FINAL TMDL Report

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

Dissolved Oxygen and Nutrient TMDL for Curlew Creek Tidal Segment, WBID 1538

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http://www.dep.state.fl.us/water/docs/2014_integrated_report.pdf

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Water Quality Status and Assessment Reports for the Springs Coast Basin
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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 Curlew 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 Curlew 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 Curlew Creek watershed encompasses 10.6 square miles (6,769 acres) in northern Pinellas County (**Figure 1.1**). The watershed area spans the jurisdictions of the cities of Dunedin and Clearwater, as well as unincorporated parts of Pinellas County. Land uses in the basin are predominantly medium- and high-density residential, commercial, and open space, and approximately 90% of the watershed is urbanized.

The headwaters are located outside the boundaries of the impaired segment in the southern part of the Springs Coast Basin in the city of Clearwater and unincorporated parts of Pinellas County (**Figure 1.2**). A major tributary to Curlew Creek is Jerry Branch, which receives drainage from Spring Lake and Jerry Lake. The main channel of Curlew Creek originates near the intersection of Enterprise Road and Countryside Boulevard, and flows in a northwest direction for approximately five miles, where it enters into St. Joseph Sound south of Causeway Boulevard.

Figure 1.1. Location of Curlew Creek Tidal Segment, WBID 1538, in the Curlew Creek Watershed and Major Geopolitical and Hydrologic Features in Pinellas County

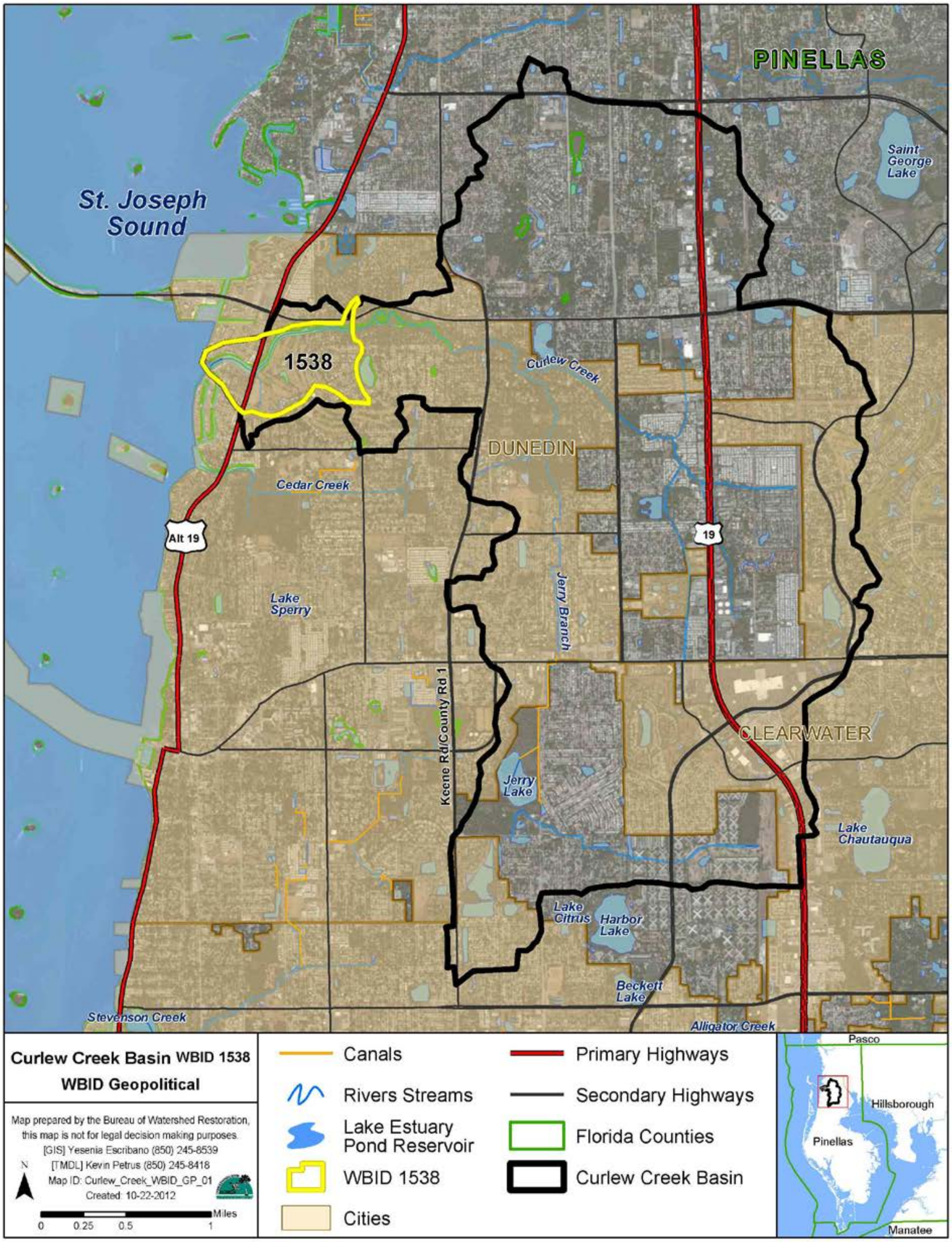

Figure 1.2. Location of Curlew Creek Tidal Segment, WBID 1538, in the Curlew Creek Watershed and Major Geopolitical and Hydrologic Features in the Area

For assessment purposes, the Florida Department of Environmental Protection has 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. Curlew Creek Tidal Segment is WBID 1538. **Figure 1.2** shows the location of the WBID in the Curlew Creek watershed. The creek channel within the tidal segment is approximately one mile long.

Curlew Creek Tidal Segment is one of 93 waterbody segments in the Springs Coast Basin, Anclote River/Coastal Pinellas County Planning Unit, and one of 22 waterbody segments in the Springs Coast Basin included on the initial 1998 303(d) list submitted by the Department to the United States Environmental Protection Agency (EPA). The 1998 303(d) list was incorporated into a 1999 Consent Decree between the EPA and EarthJustice.

The initial list used data from stations listed in the Department's 1996 305(b) report. The report used the best available information at the time to generally characterize the quality of Florida's waters. Some of the delineations of waterbody areas and locations of sampling stations for the 1998 303(d) list were inaccurate due to technical limitations at that time. With the primary goal of providing more accurate assessments, the Department has revised these delineations over time. The EPA has labeled the redrawing of WBID boundaries "resegmentation," as the original stations corresponded to specific WBID areas or segments. Resegmented WBIDs are those WBIDs that have been altered from the initial 1998 303(d) Consent Decree or previous cycle boundaries. As a result of the resegmentation process for the Group 5 basins, there are currently 40 Consent Decree waterbody segments in the Springs Coast Basin. This number is based on Impaired Surface Waters Rule (IWR) database Run 44x.

Curlew Creek is located in the west-central coastal region of peninsular Florida, in the area identified as the Gulf Coastal Lowlands physiographic region, where soils are poorly drained and the water table is near the land surface. Soils in this region are variable, ranging from excessively drained sands to moderate or poorly drained soils with a sandy subsoil (United States Department of Agriculture [USDA] 2006). As a result of extensive changes of the land surface for development, large portions of this area have soil types characterized as urban land (Southwest Florida Water Management District [SWFWMD] 2002).

Two main aquifers are found in Pinellas County: the surficial aquifer and the Floridan aquifer. The surficial aquifer system consists of undifferentiated sands, shell material, silts, and clayey sands of varying thickness (Causseaux 1985). The principal uses for the surficial aquifer in Pinellas County are irrigation, limited domestic use, and dewatering projects for mining and infrastructure installation (SWFWMD 2006). The Floridan aquifer system consists primarily of highly permeable carbonate rocks and is separated into two principal zones consisting of the fresh potable water of the upper Floridan aquifer and the highly mineralized water of the lower Floridan aquifer (Causseaux 1985). In Pinellas County, the upper Floridan aquifer is the principal source of water and is used for industrial, mining, public supply, domestic use, and irrigation purposes, as well as brackish water desalination in coastal communities (SWFWMD 2006).

An important feature of the area is karst topography. Watersheds located in karst regions are extremely vulnerable to contamination. Many of these karst features infiltrate the water table, forming a direct connection between the land surface and the underlying aquifer systems, allowing interaction between surface and ground waters (SWFWMD 2002) and increasing the threat of ground water contamination from surface water pollutants (Trommer 1987). Potential sources of contamination include saltwater encroachment and the infiltration of contaminants carried in surface water, the direct infiltration of contaminants (chemicals or pesticides applied to or spilled on the land, fertilizer carried in surface runoff), landfills, septic tanks, sewage-plant treatment ponds, and wells used to dispose of stormwater runoff or industrial waste (Miller 1990).

Additional information about the region’s hydrology and geology are available in the Water Quality Status Report for the Springs Coast (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 Curlew Creek Tidal Segment. These activities will depend heavily on the active participation of the 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.

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 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 Curlew Creek Tidal Segment, WBID 1538, and verified the impairment for DO and nutrients (**Table 2.1**) in the Cycle 1 verified period (January 1, 1999–June 30, 2006) that was adopted by Secretarial Order in December 2007. The tidal segment was reassessed in 2011 for the Cycle 2 verified period (January 1, 2004–June 30, 2011); however, no additional data were uploaded to the Department's **STO**rage and **RET**rieval (STORET) database after the Cycle 1 assessment was performed.

Table 2.1. Verified Impairment in Curlew Creek Tidal Segment, WBID 1538

Parameter Causing Impairment	Priority for TMDL Development	Projected Year For TMDL Development
DO	Low	2011
Nutrients	Low	2011

The data for the Cycle 1 and Cycle 2 IWR assessments of WBID 1538 were obtained from stations sampled by the Pinellas County Department of Environmental Management (21FLPDEM…) and the Department's Southwest District (21FLTPA…). Sampling was conducted by Pinellas County at Station 21FLPDEMAMB 10-1 between 1999 and 2002. The Department also collected data from the following stations: 21FLTPA 28023978246557, 21FLTPA 28024368247030, 21FLTPA 28025058246472, and 21FLTPA 28025268246380 in 2004. **Figure 2.1** displays the sampling locations in the Curlew Creek watershed, and **Figure 2.2** shows the sampling locations in the WBID.

The individual water quality measurements used in this analysis are available in the IWR database (Run 44x) and are available on request. **Table 2.2** summarizes the DO data collected during the Cycle 1 verified period, and **Figure 2.3** displays the results. 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 verified period. In performing estuarine nutrient evaluations following the IWR methodology, annual average chlorophyll *a* values were used as the primary measurement for assessing nutrient impairment because its concentrations are a good measure of phytoplankton biomass (the microscopic algae suspended in the water column) that utilize nutrients for growth. The results used to calculate the annual average chlorophyll a values are displayed in Figure 2.4. During the Cycle 1 verified period, the annual average chlorophyll *a* values for Curlew Creek Tidal Segment were above the estuarine threshold of 11 micrograms per liter (µg/L) in the five years with sufficient data to calculate annual average concentrations. Between 1999 and 2004, annual averages varied between 15 and 35 µg/L (**Table 2.3** and **Figure 2.5**).

Table 2.2. Summary of DO Data for Curlew Creek Tidal Segment, WBID 1538 (1999–2004)

Number of Samples	Minimum (mg/L)	Mean (mg/L)	Median (mg/L)	Maximum (mg/L)	Number of Exceedances
71	0.8	5.5	4.9	27.1	28

Table 2.3. Summary of Chlorophyll a Data for Curlew Creek Tidal Segment, WBID 1538 (1999–2004)

Year	Annual Mean Chlorophyll a (µg/L)
1999	27
2000	32
2001	35
2002	15
2004	25

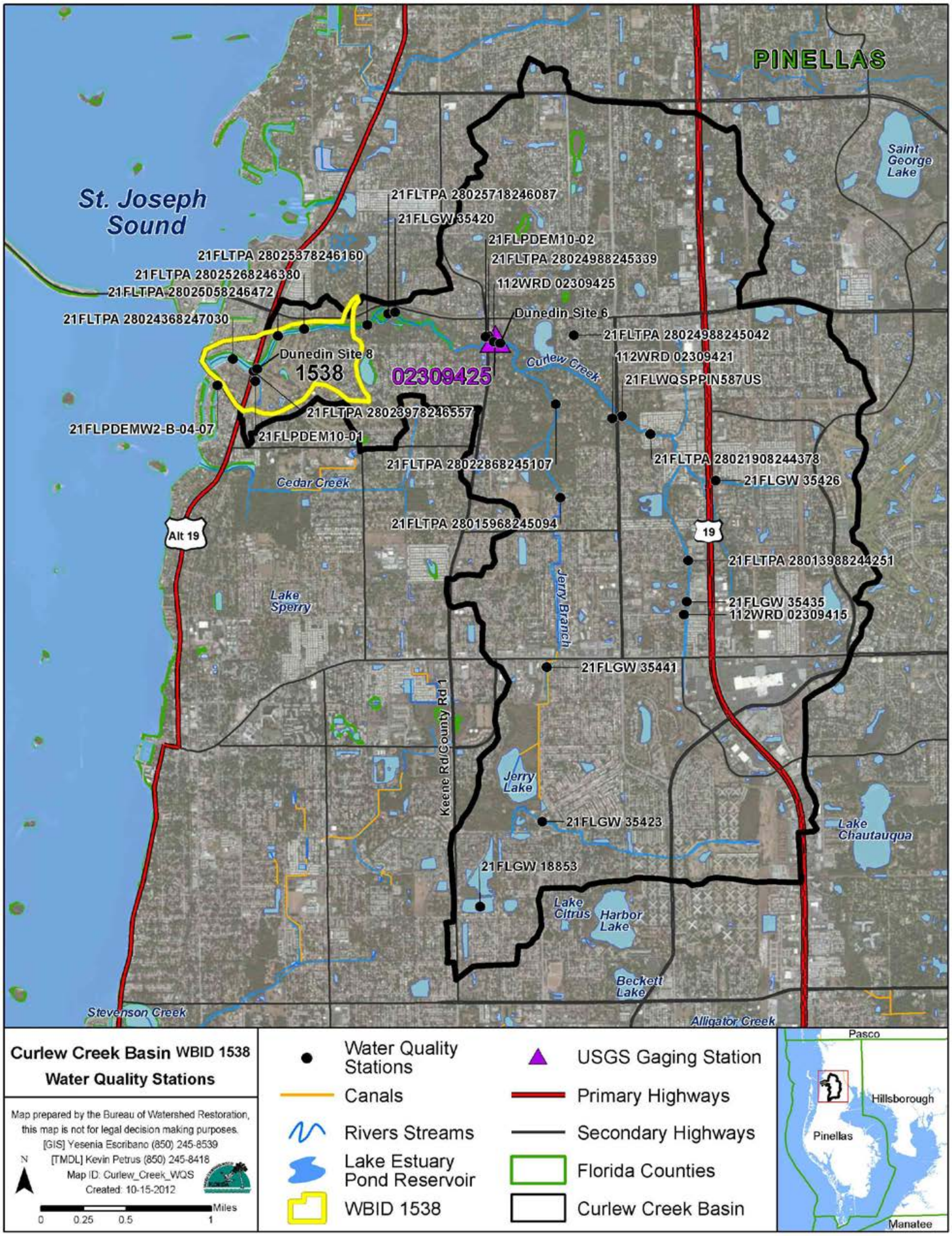

Figure 2.1. Surface Water Monitoring Locations in the Curlew Creek Watershed

Figure 2.2. Surface Water Monitoring Locations in Curlew Creek Tidal Segment, WBID 1538

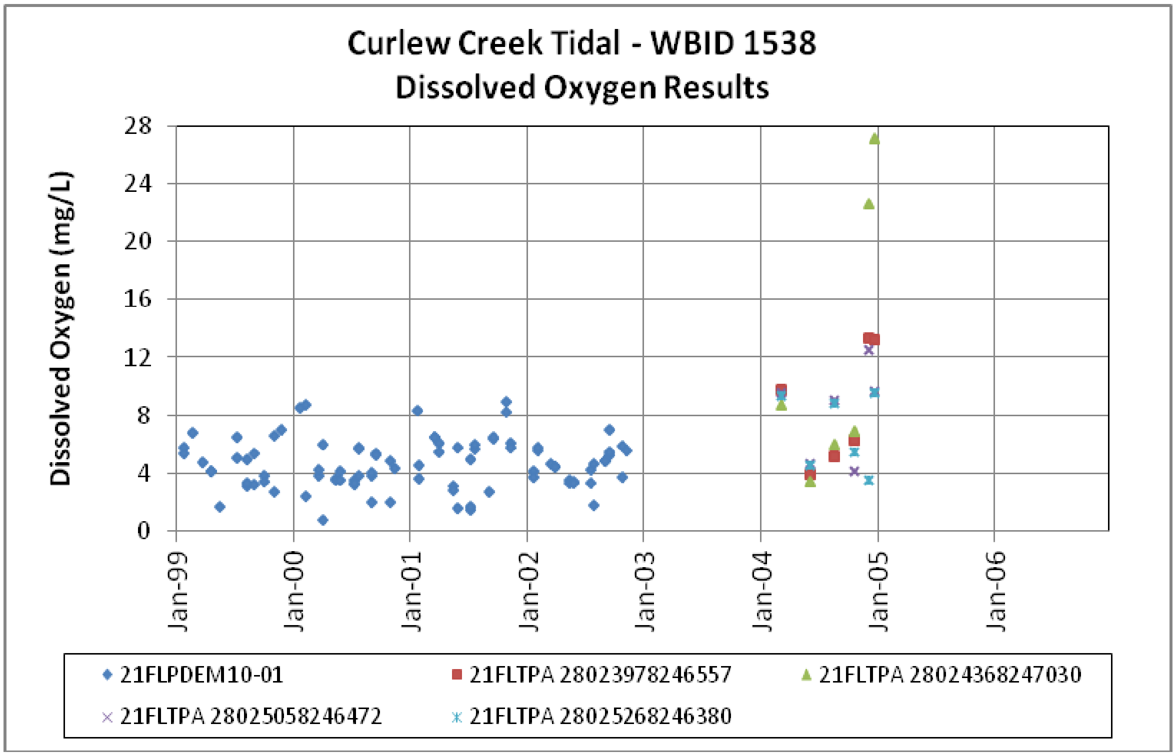

Figure 2.3. DO Measurements in Curlew Creek Tidal Segment, WBID 1538, During the Cycle 1 Verified Period

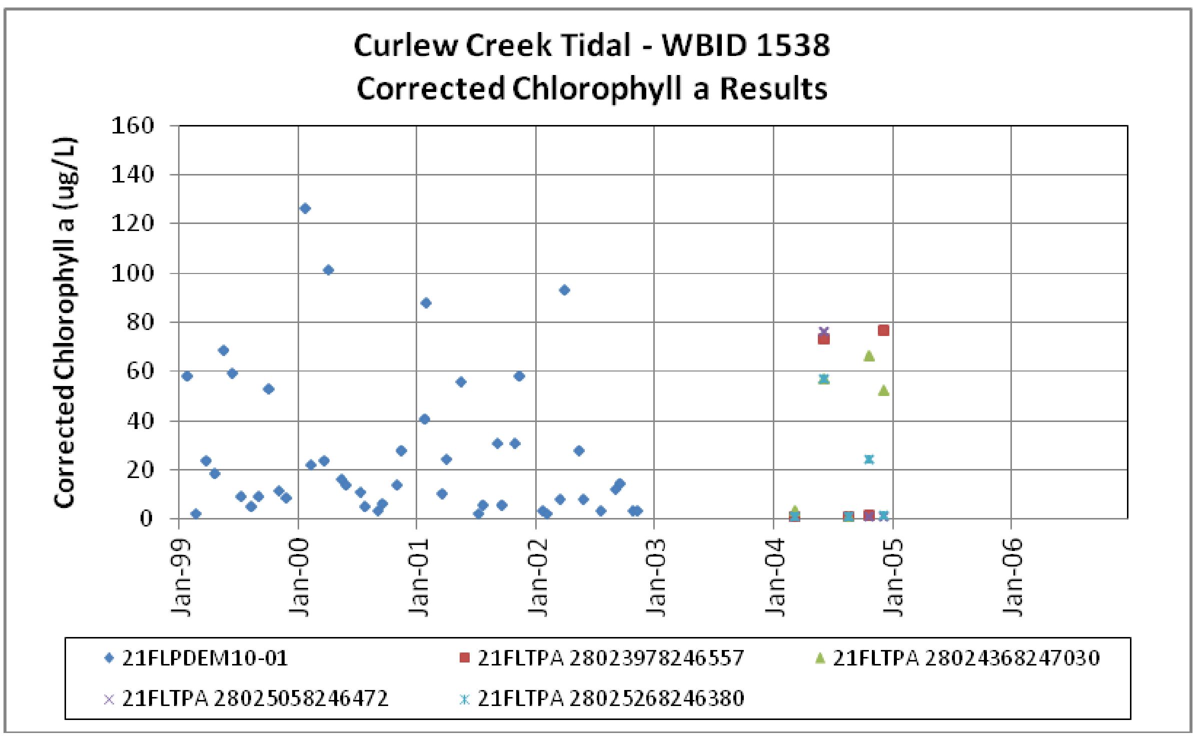

Figure 2.4. Chlorophyll a Measurements in Curlew Creek Tidal Segment, WBID 1538, During the Cycle 1 Verified Period

Subsequent to the verified impairment listings in Cycle 1, the tidal segment was reassessed for the Cycle 2 verified period (January 1, 2004–June 30, 2011). Since no additional data were uploaded to STORET and made available in the IWR database after 2004, the Cycle 2 assessment was based on the one year of data collected in 2004, which was the first year of the Cycle 2 verified period.

After the Cycle 2 assessment was completed, it was made known to the Department that the city of Dunedin has a monitoring station in Curlew Creek Tidal Segment where it has collected data since June 2010 to assist in compliance with the city's municipal separate storm sewer system (MS4) permit. **Figures 2.6** and **2.7** show the DO and chlorophyll *a* results collected by the city along with the available data in the IWR database (Run 44x) for the Cycle 1 and Cycle 2 verified periods, respectively.

The results suggest improvements in water quality for both DO and chlorophyll *a* since 1999. There are fewer exceedances of the DO criterion of 4 mg/L and lower concentrations of chlorophyll *a* values in more recent years. If all the available DO results for the Cycle 2 verified period are evaluated following the IWR methodology, there are five exceedances of the criterion out of a total of 33 samples, suggesting that the segment is not impaired for DO. However, the DO exceedance rate is not low enough to delist the segment for DO impairment following the IWR methodology.

The graphs in **Appendix B** display water quality results for the period of record for variables relevant to this TMDL effort that were collected by all sampling agencies.

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 Curlew Creek Tidal Segment supports this conclusion.

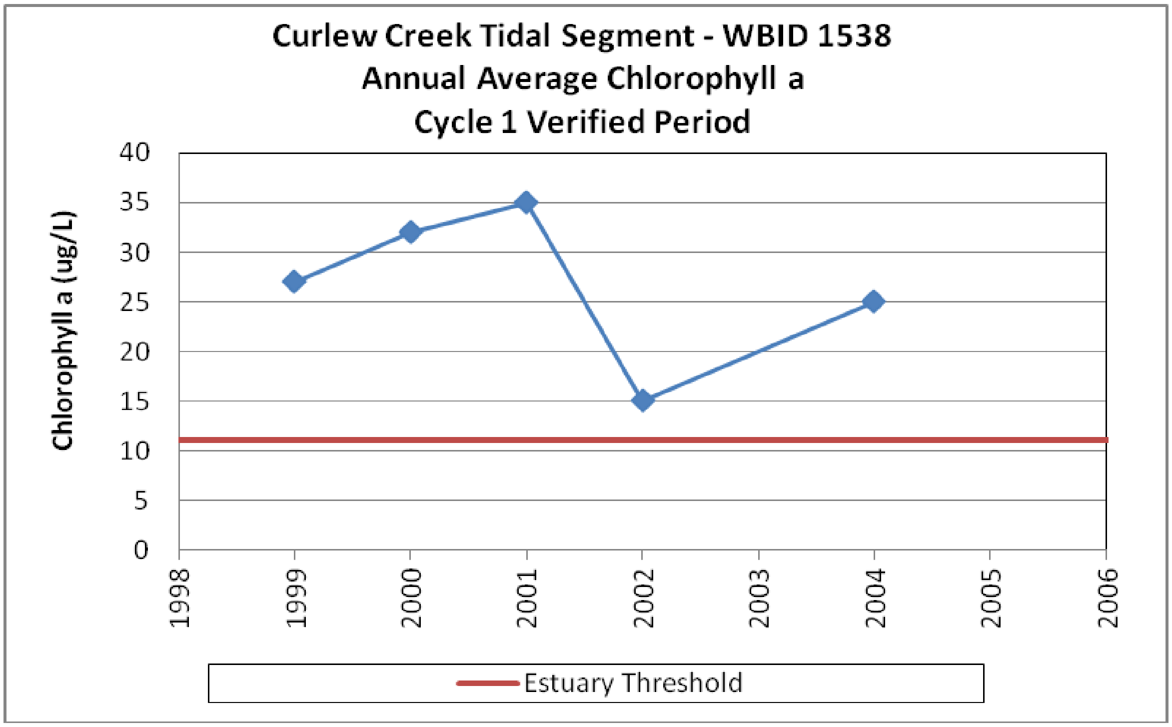

Figure 2.5. Chlorophyll a Annual Averages in Curlew Creek Tidal Segment, WBID 1538, During the Cycle 1 Verified Period

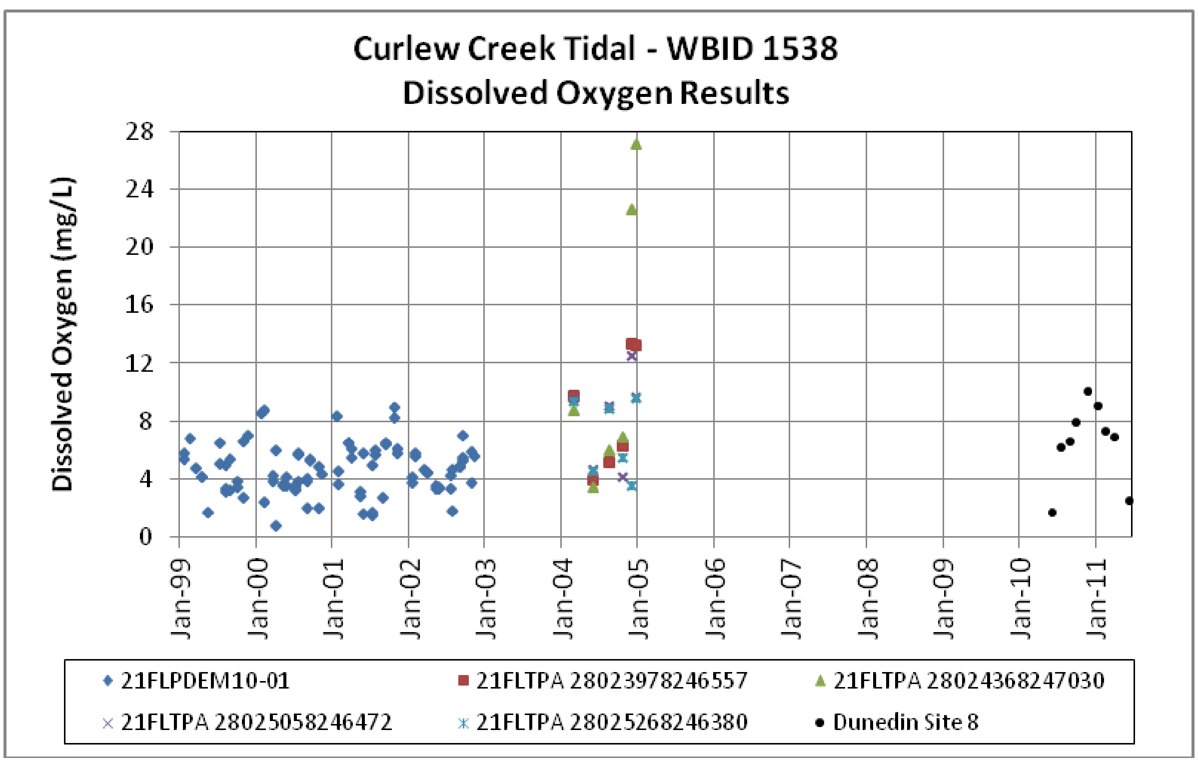

Figure 2.6. DO Measurements in Curlew Creek Tidal Segment, WBID 1538, During the Cycle 1 and Cycle 2 Verified Periods

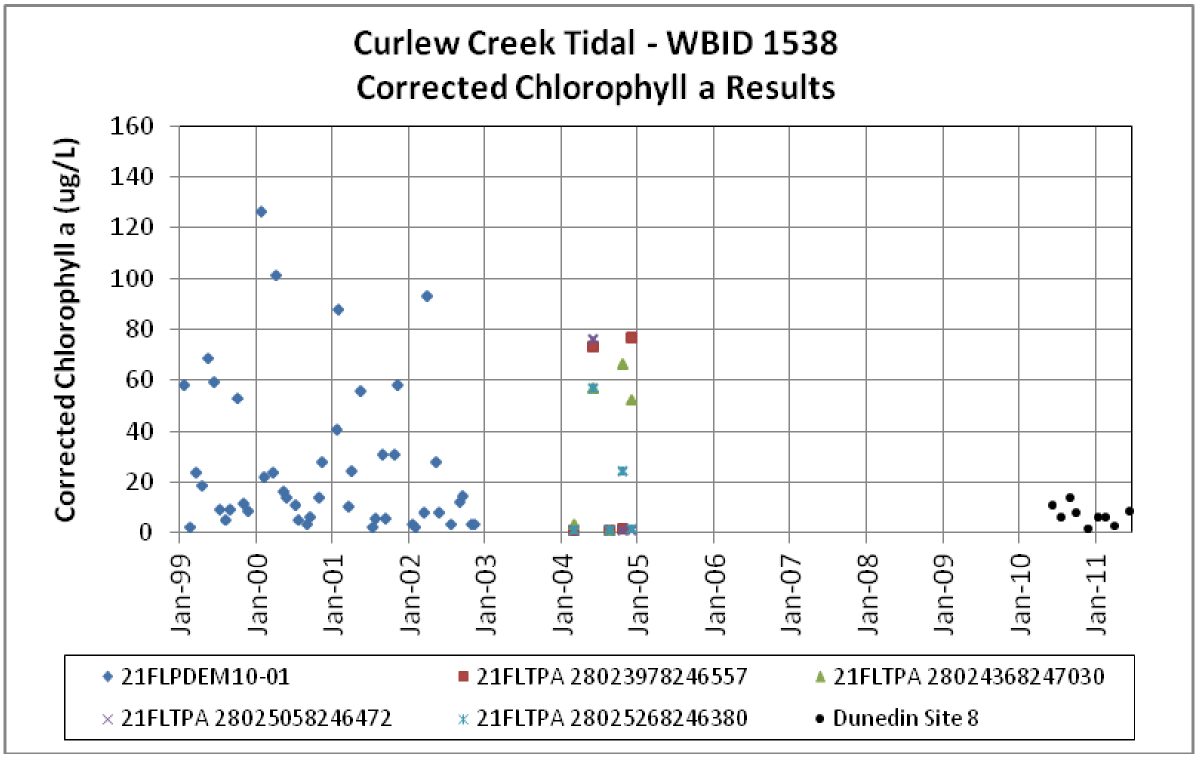

Figure 2.7. Chlorophyll a Measurements in Curlew Creek Tidal Segment, WBID 1538, During the Cycle 1 and Cycle 2 Verified Periods

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 7.9 (computed from 67 paired values), indicating that nitrogen is the limiting nutrient in Curlew Creek Tidal Segment.

Since nitrogen is the limiting nutrient, decreased levels of TN would be expected to result in decreases in algal growth, as measured by chlorophyll *a* concentrations. Reductions in TN are also expected to result in additional benefits, including increases in DO and decreases in 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, lower 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 Curlew 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 these TMDLs 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 (Rule 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 the waterbody.

In translating the narrative nutrient criterion for this TMDL analysis, the Department selected estuarine segments not considered impaired for nutrients to identify a target chlorophyll *a* concentration for establishing the TMDL. **Table 3.1** summarizes results for the estuarine segments where the 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 Curlew Creek that are located in the Anclote River/Coastal Pinellas County Planning Unit. Given the uncertainty of nutrient reactions within estuaries, the Department applied a chlorophyll *a* target of 8.0 µg/L for establishing the TMDL, a level that falls within the range of long-term average chlorophyll *a* concentrations in the estuarine waters not listed as impaired for nutrients. Using this target value for establishing the TMDL is expected to result in annual average chlorophyll *a* values below the estuarine impairment threshold 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 Used To Establish the Chlorophyll a Target

Note: Annual average chlorophyll *a* values during the 1999 to 2010 period as contained in IWR Database Run 44x.

Year	Clearwater Harbor (WBID 1528)	The Narrows (WBID 1528A)	Clearwater Harbor North (WBID 1528C)	Boca Ciega Bay Central (WBID 1694A)	Boca Ciega Bay North (WBID 1694B)	St. Joseph Sound (WBID 8045D)	Direct Runoff to Gulf (Minnow Creek) (WBID 1535)	Anclote River Tidal Segment (WBID 1440)
1999	8	8	7	6	7	6	5	5
2000	7	7	6	7	6	7	4	5
2001	7	7	5	7	6	5	5	5
2002	8	7	6	6	6			5
2003	9	8	5	7	7	3		4
2004	5	9	6	6	8	3		4
2005	7	7	5	8	8	3		4
2006	4	7	3	5	5	2		6
2007	4	7	3	6	5	2		5
2008	5	6	3	7	6	2		6
2009	6	10	4	8	6	3		4
2010	5	7	3	6	7	4	8	8
Long-Term Average	**6**	**8**	**5**	**7**	**6**	**4**	**6**	**5**

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

There is one permitted WWTF in the watershed with a surface water discharge. The Mid-County WWTF, NPDES Permit Number FL0034789, is a domestic wastewater treatment plant with a design flow of 0.9 million gallons per day (MGD). The facility provides advanced wastewater treatment

(AWT) and high-level disinfection. The treated effluent from the facility is discharged into the freshwater segment of Curlew Creek (WBID 1538A) via Outfall D-001, which is located between U.S. Highway 19 and Belcher Road, approximately 2.5 miles upstream of where the tidal segment begins. The point of discharge in Curlew Creek is located at Latitude 28° 02’ 18”N and Longitude 82° 44’ 32”W. **Figure 4.1** displays the location of the facility and surface water outfall in the watershed.

4.2.2 MS4 Permittees

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 Rule 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 Curlew 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 Dunedin and Clearwater, which encompass land areas within the Curlew Creek watershed, are co-permittees in the MS4 permit.

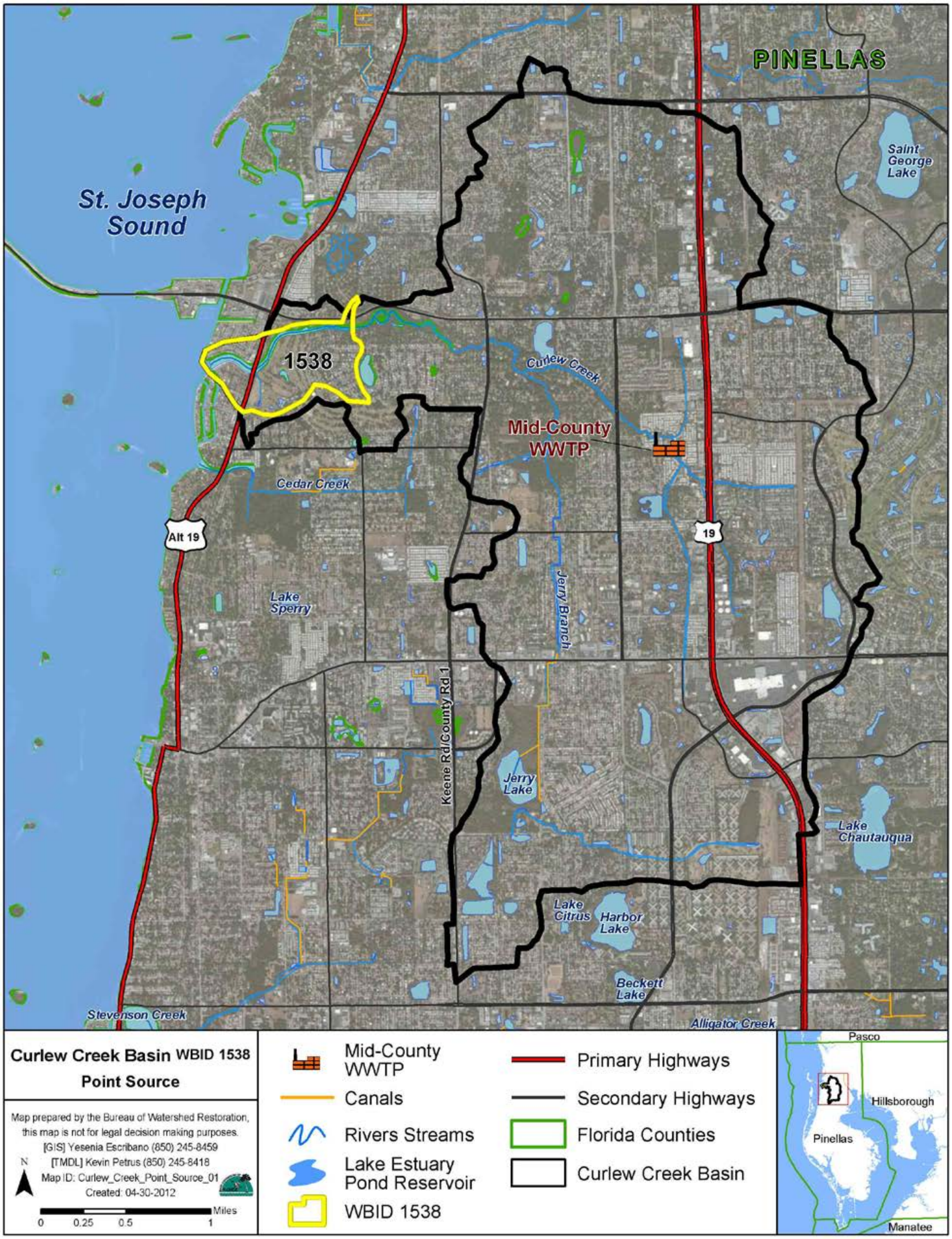

Figure 4.1. Wastewater Facility with Surface Water Discharge in the Curlew Creek Watershed

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 Curlew Creek watershed is primarily urban, agricultural fertilizer 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 2009 land use coverage contained in the Department's Geographic Information System (GIS) library. Land use categories in the Curlew Creek watershed were aggregated using the Florida Land Use Code and Classification System (FLUCCS) expanded Level 1 codes (including low-, medium-, and high-density residential) and tabulated in **Table 4.1**. **Figure 4.2** shows the spatial distribution of the principal land uses in the Curlew Creek watershed. Land use is predominately urban and residential, with approximately 67% of the land area residential. The next largest land use consists of areas classified as communication and transportation, which cover 6% of the watershed. Surface waters and wetlands combined represent over 6% of the area. Within Curlew Creek Tidal Segment (WBID 1538), land use consists of medium- and high-density residential areas and urban open area. The urban open area along the tidal segment contains two golf courses: the Stirling Links Par 3 golf course and a portion of the Dunedin Golf Club.

Table 4.1. Classification of Land Use Categories in the Curlew Creek Watershed in 2009

- = Empty cell/no data

Level 1 Code	Land Use	Acreage	% of Total
1000	Urban Open	1,266	18.7%
1100	Low-Density Residential	207	3.1%
1200	Medium-Density Residential	920	13.6%
1300	High-Density Residential	3,368	49.8%
2000	Agriculture	20	0.3%
3000+4000	Rangeland + Forest/Rural Open	134	2.0%
5000	Water	213	3.1%
6000	Wetlands	235	3.5%
7000	Barren Land	0	0.0%
8000	Communication and Transportation	406	6.0%
Total	**-**	**6,769**	**100.0%**

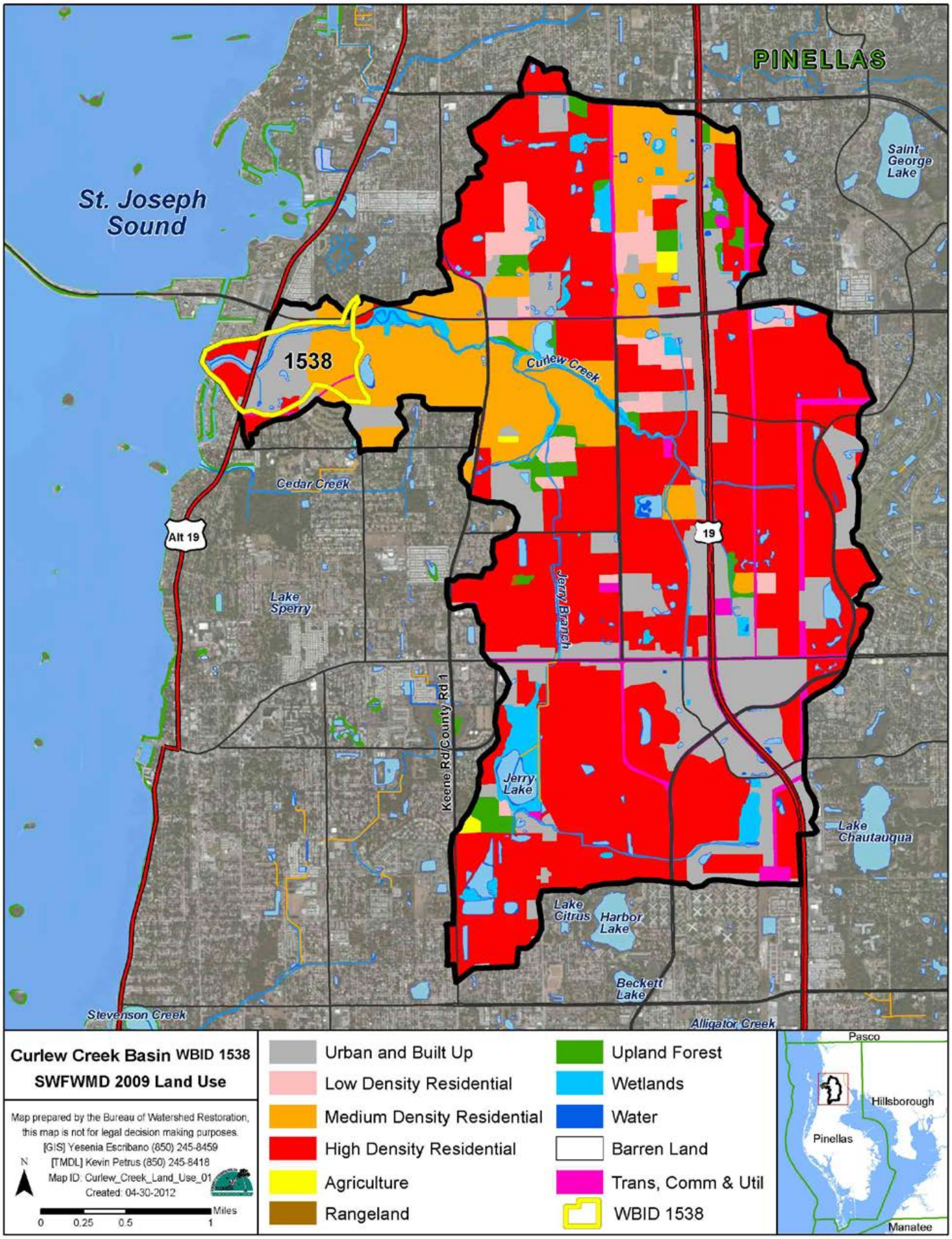

Figure 4.2. Principal Land Uses in the Curlew Creek Watershed in 2009

4.3.2 Septic Tanks

Septic tanks are another potentially important source of pollution, including nitrogen. Information on the location of septic systems was obtained from the Florida Department of Health (FDOH) Onsite Sewage Treatment Disposal Systems GIS coverage (available: http://www.floridahealth.gov/healthy-environments/onsite-sewage/ostds-statistics.html).

Figure 4.3 shows the locations of septic tanks in the Curlew Creek watershed. Currently the number of septic tanks in the drainage basin is estimated to be 278. However, there are no septic tanks located within Curlew Creek Tidal Segment. Generally, septic tanks are not located directly adjacent to the main channel of Curlew Creek and Jerry Branch.

4.4 Nonpoint and Point Source Loading Estimates

Loadings for water volume, TN, and TP were calculated based on measured data to provide an estimate of the magnitude of loads produced by nonpoint and point sources in the gaged area of the Curlew Creek watershed. Monthly loadings were calculated for the gaged area using stream flow measurements and water quality results collected at the United States Geological Survey (USGS) gaging station at County Road 1 (USGS Number 02309425) (**Figure 2.1**). Stream flow and water quality measurements have been collected routinely in the freshwater segment at County Road 1 since the summer of 1999. The site is approximately one mile upstream of where the tidal reach begins, and the Jerry Branch tributary and the Mid-County WWTF discharge point are located upstream of County Road 1. The loads at this location represent the majority of the loads generated in the watershed.

Loadings at the USGS gage were calculated as follows. Monthly hydrologic loads were calculated by averaging the daily average flows, which were downloaded from the USGS streamflow website, for each month to determine the monthly average daily flows in cubic feet per second (cfs). The monthly average daily flows were then converted to total monthly flow volume in cubic meters per month.

Monthly nutrient loadings were calculated using all available TN and TP results collected at County Road 1. The results used were from sampling conducted by the USGS (Site 112WRD 02309425), Pinellas County (Site 21FLPDEM10-02), and the Department's Southwest District Office (Site 21FLTPA 28024988245339) that are available in the IWR Run 44 database, and sampling conducted by the city of Dunedin (Site 6) that were provided in a spreadsheet format by the city.

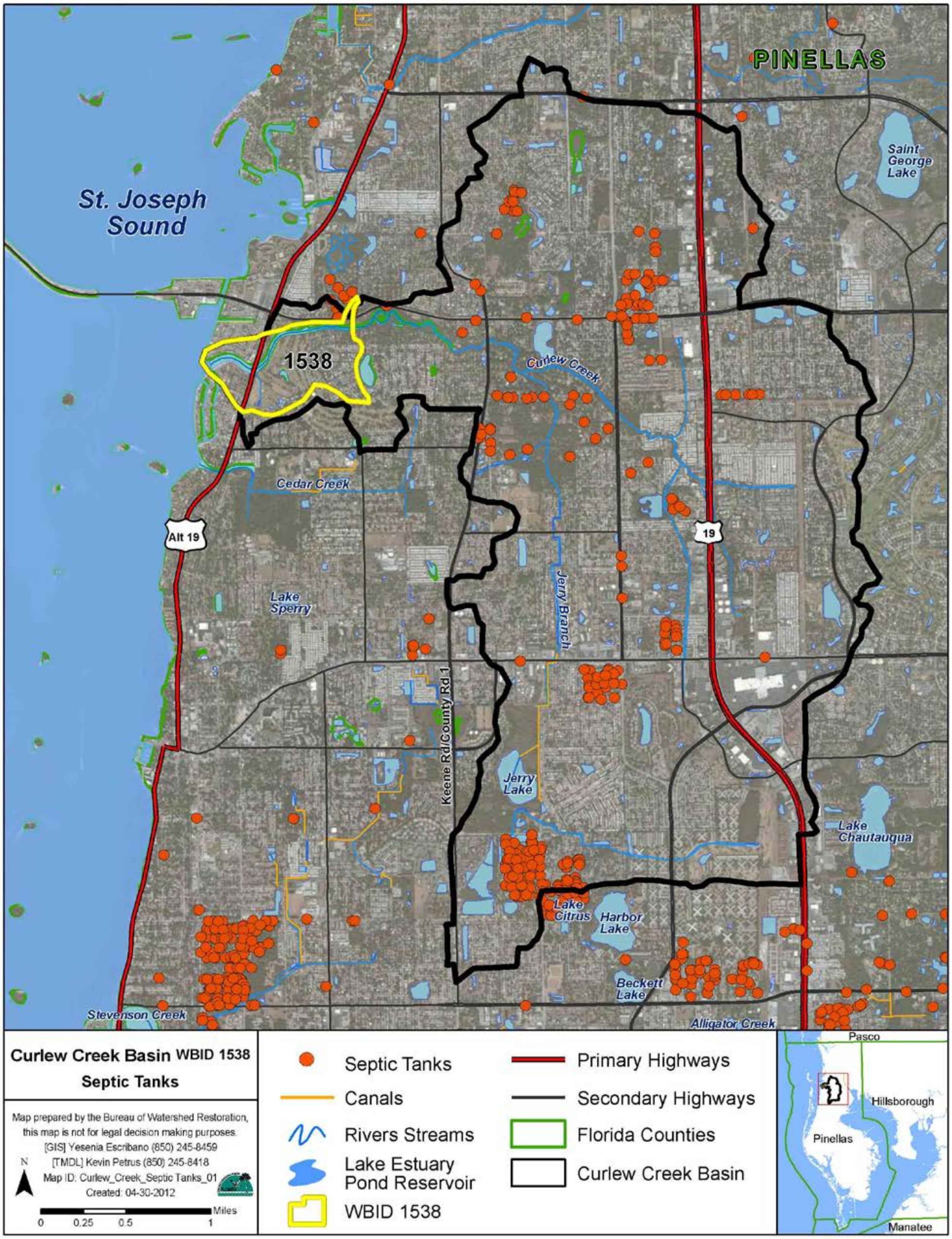

Figure 4.3. Septic Tank Locations in the Curlew Creek Watershed

In months when one result was reported, that value represented the monthly concentration value. In months when more than one result was reported, the values were averaged to obtain a monthly value. In months when no results were reported, the average of the previous month and the succeeding month values were used as the monthly concentration value. The monthly concentration values along with the monthly flow volumes were used to calculate a monthly loading estimate for TN and TP.

The point source loads were calculated using surface water discharge results for the Mid-County WWTF reported in the state Permit Compliance System (PCS) database. Monthly point source loads were calculated, in the same manner as the gage loading estimates, using the monthly average discharge flow volumes and nutrient results from the PCS database. The nonpoint source loads were estimated by subtracting the Mid-County WWTF loads from the monthly loads calculated at the USGS gage.

The USGS gage began operating in August 1999, and so annual loads were calculated for 2000 to 2011 by summing the monthly loads for each calendar year in that period. **Figures 4.4, 4.5,** and **4.6** present the annual hydrologic loads, TN loads, and TP loads, respectively. The majority of the flow volume and nutrient loadings were generated by nonpoint sources in the watershed. The percent contribution of the Mid-County WWTF to total annual hydrologic loads varied from 5% to 10% over the last 12 years. On an annual basis the wastewater facility contributed 6 to 16% of the TN load and 9% to 22% of the TP load over the last 12 years. Considering the total watershed area, the percentages of point source loads entering the tidal segment are actually less than the amounts calculated, since the analysis did not include nonpoint source loadings downstream of County Road 1.

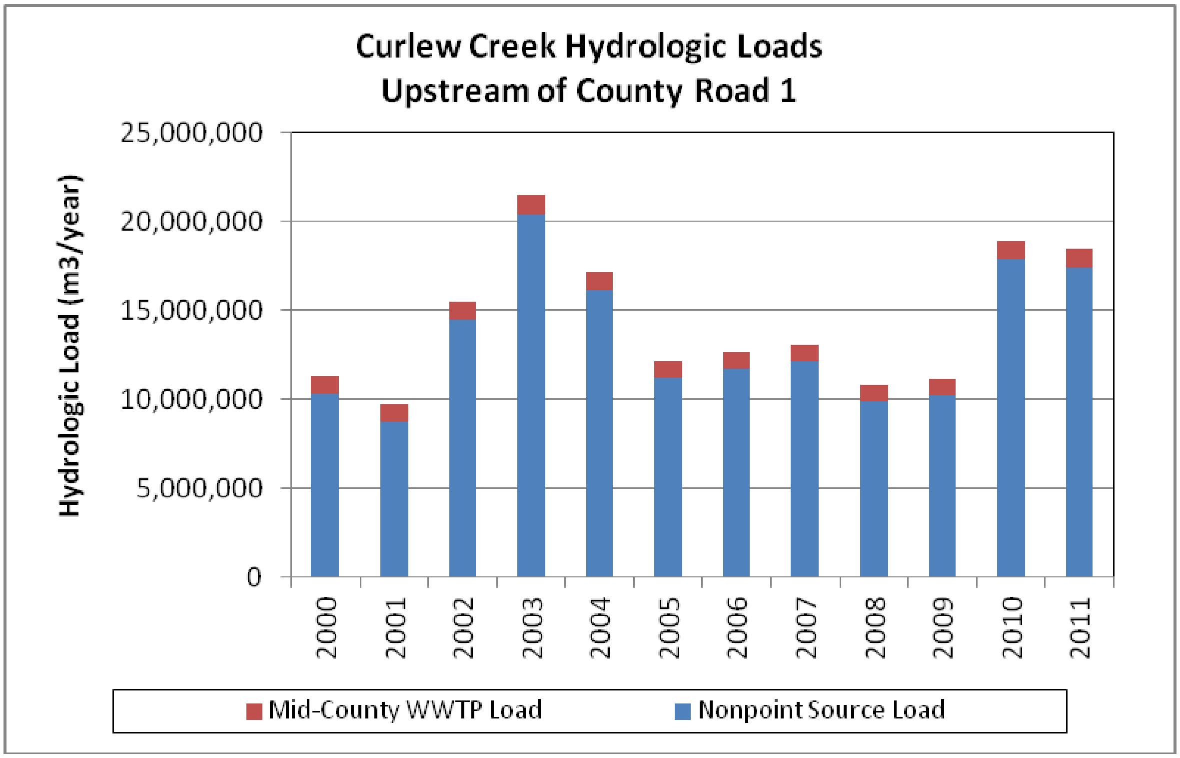

Figure 4.4. Annual Hydrologic Loads in the Curlew Creek Watershed Upstream of County Road 1

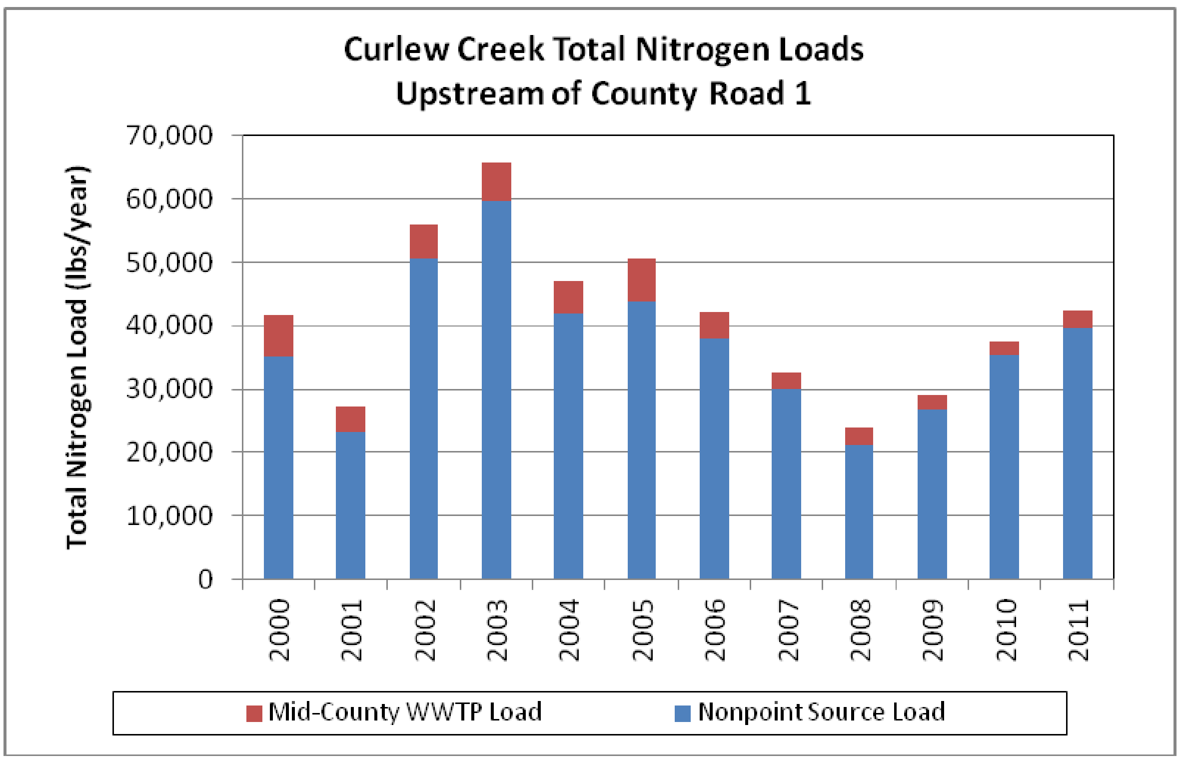

Figure 4.5. Annual TN Loads in the Curlew Creek Watershed Upstream of County Road 1

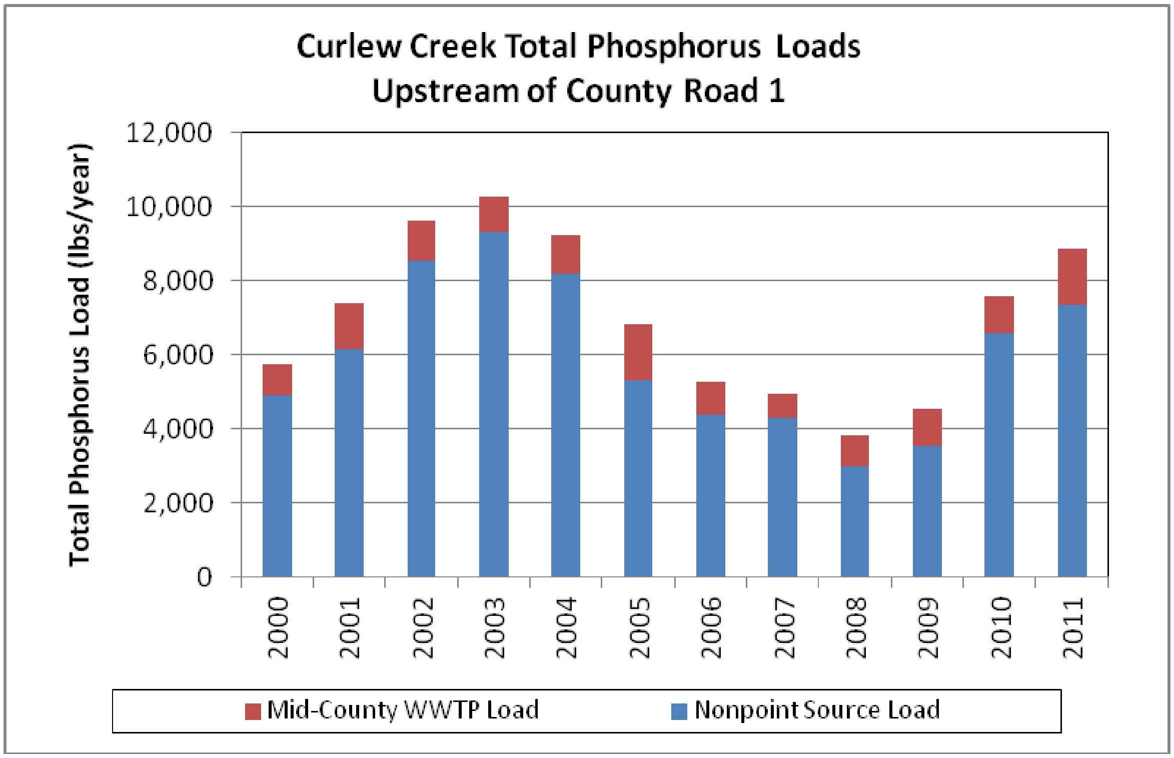

Figure 4.6. Annual TP Loads in the Curlew Creek Watershed Upstream of County Road 1

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The TMDL development process identifies a pollutant target concentration and pollutant reduction for Curlew Creek Tidal Segment to achieve the applicable DO and nutrient water quality criteria, and maintain its function and designated use as a Class III marine water. The methods utilized to address the DO and nutrient impairment included the evaluation of data in reference estuarine waters to establish a water quality target for chlorophyll *a* (a measure of algal biomass) and the application of the empirical relationship between TN and chlorophyll *a* concentrations in the tidal segment to develop the TMDL for nutrients. For addressing nonpoint sources, both NPDES stormwater discharges and non-NPDES stormwater discharges, the TMDL is expressed as a percent reduction in the existing tidal segment TN concentrations to meet the chlorophyll *a* target. The Mid-County WWTP allocation is expressed as a load, which was developed taking into consideration the level of treatment provided by the facility and the existing nutrient loading relative to the nonpoint source loads. **Section 6.3.1** describes the development of the point source wasteload allocation (WLA).

As described in **Chapter 2**, there has been a documented improvement in DO concentrations to the extent that the waterbody segment was not impaired for DO during the latest assessment cycle following the IWR methodology. Therefore, the primary focus in the implementation of this TMDL is to maintain ambient annual average chlorophyll *a* values at or below the target concentration. Lower chlorophyll *a* concentrations in the water column are expected to result in additional improvements in DO concentrations as a result of reduced organic matter accumulating in Curlew Creek Tidal Segment, in the form of dead algal biomass. Lower algal biomass should lower BOD levels in the creek, and sediment oxygen demand (SOD) in the area should also decrease over time as the reduced algal biomass results in less accumulated organic matter in the creek's sediments.

5.2 Analysis of Water Quality

Three different agencies have carried out water quality monitoring in Curlew Creek Tidal Segment over different periods. Pinellas County monitored the segment from 1991 to 2002 at the Alternate U.S. Highway 19 location. The Department's Southwest District Office sampled the creek in 2004 at Alternate U.S. Highway 19 and three other locations. Most recently, the city of Dunedin collected samples at Alternate U.S. Highway 19 starting in June 2010 and has continued to monitor conditions to the present. The Pinellas County and Department data are available in STORET and the IWR database, and the water quality results were used to perform surface water assessments for the segment. The city of Dunedin data are collected to assist in compliance with the city's MS4 permit but have not been uploaded to STORET or the IWR database.

The graphs in **Appendix B** display the individual water quality results for variables relevant to this TMDL analysis for the period of record collected by all three sampling agencies. The results suggest improvements in water quality over time, *i.e.*, higher DO concentrations and lower chlorophyll *a* concentrations in the most recent years. As described in **Chapter 2**, using all the available results for the Cycle 2 verified period (January 2004–June 2011) the IWR assessment indicates the tidal segment was not impaired for DO in the most recent years. Additionally, there are fewer elevated chlorophyll *a* results in the most recent data collected by the city of Dunedin compared with previous results observed in the Pinellas County and Department data sets.

The majority of data from the tidal segment were collected at the Alternate U.S. Highway 19 location. The other three locations where data were collected were only monitored in 2004 by the Department. The results collected at the Alternate U.S. Highway 19 location (including Sites 21FLPDEM10-01 and 21FLTPA 28023978246557, and Dunedin Site 8) were evaluated to determine if relationships existed between nutrient levels and the parameters of concern.

The IWR database contains water quality results at Site 21FLPDEM10-01 in 1991 for DO beginning in January and for chlorophyll *a* beginning in June. There are only results in the IWR database for TN and TP beginning in February 1992, and so the analysis conducted for TMDL development started in 1992. **Figures 5.1** and **5.2** display time series of annual average TN and TP concentrations, respectively, along with annual average chlorophyll *a* concentrations. The annual average concentrations were calculated using paired results for chlorophyll *a* and nutrient concentrations. The average chlorophyll *a* concentrations exhibit a pattern similar to average TN concentrations that is not evident in the comparison with average TP concentrations.

The water quality results indicate that lower chlorophyll *a* concentrations are associated with lower TN concentrations in the tidal segment. This relationship is evident when comparing the individual results (**Figure 5.3**) and the annual average concentrations (**Figure 5.4**). Since annual average chlorophyll *a* concentrations are used to identify nutrient impairment, the empirical relationship between annual average TN and chlorophyll *a* concentrations in the tidal segment was applied in the development of the TMDL. This regression analysis indicates that during the 1992 to 2011 period, 58% of the variation in annual average chlorophyll *a* is explained by annual average TN concentrations (p value < 0.05).

Other explanatory variables were analyzed in addition to TN (*e.g.*, TP concentrations and gaged freshwater inflow and nutrient loads), but no significant relationships were found between these variables and chlorophyll *a*. The analysis included a comparison of both individual results and annual average values. **Appendix C** provides the results of the regression analyses comparing individual results and annual average chlorophyll *a* concentrations with the explanatory variables.

To establish the existing TN concentration value for the tidal segment, more recent data were evaluated, as these results were considered more representative of existing conditions. Between the beginning and end of the Cycle 2 verified period, there were large differences in the annual average TN and chlorophyll *a* concentrations. The average concentrations in 2011 were considerably lower than in 2004. As the 2011 results were considered more representative of existing conditions, the annual average TN concentration of 1.12 mg/L was selected as the existing condition. The 2011 annual average chlorophyll *a* concentration (7.2 µg/L) was lower than the selected chlorophyll *a* target based on existing conditions. However, the target was only met in one year, and because there are inherent uncertainties in the relationships between nutrient levels and algal biomass, the target TN concentration was based on the empirical equation using results for the period of record. The use of the regression equation in deriving the TN target provided an additional margin of safety in TMDL development. Applying the chlorophyll a target of 8.0 µg/L in the regression equation in **Figure 5.4** resulted in a TN target concentration of 0.95 mg/L.

In consideration of the pending promulgation of numeric nutrient criteria that will address both nitrogen and phosphorus, the existing phosphorus concentration condition in the tidal segment can serve as the site-specific interpretation of the criterion. As the water quality results suggest that nitrogen is the limiting nutrient and no significant relationship has been found between phosphorus and chlorophyll *a* concentrations, the existing phosphorus concentrations are not expected to have a detrimental effect on surface water quality.

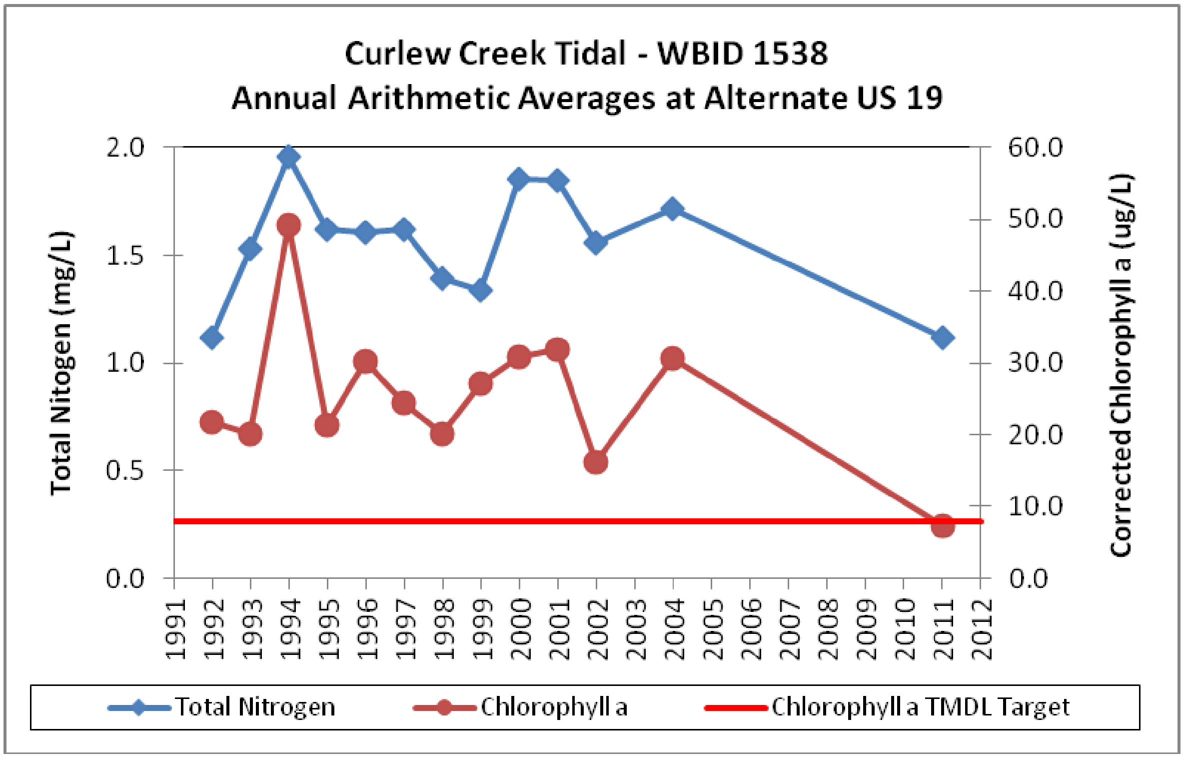

Figure 5.1. Annual Average Chlorophyll a and TN Concentrations in Curlew Creek Tidal Segment, WBID 1538

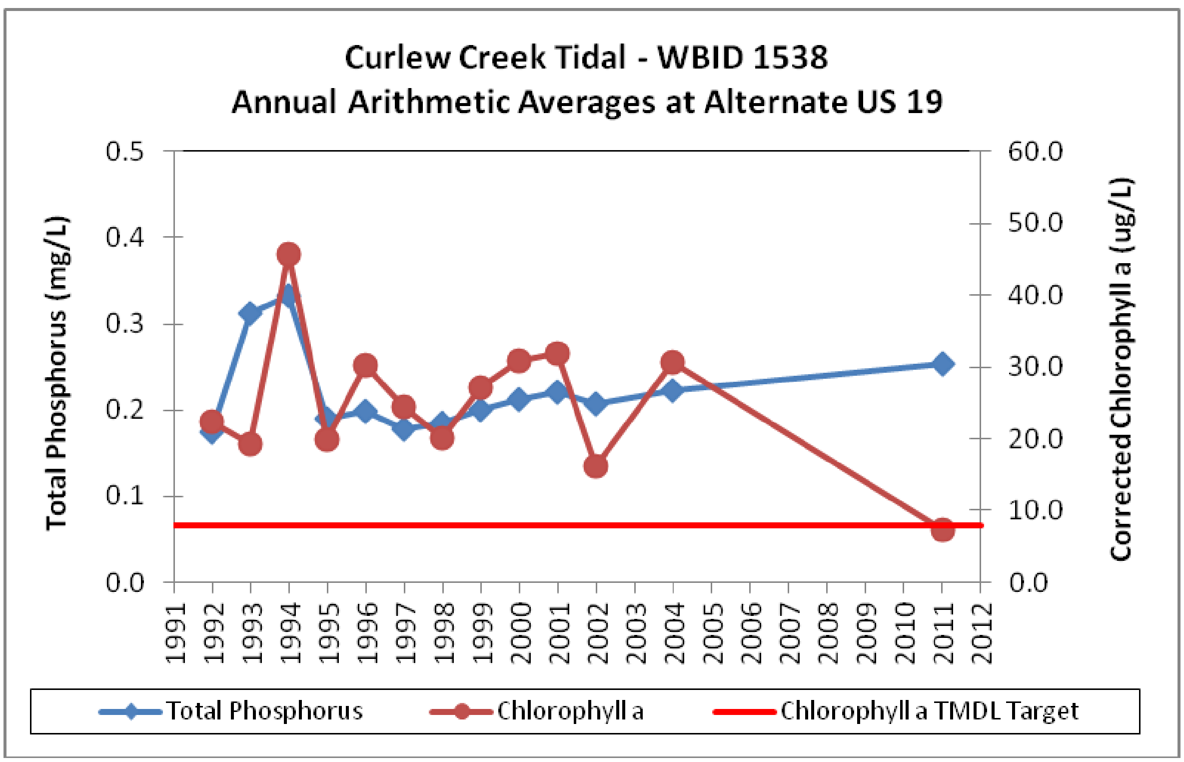

Figure 5.2. Annual Average Chlorophyll a and TP Concentrations in Curlew Creek Tidal Segment, WBID 1538

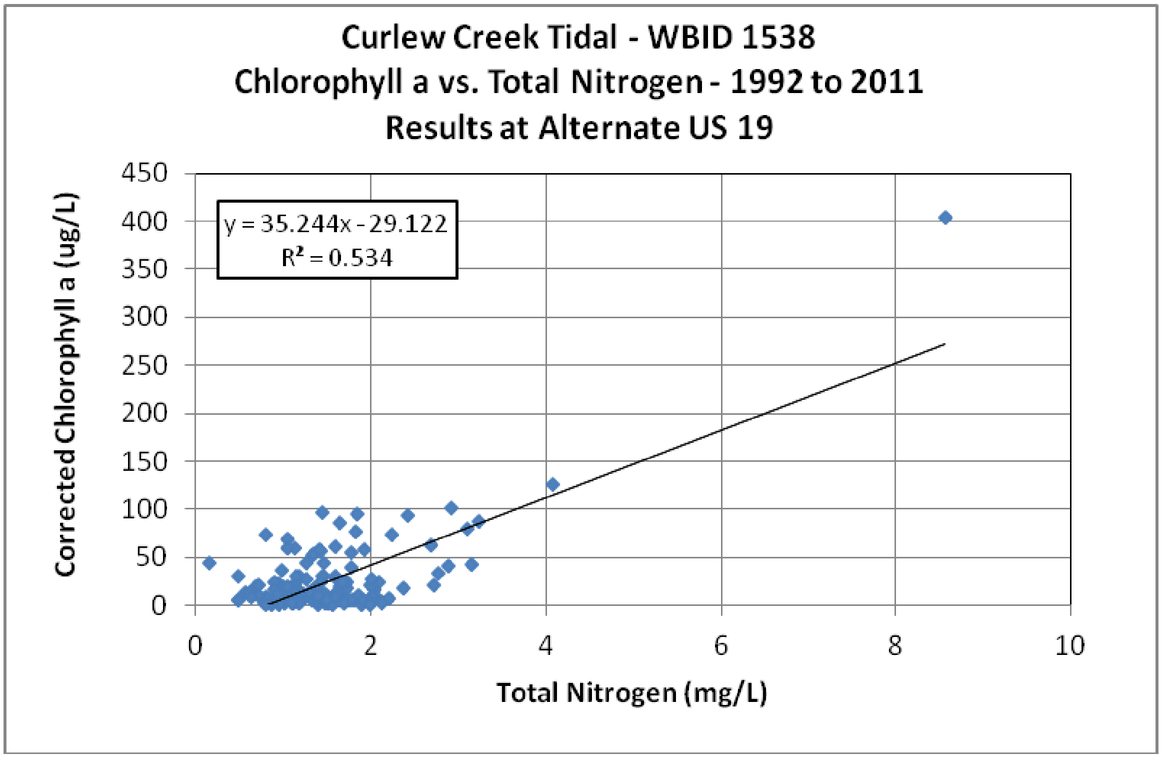

Figure 5.3. Relationship Between Chlorophyll a and TN Individual Results in Curlew Creek Tidal Segment, WBID 1538

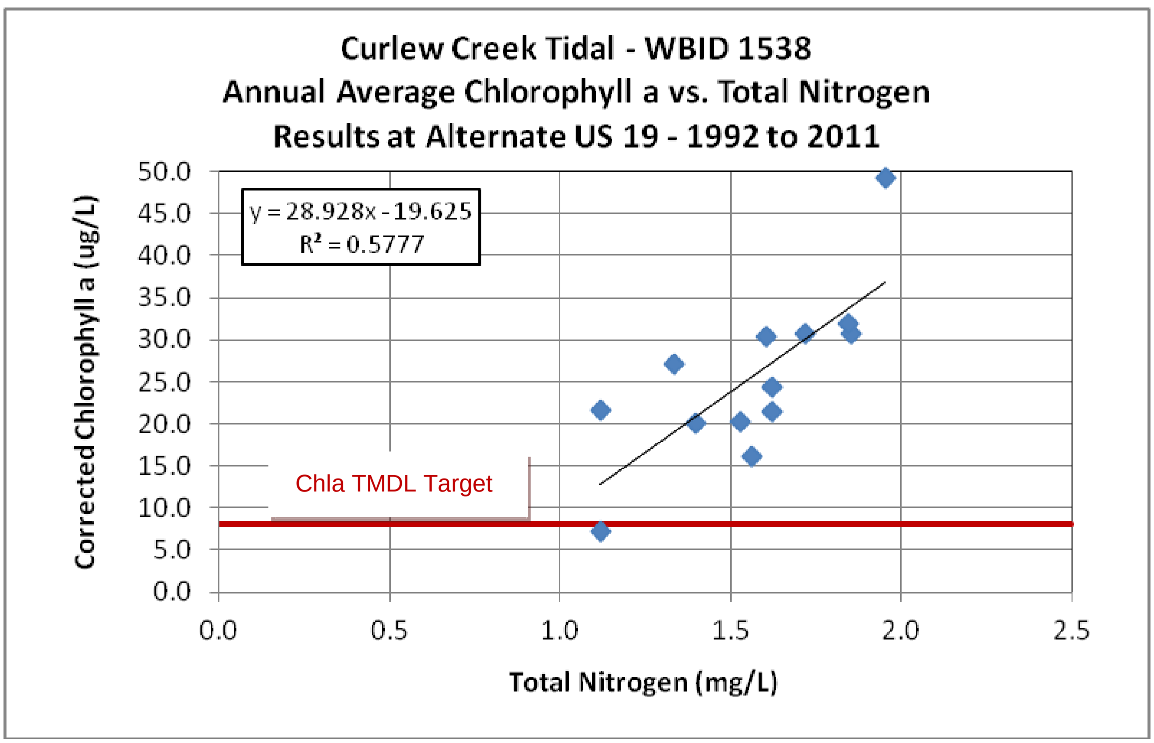

Figure 5.4. Relationship Between Chlorophyll a and TN Annual Average Results in Curlew Creek Tidal Segment, WBID 1538

5.3 Relationship Between Nutrients and DO

Reductions in TN concentrations are also expected to result in additional benefits for other parameters of concern, including DO and BOD. As described in **Chapter 2**, reduced algal biomass, as measured by chlorophyll *a*, should result in lower BOD levels. During daylight hours, algal photosynthesis consumes nutrients and produces organic matter, with oxygen produced as a byproduct of this reaction. The reverse process, respiration, may occur simultaneously and dominate at night when algae consume oxygen and their organic matter energy reserve to produce carbon dioxide and water. Because photosynthesis creates oxygen and respiration depletes oxygen, algae affect the estuary's oxygen sources. Swings in oxygen can be induced by diurnal light patterns where oxygen levels rise during daylight and become depleted at night.

Lowering algal biomass should lower BOD levels in the creek (as evident by the relationship of individual BOD to chlorophyll *a* concentrations shown in **Appendix C**), and SOD in the area should also decrease over time as algal biomass reduction leads to lower accumulations of organic matter in the sediments. Sediment processes play an important role in regulating water quality and are particularly important in a shallow estuary. A portion of the organic matter produced in the water column settles to the sediment surface. Sediment processes influence DO in the water column by serving as a long-term repository of oxygen demand. A reduction of both algal BOD and SOD will have a positive impact on DO concentrations in the water column.

5.4 TMDL Development Process

The method used for developing the TMDL is a percent reduction approach. The percent reduction in the existing TN concentration in the tidal segment was calculated to meet the selected water quality target to set the TMDL.

As discussed in **Chapter 3**, a chlorophyll *a* target of 8.0 µg/L was derived based on the conditions of estuaries in the area of Curlew Creek that are not impaired for nutrients. The Curlew Creek estuary is expected to meet the applicable DO and nutrient criteria and maintain its function and designated use as a Class III water when surface water nitrogen concentrations are reduced to the extent that the chlorophyll *a* target is met, thus addressing human contributions to water quality degradation.

The equation used to calculate the percent reduction is as follows:

$$\frac{\textbf{[measured exceedance – target]}}{\textbf{measured exceedance}} \quad \textbf{X 100}$$

For the existing TN concentration of 1.12 mg/L to achieve the target concentration of 0.95 mg/L, a 15% reduction in the annual average TN concentration is necessary. As the target concentration was derived based on monitoring station annual average values, the TMDL is expressed on an annual average basis.

5.5 Critical Conditions

The TMDL was based on annual average conditions (*i.e.*, values from all four seasons in a calendar year) rather than critical/seasonal conditions because of the following:

1. The methodology used to determine assimilative capacity does not lend itself very well to short-term assessments.

2. The net change in overall primary productivity, which is better addressed on an annual basis, is generally a better indicator of an imbalance in flora or fauna.

3. The methodology used to determine impairment is based on an annual average and requires data from all four quarters of a calendar year.

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:

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

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 (*e.g.*, 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 regulations (40 CFR § 130.2[I]) (EPA 2003), which state that TMDLs can be expressed in terms of mass per time (*e.g.*, pounds per day), toxicity, or other appropriate measure. The TMDL for Curlew Creek Tidal Segment is expressed in terms of pounds per year (lbs/yr) for the point source facility and a percent reduction for nonpoint sources (**Table 6.1a**), and pounds/day (lbs/day) for the point source facility and a percent reduction for nonpoint sources (**Table 6.1b**), and represents the maximum TN load the surface water can assimilate to meet both the nutrient and DO criteria. The TMDL to be implemented is the one expressed on a per-year basis, and the expression of the TMDL on a per-day basis is for informational purposes only.

Table 6.1a. TMDL Components Expressed on an Annual Basis for Curlew Creek Tidal Segment, WBID 1538

[1] Represents the Mid-County WWTP average annual discharge loading (2000–11) calculated using monthly data.
[2] As the TMDL represents a percent reduction, it also complies with EPA requirements to express the TMDL on a daily basis.

Parameter	TMDL (mg/L)	WLA for Wastewater (lbs/yr)[1]	WLA for NPDES Stormwater (% reduction)[2]	LA (% reduction)[2]	MOS
TN	0.95	4,245	15%	15%	Implicit

Table 6.1b. TMDL Components Expressed on a Daily Basis for Curlew Creek Tidal Segment, WBID 1538

[1] Represents the Mid-County WWTP average annual discharge loading (2000–11) divided by 365 days.
[2] As the TMDL represents a percent reduction, it also complies with EPA requirements to express the TMDL on a daily basis.

Parameter	TMDL (mg/L)	WLA for Wastewater (lbs/day)[1]	WLA for NPDES Stormwater (% reduction)[2]	LA (% reduction)[2]	MOS
TN	0.95	12	15	15	Implicit

6.2 Load Allocation

A total nitrogen reduction of 15% is required from nonpoint sources. It should be noted that the load allocation includes loading from stormwater discharges that are not part of the NPDES Stormwater Program.

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

The one point source facility discharging to Curlew Creek, Mid-County WWTP, is not considered a significant load to the tidal segment, compared with existing total nonpoint source and point source loadings. The facility's current TN load to the creek is less than 10% of the total load entering the estuary over the last 12 years. Additionally, the facility's effluent nutrient concentrations are better than domestic AWT requirements, and over the last 12 years TN concentrations have declined. As the point source load is a small fraction of the total watershed load and the facility is performing better than AWT requirements, the TN load discharged to the creek during the 2000 to 2011 period was used to establish the WLA in the TMDL.

Appendix D displays the monthly average discharge results reported for flow, TN, and TP. The discharge flows and TN concentrations shown in the graphs were used to calculate the facility's WLA. Since the facility load is small relative to the total load entering the estuary, the reductions at this time are focused on MS4 facilities and nonpoint sources.

Any future discharge permits issued in the watershed will also be required to meet the state's Class III criteria for DO and nutrients and contain appropriate discharge limitations on nitrogen that will comply with the TMDLs as well as existing state requirements related to discharges to OFWs.

In consideration of the pending promulgation of numeric nutrient criteria that will address both nitrogen and phosphorus, the existing WWTP phosphorus loading along with the existing tidal segment ambient phosphorus concentrations can serve as the site-specific interpretation of the phosphorus criterion. The existing WWTP TP load, expressed as the long-term average annual TP load from the facility during the last 12 years, is 1,054 lbs/yr. As the water quality results suggest that nitrogen is the limiting nutrient and no relationship has been found between phosphorus and chlorophyll *a* concentrations, the existing phosphorus concentrations and loads are not expected to have a detrimental effect on surface water quality.

6.3.2 NPDES Stormwater Discharges

Pinellas County and co-permittees (FDOT District 7 and the cities of Dunedin and Clearwater, respectively) are covered by a Phase I NPDES MS4 permit (FLS000005), and areas within their jurisdiction in the Curlew Creek watershed may be responsible for a 15% reduction in current anthropogenic TN loading. 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.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Department 2001), an implicit MOS was used in the development of this TMDL by selecting a TN target that results in an annual average chlorophyll *a* value that is less than the estuarine impairment threshold value of 11 µg/L, based on the empirical relationship between annual average chlorophyll *a* and TN.

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 and technically feasible, and that 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 Waterbody 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.

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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.

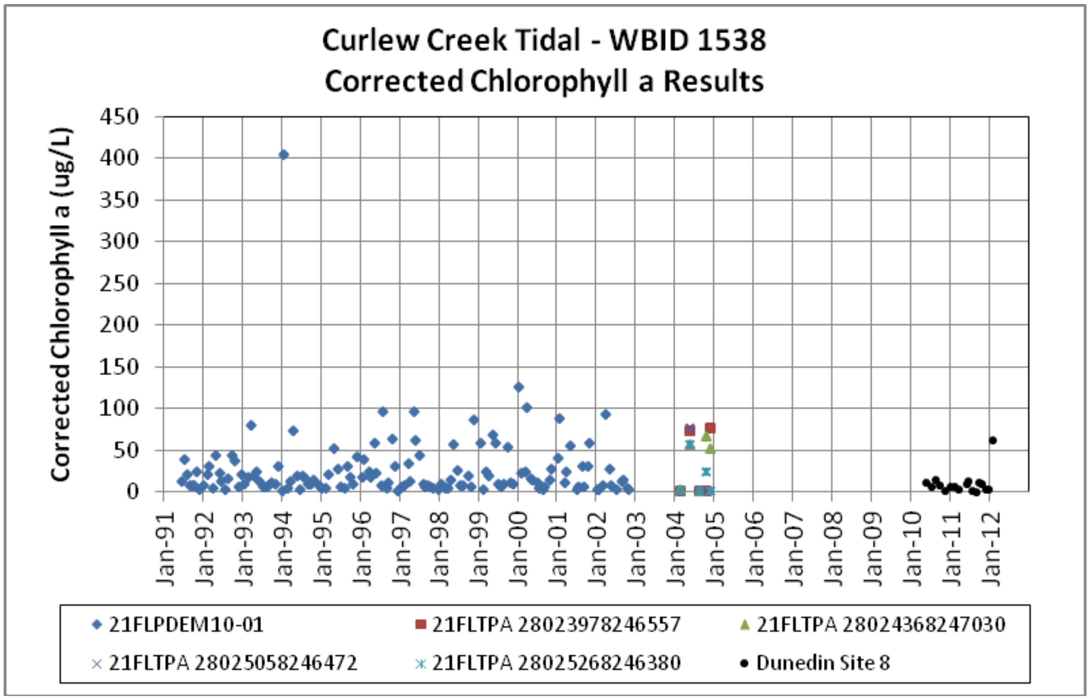
In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES stormwater permitting program to designate certain stormwater discharges as "point sources" of pollution. These stormwater discharges 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.

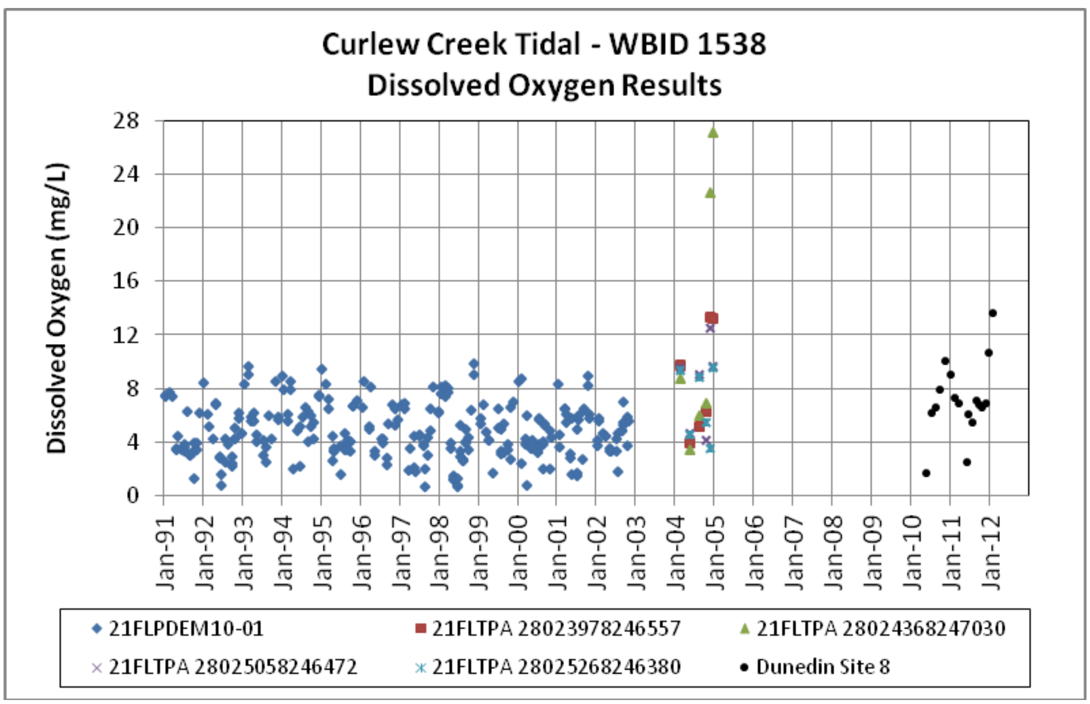
An important difference between the federal and state stormwater permitting programs is that the federal program covers both new and existing discharges, while the state program focuses on new discharges.

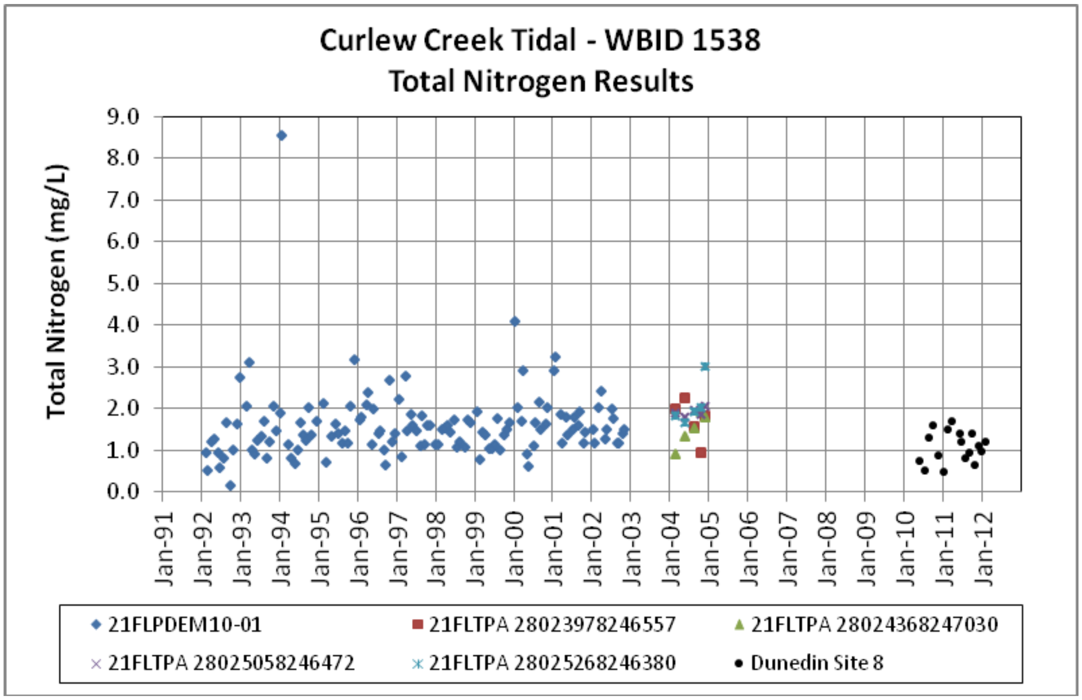
Additionally, Phase 2 of the NPDES Program, implemented in 2003, expands the need for these permits to construction sites between one and five acres, and to local governments with as few as 1,000 people. While these urban stormwater discharges are now technically referred to as "point sources" for the 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.

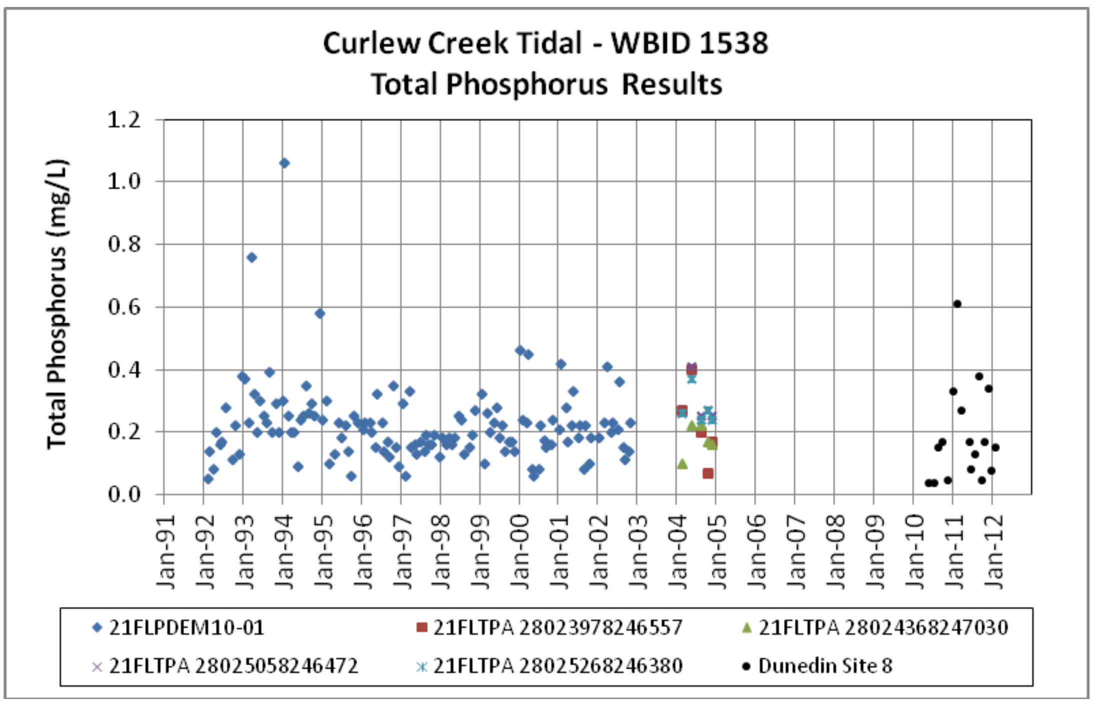
Appendix B: Graphs of Surface Water Quality Results

Source: IWR Run 44x database and the city of Dunedin





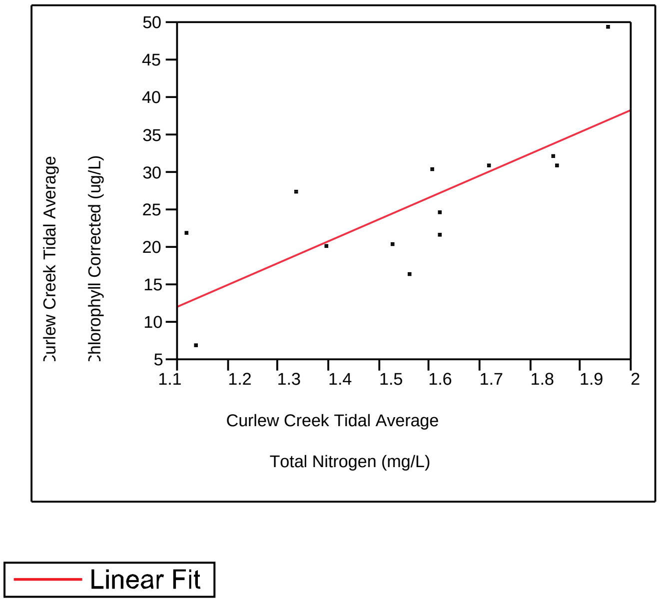

Curlew Creek Tidal - WBID 1538
Total Nitrogen Results
Total Nitrogen (mg/L)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
21FLPDEM10-01
21FLTPA 28023978246557
21FLTPA 28024368247030
21FLTPA 28025058246472
21FLTPA 28025268246380
Dunedin Site 8


Curlew Creek Tidal - WBID 1538
Total Phosphorus Results
Total Phosphorus (mg/L)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
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
Jan-10
Jan-11
Jan-12
21FLPDEM10-01
21FLTPA 28023978246557
21FLTPA 28024368247030
21FLTPA 28025058246472
21FLTPA 28025268246380
Dunedin Site 8

Appendix C: Linear Regression Analysis Results

- = Empty cell/no data

Bivariate Fit of Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) by Curlew Creek Tidal Average TN (mg/L)



Linear Fit

Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) = -20.40269 + 29.371855*Curlew Creek Tidal Average Total Nitrogen (mg/L)

Summary of Fit

Term	Result
RSquare	0.573724
RSquare Adj	0.534971
Root Mean Square Error	6.862557
Mean of Response	25.45216
Observations (or Sum Wgts)	13

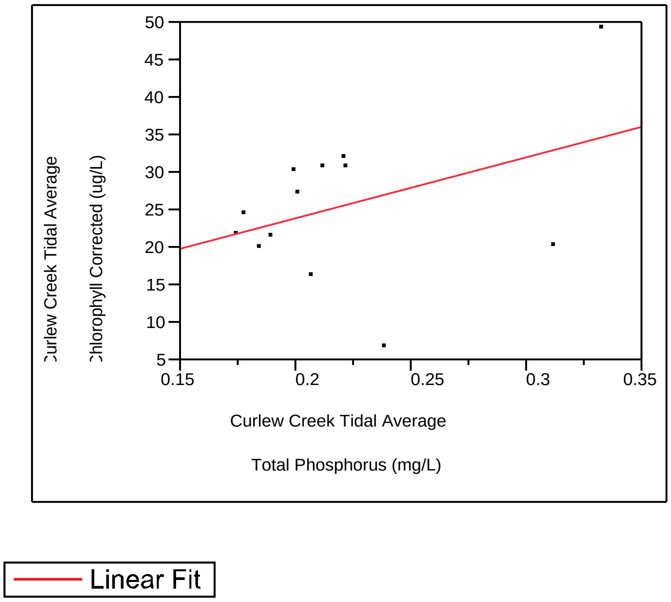
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	697.2306	697.231	14.8049
Error	11	518.0416	47.095	**Prob > F**
C. Total	12	1215.2722	-	0.0027*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-20.40269	12.06848	-1.69	0.1190
Curlew Creek Tidal Average Total Nitrogen (mg/L)	29.371855	7.633595	3.85	0.0027*

Bivariate Fit of Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) by Curlew Creek Tidal Average Total Phosphorus (mg/L)



Linear Fit

Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) = 7.4128679 + 81.736322*Curlew Creek Tidal Average Total Phosphorus (mg/L)

Summary of Fit

Term	Result
RSquare	0.156818
RSquare Adj	0.080165
Root Mean Square Error	9.651643
Mean of Response	25.45216
Observations (or Sum Wgts)	13

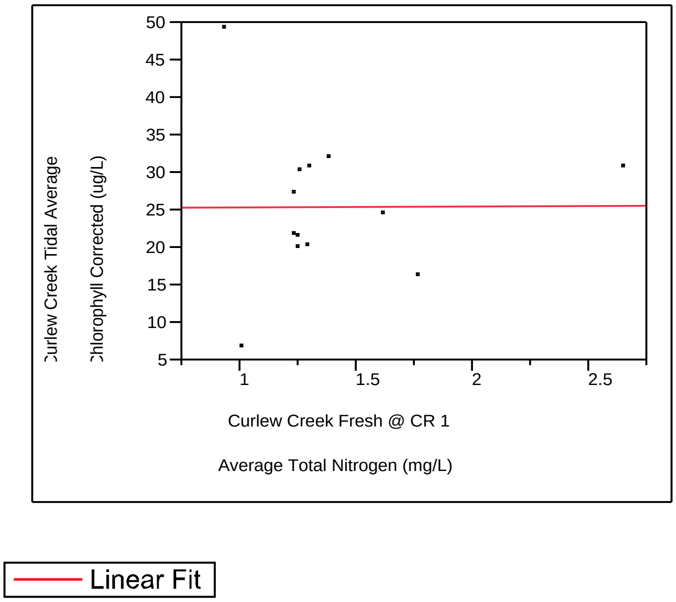
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	190.5760	190.576	2.0458
Error	11	1024.6962	93.154	**Prob > F**
C. Total	12	1215.2722	-	0.1804

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	7.4128679	12.89303	0.57	0.5769
Curlew Creek Tidal Average Total Phosphorus (mg/L)	81.736322	57.14553	1.43	0.1804

Bivariate Fit of Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) by Curlew Creek Fresh @ CR 1 Average Total Nitrogen (mg/L)



Linear Fit

Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) = 25.285053 + 0.1195057*Curlew Creek Fresh @ CR 1 Average Total Nitrogen (mg/L)

Summary of Fit

Term	Result
RSquare	2.663e-5
RSquare Adj	-0.09088
Root Mean Square Error	10.51077
Mean of Response	25.45216
Observations (or Sum Wgts)	13

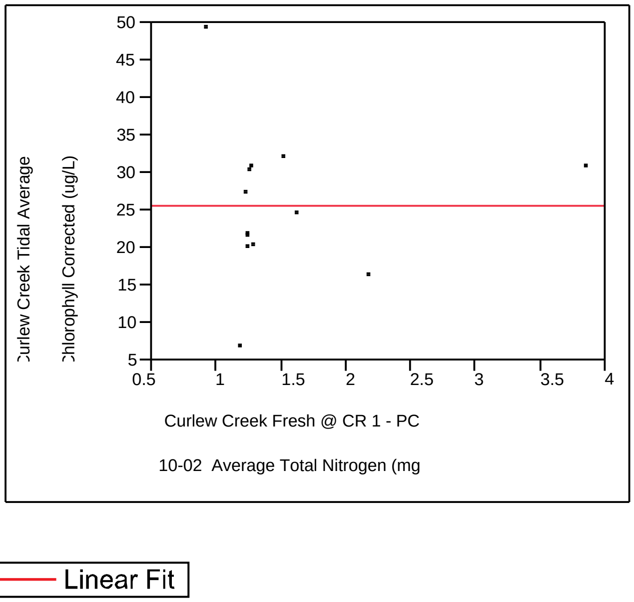
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0324	0.032	0.0003
Error	11	1215.2399	110.476	**Prob > F**
C. Total	12	1215.2722	-	0.9867

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	25.285053	10.19044	2.48	0.0305*
Curlew Creek Fresh @ CR 1 Average Total Nitrogen (mg/L)	0.1195057	6.982923	0.02	0.9867

Bivariate Fit of Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) by Curlew Creek Fresh @ CR 1 - PC 10-02 Average Total Nitrogen (mg/L)



Linear Fit

Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) = 25.367155 + 0.0550806*Curlew Creek Fresh @ CR 1 - PC 10-02 Average Total Nitrogen (mg/L)

Summary of Fit

Term	Result
RSquare	0.000017
RSquare Adj	-0.09089
Root Mean Square Error	10.51082
Mean of Response	25.45216
Observations (or Sum Wgts)	13

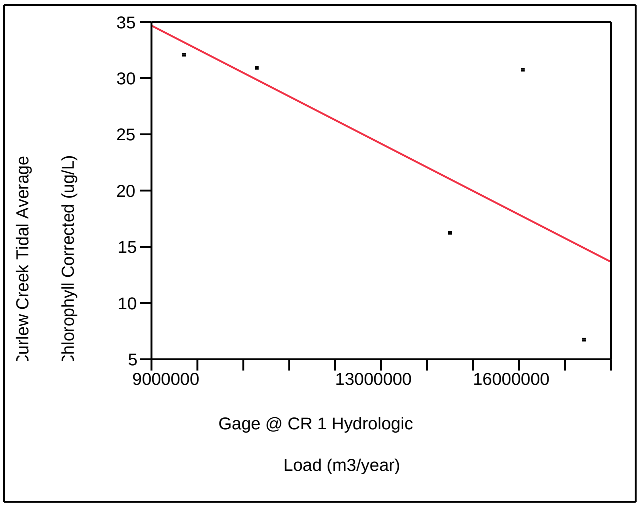
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0207	0.021	0.0002
Error	11	1215.2516	110.477	**Prob > F**
C. Total	12	1215.2722	-	0.9893

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	25.367155	6.865883	3.69	0.0035*
Curlew Creek Fresh @ CR 1 - PC 10-02 Average Total Nitrogen (mg/L)	0.0550806	4.027791	0.01	0.9893

Bivariate Fit of Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) by Gage @ CR 1 Hydrologic Load (m^3/yr)



Linear Fit

Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) = 53.594165 - 2.1045e-6*Gage @ CR 1 Hydrologic Load (m^3/year)

Summary of Fit

Term	Result
RSquare	0.487069
RSquare Adj	0.316092
Root Mean Square Error	9.347828
Mean of Response	23.25765
Observations (or Sum Wgts)	5

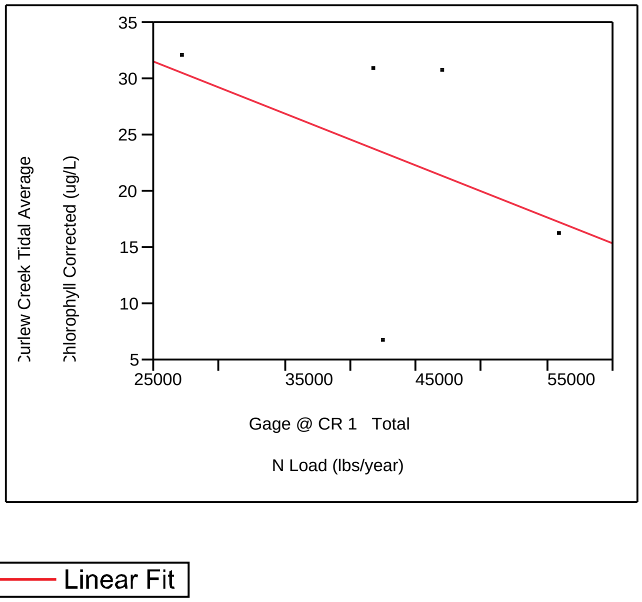
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	248.92791	248.928	2.8487
Error	3	262.14564	87.382	**Prob > F**
C. Total	4	511.07356	-	0.1900

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	53.594165	18.45355	2.90	0.0623
Gage @ CR 1 Hydrologic Load (m^3/year)	-2.104e-6	1.247e-6	-1.69	0.1900

Bivariate Fit of Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) by Gage @ CR 1 Total N Load (lbs/yr)



Linear Fit

Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) = 42.863904 - 0.0004576*Gage @ CR 1 Total N Load (lbs/year)

Summary of Fit

Term	Result
RSquare	0.177895
RSquare Adj	-0.09614
Root Mean Square Error	11.83436
Mean of Response	23.25765
Observations (or Sum Wgts)	5

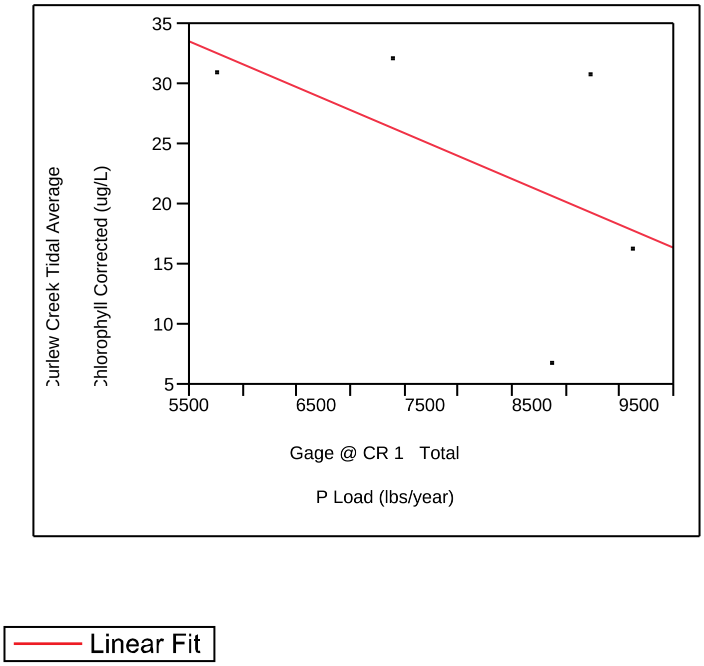
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	90.91738	90.917	0.6492
Error	3	420.15617	140.052	**Prob > F**
C. Total	4	511.07356	-	0.4794

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	42.863904	24.90303	1.72	0.1837
Gage @ CR 1 Total N Load (lbs/yr)	-0.000458	0.000568	-0.81	0.4794

Bivariate Fit of Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) by Gage @ CR 1 Total P Load (lbs/yr)



Linear Fit

Curlew Creek Tidal Average Chlorophyll Corrected (µg/L) = 54.429329 - 0.003812*Gage @ CR 1 Total P Load (lbs/year)

Summary of Fit

Term	Result
RSquare	0.290054
RSquare Adj	0.053406
Root Mean Square Error	10.99749
Mean of Response	23.25765
Observations (or Sum Wgts)	5

Analysis of Variance

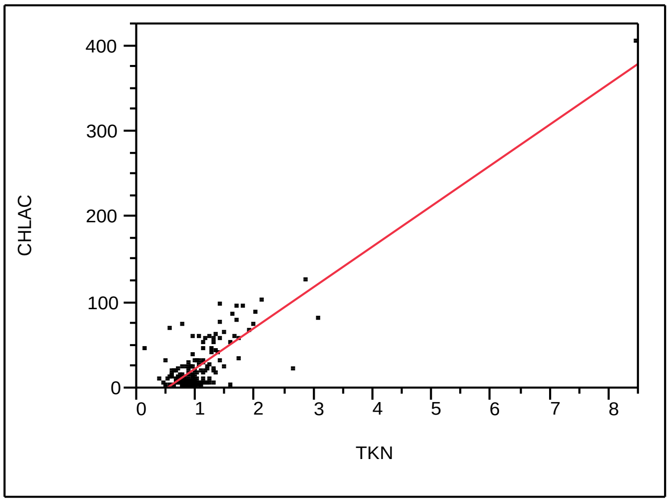
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	148.23915	148.239	1.2257
Error	3	362.83440	120.945	**Prob > F**
C. Total	4	511.07356	-	0.3490

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	54.429329	28.58242	1.90	0.1530
Gage @ CR 1 Total P Load (lbs/yr)	-0.003812	0.003443	-1.11	0.3490

Bivariate Fit of Curlew Creek Tidal Individual Results for Chlorophyll a Corrected (µg/L) by Curlew Creek Tidal Total Kjeldahl Nitrogen (mg/L)

Bivariate Fit of CHLAC by TKN



Linear Fit

CHLAC = -25.67056 + 47.333653*TKN

Summary of Fit

Term	**Result**
RSquare	0.755959
RSquare Adj	0.754287
Root Mean Square Error	20.12908
Mean of Response	26.71628
Observations (or Sum Wgts)	148

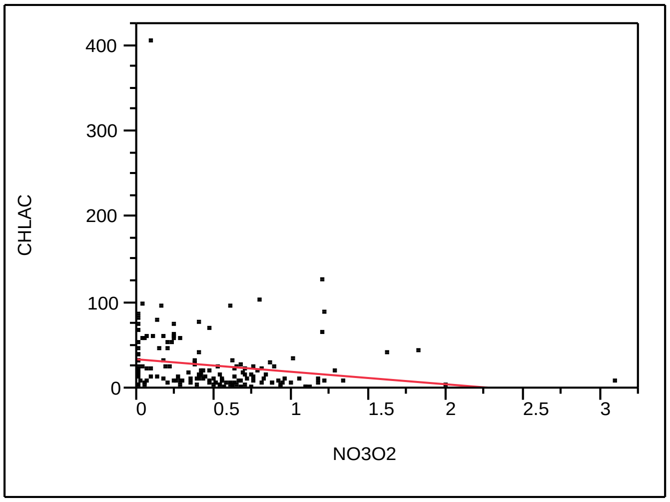
Analysis of Variance

Source	**DF**	**Sum of Squares**	**Mean Square**	**F Ratio**
Model	1	183246.28	183246	452.2591
Error	146	59156.27	405	**Prob > F**
C. Total	147	242402.55	-	<.0001*

Parameter Estimates

Term	**Estimate**	**Std Error**	**t Ratio**	**Prob>|t|**
Intercept	-25.67056	2.967468	-8.65	<.0001*
TKN	47.333653	2.22575	21.27	<.0001*

Bivariate Fit of Curlew Creek Tidal Individual Results for Chlorophyll a Corrected (µg/L) by Curlew Creek Tidal Nitrate-Nitrite (mg/L)



Linear Fit

CHLAC = 33.85576 - 14.923238*NO3O2

Summary of Fit

Term	Result
RSquare	0.028887
RSquare Adj	0.022498
Root Mean Square Error	39.44318
Mean of Response	26.38494
Observations (or Sum Wgts)	154

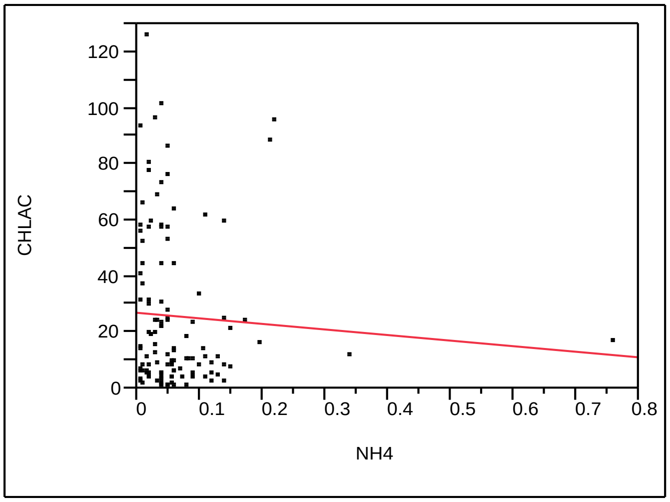
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	7034.26	7034.26	4.5214
Error	152	236476.17	1555.76	**Prob > F**
C. Total	153	243510.43	-	0.0351*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	33.85576	4.737779	7.15	<.0001*
NO3O2	-14.92324	7.018199	-2.13	0.0351*

Bivariate Fit of Curlew Creek Tidal Individual Results for Chlorophyll a Corrected (µg/L) by Curlew Creek Tidal Ammonia (mg/L)



Linear Fit

CHLAC = 26.828604 - 20.083221*NH4

Summary of Fit

Term	Result
RSquare	0.00363
RSquare Adj	-0.00503
Root Mean Square Error	27.98328
Mean of Response	25.51547
Observations (or Sum Wgts)	117

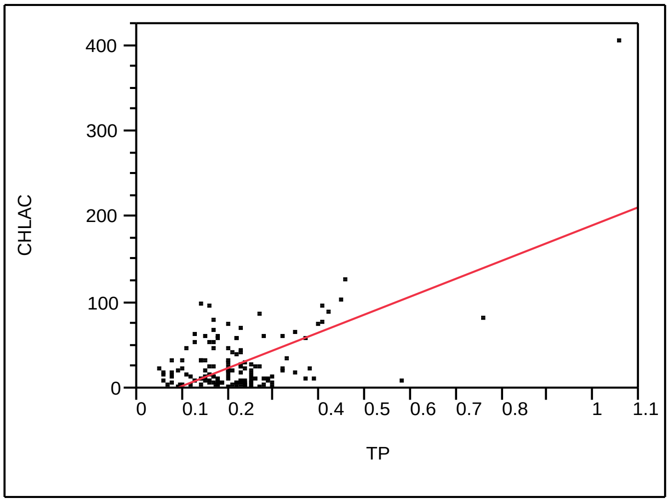
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	328.109	328.109	0.4190
Error	115	90052.358	783.064	**Prob > F**
C. Total	116	90380.467	-	0.5187

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	26.828604	3.287569	8.16	<.0001*
NH4	-20.08322	31.02579	-0.65	0.5187

Bivariate Fit of Curlew Creek Tidal Individual Results for Chlorophyll a Corrected (µg/L) by Curlew Creek Tidal Total Phosphorus (mg/L)



Linear Fit

CHLAC = -18.92564 + 207.30077*TP

Summary of Fit

Term	Result
RSquare	0.381263
RSquare Adj	0.376967
Root Mean Square Error	32.22394
Mean of Response	26.96308
Observations (or Sum Wgts)	146

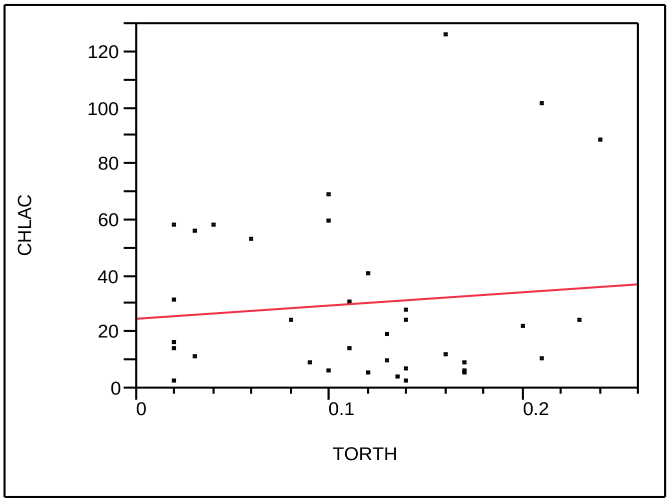
Analysis of Variance

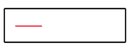
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	92138.07	92138.1	88.7323
Error	144	149527.04	1038.4	**Prob > F**
C. Total	145	241665.11	-	<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-18.92564	5.553735	-3.41	0.0008*
TP	207.30077	22.00696	9.42	<.0001*

Bivariate Fit of Curlew Creek Tidal Individual Results for Chlorophyll a Corrected (µg/L) by Curlew Creek Tidal Total Orthophosphate (mg/L)





Linear Fit

CHLAC = 24.360278 + 47.795884*TORTH

Summary of Fit

Term	Result
RSquare	0.010245
RSquare Adj	-0.01975
Root Mean Square Error	30.75248
Mean of Response	29.91143
Observations (or Sum Wgts)	35

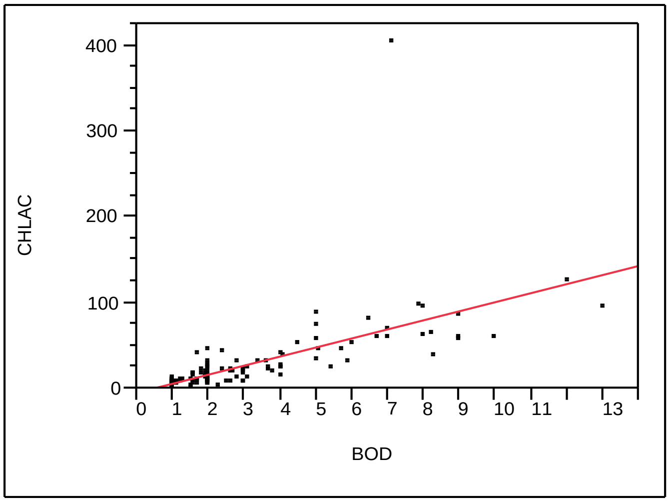
Analysis of Variance

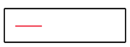
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	323.031	323.031	0.3416
Error	33	31208.605	945.715	**Prob > F**
C. Total	34	31531.635	-	0.5629

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	24.360278	10.82757	2.25	0.0312*
TORTH	47.795884	81.78034	0.58	0.5629

Bivariate Fit of Curlew Creek Tidal Individual Results for Chlorophyll a Corrected (µg/L) by Curlew Creek Tidal 5-Day BOD





Linear Fit

CHLAC = -6.129123 + 10.516063*BOD

Summary of Fit

Term	Result
RSquare	0.388904
RSquare Adj	0.383975
Root Mean Square Error	32.74986
Mean of Response	26.65429
Observations (or Sum Wgts)	126

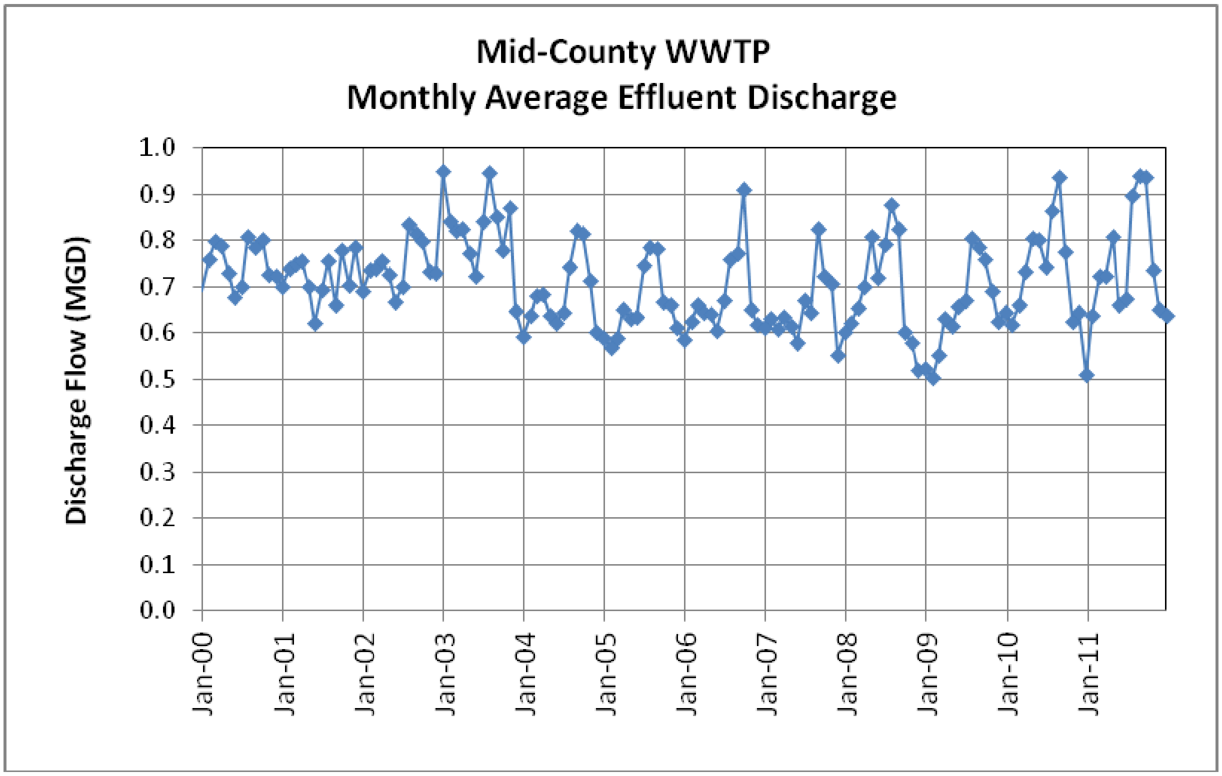
Analysis of Variance

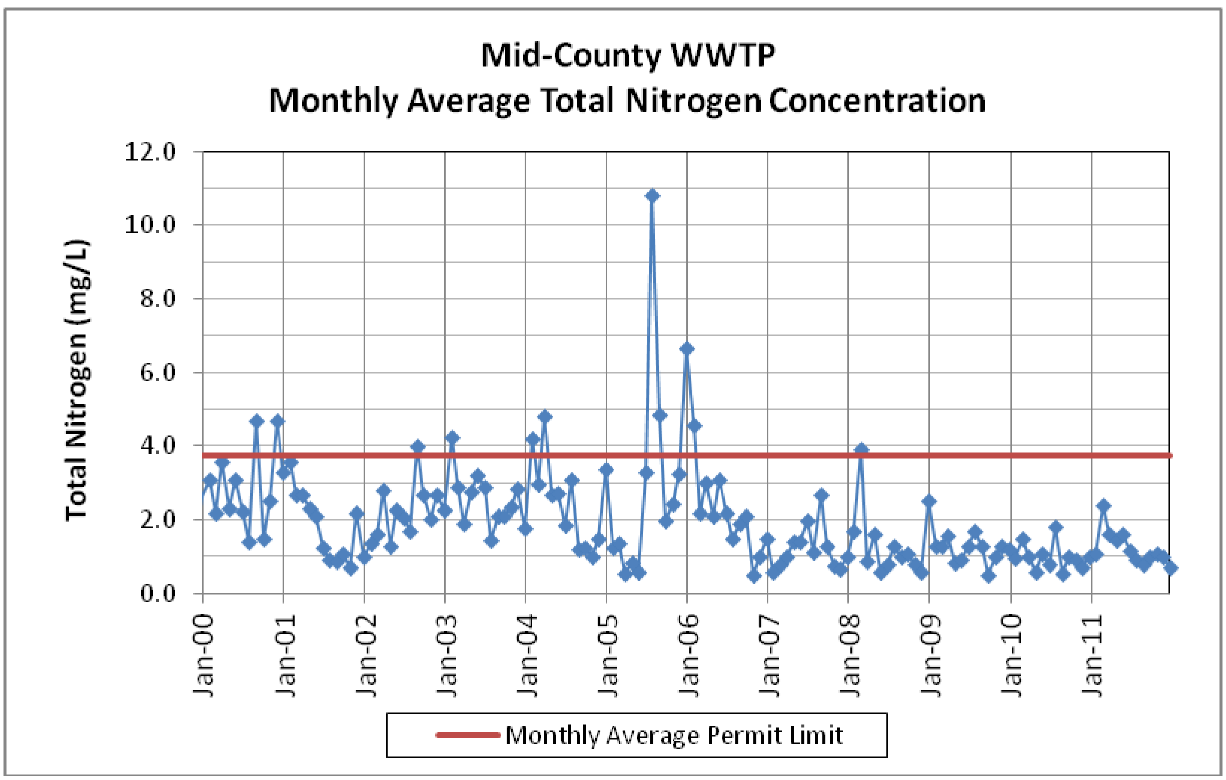
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	84639.48	84639.5	78.9140
Error	124	132996.65	1072.6	**Prob > F**
C. Total	125	217636.13	-	<.0001*

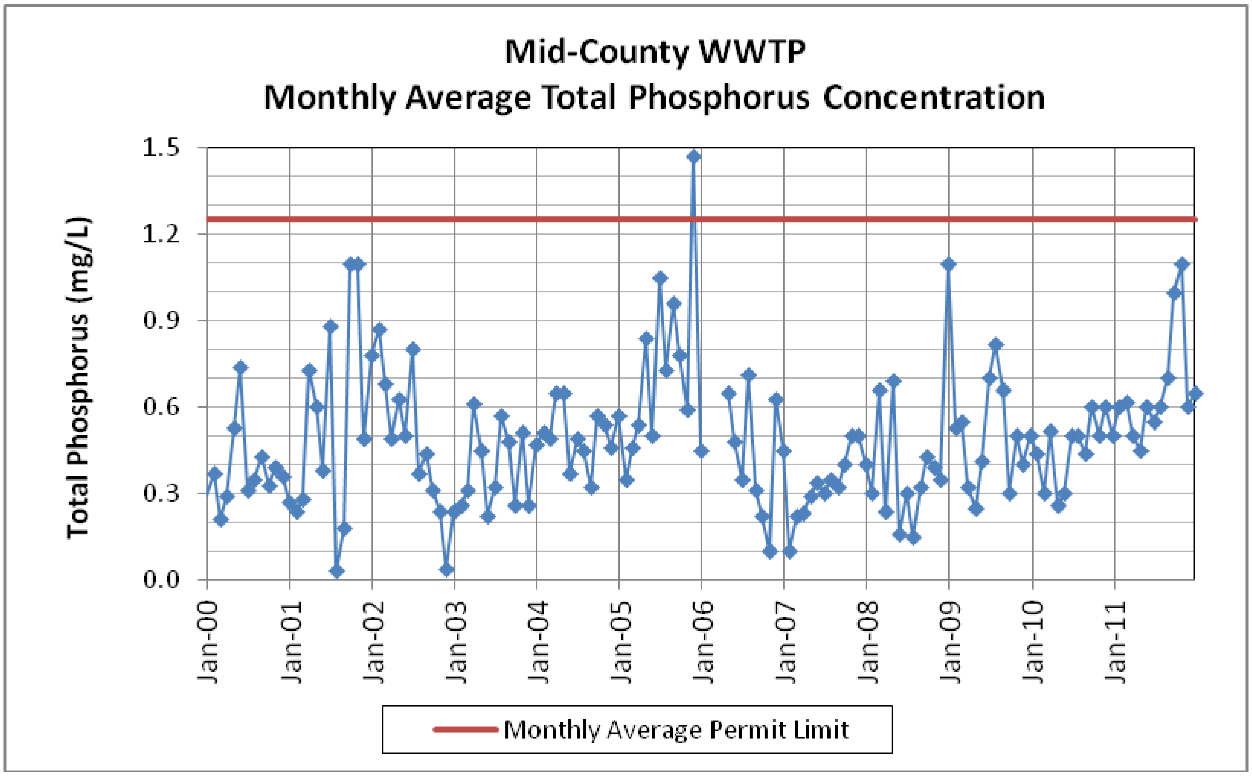
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-6.129123	4.704425	-1.30	0.1950
BOD	10.516063	1.183794	8.88	<.0001*

Appendix D: Mid-County WWTP Discharge Results Reported in the PCS Database







Mid-County WWTP
Monthly Average Total Phosphorus Concentration
Total Phosphorus (mg/L)
1.5
1.2
0.9
0.6
0.3
0.0
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Monthly Average Permit Limit

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

November 9, 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 Dissolved Oxygen and Nutrient TMDLs for the Curlew Creek Tidal Segment (WBID 1538) and the McKay Creek Tidal Segment (WBID 1633)

Dear Ms. Levy:

The Department has reviewed the Pinellas County comments, dated September 5, 2012, submitted on the draft Dissolved Oxygen and Nutrient TMDLs for the Curlew Creek Tidal Segment, (WBID 1567), and the McKay Creek Tidal Segment (WBID 1633) that were proposed in August 2012. 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).

<u>Comments Applicable to both TMDLs</u>

1. Several citations included on page 2 do not appear in the reference section including USDA, 2006; SWFWMD 2002; SWFWMD 2006; Causseaux, 1985; Trommer 1987; and Miller 1990.

   FDEP Response: The reference section of the reports has been updated with the information for the citations on page 2.

2. According to the number of exceedances, three of the reference waters (WBIDs 1535, 1140, and 1701) are impaired for dissolved oxygen, but no causative pollutant has been found and they are not impaired for nutrients, demonstrating that site specific factors play an important role in dissolved oxygen in systems in this area. The reference approach used in development of these TMDLs does not take into account these site specific factors which may include hydrology, stream morphology and alterations, land use, and temperature.

Ms. Kelli Hammer Levy
Pinellas County Department of Environment and Infrastructure
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FDEP Response: The waters used for establishing a chlorophyll a target are all the estuarine waters in the vicinity of Curlew Creek and McKay Creek that are not impaired for nutrients, based on the evaluation using annual average chlorophyll a concentrations. These waters exhibit a wide range of conditions in both tidal creeks and open waters and represent what we consider as the best information available for selecting reference waters in the area along the Pinellas County Gulf coast.

3. The majority of the WBIDS in Table 3.1 used to establish the target chlorophyll a concentration are estuarine open water waters, and are not appropriate for establishing targets in tidal creeks. There is insufficient support of the chlorophyll a target of 8 µg/L and it appears an arbitrary decision using the limited reasoning that it falls within a range of values for open estuaries not impaired for nutrients. If the Department proceeds with using the reference approach, the more appropriate chlorophyll a target is the corrected annual average of 10 µg/L for Bear Creek (see the first bullet under comment 4 below), a tidal creek rather than an open estuary.

FDEP Response: The estuarine segments presented in Table 3.1, are located in the vicinity of Curlew Creek and McKay Creek and are not impaired for nutrients based on the assessment of chlorophyll a results in the IWR Run 44 database. After further review of the Bear Creek results in the Run 44 database it was determined that the estuarine portion of the water, in recent years was incorrectly assessed using data collected at station 39-02 located in the freshwater area of the creek. The annual average chlorophyll a values reported for the 2008 to 2010 period are well below the 11 µg/L estuary threshold for impairment; however, it was determined that these values were calculated using results collected at Pinellas County's freshwater site. The annual average chlorophyll a values calculated for the period of 1999 to 2002 ranged between 11 to 13 µg/L and are based on results collected at Pinellas County's estuary monitoring site, station 39-01. Based on the averages calculated using results from the estuary site, the Bear Creek estuarine area is considered potentially impaired for nutrients and is therefore not appropriate to use as a water for establishing a chlorophyll a target.

The other two tidal creek segment averages presented in Table 3.1, the Anclote River (WBID 1440) and Minnow Creek (WBID 1535), are considered appropriate to use in establishing a chlorophyll a target as they are not impaired for nutrients, based on annual average values calculated using results from estuarine sites. It should be noted that the average chlorophyll a values in these two tidal creeks are near 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 5 µg/L in the Anclote River and 6 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 equal to or greater than those found in the tidal stream segments. The chlorophyll a value of 8 µg/L was selected as a target for TMDL development because it falls within the range of existing conditions in estuarine segments not impaired for nutrients

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along the Gulf Coast of Pinellas County. This target was considered appropriate to apply in the impaired tidal creeks as estuary segments 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. We consider the chlorophyll a results from both the tidal creeks and open water estuaries presented in Table 3.1, with the exception of the Bear Creek results, as the best information available for reasonably selecting a chlorophyll a target for the impaired estuary segments. The Bear Creek results have been removed from Table 3.1.

4. The following issues were found in the data from IWR Database Run 44x used in the calculation of average chlorophyll a concentrations for reference WBIDs in Table 3.1:

   - WBID 1701: No data is available for 2003 through 2007. County staff calculated an average chlorophyll a of 10 µg/L in this WBID, rather than the 5.0 µg/L reported. Ensure data from station 21FLPDEM 39-01 was included in the Department's calculation. The average chlorophyll a value without this data is equal to the 5.0 µg/L given in Table. 3.1. It is possible that the Department did not include station 39-01 in the calculation because the lat/long information in the IWR station run 44 shapefile does not correspond to the lat/longs in STORET or County files. The IWR files locate this station on dry land, outside WBID 1701 boundaries. The lat/long for station 39-01 needs to be corrected and this station included in the average chlorophyll a calculation for WBID 1701.

   - WBID 1528 and WBID 1528C: Data reported by 21FLTPA in 2004 are from stations named Boca Ciega Bay rather than Clearwater Harbor North and South, although the lat/longs indicate the stations are in WBID 1528 and 1528C. The majority of chlorophyll a results at these stations are less than the MDL and the maximum is 1.7 µg/L. These results are much lower than the typical range in these WBIDs. The results, lat/longs, and WBID designation for these data points need to be verified.

   - WBID 1535: No data is available for 2003, 2005, 2006, or 2007. No data is available for the first quarter of 2004. There is only one sample from 2008 and 2009, both taken during October. The available data is limited and not representative of variable hydrologic conditions that occur throughout the year. This WBID should not be used in determining chlorophyll a targets due to insufficient data.

   - WBID 1400: Ensure data from station 21FLGW 20085 were not used in average chlorophyll a determination. The station is not located in the river, rather an adjacent waterbody and is not representative of conditions in Anclote River Tidal Segment.

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FDEP Response: WBID 1701 – As described in the response to comment 3, based on a re-evaluation of the chlorophyll a results, the Bear Creek estuary segment contained in the IWR database is not correctly assessed as WBID 1701 contains monitoring results collected in both a freshwater area and estuarine area of the creek. The annual average chlorophyll a values calculated for the period of 1999 to 2002 ranged between 11 to 13 µg/L and are based on results collected at the Pinellas County estuary monitoring site, station 39-01. Based on the averages calculated using results from the estuary site, the Bear Creek estuarine area is considered potentially impaired for nutrients and is therefore not appropriate to use as a water for establishing a chlorophyll a target. The Department's Watershed Assessment Section has been advised of the issues surrounding WBID 1701, so that the appropriate revisions can be made to the assessment of this segment in the IWR database. Removing this WBID from consideration as a reference water, does not affect the chlorophyll a value selected as the water quality target for TMDL development.

WBID 1528 and 1528C – The annual average chlorophyll a concentrations were recalculated by excluding the 2004 results from the stations named Boca Ciega Bay, which were collected by the DEP SW District Office (21FLTPA). The 2004 annual averages increased from 4 µg/L to 5 µg/L for the Clearwater Harbor South segment (WBID 1528) and from 5 µg/L to 6 µg/L for the Clearwater Harbor North segment (WBID 1528C). However, for both segments the long-term average chlorophyll a concentrations for the 1999 to 2010 period, that are presented in Table 3.1 of the TMDL report, do not change with the results from the Boca Ciega Bay stations removed. The Department's Watershed Assessment Section has been advised of the comments regarding the station assignments for WBIDs 1528 and 1528C in the IWR database so that the issue can be reviewed.

WBID 1535 – The chlorophyll a results for the years 2004, 2008, and 2009 that are referenced in the comment were not used in the calculation of the long term average value. The annual average values calculated for this segment that are provided in the IWR database are from the years 1999, 2000, 2001, and 2010. We believe it is useful to present the chlorophyll a average, based on these four years, in Table 3.1 as it provides further information about chlorophyll a conditions for estuary segments not impaired for nutrients.

WBID 1440 – The annual average chlorophyll a concentration was recalculated by excluding the one chlorophyll a result collected at station 21FLGW 20085 in 2003. The 2003 annual average, 4 µg/L, did not change with this one result removed, so it does not influence the long-term average chlorophyll a value shown in Table 3.1. The Department's Watershed

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Assessment Section has been advised of the comment regarding the assignment of station 21FLGW 20085 to WBID 1440 so that the issue can be reviewed.

In summary, the issues identified with some of the reference water segments does not have an effect on the long-term average chlorophyll a concentrations that were used to select the chlorophyll a target.

5. 4.3.2 Septic Tanks: The FDOH GIS data downloaded from http://www.doh.state.fl.us/environment/programs/ehgis/EhGisDownload.htm used to determine the number of septic tanks results in a gross underestimation of the actual number septic tanks. Selecting data from this file for all tanks located in Pinellas County results in a total of 3,661 records for existing, new, or repaired septic tanks. From this data the Department found that 31 tanks were located in the McKay Creek watershed and 278 in the Curlew Creek watershed. According to the statistics at http://www.doh.state.fl.us/environment/OSTDS/statistics/ostdsstatistics.htm, there are a total of 23,869 septic tanks in Pinellas County. This is 20,208 septic tanks more than the number contained in the county-wide GIS data. The primary reason for the discrepancy is that the oldest record in the GIS data is from 1998, while the statistics are based on 1970 census data plus the number of systems installed since 1970. Any septic that was installed prior to 1998 without a DOH repair permit is not reflected in the GIS data. The GIS data is not appropriate for estimating septic tank numbers. It likely underestimates the number of septic tanks in these watersheds at a similar magnitude to the county-wide underestimation.

   FDEP Response: Our understanding is that the Florida DOH GIS coverage of septic tanks is the only one available for Pinellas County at this time. We were informed that the county is working on developing a coverage, but that this project is in the beginning stages and that it is expected to take at least several months to complete. The DOH septic tank information was not used to develop the TMDLs for either the Curlew Creek or McKay Creek tidal segments. The Curlew Creek TMDL was developed using an empirical approach based on the relationship between in-stream total nitrogen concentrations and chlorophyll a values. For the McKay Creek TMDL, it was determined based on the GIS coverage, that there are a small number of septic systems in the watershed and they were not explicitly accounted for in the watershed modeling. We have reviewed coverages of wastewater treatment plant service areas that were made available, in order to identify potential septic systems in the McKay Creek watershed. The service areas located in the McKay Creek watershed indicate that the majority of the watershed is served by wastewater treatment facilities, which supports that there are a minimal number of septic systems in the basin.

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McKay Creek Tidal Segment, WBID 1633, Dissolved Oxygen and Nutrient TMDL

1. Identification of Waterbody: The list of cities that the watershed covers is incorrect. The headwaters are not located in the City of St. Petersburg. The city boundaries in Figure 1.2 are inaccurate. Figure 1 below shows the McKay Creek basin and nearby city limits using municipal boundary data available at http://gis.pinellascounty.org/gisData/gisDataSets.aspx.

   FDEP Response: An accurate city limit coverage has been obtained and the report maps and text have been updated to exclude the references made to the City of St. Petersburg.

2. Two chlorophyll a values used in the calculation of the 2004 annual mean in Table 2.3 were Q qualified as shown in the IWR database because they failed to meet holding time. According to STORET, samples from both 21FLTPA sites on 5/25/2004 were 19 days past the 48 hour holding time. Removal of these points from the dataset reduces the annual mean from the reported 17 µg/L to 15 µg/L. County staff has concerns that poor data quality may impact the TMDL determination.

   FDEP Response: As noted in the comment, when the two values collected on 5/25/2004, 42 µg/L and 82 µg/L, that have an associated remark code of "Q" are excluded from the analysis the 2004 annual average is 15 µg/L. The removal of these two values from the calculation of the annual average does not change the nutrient assessment for the tidal segment as the 2004 average is still greater than the 11 µg/L estuary impairment threshold. In the development of the surface water quality model there was not an attempt made to adjust model coefficients to simulate the chlorophyll a levels reported on 5/25/2004, therefore the results in question would not have an impact on TMDL development. The proposed TMDLs were established based on conditions observed throughout the multi-year model simulation period rather than on any one critical/seasonal condition because the methodology used to determine impairment is based on water quality results collected in multiple years. The Department's Watershed Assessment Section has been advised of this comment so that the issue can be reviewed in the context of the surface water assessment for the tidal segment.

3. 4.2.2 Municipal Separate Storm Sewer System Permitees and 6.3.2 NPDES Stormwater Discharges: Remove all references to the City of St. Petersburg MS4 permit. See Figure 1.

   FDEP Response: The report text has been corrected to remove all references made to the City of St. Petersburg MS4 permit.

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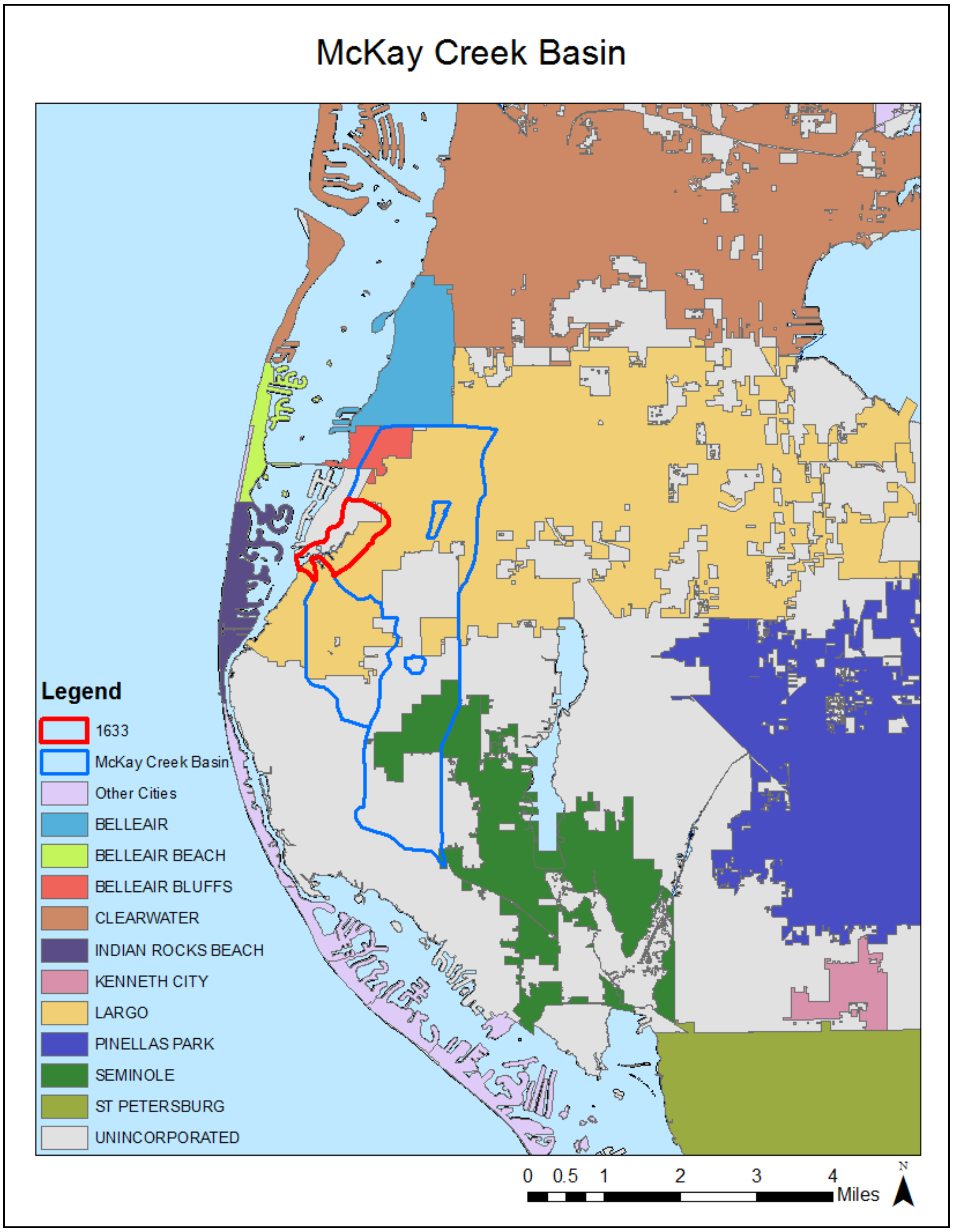

Figure 1. Map of the McKay Creek Basin and Nearby Municipalities

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4. The Technical Support Documents for the LSPC, EFDC, and WASP7 models used for TMDL determination are not available to the public. Without being able to view model assumptions, calibrations, and other details contained in these reports, Pinellas County and other stakeholders are unable to fully review, understand, and comment on the development of the TMDL. We request these documents be made available and the comment period be extended for an additional 30 days once they are available.

   FDEP Response: Technical support documents for the larger LSPC and EFDC models have been provided to the Department and are enclosed for review. The documents will be included as appendices to the TMDL report. A spreadsheet documenting the WASP coefficients used in the McKay Creek model have been provided to the Department and is enclosed for review.

5. 5.3 Model Development: McKay Creek flows through three lakes with operable weir structures-Walsingham Reservoir, Taylor Lake, and a 5-acre unnamed lake. How were these accounted for in the modeling?

   FDEP Response: The reservoirs were accounted for in the land use as open water. No data were available for daily operation of the weir flow based on an interview search, and they were assumed to be "run-of-the-stream" weirs, meaning that flow into the lakes is equal to flow out of the lakes, in the model calibration.

6. 5.3 Model Development: Sub-watersheds were assigned the hydrologic soil group that has the highest percentage of coverage within the sub-watershed boundaries. Many of the sub-watersheds have a high percentage of more than one soil group. Can the hydrologic soil groups be defined at a smaller scale for a more accurate representation?

   FDEP Response: The sub-watersheds can only be represented by one hydrologic soil group. A finer delineation is required to change the hydrologic soils assignment. In the McKay Creek watershed, different soils assignments will likely not have a large influence on results because the land use is predominantly high density development, and parameterization of high density land uses will be similar for all soil groups.

7. 5.3 Model Development: How did the Department ensure the accuracy of modeled discharge given the lack of continuous flow data in McKay Creek for calibration of the watershed model?

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FDEP Response: Flow calibration was performed using all the available flow results and we believe the simulated flows are well calibrated to the available instantaneous flow results. Much of the flow data appears to be collected during low flow periods, and the simulated discharge is in close approximation to the measured data. Additionally, the McKay Creek watershed model used the Crystal Watershed hydrodynamic calibration which was calibrated to continuous flow measurements collected at the USGS station in the Anclote River (see enclosed Crystal Watershed report).

8. 5.3 Model Development: The County has the McKay Creek watershed delineated at a smaller scale into 26 sub-basins that is available for watershed modeling.

FDEP Response: The County delineation was used to develop the boundaries for the sub-watersheds. The LSPC model is a lumped land use model, and using smaller delineations would not change the land uses and therefore not change the water quality loadings from the land uses in the sub-watersheds. Adding additional sub-basins, specifically at that fine of a scale, will not impact the model nutrient calibration, but would increase the run time.

9. 5.3. Model Development: There is additional Pinellas County data available in McKay Creek at 27-03. Why was this not used in model calibration? This station is located at a boundary of one of the 26 sub-basins. Would the use of smaller sub-basins enable calibration to this data?

FDEP Response: Station 27-03 was not used in calibration because it was not located near an outlet of a sub-watershed. A finer sub-watershed delineation would allow for validation to this station. Additionally, the purpose of the LSPC model was to provide nutrient loading to the downstream water quality model and station 21FLPDEM27-09 would still be the priority calibration station because it is downstream of 21FLPDEM27-03.

10. No flow data was plotted in Figure 5.3 or 5.4 for 2005 through mid 2009. Pinellas County flow data is available for sites 27-09 and 27-10 in STORET, but does not appear in the IWR database. The IWR database should be corrected and this data included in the graphs.

FDEP Response: The flow data in question located in STORET was not included in the IWR database because incorrect units were attached to the flow results. The missing results have been added to the flow calibration graphs provided below and have been included in the report figures. The county will need to include the correct units for the flow results in STORET so that these results can be included in the IWR database.

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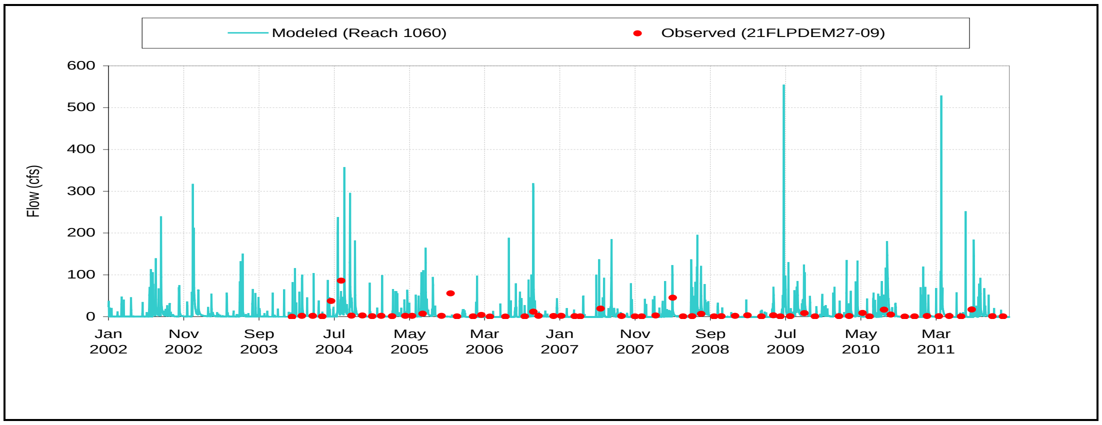

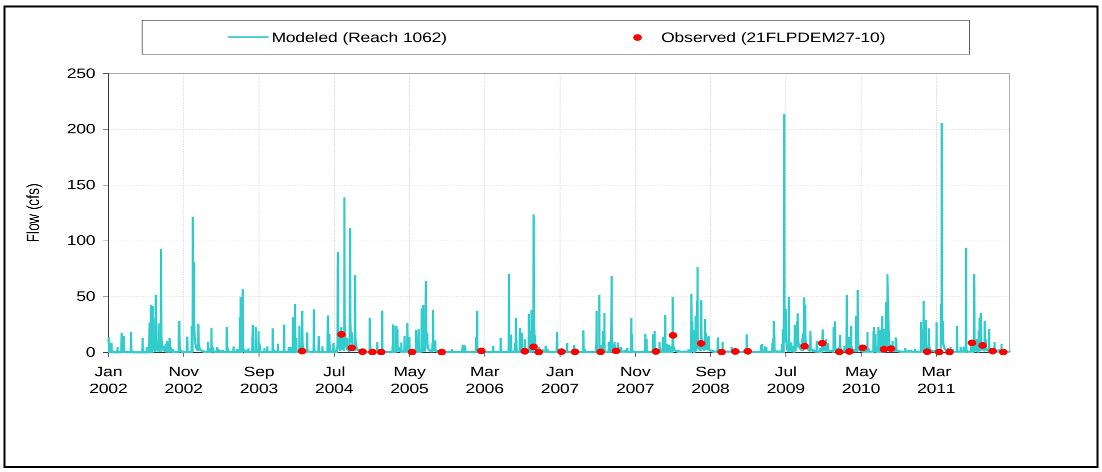

11. Figures 5.11 through 5.15, only show data at 27-09 through June 2009, but data is available in the IWR database through 2011. What time period was used for calibration?

FDEP Response: The period of calibration was from 2002 through 2009. The missing data from 2009 to 2011 has been added to the graphs and have been used for model verification for the years 2010 and 2011.

12. Calibration of the LSPC model using available data is inadequate based on the following:

- Modeled flow appears significantly higher than observed flow for many of the data points. Use of this model could overestimate loading considerably.

- The model underestimates dissolved oxygen at 27-10 in many instances and rarely overestimates DO. DO is regularly observed at levels greater than 8 mg/L, but according to the model, DO rarely surpasses this value. The model is also a poor fit for measured dissolved oxygen at 27-09. The modeled DO range is approximately 5.5 to 9 mg/L, but measured DO ranges from 1.92 to 10.32 mg/L.

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- The model overestimates TN compared to actual measured TN. Modeled TN concentrations regularly exceed the maximum measured concentration and are often more than double the highest ever observed in the creek.

- The model overestimates TP at both stations. At 27-10, nearly all measured values fall below modeled values indicating inadequate calibration with available data. The highest measured TP at 27-10 was 0.08 mg/L which occurred on May 16, 2005. Nearly all modeled concentrations exceed this value and reach up to 10x the maximum observed value.

FDEP Response: We believe that the modeled flow during low flow periods is well calibrated to the data provided. Much of the flow data appears to be collected during low flow periods, and the simulated discharge is in close approximation to the measured data. The higher flow values occur during storm events, and data is not always available for calibration during these time periods. Additionally, the model used the Crystal Watershed hydrodynamic calibration which was calibrated to flow at the USGS station in the Anclote River (see enclosed Crystal Watershed report). Calibration at this station, which included continuous USGS discharge flow data, indicated that the model slightly under predicted high flows, although the calibration to high flows was still within the accepted USGS error percentage range.

The purpose of the LSPC model was to provide loads to the WASP water quality model. For that reason all in-stream transformations that impact DO were not simulated in the LSPC model, but were simulated in the WASP model. The purpose of the LSPC model was to represent the general trends occurring in the measured DO. The model represents the low DO measurements that occurred in the summer of 2003 and 2010 at station 27-10. The low DO measurements in the WASP model are used as the critical condition to develop the TMDL load, and increasing DO concentrations during the winter months, when the highest DO results were measured, would not impact the TMDL reductions for this reason. The DO at station 27-09, located in the WASP model domain, has the same trend as DO at station 27-10.

The TN calibration was performed to best represent the overall loading to the WASP water quality model. The TN concentrations are higher during summer rainfall events, likely because of the flashiness that occurs in the developed watersheds. Additionally, the model also has periods of modeled TN that are lower than measured.

The TP calibration was done to best represent the overall loading to the WASP water quality model. TP concentrations are higher during summer rainfall events, likely because of the flashiness that occurs in the developed watersheds. Additionally, the model also has periods of modeled TP that are lower than measured TP at station 27-09, which is the downstream station located in the WASP model domain that is closest to where the watershed loads enter the WASP water quality model.

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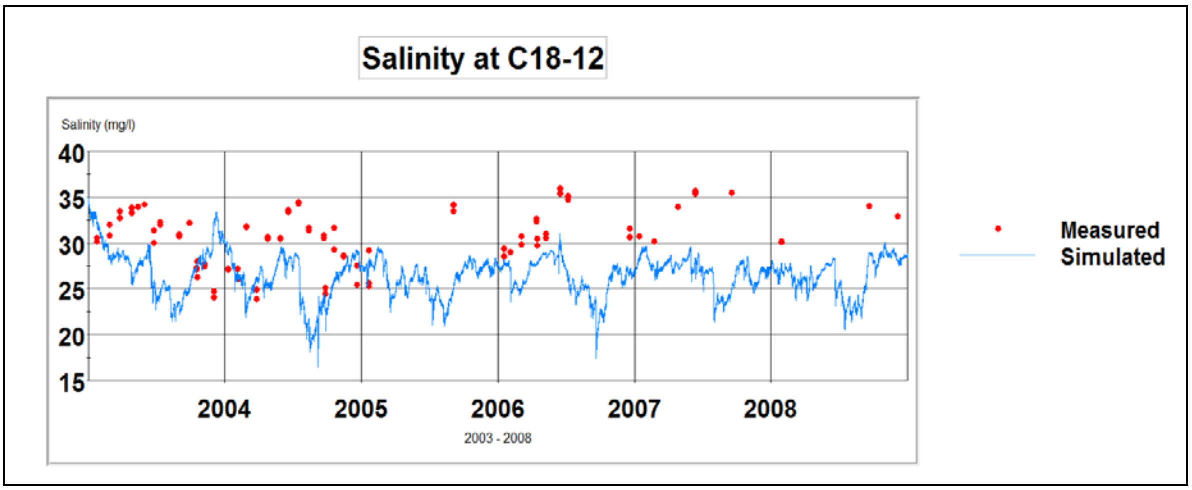
13. 5.3.2 EFDC Model Development: Measured salinity at station 21FLDPEM27-01 and Pinellas County stations in Clearwater Harbor are better representations of salinity for use with the EFDC model than average Gulf of Mexico salinity and are more appropriate for use in model simulation.

    FDEP Response: The time series salinity model output from the Big Bend model was used as a boundary condition for the McKay Creek model, not the average salinity in Gulf of Mexico. See the calibration plot below for the Big Bend salinity outputs at the calibration station located closest to McKay Creek. Salinity outputs for the entire Big Bend model can be found in the enclosed Big Bend Hydrodynamic Model appendix. Additionally, Figure 5.17 in the TMDL report shows that modeled salinity in McKay Creek is similar to measured salinity at station 21FLDPEM27-01. The model is able to predict periods of both high and low salinity.



Modeled vs. Observed salinity at Station C18-12, Clearwater Harbor

14. 5.3.2. EFDC Model Development: USGS Station 02309110 located in WBID 1633 has gage height data available since 2007. Was data from this site considered for calibrating water surface elevation?

    FDEP Response: USGS station 02309110 was not used for calibrating surface elevation. The EFDC hydrodynamic model is based on grids and each grid cell represents the average width and depth of the channel over a large area. The cross-section at the USGS gage site may not be representative of the entire grid cell, and bathymetry at this location may be different than bathymetry for the entire cell.

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15. 5.3.3 WASP Model Development, pg. 36: Previous reports have used a 2.47 ratio to convert BOD to CBOD based on the EPA's 1997 Technical Guidance for Developing Total Maximum Daily Loads. Please provide explanation for the 1.5 ratio used here.

    FDEP Response: The f ratio used in the McKay model was based on the decay rate for the CBOD used in the model. The decay rate for the CBOD used in the McKay Creek model is 0.2 per day and the corresponding f ratio value is 1.5. The f ratio is a factor also used in modeling to convert BOD to CBOD.

16. Modeled existing chlorophyll a conditions in McKay Creek tidal segment in Table 5.1 meet the 11 µg/L criteria for impairment for all years except 2010 and 2011 and there have been significant improvements in DO seen during the Cycle 2 verified period. Only 6 of 43 DO measurements did not meet criteria in Cycle 2 suggesting the WBID is no longer impaired for DO. These factors bring into question the need for a TMDL in this WBID, and make the stormwater load reduction requirement of 45% appear excessive.

    FDEP Response: The models used for TMDL development were calibrated to best represent the fit to the range and pattern in the measured data. The loads used to establish the TMDLs were the loads applied in the calibrated model that were found to be necessary to meet the minimum marine DO criteria of 4 mg/L at all times and the chlorophyll a target of 8 µg/L, as an annual average, for the 10-year model simulation period. Using this approach to establish the TMDLs provides for an adequate margin of safety, which is necessary in TMDL development to address the uncertainties in the relationship between pollutant loads and receiving water quality. Please note that the segment remains on the verified list for DO because the number of criteria exceedances is not low enough to delist the segment for DO impairment following the IWR methodology. Table 4 of the IWR shows the data requirements that must be met to delist a water body for DO. In this case, with 43 results, not more than 1 value can exceed the criteria to support delisting the segment.

17. Calibration of the WASP7 model using available data is inadequate based on the following:

    - The modeled DO range is narrow compared to the measured DO. Discrepancies are especially obvious in 2002 in McKay Creek Tidal and in the fluctuation patterns at 27-09.

    - TN is modeled over a much larger range of concentrations in McKay Creek segments and a smaller range in Church Creek than measured concentrations.

    - The high range of measured nitrate-nitrite concentrations in Church Creek are not captured in the model predictions.

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- The lower end of chlorophyll a measurements in all segments are not represented in the model predictions.

FDEP Response: The WASP model provides the best overall calibration for all stations used in model calibration. In 2002 at station 27-01, the model simulation DO is higher than the measured DO. The measured data from 2002 was collected at several depths, including 0.1 meters, and the model represents average DO concentrations. Additionally, causes of the low DO in 2002 may have been removed from the system in the last decade, which is why the model was unable to represent the low DO that year. The model matches the seasonal trend for the years 2004 and 2010 in McKay Creek at this station. Additionally, the model predicts the overall trends at station 27-09. The model predicts DO between 4 mg/L and 11 mg/L, and the measured DO ranged from 2 mg/L to 10 mg/L, with most measured DO occurring within the 4 mg/L to 10 mg/L range. Calibrations at these two stations show that the model is predicting the overall trend in DO in McKay Creek and estuary. Within Church Creek, the modeled DO is also similar to the measured DO trends.

Both Church Creek and McKay Creek consist of high intensity developed land, and the modeled loads and nutrient concentrations from both watersheds were similar for this reason. The calibration was accomplished by reviewing all calibration stations in the watershed and producing the best overall result. The TN loads from the LSPC model were partitioned to provide the best representation of the TN species.

All three modeled species, NOx, NH4, and organic nitrogen were similar to the measured data, with the exception of NOx in Church Creek. Measured concentrations of NOx were greater than modeled concentrations, including NOx concentrations during storm events, which indicated that there may be an unidentified source of NOx in Church Creek. Measured NOx values in McKay typically ranged from approximately 0.01 mg/L to 0.4 mg/L, while modeled values were typically within this range as well. Overall, the model captured the NH4 and organic nitrogen ranges in the measured data at all three stations.

The chlorophyll a calibration was done to best represent the entire range of data collected, including the summer growth periods. The lower range of the calibrated chlorophyll a is approximately 1-2 µg/L higher than the measured data, which represents a small increase over the measured data, which is well within the acceptable difference when modeling chlorophyll.

18. The models were run through the end of 2011, but only calibrated with available data through March 2011. Pinellas County data for stations 27-08, 27-09, 27-10 are available through the end of 2011 in STORET and should be included for better calibration.

FDEP Response: Revised plots featuring additional data collected through the end of 2011 at stations 27-08, 27-09, and 27-10 will be included in the updated TMDL report.

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Curlew Creek Tidal Segment, WBID 1538, Dissolved Oxygen and Nutrients TMDL

1. 1.2 Identification of Waterbody: The City of Safety Harbor is not within the boundaries of the Curlew Creek watershed.

   FDEP Response: An accurate city limit coverage has been obtained and the report maps and text have been updated to exclude the City of Safety Harbor.

2. Table 2.1: The table is incorrectly titled Mckay Creek Tidal.

   FDEP Response: The title for Table 2.1 has been corrected.

3. 4.2.2 MS4 Co-permitees and 6.3.2 NPDES Stormwater Discharges: Remove Safety Harbor from the list of co-permittees.

   FDEP Response: The report text has been corrected to remove Safety Harbor as a co-permittee to the Pinellas County MS4 permit.

4. 4.4 Nonpoint Loading Estimates: Include station IDs for the water quality data at County Road 1 used to calculate loads.

   FDEP Response: The text in section 4.4 has been revised to identify the stations for the water quality data at County Road 1 used to calculate loads. Monthly nutrient loadings were calculated using all available total nitrogen and total phosphorus results collected at County Road 1. The results used were from sampling conducted by the USGS (site 112WRD 02309425), Pinellas County (site 21FLPDEM10-02), and the DEP SW District Office (site 21FLTPA 28024988245339), that are available in the IWR Run 44 database, and sampling results collected by the City of Dunedin (site 6), that were provided by the city.

5. 4.4 Nonpoint Loading Estimates: Monthly loads were summed to find annual loads. Please provide information on the methods used to calculate monthly loads given the stream flow measurements are available at 15 minute intervals and water quality data are available at varying intervals with some months having multiple water quality measurements and some months having no water quality measurements.

   FDEP Response: The text in section 4.4 has been revised to include the methods used to calculate monthly loads. Loadings at the USGS gage were calculated as follows. Monthly hydrologic loads were calculated by averaging the daily average flows, which were downloaded from the USGS stream flow web site, for each month to determine a monthly

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average daily flow in cubic feet per second (cfs). The monthly average daily flows were then converted to a total monthly flow volume in cubic meters per month.

Monthly nutrient loadings were calculated using all available total nitrogen and total phosphorus results collected at County Road 1 at the sites identified in the response to comment 4. In months when one result is reported, that value represents the monthly concentration value. In months when more than one result is reported, the values were averaged to obtain a monthly value. In months when no results are reported, the average of the previous month and the succeeding month values was used as the monthly concentration value. The monthly concentration values, along with the monthly flow volumes, were used to calculate a monthly loading estimate for total nitrogen and total phosphorus.

6. Figure 4.6: Why are Mid-County TP results for 2005 not available? Include the calculated total load for 2005 in the graph.

   FDEP Response: The 2005 Mid-County WWTP total phosphorus results have been obtained directly from the DEP Southwest District Office and Figure 4.6 has been updated to include the annual loading estimates for 2005.

7. The City of Dunedin data was provided to attendees at the public workshop on 8/21/2012. The files do not indicate whether or not the reported chlorophyll a values were corrected for pheophytin. For TMDL use, data should meet the guidelines set forth in *Applicability of Chlorophyll a Methods* (DEP-SAS-002/10, October 24, 2011).

   FDEP Response: The City of Dunedin confirmed in a September 13, 2012 email (enclosed), which was sent to the Department and Pinellas County, that the method used for the city's chlorophyll a analysis includes correction for pheophytin.

8. 5.2 Pinellas County began monitoring the tidal segment at station 10-01 in 1991 (not 1992). Data from 1991 is available in the IWR database, but was not used in the analyses in the section. Please include 1991 data or provide an explanation for its exclusion.

   FDEP Response: Based on the IWR database, there are water quality results at station 10-01 in 1991 for dissolved oxygen beginning in January and for chlorophyll a beginning in June. However, there are only results in the IWR database for total nitrogen and total phosphorus beginning in February 1992, so the analysis conducted for TMDL development started in 1992. For information purposes, the dissolved oxygen and chlorophyll a graphs in Appendix B have been updated to include the results from 1991. Text has been added to the report to explain why the analysis for TMDL development started in 1992.

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9. 5.2 Analysis of water quality: Include the station names for sites at Alternate US 19 used in the analysis.

   FDEP Response: The text in section 5.2 has been revised to include the monitoring site identification numbers at Alternate US 19.

10. 5.2 Analysis of water quality: A comparison of individual results for exploratory variables in addition to TN (TP, freshwater inflow, and nutrient loads) would aid in determining whether or not other relationships exist. Although analyses are provided comparing annual average values in Appendix C, a comparison of individual results, like was done with TN as shown in Figure 5.3, would provide a larger sample size and may reveal other relevant relationships.

    FDEP Response: The original analysis performed included a comparison of both individual results and annual average values. Appendix C has been updated to include the results of the regression analyses comparing individual results of chlorophyll a concentrations to explanatory variables. The analysis of individual results did not show a strong relationship of chlorophyll a results to explanatory variables. The strongest relationship identified was between annual average in-stream chlorophyll a and total nitrogen concentrations. The annual average relationship is most useful for TMDL development, as annual average chlorophyll a concentrations are used to identify nutrient impairment following the state's Impaired Waters Rule methodology.

11. 5.2 Analysis of water quality, pg 27, par 5: "The 2011 annual average chlorophyll a concentration was lower than the selected chlorophyll a target based on current conditions." Please provide the 2011 average.

    FDEP Response: Please note that after the Department proposed the TMDL, the City of Dunedin's contract laboratory provided an accurate chlorophyll a result for the 9/22/2011 sampling event that was not included in the original analysis. There was an error in the reporting of chlorophyll a results for the September 2011 sampling event and the city's result at the Alternate US 19 location on Curlew Creek, previously provided, was off by 1000. The correct result for 9/22/2011 is 12 µg/L. The 2011 annual average without the September result is 6.7 µg/L and with the result included it is 7.2 µg/L. The updated 2011 annual average chlorophyll a value of 7.2 µg/L has been added to Section 5.2 of the report.

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Including the chlorophyll a and total nitrogen results for the 9/22/2011 sampling event in the regression analysis, 12 µg/L and 0.94 mg/L respectively, results in a 2011 annual average chlorophyll a value of 7.2 µg/L and an annual value for total nitrogen of 1.12 mg/L. The r-square value of the relationship between annual average chlorophyll a and total nitrogen improves slightly to 0.58 with the September 2011 results included. Chapter 5 of the report has been revised with the updated regression analysis.

12. The relationship between chlorophyll a and TN as shown in Figures 5.3 and 5.4 is skewed by the high chlorophyll a concentration of 404 µg/L from 1/26/1994. Field notes and other data from this sampling day (ex. dissolved oxygen, pH, turbidity) are not indicative of an algae bloom, brining into question the validity of the chlorophyll a result. Does the r^2 improve if this data point is removed? If it does, the Department should consider removing the data point and recalculating the TMDL based on the revised regression equation.

FDEP Response: The regression analysis used to establish the total nitrogen TMDL was also performed by excluding the 1/26/1994 total nitrogen and chlorophyll a results and including the results for 9/22/2011, as explained in the response to comment 11. The r-square value of the relationship between annual average chlorophyll a and total nitrogen concentrations is 0.51 (p value < 0.05) when the 1/26/1994 results are excluded. If the regression equation for this relationship is applied, the total nitrogen concentration needed to meet the chlorophyll a target is lower and results in a higher percent reduction in the existing total nitrogen concentration.

13. Only 57 percent of the variation in average chlorophyll a concentration is explained by average TN concentrations indicating other variables may significantly influence chlorophyll a values.

FDEP Response: It is recognized that other factors besides nutrient concentrations will influence chlorophyll a values in surface waters. However, we believe that the significant relationship identified between annual average chlorophyll a and total nitrogen values is sufficient for establishing a nutrient TMDL and is the best way to move forward in addressing water quality problems in the Curlew Creek tidal segment.

14. Using the formula $y = 29.372x - 20.403$ provided in Figure 5.4 and a target chlorophyll a concentration of 8 µg/L, the target TN load is calculated as 0.97, rather than the 0.96 mg/L stated in the report. This change makes the required reduction 15%, rather than the reported 16%. Please verify whether the difference is due to rounding or calculation error and correct as needed.

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FDEP Response: The slight discrepancy in the calculation of the total nitrogen target is due to a difference in rounding. The Department used the regression equation to calculate a total nitrogen concentration that results in achieving a chlorophyll a concentration of 8.0 µg/L. Using a total nitrogen concentration of 0.97 mg/L in the equation results in a chlorophyll a concentration of 8.1 µg/L.

As noted in the response to comment 11, the regression equation has been updated with the results from the September 2011 sampling event. The updated regression equation is y=28.928x – 19.625, and using this equation results in a total nitrogen concentration of 0.95 mg/L to achieve a chlorophyll a value of 8.0 µg/L. The existing total nitrogen concentration, using the 2011 average of 1.12 mg/L, is slightly lower than the value originally used. The existing total nitrogen concentration will need to be reduced by 15 percent to achieve the revised target concentration of 0.95 mg/L. Chapters 5 and 6 of the report have been revised using the updated total nitrogen concentration target and percent reduction calculation.

15. Load reductions required to meet the concentration target were not determined.

FDEP Response: The analysis conducted for TMDL development included the comparison of watershed loads at the USGS gage to chlorophyll a results, however, there were no significant relationships found. The establishment of a TMDL based on a concentration target and percent reduction is an appropriate method for expressing a TMDL. We believe this method is the best way to move forward in addressing water quality problems in the Curlew Creek tidal segment. EPA supports using either (or both) a concentration or load target when setting nutrient TMDLs, as appropriate.

16. 6.3.2 NPDES Stormwater Dischargers: This section states that permitees "may be responsible for a 29 percent reduction in current anthropogenic total nitrogen loading"; however the derived TMDL was calculated as a total nitrogen concentration. No relationship has been established between loading and concentration.

FDEP Response: As noted in the response to comment 14, the reduction needed in the existing ambient concentration to meet the total nitrogen target is 15 percent, using the updated regression analysis. As indicated in Section 6.3.2, jurisdictions in the watershed may be responsible for meeting the TMDL percent reduction in their current anthropogenic load. This determination can be made after further evaluation in the development of a restoration plan. Other factors, such as in-stream processes which also influence algal biomass, can be taken into consideration when developing the specific load reductions in the restoration plan and may result in anthropogenic load reductions that are different than the percent reduction expressed in the TMDL.

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We greatly appreciate the County's involvement in reviewing and commenting on the TMDL reports which resulted in improvements to the reports. 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

Enclosures

cc: Sarah Malone, Pinellas County, w/o Enclosures
Thomas Burke, City of Dunedin, w/o Enclosures
ec: Kevin O'Donnell, DEP, w/o Enclosures
ec: Terry Hansen, DEP, w/o Enclosures

November 9, 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 Dissolved Oxygen and Nutrient TMDL for the Curlew Creek Tidal Segment (WBID 1538)

Dear Mr. Peene:

The Department has reviewed the Applied Technology and Management, Inc. comments on the proposed Dissolved Oxygen and Nutrient TMDL for the Curlew Creek Tidal Segment (WBID 1538) that were submitted via email on September 10, 2012 on behalf of the Florida Department of Transportation. 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. The use of a reference approach for developing Chl *a* target levels may not be the best method for determining target Chl *a* levels in tidal tributaries. In tidal waters targets developed based on impacts to resources and habitat have ranged as high as 15 µg/L locally. Presently there are ongoing studies in the Tampa Bay area to define appropriate Chl *a* targets for tidal tributaries, the report should at least recognize this ongoing effort and the limitations of a reference approach.

   FDEP Response: The Department recognizes that there are limitations to the reference approach and is aware of the efforts in the Tampa Bay area to identify targets for tidal tributaries. It is also important to note that in some Tampa Bay segments chlorophyll a targets less than the IWR threshold of 11 µg/L (as low as 5 µg/L) were established for seagrass restoration. We believe the reference approach used to develop a chlorophyll a target for the impaired tidal creek segments is the best information currently available for deriving an estuary water quality target along the Pinellas County Gulf coast. In the future, if the approach being applied to develop targets for Tampa Bay area tidal tributaries is successful, consideration can be given to investigating its applicability in other tidal systems.

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2. The data that was provided by the City of Dunedin appears to show that there may be a change in the system that occurred after 2005. The Chl a levels are lower, the DO levels are higher, and the TN levels are lower. Examination of the hydrologic loads and the TN loads do not indicate that this year was significantly different than other years, although the ratio of the TN load to the hydrologic load appears different. This raises the question does the relationship developed primarily from data prior to 2005 still hold. It is significant to note that in 2011 the Chl a annual average was below the target with a TN level well above the target. The limited data since 2005 makes any conclusion on this difficult, but the issue needs to be flushed out further before the TMDL is finalized.

   FDEP Response: The tidal segment and the lower reaches of the freshwater segment lie within the Dunedin city limits. The Department contacted the city to determine if there were any activities that occurred that could have effects on surface water quality, however, there were no activities identified in this area that occurred between 2005 and 2011. As noted, there are limited data in the tidal segment since 2005. We believe the approach used to develop the TMDL is the best way of moving forward to address water quality issues. Further data collection can be conducted as part of a restoration plan, to assist in identifying factors that may have led to the large decrease in chlorophyll a levels that occurred in 2011.

Response to comments in DETAILED COMMENTS

1. The 2011 annual average Chl *a* concentration was lower than the selected Chl *a* target (8 µg/L) based on existing conditions (see the figure below). Unfortunately, there is a 7-year gap in the recent data record so that it shows the target has been met in one year only. If near-term data from 2012 and beyond also show that the Chl *a* target is being met with TN concentrations greater than 0.96 mg/L or without additional best management practices (BMP) implementation occurring, would the department determine the TMDL has been achieved and that the reduction proposed for the WBID is not required before the next review cycle? Some discussion by FDEP would be useful given that the proposed reduction is not large and has some inherent uncertainty (i.e., may not be required to meet the water quality target) given the 7-year data gap.

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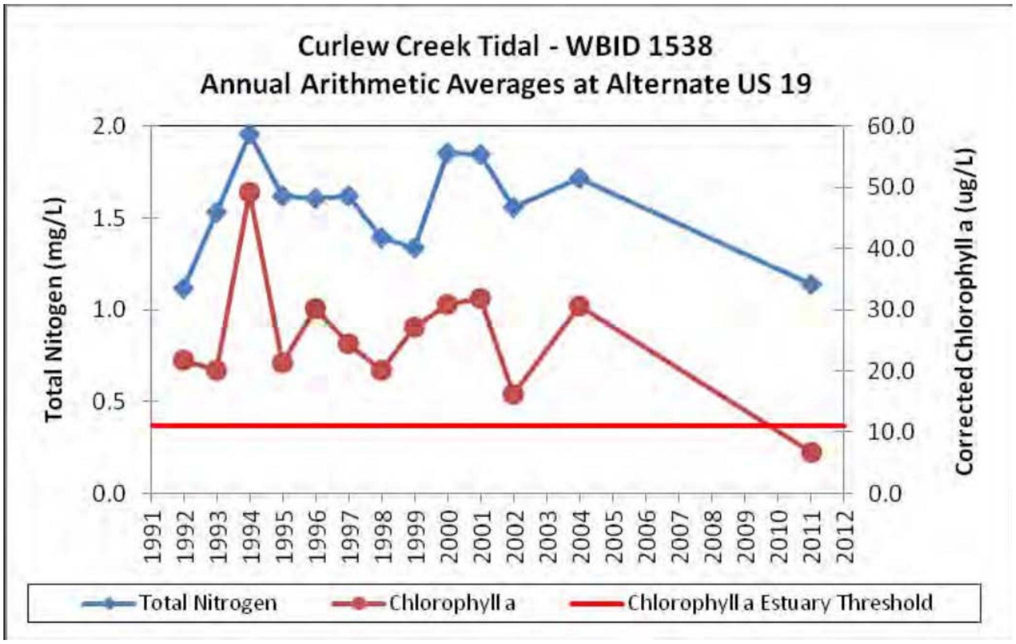

FDEP Response: Following the IWR methodology, a water segment may be removed from the verified list for nutrients if the annual average chlorophyll a values are less than the estuary threshold of 11 µg/L for three consecutive years. This same reasoning may be applied using the selected water quality target for chlorophyll a. After the TMDL is adopted, the Department's Watershed Planning and Coordination Section will work with the stakeholders in the watershed to determine a path forward for assessing future water quality and develop a schedule for the implementation of activities to address the TMDL. Additional activities may include further study to help determine the factors leading to the recent improvements in water quality.

2. The use of a reference approach for developing Chl a target levels may not be the best method for determining target Chl a levels in tidal tributaries. In tidal waters targets developed based on impacts to resources and habitat have ranged as high as 15 µg/L locally. Presently there are ongoing studies in the Tampa Bay area to define appropriate Chl a targets for tidal tributaries, the report should at least recognize this ongoing effort and the limitations of a reference approach.

   FDEP Response: Please see the response to comment 1 under Summary of Findings, as this comment is the same as comment 1.

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We want to inform you that after the Department proposed the TMDL, the City of Dunedin's contract laboratory provided an accurate chlorophyll a result for the 9/22/2011 sampling event that was not included in the original analysis. There was an error in the reporting of chlorophyll a results for the September 2011 sampling event and the city's result at the Alternate US 19 location on Curlew Creek, previously provided, was off by a factor of 1,000. The correct result for 9/22/2011 is 12 µg/L. Including the chlorophyll a and total nitrogen results for the 9/22/2011 sampling event in the regression analysis, 12 µg/L and 0.94 mg/L respectively, results in a 2011 annual average chlorophyll a value of 7.2 µg/L and an annual value for total nitrogen of 1.12 mg/L. The r-square value of the relationship between annual average chlorophyll a and total nitrogen improves slightly to 0.58 with the September 2011 results included.

The updated regression equation is $y=28.928x - 19.625$, and using this equation results in a total nitrogen concentration of 0.95 mg/L to achieve a chlorophyll a value of 8.0 µg/L. The existing total nitrogen concentration, using the 2011 average of 1.12 mg/L, is slightly lower than the value originally used. The existing total nitrogen concentration will need to be reduced by 15 percent to achieve the revised target concentration of 0.95 mg/L. Chapters 5 and 6 of the report have been updated with this new information.

Thank you for your time and effort in reviewing the proposed Curlew 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

cc: Janet Hearn, ATM
Robert Burleson, ATM
Sue Moore, Florida DOT
ec: Terry Hansen, DEP