrate concentrations of the measured results. The average measured nitrate concentrations are 0.155 mg/L in Spring Branch and 0.168 mg/L in Upper Stevenson Creek. The results of this alternative baseline model run show that the DO exceedance rate of 39.6 percent and average chlorophyll a concentration of 11.1 µg/L for the eight-year model simulation period are similar to the baseline results shown in Table 5.1 of the draft TMDL report.

Second, a load reduction model run was conducted by reducing the average sub-basin nitrate concentrations by 85 percent, along with the same reductions in the other constituent concentrations applied in the selected TMDL scenario. The results of this alternative TMDL model run scenario show that the DO exceedance rate of 10.2 percent and average chlorophyll a value of 7.0 µg/L are similar to the model results shown for the selected TMDL scenario in Table 5.1 of the draft TMDL report.

Additionally, the average model predicted chlorophyll a values for each station and year for both the alternative baseline and TMDL load scenario runs are similar to the chlorophyll a values for the baseline run and TMDL scenario run presented in the draft TMDL report. These chlorophyll a results are displayed in the enclosed.

4. Analyses of the available data within the impaired WBID do show that the nitrate-nitrite levels near where the Douglas Avenue Bypass crosses the creek are elevated above those stations upstream and downstream. This elevation is localized and is not seen in the upper watershed. The modeling appears to be accounting for this by over simulating the loads from the watershed. This would impact significantly the levels of load reduction assigned to the watershed segments and the modeling is most likely missing a significant alternate source.

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Department Response: The Douglas Avenue Bypass sampling location is approximately 250 m downstream of the Clearwater-Marshall St. AWWTP facility outfall into Stevenson Creek. The elevated nitrate concentrations observed in that area can be attributed to the domestic wastewater facility discharge to the creek which is simulated in the EFDC model. Due to the location of the AWWTP facility outfall, the effluent discharge can be expected to have a greater influence on the nitrate concentrations in the creek at Douglas Avenue compared to the more distant tributary contributions. Based on the available discharge data, about 60 percent of the nitrogen in the facility effluent is in the form of nitrate. The nitrate results presented in Figures B-17 and C-10 of the TMDL model development report show that in general the EFDC model simulates the pattern and magnitude of the measured results reasonably well at the Douglas Avenue location.

5. Reference WBIDs utilized to develop the Chl a target, included data that are from open water bay segments. Establishment of chl thresholds utilizing open estuarine segments for comparison does not account for the effects of residence time in stream algal biomass expression, which are likely much more pronounced in tidal streams than in larger estuarine segments.

Department Response: As shown in Table 3.1, the average chlorophyll a values from the two tidal stream segments, the Anclote River (WBID 1440) and Minnow Creek (WBID 1535), which were considered in establishing a chlorophyll a target, are at the lower end in the range of average chlorophyll a values for estuarine segments not impaired for nutrients. The average chlorophyll a values for the tidal stream segments are 4.3 µg/L in the Anclote River and 5.1 µg/L in Minnow Creek. The open estuarine segments in Table 3.1, considered in developing the chlorophyll a target, have average chlorophyll a values greater than those found in the tidal stream segments. The chlorophyll a value of 8 µg/L was used as a target for TMDL development because it falls within the range of existing conditions in estuarine segments not impaired for nutrients in the area around Stevenson Creek. This target was considered appropriate to apply in Stevenson Creek since estuaries in this area with good water quality, including open bay waters and tidal streams, have annual average chlorophyll a values at or below 8 µg/L.

Response to comments in DETAILED COMMENTS

1. The figures below show the TN levels measured at the stations in the two primary watersheds draining to the Stevenson Creek Tidal segment (Upper Stevenson Creek and Spring Branch). The TN levels are not elevated in relation to typical stream levels and are at or below levels found in natural systems in the area.

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Additionally, the TN levels in the upper creek are below the levels found within the tidal portion of Stevenson Creek. For the natural condition simulations and for the TMDL reduction simulations, the modeling assumed that the TN load would be reduced by 85 percent. For these simulations it does not appear that the hydrologic loads from the watershed were reduced. Therefore in order to achieve the loads shown in the modeling, the concentrations in the flows coming out of the watershed had to be reduced by 85%. This would put the natural and the TMDL reduction TN concentrations below 0.3 mg/L on average, this is not a realistic or technically defensible condition. It is important when utilizing models to examine what the model is determining to see if it makes sense, if not then the results should be re-examined.

Department Response: It is acknowledged that the TN concentrations in the two major tributaries draining to the tidal segment tend to be lower than the concentrations in the tidal segment. However, the freshwater nitrogen concentrations delivered downstream can still contribute to the eutrophication process in the tidal segment due to hydrologic factors in the tidal area, e.g., longer residence times. Another important factor contributing to the eutrophication and higher nitrogen concentrations in the tidal segment are the benthic nutrient fluxes. The ammonia benthic flux rate and sediment oxygen demand (SOD) were important factors which needed to be accounted for in the modeling to establish the baseline conditions and develop the TMDL load scenario. Estimates of the reduction in SOD and benthic nutrient flux rates along with the reduction in watershed loadings were included in the development of model scenarios tested, as explained in the TMDL report.

As explained in the response to the first comment under Summary of Findings, only the concentrations were reduced in deriving load reductions, as it is not certain to what extent hydrologic loadings would be affected by management actions designed to reduce nutrients entering the surface waters throughout the watershed. The TMDLs are solely expressed as loads to provide an approximation of the load reductions necessary to meet the water quality targets. It is not the intent of the TMDL to drive a reduction of the nitrogen and biochemical oxygen demand concentrations in the receiving waters to achieve a specific value.

2. The model report presents comparisons of the HSPF predicted flows and the limited available measured flows. The comparison plots are presented below. The plots show and the report identifies that the model significantly over predicts the flows, especially during rain events. The over prediction is at times more than double.

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Department Response: It is acknowledged that the HSPF model did not simulate peak flows well for the limited five month calibration period in 2006. Although the flow calibration would be highly improved if a continuous, long-term stream flow time series were available, an independent assessment of the flow calibration using instantaneous flow measurements collected by Pinellas County during routine monitoring at stations 21FLPDEM18-03, and 21FLPDEM15-04 indicates that the flow simulation is adequate for both Upper Stevenson Creek and Spring Branch. Figures 4-6 and 4-7 in the TMDL model development report present a comparison of these instantaneous flow measurements versus the HSPF modeled flows. The figures indicate the modeled flow fits the observed data reasonably well.

The HSPF generated watershed flow volumes were used as input to the tidal Stevenson Creek EFDC model for the entire 8-year model simulation period. The watershed flows provided for an adequate simulation of salinity in the EFDC model of the tidal creek that was subsequently used to simulate design scenarios for the development of the TMDLs.
We recognize that some of the HSPF model results did not fit the observed data well and that there are limited data available for the tributaries and some of the water quality model variables; however, we believe that the model is sufficient for use. The model development report does identify additional data collection efforts that could be performed as part of a restoration plan after rule adoption of the TMDLs.

3. The model report presents comparisons of the simulated and measured nitrogen species in the Spring Hill Branch and Upper Stevenson Creek watersheds. While there are errors seen in all of the comparisons, the most concerning are the nitrate-nitrite comparisons. The figures below show the simulated versus measured results for Upper Stevenson Creek, the largest contributing watershed. The data plots show significant levels of over prediction of the Nitrate-Nitrite concentrations coming out of the watershed. This coupled with the over prediction of the flows brings into concern the accuracy of the watershed loadings for nitrate-nitrite. An interesting point to note is that the limited data available for comparison of nitrate-nitrite level differences longitudinally along the creek shows elevated levels at Station 18-01 compared to levels upstream and downstream. Using the limited periods of measurement of nitrogen species simultaneously at four stations along the tidal portion of Stevenson Creek (FDEP data in 2004 and 2009) the average values were calculated. The map shows the locations of the FDEP stations, they are identified by the 21FLTPA designation at the front of the station name, the last three numbers match those shown on the bar graph. The bar graph shows the differences in the stations. The data show the elevated levels in the system and their localized nature. While no data are available within Hammond Branch, it is unlikely (given the values measured in the adjacent watersheds, Spring Branch and Upper Stevenson Creek) that the levels in Hammond Branch would be significantly elevated over the surrounding watersheds unless there is an alternate source not accounted for in that watershed. Clearly the simulation of the elevated Nitrate-Nitrite levels in the receiving model, came from over simulation of the upstream loads rather than a potential localized source.

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Department Response: As explained in the response to the fourth comment under Summary of Findings, the elevated nitrate concentrations at the Douglas Avenue Bypass sampling location (Pinellas County station 18-01 and FDEP station 171) can be attributed to the Clearwater-Marshall St. AWWTP discharge, which is located approximately 250 m upstream of this sampling location. The domestic facility discharge load is simulated in the EFDC model and the nitrate concentrations used in the model simulations are based on discharge monitoring report results in the Permit Compliance System database. Due to the location of the AWWTP facility outfall, the effluent discharge can be expected to have a greater influence on the nitrate concentrations in the creek at Douglas Avenue compared to the more distant tributary contributions. Based on the available discharge data, about 60 percent of the nitrogen in the facility effluent is in the form of nitrate. The nitrate results presented in Figures B-17 and C-10 of the model development report show that in general the EFDC model simulates the pattern and magnitude of the measured results reasonably well at the Douglas Avenue location.

4. In the model report, based on the comparison of the HSPF modeled flow to observed flows in Stevenson Creek (Figs 4-4, 4-5), the model is not sufficiently calibrated for use as the loading model in TMDL development. Measured flows of 10-20 cfs correspond to simulated flows of 1-45 cfs.

Department Response: As explained in the response to Comment 2, there is other information that needs to be considered when evaluating the adequacy of the model flow simulations. Figures 4-4 and 4-5 present flow results for only the last five-months of the eight-year model simulation period. We believe the models provide an adequate simulation and can used in TMDL development when all the relevant information is taken into consideration.

Additional model flow comparisons to instantaneous flow measurements collected by Pinellas County during routine monitoring at stations 21FLPDEM18-03, and 21FLPDEM15-04 indicates that the flow simulations fit the observed data reasonably well for both Upper Stevenson Creek and Spring Branch. Figures 4-6 and 4-7 in the TMDL model development report present a comparison of these instantaneous flow measurements to the HSPF modeled flows.

The HSPF generated watershed flow volumes were used as input to the tidal Stevenson Creek EFDC model for the entire 8-year model simulation period. The watershed flows provided for an adequate simulation of salinity in the EFDC model, which was subsequently used to simulate design scenarios for the development of the TMDLs.

5. In the model report, based on comparison of the HSPF modeled water quality to observed water quality in Stevenson Creek (Figs 4-9 through 4-13) and its tributaries (Figs 4-19 through 4-27), the model is not sufficiently calibrated for use as the loading model in TMDL development.

Response to Comments on the Proposed State Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek Tidal Segment (WBID 1567)
February 29, 2012, Page Eight

Department Response: We recognize that some of the HSPF model results did not fit the observed data well and that there are limited data available for the tributaries and some of the water quality model variables; however, we believe that the model is sufficient for use. The model development report does identify additional data collection efforts that could be performed as part of a restoration plan after rule adoption of the TMDLs. We believe it is in the best interest of addressing water quality problems to adopt the TMDL using the available data and models and then work with stakeholders on implementing additional data collection efforts and projects that would improve water quality. The HSPF generated watershed flow volumes and loads were used as input to the tidal Stevenson Creek EFDC model, and provided for an adequate calibration of the EFDC model that was subsequently used to simulate design scenarios for the development of the TMDLs.

6. In the model report, Table 4-41 provides calibration statistics for the EFDC water quality constituents. This table does not support the contention that the EFDC model is calibrated, rather the converse, with simulated average chl only ¼ of the observed, simulated TN only ½ of the observed, and simulated TP only 1/3 of the observed. Similarly, the validation statistics presented in Appendix C do not support the contention that the model may be used for TMDL evaluation.

Department Response: Some of the calibration statistic values shown in Table 4-41 in the TMDL model development report show considerable differences in the average values of the observed data and the model simulated results. However, we believe the EFDC model is sufficiently calibrated for use in TMDL development when all the information is taken into consideration. The measured data averages in the table are calculated using all the results, and in some cases unusually high observed results skew the averages. The average chlorophyll a value calculated for the 2004 calibration period includes four observations equal to or greater than 150 µg/L, and three of these elevated observations occurred on November 1, 2004, which are evident in the calibration graphs in Appendix B of the model development report. For total nitrogen, the average value for the 2004 calibration period includes two observations equal to or greater than 4 mg/L, which also occurred on November 1, 2004. The remainder of the TN results are in the range of 0.82 – 2.21 mg/L.

The differences seen in the averages of the observed and model simulated results for the validation period are also skewed by unusually high results. For example, the validation period chlorophyll a graphs in Appendix C of the model development report show that on occasion there are much higher measured values (greater than 150 µg/L) compared to the majority of the results. These same graphs show that the model closely matches the majority of the measured results.

Response to Comments on the Proposed State Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek Tidal Segment (WBID 1567)
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In evaluating model performance it is important to review how well the model fits the majority of the observed results. We believe the graphs comparing the measured and predicted chlorophyll a and nutrient concentrations during the calibration and validation periods, which are provided in Appendix Band C of the model development report, indicate the model closely approximates many of the measured values.

It would be extremely difficult to attempt to calibrate the model to the conditions under which the highest chlorophyll a and nutrient concentration values were observed. To address the nutrient impairment in the TMDL development process, more emphasis should be placed on the overall conditions observed throughout the eight-year model simulation period rather than on any critical conditions because the methodology used to determine nutrient impairment is based on annual average values observed throughout the verified period.

Thank you for your time and effort in reviewing the Stevenson Creek TMDL. If you have any questions about our comments, please contact me or Kevin Petrus at 850-245-8449.
Sincerely,

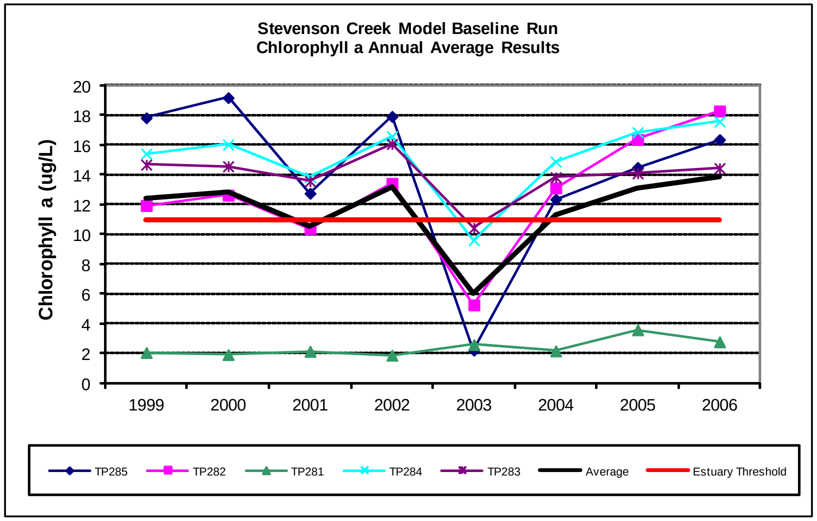
Jan Mandrup-Poulsen, Environmental Administrator
Watershed Evaluation and TMDL Section

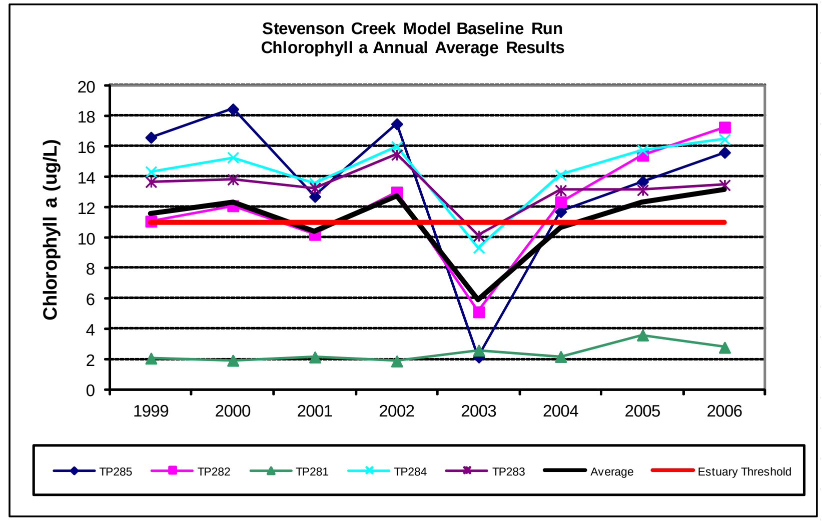
Enclosure

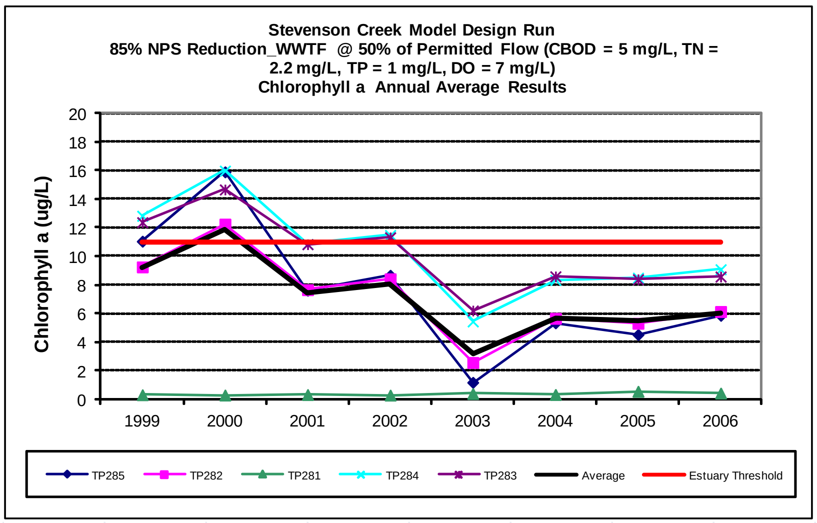
cc: Kelli Levy, Pinellas County
Sue Moore, Florida DOT
Tony Janicki, Janicki Environmental, Inc.
Jeff Greenwell
Charles Kovach

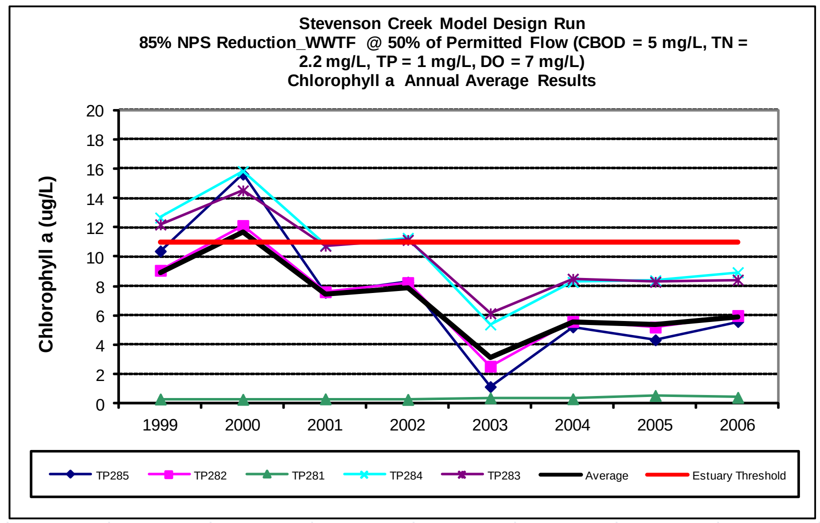
Model Run Results Used for TMDL Development

Model Run Results Using Average Tributary Nitrate Concentrations









February 29, 2012

Ms. Kelli Hammer Levy
Pinellas County Department of Environment and Infrastructure
Watershed Management
300 South Garden Avenue
Clearwater, FL 33756

SUBJECT: Response to Comments on the Proposed State Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek Tidal Segment (WBID 1567)

Dear Ms. Levy:

The Department has reviewed the Pinellas County comments provided on the proposed Dissolved Oxygen and Nutrient TMDL for the Stevenson Creek Tidal Segment, (WBID 1567) which were submitted on December 23, 2011. We appreciated the opportunity to have a discussion about your comments and exchange additional information about the TMDL development process at the meeting on February 13. We have prepared responses to each of your comments as itemized below.

In the order in which they were presented, what follows are the comments and our responses (shown in blue).

1. Page 9: Figure 2.2 shows Chla values of 492 µg/L at site 15-1 and Chla >150 µg/L at site 18-1 in November 2001. Field notes entered into STORET indicated there was a very strong incoming tide and that the water was very turbid. Based on the state's red tide database, a red tide was occurring during November 2001. This data should be removed and all other outliers verified per IWR rules (item also addressed in 07/07/08 letter and 12/8/08 letter).

Department Response: It is acknowledged that these values are much higher than many of the other values reported; however, this date was not the only time when chlorophyll a levels were at or above 150 µg/L. Chlorophyll a values equal to and greater than 150 µg/L were measured nine times in the 2000 to 2004 period, so the elevated values are not considered an unusual occurrence. Even if the chlorophyll a values reported in November 2001 are excluded from the assessment, the tidal segment of Stevenson Creek is impaired for nutrients. The modeling effort did not attempt to simulate the conditions observed during these events as it would be extremely difficult to attempt to calibrate the model to the conditions under which the elevated chlorophyll a values were observed. The proposed TMDLs were established based on conditions observed throughout the eight-year model simulation period rather than on any one critical/seasonal condition because the methodology used to determine impairment was based on water quality results collected throughout the multi-year assessment period. The Department does not believe that the elevated chlorophyll a values reported in November 2001 should be excluded from the surface water assessment using the IWR methodology.

Response to Comments on the Proposed State Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek Tidal Segment (WBID 1567
February 29, 2012, Page Two

2. Table 3.1 These WBIDS are estuarine open waters, and are not appropriate for establishing targets in tidal creeks. Unimpaired tidal creeks of similar hydrological makeup should be used. Therefore, the 8 ug/L Chla target is not appropriate for this WBID. In addition, the nutrient levels set in the model run (table 5.1) to attain Chla lower than 8ug/L are also inappropriate and lower than the Department's proposed Numeric Nutrient Criteria values.

Department Response: The ten estuarine segments in the vicinity of Stevenson Creek that are presented in Table 3.1, which are not impaired for nutrients, were considered in the development of the chlorophyll a target. Two of these segments are tidal stream segments, the Anclote River (WBID 1440) and Minnow Creek (WBID 1535), which have average chlorophyll a values that are at the lower end in the range of chlorophyll a values for estuarine segments not impaired for nutrients. The average chlorophyll a values for the tidal stream segments are 4.3 µg/L in the Anclote River and 5.1 µg/L in Minnow Creek. The open estuarine segments in Table 3.1, considered in developing the chlorophyll a target, have average chlorophyll a values greater than those found in the tidal stream segments. The chlorophyll a value of 8 µg/L was used as a target for TMDL development because it falls within the range of existing conditions in estuarine segments not impaired for nutrients in the area around Stevenson Creek. This target was considered appropriate to apply in Stevenson Creek as estuaries in this area with good water quality, including open bay waters and tidal streams, have annual average chlorophyll a values at or below 8 µg/L.

The water quality constituent concentrations in the sub-basin runoff and the domestic wastewater facility effluent discharge were systematically reduced to then estimate the load reductions that were applied in the model scenarios. The TMDLs are solely expressed as loads to provide an approximation of the load reductions necessary to meet the water quality targets. It is not the intent of the TMDL to reduce the nitrogen and biochemical oxygen demand concentrations in the receiving waters to a specific value.

In situations where ambient nutrient concentrations are lower than any proposed numeric nutrient criteria values, the delivery of the nutrients to downstream waters can still contribute to the eutrophication process due to changes in hydrologic conditions. This is the case in the Stevenson Creek watershed, where the model predicts reductions in the tidal segment chlorophyll a concentrations when the tributary stream nitrogen concentrations are reduced.

3. Section 4.3.2 mentions 487 known septic tanks in the watershed. The city of Clearwater is currently in the design phases (30% design and permits received) for a sanitary sewer line construction project in the watershed. This project has received grant funding to support the removal of 450 septic tanks in the watershed. Construction will begin in 2013. According to a study by the Florida State University

Response to Comments on the Proposed State Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek Tidal Segment (WBID 1567
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(http://www.florida-stormwater.org/files/Member%20Services/Conferences/2011%20Winter%20Conference/09-%5BBos,%20Siebold,%20Busby%5D.pdf see slide 23), the average contribution of a septic tank to a watershed is about 8.2kg of Nitrogen per year. A similar home on sanitary sewer contributes 1.4kg Nitrogen per year. Connection to the sanitary of these 450 systems would therefore be equivalent to a 3.37 tons/year Nitrogen reduction in the watershed. Table 4.2 estimates that the average Nitrogen Load in the basin is around 21 tons. This project would therefore create an approximate 16% Nitrogen Load reduction in the Stevenson's Creek watershed. However, the majority of the nitrogen present in the water column is TKN (see Table 1 below). According to an FDEP study http://www.dep.state.fl.us/water/wekiva/, nitrate is an indicator of septic tank effluents, nitrate is not typically observed in the Stevenson's Creek water quality data.

Department Response: Thank you. The Department was informed of the City of Clearwater's project to remove a large number of septic systems from the watershed and connect those parcels to the central sewer system. The completion of this project would be taken into account in the development of a restoration plan, such as a Basin Management Action Plan (BMAP), after rule adoption of the TMDLs. To evaluate the effectiveness of this project, it will be important to conduct monitoring designed to evaluate changes in surface water quality associated with the implementation of this project.

4. Section 5.9 on page 30, last paragraph: "A model scenario was performed to predict tidal creek water quality at loadings that represent undeveloped natural conditions. These results indicate that at watershed loads representative of natural background conditions, the DO regime in the tidal creek would still not meet the marine minimum DO criterion." We are in agreement. This tidal system is dominated by mangrove communities. Natural background would not have met current DO standards

Department Response: This comment is acknowledged.

5. Table 1 below shows an excerpt of high nutrient readings for the period of record. The TN is almost entirely composed of TKN, indicative of an organic nitrogen source in the system. As stated above, the tidal portion of Stevenson's Creek is a shallow, mangrove-fringed system. In situ sediments are a known source of nutrients to the water column in the creek. There are several reports readily available from the City of Clearwater including the Sediment Characterization and Removal Feasibility Study (1998 BCI), Sediment and Water Quality Study (July 2001 ACOE), and the Ecosystem Restoration Report and Environmental Assessment (February 2003 ACOE). The Department has been made aware of these reports and should use the data to estimate sediment nutrient contributions to the water column. Currently, the report assumes the nitrogen load is entirely caused by stormwater and wastewater treatment plant (Table 4.2) and does not acknowledge any nitrogen contributions from the sediments.

Response to Comments on the Proposed State Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek Tidal Segment (WBID 1567
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Additionally, the City of Clearwater reports that the Army Corps of Engineers' creek dredging project will be complete within the next 6 months. This should greatly improve water quality once complete.

Station	Date	CHLAC	TKN	TN
21FLPDEM18-01	5/19/1999	74.4	0.62	0.64
21FLPDEM15-01	10/25/2000	68.6	1.61	1.83
21FLPDEM18-01	10/25/2000	162	2.4	2.5
21FLPDEM18-01	11/14/2000	84.2	1.58	1.79
21FLPDEM15-01	5/10/2001	203	3.12	3.35
21FLPDEM18-01	11/14/2001	158	3.07	3.13
21FLPDEM15-01	11/14/2001	492	4.16	4.2
21FLPDEM18-01	10/23/2002	156	1.19	2.19
21FLTPA 27591358247312	5/24/2004	115	1.5	1.54
21FLTPA 27591398247218	5/24/2004	94	1.8	1.83
21FLTPA 27584438247015	5/24/2004	150	2.2	2.21
21FLTPA 27591398247218	11/1/2004	60	1.6	1.7
21FLTPA 27585948247171	11/1/2004	110	3.4	4
21FLTPA 27592358247432	11/1/2004	150	3.8	36
21FLTPA 27584438247015	11/1/2004	210	5	5.07
21FLTPA 27591358247312	11/1/2004	250	5.2	4.4
21FLTPA 27584438247015	4/20/2009	130	2.4	2.444
21FLTPA 27585948247171	4/20/2009	120	2.6	2.78
21FLTPA 27591398247218	4/20/2009	100	2.6	2.62
21FLTPA 27585948247171	8/10/2009	110	0.91	1.09
21FLTPA 27584438247015	10/26/2009	140	1.5	1.505

Table 1 – Chl-a Values Above 60 for the Period of Record

Response to Comments on the Proposed State Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek Tidal Segment (WBID 1567
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Department Response: The Department recognizes the importance of the creek's sediment in developing the TMDLs and methods were employed in the modeling to estimate the sediment flux influences on surface water quality. A review of the three reports referenced in your comment was conducted; however, none of those documents provided quantitative information on sediment flux rates needed to parameterize the surface water quality model. The ammonia benthic flux rate and sediment oxygen demand (SOD) are important factors which were accounted for in the modeling to establish the baseline conditions and for developing the TMDL loading scenario. The sediment flux rates used for model calibration were selected by considering the rates used in other Department water quality modeling projects conducted in the area. Estimates of the reduction in SOD and benthic nutrient flux rates associated with decreases in water column phytoplankton abundance (chlorophyll a) due to reductions in watershed loads were included in the development of the model scenarios tested, as explained in Section 5.9 of the draft TMDL report.

The Department is aware of the USACE sediment dredging project. The completion of this project would be taken into account in the development of a restoration plan, such as a BMAP, after rule adoption of the TMDLs. To evaluate the response of the tidal creek, it will be important to conduct monitoring designed to evaluate changes in surface water quality associated with the implementation of this project.

6. Tables 6.1.a and 6.1.b require the MS4s to reduce TN and CBOD5 loads by 85%. This does not take into consideration nutrient contributions from sediments. The load reductions need to be adjusted to account for contributions from sediments that are not attributable to the MS4s.

Department Response: As explained in the response to comment 5, sediment nutrient flux rates and SOD were accounted for in TMDL development, as described in Section 5.9 of the draft TMDL report. As part of the planned Basin Management Action Plan process for Stevenson Creek, added monitoring following the completion of the dredging project will allow us to refine the needed load reductions.

Thank you for your time and effort in the further review of the TMDL report for Stevenson Creek. If you have any questions about our comments, please contact me or Kevin Petrus at 850-245-8449.

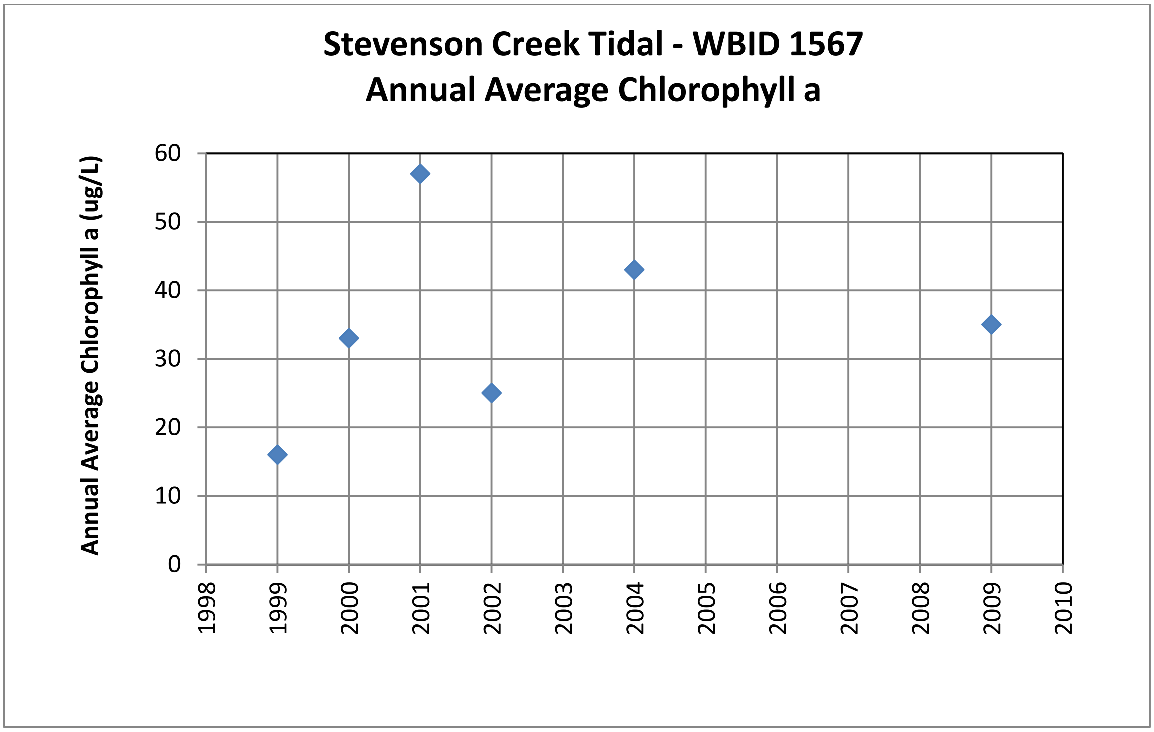
Sincerely,

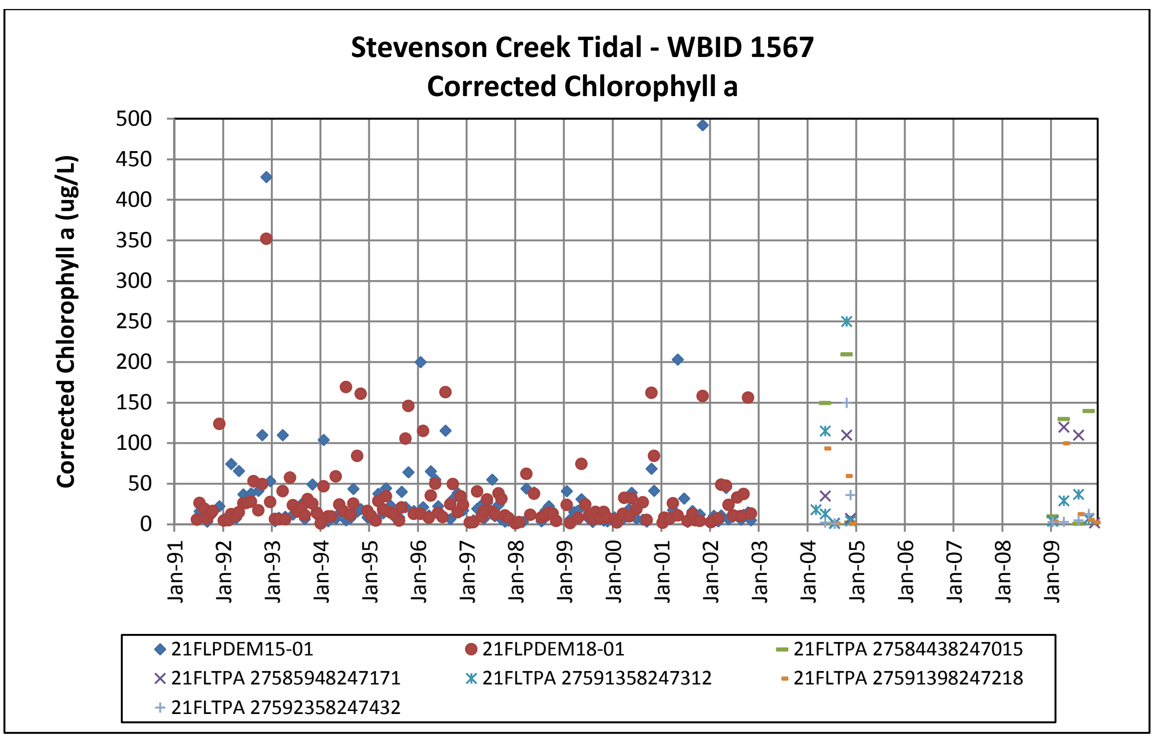
Jan Mandrup-Poulsen, Environmental Administrator
Watershed Evaluation and TMDL Section

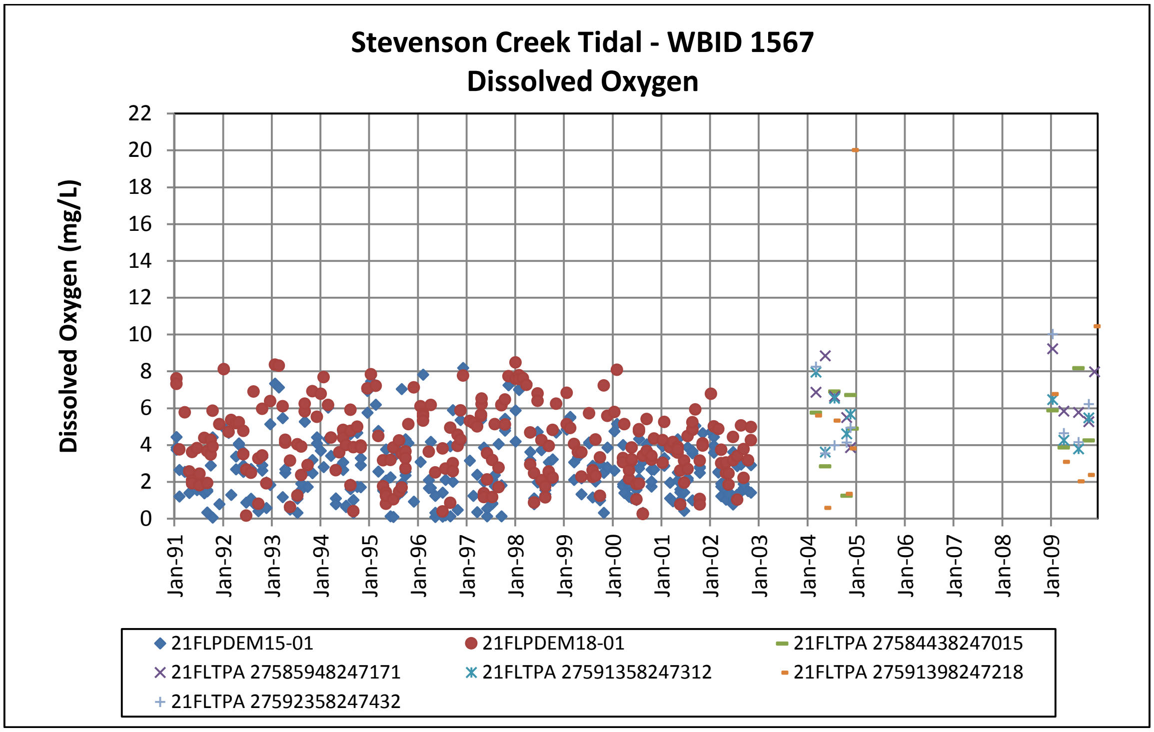
Response to Comments on the Proposed State Dissolved Oxygen and Nutrient TMDLs for Stevenson Creek Tidal Segment (WBID 1567
February 29, 2012, Page Six

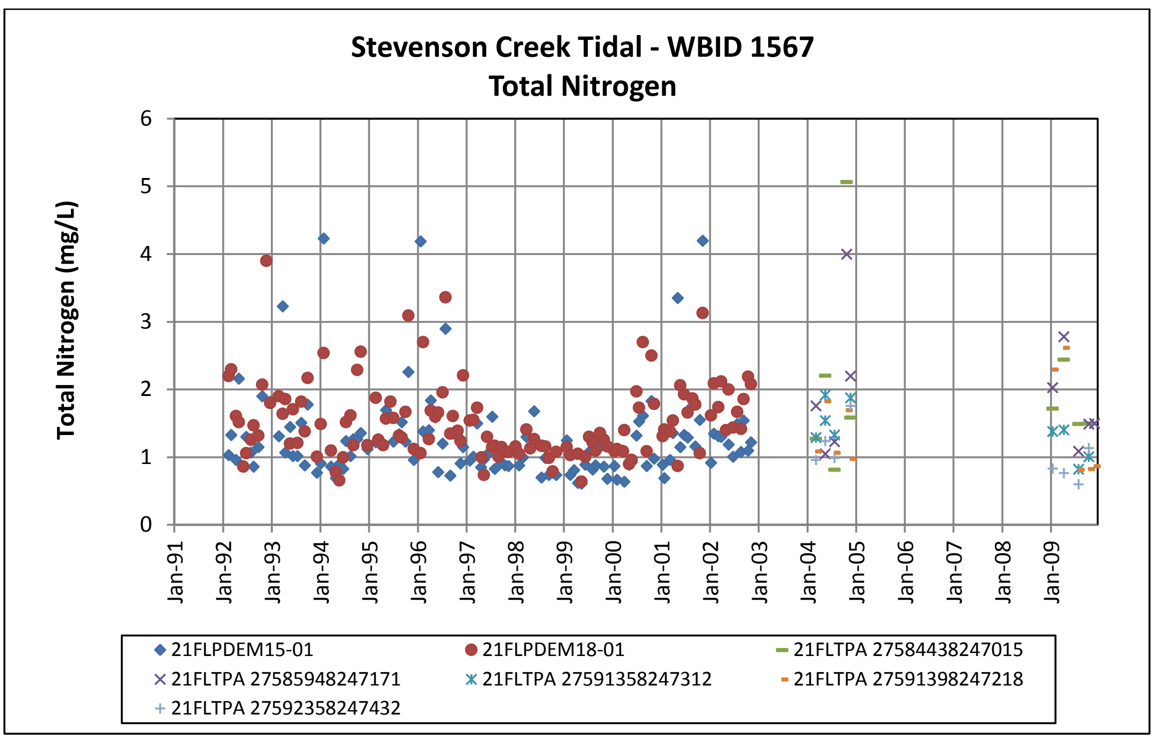
cc: Dave McCrea, Pinellas County
Melanie Weed, Pinellas County
Tony Janicki, Janicki Environmental, Inc.
Jeff Greenwell
Charles Kovach

Appendix C: Graphs of Surface Water Quality Results — Source: IWR Run 44 Database






Stevenson Creek Tidal - WBID 1567
Dissolved Oxygen
Dissolved Oxygen (mg/L)
22
20
18
16
14
12
10
8
6
4
2
0
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
21FLPDEM15-01
21FLPDEM18-01
21FLTPA 27584438247015
21FLTPA 27585948247171
21FLTPA 27591358247312
21FLTPA 27591398247218
21FLTPA 27592358247432


Stevenson Creek Tidal - WBID 1567
Total Nitrogen
Total Nitrogen (mg/L)
6
5
4
3
2
1
0
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
21FLPDEM15-01
21FLPDEM18-01
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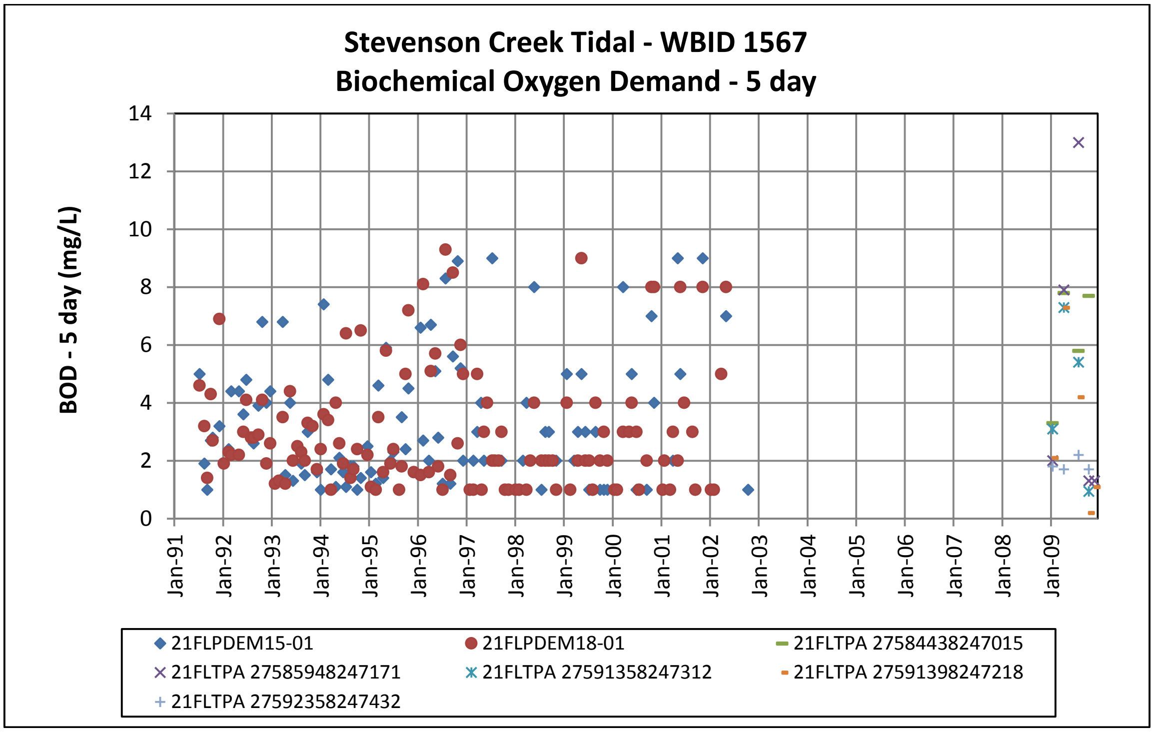
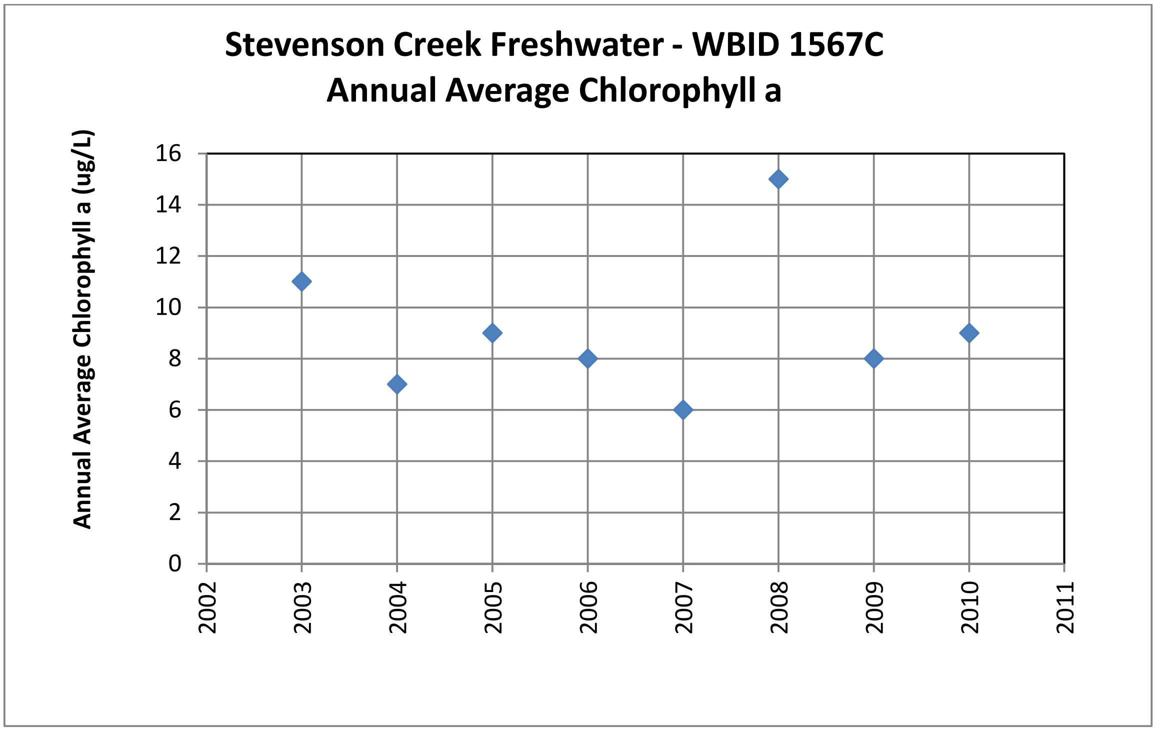
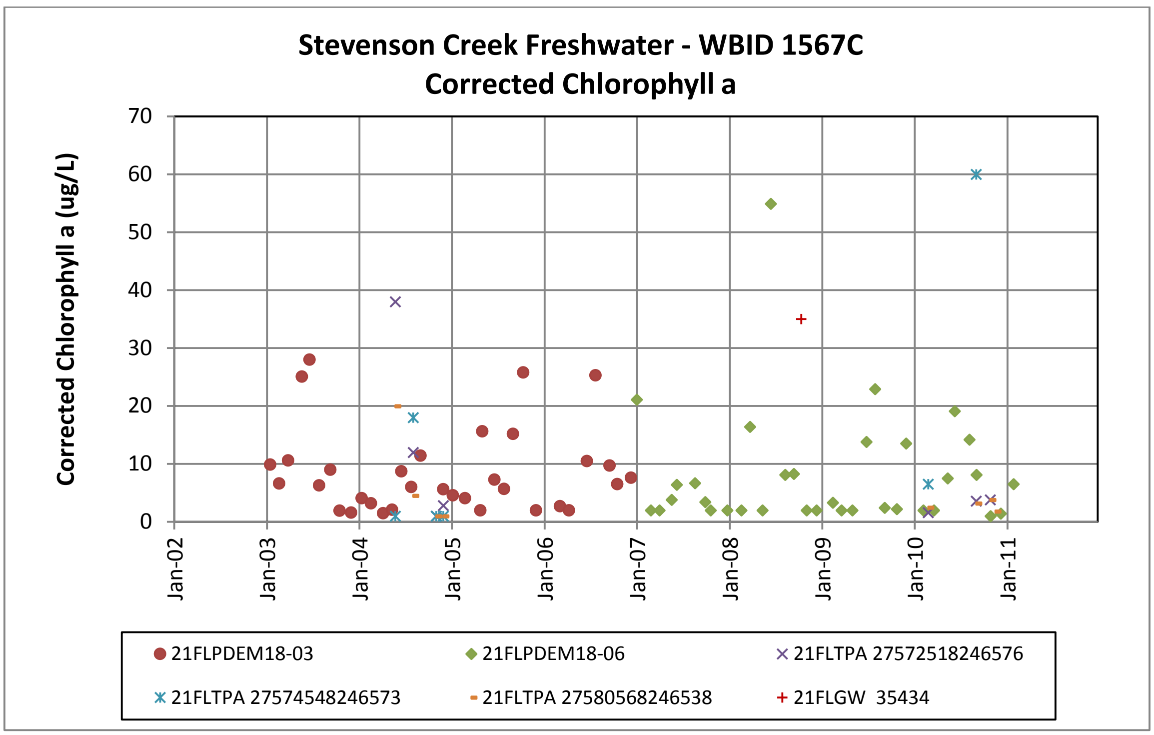
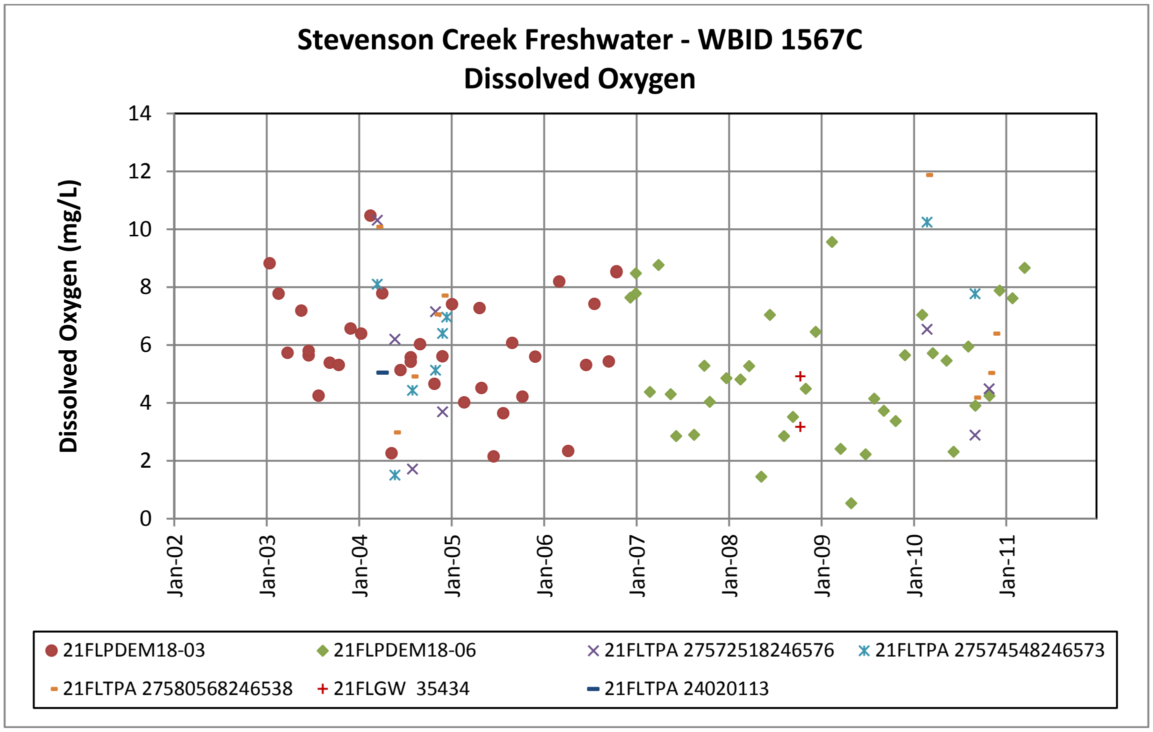
21FLTPA 27592358247432


Stevenson Creek Tidal - WBID 1567
Biochemical Oxygen Demand - 5 day
BOD - 5 day (mg/L)
0
2
4
6
8
10
12
14
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
21FLPDEM15-01
21FLPDEM18-01
21FLTPA 27584438247015
21FLTPA 27585948247171
21FLTPA 27591358247312
21FLTPA 27591398247218
21FLTPA 27592358247432


Stevenson Creek Freshwater - WBID 1567C
Annual Average Chlorophyll a
Annual Average Chlorophyll a (ug/L)
0
2
4
6
8
10
12
14
16
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011


Stevenson Creek Freshwater - WBID 1567C
Corrected Chlorophyll a
Corrected Chlorophyll a (ug/L)
0
10
20
30
40
50
60
70
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
21FLPDEM18-03
21FLPDEM18-06
21FLTPA 27572518246576
21FLTPA 27574548246573
21FLTPA 27580568246538
21FLGW 35434



Stevenson Creek Freshwater - WBID 1567C
Dissolved Oxygen
Dissolved Oxygen (mg/L)
14
12
10
8
6
4
2
0
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
21FLPDEM18-03
21FLPDEM18-06
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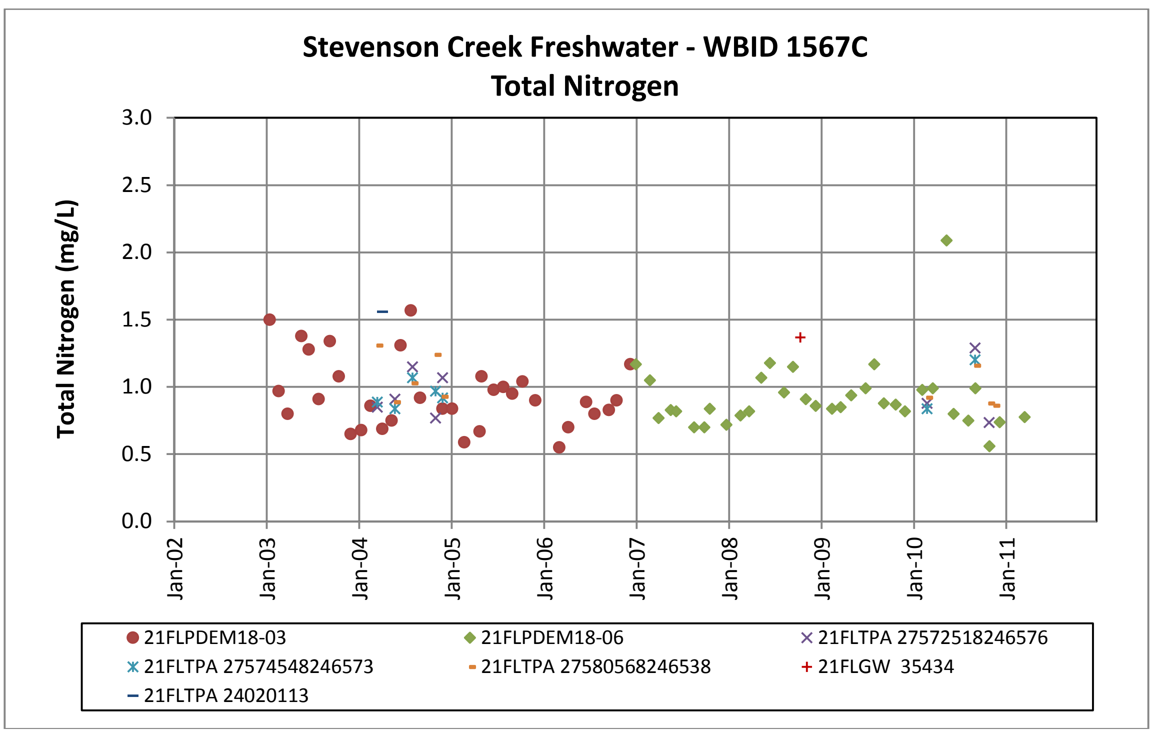
21FLGW 35434
21FLTPA 24020113



Stevenson Creek Freshwater - WBID 1567C
Total Nitrogen
Total Nitrogen (mg/L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
21FLPDEM18-03
21FLPDEM18-06
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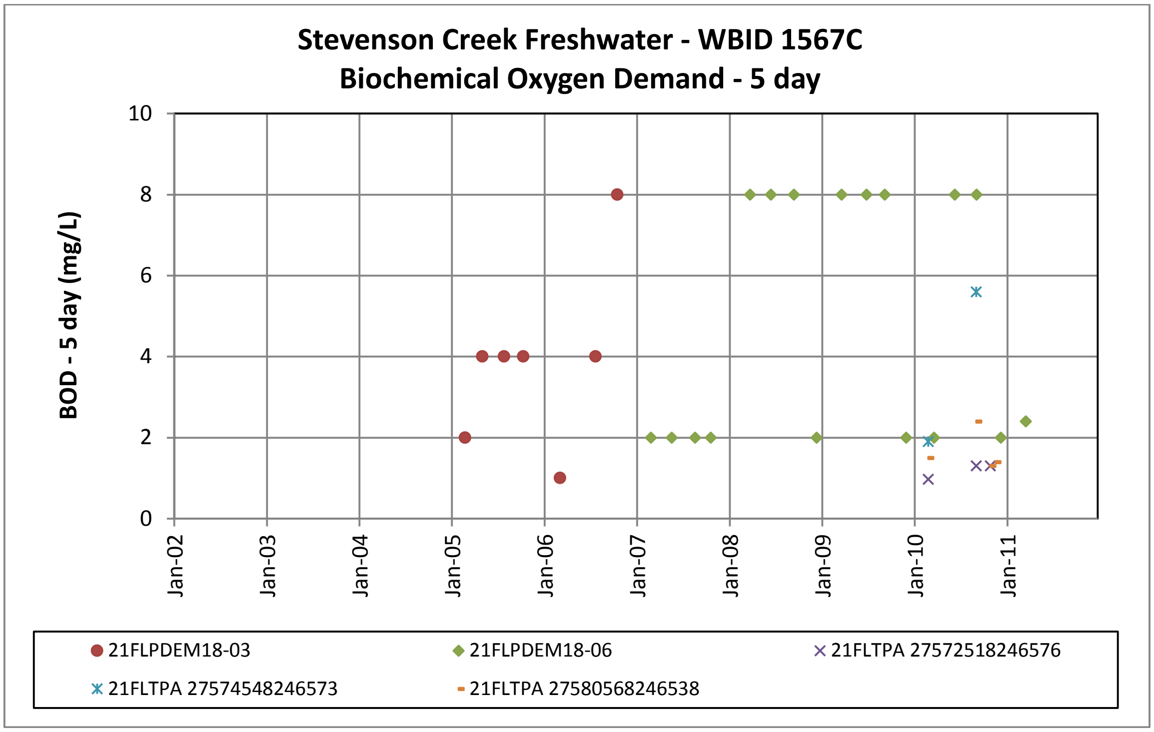
21FLGW 35434
21FLTPA 24020113


Stevenson Creek Freshwater - WBID 1567C
Biochemical Oxygen Demand - 5 day
BOD - 5 day (mg/L)
0
2
4
6
8
10
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
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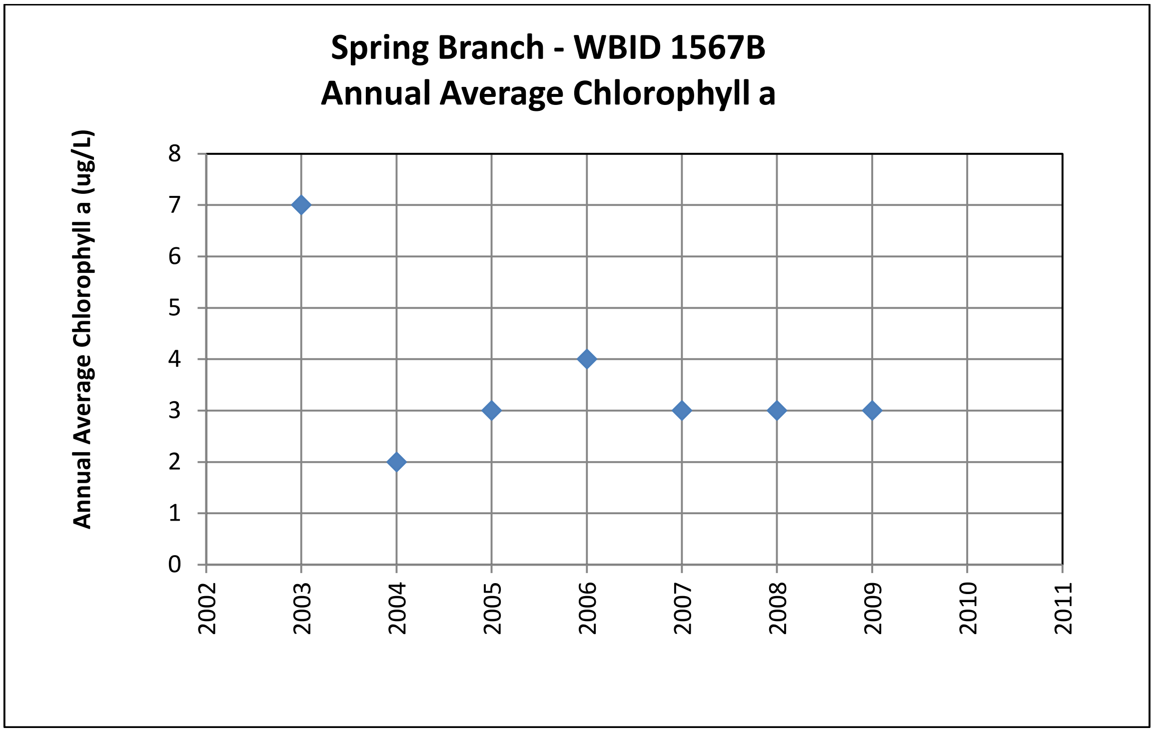
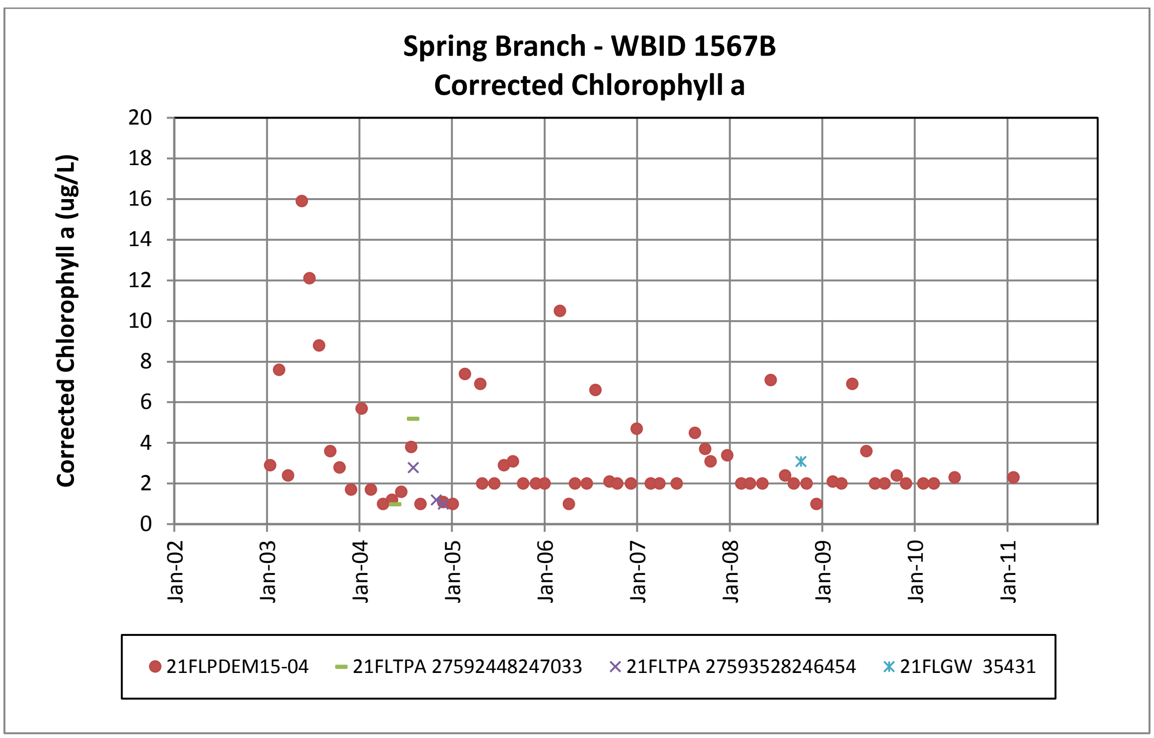
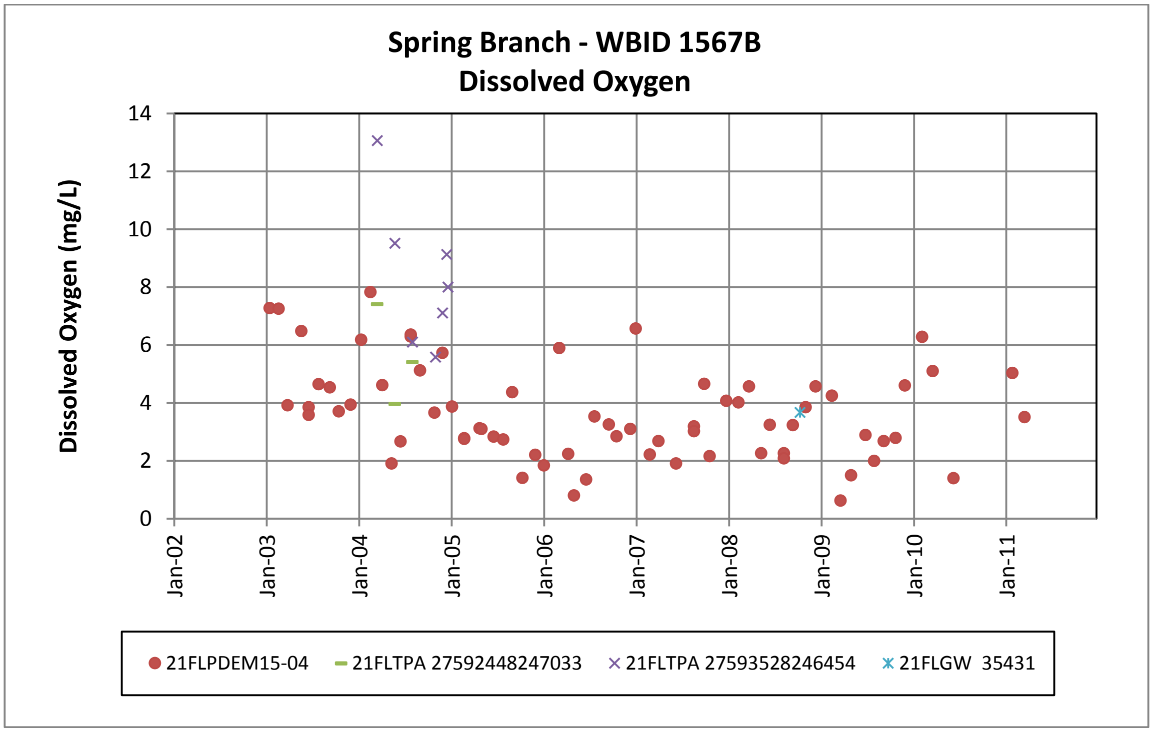
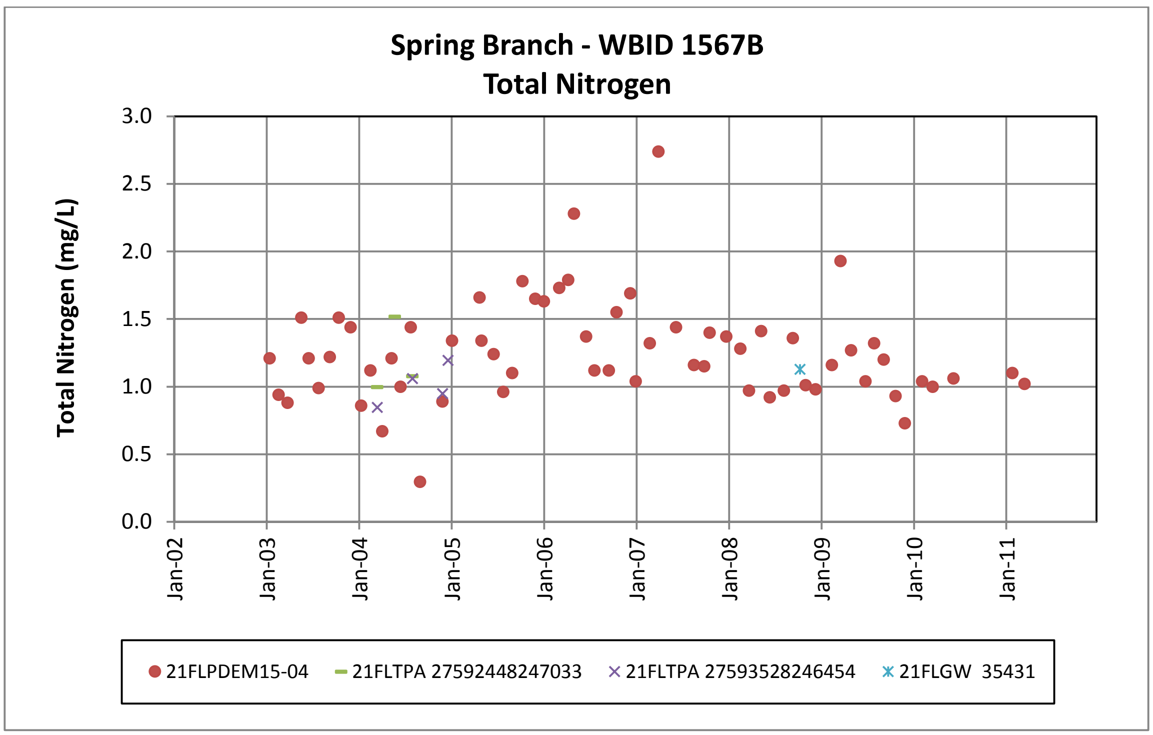
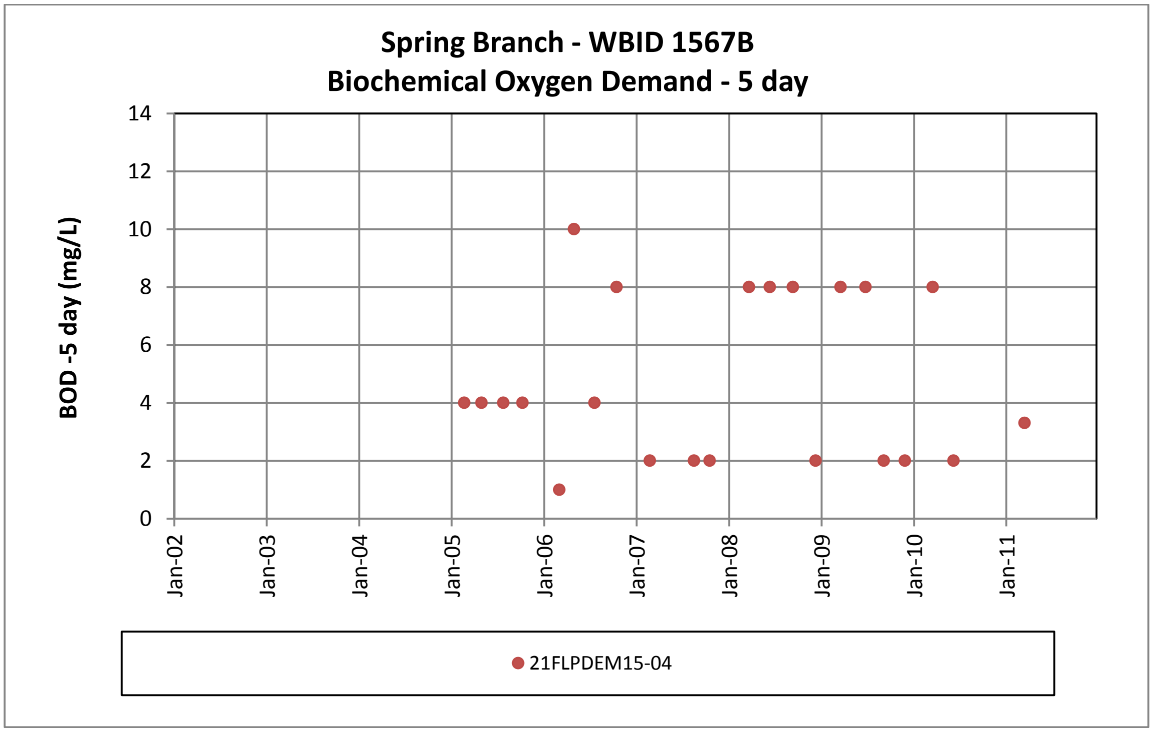
21FLTPA 27580568246538


Spring Branch - WBID 1567B
Annual Average Chlorophyll a
Annual Average Chlorophyll a (ug/L)
0
1
2
3
4
5
6
7
8
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011


Spring Branch - WBID 1567B
Corrected Chlorophyll a
Corrected Chlorophyll a (ug/L)
0
2
4
6
8
10
12
14
16
18
20
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
21FLPDEM15-04
21FLTPA 27592448247033
21FLTPA 27593528246454
21FLGW 35431


Spring Branch - WBID 1567B
Dissolved Oxygen
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
14
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
21FLPDEM15-04
21FLTPA 27592448247033
21FLTPA 27593528246454
21FLGW 35431


Spring Branch - WBID 1567B
Total Nitrogen
Total Nitrogen (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
21FLPDEM15-04
21FLTPA 27592448247033
21FLTPA 27593528246454
21FLGW 35431


Spring Branch - WBID 1567B
Biochemical Oxygen Demand - 5 day
BOD -5 day (mg/L)
14
12
10
8
6
4
2
0
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
21FLPDEM15-04