NORTHWEST DISTRICT • OCHLOCKONEE–ST. MARKS BASIN

Final TMDL Report
Nutrient TMDLs for Lake Tallavana
(WBID 540A)

and Documentation in Support of the Development of Site-Specific Numeric Interpretations of the Narrative Nutrient Criterion

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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Loads (TMDLs) developed to address the nutrient impairment of Lake Tallavana, which is located in the Ochlockonee–St. Marks Basin. The TMDLs will constitute the site-specific numeric interpretation of the narrative nutrient criterion set forth in Paragraph 62-302.530(47)(b), Florida Administrative Code (F.A.C.), that will replace the otherwise applicable numeric nutrient criteria (NNC) in Subsection 62-302.531(2), F.A.C., for this particular water, pursuant to Paragraph 62-302.531(2)(a), F.A.C.. The lake was verified as impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.), and was included on the Verified List of Impaired Waters for the Ochlockonee–St. Marks Basin that was adopted by Secretarial Order on March 11, 2003.

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 criteria based on the relationship between pollution sources and water quality in the receiving waterbody. The TMDLs establish the allowable loadings to Lake Tallavana that would restore the waterbody so that it meets its applicable water quality criteria for nutrients.

1.2 Identification of Waterbody

For assessment purposes, the Florida Department of Environmental Protection has divided the Ochlockonee–St. Marks Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each segment. Lake Tallavana is WBID 540A.

Lake Tallavana is an approximately 160-acre waterbody located west of Havana in Gadsden County, Florida (**Figures 1.1** and **1.2**). Lake Tallavana is part of the Hurricane Creek drainage system, with the lake outlet discharging into Hurricane Creek, which flows into the Little River, then Lake Talquin, and eventually into the Ochlockonee River. During the late 1920s and into 1930, a logging community was established near the current site of the entrance gate of the Lake Tallavana Community. The community was serviced by a railroad that ran through Pine Top Plantation. When this tract was purchased in 1971, Pine Top Lake was a 40-acre lake. The Burt and Harrell families sold Pine Top Lake to a group of five investors who set about expanding the 40-acre lake to 160 acres and renamed it Lake Tallavana. The first lots were made available for sale in March 1972.

The lake lies in the Quincy Hills division of the Tifton Uplands District. The Tifton Uplands region (locally known as the Tallahassee Hills) consists of clay-capped ridges that have been eroded and dissected by streams, with a relatively high potential for runoff (Department 2001). The geology in the area is dominated by clayey sand and clayey limestone of the Hawthorn Formation. In the eastern Panhandle of north Florida, this type of clay is associated with the Torreya Formation of the Hawthorn Group (Scott 1988).

For the purposes of this TMDL analysis, the Lake Tallavana watershed boundary is defined as shown in **Figure 1.3.** The lake watershed, which encompasses approximately 4,063.6 acres, includes three main subbasins: Hurricane Creek (approximately 1,715.1 acres), Beaver Creek (approximately 1,339.9 acres), and Magnolia Hammock (approximately 386.3 acres). The remaining acreage is considered independent from the three subbasins. The Hurricane Creek subbasin is drained by Hurricane Creek, which originates slightly north of the County Road 159 overpass, and is fed by a number of intermittent streams. The topography at the headwaters of the creek consists of gently rolling to fairly steep draws. The topography in the lower parts of the subbasin is relatively flat, containing a broad riverine forested floodplain and riparian wetlands. The Beaver Creek subbasin is drained by Beaver Creek, which originates near County Road 159, and is fed by several well-defined secondary, intermittent streams. The topography in this subbasin is fairly steep and is made up of several secondary ravines. The Magnolia Hammock subbasin drains to the southern part of the lake. The main tributary, Magnolia Hammock, originates near County Road 270 and is fed by two small, intermittent streams.

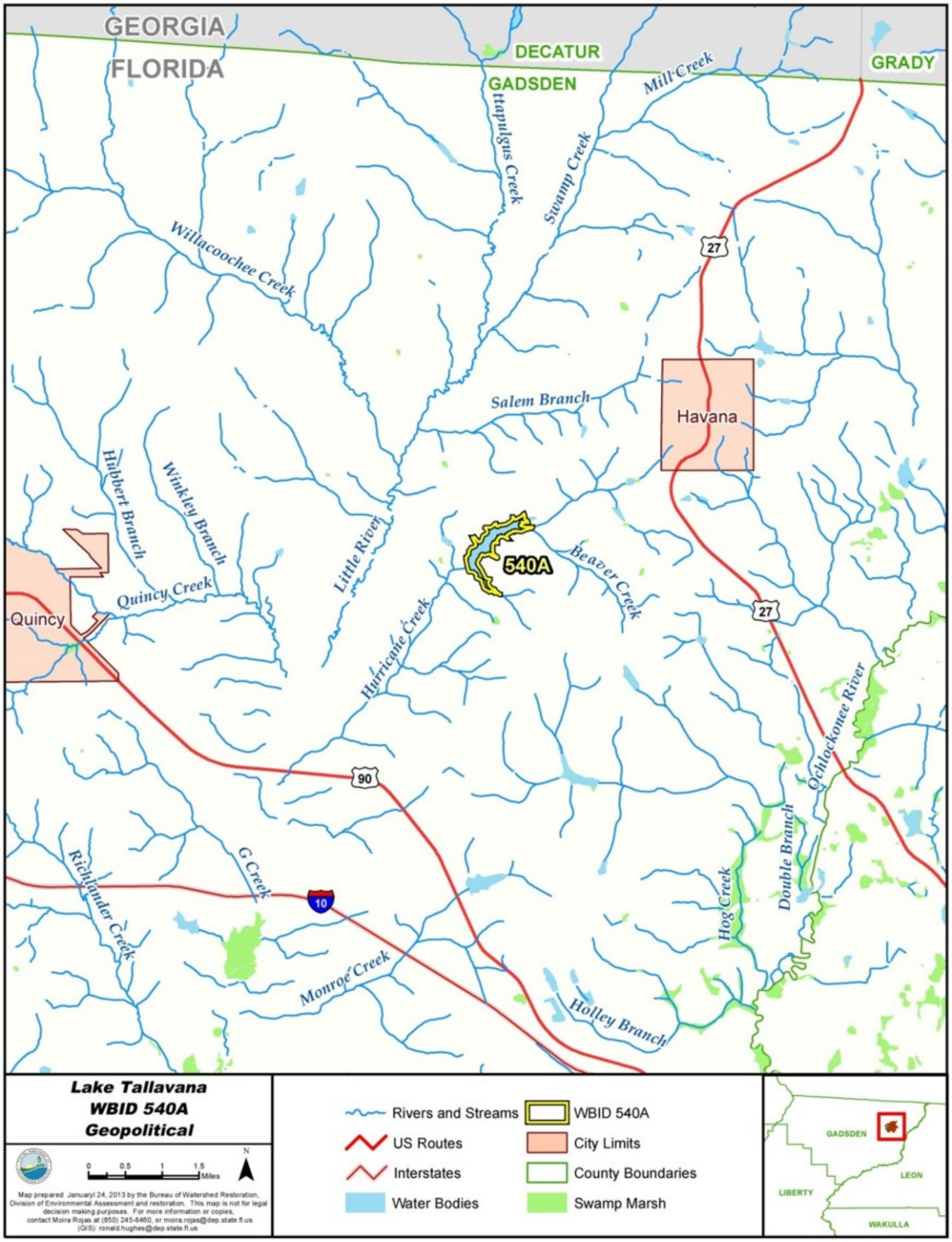


Figure 1.1. Location of Lake Tallavana (WBID 540A) in Gadsden County and Major Hydrologic and Geopolitical Features in the Area

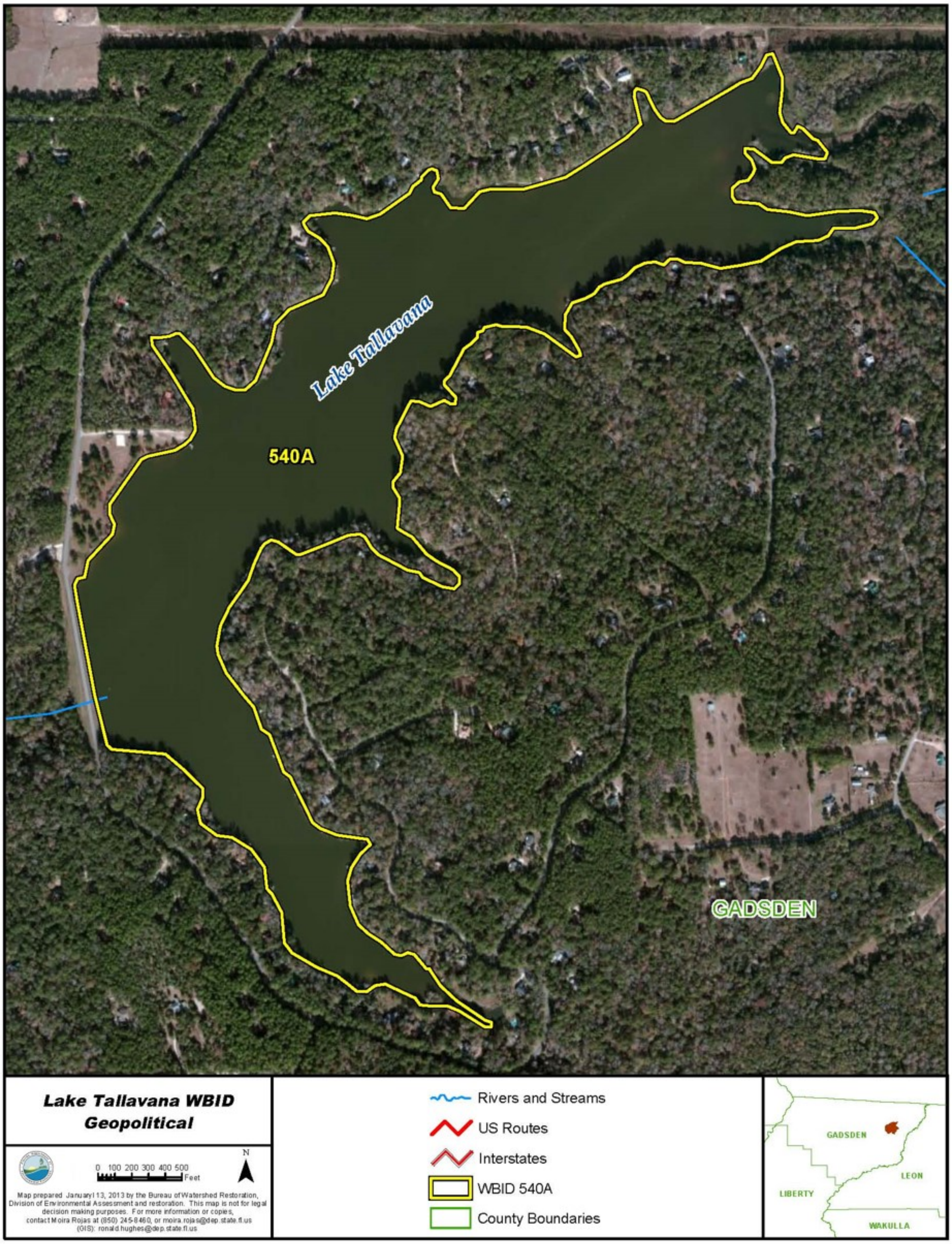


Figure 1.2. Location of Lake Tallavana (WBID 540A)

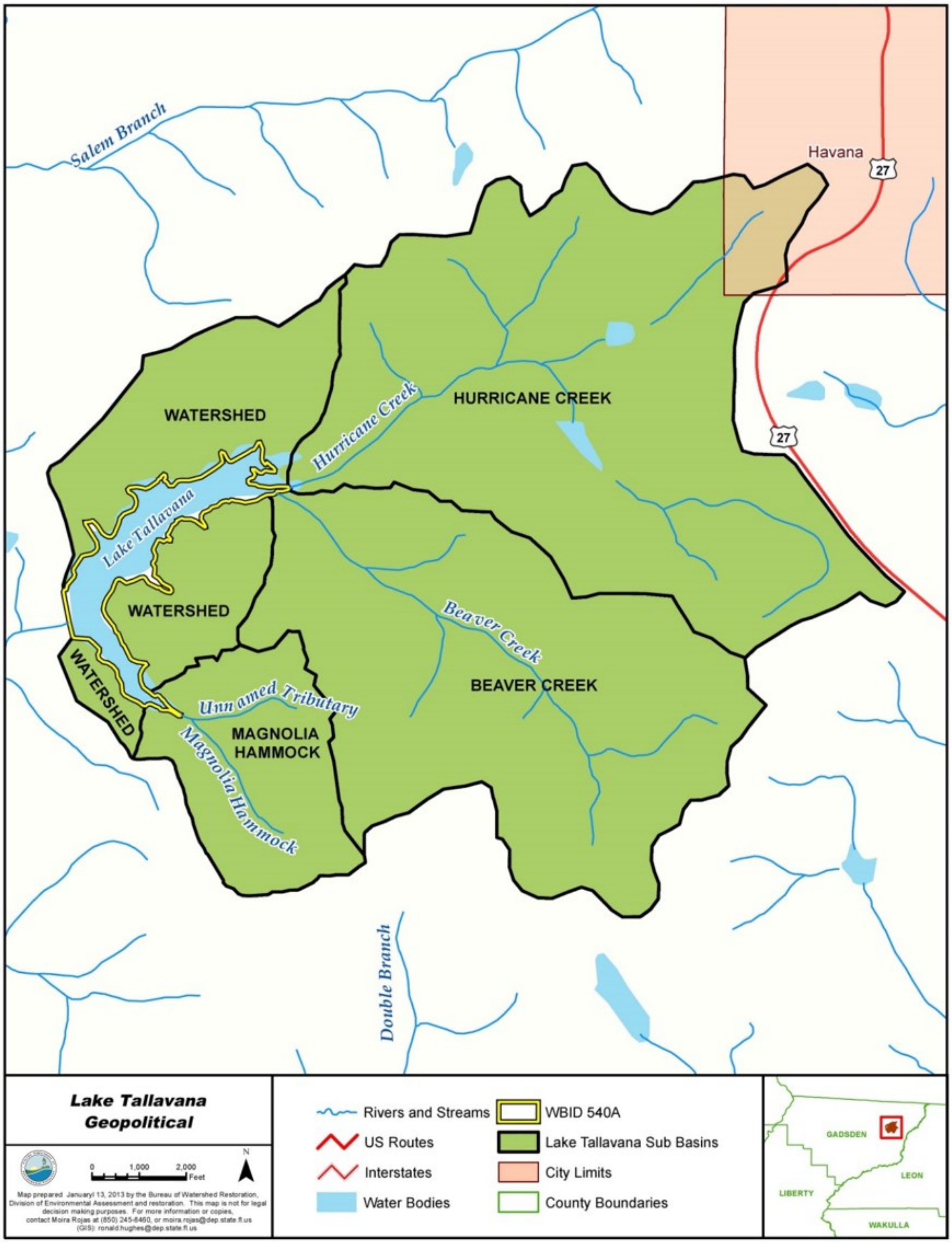


Figure 1.3. Lake Tallavana Watershed Boundary and Surrounding Subbasins

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).

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 designed to reduce the amount of nutrients or causative pollutants that caused the verified impairment of Lake Tallavana (WBID 540A). These activities will depend heavily on the active participation of the Northwest Florida Water Management District (NWFMD), 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 United States Environmental Protection Agency (EPA) lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment of listed waters on a schedule. The department has developed such lists, commonly referred to as 303(d) lists, since 1992. The FWRA (Section 403.067, F.S.) 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, F.A.C. (Identification of Impaired Surface Waters Rule, or IWR), in April 2001; the rule was amended in 2006, 2007, 2012, and 2013.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.]); the state's 303(d) list is amended annually to include basin updates.

2.2 Information on Verified Impairment

The department used the IWR to assess water quality impairments in Lake Tallavana, and the lake was verified as impaired for nutrients based on elevated annual average Trophic State Index (TSI) during the Cycle 1 verified period (January 1, 1995–June 30, 2002). Prior to 2013, which includes the assessment periods for Lake Tallavana, the IWR methodology used three water quality variables—total nitrogen (TN), total phosphorus (TP), and chlorophyll *a* (a measure of algal mass, corrected and uncorrected)—in calculating annual TSI values and in interpreting Florida's narrative nutrient threshold. The TSI was calculated based on concentrations of TP, TN, and chlorophyll *a*. Exceeding a TSI of 40 when annual mean color is less than 40 platinum cobalt units (PCU), or exceeding a TSI of 60 when annual mean color is greater than 40 PCU or color data are missing in any one year of the verified period, was sufficient for identifying a lake as impaired for nutrients.

In Lake Tallavana, the TSI threshold was exceeded from 1995 to 2000, and from 2004 to 2006. This impairment was confirmed during the Cycle 2 verified period (January 1, 2000–June 30, 2007) and the more recent Cycle 3 verified period assessment (January 1, 2005–June 30, 2012), when annual mean TSI values continued to exceed the TSI threshold; therefore, the lake has remained on the Verified List of waters that need a TMDL. **Table 2.1** summarizes the annual average TSI values for Lake Tallavana.

Table 2.1. Summary of Annual Average TSI Values for Lake Tallavana (WBID 540A), 1995–2012

- = Empty cell/no data

Year	Mean Color (PCU)	Mean TSI	Exceedance
1995	-	50	
1996	-	50	
1997	-	50	
1998	-	50	
1999	-	58	
2000	-	70	Yes
2001	-	-	-
2002	-	-	-
2003	-	-	-
2004	-	77	Yes
2005	-	74	Yes
2006	26.9	51	Yes
2007	55.0	-	-
2008	-	-	-
2009	23.8	60	Yes
2010	45.0	-	-
2011	38.4	62	Yes
2012	41.4	-	-

Florida adopted NNC for lakes, spring vents, and streams in 2011 that were approved by the United States Environmental Protection Agency (EPA) in 2012. Pursuant to Chapter 2013-71, Laws of Florida, the criteria went into effect on October 27, 2014. It is envisioned that these standards, in combination with the related bioassessment tools, will facilitate the assessment of designated use attainment for these waters and provide a better means to protect state waters from the adverse effects of nutrient overenrichment. The new lake NNC, set forth in Subparagraph 62-302.531(2)(b)1., F.A.C., are expressed as annual geometric mean (AGM) values for chlorophyll *a*, TN, and TP, which are further described in Chapter 3.

Although the department has not formally assessed the data for Lake Tallavana using the new NNC, based on an analysis of the data from 2002 to 2012 in IWR Database Run 49, the preliminary results indicate that Lake Tallavana would not attain the lake NNC for chlorophyll *a* and TP for low-color (< 40 PCU), high-alkalinity (> 20 milligrams per liter [mg/L] calcium carbonate [$CaCO_3$]) lakes, and thus remains impaired for nutrients. This time frame represents the Cycle 2 verified period and more recent water quality data that have been reported. Under the NNC, Lake Tallavana is classified as a lake with lower color (<40 PCU) and high alkalinity (>20 mg/L $CaCO_3$), based on the long-term geometric mean values for color and alkalinity. **Table 3.2** lists the preliminary AGM values for chlorophyll *a*, TN, and TP during the 2002 to 2012 period.

The sources of data for the Cycle 1, Cycle 2, and Cycle 3 IWR assessment of WBID 540A, and results reported in more recent years, came from stations sampled by Florida LakeWatch (21FLKWAT…), McGlynn Laboratories (21FLMCGLTAL…), and the department's Northwest District Office (21FLPNS…). The other organizations sampling the lake, including Biological Research Associates (21FLBRA…) and the department's Ambient Monitoring Section (21FLGW…), conducted monitoring intermittently in 2006 and 2009, and the department's Watershed Assessment Section (21FLWQA…) conducted sampling in 2006. **Figure 2.1** displays the sampling locations. The individual water quality measurements used in this analysis are available in the IWR database (Run 49), and are available on request. Water quality results for the period of record for variables relevant to this TMDL effort, collected by all sampling entities, are displayed in the tables in **Appendix B**.

In Florida waterbodies, nitrogen and phosphorus are most often the limiting nutrients. A limiting nutrient is defined as the nutrient(s) that limits plant growth (both macrophytes and algae) when it is not available in sufficient quantities. In the past, management activities to control lake eutrophication focused on phosphorus reduction, as phosphorus was generally considered the limiting nutrient in freshwater systems. Recent studies, however, support the reduction of both nitrogen and phosphorus to control algal growth in aquatic systems (Conley 2009, Paerl 2009, Paerl and Otten 2013). Furthermore, the analysis used in the development of the Florida lake NNC supports this idea, as statistically significant relationships were found between chlorophyll *a* values and both nitrogen and phosphorus concentrations (Department 2012).

2.3 Data Used in the Determination of the TMDL

Since 1991 water quality measurements for chlorophyll *a* and nutrients have been collected at 21 stations in Lake Tallavana (**Figure 2.1**). **Table 2.2** contains information on each of the water quality sampling stations.

The majority of the chlorophyll *a* data collected in the lake are uncorrected chlorophyll *a* data (CHLA). **Table 2.3** provides summary information on the stations with collected CHLA in Lake Tallavana, and **Table 2.4** provides a statistical summary of corrected chlorophyll *a* (CHLAC) observations (N represents the number of CHLA or CHLAC observations) at the 13 stations with multiple sampling dates, and **Appendix B** contains historical CHLA, CHLAC, temperature (TEMP), TN, and TP observations from sampling sites in WBID 540A from 1991 to 2012. The 25th and 75th percentile values are included in **Table 2.4**. **Figures 2.2** and **2.3** show the trend of CHLA and CHLAC levels, respectively, in Lake Tallavana. The simple linear regression of chlorophyll *a* versus sampling date in **Figure 2.2** was significant at an alpha (α) level of 0.05 ($R^2 = 0.194$, $p<0.0001$) and indicated an increasing trend in CHLA.

Table 2.2. Water Quality Stations in Lake Tallavana during the Period of Record (1991–2012)

Station ID	Agency	Period of Observation
21FLBRA 540A-A	Biological Research Associates (ENTRIX)	2006–07
21FLBRA 540A-B	Biological Research Associates (ENTRIX)	2006
21FLBRA 540A-D	Biological Research Associates (ENTRIX)	2006
21FLBRA 540A-E	Biological Research Associates (ENTRIX)	2006
21FLBRA 540A-F	Biological Research Associates (ENTRIX)	2006
21FLGW 36986	Department	2009
21FLGW 37922	Department	2009
21FLWQA 303552108428052	Department	2006
21FLGW 9230	Department	2000
21FLKWATGAD-TALLAVANA-1	Florida LakeWatch	1991–2009
21FLKWATGAD-TALLAVANA-2	Florida LakeWatch	1991–2011
21FLKWATGAD-TALLAVANA-3	Florida LakeWatch	1991–2009
21FLKWATGAD-TALLAVANA-4	Florida LakeWatch	1992–2011
21FLKWATGAD-TALLAVANA-5	Florida LakeWatch	1999–2011
21FLMCGLTAL-BC	McGlynn Laboratories, Inc.	2009–12
21FLMCGLTAL-HC	McGlynn Laboratories, Inc.	2009–12
21FLMCGLTAL-MH	McGlynn Laboratories, Inc.	2009–12
21FLMCGLTAL-OUT	McGlynn Laboratories, Inc.	2009–12
21FLPNS 303552108428052	Department (Northwest District)	2011–12
21FLPNS 540A-E	Department (Northwest District)	2011–12
21FLPNS GAD-TALLAVANA-5	Department (Northwest District)	2011–12

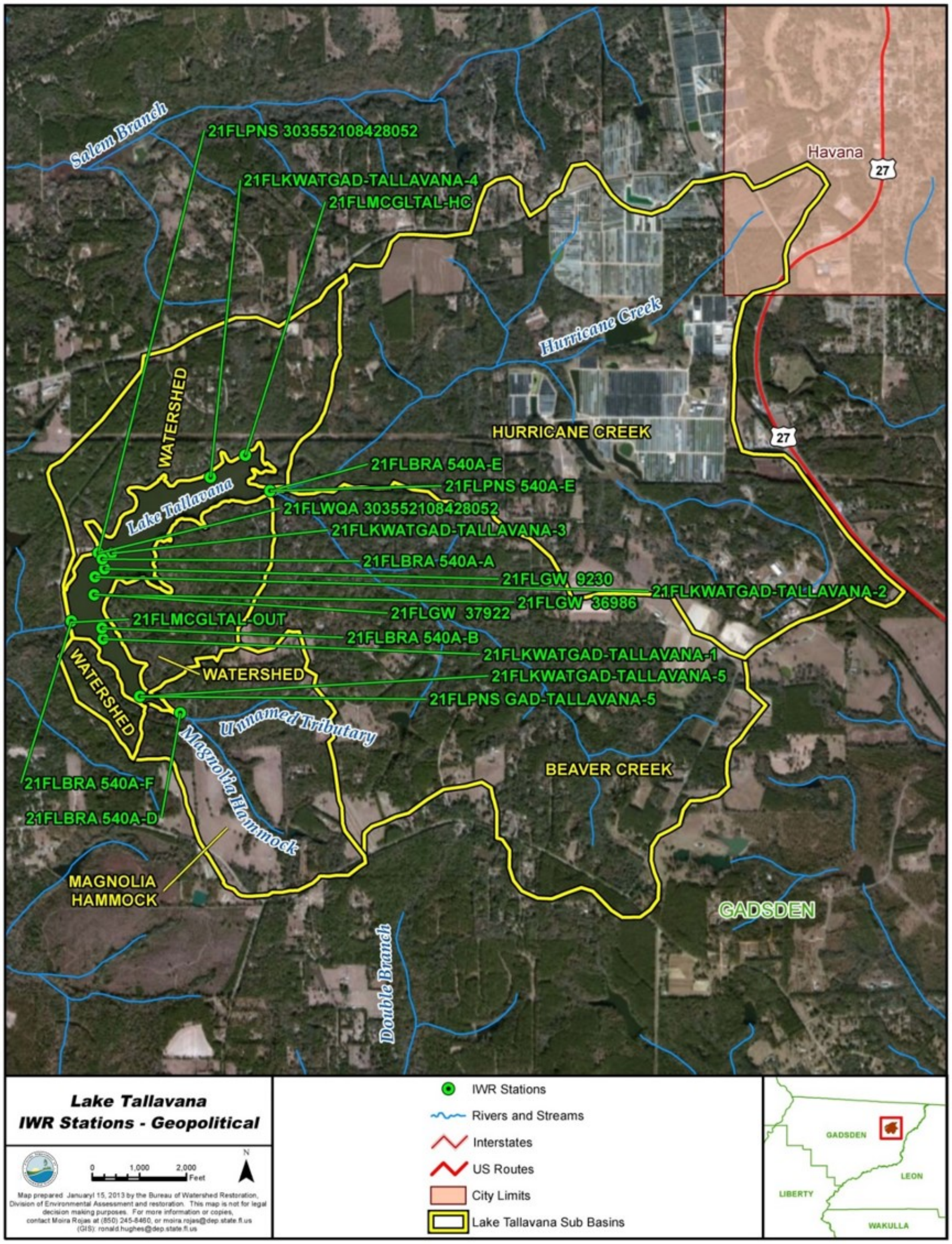


Figure 2.1. Lake Tallavana Water Quality Sampling Stations

Table 2.3. Summary Statistics for Lake Tallavana Stations with Multiple CHLA Measurements (µg/L)

Station	N	Minimum	25th Percentile	Median	Mean	75th Percentile	Maximum
21FLBRA 540A-A	10	1.3	8.7	31.5	36.4	70.5	83.0
21FLBRA 540A-B	4	1.3	7.7	35.0	37.3	69.3	78.0
21FLBRA 540A-D	4	36.0	38.3	45.5	46.8	56.5	60.0
21FLBRA 540A-E	7	1.0	1.6	14.0	34.9	78.0	85.0
21FLBRA 540A-F	2	87.0	87.0	90.5	90.5	94.0	94.0
21FLKWATGAD-TALLAVANA-1	169	5.0	34.5	56.0	64.2	83.5	189.0
21FLKWATGAD-TALLAVANA-2	178	6.0	36.0	57.0	65.3	91.3	212.0
21FLKWATGAD-TALLAVANA-3	167	5.0	35.0	55.0	68.5	93.0	380.0
21FLKWATGAD-TALLAVANA-4	165	6.0	35.0	63.0	76.0	102.5	423.0
21FLKWATGAD-TALLAVANA-5	87	19.0	56.0	77.0	85.5	99.0	198.0

Table 2.4. Summary Statistics for Lake Tallavana Stations with Multiple CHLAC Measurements (µg/L)

Station	N	Minimum	25th Percentile	Median	Mean	75th Percentile	Maximum
21FLBRA 540A-A	10	1.0	1.0	1.8	6.8	3.8	48.0
21FLBRA 540A-B	4	1.0	1.0	1.9	5.9	14.9	19.0
21FLBRA 540A-D	4	1.0	1.4	3.1	2.9	4.1	4.3
21FLBRA 540A-E	7	1.0	1.0	1.0	5.6	7.5	21.0
21FLBRA 540A-F	2	3.2	3.2	4.3	4.3	5.3	5.3
21FLMCGLTAL-BC	10	10.1	12.9	33.8	39.5	53.2	112.4
21FLMCGLTAL-HC	12	5.3	23.6	35.6	40.9	61.6	87.7
21FLMCGLTAL-MH	11	1.0	6.5	43.8	44.7	55.9	160.2
21FLMCGLTAL-OUT	24	3.0	24.0	37.0	46.2	63.1	154.6
21FLPNS 303552108428052	4	23.0	24.3	34.5	35.5	47.8	50.0
21FLPNS 540A-E	4	24.0	28.0	44.5	41.8	52.8	54.0
21FLPNS GAD-TALLAVANA-5	2	34.0	34.0	36.0	36.0	38.0	38.0
21FLWQA 303552108428052	2	54.0	54.0	58.5	58.5	63.0	63.0

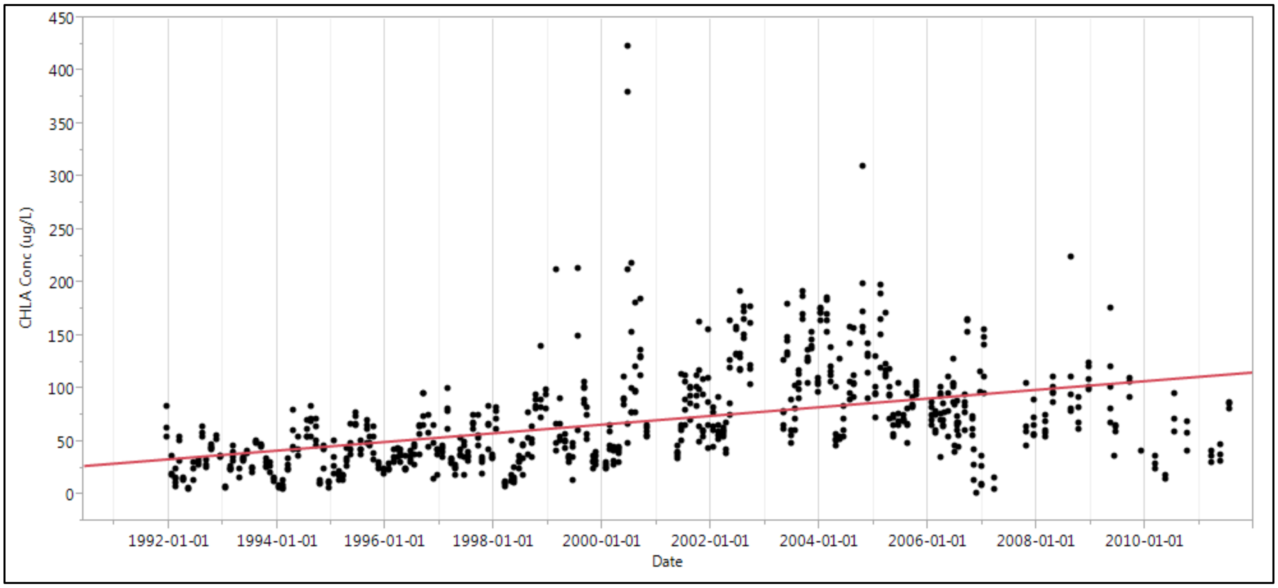


Figure 2.2. CHLA Time Series for Lake Tallavana

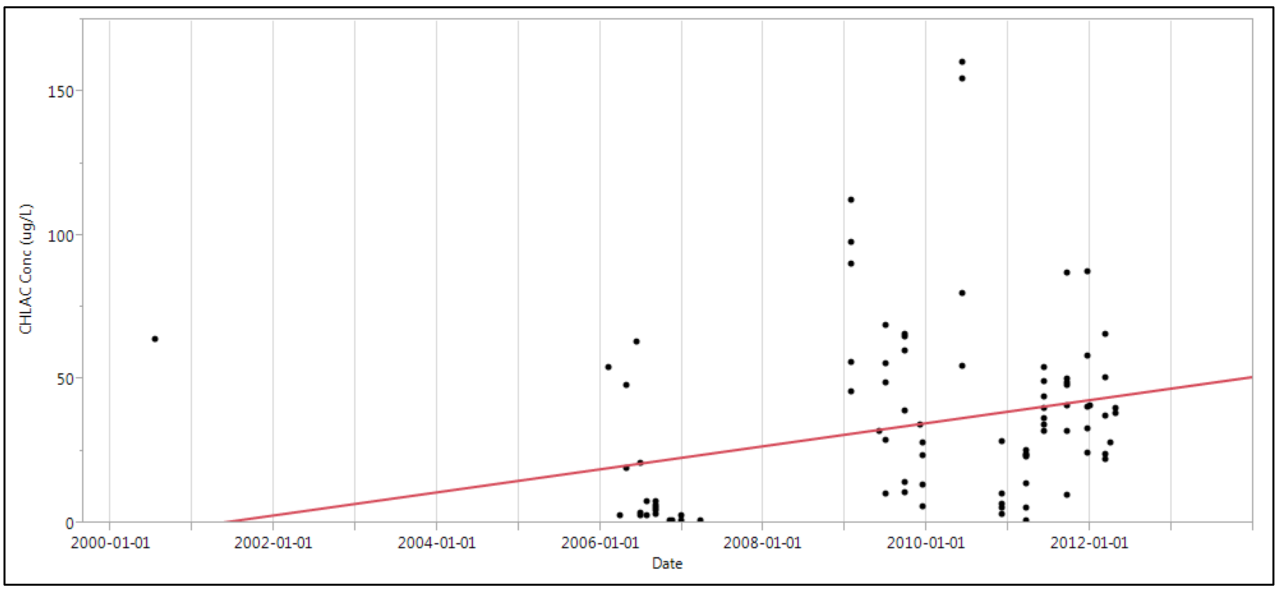


Figure 2.3. CHLAC Time Series for Lake Tallavana

There were 16 stations in Lake Tallavana with multiple measurements of TN. **Table 2.5** provides summary statistics for TN measurements at these stations, and observations are graphed in **Figure 2.4**. The simple linear regression of TN versus sampling date in **Figure 2.4** was significant at an alpha (α) level of 0.05 ($R^2 = 0.322$, $p < 0.0001$) and indicated an increasing trend in TN. Temporal patterns in TN concentrations were similar to those seen for CHLA concentrations.

Table 2.5. Summary Statistics for Stations in Lake Tallavana with Multiple TN Measurements (mg/L)

Station	N	Minimum	25th Percentile	Median	Mean	75th Percentile	Maximum
21FLBRA 540A-A	9	0.76	0.89	1.31	1.23	1.51	1.54
21FLBRA 540A-B	4	1.22	1.28	1.47	1.44	1.57	1.60
21FLBRA 540A-D	3	0.71	0.71	1.10	1.13	1.56	1.56
21FLBRA 540A-E	6	0.85	1.02	1.23	1.28	1.63	1.69
21FLKWATGAD-TALLAVANA-1	170	0.35	0.66	0.86	0.98	1.24	2.04
21FLKWATGAD-TALLAVANA-2	178	0.37	0.68	0.87	1.00	1.26	1.98
21FLKWATGAD-TALLAVANA-3	169	0.39	0.70	0.89	1.02	1.30	2.78
21FLKWATGAD-TALLAVANA-4	165	0.43	0.75	1.00	1.14	1.51	3.17
21FLKWATGAD-TALLAVANA-5	86	0.66	1.06	1.32	1.33	1.60	2.09
21FLMCGLTAL-BC	10	0.38	0.48	0.85	0.84	1.07	1.60
21FLMCGLTAL-HC	12	0.50	0.66	1.05	1.59	2.01	5.82
21FLMCGLTAL-MH	11	0.19	0.48	0.64	1.01	1.62	2.81
21FLMCGLTAL-OUT	24	0.29	0.46	0.71	0.90	1.26	3.76
21FLPNS 303552108428052	4	0.80	0.82	1.04	1.05	1.28	1.30
21FLPNS 540A-E	4	1.10	1.13	1.27	1.26	1.38	1.40
21FLPNS GAD-TALLAVANA-5	2	1.00	1.00	1.05	1.05	1.10	1.10

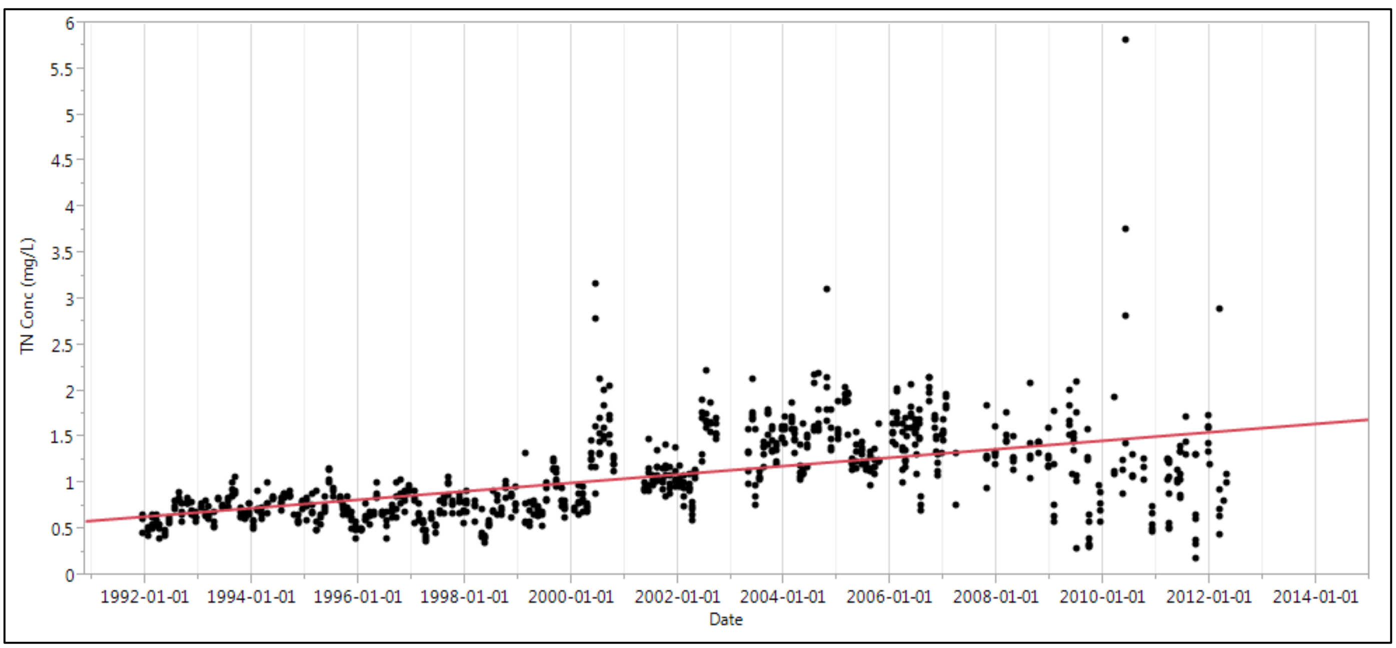


Figure 2.4. TN Time Series for Lake Tallavana

There were 19 stations in Lake Tallavana with multiple measurements of TP. **Table 2.6** provides summary statistics for TP measurements at these stations, and observations are graphed in **Figure 2.5**. The simple linear regression of TP versus sampling date in **Figure 2.5** was significant at an alpha (α) level of 0.05 ($R^2 = 0.302$ $p < 0.0001$) and indicated an increasing trend in TP.

The state-adopted NNC for lakes presented in **Chapter 3** are related to the long-term geometric mean color and alkalinity of a lake. The long-term geometric means for color and alkalinity in Lake Tallavana were 25 PCU and 57 mg/L as $CaCO_3$, respectively. **Figures 2.6** and **2.7** show time series graphs of color and alkalinity, respectively. **Table 2.7** summarizes the distribution of key water quality parameters in Lake Tallavana based on measurements from 1991 to 2012.

Table 2.6. Summary Statistics for Lake Tallavana Stations with Multiple TP Measurements (mg/L)

Station	N	Minimum	25th Percentile	Median	Mean	75th Percentile	Maximum
21FLBRA 540A-A	10	0.086	0.138	0.175	0.186	0.218	0.310
21FLBRA 540A-B	4	0.150	0.153	0.165	0.168	0.185	0.190
21FLBRA 540A-D	4	0.089	0.107	0.160	0.167	0.235	0.260
21FLBRA 540A-E	7	0.095	0.170	0.190	0.214	0.290	0.300
21FLBRA 540A-F	2	0.330	0.330	0.355	0.355	0.380	0.380
21FLKWATGAD-TALLAVANA-1	170	0.026	0.057	0.081	0.104	0.142	0.297
21FLKWATGAD-TALLAVANA-2	178	0.029	0.061	0.088	0.109	0.151	0.318
21FLKWATGAD-TALLAVANA-3	169	0.030	0.060	0.082	0.113	0.161	0.459
21FLKWATGAD-TALLAVANA-4	165	0.029	0.071	0.122	0.148	0.209	0.498
21FLKWATGAD-TALLAVANA-5	87	0.053	0.123	0.151	0.155	0.178	0.371
21FLMCGLTAL-BC	10	0.046	0.074	0.113	0.114	0.123	0.281
21FLMCGLTAL-HC	12	0.088	0.096	0.181	0.225	0.278	0.782
21FLMCGLTAL-MH	11	0.007	0.048	0.120	0.113	0.141	0.343
21FLMCGLTAL-OUT	24	0.004	0.105	0.167	0.279	0.333	1.252
21FLPNS 303552108428052	4	0.099	0.102	0.120	0.172	0.295	0.350
21FLPNS 540A-E	4	0.180	0.180	0.220	0.238	0.313	0.330
21FLPNS GAD-TALLAVANA-5	2	0.140	0.140	0.165	0.165	0.190	0.190

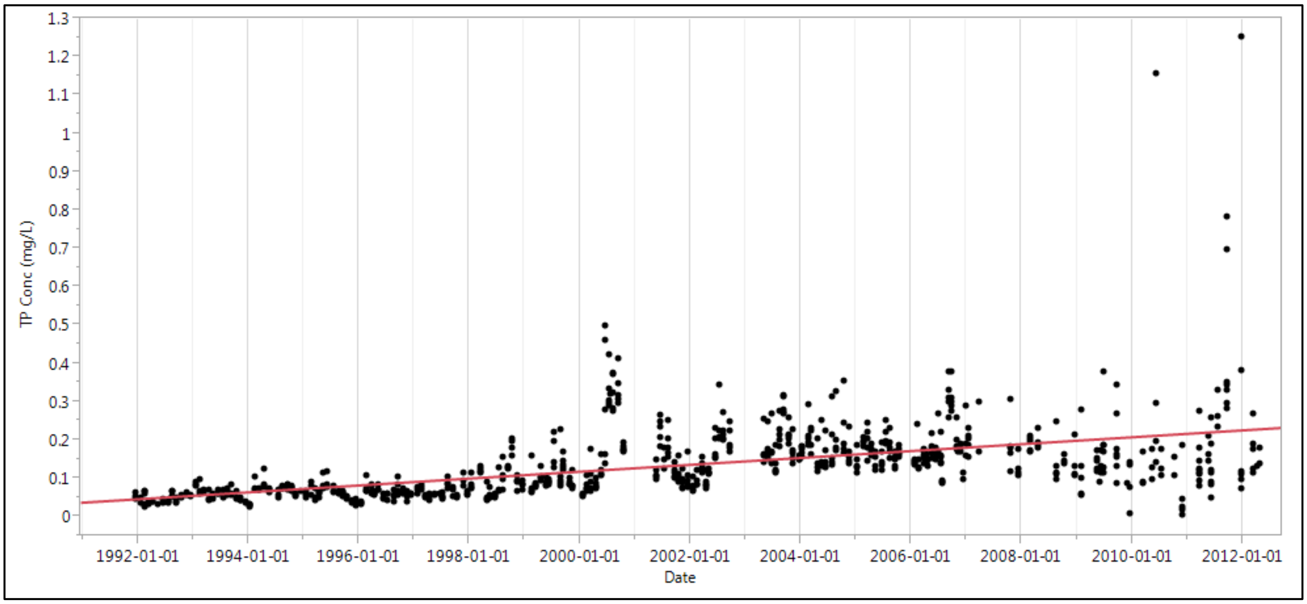


Figure 2.5. TP Time Series for Lake Tallavana

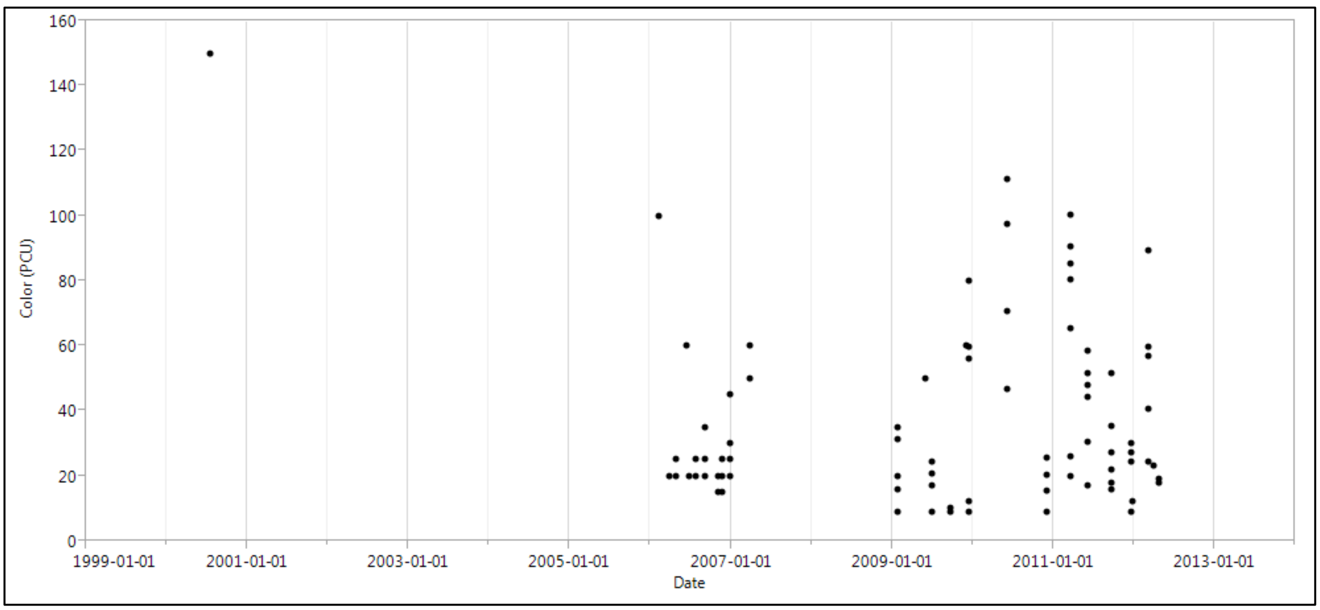


Figure 2.6. Color Time Series for Lake Tallavana

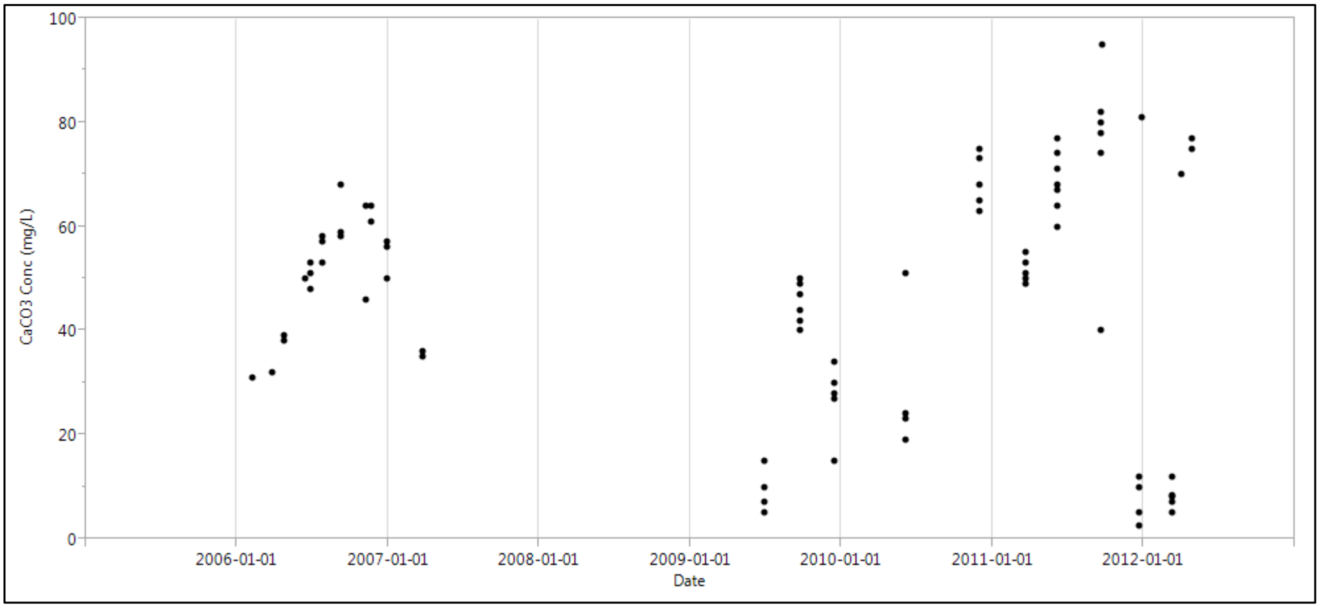


Figure 2.7. Alkalinity Time Series for Lake Tallavana

Table 2.7. Summary Statistics for Key Water Quality Parameters in Lake Tallavana

µg/L = Micrograms per liter; µmhos/cm = micromhos per centimeter; su = Standard units; NTU = Nephelometric turbidity units

Parameter	N	Minimum	25th Percentile	Median	Mean	75th Percentile	Maximum
Alkalinity (mg/L as $CaCO_3$)	91	2.5	30.0	51.0	46.8	64.0	95.0
Biochemical Oxygen Demand (BOD) (mg/L)	94	0.5	3.1	4.4	4.7	6.2	13.4
Uncorrected Chlorophyll (CHLA) (µg/L)	795	1.0	36.0	59.0	69.3	93.0	423.0
Corrected Chlorophyll (CHLAC) (µg/L)	99	1.0	5.3	27.8	33.0	49.1	160.2
Chloride (mg/L)	99	1.8	11.5	17.7	16.2	21.3	30.1
Color (PCU)	99	9	17	22	34	48	150
Conductance (µmhos/cm)	96	63	187	263	248	315	460
Dissolved Oxygen (DO) (mg/L)	96	0.1	6.6	8.3	11.3	10.0	145.0
Ammonium (NH_4) (mg/L)	99	0.010	0.022	0.064	0.131	0.143	2.545
Nitrite + Nitrate (NO_3O_2) (mg/L)	99	0.004	0.006	0.024	0.146	0.189	3.014
pH (su)	96	6.4	7.3	7.6	7.8	8.3	9.8
Secchi Depth (m)	800	0.15	0.46	0.61	0.69	0.85	1.98
Water Temperature (°C.)	96	10.3	15.5	22.3	22.1	28.3	33.2
Total Nitrogen (TN) (mg/L)	861	0.19	0.70	0.96	1.07	1.38	5.82
Total Organic Carbon (TOC) (mg/L)	41	5.40	7.70	8.30	8.27	8.80	11.00
Total Phosphorus (TP) (mg/L)	867	0.004	0.067	0.113	0.131	0.171	1.252
Total Suspended Solids (TSS) (mg/L)	94	6.0	11.0	14.7	17.2	21.0	88.7
Turbidity (NTU)	104	2	6	9	10	14	27

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criterion Applicable to the TMDL

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

Class I	**Potable water supplies**
Class II	**Shellfish propagation or harvesting**
Class III	**Fish consumption; recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife**
Class III – Limited	**Fish consumption; recreation or limited recreation; and/or propagation and maintenance of a limited 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)**

Lake Tallavana (WBID 540A) is a Class III freshwater waterbody, with a designated use of fish consumption, recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criteria applicable to the verified impairments (nutrients) for the lake are the adopted lake nutrient criteria in Rule 62-302.531, F.A.C., for TN, TP and chlorophyll *a*; however, the department has not formally assessed the data for Lake Tallavana under the NNC. Based on a preliminary analysis, Lake Tallavana, which was initially listed as verified impaired for nutrients based on TSI, remains impaired under the NNC.

3.2 Numeric Interpretation of the Narrative Nutrient Criterion for Lakes

The NNC for inland waters were adopted in Florida on December 8, 2011; were approved by the EPA on July 3, 2012; and have been in effect since October 27, 2014. The nutrient TMDLs in this report, upon adoption into Chapter 62-304, F.A.C, will constitute the site-specific numeric interpretations of the narrative nutrient criterion set forth in Paragraph 62-302.530(47)(b), F.A.C., that will supersede the otherwise applicable NNC in Subsection 62-302.531(2), F.A.C., for this particular waterbody. **Appendix C** summarizes the relevant TMDL information, including information that the TMDL provides for the attainment and maintenance of water quality criteria in downstream waters (pursuant to Subsection 62-302.531[4], F.A.C.), to support using the TMDL nutrient targets as the site-specific numeric interpretations of the narrative nutrient criterion.

The NNC rule language for lakes in Rule 62-302.531(2), F.A.C. states:

> **62-302.531(2)(b)1.** For lakes, the applicable numeric interpretations of the narrative nutrient criterion in paragraph 62-302.530(47)(b), F.A.C., for chlorophyll *a* are shown in **Table 3.1**. The applicable interpretations for TN and TP will vary on an annual basis, depending on the availability of chlorophyll *a* data and the concentrations of nutrients and chlorophyll *a* in the lake, as described below. The applicable numeric interpretations for TN, TP, and chlorophyll *a* shall not be exceeded more than once in any consecutive three-year period.
>
> a. If there are sufficient data to calculate the annual geometric mean chlorophyll *a* and the mean does not exceed the chlorophyll *a* value for the lake type in the table below, then the TN and TP numeric interpretations for that calendar year shall be the annual geometric means of lake TN and TP samples, subject to the minimum and maximum limits in the table below. [However, for lakes with color > 40 PCU in the West Central Nutrient Watershed Region, the maximum TP limit shall be the 0.49 mg/L TP streams threshold for the region]; or
>
> b. If there are insufficient data to calculate the annual geometric mean chlorophyll *a* for a given year or the annual geometric mean chlorophyll *a* exceeds the values in the table below for the lake type, then the applicable numeric interpretations for TN and TP shall be the minimum values in the table below.

Based on the data retrieved from IWR Run 49, the long-term geometric mean color value for Lake Tallavana is about 25 PCU, which is lower than the 40 PCU value that distinguishes high-color lakes from clear lakes. The long-term geometric mean of alkalinity is 57 mg/L $CaCO_3$, which is higher than the 20 mg/L threshold that distinguishes high-alkalinity lakes from low-alkalinity lakes. Lake Tallavana is, therefore, considered a low-color and high-alkalinity lake. The chlorophyll *a* target applicable to Lake Tallavana is **20 µg/L**, and the TN and TP criteria vary annually within an allowable range depending on whether the chlorophyll a criterion is met (Table 3.1).

Table 3.1. Chlorophyll *a*, TN, and TP Criteria for Florida Lakes (Subparagraph 62-302.531[2][b]1, F.A.C.)

[1] For lakes with color > 40 PCU in the West Central Nutrient Watershed Region, the maximum TP limit shall be the 0.49 mg/L TP streams threshold for the region.

Long-Term Geometric Mean Lake Color and Alkalinity	Annual Geometric Mean Chlorophyll *a*	Minimum Calculated Annual Geometric Mean TP NNC	Minimum Calculated Annual Geometric Mean TN NNC	Maximum Calculated Annual Geometric Mean TP NNC	Maximum Calculated Annual Geometric Mean TN NNC
>40 PCU	20 µg/L	0.05 mg/L	1.27 mg/L	0.16 mg/L[1]	2.23 mg/L
≤ 40 PCU and > 20 mg/L $CaCO_3$	20 µg/L	0.03 mg/L	1.05 mg/L	0.09 mg/L	1.91 mg/L
≤ 40 PCU and ≤ 20 mg/L $CaCO_3$	6 µg/L	0.01 mg/L	0.51 mg/L	0.03 mg/L	0.93 mg/L

To calculate an annual geometric mean for TN, TP, or chlorophyll *a*, there must be at least four temporally independent samples per year with at least one sample taken between May 1 and September 30 and at least one sample taken during the other months of the calendar year. To be treated as temporally-independent, samples must be taken at least one week apart.

Table 3.2 lists the AGM concentrations for CHLAC, TN, and TP for 2005 to 2012 that meet the data sufficiency requirement of Subsection 62-302.531(6), F.A.C. These CHLAC data were retrieved from IWR Run 49. The table shows that the AGM for CHLAC in all three years meeting the data sufficiency requirement exceeded the 20 µg/L criterion. Therefore, the applicable TN and TP criteria are the minimum TN and TP concentrations listed in **Rule 62-302.531, F.A.C.,** for low-color and high-alkalinity lakes, or **1.05 mg/L** and **0.030 mg/L**, respectively. The minimum values are also applicable when there are insufficient data to calculate an AGM. **Figures 3.1** through **3.3** show the long-term AGM values for TN, TP, and CHLAC, respectively.

Table 3.2. Lake Tallavana AGM Values for the Cycle 3 Verified Period (January 1, 2005–June 30, 2012)

ND = No data
ID = Insufficient data to calculate geometric means per the requirements of Chapter 62-303, F.A.C.
Note: Values shown shaded and in boldface type are greater than the applicable NNC. Rule 62-302.531, F.A.C., states that the applicable numeric interpretations for TN, TP, and chlorophyll a shall not be exceeded more than once in any consecutive three-year period.

YEAR	CHLAC (µG/L)	TN (MG/L)	TP (MG/L)
2005	ND	**1.393**	**0.168**
2006	ID	**1.503**	**0.175**
2007	ID	**1.395**	**0.170**
2008	ND	**1.386**	**0.158**
2009	**35.2**	0.927	**0.123**
2010	**24.5**	**1.192**	**0.103**
2011	**29.2**	0.980	**0.183**
2012	ID	ID	ID

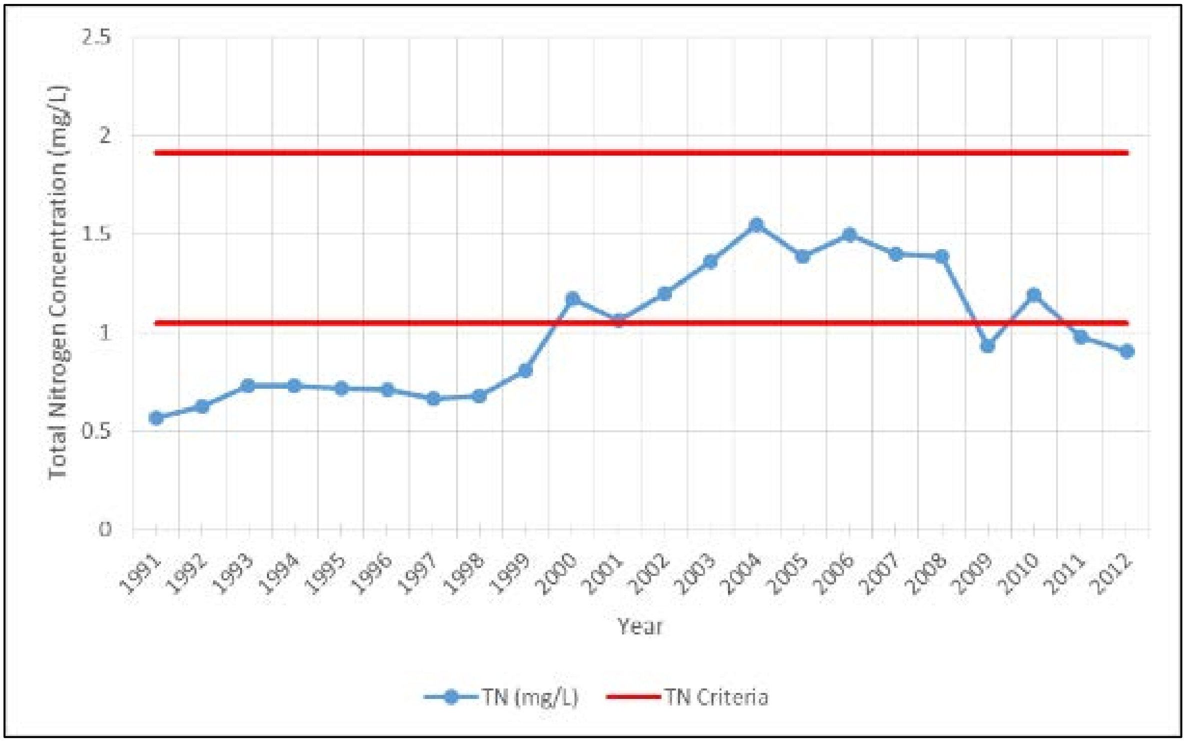


Figure 3.1. Long-Term AGM for TN

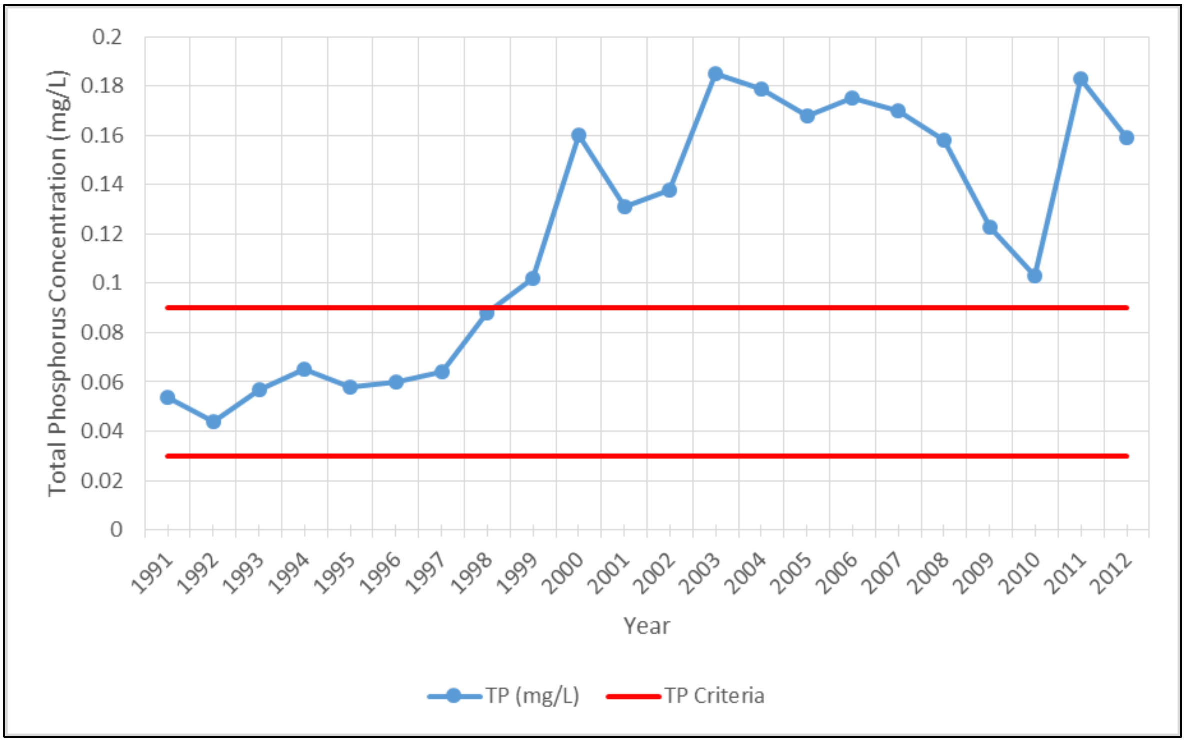


Figure 3.2. Long-Term AGM for TP

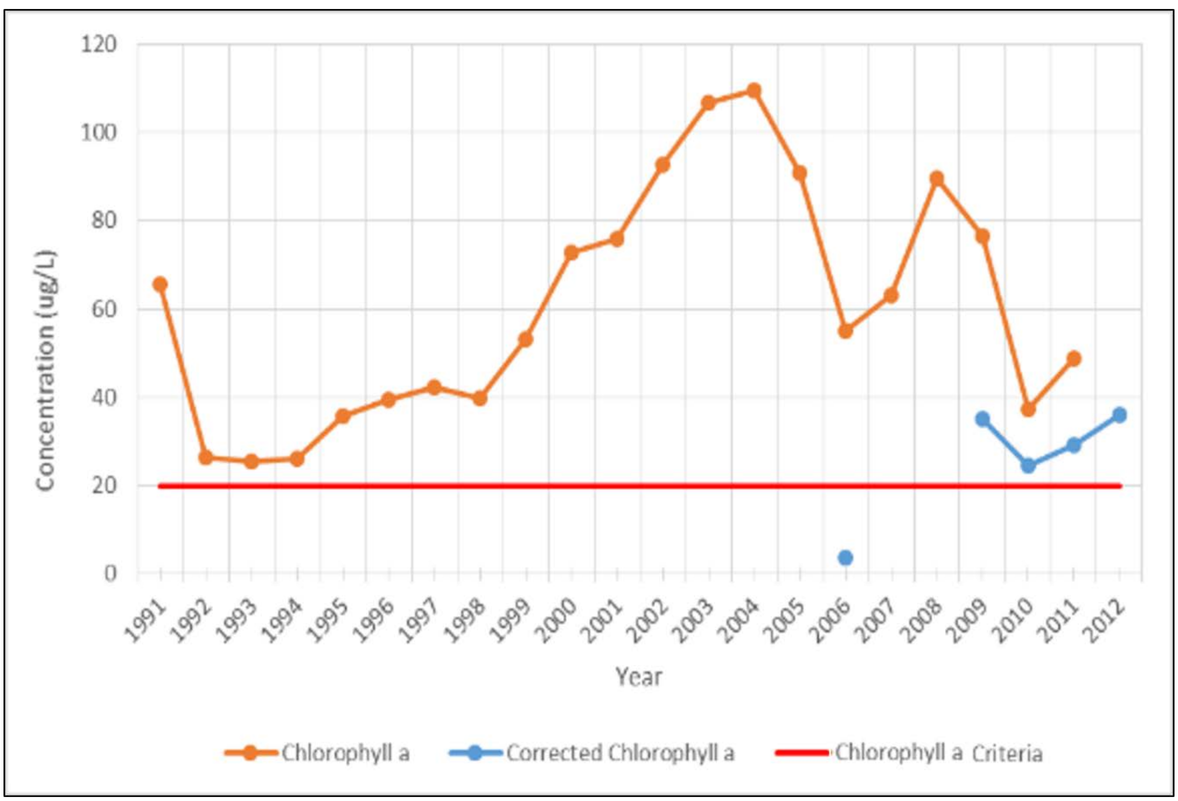


Figure 3.3. Long-Term AGMs for CHLA and CHLAC

3.3 Water Quality Variable Definitions

3.3.1 Chlorophyll a

Chlorophyll is a green pigment found in plants and is an essential component in the process of converting light energy into chemical energy. Chlorophyll is capable of channeling the energy of sunlight into chemical energy through the process of photosynthesis. In photosynthesis, the energy absorbed by chlorophyll transforms carbon dioxide and water into carbohydrates and oxygen. The chemical energy stored by photosynthesis in carbohydrates drives biochemical reactions in nearly all living organisms. Thus, chlorophyll is at the center of the photosynthetic oxidation-reduction reaction between carbon dioxide and water.

There are several types of chlorophyll; however, the predominant form is chlorophyll *a*. The measurement of chlorophyll *a* in a water sample is a useful indicator of phytoplankton biomass, especially when used in conjunction with the analysis of algal growth potential and species abundance. If chlorophyll *a* is abundant, then algae are also abundant. Algae are the primary producers in the aquatic food web and thus are very important in characterizing the productivity of lakes and streams. As noted earlier, chlorophyll *a* measurements are also used to estimate the trophic conditions of lakes and lentic waters.

3.3.2 Nitrogen Total as N (TN)

TN is the combined measurement of nitrate (NO_3), nitrite (NO_2), ammonia, and organic nitrogen found in water. Nitrogen compounds function as important nutrients to many aquatic organisms and are essential to the chemical processes that occur between land, air, and water. The most readily bioavailable forms of nitrogen are ammonia and nitrate. These compounds, in conjunction with other nutrients, serve as an important base for primary productivity.

The major sources of excessive amounts of nitrogen in surface water are the effluent from municipal treatment plants and runoff from urban and agricultural sites. When nutrient concentrations consistently exceed natural levels, the resulting nutrient imbalance can cause undesirable changes in a waterbody’s biological community and drive an aquatic system into an accelerated rate of eutrophication. Usually, the eutrophication process is observed as a change in the structure of the algal community and includes severe algal blooms that may cover large areas for extended periods. Large algal blooms are generally followed by depletion in DO concentrations as a result of algal decomposition.

3.3.3 Phosphorus Total as P (TP)

Phosphorus is one of the primary nutrients that regulates algal and macrophyte growth in natural waters, particularly in fresh water. Phosphate, the form in which almost all phosphorus is found in the water column, can enter the aquatic environment in a number of ways. Natural processes transport phosphate to water through atmospheric deposition, groundwater percolation, and terrestrial runoff. Municipal treatment plants, industries, agriculture, and domestic activities also contribute to phosphate loading through direct discharge and natural transport mechanisms. The very high levels of phosphorus in some of Florida's streams and estuaries are sometimes linked to phosphate mining and fertilizer processing activities.

High phosphorus concentrations are frequently responsible for accelerating the process of eutrophication, or accelerated aging, of a waterbody. Once phosphorus and other important nutrients enter the ecosystem, they are extremely difficult to remove. They become tied up in biomass or deposited in sediments. Nutrients, particularly phosphates, deposited in sediments generally are redistributed to the water column. This type of cycling compounds the difficulty of halting the eutrophication process.

3.4 Determination of Site-Specific Numeric Interpretation

The site-specific TN and TP targets for this TMDL were established to achieve the generally applicable chlorophyll a criterion (20 µg/L) for low-color, high alkalinity lakes. Based on several lines of evidence discussed in detail in the Technical Support Document for the Numeric Nutrient Criteria (DEP, 2012), achieving 20 µg/L chlorophyll a concentration in this type of waterbodies will prevent algal blooms and ensure there will be no harmful phytoplankton that will impair the designated use. At the time of this TMDL development, there was no site-specific information indicating that 20 µg/L is not protective of the designated use for this waterbody.

Using the modeling approach, the target TN and TP concentrations to achieve the 20 µg/L chlorophyll *a* criterion were found to be 0.95 mg/L and 0.051 mg/L, respectively. Using the water quality model, the department determined the nutrient loads that attain the target nutrient concentrations and chlorophyll *a* criterion. These nutrient loads are the site-specific numeric interpretations of the narrative nutrient criteria for Lake Tallavana. Chapter 5 of this report provides detailed discussions on how water quality models were used in establishing the target TN and TP concentrations and loads.

Table 3.3. Lake Tallavana TN and TP Concentrations To Attain the CHLAC Target Concentration

APPROACH	CHLAC TARGET (µG/L)	TN CONCENTRATION (MG/L)	TP CONCENTRATION (MG/L)
NNC Criteria	20	1.050 – 1.91	0.030 – 0.09
Model-Derived Concentrations	20	0.95	0.051

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of pollutants in the impaired waterbody and the amount of pollutant loadings 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" will be used to describe traditional point sources (such as domestic and industrial wastewater discharges) *and* stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 6.1**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

4.2 Potential Sources of Nutrients in the Lake Tallavana Watershed

4.2.1 Point Sources

4.2.1.1 Wastewater Point Sources

There are no NPDES-permitted facilities within the Lake Tallavana watershed boundary; therefore, there is no impact on nutrient concentrations in the lake from these types of facilities.

4.2.1.2 Municipal Separate Storm Sewer Systems

Municipal separate storm sewer systems (MS4s) may also discharge pollutants to waterbodies in response to storm events. To address stormwater discharges, the EPA developed the NPDES stormwater permitting program in two phases. Phase 1, promulgated in 1990, addresses large and medium-size MS4s located in incorporated areas and counties with populations of 100,000 or more. Phase 2 permitting began in 2003. Regulated Phase 2 MS4s are defined in 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). There are no NPDES Phase I or Phase II MS4 permits in the Lake Tallavana watershed.

4.2.2 Nonpoint Sources

Because there are no point source dischargers located in the Lake Tallavana watershed, nutrient loadings to Lake Tallavana are primarily generated from nonpoint sources. The nonpoint sources addressed in this TMDL primarily include surface runoff, baseflow, and precipitation directly onto the lake surface.

4.2.2.1 Loading Simulation Program in C++ (LSPC) Model

Loading Simulation Program in C++ (LSPC) is a watershed modeling system that includes streamlined Hydrologic Simulation Program FORTRAN (HSPF) algorithms for simulating hydrology, sediment, and general water quality on land as well as a simplified stream transport model. In coordination with the department in developing the Lake Talquin nutrient TMDL, the EPA Region 4 developed a watershed loading model to determine loading characteristics from the Lake Talquin watershed. Detailed model structure, parameterization, input time series, and calibration and validation for the EPA LSPC model can be found in the Lake Talquin modeling report (EPA 2015). The department revised the EPA LSPC model and redelineated the watershed containing Lake Tallavana into four subbasins. The subbasins used in the LSPC model to simulate hydrology and water quality conditions in the Lake Tallavana watershed are illustrated in **Figure 4.1**. **Tables 4.8a** through **4.8d** and **Tables 4.9a** and **4.9b** contain the subbasin flow and loading information from the LSPC, which was used in the Bathtub modeling.

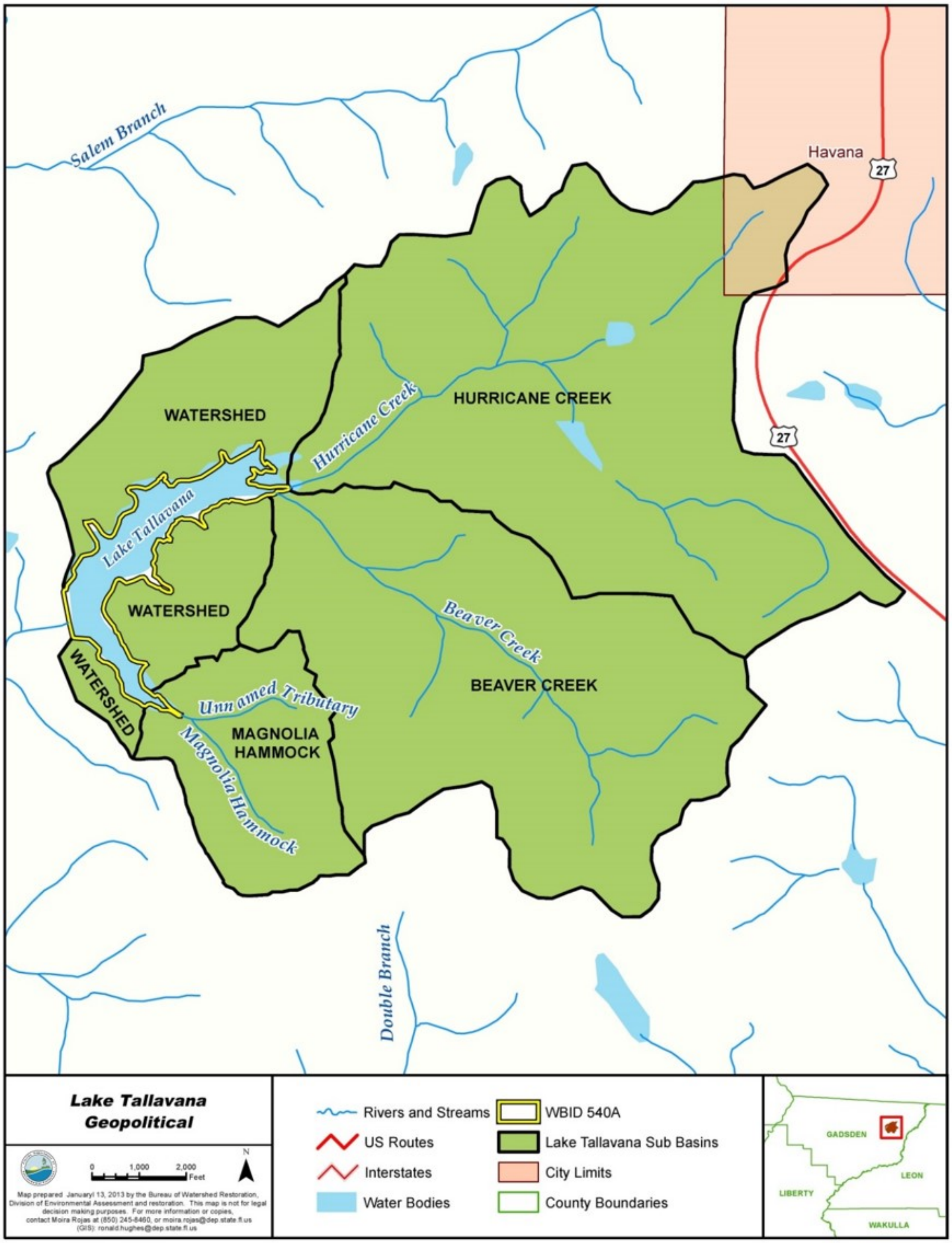


Figure 4.1. Subbasins in the Lake Tallavana Watershed Used for the LSPC Model

LAND USES

The spatial distribution and acreage of different land use categories were identified using the 2012–13 NWFWMD land use coverage contained in the department's geographic information system (GIS) library. Land use categories within the Lake Tallavana watershed boundary were aggregated using the simplified land use codes similar to those of the National Landcover Database (NLCD) used in the LSPC watershed model and tabulated in **Table 4.1**.

The Lake Tallavana watershed boundary encompasses approximately 4,000 acres (6.2 square miles [mi^2]), with the breakdown of the subbasins as follows: the total area within the Hurricane Creek subbasin is approximately 1,680 acres (2.7 mi^2), the total area within the Beaver Creek subbasin is approximately 1,316 acres (2.0 mi^2), and the total area within the Magnolia Hammock subbasin is approximately 386 acres (0.6 mi^2). The remaining acreage ("Immediate Watershed") is considered independent from the three subbasins and is approximately 622 acres (0.9 mi^2) in size. **Figure 4.2** shows the spatial distribution of the principal land uses in the subbasins based on the level code in **Table 4.1**.

The predominant land uses in all three subbasins and the surrounding area ("Watershed") are low impact. In addition, the watershed is surrounded by medium- and high-density residential and transportation, communication, and utilities areas.

Within the Lake Tallavana watershed boundary, the dominant land use categories are low-impact land uses (primarily upland forests and wetlands), which account for approximately 54% of the total acreage for the "watershed" area and range from 45% to 58% of the total acreage for each of the three subbasins. With the exception of Hurricane Creek, where agricultural lands cover approximately 32% of the total acreage, areas covered by agricultural lands are relatively small in the Tallavana watershed. Residential (low-, medium-, or high-density) and urban built-up (commercial and services, industrial, institutional, and recreational) land uses are also relatively small within the Tallavana watershed boundary. The highest percent total acres of residential and urban built-up land uses occur in the "watershed" area (approximately 38%).

Table 4.1. Classification of Land Use Categories within the Lake Tallavana Subbasin Boundaries

- = Empty cell/no data

Level Code	Land Use Description	Hurricane Creek Acreage	Hurricane Creek % Acreage	Beaver Creek Acreage	Beaver Creek % Acreage	Magnolia Hammock Acreage	Magnolia Hammock % Acreage	Watershed Acreage	Watershed % Acreage
11	Open Water	43.95	2.6%	16.81	1.3%	4.85	1.3%	8.81	1.4%
20	Utilities	16.30	1.0%	-	0.0%	-	0.0%	14.33	2.3%
21	Open Land	6.68	0.4%	-	0.0%	-	0.0%	0.10	0.0%
22	Residential, Low Density	140.26	8.4%	190.35	14.5%	31.46	8.1%	37.16	6.0%
23	Residential, Medium Density	40.20	2.4%	143.62	10.9%	31.97	8.3%	197.24	31.7%
24	Residential High Density/ Industrial/ Commercial Services	96.44	5.8%	14.72	1.1%	-	0.0%	2.82	0.5%
31	Rangeland	37.35	2.2%	8.32	0.6%	-	0.0%	11.84	1.9%
41	Upland Hardwood Forests	22.49	1.3%	26.78	2.0%	20.08	5.2%	1.27	0.2%
42	Tree Plantations/ Upland Coniferous Forests	177.73	10.7%	147.36	11.2%	24.23	6.3%	131.02	21.1%
43	Upland Mixed Forests	190.55	11.4%	303.11	23.0%	134.08	34.7%	174.67	28.1%
80	Cropland and Pastureland	155.53	9.3%	123.18	9.4%	108.15	28.0%	12.24	2.0%
83	Tree Crops/ Nurseries	378.03	22.7%	53.52	4.1%	0.26	0.1%	-	0.0%
91	Wetland Forested Mixed	314.80	18.9%	283.70	21.6%	31.21	8.1%	28.13	4.5%
93	Non-Forested Wetlands	45.95	2.8%	4.80	0.4%	-	0.0%	1.95	0.3%
-	**TOTAL**	**1,666.3**	**100.0%**	**1,316.3**	**100.0%**	**386.3**	**100.0%**	**621.6**	**100.0%**

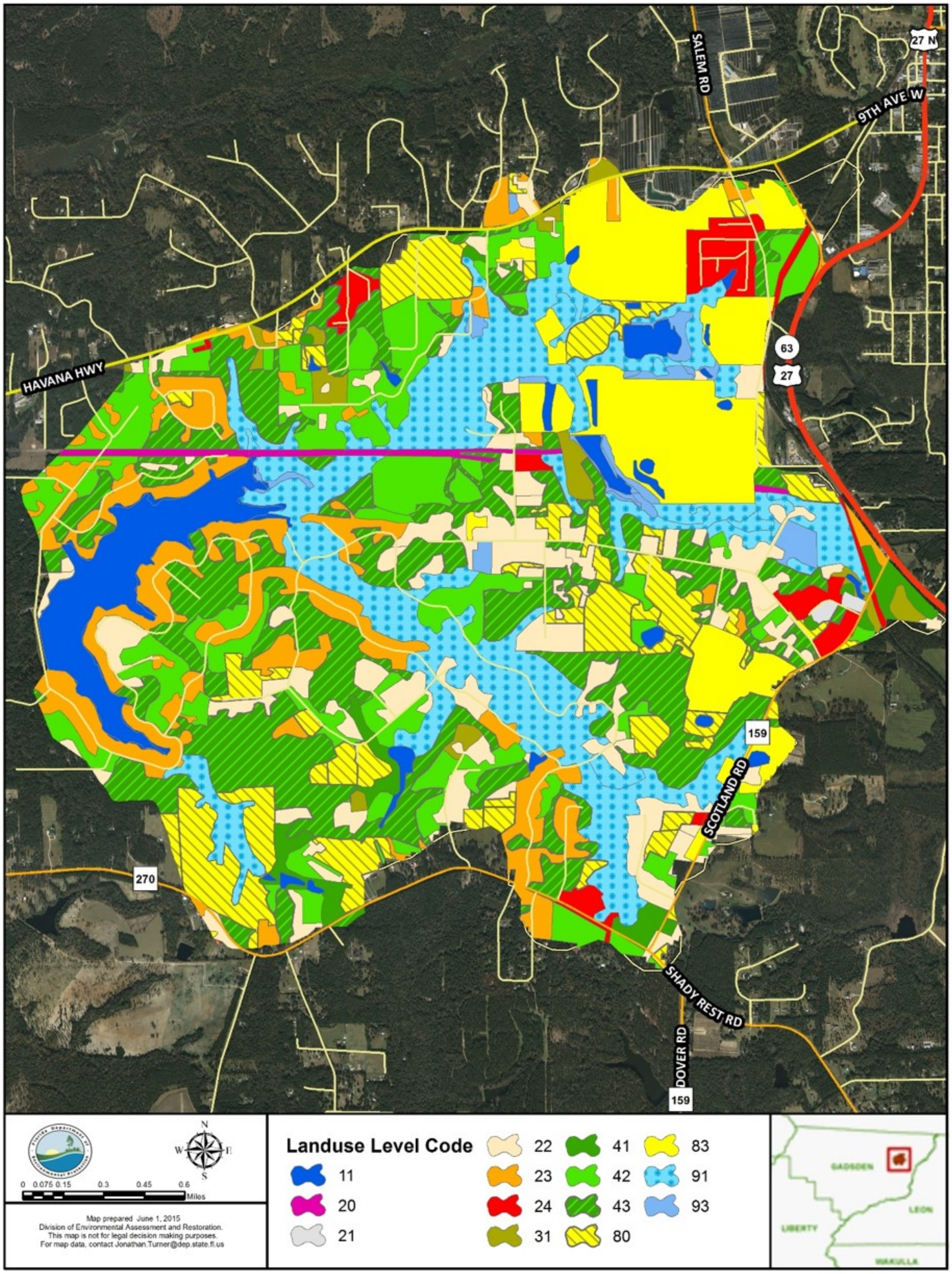


Figure 4.2. Principal Land Uses in the Lake Tallavana Watershed

METEOROLOGICAL INFORMATION

Figure 4.3 presents the precipitation information for the Lake Tallavana watershed. The Quincy 3 SSW station (IDL 087429) is located at Quincy Municipal Airport and has been operational since 1968. The long-term average annual rainfall for Quincy is 55 inches per year.

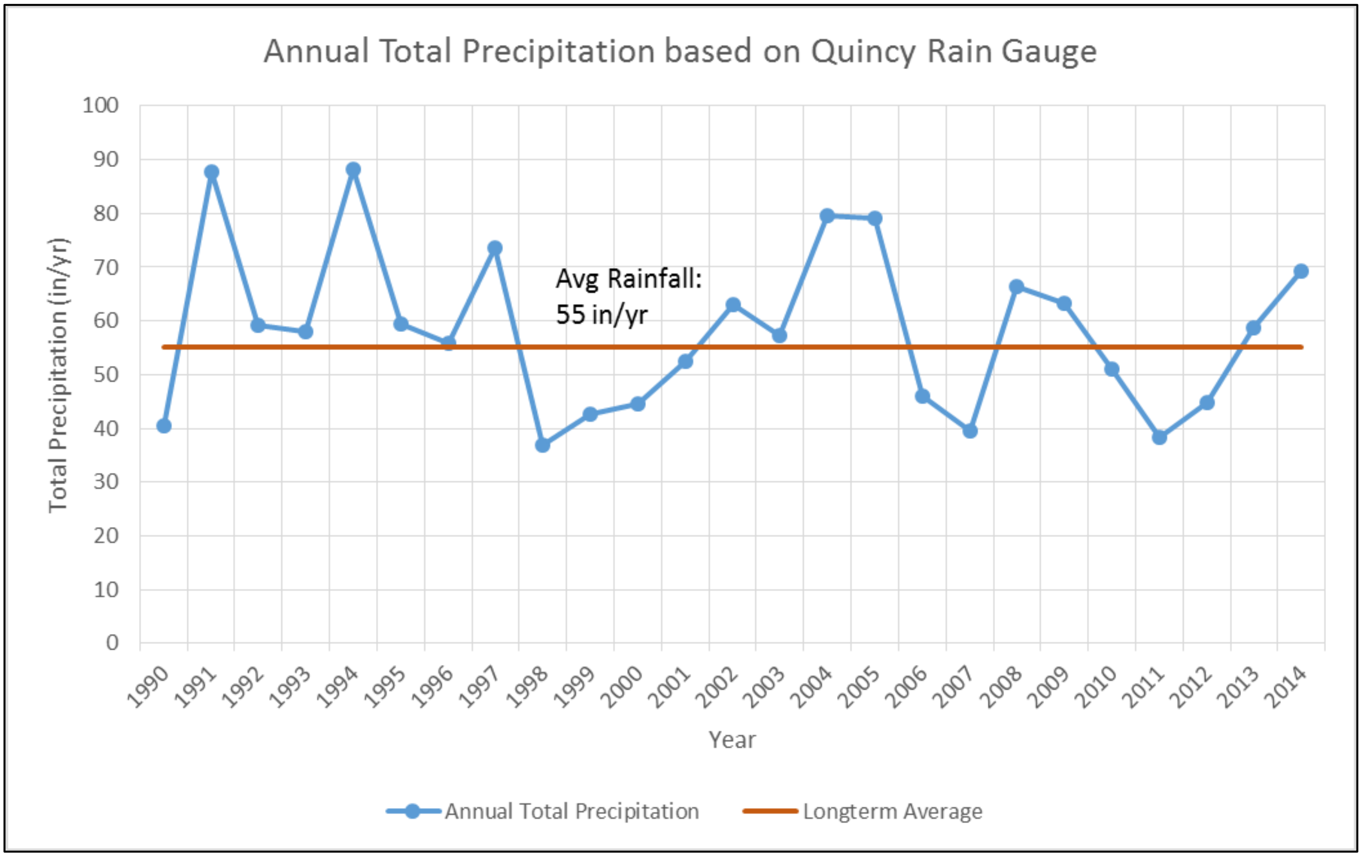


Figure 4.3. Annual Rainfall Measured at the Quincy 3 SSW Station

ATMOSPHERIC DEPOSITION

The National Atmospheric Deposition Program (NADP) National Trends Network (NTN) monitors precipitation chemistry at a network of 250 sites across the country. Ammonia and nitrate are among the constituents measured at these sites. The NADP Quincy (FL14) site, located in Gadsden County approximately 8.5 miles west-southwest from Lake Tallavana, has been operational since 1984. Precipitation weighted mean annual concentrations for ammonium and nitrate from the Quincy NADP site were downloaded and used in the modeling (**Table 4.2**).

Table 4.2. Summary of Quincy Weighted Mean Annual Wet Deposition Ammonium and Nitrate Concentrations

SITE ID	YEAR	NH_4 (MG/L)	NO_3 (MG/L)
FL14	1984	0.12	0.622
FL14	1985	0.073	0.41
FL14	1986	0.044	0.515
FL14	1987	0.077	0.549
FL14	1988	0.064	0.747
FL14	1989	0.144	0.636
FL14	1990	0.153	0.73
FL14	1991	0.068	0.538
FL14	1992	0.074	0.544
FL14	1993	0.114	0.711
FL14	1994	0.062	0.457
FL14	1995	0.166	0.614
FL14	1996	0.109	0.565
FL14	1997	0.091	0.63
FL14	1998	0.096	0.599
FL14	1999	0.095	0.69
FL14	2000	0.123	0.768
FL14	2001	0.101	0.611
FL14	2002	0.085	0.539
FL14	2003	0.113	0.628
FL14	2004	0.082	0.564
FL14	2005	0.11	0.551
FL14	2006	0.151	0.681
FL14	2007	0.11	0.557
FL14	2008	0.069	0.429
FL14	2009	0.132	0.451
FL14	2010	0.13	0.489
FL14	2011	0.148	0.495
FL14	2012	0.108	0.54
FL14	2013	0.107	0.48
FL14	2014	0.113	0.421

OTHER POTENTIAL SOURCES OF NUTRIENT LOADS IN THE LAKE TALLAVANA WATERSHED

Population – The 2010 United States Census block data were used to estimate the human population in the Lake Tallavana watershed. Total population data for census blocks covering the watershed were clipped using GIS to estimate the population in the Lake Tallavana watershed based on the fraction of the block contained in the watershed. This yielded an estimated population of 1,500. Based on an average of 2.61 persons per household in Gadsden County, there were an estimated 574 occupied residential units in the Lake Tallavana watershed.

Onsite Sewage Treatment and Disposal Systems – OSTDS, or septic tanks, are used for the disposal of domestic waste at homes that are not on central sewer, often because providing central sewer is not available, cost-effective, or practical. When properly sited, designed, constructed, maintained, and operated, OSTDS provide a sanitary means of disposing of domestic waste. The nitrogen concentrations in effluent from OSTDS are considerably higher than those in effluent from typical domestic wastewater facilities, although the wastewater profile can vary from home to home. The physical setting of an OSTDS (soil and aquifer characteristics and proximity) is also a factor in the amount of nitrogen that it can leach to ground water and springs (United States Geological Survey [USGS] 2010). The physical properties of an aquifer, such as thickness, sediment type (sand, silt, and clay), and location play a large part in determining whether contaminants from the land surface will reach ground water (USGS 2010). **Figure 4.4** shows the hydrologic soil types in the Lake Tallavana watershed.

Figure 4.5 shows the approximate locations of OSTDS (septic tanks) and sewer systems in the residential land use areas within and surrounding the Lake Tallavana WBID boundary, based on property records. The risk of contamination is greater for unconfined (water table) aquifers than for confined aquifers because they usually are nearer to the land surface and lack an overlying confining layer to impede the movement of contaminants (USGS 2010).

Septic tanks may also cause nutrient pollution when they are built too close to irrigation wells. Any well that is installed in the surficial aquifer system will cause a drawdown. If the septic tank system is built too close to the well (*e.g.,* less than 75 feet), the septic tank discharge will be within the cone of influence of the well. As a result, septic tank effluent may enter the well, and once the polluted water is used to irrigate lawns, nitrogen pollution may reach the land surface and wash into surface waters through stormwater runoff. According to property records and the estimated locations of sewage treatment, there are an estimated 939 septic tanks in the Lake Tallavana watershed. Loading from septic tanks are implicitly considered during the modeling process using the LSPC watershed model.

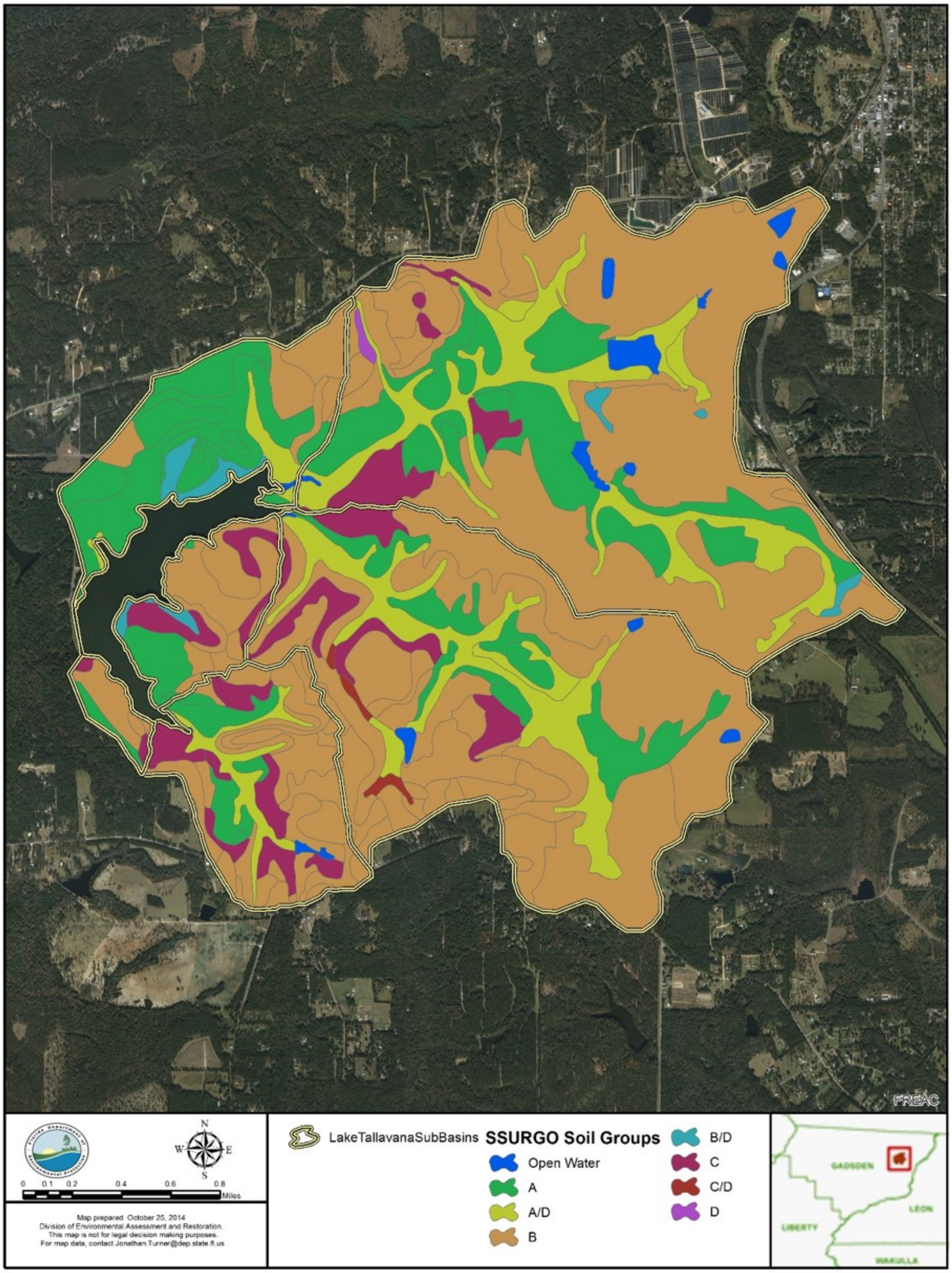


Figure 4.4. Hydrologic Soil Types in the Lake Tallavana Watershed

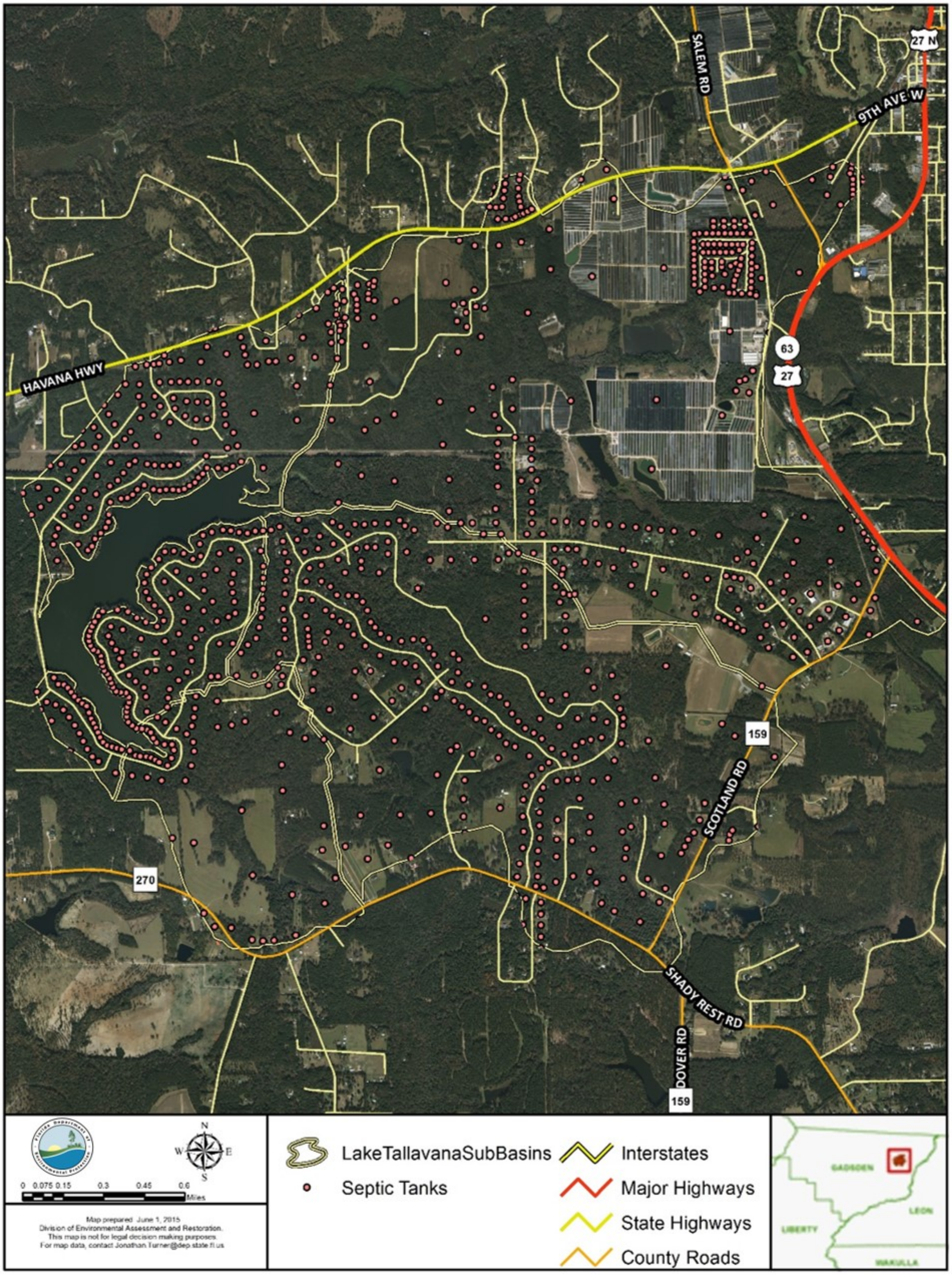
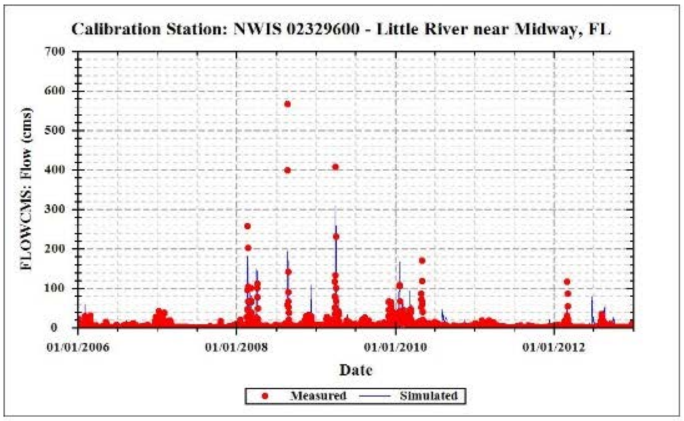
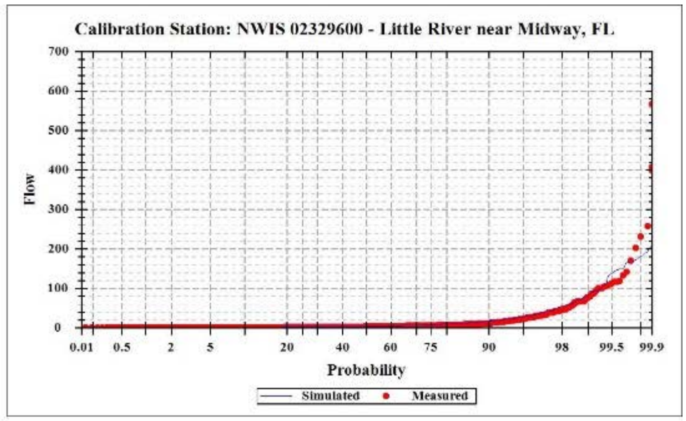


Figure 4.5. Distribution of OSTDS (Septic Tanks) and Sewer Systems in the Lake Tallavana Watershed

WATERSHED LOADING MODEL CALIBRATION

Little River Calibration – The Lake Talquin watershed flow simulated by the EPA's LSPC model was calibrated to USGS gauges on the Little River near Midway (NWIS 02329600), the Ochlockonee River near Thomasville, GA (NWIS 02327500), and the Ochlockonee River near Havana, FL (NWIS 02329000). Lake Tallavana falls within the Little River subbasin. **Figures 4.6** through **4.8** show the figures for the calibration of flow, TN, and TP of the Little River watershed from the draft Lake Talquin Modeling Report (EPA 2015).





Calibration Statistics

Station: NWIS 02329600; Parameter: FLOWCMS

Statistic	Measured	Simulated
Count:	2558	2557
Mean:	6.927	7.656
Median:	3.426	3.533
Std Dev:	21.232	17.231
Min:	0.147	0.205
Max:	566.200	310.018
5 %tile:	0.453	0.560
10 %tile:	0.679	0.784
90 %tile:	11.415	16.043
95 %tile:	22.291	26.494
Coef of Det (R^2):	0.57	
Mean Abs Error:	4.411	
RMS Error:	14.008	
Norm RMS Error:	0.772	
Index of Agreement:	0.85	

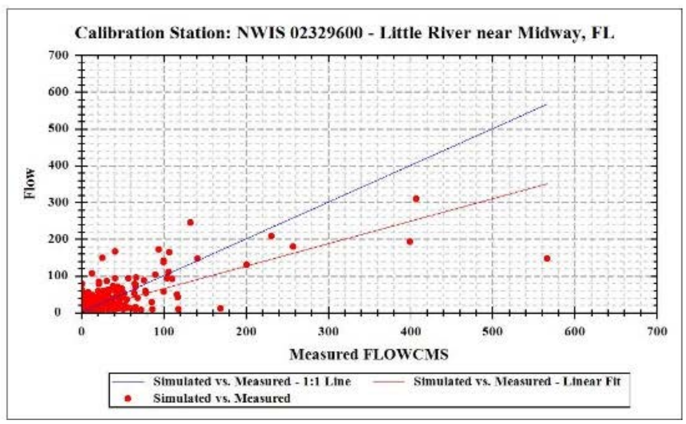
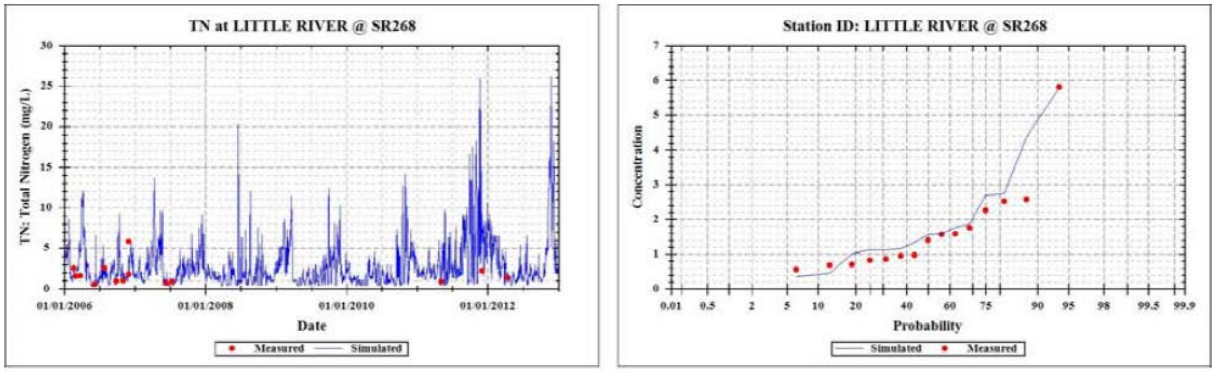


Figure 4.6. Flow Calibration Figures for the Little River Watershed



Calibration Statistics

Station: LITTLE RIVER @ SR268; Parameter: TN

Statistic	Measured	Simulated
Count:	15	15
Mean:	1.665	1.918
Median:	1.518	1.575
Std Dev:	1.325	1.465
Min:	0.560	0.343
Max:	5.800	5.767
5 %tile:	0.000	0.000
10 %tile:	0.632	0.408
90 %tile:	3.862	4.920
95 %tile:	0.000	0.000
Coef of Det (R^2):	0.18	
Mean Abs Error:	1.003	
RMS Error:	1.478	
Norm RMS Error:	0.744	
Index of Agreement:	0.60	

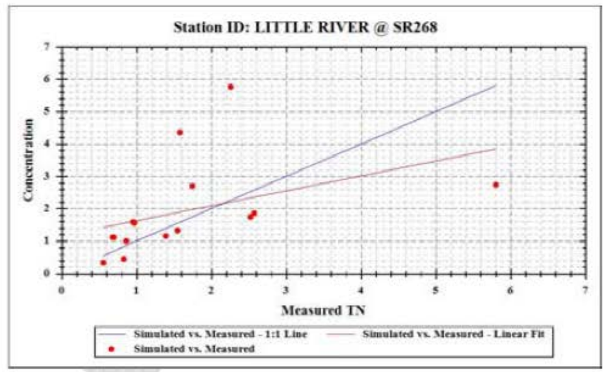
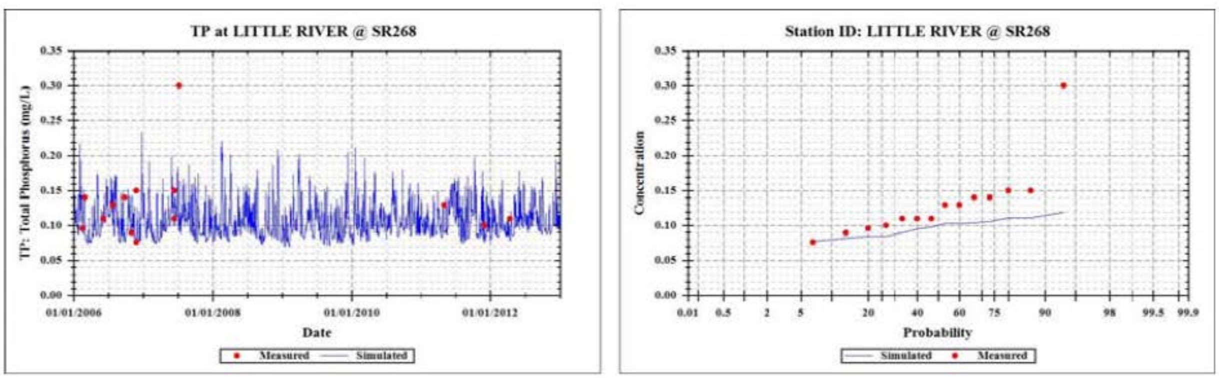


Figure 4.7. TN Calibration Figures for the Little River Watershed



Calibration Statistics

Station: LITTLE RIVER @ SR268; Parameter: TP

Statistic	Measured	Simulated
Count:	14	14
Mean:	0.131	0.097
Median:	0.130	0.103
Std Dev:	0.054	0.013
Min:	0.076	0.077
Max:	0.300	0.119
5 %tile:	0.000	0.000
10 %tile:	0.083	0.079
90 %tile:	0.225	0.115
95 %tile:	0.000	0.000
Coef of Det (R^2):	0.19	
Mean Abs Error:	0.037	
RMS Error:	0.058	
Norm RMS Error:	0.512	
Index of Agreement:	0.33	

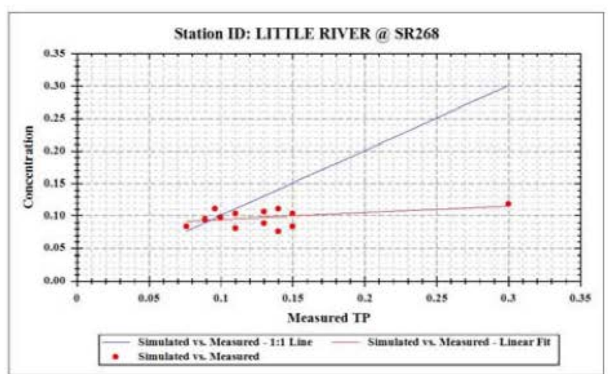


Figure 4.8. TP Calibration Figures for the Little River Watershed

Lake Tallavana TMDL Water Quality Survey (2013) – To gain a better understanding of the possible sources of nutrients in the Lake Tallavana watershed and the relative contributions from these sources, the department conducted a six-month intensive survey around the Lake Tallavana watershed. The survey focused on evaluating the nutrient loading from several tributaries entering the lake, to help refine the model calibration. These tributaries are Hurricane Creek, Beaver Creek, Magnolia Hammock, and an unnamed tributary next to Magnolia Hammock. Water quality data from several stations located in the lake and the lake outfall were also collected to evaluate the responses of the in-lake concentrations to the watershed loads. **Figure 4.9** shows the locations of the sites sampled during the intensive survey. The in-lake stations were sampled at two depths, at the surface (< 0.5 meters from the surface) and at the bottom (1 foot off the bottom).

The survey consisted of six monthly sampling trips, taking place from January through June 2013. The sampling crews collected both physical and chemical water quality parameters during these trips. **Table 4.3** lists the sampling locations and **Table 4.4** lists the parameters sampled from lake or stream sites. **Figures 4.10** through **4.13** and **Tables 4.5a** through **4.5d** provide the survey results for the tributaries. **Tables 4.6a** through **4.6c** and **Figures 4.14** through **4.16** provide the results for the lake stations.

Table 4.3. Water Quality Stations Sampled for the Lake Tallavana Water Quality Survey

Station ID	Station Name	Latitude	Longitude
SS1	Beaver Creek between Spruce Lane and Lake Bluff Lane	30.598806	-84.452194
SS3	Hurricane Creek at outlet (below the lake)	30.593500	-84.470583
SS4	Magnolia Hammock upstream of lake	30.587194	-84.461222
SS5	Unnamed trib north of Magnolia Hammock	30.587750	-84.460833
SS6	Hurricane Creek at Bridge	30.602972	-84.451611
LS1	Lake Station 1	30.592278	-84.466944
LS2	Lake Station 2	30.595014	-84.468694
LS3	Lake Station 3	30.597333	-84.467208
LS4	Lake Station 4	30.599639	-84.464503

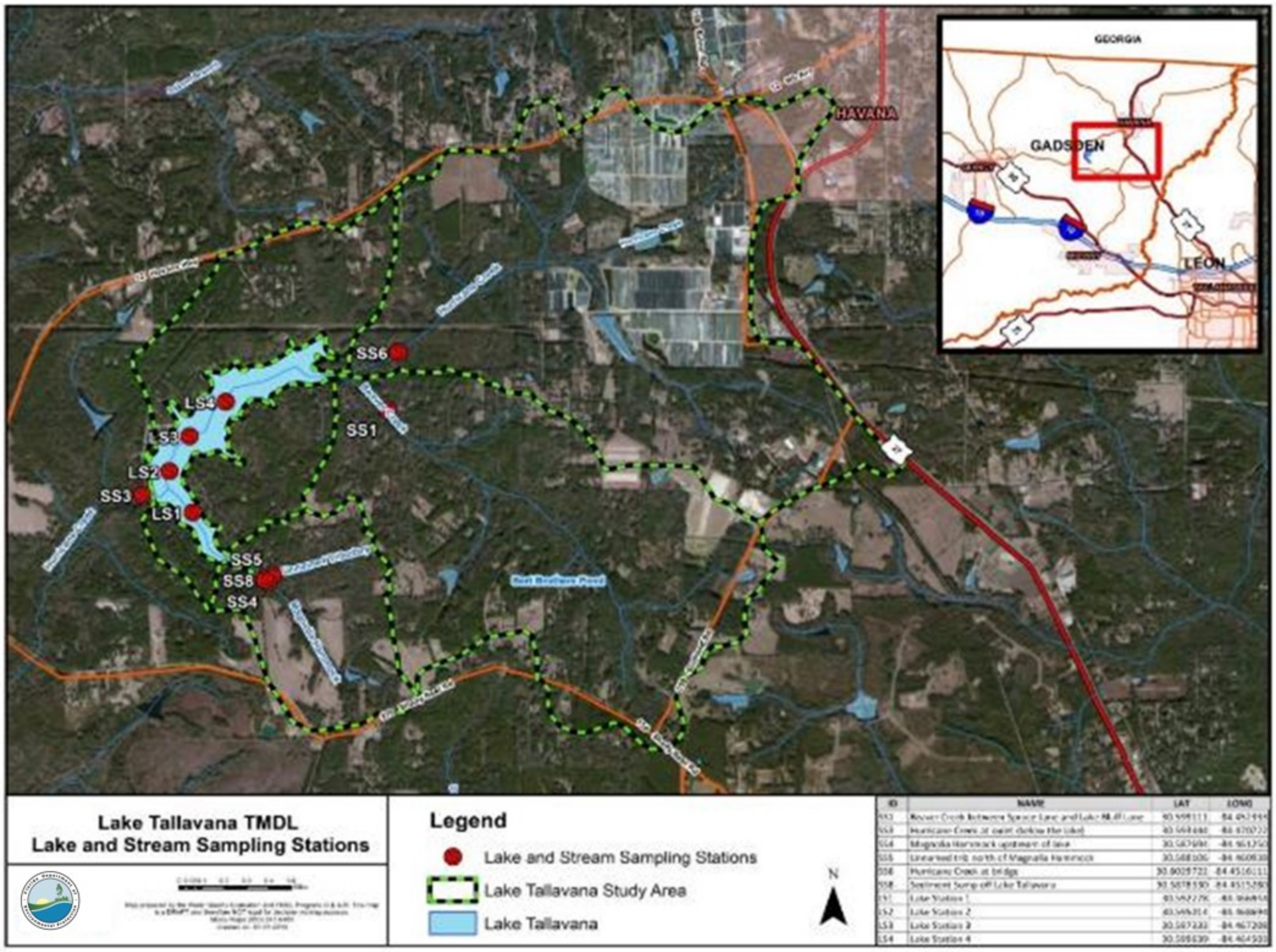


Figure 4.9. **Lake Tallavana TMDL Water Quality Survey Sampling Locations**

Table 4.4. Water Quality Parameters Sampled for the Lake Tallavana Water Quality Survey

PARAMETER	LAKE OR STREAM STATION
Secchi Depth	Lake and Stream
Orthophosphate (PO_4)	Lake and Stream
Total Phosphorus (TP)	Lake and Stream
Nitrate/Nitrite (NO_2NO_3)	Lake and Stream
Ammonia (NH_4)	Lake and Stream
Total Kjeldahl Nitrogen (TKN)	Lake and Stream
Total Nitrogen (TN)	Lake and Stream
Corrected Chlorophyll *a* (CHLAC)	Lake and Stream
Uncorrected Chlorophyll *a* (CHLA)	Lake and Stream
Total Suspended Solids (TSS)	Lake
Alkalinity	Lake
Color	Lake and Stream
Stream Discharge	Stream
Temperature	Lake and Stream
pH	Lake and Stream
Dissolved Oxygen (DO)	Lake and Stream
Dissolved Oxygen Percent Saturation	Lake and Stream
Conductivity	Lake and Stream
Salinity	Lake and Stream

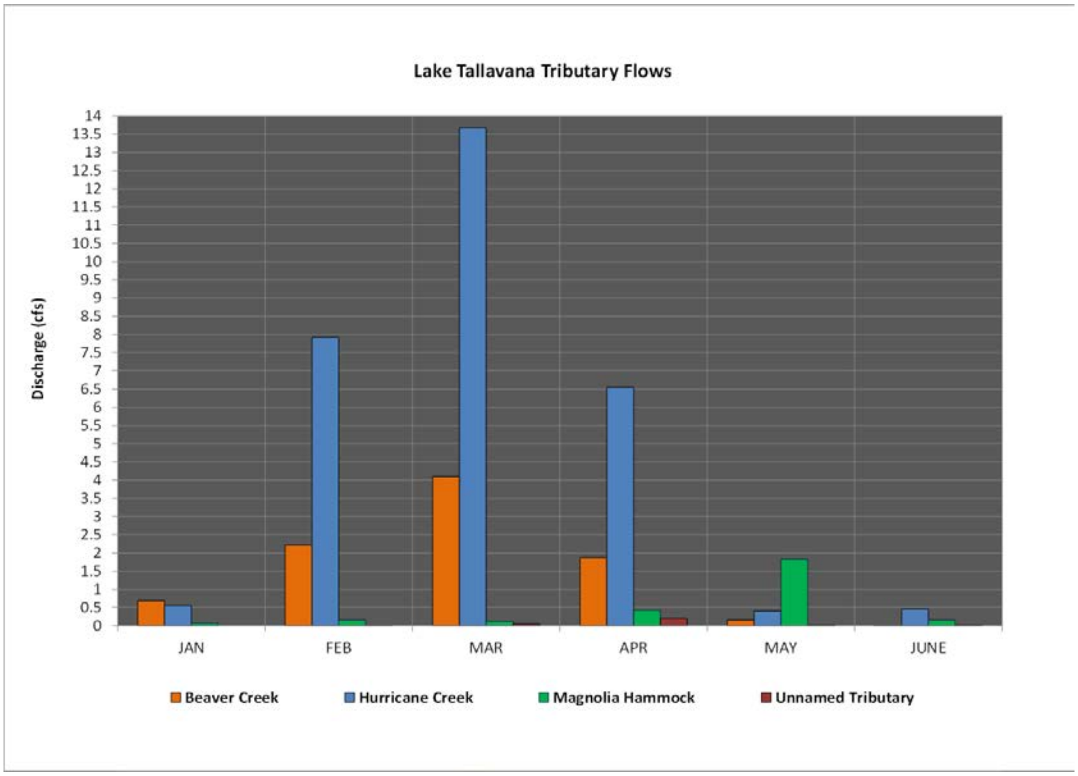


Figure 4.10. Flow Data for the Tributaries to Lake Tallavana

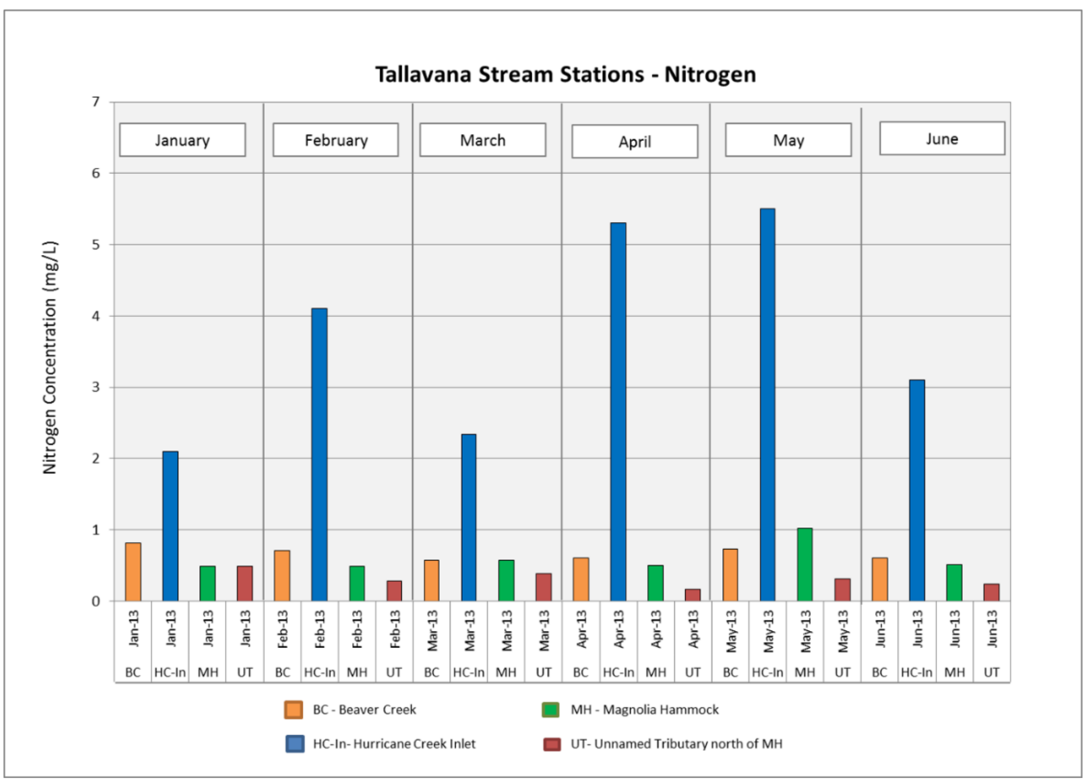


Figure 4.11. TN Concentrations for the Tributaries to Lake Tallavana

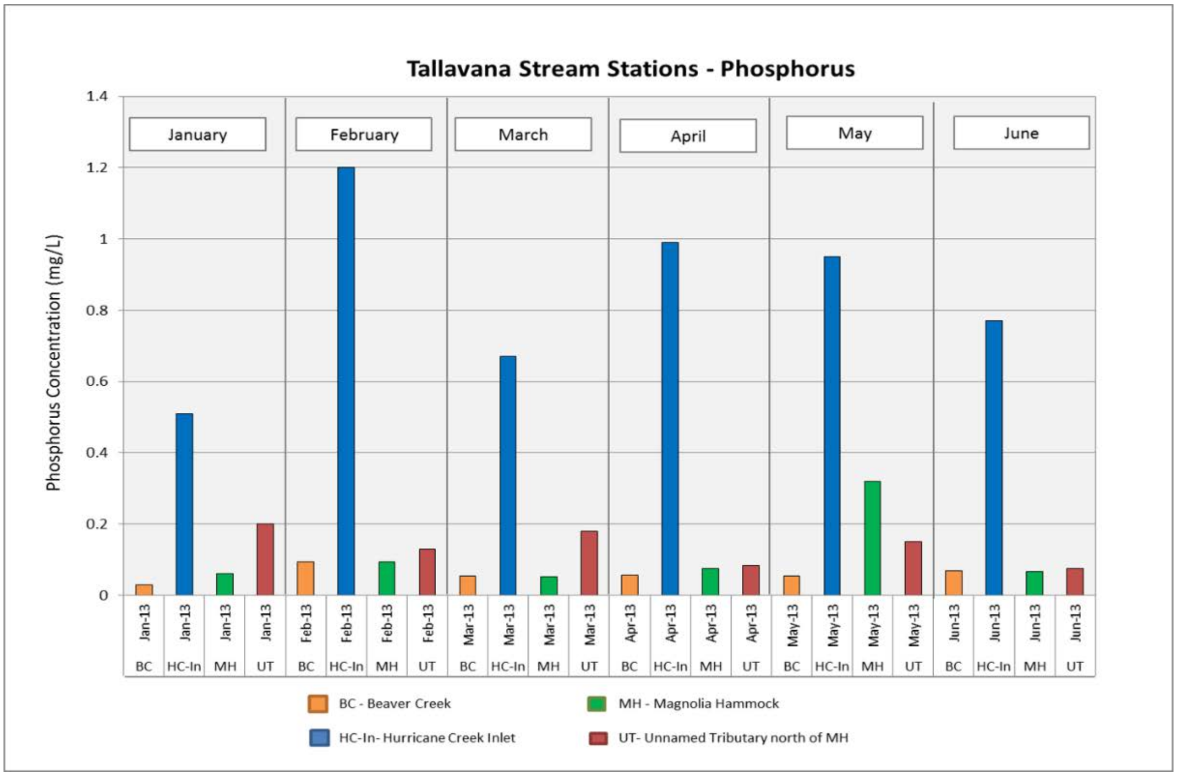


Figure 4.12. TP Concentrations for the Tributaries to Lake Tallavana

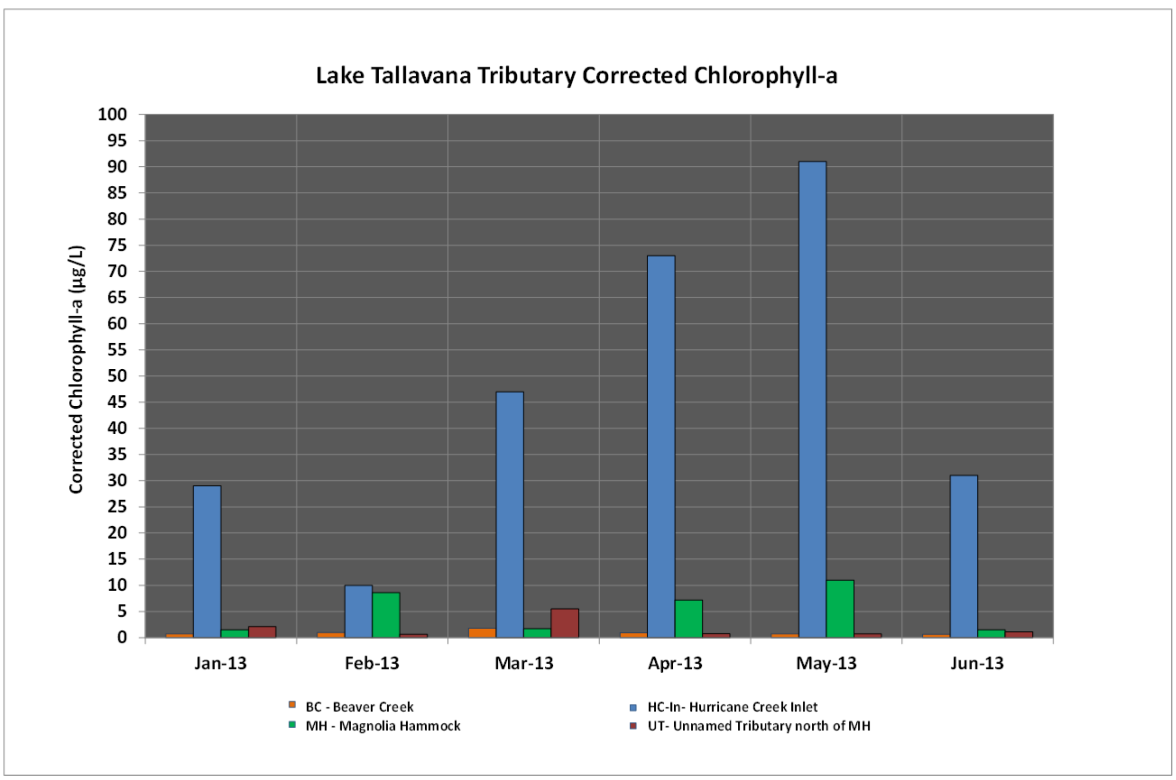


Figure 4.13. CHLAC Concentrations for the Tributaries to Lake Tallavana

Table 4.5a. Summary Statistics for TN in the Tributaries

Stream	N	Mean (mg/L)	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)
Beaver Creek	6	0.67	0.66	0.57	0.81
Hurricane Creek – Inlet	6	3.74	3.60	2.10	5.50
Magnolia Hammock	6	0.60	0.51	0.49	1.02
Unnamed Tributary	6	0.31	0.29	0.17	0.49
Hurricane Creek – Outlet	6	1.20	1.17	0.90	1.56

Table 4.5b. Summary Statistics for TP in the Tributaries

Stream	N	Mean (mg/L)	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)
Beaver Creek	6	0.059	0.056	0.029	0.093
Hurricane Creek – Inlet	6	0.848	0.860	0.510	1.200
Magnolia Hammock	6	0.111	0.071	0.053	0.320
Unnamed Tributary	6	0.136	0.140	0.075	0.200
Hurricane Creek – Outlet	6	0.228	0.220	0.126	0.340

Table 4.5c. Summary Statistics for CHLAC in the Tributaries

Stream	N	Mean (µg/L)	Median (µg/L)	Minimum (µg/L)	Maximum (µg/L)
Beaver Creek	6	0.9	0.8	0.6	1.8
Hurricane Creek – Inlet	6	46.8	39.0	10.0	91.0
Magnolia Hammock	6	5.3	4.5	1.5	11.0
Unnamed Tributary	6	1.8	0.9	0.6	5.5
Hurricane Creek – Outlet	6	66.8	56.5	6.9	190.0

Table 4.5d. Summary Statistics for Flow in the Tributaries

Stream	N	Mean (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
Beaver Creek	6	1.50	1.28	0.003	4.10
Hurricane Creek – Inlet	6	4.92	3.55	0.40	13.67
Magnolia Hammock	6	0.46	0.16	0.073	1.84
Unnamed Tributary	6	0.050	0.019	0.001	0.206
Hurricane Creek – Outlet	4	12.3	11.3	2.9	23.5

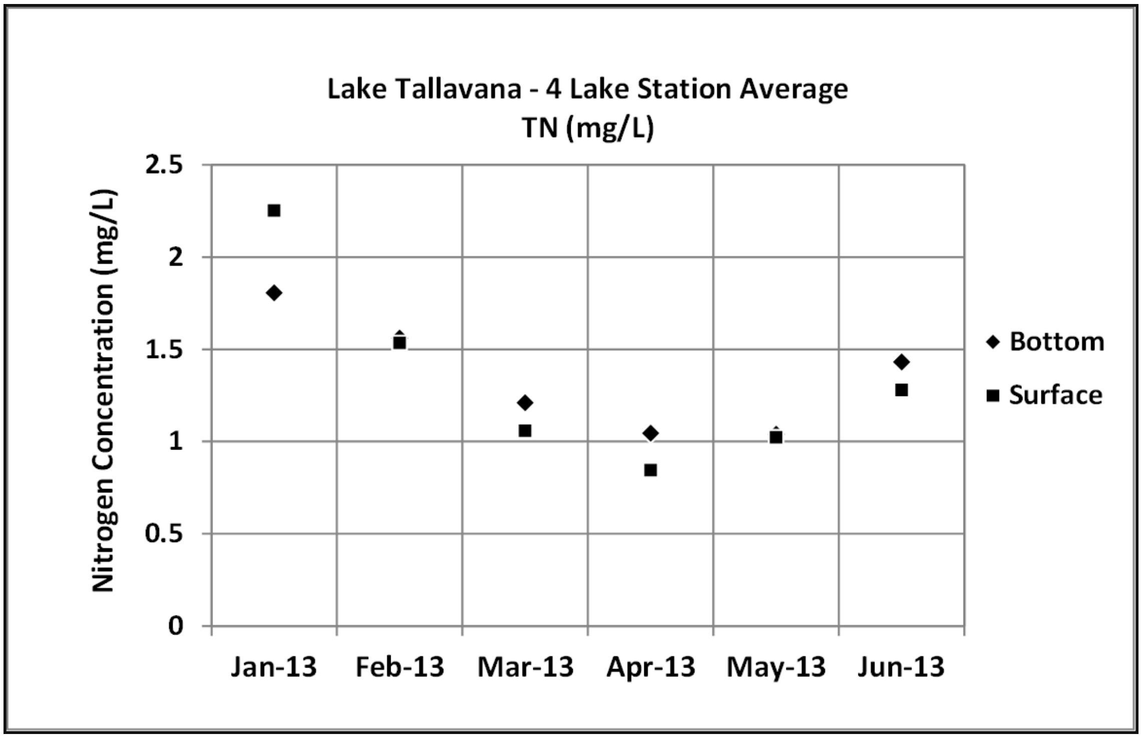


Figure 4.14. Average TN Concentrations for the Lake Tallavana Stations

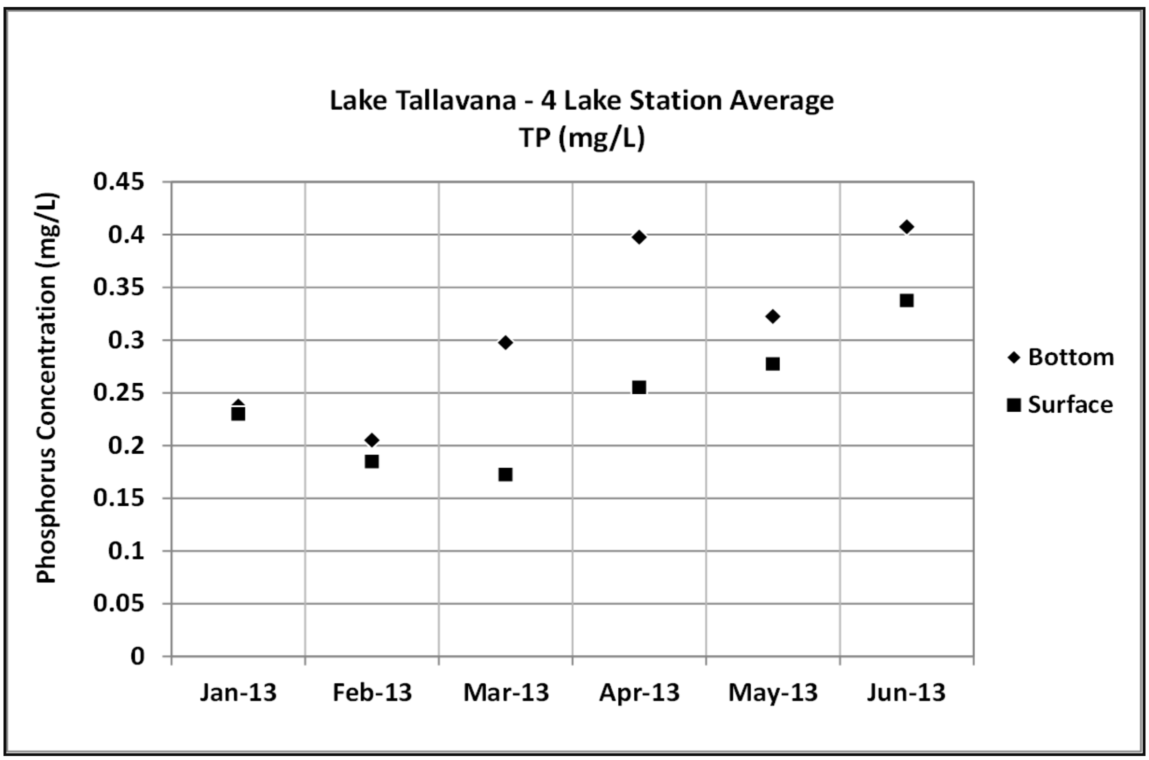


Figure 4.15. Average TP Concentrations for the Lake Tallavana Stations

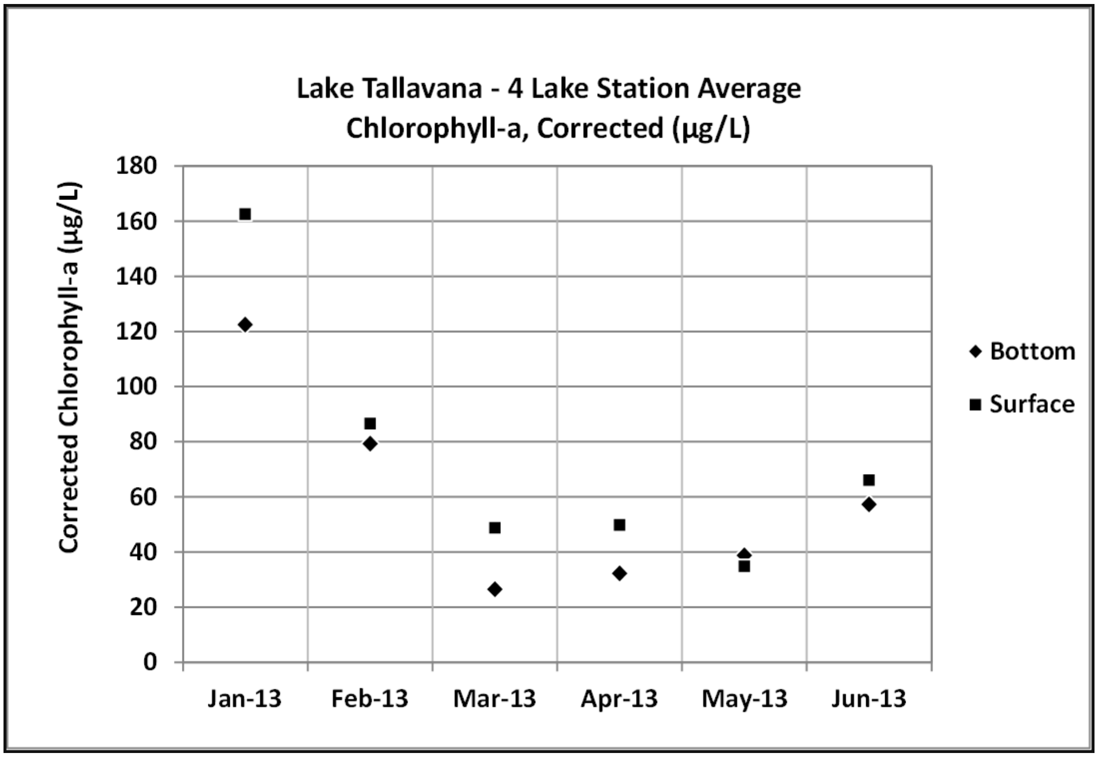


Figure 4.16. Average CHLAC Concentrations for the Lake Tallavana Stations

Table 4.6a. Summary Statistics for TN in Lake Tallavana

Station	N	Mean (mg/L)	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)
TAL-LS1	12	1.197	1.068	0.759	1.980
TAL-LS2	12	1.360	1.246	0.837	1.967
TAL-LS3	12	1.392	1.405	0.844	1.890
TAL-LS4	12	1.271	1.238	0.930	1.787
Overall	**48**	**1.305**	**1.206**	**0.759**	**1.98**

Table 4.6b. Summary Statistics for TP in Lake Tallavana

Station	N	Mean (mg/L)	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)
TAL-LS1	12	0.233	0.245	0.150	0.330
TAL-LS2	12	0.308	0.280	0.170	0.600
TAL-LS3	12	0.304	0.260	0.170	0.500
TAL-LS4	12	0.263	0.250	0.180	0.350
Overall	**48**	**0.277**	**0.260**	**0.150**	**0.60**

Table 4.6c. Summary Statistics for CHLAC in Lake Tallavana

STATION	N	MEAN (µG/L)	MEDIAN (µG/L)	MINIMUM (µG/L)	MAXIMUM (µG/L)
TAL-LS1	12	65.9	54.5	27.0	170
TAL-LS2	12	67.6	51.5	24.0	160
TAL-LS3	12	66.9	54.5	22.0	170
TAL-LS4	12	67.6	65.5	19.0	150
Overall	**48**	**67.0**	**54.5**	**19.0**	**170**

Hurricane Creek Water Quality Survey (2014-15) – During the development of this TMDL, the department analyzed the available water quality data collected from all tributaries discharging into Lake Tallavana. Nutrient concentrations and flows in Hurricane Creek were consistently higher than nutrient concentrations and flows in other tributaries. To improve and help calibrate the watershed loading model, it was important to identify the major sources in the Hurricane Creek watershed that contribute nutrient loads to the lake. In addition to helping with model calibration, identifying these sources would be a critical step toward developing an effective nutrient management plan to restore Lake Tallavana.

With the cooperation of the Florida Department of Agriculture and Consumer Services (FDACS) and both May and Clinton Nurseries, the department was able to sample the direct discharge into Hurricane Creek from both nurseries. Additional stations were also sampled both upstream and downstream of the nurseries. **Table 4.7** and **Figure 4.17** describe and show the stations sampled for this analysis.

The sampling began in November 2014, took place monthly, and was completed in October 2015. **Tables 4.8a** through **4.8c** contain summary statistics for the ambient water quality monitoring stations.

Table 4.7. Stations Sampled for the Hurricane Creek Study

Station ID	Station Description	Station Type	Latitude at Site	Longitude at Site
HC01	End of pipe of Mays settling pond	Nursery outfall	30.6149	-84.4376
HC02	Ditch receiving irrigation discharge	Nursery outfall	30.613	-84.4283
HC03	Downstream of Clinton southern pond into Hurricane Creek	Ambient	Sampled at Confluence: 30.60855	Sampled at Confluence: -84.43738
HC04	Hurricane Creek at outlet of Tobacco Rd. stormwater pond	Ambient	30.61387	-84.42795
HC05	Northern branch of confluence	Ambient	Confluence: 30.60855	Confluence: -84.43738
HC06	Discharge of Clinton west pond	Nursery outfall	30.6088	-84.4388
HC07	Downstream of Hurricane Creek confluence	Ambient	30.6088	-84.4391
HC08	Composite sample of the three May irrigation wells that discharge into Hurricane Creek	Nursery irrigation water	Well #1: 30.61819 Well #2: 30.61845 Well #3: 30.62041	Well #1: -84.43171 Well #2: -84.43069 Well #3: -84.43280
HC10	Composite of Clinton irrigation wells	Nursery irrigation water	Well #1: 30.61115 Well #2: 30.60749 Well #3: 30.60429 Well #4: 30.60575	Well #1: -84.42858 Well #2: -84.42728 Well #3: -84.43215 Well #4: -84.43812
HC11	Hurricane Creek off Paradise Rd.	Ambient	30.60904	-84.44147
HC12	Tributary downstream of Mays near Paradise Rd.	Ambient	30.60918	-84.44073
TALSS6	Hurricane Creek upstream of Lake Tallavana	Ambient	30.6028	-84.4516

Figure 4.17.   Stations Sampled for the Hurricane Creek Study

Table 4.8a.   Summary of TN Data from Ambient Water Quality Stations Sampled for the Hurricane Creek Study

Station	N	Mean (mg/L)	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)
HC03	8	1.61	1.67	1.11	2.35
HC04	5	0.98	0.95	0.65	1.41
HC05	8	5.40	4.30	2.60	13.20
HC11	8	3.93	3.10	0.88	8.70
HC12	8	3.28	2.15	0.91	7.01
TALSS6	8	3.45	2.47	1.53	8.20

Table 4.8b. Summary of TP Data from Ambient Water Quality Stations Sampled for the Hurricane Creek Study

Station	N	Mean (mg/L)	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)
HC03	8	0.72	0.73	0.30	1.10
HC04	5	0.11	0.08	0.04	0.21
HC05	8	1.45	1.20	0.80	3.00
HC11	8	0.95	0.79	0.19	2.00
HC12	8	0.67	0.66	0.14	1.40
TALSS6	8	0.95	0.90	0.42	1.90

Table 4.8c. Summary of CHLAC Data from Ambient Water Quality Stations Sampled for the Hurricane Creek Study

Station	N	Mean (µg/L)	Median (µg/L)	Minimum (µg/L)	Maximum (µg/L)
HC03	8	37.4	29.0	2.7	93.0
HC04	5	8.3	6.4	2.8	18.0
HC05	8	109.4	73.0	21.0	340.0
HC11	8	82.0	43.0	0.8	280.0
HC12	8	20.9	17.5	2.1	59.0
TALSS6	8	63.5	36.0	7.3	200.0

4.2.3 Output Tables from the LSPC Model

To calibrate the watershed model, irrigation data from both Clinton Nursery and May Nursery were used, in addition to nutrient concentration data from both intensive surveys. The data used for this additional water source were added into the LSPC model as an additional point source, combining both of the nurseries into a single source into Hurricane Creek. A 2013 Pumping Report Compliance Audit Sheet submitted to the NWFWMD for each nursery was used to determine how much additional volume needed to be added. Once the loading from the watershed was calibrated, to account for the additional hydrology in the Hurricane Creek watershed, the output nutrient concentrations and flow rates for each subwatershed were entered into the lake eutrophication model.

The natural background scenario represents the model prediction of water quality conditions under a reference condition. All urban, open, agricultural, pasture, rangeland, and forest regeneration land uses in the Lake Tallavana watershed were converted to forest and/or wetland based on hydrologic soil characteristics. **Tables 4.9a** through **4.9d** show the total simulated annual runoff from the surface runoff, interflow, baseflow, and, for the Hurricane Creek watershed, additional flow from irrigation in the watershed. **Tables 4.10a** and **4.10b** list the TN and TP concentrations for each of the four subwatersheds in Lake Tallavana from the LSPC model.

Table 4.9a. Total Annual Flow as Simulated in the LSPC Model for the Hurricane Creek Watershed (inch*acre/yr)

Year	Surface Runoff	Interflow	Baseflow	Total Watershed Flow	Additional Irrigation Flow	Total Reach Flow
2002	4,194	5,368	14,627	24,189	34,992	59,180
2003	3,755	8,315	16,166	28,236	35,115	63,351
2004	5,308	17,966	24,013	47,287	35,610	82,896
2005	6,845	28,533	23,111	58,489	35,694	94,183
2006	2,985	1,792	8,123	12,899	34,790	47,689
2007	2,552	680	4,247	7,479	34,629	42,108
2008	4,514	12,130	18,589	35,233	35,353	70,585
2009	4,378	11,644	15,472	31,494	35,232	66,726
2010	3,333	5,275	13,106	21,714	34,859	56,573
2011	2,475	258	4,864	7,598	34,568	42,166
2012	2,883	92	5,125	8,100	34,708	42,808

Table 4.9b. Total Annual Flow as Simulated in the LSPC Model for the Beaver Creek Watershed (inch*acre/yr)

Year	Surface Runoff	Interflow	Baseflow	Total Reach Flow
2002	1,445.53	4,183.79	11,896.37	17,525.69
2003	1,257.52	6,494.71	13,372.24	21,124.47
2004	1,833.59	14,159.46	19,425.43	35,418.48
2005	3,097.36	22,730.16	18,751.98	44,579.50
2006	981.32	1,440.89	6,715.28	9,137.49
2007	834.85	463.76	3,504.49	4,803.10
2008	1,607.36	9,586.56	15,096.36	26,290.28
2009	1,588.13	9,142.19	12,620.04	23,350.36
2010	1,110.93	4,032.89	10,988.46	16,132.28
2011	809.06	184.29	4,125.46	5,118.81
2012	944.59	76.70	4,651.45	5,672.73

Table 4.9c. Total Annual Flow as Simulated in the LSPC Model for the Magnolia Hammock Watershed (inch*acre/yr)

Year	Surface Runoff	Interflow	Baseflow	Total Reach Flow
2002	383.71	1,046.50	3,507.44	4,937.66
2003	339.59	1,677.86	3,955.14	5,972.59
2004	488.59	3,567.55	5,720.46	9,776.59
2005	785.33	5,980.69	5,679.75	12,445.77
2006	265.70	327.53	2,007.10	2,600.33
2007	226.51	118.56	1,035.63	1,380.69
2008	426.66	2,524.40	4,496.26	7,447.32
2009	416.17	2,390.35	3,763.95	6,570.46
2010	299.85	1,036.07	3,240.90	4,576.82
2011	219.56	43.60	1,215.29	1,478.45
2012	256.25	14.47	1,357.12	1,627.84

Table 4.9d. Total Annual Flow as Simulated in the LSPC Model for the Surrounding Lake Tallavana Watershed (inch*acre/yr)

Year	Surface Runoff	Interflow	Baseflow	Total Reach Flow
2002	4,194	5,368	14,627	24,189
2003	3,755	8,315	16,166	28,236
2004	5,308	17,966	24,013	47,287
2005	6,845	28,533	23,111	58,489
2006	2,985	1,792	8,123	12,899
2007	2,552	680	4,247	7,479
2008	4,514	12,130	18,589	35,233
2009	4,378	11,644	15,472	31,494
2010	3,333	5,275	13,106	21,714
2011	2,475	258	4,864	7,598
2012	2,883	92	5,125	8,100

Table 4.10a. Average TN Concentration as Simulated in the LSPC Model for the Subbasins in the Lake Tallavana Watershed

ppb = Parts per billion

Year	Average TN Concentration from Hurricane Creek (ppb)	Average TN Concentration from Beaver Creek (ppb)	Average TN Concentration from Magnolia Hammock (ppb)	Average TN Concentration from Watershed (ppb)
2002	2,129.7	444.21	425.7	433.9
2003	2,168.6	455.87	426.2	430.6
2004	2,060.3	473.04	444.2	440.3
2005	2,082.4	479.22	447.8	442.5
2006	2,416.1	417.28	402.4	412.3
2007	2,563.0	442.46	432.6	440.9
2008	2,160.6	431.14	413.8	419.1
2009	2,263.4	441.54	418.2	425.2
2010	2,286.7	429.18	413.8	420.1
2011	2,543.1	451.27	442.9	451.2
2012	2,572.7	421.27	414.1	424.3

Table 4.10b. Average TP Concentration as Simulated in the LSPC Model for the Subbasins in the Lake Tallavana Watershed

ppb = Parts per billion

Year	Average TP Concentration from Hurricane Creek (ppb)	Average TP Concentration from Beaver Creek (ppb)	Average TP Concentration from Magnolia Hammock (ppb)	Average TP Concentration from Watershed (ppb)
2002	693.8	70.16	90.6	67.8
2003	707.4	76.45	94.0	69.7
2004	667.6	81.65	97.7	72.8
2005	674.4	82.38	96.9	72.4
2006	796.0	65.28	86.4	64.4
2007	846.6	64.38	84.9	65.4
2008	706.5	69.23	87.7	66.9
2009	740.7	71.82	89.5	67.8
2010	748.8	66.86	86.3	65.0
2011	837.9	63.47	81.3	65.3
2012	847.0	60.41	76.8	62.5

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 TMDL Development Process—Establishing Nutrient Targets

For this TMDL, a calibrated model–based prediction was used to estimate the nutrient concentrations necessary to achieve an annual geometric mean corrected chlorophyll *a* concentration of 20 µg/L.

5.1.1 Lake Water Quality Models

5.1.1.1 Bathtub Eutrophication Model

The Bathtub eutrophication model is a suite of empirically derived steady-state models developed by the United States Army Corps of Engineers (ACOE) Waterways Experimental Station. The primary function of these models is to estimate nutrient concentrations and algal biomass resulting from different patterns of nutrient loadings. The procedures for selecting the appropriate model for a particular lake are described in the User's Manual (Walker 2004). The empirical prediction of lake eutrophication using this approach typically can be described as a two-stage procedure using the following two categories of models (Walker 1999):

- The ***nutrient balance model*** relates to the in-lake nutrient concentration to external nutrient loadings, morphometrics, and hydraulics of the lake.
- The ***eutrophication response model*** describes the relationships among eutrophication indicators in the lake, including nutrient levels, chlorophyll *a*, transparency, and hypolimnetic oxygen depletion.

Table 5.1a. AGMs for in Lake Tallavana, 1991–2012

- = Empty cell/no data

Year	CHLA (µg/L)	CHLAC (µg/L)	TN (mg/L)	TP (mg/L)	Color (PCU)	ALK (mg/L as $CaCO_3$)
1991	65.6	-	0.57	0.054	-	-
1992	26.5	-	0.63	0.044	-	-
1993	25.4	-	0.73	0.057	-	-
1994	26.1	-	0.73	0.065	-	-
1995	35.6	-	0.72	0.058	-	-
1996	39.6	-	0.71	0.060	-	-
1997	42.2	-	0.67	0.064	-	-
1998	39.7	-	0.68	0.088	-	-
1999	53.2	-	0.81	0.102	-	-
2000	72.7	-	1.17	0.160	150	-
2001	76.0	-	1.06	0.131	-	-
2002	92.6	-	1.20	0.138	-	-
2003	106.8	-	1.36	0.185	-	-
2004	109.6	-	1.55	0.179	-	-
2005	91.0	-	1.39	0.168	-	-
2006	55.1	3.6	1.50	0.175	24.1	53.5
2007	63.0	-	1.40	0.170	54.8	35.5
2008	89.5	-	1.39	0.158	-	-
2009	76.6	35.2	0.93	0.123	17.6	21.0
2010	37.4	24.5	1.19	0.103	30.5	45.4
2011	48.8	29.2	0.98	0.183	30.8	40.7
2012	-	36.0	0.91	0.159	35.2	18.1

Table 5.1b. Average of AGMs for Key Water Quality Parameters in Lake Tallavana

Average	CHLA (µg/L)	CHLAC (µg/L)	TN (mg/L)	TP (mg/L)	Color (PCU)	ALK (mg/L as $CaCO_3$)
Long-Term Average (1991–2012)	60.62	25.72	1.01	0.119	32.18	35.70
Average (2000–12)	76.59	25.72	1.23	0.156	32.18	35.70

Figure 5.1 shows the scheme used by Bathtub to relate the external loading of nutrients to the in-lake nutrient concentrations and the physical, chemical, and biological response of the lake to the level of nutrients. The Bathtub model includes a suite of phosphorus and nitrogen sedimentation models along with a set of chlorophyll and Secchi depth models. The nutrient balance models assume that the net accumulation of nutrients in a lake is the difference between nutrient loadings into the lake from various sources and the nutrients carried out through outflow and the losses of nutrients through decay processes inside the lake. Different limiting factors such as nitrogen, phosphorus, light, or flushing are considered in the selection of an appropriate chlorophyll *a* model.

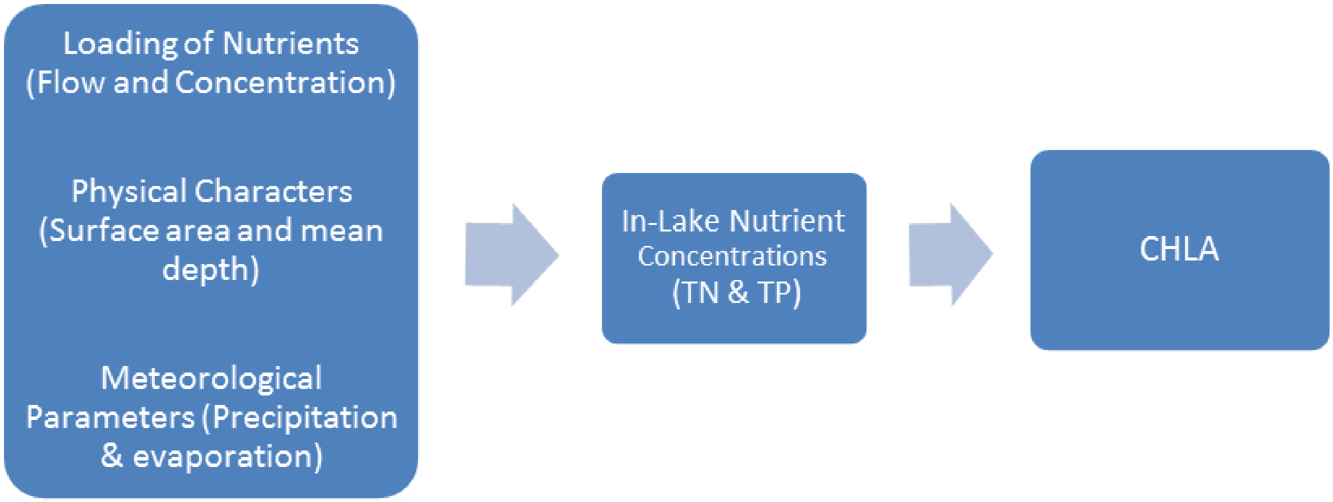


Figure 5.1. Bathtub Concept Scheme

The Bathtub model was chosen for Lake Tallavana due to the lake's nature as a reservoir, with the stage level generally remaining consistent over an annual basis. Bathtub was set up to simulate in-lake TN, TP, and CHLAC concentrations each year from 2002 to 2012 based on simulated TN and TP loads from the LSPC model (**Tables 4.8a** through **4.8d** and **Tables 4.9a** through **4.9b**). AGM concentrations for TN, TP, and CHLAC calculated from available water quality data were used to calibrate Bathtub and guide the selection of nitrogen, phosphorus, and chlorophyll models.

Model Option 1, based on a second-order decay rate of available nutrients, was used to simulate both nitrogen and phosphorus sedimentation, as these are considered to be the most generally applicable formulation for representing nutrient sedimentation in reservoirs. Chlorophyll Model 1 was selected, and included phosphorus, nitrogen, turbidity, and light/transparency as potential limiting factors to algal production. This model option attempts to account for the effects of all factors of limitation on chlorophyll *a* levels.

The Bathtub model includes calibration factors as a mean for adjusting model predictions to account for site-specific conditions. Calibration variables include TP, TN, and CHLAC, and calibration factors apply to sedimentation rates (default) or predicted concentrations. For this TMDL, calibration factors were not applied to either TN or CHLAC in the Bathtub model run, but a calibration factor of 1.2 was applied to the sedimentation rates for TP.

Tables 5.2a through **5.2c** present the results from the calibrated application of these selected model options. The differences between simulated and measured AGM TP concentrations ranged between 0%

(2011) and 43% (2010), with the average difference between simulated and observed TP concentrations of 7.5%. The difference between simulated and observed AGM TN concentrations was 4.6%, with individual years ranging between 3% (2010) and 33% (2011). The limited availability of CHLAC data made it difficult to properly calibrate the model for chlorophyll *a* concentrations.

Table 5.2a. Calibrated Bathtub Model for TN, Annual Average Geometric Mean 2002–12

Year	TN Simulated (ppb)	TN Observed (ppb)	% Difference
2002	1,076	1,200	10.3%
2003	1,125	1,357	17.1%
2004	1,072	1,545	30.6%
2005	1,080	1,393	22.5%
2006	1,253	1,510	17.0%
2007	1,341	1,430	6.2%
2008	1,100	1,385	20.6%
2009	1,150	1,032	-11.4%
2010	1,160	1,200	3.3%
2011	1,345	1,011	-33.0%
2012	1,305	985	-32.5%

Table 5.2b. Calibrated Bathtub Model for TP, Annual Average Geometric Mean 2002–12

Year	TP Simulated (ppb)	TP Observed (ppb)	% Difference
2002	154	138	-11.6%
2003	158	184	14.1%
2004	159	178	10.7%
2005	164	168	2.4%
2006	168	172	2.3%
2007	177	168	-5.4%
2008	159	158	-0.6%
2009	163	120	-35.8%
2010	161	112	-43.8%
2011	177	177	0.0%
2012	173	151	-14.6%

Table 5.2c. Calibrated Bathtub Model for CHLAC, Annual Average Geometric Mean 2002–12

- = Empty cell/no data

Year	CHLAC Simulated (ppb)	CHLAC Observed (ppb)	% Difference
2002	28	-	-
2003	29	-	-
2004	26	-	-
2005	25	-	-
2006	34	4	750.0%
2007	37	-	-
2008	28	-	-
2009	29	34	14.7%
2010	31	27	14.8%
2011	37	29	27.6%
2012	36	35	2.9%

Modeled Approach

Once the existing conditions model was determined to be calibrated, the Bathtub model was used to determine the allowable TN and TP concentrations that would meet the chlorophyll *a* target of 20 µg/L. Anthropogenic land use runoff concentrations were incrementally reduced until the target chlorophyll *a* concentration was achieved, never exceeding the target of 20 µg/L chlorophyll *a* in any single year. **Table 5.3** summarizes annual geometric mean concentrations required to meet the target condition of 20 µg/L for CHLAC. The long-term average of the annual geometric means for TN and TP from the modeled simulations are **0.95 mg/L** and **0.051 mg/L**, respectively.

Table 5.3. TMDL Nutrient Concentrations To Achieve the CHLAC Target for Lake Tallavana, Annual Average Geometric Mean 2002–12

Year	Target TP Concentration (ppb)	Target TN Concentration (ppb)	Target CHLAC Concentration (ppb)
2002	48	883	16
2003	50	899	16
2004	49	837	15
2005	51	845	15
2006	52	1014	18
2007	55	1088	20
2008	49	867	15
2009	51	913	16
2010	51	931	17
2011	55	1097	20
2012	54	1061	19

MODELED NATURAL BACKGROUND CONDITION

To ensure that the nutrient concentration targets and chlorophyll *a* criterion used in these TMDLs will not abate the natural background condition, the LSPC model TN, TP, and chlorophyll *a* simulations for natural background conditions were examined to ensure that they were not higher than the TN and TP concentration targets or chlorophyll *a* criterion. For the natural background model runs, anthropogenic land use types were converted to either upland forest or wetlands, depending on the hydrologic soil type. Human land use with hydrologic soil types A and B were converted to upland forest, while those with C and D soil types were converted into wetland areas.

The same TN and TP model parameters used to simulate the current conditions were used to simulate natural conditions. **Table 5.4** lists the results. The long-term average AGMs for TN, TP, and chlorophyll *a* from the natural background simulations are **0.52 mg/L, 0.034 mg/L**, and **9 µg/L**, respectively—all of which are lower than the TN and TP concentrations needed to achieve a 20 µg/L chlorophyll *a* target. This indicates that using the 20 µg/L chlorophyll *a* target for Lake Tallavana will protect the designated use and, at the same time, will not abate the natural condition.

Table 5.4. Natural Background Condition Run of the Bathtub Model, Annual Average Geometric Mean 2002–12

YEAR	TN SIMULATED (PPB)	TP SIMULATED (PPB)	CHLAC SIMULATED (PPB)
2002	499	34	9
2003	505	35	9
2004	492	38	9
2005	500	39	9
2006	539	32	9
2007	577	32	10
2008	486	35	9
2009	501	35	9
2010	489	33	9
2011	611	34	11
2012	532	29	9

5.2 Calculation of TMDL and Applicable TN and TP Load-Based Criteria

In order to achieve the 20 µg/L chlorophyll *a* target every year, the long-term mean TN and TP loads that achieve the chlorophyll *a* target were simulated using the Bathtub model. Anthropogenic land use loadings based on the current condition scenario were incrementally reduced until the in-lake chlorophyll *a* geometric mean concentration of 20 µg/L was achieved every year, which provided the

TN and TP loads. **Table 5.5** summarizes annual loads under current conditions and TMDL loads for TP. The TMDL long-term average load represents an 83% reduction from the long-term average load under the current conditions.

Table 5.6 summarizes annual loads under current conditions and TMDL loads for TN. The TMDL long-term average load represents a 25% reduction from the long-term average load under the current conditions. **Table 5.7** shows the CHLAC concentrations in Lake Tallavana under the target conditions.

5.3 Critical Conditions/Seasonality

The estimated assimilative capacity is based on annual conditions, rather than critical/seasonal conditions because (1) the methodology used to determine assimilative capacity does not lend itself very well to short-term assessments, (2) the department is generally more concerned with the net change in overall primary productivity in the segment, which is better addressed on an annual basis, and (3) the methodology used to determine impairment is based on annual conditions (AGMs or arithmetic means).

Table 5.5. TP TMDL Loads To Achieve the Chlorophyll *a* Target for Lake Tallavana, Annual Average Geometric Mean 2002–12

kg/yr = Kilograms per year

Year	Total Current TP Load (kg/yr)	Total TMDL TP Load (kg/yr)	% Reduction
2002	4,475	742	83.4%
2003	4,903	850	82.7%
2004	6,210	1,122	81.9%
2005	7,196	1,355	81.2%
2006	4,015	626	84.4%
2007	3,722	554	85.1%
2008	5,472	946	82.7%
2009	5,394	923	82.9%
2010	4,556	760	83.3%
2011	3,693	556	84.9%
2012	3,792	574	84.9%
Average	**4,857**	**785**	**83.4%**

Table 5.6. TN TMDL Loads to Achieve the Chlorophyll *a* Target for Lake Tallavana

Year	Total Current TN Load (kg/yr)	Total TMDL TN Load (kg/yr)	% Reduction
2002	14,703	11,127	24.3%
2003	16,418	12,397	24.5%
2004	21,053	15,681	25.5%
2005	24,524	18,415	24.9%
2006	13,071	9,843	24.7%
2007	11,834	8,862	25.1%
2008	18,211	13,615	25.2%
2009	17,955	13,489	24.9%
2010	14,953	11,290	24.5%
2011	11,871	8,944	24.7%
2012	12,213	9,207	24.6%
Average	**16,073**	**11,757**	**24.8%**

Table 5.7. CHLAC AGMs under the TMDL Nutrient Loads for Lake Tallavana

Year	Annual CHLAC Geometric Mean with TMDL Nutrient Loads (ppb)
2002	16
2003	16
2004	15
2005	15
2006	18
2007	20
2008	15
2009	16
2010	17
2011	20
2012	19

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:

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

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

$$\mathbf{TMDL \cong \sum \square WLAs_{wastewater} + \sum \square WLAs_{NPDES\ Stormwater} + \sum \square LAs + MOS}$$

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

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

This approach is consistent with federal regulations (40 Code of Federal Regulations § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (*e.g.*, pounds per day), toxicity, or other appropriate measure. The TMDLs for Lake Tallavana are expressed as the long-term geometric mean annual load of TN and TP the waterbody can assimilate and maintain the Class III narrative nutrient criteria, and the needed percent reductions from the existing condition in order to achieve the TMDL target (see **Table 6.1**). These TMDLs were based on long-term (11-year) averages of simulated data from 2002 to 2012. The restoration goal is to achieve the generally applicable chlorophyll *a* criterion of 20 µg/L, as an AGM not to be exceeded more than once in any consecutive three year period.

Table 6.1. TMDL Components for Nutrients in Lake Tallavana (WBID 540A)

N/A = Not applicable
Note: The required percent reductions shown in this table represent the reduction from all sources. The needed percent reduction for each individual watershed can be calculated based on the relative load contribution from each provided in **Chapter 4**.
(KG/YR*) = The TN and TP TMDLs are long-term averages of annual loads, where future long-term averages will be assessed over the most recent seven-year average in the verified period. The Chla criterion is the generally applicable criterion of 20 µg/L as an AGM not to be exceeded more than once in any consecutive three-year period.

Parameter	TMDL (kg/yr*)	WLA Wastewater (% reduction)	WLA NPDES Stormwater (% reduction)	LA (% reduction)	MOS
TN	11,757	N/A	N/A	25%	Implicit
TP	785	N/A	N/A	83%	Implicit

6.2 Load Allocation

Long-term average percent reductions from the existing loadings of **25% for TN** and **83% for TP** correspond to long-term average AGM concentrations of **0.95 mg/L for TN** and **0.051 mg/L for TP** in Lake Tallavana, which are not to exceed the target chlorophyll *a* concentration of 20 µg/L. It should be noted that the LA includes loading from stormwater discharges regulated by the department and the water management districts that are not part of the NPDES stormwater program (see **Appendix A**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

There are no NPDES-permitted wastewater facilities in the Lake Tallavana watershed.

6.3.2 NPDES Stormwater Discharges

There are no NPDES Phase I or Phase II MS4 permits in the Lake Tallavana watershed. It should be noted that any MS4 permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

The MOS can either be implicitly accounted for by choosing conservative assumptions about loading or water quality response, or explicitly accounted for during the allocation of loadings. Consistent with the recommendations of the Allocation Technical Advisory Committee (Department 2001), an implicit MOS was used in the development of these TMDLs. The MOS is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving waterbody (Clean Water Act, Section 303[d][1][c]). Considerable uncertainty is usually inherent in estimating nutrient loading from nonpoint sources, as well as predicting water quality response. The effectiveness of management activities (*e.g.,* stormwater management plans) in reducing loading is also subject to uncertainty.

An implicit MOS was used because the TMDLs were based on the conservative decisions associated with a number of the modeling assumptions in determining assimilative capacity (*i.e.,* loading and water quality response for Lake Tallavana). The TMDLs were developed using water quality results from both high and low rainfall years. Additionally, the TMDL nutrient concentration targets are established as annual limits not to be exceeded based on the development of site-specific alternative water quality targets.

Chapter 7: TMDL IMPLEMENTATION

7.1 Basin Management Action Plans

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.).

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

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

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

— 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.

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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 Rule 62-40, F.A.C. In 1994, the department's stormwater treatment requirements were integrated with the stormwater flood control requirements of the water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations, as authorized under Part IV of Chapter 373, F.S.

Rule 62-40 also requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES permitting program to designate certain stormwater discharges as "point sources" of pollution. The EPA promulgated regulations and began implementing the Phase I NPDES stormwater program in 1990 to address, stormwater discharges associated with industrial activity," which includes eleven categories of industrial activity, construction activities disturbing 5 or more acres of land, and Large" and "medium" municipal separate storm sewer systems (MS4s) located in incorporated places and counties with populations of 100,000 or more. However, because the master drainage systems of most local governments in Florida are physically interconnected, the EPA implemented Phase I of the MS4 permitting program on a countywide basis, which brought in all cities (incorporated areas), Chapter 298 special districts; community development districts, water control districts, and the Florida Department of Transportation throughout the 15 counties meeting the population criteria. The department received authorization to implement the NPDES stormwater program in October 2000. The department authority to administer the program is set forth in section 403.0885 F.S.

Additionally, the Phase II NPDES stormwater program, promulgated in 1999, 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 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 Phase I MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Appendix B: Surface Water Quality Results

- = Empty cell/no data

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-1	12/15/1991	83	-	-	0.66	0.053
21FLKWATGAD-TALLAVANA-2	12/15/1991	54	-	-	0.61	0.064
21FLKWATGAD-TALLAVANA-3	12/15/1991	63	-	-	0.46	0.047
21FLKWATGAD-TALLAVANA-1	1/18/1992	36	-	-	0.52	0.048
21FLKWATGAD-TALLAVANA-2	1/18/1992	19	-	-	0.43	0.036
21FLKWATGAD-TALLAVANA-3	1/18/1992	20	-	-	0.48	0.036
21FLKWATGAD-TALLAVANA-1	2/15/1992	25	-	-	0.64	0.026
21FLKWATGAD-TALLAVANA-2	2/15/1992	15	-	-	0.66	0.029
21FLKWATGAD-TALLAVANA-3	2/15/1992	16	-	-	0.63	0.031
21FLKWATGAD-TALLAVANA-1	2/19/1992	11	-	-	0.50	0.060
21FLKWATGAD-TALLAVANA-2	2/19/1992	7	-	-	0.54	0.066
21FLKWATGAD-TALLAVANA-3	2/19/1992	11	-	-	0.55	0.068
21FLKWATGAD-TALLAVANA-1	3/14/1992	54	-	-	0.53	0.032
21FLKWATGAD-TALLAVANA-2	3/14/1992	32	-	-	0.65	0.032
21FLKWATGAD-TALLAVANA-3	3/14/1992	51	-	-	0.59	0.038
21FLKWATGAD-TALLAVANA-1	4/11/1992	16	-	-	0.40	0.039
21FLKWATGAD-TALLAVANA-2	4/11/1992	14	-	-	0.55	0.040
21FLKWATGAD-TALLAVANA-3	4/11/1992	15	-	-	0.51	0.038
21FLKWATGAD-TALLAVANA-1	5/15/1992	5	-	-	0.43	0.031
21FLKWATGAD-TALLAVANA-2	5/15/1992	6	-	-	0.46	0.032
21FLKWATGAD-TALLAVANA-3	5/15/1992	5	-	-	0.49	0.032
21FLKWATGAD-TALLAVANA-1	6/17/1992	14	-	-	0.63	0.036
21FLKWATGAD-TALLAVANA-2	6/17/1992	24	-	-	0.59	0.041
21FLKWATGAD-TALLAVANA-3	6/17/1992	30	-	-	0.57	0.045
21FLKWATGAD-TALLAVANA-1	7/18/1992	33	-	-	0.72	0.039
21FLKWATGAD-TALLAVANA-2	7/18/1992	30	-	-	0.75	0.035
21FLKWATGAD-TALLAVANA-3	7/18/1992	28	-	-	0.80	0.044
21FLKWATGAD-TALLAVANA-1	8/15/1992	64	-	-	0.80	0.054
21FLKWATGAD-TALLAVANA-2	8/15/1992	54	-	-	0.84	0.052
21FLKWATGAD-TALLAVANA-3	8/15/1992	58	-	-	0.90	0.065
21FLKWATGAD-TALLAVANA-4	8/15/1992	64	-	-	0.81	0.067
21FLKWATGAD-TALLAVANA-1	9/12/1992	26	-	-	0.58	0.040
21FLKWATGAD-TALLAVANA-2	9/12/1992	26	-	-	0.68	0.037

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-3	9/12/1992	33	-	-	0.77	0.045
21FLKWATGAD-TALLAVANA-4	9/12/1992	28	-	-	0.65	0.049
21FLKWATGAD-TALLAVANA-1	10/17/1992	44	-	-	0.80	0.049
21FLKWATGAD-TALLAVANA-2	10/17/1992	43	-	-	0.78	0.052
21FLKWATGAD-TALLAVANA-3	10/17/1992	47	-	-	0.83	0.050
21FLKWATGAD-TALLAVANA-4	10/17/1992	45	-	-	0.77	0.055
21FLKWATGAD-TALLAVANA-1	11/18/1992	56	-	-	0.66	0.055
21FLKWATGAD-TALLAVANA-2	11/18/1992	56	-	-	0.68	0.056
21FLKWATGAD-TALLAVANA-3	11/18/1992	52	-	-	0.70	0.060
21FLKWATGAD-TALLAVANA-4	11/18/1992	56	-	-	0.79	0.063
21FLKWATGAD-TALLAVANA-1	12/17/1992	36	-	-	0.68	0.052
21FLKWATGAD-TALLAVANA-2	12/17/1992	37	-	-	0.62	0.055
21FLKWATGAD-TALLAVANA-3	12/17/1992	35	-	-	0.63	0.051
21FLKWATGAD-TALLAVANA-4	12/17/1992	36	-	-	0.58	0.056
21FLKWATGAD-TALLAVANA-1	1/16/1993	7	-	-	0.74	0.084
21FLKWATGAD-TALLAVANA-2	1/16/1993	6	-	-	0.73	0.083
21FLKWATGAD-TALLAVANA-3	1/16/1993	6	-	-	0.73	0.080
21FLKWATGAD-TALLAVANA-4	1/16/1993	7	-	-	0.77	0.092
21FLKWATGAD-TALLAVANA-1	2/17/1993	25	-	-	0.65	0.059
21FLKWATGAD-TALLAVANA-2	2/17/1993	23	-	-	0.64	0.065
21FLKWATGAD-TALLAVANA-3	2/17/1993	27	-	-	0.68	0.066
21FLKWATGAD-TALLAVANA-4	2/17/1993	24	-	-	0.81	0.098
21FLKWATGAD-TALLAVANA-1	3/12/1993	46	-	-	0.75	0.070
21FLKWATGAD-TALLAVANA-2	3/12/1993	40	-	-	0.65	0.063
21FLKWATGAD-TALLAVANA-3	3/12/1993	35	-	-	0.61	0.066
21FLKWATGAD-TALLAVANA-4	3/12/1993	32	-	-	0.64	0.070
21FLKWATGAD-TALLAVANA-1	4/18/1993	16	-	-	0.54	0.042
21FLKWATGAD-TALLAVANA-2	4/18/1993	16	-	-	0.52	0.043
21FLKWATGAD-TALLAVANA-3	4/18/1993	16	-	-	0.58	0.046
21FLKWATGAD-TALLAVANA-4	4/18/1993	24	-	-	0.68	0.071
21FLKWATGAD-TALLAVANA-1	5/15/1993	34	-	-	0.84	0.045
21FLKWATGAD-TALLAVANA-2	5/15/1993	32	-	-	0.82	0.044
21FLKWATGAD-TALLAVANA-3	5/15/1993	33	-	-	0.82	0.054
21FLKWATGAD-TALLAVANA-4	5/15/1993	35	-	-	0.82	0.061
21FLKWATGAD-TALLAVANA-1	6/15/1993	-	-	-	0.75	0.059

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-2	6/15/1993	41	-	-	0.73	0.063
21FLKWATGAD-TALLAVANA-3	6/15/1993	-	-	-	0.76	0.061
21FLKWATGAD-TALLAVANA-4	6/15/1993	39	-	-	0.75	0.071
21FLKWATGAD-TALLAVANA-1	7/18/1993	21	-	-	0.80	0.051
21FLKWATGAD-TALLAVANA-2	7/18/1993	26	-	-	0.75	0.053
21FLKWATGAD-TALLAVANA-3	7/18/1993	24	-	-	0.73	0.056
21FLKWATGAD-TALLAVANA-4	7/18/1993	26	-	-	0.83	0.069
21FLKWATGAD-TALLAVANA-1	8/15/1993	51	-	-	0.86	0.057
21FLKWATGAD-TALLAVANA-2	8/15/1993	50	-	-	0.87	0.062
21FLKWATGAD-TALLAVANA-3	8/15/1993	48	-	-	1.01	0.066
21FLKWATGAD-TALLAVANA-4	8/15/1993	50	-	-	0.93	0.074
21FLKWATGAD-TALLAVANA-1	9/12/1993	46	-	-	0.91	0.059
21FLKWATGAD-TALLAVANA-2	9/12/1993	47	-	-	0.91	0.056
21FLKWATGAD-TALLAVANA-3	9/12/1993	45	-	-	0.89	0.058
21FLKWATGAD-TALLAVANA-4	9/12/1993	45	-	-	1.07	0.084
21FLKWATGAD-TALLAVANA-1	10/16/1993	27	-	-	0.64	0.046
21FLKWATGAD-TALLAVANA-2	10/16/1993	34	-	-	0.73	0.065
21FLKWATGAD-TALLAVANA-3	10/16/1993	30	-	-	0.68	0.045
21FLKWATGAD-TALLAVANA-4	10/16/1993	26	-	-	0.62	0.050
21FLKWATGAD-TALLAVANA-1	11/14/1993	21	-	-	0.63	0.041
21FLKWATGAD-TALLAVANA-2	11/14/1993	30	-	-	0.62	0.043
21FLKWATGAD-TALLAVANA-3	11/14/1993	30	-	-	0.61	0.042
21FLKWATGAD-TALLAVANA-4	11/14/1993	27	-	-	0.69	0.049
21FLKWATGAD-TALLAVANA-1	12/11/1993	15	-	-	0.66	0.035
21FLKWATGAD-TALLAVANA-2	12/11/1993	16	-	-	0.77	0.038
21FLKWATGAD-TALLAVANA-3	12/11/1993	16	-	-	0.69	0.039
21FLKWATGAD-TALLAVANA-4	12/11/1993	12	-	-	0.78	0.038
21FLKWATGAD-TALLAVANA-1	1/14/1994	8	-	-	0.51	0.027
21FLKWATGAD-TALLAVANA-2	1/14/1994	8	-	-	0.58	0.031
21FLKWATGAD-TALLAVANA-3	1/14/1994	9	-	-	0.53	0.033
21FLKWATGAD-TALLAVANA-4	1/14/1994	6	-	-	0.59	0.029
21FLKWATGAD-TALLAVANA-1	2/12/1994	5	-	-	0.72	0.069
21FLKWATGAD-TALLAVANA-2	2/12/1994	6	-	-	0.71	0.070
21FLKWATGAD-TALLAVANA-3	2/12/1994	9	-	-	0.70	0.075
21FLKWATGAD-TALLAVANA-4	2/12/1994	14	-	-	0.92	0.103

STATION ID	DATE	CHLA (µG/L)	CHLA (µG/L)	COLOR (PCU)	TN (MG/L)	TP (MG/L)
21FLKWATGAD-TALLAVANA-1	3/12/1994	34	-	-	0.67	0.069
21FLKWATGAD-TALLAVANA-2	3/12/1994	28	-	-	0.61	0.068
21FLKWATGAD-TALLAVANA-3	3/12/1994	23	-	-	0.73	0.075
21FLKWATGAD-TALLAVANA-4	3/12/1994	25	-	-	0.66	0.071
21FLKWATGAD-TALLAVANA-1	4/16/1994	43	-	-	0.67	0.077
21FLKWATGAD-TALLAVANA-2	4/16/1994	60	-	-	0.78	0.084
21FLKWATGAD-TALLAVANA-3	4/16/1994	45	-	-	0.77	0.079
21FLKWATGAD-TALLAVANA-4	4/16/1994	80	-	-	1.01	0.124
21FLKWATGAD-TALLAVANA-1	5/22/1994	54	-	-	0.85	0.071
21FLKWATGAD-TALLAVANA-2	5/22/1994	37	-	-	0.82	0.062
21FLKWATGAD-TALLAVANA-3	5/22/1994	43	-	-	0.84	0.065
21FLKWATGAD-TALLAVANA-4	5/22/1994	43	-	-	0.82	0.075
21FLKWATGAD-TALLAVANA-1	7/21/1994	55	-	-	0.70	0.055
21FLKWATGAD-TALLAVANA-2	7/21/1994	54	-	-	0.78	0.051
21FLKWATGAD-TALLAVANA-3	7/21/1994	62	-	-	0.79	0.054
21FLKWATGAD-TALLAVANA-4	7/21/1994	70	-	-	0.83	0.069
21FLKWATGAD-TALLAVANA-1	8/13/1994	72	-	-	0.88	0.075
21FLKWATGAD-TALLAVANA-2	8/13/1994	83	-	-	0.89	0.077
21FLKWATGAD-TALLAVANA-3	8/13/1994	55	-	-	0.83	0.080
21FLKWATGAD-TALLAVANA-4	8/13/1994	69	-	-	0.83	0.073
21FLKWATGAD-TALLAVANA-1	9/17/1994	64	-	-	0.85	0.071
21FLKWATGAD-TALLAVANA-2	9/17/1994	46	-	-	0.87	0.082
21FLKWATGAD-TALLAVANA-3	9/17/1994	51	-	-	0.91	0.085
21FLKWATGAD-TALLAVANA-4	9/17/1994	72	-	-	0.86	0.073
21FLKWATGAD-TALLAVANA-1	10/15/1994	14	-	-	0.66	0.066
21FLKWATGAD-TALLAVANA-2	10/15/1994	11	-	-	0.66	0.081
21FLKWATGAD-TALLAVANA-3	10/15/1994	10	-	-	0.66	0.074
21FLKWATGAD-TALLAVANA-4	10/15/1994	10	-	-	0.66	0.076
21FLKWATGAD-TALLAVANA-1	11/12/1994	46	-	-	0.56	0.052
21FLKWATGAD-TALLAVANA-2	11/12/1994	44	-	-	0.60	0.052
21FLKWATGAD-TALLAVANA-3	11/12/1994	42	-	-	0.58	0.057
21FLKWATGAD-TALLAVANA-4	11/12/1994	24	-	-	0.65	0.059
21FLKWATGAD-TALLAVANA-1	12/17/1994	11	-	-	0.77	0.067
21FLKWATGAD-TALLAVANA-2	12/17/1994	12	-	-	0.81	0.067
21FLKWATGAD-TALLAVANA-3	12/17/1994	12	-	-	0.79	0.067

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-4	12/17/1994	6	-	-	0.72	0.066
21FLKWATGAD-TALLAVANA-1	1/14/1995	20	-	-	0.59	0.051
21FLKWATGAD-TALLAVANA-2	1/14/1995	35	-	-	0.83	0.059
21FLKWATGAD-TALLAVANA-3	1/14/1995	51	-	-	0.81	0.066
21FLKWATGAD-TALLAVANA-4	1/14/1995	27	-	-	0.74	0.056
21FLKWATGAD-TALLAVANA-1	2/19/1995	22	-	-	0.89	0.081
21FLKWATGAD-TALLAVANA-2	2/19/1995	19	-	-	0.67	0.057
21FLKWATGAD-TALLAVANA-3	2/19/1995	18	-	-	0.69	0.057
21FLKWATGAD-TALLAVANA-4	2/19/1995	14	-	-	0.76	0.089
21FLKWATGAD-TALLAVANA-1	3/18/1995	19	-	-	0.48	0.044
21FLKWATGAD-TALLAVANA-2	3/18/1995	17	-	-	0.58	0.048
21FLKWATGAD-TALLAVANA-3	3/18/1995	14	-	-	0.49	0.048
21FLKWATGAD-TALLAVANA-4	3/18/1995	18	-	-	0.91	0.072
21FLKWATGAD-TALLAVANA-1	4/15/1995	32	-	-	0.55	0.048
21FLKWATGAD-TALLAVANA-2	4/15/1995	44	-	-	0.66	0.061
21FLKWATGAD-TALLAVANA-3	4/15/1995	34	-	-	0.66	0.063
21FLKWATGAD-TALLAVANA-4	4/15/1995	27	-	-	0.62	0.067
21FLKWATGAD-TALLAVANA-1	5/14/1995	42	-	-	0.68	0.075
21FLKWATGAD-TALLAVANA-2	5/14/1995	38	-	-	0.72	0.074
21FLKWATGAD-TALLAVANA-3	5/14/1995	48	-	-	0.75	0.079
21FLKWATGAD-TALLAVANA-4	5/14/1995	67	-	-	0.85	0.115
21FLKWATGAD-TALLAVANA-1	6/10/1995	78	-	-	1.16	0.082
21FLKWATGAD-TALLAVANA-2	6/10/1995	67	-	-	1.03	0.078
21FLKWATGAD-TALLAVANA-3	6/10/1995	74	-	-	1.14	0.083
21FLKWATGAD-TALLAVANA-4	6/10/1995	65	-	-	1.00	0.119
21FLKWATGAD-TALLAVANA-1	7/15/1995	51	-	-	0.95	0.066
21FLKWATGAD-TALLAVANA-2	7/15/1995	38	-	-	0.85	0.062
21FLKWATGAD-TALLAVANA-3	7/15/1995	42	-	-	0.91	0.065
21FLKWATGAD-TALLAVANA-4	7/15/1995	43	-	-	0.85	0.080
21FLKWATGAD-TALLAVANA-1	8/27/1995	70	-	-	0.85	0.057
21FLKWATGAD-TALLAVANA-2	8/27/1995	62	-	-	0.81	0.058
21FLKWATGAD-TALLAVANA-3	8/27/1995	66	-	-	0.84	0.063
21FLKWATGAD-TALLAVANA-4	8/27/1995	49	-	-	0.82	0.066
21FLKWATGAD-TALLAVANA-1	9/16/1995	55	-	-	0.76	0.058
21FLKWATGAD-TALLAVANA-2	9/16/1995	48	-	-	0.66	0.053

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-3	9/16/1995	46	-	-	0.75	0.062
21FLKWATGAD-TALLAVANA-4	9/16/1995	55	-	-	0.71	0.067
21FLKWATGAD-TALLAVANA-1	10/14/1995	39	-	-	0.66	0.045
21FLKWATGAD-TALLAVANA-2	10/14/1995	64	-	-	0.71	0.052
21FLKWATGAD-TALLAVANA-3	10/14/1995	55	-	-	0.85	0.054
21FLKWATGAD-TALLAVANA-4	10/14/1995	33	-	-	0.73	0.051
21FLKWATGAD-TALLAVANA-1	11/18/1995	25	-	-	0.51	0.035
21FLKWATGAD-TALLAVANA-2	11/18/1995	28	-	-	0.59	0.038
21FLKWATGAD-TALLAVANA-3	11/18/1995	30	-	-	0.68	0.036
21FLKWATGAD-TALLAVANA-4	11/18/1995	28	-	-	0.62	0.044
21FLKWATGAD-TALLAVANA-1	12/16/1995	20	-	-	0.40	0.030
21FLKWATGAD-TALLAVANA-2	12/16/1995	23	-	-	0.58	0.036
21FLKWATGAD-TALLAVANA-3	12/16/1995	23	-	-	0.48	0.030
21FLKWATGAD-TALLAVANA-4	12/16/1995	24	-	-	0.53	0.047
21FLKWATGAD-TALLAVANA-1	1/20/1996	29	-	-	0.51	0.038
21FLKWATGAD-TALLAVANA-2	1/20/1996	25	-	-	0.50	0.032
21FLKWATGAD-TALLAVANA-3	1/20/1996	25	-	-	0.48	0.034
21FLKWATGAD-TALLAVANA-4	1/20/1996	23	-	-	0.49	0.035
21FLKWATGAD-TALLAVANA-1	2/24/1996	30	-	-	0.61	0.068
21FLKWATGAD-TALLAVANA-2	2/24/1996	32	-	-	0.60	0.065
21FLKWATGAD-TALLAVANA-3	2/24/1996	35	-	-	0.64	0.075
21FLKWATGAD-TALLAVANA-4	2/24/1996	43	-	-	0.78	0.109
21FLKWATGAD-TALLAVANA-1	3/23/1996	44	-	-	0.55	0.060
21FLKWATGAD-TALLAVANA-2	3/23/1996	43	-	-	0.64	0.067
21FLKWATGAD-TALLAVANA-3	3/23/1996	43	-	-	0.69	0.080
21FLKWATGAD-TALLAVANA-4	3/23/1996	35	-	-	0.69	0.085
21FLKWATGAD-TALLAVANA-1	4/13/1996	36	-	-	0.68	0.057
21FLKWATGAD-TALLAVANA-2	4/13/1996	42	-	-	0.68	0.059
21FLKWATGAD-TALLAVANA-3	4/13/1996	39	-	-	0.68	0.061
21FLKWATGAD-TALLAVANA-4	4/13/1996	30	-	-	0.66	0.068
21FLKWATGAD-TALLAVANA-1	5/11/1996	25	-	-	0.85	0.070
21FLKWATGAD-TALLAVANA-2	5/11/1996	24	-	-	0.88	0.071
21FLKWATGAD-TALLAVANA-3	5/11/1996	37	-	-	0.84	0.069
21FLKWATGAD-TALLAVANA-4	5/11/1996	23	-	-	1.01	0.084
21FLKWATGAD-TALLAVANA-1	6/15/1996	30	-	-	0.66	0.046

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-2	6/15/1996	41	-	-	0.68	0.049
21FLKWATGAD-TALLAVANA-3	6/15/1996	33	-	-	0.65	0.050
21FLKWATGAD-TALLAVANA-4	6/15/1996	37	-	-	0.69	0.059
21FLKWATGAD-TALLAVANA-1	7/13/1996	28	-	-	0.54	0.043
21FLKWATGAD-TALLAVANA-2	7/13/1996	45	-	-	0.40	0.060
21FLKWATGAD-TALLAVANA-3	7/13/1996	47	-	-	0.69	0.058
21FLKWATGAD-TALLAVANA-4	7/13/1996	38	-	-	0.59	0.059
21FLKWATGAD-TALLAVANA-1	8/17/1996	38	-	-	0.63	0.040
21FLKWATGAD-TALLAVANA-2	8/17/1996	66	-	-	0.68	0.056
21FLKWATGAD-TALLAVANA-3	8/17/1996	64	-	-	0.72	0.054
21FLKWATGAD-TALLAVANA-4	8/17/1996	57	-	-	0.76	0.069
21FLKWATGAD-TALLAVANA-1	9/14/1996	66	-	-	0.63	0.056
21FLKWATGAD-TALLAVANA-2	9/14/1996	74	-	-	0.71	0.068
21FLKWATGAD-TALLAVANA-3	9/14/1996	95	-	-	0.86	0.085
21FLKWATGAD-TALLAVANA-4	9/14/1996	96	-	-	1.01	0.105
21FLKWATGAD-TALLAVANA-1	10/18/1996	75	-	-	1.04	0.074
21FLKWATGAD-TALLAVANA-2	10/18/1996	58	-	-	0.85	0.062
21FLKWATGAD-TALLAVANA-3	10/18/1996	-	-	-	0.89	0.063
21FLKWATGAD-TALLAVANA-4	10/18/1996	45	-	-	0.77	0.060
21FLKWATGAD-TALLAVANA-1	11/18/1996	49	-	-	0.80	0.054
21FLKWATGAD-TALLAVANA-2	11/18/1996	65	-	-	0.91	0.066
21FLKWATGAD-TALLAVANA-3	11/18/1996	49	-	-	0.85	0.064
21FLKWATGAD-TALLAVANA-4	11/18/1996	15	-	-	0.69	0.039
21FLKWATGAD-TALLAVANA-1	12/14/1996	42	-	-	0.97	0.056
21FLKWATGAD-TALLAVANA-2	12/14/1996	43	-	-	0.91	0.058
21FLKWATGAD-TALLAVANA-3	12/14/1996	38	-	-	0.94	0.057
21FLKWATGAD-TALLAVANA-4	12/14/1996	18	-	-	0.92	0.061
21FLKWATGAD-TALLAVANA-1	1/22/1997	35	-	-	0.84	0.061
21FLKWATGAD-TALLAVANA-2	1/22/1997	44	-	-	0.91	0.070
21FLKWATGAD-TALLAVANA-3	1/22/1997	46	-	-	0.80	0.071
21FLKWATGAD-TALLAVANA-4	1/22/1997	40	-	-	0.56	0.076
21FLKWATGAD-TALLAVANA-1	2/19/1997	81	-	-	0.77	0.077
21FLKWATGAD-TALLAVANA-2	2/19/1997	100	-	-	0.65	0.081
21FLKWATGAD-TALLAVANA-3	2/19/1997	79	-	-	0.67	0.082
21FLKWATGAD-TALLAVANA-4	2/19/1997	62	-	-	0.60	0.070

Station ID	Date	CHLA (µg/L)	CHLA (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-1	3/16/1997	33	-	-	0.56	0.057
21FLKWATGAD-TALLAVANA-2	3/16/1997	34	-	-	0.59	0.054
21FLKWATGAD-TALLAVANA-3	3/16/1997	29	-	-	0.57	0.050
21FLKWATGAD-TALLAVANA-4	3/16/1997	30	-	-	0.48	0.056
21FLKWATGAD-TALLAVANA-1	4/13/1997	18	-	-	0.39	0.043
21FLKWATGAD-TALLAVANA-2	4/13/1997	26	-	-	0.37	0.056
21FLKWATGAD-TALLAVANA-3	4/13/1997	24	-	-	0.42	0.050
21FLKWATGAD-TALLAVANA-4	4/13/1997	28	-	-	0.48	0.060
21FLKWATGAD-TALLAVANA-1	5/17/1997	38	-	-	0.67	0.061
21FLKWATGAD-TALLAVANA-2	5/17/1997	53	-	-	0.63	0.057
21FLKWATGAD-TALLAVANA-3	5/17/1997	43	-	-	0.61	0.060
21FLKWATGAD-TALLAVANA-4	5/17/1997	37	-	-	0.63	0.060
21FLKWATGAD-TALLAVANA-1	6/17/1997	46	-	-	0.55	0.058
21FLKWATGAD-TALLAVANA-2	6/17/1997	50	-	-	0.53	0.061
21FLKWATGAD-TALLAVANA-3	6/17/1997	35	-	-	0.54	0.058
21FLKWATGAD-TALLAVANA-4	6/17/1997	19	-	-	0.45	0.059
21FLKWATGAD-TALLAVANA-1	7/12/1997	32	-	-	0.80	0.045
21FLKWATGAD-TALLAVANA-2	7/12/1997	36	-	-	0.70	0.049
21FLKWATGAD-TALLAVANA-3	7/12/1997	40	-	-	0.70	0.053
21FLKWATGAD-TALLAVANA-4	7/12/1997	35	-	-	0.67	0.062
21FLKWATGAD-TALLAVANA-1	8/16/1997	62	-	-	0.82	0.074
21FLKWATGAD-TALLAVANA-2	8/16/1997	67	-	-	0.86	0.087
21FLKWATGAD-TALLAVANA-3	8/16/1997	68	-	-	0.77	0.082
21FLKWATGAD-TALLAVANA-4	8/16/1997	75	-	-	0.67	0.105
21FLKWATGAD-TALLAVANA-1	9/13/1997	46	-	-	0.99	0.054
21FLKWATGAD-TALLAVANA-2	9/13/1997	53	-	-	1.06	0.069
21FLKWATGAD-TALLAVANA-3	9/13/1997	56	-	-	1.00	0.068
21FLKWATGAD-TALLAVANA-4	9/13/1997	75	-	-	0.87	0.077
21FLKWATGAD-TALLAVANA-1	10/11/1997	33	-	-	0.67	0.055
21FLKWATGAD-TALLAVANA-2	10/11/1997	35	-	-	0.77	0.053
21FLKWATGAD-TALLAVANA-3	10/11/1997	31	-	-	0.80	0.048
21FLKWATGAD-TALLAVANA-4	10/11/1997	20	-	-	0.76	0.049
21FLKWATGAD-TALLAVANA-1	11/22/1997	42	-	-	0.67	0.079
21FLKWATGAD-TALLAVANA-2	11/22/1997	83	-	-	0.83	0.095
21FLKWATGAD-TALLAVANA-3	11/22/1997	66	-	-	0.88	0.094

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-4	11/22/1997	67	-	-	0.79	0.114
21FLKWATGAD-TALLAVANA-1	12/20/1997	35	-	-	0.79	0.058
21FLKWATGAD-TALLAVANA-2	12/20/1997	38	-	-	0.69	0.056
21FLKWATGAD-TALLAVANA-3	12/20/1997	34	-	-	0.70	0.055
21FLKWATGAD-TALLAVANA-4	12/20/1997	35	-	-	0.56	0.068
21FLKWATGAD-TALLAVANA-1	1/11/1998	79	-	-	0.81	0.072
21FLKWATGAD-TALLAVANA-2	1/11/1998	82	-	-	0.68	0.076
21FLKWATGAD-TALLAVANA-3	1/11/1998	72	-	-	0.78	0.082
21FLKWATGAD-TALLAVANA-4	1/11/1998	62	-	-	0.91	0.116
21FLKWATGAD-TALLAVANA-1	3/14/1998	12	-	-	0.58	0.115
21FLKWATGAD-TALLAVANA-2	3/14/1998	10	-	-	0.81	0.119
21FLKWATGAD-TALLAVANA-3	3/14/1998	11	-	-	0.76	0.126
21FLKWATGAD-TALLAVANA-4	3/14/1998	7	-	-	0.75	0.130
21FLKWATGAD-TALLAVANA-1	4/25/1998	12	-	-	0.41	0.044
21FLKWATGAD-TALLAVANA-2	4/25/1998	13	-	-	0.42	0.046
21FLKWATGAD-TALLAVANA-3	4/25/1998	18	-	-	0.46	0.051
21FLKWATGAD-TALLAVANA-4	4/25/1998	51	-	-	0.72	0.092
21FLKWATGAD-TALLAVANA-1	5/16/1998	16	-	-	0.35	0.056
21FLKWATGAD-TALLAVANA-2	5/16/1998	13	-	-	0.41	0.048
21FLKWATGAD-TALLAVANA-3	5/16/1998	11	-	-	0.39	0.051
21FLKWATGAD-TALLAVANA-4	5/16/1998	26	-	-	0.43	0.077
21FLKWATGAD-TALLAVANA-1	6/20/1998	36	-	-	0.60	0.052
21FLKWATGAD-TALLAVANA-2	6/20/1998	31	-	-	0.57	0.050
21FLKWATGAD-TALLAVANA-3	6/20/1998	32	-	-	0.55	0.056
21FLKWATGAD-TALLAVANA-4	6/20/1998	24	-	-	0.54	0.060
21FLKWATGAD-TALLAVANA-1	7/18/1998	46	-	-	0.68	0.067
21FLKWATGAD-TALLAVANA-2	7/18/1998	47	-	-	0.70	0.069
21FLKWATGAD-TALLAVANA-3	7/18/1998	34	-	-	0.70	0.069
21FLKWATGAD-TALLAVANA-4	7/18/1998	18	-	-	0.92	0.127
21FLKWATGAD-TALLAVANA-1	8/15/1998	38	-	-	0.65	0.070
21FLKWATGAD-TALLAVANA-2	8/15/1998	77	-	-	0.80	0.109
21FLKWATGAD-TALLAVANA-3	8/15/1998	53	-	-	0.80	0.098
21FLKWATGAD-TALLAVANA-4	8/15/1998	38	-	-	0.87	0.157
21FLKWATGAD-TALLAVANA-1	9/12/1998	64	-	-	0.65	0.128
21FLKWATGAD-TALLAVANA-2	9/12/1998	52	-	-	0.73	0.128

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-3	9/12/1998	48	-	-	0.73	0.126
21FLKWATGAD-TALLAVANA-4	9/12/1998	35	-	-	0.70	0.133
21FLKWATGAD-TALLAVANA-1	10/10/1998	81	-	-	0.94	0.179
21FLKWATGAD-TALLAVANA-2	10/10/1998	84	-	-	0.83	0.160
21FLKWATGAD-TALLAVANA-3	10/10/1998	89	-	-	0.98	0.197
21FLKWATGAD-TALLAVANA-4	10/10/1998	94	-	-	1.02	0.202
21FLKWATGAD-TALLAVANA-1	11/14/1998	82	-	-	0.87	0.089
21FLKWATGAD-TALLAVANA-2	11/14/1998	89	-	-	0.85	0.093
21FLKWATGAD-TALLAVANA-3	11/14/1998	140	-	-	0.89	0.106
21FLKWATGAD-TALLAVANA-4	11/14/1998	73	-	-	0.63	0.068
21FLKWATGAD-TALLAVANA-1	12/19/1998	94	-	-	0.96	0.094
21FLKWATGAD-TALLAVANA-2	12/19/1998	99	-	-	0.76	0.084
21FLKWATGAD-TALLAVANA-3	12/19/1998	81	-	-	0.77	0.082
21FLKWATGAD-TALLAVANA-4	12/19/1998	81	-	-	0.70	0.069
21FLKWATGAD-TALLAVANA-1	2/20/1999	67	-	-	0.77	0.075
21FLKWATGAD-TALLAVANA-2	2/20/1999	41	-	-	0.58	0.063
21FLKWATGAD-TALLAVANA-3	2/20/1999	48	-	-	0.56	0.067
21FLKWATGAD-TALLAVANA-4	2/20/1999	213	-	-	1.32	0.158
21FLKWATGAD-TALLAVANA-1	3/20/1999	91	-	-	0.70	0.081
21FLKWATGAD-TALLAVANA-2	3/20/1999	67	-	-	0.79	0.088
21FLKWATGAD-TALLAVANA-3	3/20/1999	55	-	-	0.58	0.078
21FLKWATGAD-TALLAVANA-4	3/20/1999	51	-	-	0.53	0.084
21FLKWATGAD-TALLAVANA-1	4/24/1999	51	-	-	0.76	0.095
21FLKWATGAD-TALLAVANA-2	4/24/1999	50	-	-	0.65	0.100
21FLKWATGAD-TALLAVANA-3	4/24/1999	44	-	-	0.78	0.103
21FLKWATGAD-TALLAVANA-4	4/24/1999	57	-	-	0.81	0.130
21FLKWATGAD-TALLAVANA-1	5/22/1999	35	-	-	0.64	0.092
21FLKWATGAD-TALLAVANA-2	5/22/1999	31	-	-	0.70	0.081
21FLKWATGAD-TALLAVANA-3	5/22/1999	34	-	-	0.71	0.085
21FLKWATGAD-TALLAVANA-4	5/22/1999	37	-	-	0.74	0.105
21FLKWATGAD-TALLAVANA-1	6/13/1999	49	-	-	0.66	0.092
21FLKWATGAD-TALLAVANA-2	6/13/1999	45	-	-	0.68	0.089
21FLKWATGAD-TALLAVANA-3	6/13/1999	35	-	-	0.53	0.082
21FLKWATGAD-TALLAVANA-4	6/13/1999	14	-	-	0.68	0.098
21FLKWATGAD-TALLAVANA-1	7/17/1999	60	-	-	0.82	0.128

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-2	7/17/1999	60	-	-	0.81	0.141
21FLKWATGAD-TALLAVANA-3	7/17/1999	150	-	-	0.95	0.196
21FLKWATGAD-TALLAVANA-4	7/17/1999	214	-	-	1.00	0.220
21FLKWATGAD-TALLAVANA-1	8/28/1999	102	-	-	1.16	0.081
21FLKWATGAD-TALLAVANA-2	8/28/1999	100	-	-	1.23	0.094
21FLKWATGAD-TALLAVANA-3	8/28/1999	89	-	-	1.14	0.104
21FLKWATGAD-TALLAVANA-4	8/28/1999	107	-	-	1.27	0.229
21FLKWATGAD-TALLAVANA-5	8/28/1999	86	-	-	1.14	0.087
21FLKWATGAD-TALLAVANA-1	9/18/1999	82	-	-	1.03	0.129
21FLKWATGAD-TALLAVANA-2	9/18/1999	75	-	-	1.11	0.145
21FLKWATGAD-TALLAVANA-3	9/18/1999	57	-	-	0.96	0.123
21FLKWATGAD-TALLAVANA-4	9/18/1999	52	-	-	1.01	0.169
21FLKWATGAD-TALLAVANA-5	9/18/1999	82	-	-	1.15	0.136
21FLKWATGAD-TALLAVANA-1	10/31/1999	30	-	-	0.81	0.082
21FLKWATGAD-TALLAVANA-2	10/31/1999	32	-	-	0.80	0.085
21FLKWATGAD-TALLAVANA-3	10/31/1999	25	-	-	0.75	0.081
21FLKWATGAD-TALLAVANA-4	10/31/1999	30	-	-	0.75	0.100
21FLKWATGAD-TALLAVANA-5	10/31/1999	37	-	-	0.94	0.091
21FLKWATGAD-TALLAVANA-1	11/14/1999	40	-	-	0.63	0.074
21FLKWATGAD-TALLAVANA-2	11/14/1999	40	-	-	0.72	0.079
21FLKWATGAD-TALLAVANA-3	11/14/1999	32	-	-	0.73	0.081
21FLKWATGAD-TALLAVANA-4	11/14/1999	28	-	-	0.76	0.122
21FLKWATGAD-TALLAVANA-5	11/14/1999	36	-	-	0.81	0.078
21FLKWATGAD-TALLAVANA-1	1/23/2000	26	-	-	0.70	0.057
21FLKWATGAD-TALLAVANA-2	1/23/2000	30	-	-	0.73	0.061
21FLKWATGAD-TALLAVANA-3	1/23/2000	28	-	-	0.70	0.060
21FLKWATGAD-TALLAVANA-5	1/23/2000	25	-	-	0.70	0.053
21FLKWATGAD-TALLAVANA-1	2/19/2000	46	-	-	0.79	0.073
21FLKWATGAD-TALLAVANA-2	2/19/2000	59	-	-	0.66	0.075
21FLKWATGAD-TALLAVANA-3	2/19/2000	65	-	-	0.89	0.085
21FLKWATGAD-TALLAVANA-4	2/19/2000	59	-	-	0.97	0.106
21FLKWATGAD-TALLAVANA-5	2/19/2000	43	-	-	0.77	0.068
21FLKWATGAD-TALLAVANA-1	3/18/2000	32	-	-	0.68	0.066
21FLKWATGAD-TALLAVANA-2	3/18/2000	45	-	-	0.79	0.091
21FLKWATGAD-TALLAVANA-3	3/18/2000	41	-	-	0.89	0.111

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-4	3/18/2000	45	-	-	0.96	0.176
21FLKWATGAD-TALLAVANA-5	3/18/2000	28	-	-	0.82	0.073
21FLKWATGAD-TALLAVANA-1	4/15/2000	45	-	-	0.73	0.088
21FLKWATGAD-TALLAVANA-2	4/15/2000	44	-	-	0.75	0.080
21FLKWATGAD-TALLAVANA-3	4/15/2000	39	-	-	0.70	0.073
21FLKWATGAD-TALLAVANA-4	4/15/2000	41	-	-	0.77	0.102
21FLKWATGAD-TALLAVANA-5	4/15/2000	31	-	-	0.69	0.077
21FLKWATGAD-TALLAVANA-1	5/20/2000	89	-	-	1.25	0.109
21FLKWATGAD-TALLAVANA-2	5/20/2000	91	-	-	1.26	0.111
21FLKWATGAD-TALLAVANA-3	5/20/2000	91	-	-	1.17	0.110
21FLKWATGAD-TALLAVANA-4	5/20/2000	111	-	-	1.46	0.162
21FLKWATGAD-TALLAVANA-5	5/20/2000	85	-	-	1.32	0.123
21FLKWATGAD-TALLAVANA-1	6/17/2000	67	-	-	1.18	0.161
21FLKWATGAD-TALLAVANA-2	6/17/2000	212	-	-	1.61	0.278
21FLKWATGAD-TALLAVANA-3	6/17/2000	380	-	-	2.78	0.459
21FLKWATGAD-TALLAVANA-4	6/17/2000	423	-	-	3.17	0.498
21FLKWATGAD-TALLAVANA-5	6/17/2000	48	-	-	0.89	0.139
21FLKWATGAD-TALLAVANA-1	7/15/2000	78	-	-	1.32	0.297
21FLKWATGAD-TALLAVANA-2	7/15/2000	100	-	-	1.44	0.303
21FLKWATGAD-TALLAVANA-3	7/15/2000	153	-	-	1.54	0.333
21FLKWATGAD-TALLAVANA-4	7/15/2000	219	-	-	2.13	0.424
21FLKWATGAD-TALLAVANA-5	7/15/2000	77	-	-	1.31	0.289
21FLGW 9230	7/19/2000		64	150	1.71	0.320
21FLKWATGAD-TALLAVANA-1	8/12/2000	97	-	-	1.51	0.281
21FLKWATGAD-TALLAVANA-2	8/12/2000	78	-	-	1.48	0.277
21FLKWATGAD-TALLAVANA-3	8/12/2000	98	-	-	1.60	0.323
21FLKWATGAD-TALLAVANA-4	8/12/2000	121	-	-	1.84	0.376
21FLKWATGAD-TALLAVANA-5	8/12/2000	181	-	-	2.01	0.371
21FLKWATGAD-TALLAVANA-1	9/16/2000	113	-	-	1.74	0.295
21FLKWATGAD-TALLAVANA-2	9/16/2000	137	-	-	1.43	0.318
21FLKWATGAD-TALLAVANA-3	9/16/2000	129	-	-	1.69	0.308
21FLKWATGAD-TALLAVANA-4	9/16/2000	131	-	-	1.53	0.411
21FLKWATGAD-TALLAVANA-5	9/16/2000	185	-	-	2.05	0.346
21FLKWATGAD-TALLAVANA-1	10/21/2000	56	-	-	1.12	0.175
21FLKWATGAD-TALLAVANA-2	10/21/2000	55	-	-	1.21	0.170

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-3	10/21/2000	65	-	-	1.20	0.184
21FLKWATGAD-TALLAVANA-4	10/21/2000	63	-	-	1.27	0.193
21FLKWATGAD-TALLAVANA-5	10/21/2000	59	-	-	1.30	0.173
21FLKWATGAD-TALLAVANA-1	5/19/2001	34	-	-	0.93	0.099
21FLKWATGAD-TALLAVANA-2	5/19/2001	36	-	-	0.91	0.105
21FLKWATGAD-TALLAVANA-3	5/19/2001	39	-	-	0.95	0.120
21FLKWATGAD-TALLAVANA-4	5/19/2001	46	-	-	1.00	0.148
21FLKWATGAD-TALLAVANA-5	5/19/2001	40	-	-	0.95	0.109
21FLKWATGAD-TALLAVANA-1	6/16/2001	60	-	-	0.92	0.208
21FLKWATGAD-TALLAVANA-2	6/16/2001	114	-	-	1.47	0.266
21FLKWATGAD-TALLAVANA-3	6/16/2001	66	-	-	1.16	0.233
21FLKWATGAD-TALLAVANA-4	6/16/2001	63	-	-	1.11	0.249
21FLKWATGAD-TALLAVANA-5	6/16/2001	51	-	-	0.97	0.183
21FLKWATGAD-TALLAVANA-1	7/14/2001	80	-	-	0.99	0.125
21FLKWATGAD-TALLAVANA-2	7/14/2001	89	-	-	1.03	0.148
21FLKWATGAD-TALLAVANA-3	7/14/2001	112	-	-	1.08	0.178
21FLKWATGAD-TALLAVANA-4	7/14/2001	106	-	-	1.02	0.178
21FLKWATGAD-TALLAVANA-5	7/14/2001	65	-	-	0.97	0.124
21FLKWATGAD-TALLAVANA-1	8/11/2001	86	-	-	1.08	0.165
21FLKWATGAD-TALLAVANA-2	8/11/2001	101	-	-	1.18	0.179
21FLKWATGAD-TALLAVANA-3	8/11/2001	93	-	-	1.17	0.204
21FLKWATGAD-TALLAVANA-4	8/11/2001	100	-	-	1.35	0.253
21FLKWATGAD-TALLAVANA-5	8/11/2001	70	-	-	1.02	0.156
21FLKWATGAD-TALLAVANA-1	9/22/2001	112	-	-	1.16	0.123
21FLKWATGAD-TALLAVANA-2	9/22/2001	83	-	-	0.93	0.102
21FLKWATGAD-TALLAVANA-3	9/22/2001	101	-	-	1.03	0.105
21FLKWATGAD-TALLAVANA-4	9/22/2001	93	-	-	1.16	0.115
21FLKWATGAD-TALLAVANA-5	9/22/2001	93	-	-	1.00	0.141
21FLKWATGAD-TALLAVANA-1	10/13/2001	64	-	-	1.08	0.090
21FLKWATGAD-TALLAVANA-2	10/13/2001	99	-	-	0.85	0.105
21FLKWATGAD-TALLAVANA-3	10/13/2001	117	-	-	1.16	0.112
21FLKWATGAD-TALLAVANA-4	10/13/2001	163	-	-	1.42	0.159
21FLKWATGAD-TALLAVANA-5	10/13/2001	50	-	-	1.19	0.095
21FLKWATGAD-TALLAVANA-1	11/10/2001	94	-	-	1.08	0.092
21FLKWATGAD-TALLAVANA-2	11/10/2001	59	-	-	0.89	0.074

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-3	11/10/2001	55	-	-	0.95	0.078
21FLKWATGAD-TALLAVANA-4	11/10/2001	61	-	-	0.99	0.099
21FLKWATGAD-TALLAVANA-5	11/10/2001	109	-	-	1.17	0.124
21FLKWATGAD-TALLAVANA-1	12/15/2001	66	-	-	1.04	0.083
21FLKWATGAD-TALLAVANA-2	12/15/2001	87	-	-	1.02	0.093
21FLKWATGAD-TALLAVANA-3	12/15/2001	110	-	-	1.13	0.107
21FLKWATGAD-TALLAVANA-4	12/15/2001	156	-	-	1.38	0.171
21FLKWATGAD-TALLAVANA-5	12/15/2001	44	-	-	0.96	0.076
21FLKWATGAD-TALLAVANA-1	1/19/2002	77	-	-	1.05	0.080
21FLKWATGAD-TALLAVANA-2	1/19/2002	64	-	-	1.00	0.077
21FLKWATGAD-TALLAVANA-3	1/19/2002	61	-	-	0.97	0.071
21FLKWATGAD-TALLAVANA-4	1/19/2002	82	-	-	1.19	0.103
21FLKWATGAD-TALLAVANA-5	1/19/2002	45	-	-	0.96	0.065
21FLKWATGAD-TALLAVANA-1	2/17/2002	66	-	-	0.86	0.095
21FLKWATGAD-TALLAVANA-2	2/17/2002	56	-	-	0.75	0.083
21FLKWATGAD-TALLAVANA-3	2/17/2002	52	-	-	0.95	0.085
21FLKWATGAD-TALLAVANA-4	2/17/2002	59	-	-	1.00	0.094
21FLKWATGAD-TALLAVANA-5	2/17/2002	92	-	-	1.08	0.123
21FLKWATGAD-TALLAVANA-1	3/23/2002	55	-	-	0.91	0.113
21FLKWATGAD-TALLAVANA-2	3/23/2002	57	-	-	0.94	0.127
21FLKWATGAD-TALLAVANA-3	3/23/2002	60	-	-	0.95	0.140
21FLKWATGAD-TALLAVANA-4	3/23/2002	63	-	-	1.09	0.155
21FLKWATGAD-TALLAVANA-5	3/23/2002	59	-	-	0.99	0.124
21FLKWATGAD-TALLAVANA-1	4/14/2002	39	-	-	0.71	0.081
21FLKWATGAD-TALLAVANA-2	4/14/2002	43	-	-	0.59	0.083
21FLKWATGAD-TALLAVANA-3	4/14/2002	43	-	-	0.74	0.074
21FLKWATGAD-TALLAVANA-4	4/14/2002	68	-	-	0.79	0.123
21FLKWATGAD-TALLAVANA-5	4/14/2002	39	-	-	0.66	0.090
21FLKWATGAD-TALLAVANA-1	5/4/2002	164	-	-	1.12	0.112
21FLKWATGAD-TALLAVANA-2	5/4/2002	120	-	-	1.14	0.125
21FLKWATGAD-TALLAVANA-3	5/4/2002	127	-	-	1.14	0.116
21FLKWATGAD-TALLAVANA-4	5/4/2002	75	-	-	1.10	0.116
21FLKWATGAD-TALLAVANA-5	5/4/2002	86	-	-	1.05	0.114
21FLKWATGAD-TALLAVANA-1	6/15/2002	132	-	-	1.31	0.156
21FLKWATGAD-TALLAVANA-2	6/15/2002	133	-	-	1.23	0.151

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-3	6/15/2002	133	-	-	1.71	0.161
21FLKWATGAD-TALLAVANA-4	6/15/2002	156	-	-	1.90	0.230
21FLKWATGAD-TALLAVANA-5	6/15/2002	158	-	-	1.76	0.202
21FLKWATGAD-TALLAVANA-1	7/14/2002	117	-	-	1.67	0.202
21FLKWATGAD-TALLAVANA-2	7/14/2002	119	-	-	1.66	0.207
21FLKWATGAD-TALLAVANA-3	7/14/2002	133	-	-	1.60	0.225
21FLKWATGAD-TALLAVANA-4	7/14/2002	192	-	-	2.23	0.344
21FLKWATGAD-TALLAVANA-5	7/14/2002	129	-	-	1.75	0.208
21FLKWATGAD-TALLAVANA-1	8/10/2002	173	-	-	1.56	0.224
21FLKWATGAD-TALLAVANA-2	8/10/2002	151	-	-	1.66	0.199
21FLKWATGAD-TALLAVANA-3	8/10/2002	147	-	-	1.66	0.205
21FLKWATGAD-TALLAVANA-4	8/10/2002	165	-	-	1.88	0.273
21FLKWATGAD-TALLAVANA-5	8/10/2002	177	-	-	1.65	0.214
21FLKWATGAD-TALLAVANA-1	9/21/2002	104	-	-	1.47	0.170
21FLKWATGAD-TALLAVANA-2	9/21/2002	118	-	-	1.64	0.187
21FLKWATGAD-TALLAVANA-3	9/21/2002	162	-	-	1.54	0.223
21FLKWATGAD-TALLAVANA-4	9/21/2002	177	-	-	1.71	0.249
21FLKWATGAD-TALLAVANA-5	9/21/2002	122	-	-	1.52	0.179
21FLKWATGAD-TALLAVANA-1	4/30/2003	62	-	-	1.13	0.157
21FLKWATGAD-TALLAVANA-2	4/30/2003	79	-	-	1.32	0.163
21FLKWATGAD-TALLAVANA-3	4/30/2003	78	-	-	1.34	0.158
21FLKWATGAD-TALLAVANA-4	4/30/2003	127	-	-	1.59	0.254
21FLKWATGAD-TALLAVANA-5	4/30/2003	65	-	-	0.99	0.142
21FLKWATGAD-TALLAVANA-1	5/31/2003	132	-	-	1.70	0.152
21FLKWATGAD-TALLAVANA-2	5/31/2003	145	-	-	1.69	0.159
21FLKWATGAD-TALLAVANA-3	5/31/2003	149	-	-	1.77	0.175
21FLKWATGAD-TALLAVANA-4	5/31/2003	180	-	-	2.13	0.249
21FLKWATGAD-TALLAVANA-5	5/31/2003	134	-	-	1.74	0.171
21FLKWATGAD-TALLAVANA-1	6/21/2003	49	-	-	0.97	0.139
21FLKWATGAD-TALLAVANA-2	6/21/2003	61	-	-	0.97	0.165
21FLKWATGAD-TALLAVANA-3	6/21/2003	56	-	-	0.76	0.170
21FLKWATGAD-TALLAVANA-4	6/21/2003	90	-	-	1.59	0.267
21FLKWATGAD-TALLAVANA-5	6/21/2003	49	-	-	0.85	0.143
21FLKWATGAD-TALLAVANA-1	7/19/2003	71	-	-	1.05	0.117
21FLKWATGAD-TALLAVANA-2	7/19/2003	71	-	-	1.07	0.120

STATION ID	DATE	CHLA (µG/L)	CHLA (µG/L)	COLOR (PCU)	TN (MG/L)	TP (MG/L)
21FLKWATGAD-TALLAVANA-3	7/19/2003	81	-	-	1.13	0.139
21FLKWATGAD-TALLAVANA-4	7/19/2003	103	-	-	1.13	0.188
21FLKWATGAD-TALLAVANA-5	7/19/2003	60	-	-	1.04	0.114
21FLKWATGAD-TALLAVANA-1	8/16/2003	99	-	-	1.18	0.201
21FLKWATGAD-TALLAVANA-2	8/16/2003	105	-	-	1.40	0.213
21FLKWATGAD-TALLAVANA-3	8/16/2003	114	-	-	1.31	0.229
21FLKWATGAD-TALLAVANA-4	8/16/2003	117	-	-	1.44	0.276
21FLKWATGAD-TALLAVANA-5	8/16/2003	91	-	-	1.38	0.183
21FLKWATGAD-TALLAVANA-1	9/13/2003	165	-	-	1.52	0.280
21FLKWATGAD-TALLAVANA-2	9/13/2003	165	-	-	1.76	0.271
21FLKWATGAD-TALLAVANA-3	9/13/2003	170	-	-	1.41	0.269
21FLKWATGAD-TALLAVANA-4	9/13/2003	187	-	-	1.79	0.317
21FLKWATGAD-TALLAVANA-5	9/13/2003	192	-	-	1.75	0.312
21FLKWATGAD-TALLAVANA-1	10/12/2003	129	-	-	1.62	0.203
21FLKWATGAD-TALLAVANA-2	10/12/2003	127	-	-	1.34	0.214
21FLKWATGAD-TALLAVANA-3	10/12/2003	126	-	-	1.58	0.210
21FLKWATGAD-TALLAVANA-4	10/12/2003	136	-	-	1.46	0.258
21FLKWATGAD-TALLAVANA-5	10/12/2003	105	-	-	1.35	0.190
21FLKWATGAD-TALLAVANA-1	11/9/2003	138	-	-	1.36	0.137
21FLKWATGAD-TALLAVANA-2	11/9/2003	140	-	-	1.21	0.152
21FLKWATGAD-TALLAVANA-3	11/9/2003	140	-	-	1.40	0.166
21FLKWATGAD-TALLAVANA-4	11/9/2003	153	-	-	1.43	0.229
21FLKWATGAD-TALLAVANA-5	11/9/2003	146	-	-	1.24	0.174
21FLKWATGAD-TALLAVANA-1	12/20/2003	106	-	-	1.50	0.148
21FLKWATGAD-TALLAVANA-2	12/20/2003	104	-	-	1.59	0.150
21FLKWATGAD-TALLAVANA-3	12/20/2003	110	-	-	1.61	0.159
21FLKWATGAD-TALLAVANA-5	12/20/2003	97	-	-	1.48	0.147
21FLKWATGAD-TALLAVANA-1	1/10/2004	175	-	-	1.59	0.165
21FLKWATGAD-TALLAVANA-2	1/10/2004	172	-	-	1.72	0.175
21FLKWATGAD-TALLAVANA-3	1/10/2004	176	-	-	1.72	0.184
21FLKWATGAD-TALLAVANA-4	1/10/2004	164	-	-	1.62	0.182
21FLKWATGAD-TALLAVANA-5	1/10/2004	171	-	-	1.43	0.156
21FLKWATGAD-TALLAVANA-1	2/22/2004	183	-	-	1.72	0.294
21FLKWATGAD-TALLAVANA-2	2/22/2004	153	-	-	1.59	0.186
21FLKWATGAD-TALLAVANA-3	2/22/2004	164	-	-	1.69	0.194

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-4	2/22/2004	186	-	-	1.88	0.211
21FLKWATGAD-TALLAVANA-5	2/22/2004	170	-	-	1.66	0.204
21FLKWATGAD-TALLAVANA-1	3/13/2004	107	-	-	1.47	0.187
21FLKWATGAD-TALLAVANA-2	3/13/2004	116	-	-	1.46	0.224
21FLKWATGAD-TALLAVANA-3	3/13/2004	139	-	-	1.58	0.232
21FLKWATGAD-TALLAVANA-4	3/13/2004	121	-	-	1.54	0.223
21FLKWATGAD-TALLAVANA-5	3/13/2004	112	-	-	1.32	0.163
21FLKWATGAD-TALLAVANA-1	4/24/2004	46	-	-	1.04	0.117
21FLKWATGAD-TALLAVANA-2	4/24/2004	52	-	-	1.06	0.117
21FLKWATGAD-TALLAVANA-3	4/24/2004	51	-	-	1.11	0.128
21FLKWATGAD-TALLAVANA-4	4/24/2004	102	-	-	1.41	0.204
21FLKWATGAD-TALLAVANA-5	4/24/2004	57	-	-	1.19	0.140
21FLKWATGAD-TALLAVANA-1	5/15/2004	53	-	-	1.10	0.131
21FLKWATGAD-TALLAVANA-2	5/15/2004	52	-	-	1.14	0.134
21FLKWATGAD-TALLAVANA-3	5/15/2004	55	-	-	1.11	0.139
21FLKWATGAD-TALLAVANA-4	5/15/2004	128	-	-	1.65	0.252
21FLKWATGAD-TALLAVANA-5	5/15/2004	53	-	-	1.09	0.142
21FLKWATGAD-TALLAVANA-1	6/13/2004	54	-	-	1.18	0.132
21FLKWATGAD-TALLAVANA-2	6/13/2004	54	-	-	1.41	0.127
21FLKWATGAD-TALLAVANA-3	6/13/2004	72	-	-	1.50	0.173
21FLKWATGAD-TALLAVANA-4	6/13/2004	84	-	-	1.52	0.225
21FLKWATGAD-TALLAVANA-5	6/13/2004	61	-	-	1.38	0.141
21FLKWATGAD-TALLAVANA-1	7/24/2004	106	-	-	1.61	0.152
21FLKWATGAD-TALLAVANA-2	7/24/2004	95	-	-	1.58	0.142
21FLKWATGAD-TALLAVANA-3	7/24/2004	90	-	-	1.57	0.135
21FLKWATGAD-TALLAVANA-4	7/24/2004	158	-	-	2.18	0.314
21FLKWATGAD-TALLAVANA-5	7/24/2004	142	-	-	2.09	0.214
21FLKWATGAD-TALLAVANA-1	8/21/2004	104	-	-	1.57	0.173
21FLKWATGAD-TALLAVANA-2	8/21/2004	113	-	-	1.60	0.178
21FLKWATGAD-TALLAVANA-3	8/21/2004	92	-	-	1.65	0.199
21FLKWATGAD-TALLAVANA-4	8/21/2004	157	-	-	2.20	0.327
21FLKWATGAD-TALLAVANA-5	8/21/2004	105	-	-	1.80	0.179
21FLKWATGAD-TALLAVANA-1	10/17/2004	154	-	-	1.67	0.165
21FLKWATGAD-TALLAVANA-2	10/17/2004	173	-	-	1.79	0.189
21FLKWATGAD-TALLAVANA-3	10/17/2004	199	-	-	2.14	0.246

STATION ID	DATE	CHLA (μG/L)	CHLA (μG/L)	COLOR (PCU)	TN (MG/L)	TP (MG/L)
21FLKWATGAD-TALLAVANA-4	10/17/2004	310	-	-	3.10	0.354
21FLKWATGAD-TALLAVANA-5	10/17/2004	158	-	-	2.04	0.177
21FLKWATGAD-TALLAVANA-1	11/21/2004	115	-	-	1.35	0.139
21FLKWATGAD-TALLAVANA-2	11/21/2004	131	-	-	1.48	0.154
21FLKWATGAD-TALLAVANA-3	11/21/2004	133	-	-	1.39	0.146
21FLKWATGAD-TALLAVANA-4	11/21/2004	143	-	-	1.80	0.233
21FLKWATGAD-TALLAVANA-5	11/21/2004	91	-	-	1.60	0.168
21FLKWATGAD-TALLAVANA-1	1/8/2005	94	-	-	1.53	0.150
21FLKWATGAD-TALLAVANA-2	1/8/2005	95	-	-	1.56	0.131
21FLKWATGAD-TALLAVANA-3	1/8/2005	101	-	-	1.59	0.127
21FLKWATGAD-TALLAVANA-4	1/8/2005	131	-	-	1.89	0.187
21FLKWATGAD-TALLAVANA-5	1/8/2005	73	-	-	1.48	0.116
21FLKWATGAD-TALLAVANA-1	2/19/2005	189	-	-	2.04	0.183
21FLKWATGAD-TALLAVANA-2	2/19/2005	165	-	-	1.97	0.184
21FLKWATGAD-TALLAVANA-3	2/19/2005	151	-	-	1.90	0.195
21FLKWATGAD-TALLAVANA-4	2/19/2005	120	-	-	1.91	0.206
21FLKWATGAD-TALLAVANA-5	2/19/2005	198	-	-	1.87	0.192
21FLKWATGAD-TALLAVANA-1	3/19/2005	114	-	-	1.96	0.203
21FLKWATGAD-TALLAVANA-2	3/19/2005	123	-	-	1.89	0.222
21FLKWATGAD-TALLAVANA-3	3/19/2005	111	-	-	1.98	0.145
21FLKWATGAD-TALLAVANA-4	3/19/2005	117	-	-	1.97	0.243
21FLKWATGAD-TALLAVANA-5	3/19/2005	172	-	-	1.53	0.178
21FLKWATGAD-TALLAVANA-1	4/16/2005	102	-	-	1.14	0.159
21FLKWATGAD-TALLAVANA-2	4/16/2005	94	-	-	1.24	0.168
21FLKWATGAD-TALLAVANA-3	4/16/2005	93	-	-	1.21	0.167
21FLKWATGAD-TALLAVANA-4	4/16/2005	72	-	-	1.26	0.190
21FLKWATGAD-TALLAVANA-5	4/16/2005	118	-	-	1.22	0.177
21FLKWATGAD-TALLAVANA-1	5/14/2005	73	-	-	1.34	0.132
21FLKWATGAD-TALLAVANA-2	5/14/2005	57	-	-	1.24	0.121
21FLKWATGAD-TALLAVANA-3	5/14/2005	55	-	-	1.16	0.132
21FLKWATGAD-TALLAVANA-4	5/14/2005	66	-	-	1.42	0.169
21FLKWATGAD-TALLAVANA-5	5/14/2005	75	-	-	1.55	0.156
21FLKWATGAD-TALLAVANA-1	6/18/2005	65	-	-	1.31	0.122
21FLKWATGAD-TALLAVANA-2	6/18/2005	76	-	-	1.21	0.135
21FLKWATGAD-TALLAVANA-3	6/18/2005	105	-	-	1.35	0.171

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-4	6/18/2005	69	-	-	1.44	0.193
21FLKWATGAD-TALLAVANA-5	6/18/2005	69	-	-	1.38	0.143
21FLKWATGAD-TALLAVANA-1	7/16/2005	71	-	-	1.23	0.197
21FLKWATGAD-TALLAVANA-2	7/16/2005	75	-	-	1.14	0.191
21FLKWATGAD-TALLAVANA-3	7/16/2005	70	-	-	1.17	0.219
21FLKWATGAD-TALLAVANA-4	7/16/2005	70	-	-	1.23	0.252
21FLKWATGAD-TALLAVANA-5	7/16/2005	69	-	-	1.20	0.193
21FLKWATGAD-TALLAVANA-1	8/13/2005	65	-	-	0.97	0.169
21FLKWATGAD-TALLAVANA-2	8/13/2005	67	-	-	1.12	0.181
21FLKWATGAD-TALLAVANA-3	8/13/2005	81	-	-	1.34	0.193
21FLKWATGAD-TALLAVANA-4	8/13/2005	96	-	-	1.29	0.231
21FLKWATGAD-TALLAVANA-5	8/13/2005	49	-	-	1.16	0.151
21FLKWATGAD-TALLAVANA-1	9/17/2005	84	-	-	1.18	0.133
21FLKWATGAD-TALLAVANA-2	9/17/2005	82	-	-	1.10	0.125
21FLKWATGAD-TALLAVANA-3	9/17/2005	85	-	-	1.17	0.150
21FLKWATGAD-TALLAVANA-4	9/17/2005	92	-	-	1.25	0.157
21FLKWATGAD-TALLAVANA-5	9/17/2005	85	-	-	1.37	0.169
21FLKWATGAD-TALLAVANA-1	10/15/2005	107	-	-	1.24	0.167
21FLKWATGAD-TALLAVANA-2	10/15/2005	98	-	-	1.23	0.157
21FLKWATGAD-TALLAVANA-3	10/15/2005	101	-	-	1.25	0.176
21FLKWATGAD-TALLAVANA-4	10/15/2005	104	-	-	1.23	0.161
21FLKWATGAD-TALLAVANA-5	10/15/2005	94	-	-	1.64	0.187
21FLKWATGAD-TALLAVANA-1	1/21/2006	70	-	-	1.55	0.142
21FLKWATGAD-TALLAVANA-2	1/21/2006	82	-	-	1.65	0.149
21FLKWATGAD-TALLAVANA-3	1/21/2006	75	-	-	1.54	0.136
21FLKWATGAD-TALLAVANA-4	1/21/2006	87	-	-	1.76	0.144
21FLKWATGAD-TALLAVANA-5	1/21/2006	65	-	-	1.44	0.139
21FLWQA 303552108428052	2/8/2006	-	54	100	1.41	0.240
21FLKWATGAD-TALLAVANA-1	2/18/2006	61	-	-	1.70	0.124
21FLKWATGAD-TALLAVANA-2	2/18/2006	58	-	-	1.77	0.124
21FLKWATGAD-TALLAVANA-3	2/18/2006	61	-	-	1.99	0.127
21FLKWATGAD-TALLAVANA-4	2/18/2006	75	-	-	2.02	0.150
21FLKWATGAD-TALLAVANA-5	2/18/2006	79	-	-	1.65	0.150
21FLKWATGAD-TALLAVANA-1	3/25/2006	96	-	-	1.55	0.173
21FLKWATGAD-TALLAVANA-2	3/25/2006	93	-	-	1.65	0.168

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-3	3/25/2006	102	-	-	1.39	0.176
21FLKWATGAD-TALLAVANA-4	3/25/2006	70	-	-	1.14	0.153
21FLKWATGAD-TALLAVANA-5	3/25/2006	76	-	-	1.36	0.159
21FLBRA 540A-A	3/28/2006	35	3	20	1.00	0.140
21FLKWATGAD-TALLAVANA-1	4/15/2006	64	-	-	1.24	0.142
21FLKWATGAD-TALLAVANA-2	4/15/2006	70	-	-	1.18	0.161
21FLKWATGAD-TALLAVANA-3	4/15/2006	65	-	-	1.25	0.140
21FLKWATGAD-TALLAVANA-4	4/15/2006	65	-	-	1.36	0.143
21FLKWATGAD-TALLAVANA-5	4/15/2006	86	-	-	1.71	0.153
21FLBRA 540A-A	4/25/2006	78	48	25	1.51	0.130
21FLBRA 540A-B	4/25/2006	78	19	20	1.60	0.150
21FLKWATGAD-TALLAVANA-1	5/20/2006	111	-	-	1.60	0.177
21FLKWATGAD-TALLAVANA-2	5/20/2006	96	-	-	1.75	0.184
21FLKWATGAD-TALLAVANA-3	5/20/2006	79	-	-	1.82	0.167
21FLKWATGAD-TALLAVANA-4	5/20/2006	54	-	-	2.07	0.218
21FLKWATGAD-TALLAVANA-5	5/20/2006	79	-	-	1.72	0.151
21FLWQA 303552108428052	6/14/2006	-	63	60	-	-
21FLKWATGAD-TALLAVANA-1	6/17/2006	102	-	-	1.63	0.161
21FLKWATGAD-TALLAVANA-2	6/17/2006	105	-	-	1.42	0.166
21FLKWATGAD-TALLAVANA-3	6/17/2006	104	-	-	1.55	0.168
21FLKWATGAD-TALLAVANA-4	6/17/2006	128	-	-	1.69	0.178
21FLKWATGAD-TALLAVANA-5	6/17/2006	87	-	-	1.54	0.150
21FLBRA 540A-A	6/27/2006	40	3	20	1.30	0.170
21FLBRA 540A-D	6/27/2006	46	4	20	1.10	0.160
21FLBRA 540A-E	6/27/2006	85	21	20	1.60	0.270
21FLKWATGAD-TALLAVANA-1	7/15/2006	68	-	-	1.69	0.142
21FLKWATGAD-TALLAVANA-2	7/15/2006	60	-	-	1.48	0.139
21FLKWATGAD-TALLAVANA-3	7/15/2006	66	-	-	1.50	0.160
21FLKWATGAD-TALLAVANA-4	7/15/2006	88	-	-	1.80	0.221
21FLKWATGAD-TALLAVANA-5	7/15/2006	74	-	-	1.64	0.154
21FLBRA 540A-A	7/26/2006	68	3	20	0.77	0.086
21FLBRA 540A-D	7/26/2006	45	3	20	0.71	0.089
21FLBRA 540A-E	7/26/2006	56	8	25	0.85	0.095
21FLBRA 540A-A	9/8/2006	83	8	20	-	0.310
21FLBRA 540A-D	9/8/2006	60	4	25	-	0.260

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLBRA 540A-E	9/8/2006	78	6	35	-	0.300
21FLBRA 540A-F	9/8/2006	87	3	20	-	0.380
21FLKWATGAD-TALLAVANA-1	9/23/2006	154	-	-	1.89	0.277
21FLKWATGAD-TALLAVANA-2	9/23/2006	154	-	-	1.98	0.289
21FLKWATGAD-TALLAVANA-3	9/23/2006	164	-	-	2.15	0.311
21FLKWATGAD-TALLAVANA-4	9/23/2006	164	-	-	2.14	0.377
21FLKWATGAD-TALLAVANA-5	9/23/2006	165	-	-	2.04	0.298
21FLKWATGAD-TALLAVANA-1	10/28/2006	62	-	-	1.69	0.183
21FLKWATGAD-TALLAVANA-2	10/28/2006	74	-	-	1.69	0.201
21FLKWATGAD-TALLAVANA-3	10/28/2006	74	-	-	1.70	0.201
21FLKWATGAD-TALLAVANA-4	10/28/2006	72	-	-	1.74	0.258
21FLKWATGAD-TALLAVANA-5	10/28/2006	56	-	-	1.60	0.176
21FLBRA 540A-A	11/7/2006	28	1	20	1.51	0.180
21FLBRA 540A-B	11/7/2006	43	1	15	1.48	0.170
21FLBRA 540A-E	11/7/2006	14	1	20	1.34	0.180
21FLBRA 540A-A	11/21/2006	1	1	20	1.31	0.180
21FLBRA 540A-B	11/21/2006	1	1	15	1.22	0.190
21FLBRA 540A-E	11/21/2006	1	1	20	1.13	0.190
21FLKWATGAD-TALLAVANA-1	12/16/2006	116	-	-	1.53	0.114
21FLKWATGAD-TALLAVANA-2	12/16/2006	97	-	-	1.32	0.096
21FLKWATGAD-TALLAVANA-3	12/16/2006	-	-	-	-	-
21FLKWATGAD-TALLAVANA-4	12/16/2006	-	-	-	-	-
21FLKWATGAD-TALLAVANA-5	12/16/2006	-	-	-	-	-
21FLBRA 540A-A	12/28/2006	10	1	30	1.54	0.190
21FLBRA 540A-B	12/28/2006	27	3	20	1.46	0.160
21FLBRA 540A-D	12/28/2006	36	1	25	1.56	0.160
21FLBRA 540A-E	12/28/2006	9	1	45	1.69	0.290
21FLKWATGAD-TALLAVANA-1	1/13/2007	141	-	-	1.85	0.187
21FLKWATGAD-TALLAVANA-2	1/13/2007	149	-	-	1.93	0.204
21FLKWATGAD-TALLAVANA-3	1/13/2007	156	-	-	1.96	0.210
21FLKWATGAD-TALLAVANA-4	1/13/2007	111	-	-	1.81	0.231
21FLKWATGAD-TALLAVANA-5	1/13/2007	95	-	-	-	0.157
21FLBRA 540A-A	3/26/2007	5	1	50	1.32	0.170
21FLKWATGAD-TALLAVANA-1	10/20/2007	59	-	-	1.27	0.167
21FLKWATGAD-TALLAVANA-2	10/20/2007	59	-	-	1.29	0.179

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLKWATGAD-TALLAVANA-3	10/20/2007	64	-	-	1.28	0.184
21FLKWATGAD-TALLAVANA-4	10/20/2007	105	-	-	1.84	0.305
21FLKWATGAD-TALLAVANA-5	10/20/2007	46	-	-	0.95	0.119
21FLKWATGAD-TALLAVANA-1	12/15/2007	66	-	-	1.32	0.107
21FLKWATGAD-TALLAVANA-2	12/15/2007	57	-	-	1.20	0.108
21FLKWATGAD-TALLAVANA-3	12/15/2007	73	-	-	1.29	0.125
21FLKWATGAD-TALLAVANA-4	12/15/2007	90	-	-	1.61	0.177
21FLKWATGAD-TALLAVANA-5	12/15/2007	56	-	-	1.34	0.113
21FLKWATGAD-TALLAVANA-1	3/1/2008	54	-	-	1.45	0.173
21FLKWATGAD-TALLAVANA-2	3/1/2008	61	-	-	1.76	0.198
21FLKWATGAD-TALLAVANA-3	3/1/2008	75	-	-	1.76	0.211
21FLKWATGAD-TALLAVANA-4	3/1/2008	58	-	-	1.53	0.204
21FLKWATGAD-TALLAVANA-5	3/1/2008	69	-	-	1.46	0.168
21FLKWATGAD-TALLAVANA-1	4/19/2008	97	-	-	1.28	0.179
21FLKWATGAD-TALLAVANA-2	4/19/2008	111	-	-	1.26	0.192
21FLKWATGAD-TALLAVANA-3	4/19/2008	102	-	-	1.14	0.187
21FLKWATGAD-TALLAVANA-4	4/19/2008	95	-	-	1.51	0.230
21FLKWATGAD-TALLAVANA-5	4/19/2008	87	-	-	1.23	0.186
21FLKWATGAD-TALLAVANA-1	8/17/2008	81	-	-	1.05	0.096
21FLKWATGAD-TALLAVANA-2	8/17/2008	94	-	-	1.26	0.111
21FLKWATGAD-TALLAVANA-3	8/17/2008	111	-	-	1.30	0.113
21FLKWATGAD-TALLAVANA-4	8/17/2008	224	-	-	2.08	0.249
21FLKWATGAD-TALLAVANA-5	8/17/2008	79	-	-	1.43	0.130
21FLKWATGAD-TALLAVANA-1	10/11/2008	68	-	-	1.32	0.140
21FLKWATGAD-TALLAVANA-2	10/11/2008	92	-	-	1.44	0.162
21FLKWATGAD-TALLAVANA-3	10/11/2008	82	-	-	1.45	0.161
21FLKWATGAD-TALLAVANA-5	10/11/2008	62	-	-	1.43	0.147
21FLKWATGAD-TALLAVANA-1	12/20/2008	102	-	-	1.19	0.111
21FLKWATGAD-TALLAVANA-2	12/20/2008	109	-	-	1.26	0.131
21FLKWATGAD-TALLAVANA-3	12/20/2008	124	-	-	1.30	0.131
21FLKWATGAD-TALLAVANA-4	12/20/2008	121	-	-	1.60	0.214
21FLKWATGAD-TALLAVANA-5	12/20/2008	99	-	-	1.17	0.106
21FLMCGLTAL-BC	1/29/2009	-	112	20	0.64	0.061
21FLMCGLTAL-HC	1/29/2009	-	46	31	1.21	0.278
21FLMCGLTAL-MH	1/29/2009	-	56	35	0.59	0.057

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLMCGLTAL-OUT	1/29/2009	-	98	16	1.78	0.131
21FLKWATGAD-TALLAVANA-1	5/16/2009	176	-	-	2.01	0.147
21FLKWATGAD-TALLAVANA-2	5/16/2009	121	-	-	1.68	0.126
21FLKWATGAD-TALLAVANA-3	5/16/2009	102	-	-	1.52	0.118
21FLKWATGAD-TALLAVANA-4	5/16/2009	68	-	-	1.63	0.173
21FLKWATGAD-TALLAVANA-5	5/16/2009	81	-	-	1.85	0.151
21FLGW 36986	6/4/2009	37	32	50	1.10	0.092
21FLKWATGAD-TALLAVANA-1	6/13/2009	64	-	-	1.44	0.121
21FLKWATGAD-TALLAVANA-2	6/13/2009	59	-	-	1.35	0.114
21FLKWATGAD-TALLAVANA-3	6/13/2009	65	-	-	1.44	0.130
21FLKWATGAD-TALLAVANA-4	6/13/2009	59	-	-	1.50	0.172
21FLKWATGAD-TALLAVANA-5	6/13/2009	65	-	-	1.54	0.122
21FLMCGLTAL-BC	6/30/2009	-	49	24	1.08	0.116
21FLMCGLTAL-HC	6/30/2009	-	10	21	2.10	0.185
21FLMCGLTAL-MH	6/30/2009	-	56	17	1.76	0.128
21FLMCGLTAL-OUT	6/30/2009	-	29	9	1.02	0.377
21FLKWATGAD-TALLAVANA-2	9/19/2009	110	-	-	1.28	0.154
21FLKWATGAD-TALLAVANA-4	9/19/2009	106	-	-	1.59	0.267
21FLKWATGAD-TALLAVANA-5	9/19/2009	92	-	-	1.25	0.154
21FLMCGLTAL-BC	9/22/2009	-	11	9	0.40	0.131
21FLMCGLTAL-HC	9/22/2009	-	66	10	0.66	0.088
21FLMCGLTAL-MH	9/22/2009	-	60	9	0.31	0.177
21FLMCGLTAL-OUT	9/22/2009	-	14	9	0.32	0.345
21FLGW 37922	12/1/2009	41	34	60	0.97	0.086
21FLMCGLTAL-BC	12/15/2009	-	28	56	0.77	0.078
21FLMCGLTAL-HC	12/15/2009	-	23	60	0.90	0.142
21FLMCGLTAL-MH	12/15/2009	-	6	9	0.58	0.007
21FLMCGLTAL-OUT	12/15/2009	-	13	80	0.89	0.135
21FLKWATGAD-TALLAVANA-2	3/13/2010	29	-	-	1.13	0.091
21FLKWATGAD-TALLAVANA-4	3/13/2010	37	-	-	1.94	0.168
21FLKWATGAD-TALLAVANA-5	3/13/2010	25	-	-	1.09	0.088
21FLKWATGAD-TALLAVANA-2	5/15/2010	15	-	-	0.89	0.098
21FLKWATGAD-TALLAVANA-4	5/15/2010	15	-	-	1.25	0.175
21FLKWATGAD-TALLAVANA-5	5/15/2010	19	-	-	1.14	0.127
21FLMCGLTAL-HC	6/6/2010	-	80	71	5.82	0.295

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLMCGLTAL-MH	6/6/2010	-	160	98	2.81	0.141
21FLMCGLTAL-OUT	6/6/2010	-	55	111	3.76	1.157
21FLKWATGAD-TALLAVANA-2	7/17/2010	72	-	-	1.08	0.126
21FLKWATGAD-TALLAVANA-4	7/17/2010	95	-	-	1.31	0.176
21FLKWATGAD-TALLAVANA-5	7/17/2010	59	-	-	1.06	0.108
21FLKWATGAD-TALLAVANA-2	10/9/2010	58	-	-	1.17	0.108
21FLKWATGAD-TALLAVANA-4	10/9/2010	41	-	-	1.04	0.108
21FLKWATGAD-TALLAVANA-5	10/9/2010	69	-	-	1.27	0.155
21FLMCGLTAL-BC	12/2/2010	-	10	9	0.50	0.046
21FLMCGLTAL-HC	12/2/2010	-	29	25	0.75	0.188
21FLMCGLTAL-MH	12/2/2010	-	7	15	0.48	0.018
21FLMCGLTAL-OUT	12/2/2010	-	5	20	0.66	0.004
21FLKWATGAD-TALLAVANA-2	3/19/2011	30	-	-	1.03	0.095
21FLKWATGAD-TALLAVANA-4	3/19/2011	37	-	-	1.25	0.116
21FLKWATGAD-TALLAVANA-5	3/19/2011	41	-	-	1.26	0.126
21FLMCGLTAL-BC	3/23/2011	-	14	65	1.06	0.120
21FLMCGLTAL-HC	3/23/2011	-	5	85	0.50	0.277
21FLMCGLTAL-MH	3/23/2011	-	1	90	1.25	0.120
21FLMCGLTAL-OUT	3/23/2011	-	24	80	0.57	0.145
21FLPNS 303552108428052	3/23/2011	-	23	20	0.88	0.110
21FLPNS 540A-E	3/23/2011	-	24	26	1.22	0.180
21FLKWATGAD-TALLAVANA-2	5/21/2011	38	-	-	1.04	0.162
21FLKWATGAD-TALLAVANA-4	5/21/2011	32	-	-	1.01	0.145
21FLKWATGAD-TALLAVANA-5	5/21/2011	47	-	-	1.14	0.211
21FLMCGLTAL-BC	6/8/2011	-	40	44	1.03	0.083
21FLMCGLTAL-HC	6/8/2011	-	49	48	1.33	0.089
21FLMCGLTAL-MH	6/8/2011	-	44	52	0.87	0.048
21FLMCGLTAL-OUT	6/8/2011	-	32	59	1.35	0.123
21FLPNS 540A-E	6/8/2011	-	54	17	1.40	0.260
21FLPNS GAD-TALLAVANA-5	6/8/2011	-	34	17	1.10	0.190
21FLKWATGAD-TALLAVANA-2	7/23/2011	81	-	-	1.31	0.235
21FLKWATGAD-TALLAVANA-4	7/23/2011	86	-	-	1.45	0.331
21FLKWATGAD-TALLAVANA-5	7/23/2011	87	-	-	1.72	0.262
21FLMCGLTAL-BC	9/21/2011	-	41	22	0.38	0.281
21FLMCGLTAL-HC	9/21/2011	-	32	22	0.66	0.782

Station ID	Date	Chla (µg/L)	Chla (µg/L)	Color (PCU)	TN (mg/L)	TP (mg/L)
21FLMCGLTAL-MH	9/21/2011	-	48	35	0.19	0.343
21FLMCGLTAL-OUT	9/21/2011	-	10	27	0.61	0.698
21FLPNS 303552108428052	9/22/2011	-	50	16	1.30	0.350
21FLPNS 540A-E	9/22/2011	-	49	18	1.31	0.330
21FLMCGLTAL-BC	12/22/2011	-	24	30	1.60	0.112
21FLMCGLTAL-HC	12/22/2011	-	88	25	1.74	0.117
21FLMCGLTAL-MH	12/22/2011	-	33	27	1.62	0.075
21FLMCGLTAL-OUT	12/22/2011	-	40	9	1.34	1.252
21FLPNS 303552108428052	12/29/2011	-	41	12	1.20	0.099
21FLMCGLTAL-BC	3/9/2012	-	66	25	0.93	0.113
21FLMCGLTAL-HC	3/9/2012	-	24	57	2.89	0.176
21FLMCGLTAL-MH	3/9/2012	-	22	60	0.64	0.124
21FLMCGLTAL-OUT	3/9/2012	-	37	41	0.72	0.269
21FLPNS 303552108428052	4/3/2012	-	28	23	0.80	0.130
21FLPNS 540A-E	4/26/2012	-	40	19	1.10	0.180
21FLPNS GAD-TALLAVANA-5	4/26/2012	-	38	18	1.00	0.140

Appendix C: Information in Support of Site-Specific Interpretations of the Narrative Nutrient Criterion

Table C-1. Spatial Extent of the Numeric Interpretation of the Narrative Nutrient Criterion

— *Documents location and descriptive information.*

Waterbody Location Information	Description of Waterbody Location Information
Waterbody Name	Lake Tallavana
Waterbody Type(s)	Lake
Waterbody ID (WBID)	WBID 540A (see **Figure C-1**)
Description	Lake Tallavana is located in Gadsden County, Florida, near the city of Havana. The estimated surface area of the lake is 160 acres, and the watershed encompasses approximately 4,063 acres. The average depth of the lake is 6.1 feet, with a maximum depth of approximately 14 feet. The lake discharges into Hurricane Creek, which, after converging with the Little River, eventually discharges into Lake Talquin.
Specific Location (Latitude/ Longitude or River Miles)	The center of Lake Tallavana is located at N: 30^{0} 35’45.8”/ W: 84^{0} 28’6.3”. The site-specific criteria apply as a spatial average for the lake, as defined by WBID 540A.
Map	**Figure C-1** shows the general location of Lake Tallavana and its watershed, and **Figure C-2** shows land uses in the watershed. The predominant land use in the watershed is natural (upland forest, water, and wetland), making up 53% of the watershed area. Urban and residential land uses make up about 24% of the watershed. Agricultural lands (predominantly container nurseries) occupy about 20% of the land area.
Classification(s)	Class III Freshwater
Basin Name (Hydrologic Unit Code [HUC] 8)	Ochlockonee River Basin (03120003)

Table C-2. Description of the Numeric Interpretation of the Narrative Nutrient Criterion

— *Provides a specific list of parameters/constituents for which state NNC are adopted and for which site-specific numeric interpretation are proposed.*

— *Provides sufficient detail on magnitude, duration, and frequency to ensure criteria can be used to verify impairment or delisting in the future.*

— *Indicates how criteria developed are spatially and temporally representative of the waterbody or critical condition.*

NUMERIC INTERPRETATION OF NARRATIVE NUTRIENT CRITERION	PARAMETER INFORMATION RELATED TO NUMERIC INTERPRETATION OF THE NARRATIVE NUTRIENT CRITERION
NNC Summary: Default Nutrient Watershed Region or Lake Classification (if applicable) and Corresponding NNC	Lake Tallavana is low color (≤ 40 PCU) and high alkalinity (> 20 mg/L $CaCO_3$), and the generally applicable NNC, which are expressed as AGM concentrations not to be exceeded more than once in any three-year period, are corrected chlorophyll *a* (CHLAC) of 20 µg/L, TN of 1.05 to 1.91 mg/L, and TP of 0.03 to 0.09 mg/L.
Proposed TN, TP, Chlorophyll *a*, and/or Nitrate + Nitrite Concentrations (magnitude, duration, and frequency)	Numeric interpretations of the narrative nutrient criteria: This TMDL is only modifying the default NNC for TN and TP. (The default NNC for Chla is not being changed, as the department has no evidence that the default criterion is not protective of the designated uses of the lake.) The revised TN and TP NNC are expressed as long-term loads. Specifically, the TN load of 11,757 kg/yr and TP load of 785 kg/yr, are both expressed as long-term (7 year) averages of annual loads, not to be exceeded. The TMDL condition for Lake Tallavana will result in the default in-lake AGM Chla concentration of 20 µg/L being attained. Nutrient concentrations are provided for comparative purposes only.
Period of Record Used To Develop Numeric Interpretations of the Narrative Nutrient Criteria for TN and TP	The criteria are based on the application of the LSPC watershed loading model and the receiving water Bathtub model that simulated water quality conditions from 2002 to 2012. The primary datasets for this period include water quality data from the IWR database (IWR Run 49), as well as rainfall and evapotranspiration data.
How the Criteria Developed Are Spatially and Temporally Representative of the Waterbody or Critical Condition **Are the stations used representative of the entire extent of the WBID and where the criteria are applied? In addition, for older TMDLs, an explanation of the representativeness of the data period is needed (*e.g.*, have data or information become available since the TMDL analysis?). These details are critical to demonstrate why the resulting criteria will be protective as opposed to the otherwise applicable criteria (in cases where a numeric criterion is otherwise in effect, unlike this case).**	The water quality results applied in the analysis spanned the 2002–12 period, which included both wet and dry years. The annual average rainfall for 2002 to 2012 was 49.5 inches/year. The years 2002, 2006, and 2007 were dry years, 2003 to 2005 and 2010 to 2012 were average years, and 2008 and 2009 were wet years. **Figure C-3** shows the sampling stations in Lake Tallavana. The stations are located throughout the lake, including near the major tributaries into Lake Tallavana. Water quality data for variables relevant to TMDL development are presented in **Appendix B** of this report.

Table C-3. Designated Use, Verified Impairment, and Approach To Establish Protective Restoration Targets

— Summarizes how the designated use(s) are demonstrated to be protected by the criteria.

— Summarizes the review associated with the more recent data collected since the development of the TMDL.

— Evaluates the current relevance of assumptions made in TMDL development.

Designated Use Requirements	Information Related to Designated Use Requirements
History of Assessment of Designated Use Support	Lake Tallavana was verified as impaired during the Cycle 2 verified period assessment (January 1, 2000–June 30, 2007) due to excessive nutrients, because the TSI threshold of 40 was exceeded using the methodology in the IWR (Chapter 62-303, F.A.C.). As a result, the lake was included on the Cycle 2 Verified List of Impaired Waters for the Ochlockonee–St Marks River Basin that was adopted by Secretarial Order on May 19, 2009. The impairment was confirmed for the Cycle 3 verified period assessment (January 1, 2005–June 30, 2012). Based on an analysis of the data from 2002 to 2012 in IWR Database Run 49, the results indicate that Lake Tallavana would not attain the generally applicable lake NNC for chlorophyll *a*, TN, and TP for low-color, high-alkalinity lakes, and thus will remain assessed as impaired for nutrients.
Basis for Use Support	The site-specific TN and TP targets for this TMDL were established to achieve the generally applicable chlorophyll a criterion (20 µg/L) for low-color, high alkalinity lakes. Based on several lines of evidence discussed in details in the Technical Support Document for the Numeric Nutrient Criteria (DEP, 2012), achieving 20 µg/L chlorophyll a in this type of lakes will prevent algal blooms and ensure there will be no harmful phytoplankton that will impair the designated use. At the time of this TMDL development, there was no site-specific information indicating that 20 µg/L is not protective of the designated use for this waterbody.
Approach Used To Develop Criteria and How it Protects Uses	For the Lake Tallavana nutrient TMDLs, the department created loading-based criteria using a calibrated LSPC watershed loading model to simulate the watershed loading from the Lake Tallavana watershed, and these information were fed into the receiving water model, Bathtub. The long-term mean of these TN and TP loadings to achieve the 20 µg/L chlorophyll *a* target were determined by incrementally lowering the TN and TP loads into the lake until the chlorophyll *a* target was achieved.
How the TMDL Analysis Will Ensure that Nutrient-Related Parameters Are Attained To Demonstrate that the TMDLs Will Not Negatively Impact Other Water Quality Criteria. **These parameters must be analyzed with the appropriate frequency and duration. If compliance with 47(a) is not indicated in the TMDL analysis, it should be made clear that further reductions may be required in the future.**	There were no other impairments verified for Lake Tallavana that may be related to nutrients (such as DO or unionized ammonia). Reducing nutrient loads entering the lake will not negatively impact other water quality parameters for the lake.

Table C-4. Documentation of the Means To Attain and Maintain Water Quality Standards for Downstream Waters

Downstream Waters Protection and Monitoring Requirements	Information Related to Downstream Waters Protection and Monitoring Requirements
Identification of Downstream Waters: List receiving waters and identify technical justification for concluding downstream waters are protected.	Lake Tallavana discharges into Hurricane Creek, which runs to the Little River, which drains into Lake Talquin. Lake Talquin is the only downstream waterbody verified impaired for nutrients, does not meet applicable lake criteria for TN and TP, and is scheduled for TMDL development in 2016. If the percent reduction needed to achieve the Lake Talquin TMDL is higher, then the Lake Talquin percent reduction will be applied to the entire watershed, including Lake Tallavana. The Lake Tallavana TMDL should improve water quality in downstream waterbodies which are not impaired for nutrients.
Summary of Existing Monitoring and Assessment Related to the Implementation of Subsection 62-302.531(4), F.A.C., and trends tests in Chapter 62-303, F.A.C.	McGlynn Laboratories and Florida LakeWatch conduct routine monitoring of Lake Tallavana. Future monitoring results from waters downstream of Lake Tallavana, and from Lake Tallavana itself, will be used to assess the lake.

Table C-5. Documentation To Demonstrate Administrative Requirements Are Met

Administrative Requirements	Information for Administrative Requirements
Notice and Comment Notifications	The department published a Notice of Development of Rulemaking on April 6, 2015, to initiate the TMDL development for impaired waters in the Ochlockonee River Basin. A rule development public workshop for the TMDLs was held on May 4, 2015. Public comments were received for the TMDLs after that. The department has prepared a responsiveness summary for these comments.
Hearing Requirements and Adoption Format Used; Responsiveness Summary	Once any needed revisions are made, the department will publish a Notice of Proposed Rule in the *Florida Administrative Register*, and the notice will initiate a 21-day challenge period.
Official Submittal to EPA for Review and GC Certification	If the department does not receive a rule challenge, the certification package for the rule will be prepared by the department's program attorney. The department will prepare the TMDL and submittal package for the TMDLs to be considered a site-specific interpretation of the narrative nutrient criteria, and submit these documents to the EPA.

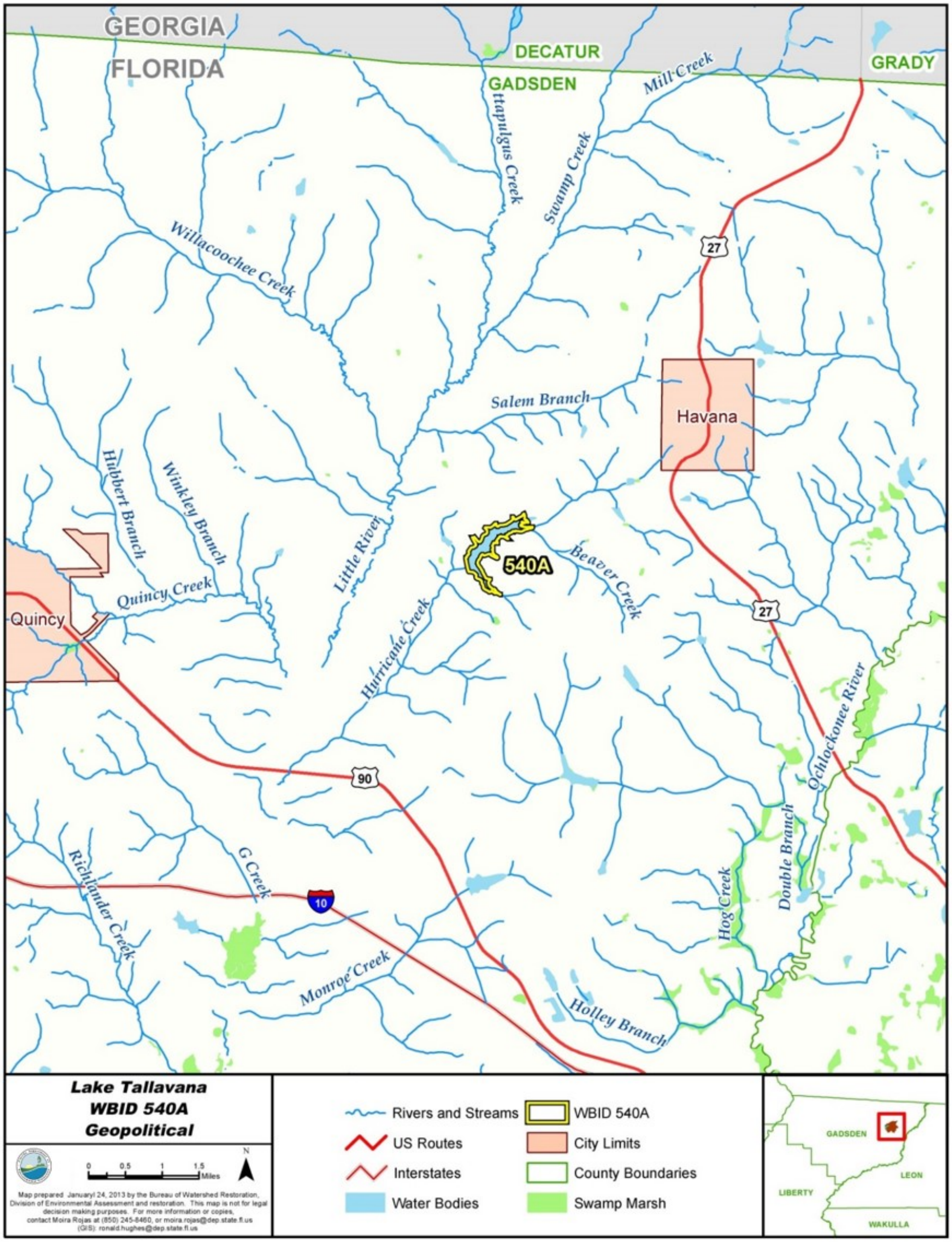

Figure C-1. Location of the Lake Tallavana Watershed in Gadsden County, Florida

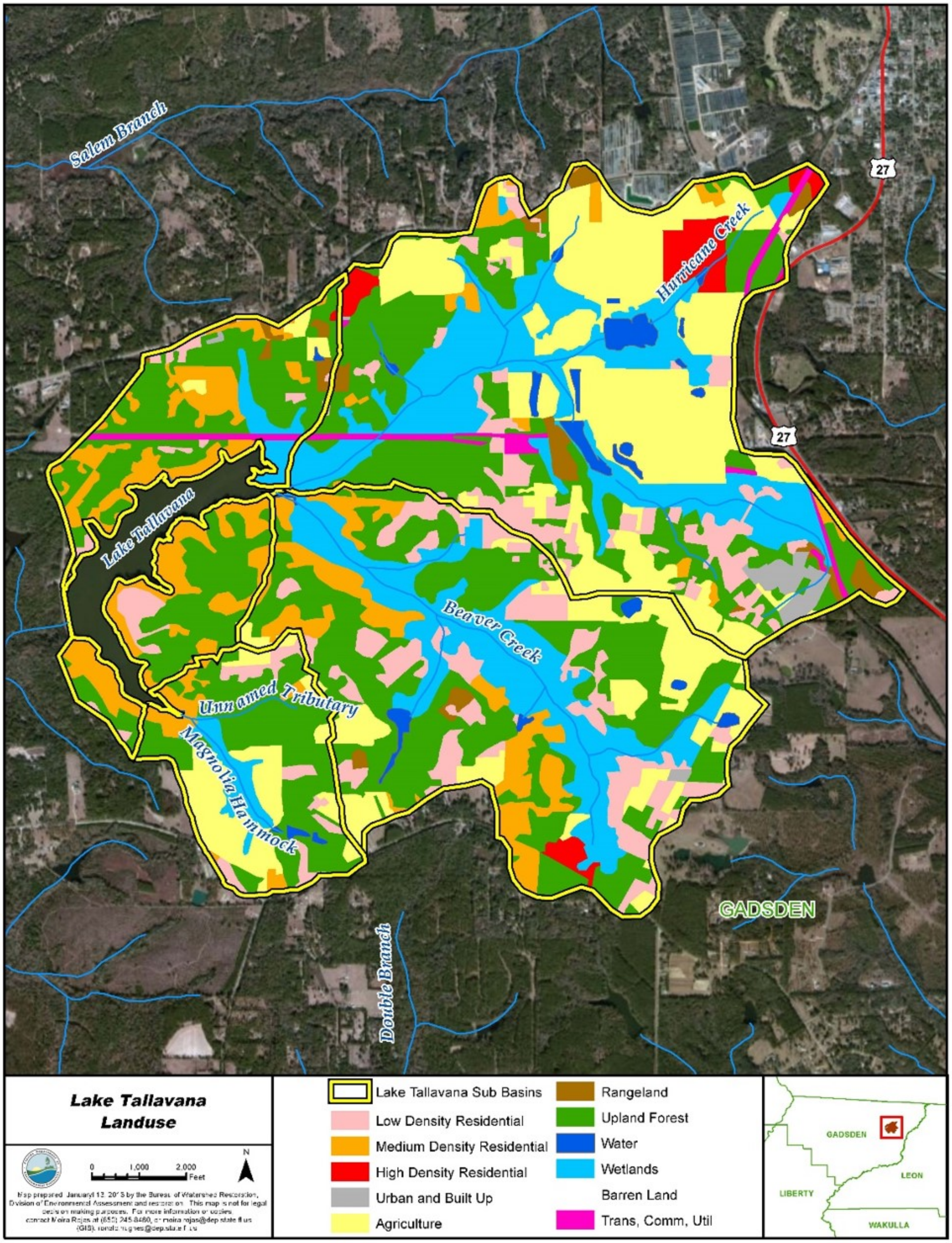

Figure C-2. Lake Tallavana Watershed Land Use

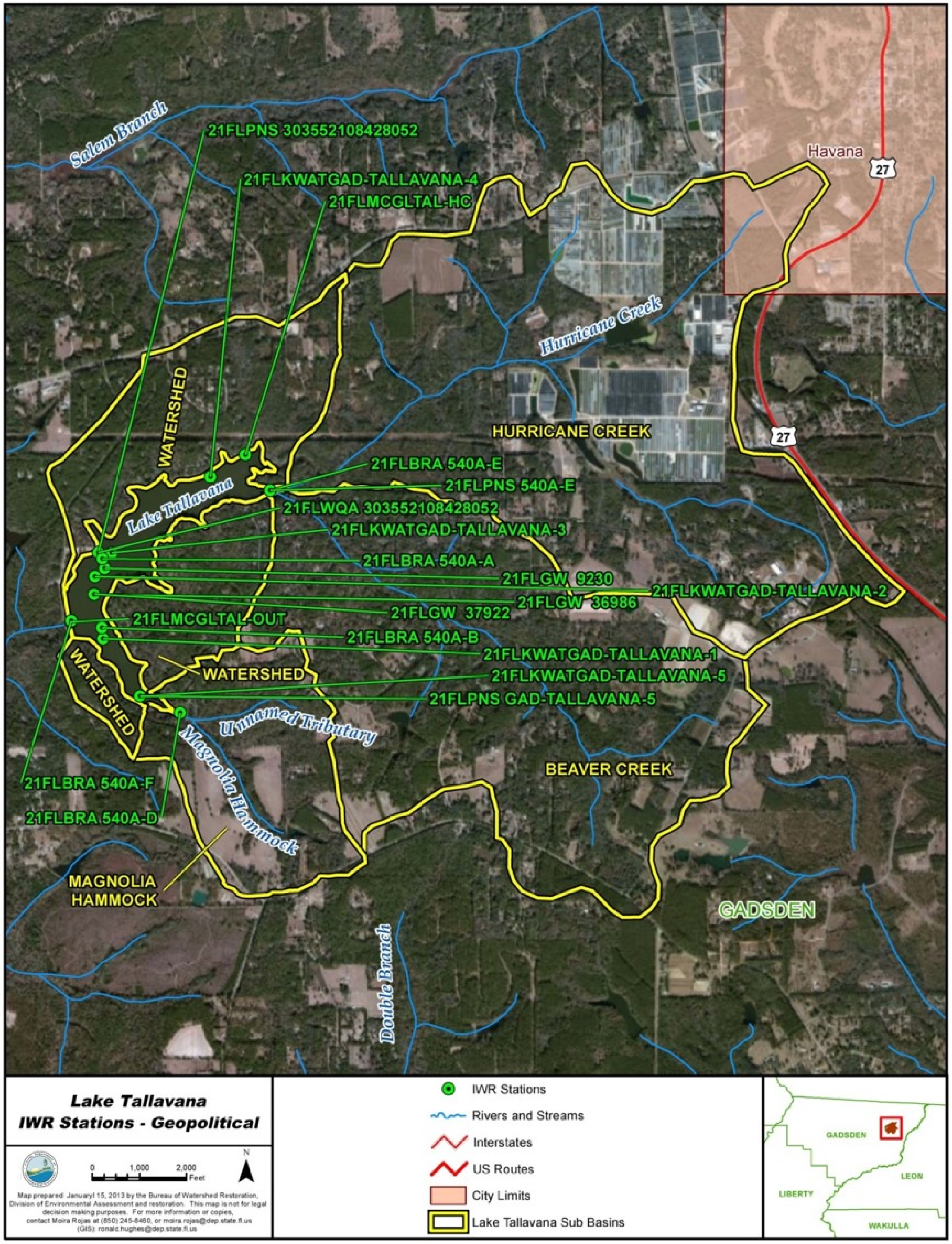

Figure C-3. Lake Tallavana Sampling Stations