Lake Assessment Report for Bay Lake in Hillsborough County, Florida

Date Assessed: July 26, 2013
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INTRODUCTION

This assessment was conducted to update existing physical and ecological data for Bay Lake on the Hillsborough County & City of Tampa Water Atlas. The project is a collaborative effort between the University of South Florida's Center for Community Design and Research and Hillsborough County Stormwater Management Section. The project is funded by Hillsborough County and the Southwest Florida Water Management District. The project has, as its primary goal, the rapid assessing of up to 150 lakes in Hillsborough County during a five-year period. The product of these investigations will provide the County, lake property owners and the general public a better understanding of the general health of Hillsborough County lakes, in terms of shoreline development, water quality, lake morphology (bottom contour, volume, area, etc.) and the plant biomass and species diversity. These data are intended to assist the County and its citizens to better manage lakes and lake-centered watersheds.

Figure 1. . General Photograph of Bay Lake

The first section of the report provides the results of the overall morphological assessment of the lake. Primary data products include: a contour (bathymetric) map of the lake, area, volume and depth statistics, and the water level at the time of assessment. These data are useful for evaluating trends and for developing management actions such as plant management where depth and lake volume are needed.

The second section provides the results of the vegetation assessment conducted on the lake. These results can be used to better understand and manage vegetation in the lake. A list is provided with the different plant species found at various sites around the lake. Potentially invasive, exotic (non-native) species are identified in a plant list and the percent of exotics is presented in a summary table. Watershed values provide a means of reference.

The third section provides the results of the water quality sampling of the lake. Both field data and laboratory data are presented. The trophic state index (TSI)[i] is used to develop a general lake health statement, which is calculated for both the water column with vegetation and the water column if vegetation were removed. These data are derived from the water chemistry and vegetative submerged biomass assessments and are useful in understanding the results of certain lake vegetation management practices.

The intent of this assessment is to provide a starting point from which to track changes in the lake, and where previous comprehensive assessment data is available, to track changes in the lake's general health. These data can provide the information needed to determine changes and to monitor trends in physical condition and ecological health of the lake.

Section 1: Lake Morphology

Bathymetric Map[ii]**.**

Table 1 provides the lake's morphologic parameters in various units. The bottom of the lake was mapped using a Lowrance LCX 28C HD or a Lowrance HDS 5 Gen 2 Wide Area Augmentation System (WAAS)[iii] enabled Global Positioning System (GPS) with fathometer (bottom sounder) to

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[i] The trophic state index is used by the Water Atlas to provide the public with an estimate of their lake resource quality. For more information, see end note 1.

[ii] A bathymetric map is a map that accurately depicts all of the various depths of a water body. An accurate bathymetric map is important for effective herbicide application and can be an important tool when deciding which form of management is most appropriate for a water body. Lake volumes, hydraulic retention time and carrying capacity are important parts of lake management that require the use of a bathymetric map.

[iii] WAAS is a form of differential GPS (DGPS) where data from 25 ground reference stations located in the United States receive GPS signals form GPS satellites in view and retransmit these

determine the boat's position, and bottom depth in a single measurement. The result is an estimate of the lake's area, mean and maximum depths, and volume and the creation of a bottom contour map (Figure 2). Besides pointing out the deeper fishing holes in the lake, the morphologic data derived from this part of the assessment can be valuable to overall management of the lake vegetation as well as providing flood storage data for flood models**.**

Table 1. Lake Morphologic Data (Area, Depth and Volume)

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	1,575,130	146,334	36.16	0	0
Mean Depth	5.95	1.81	0	0	0
Maximum Depth	12.72	3.88	0	0	0
Volume (cubic)	10,109,940	286,282	0	232.10	75,627,604
Gauge (relative)	45.70	13.93	0	0	0

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data to a master control site and then to geostationary satellites. For more information, see end note 2.

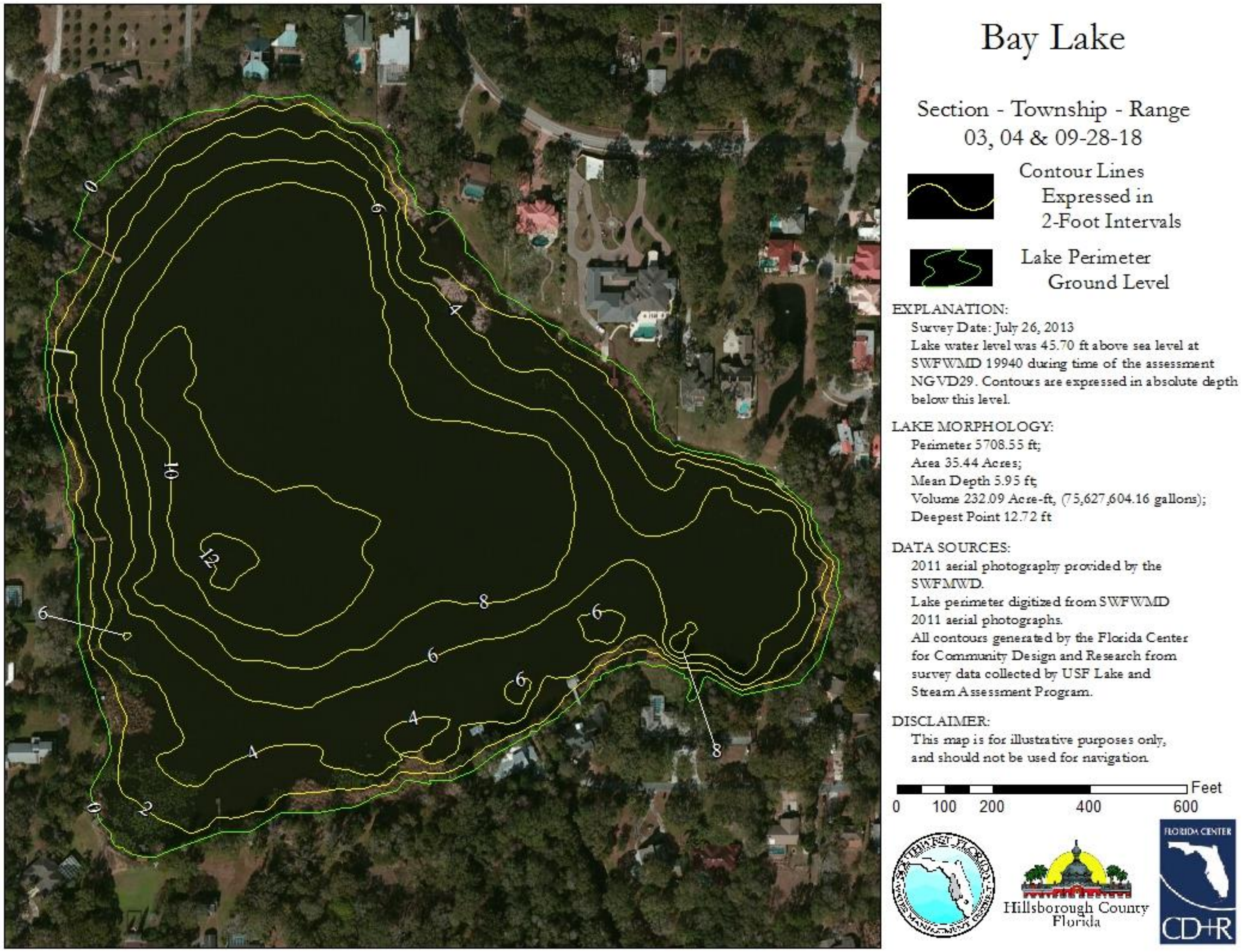

Figure 2. 2013 2-Foot bathymetric contour map for Bay Lake

Section 2: Lake Ecology (Vegetation)

The lake's apparent vegetative cover and shoreline detail are evaluated using the latest lake aerial photograph as shown in and by use of WAAS-enabled GPS. Submerged vegetation is determined from the analysis of bottom returns from the Lowrance 28c HD or Lowrance HDS 5 Gen 2 combined GPS/fathometer described earlier. As depicted in Figure 3, 10 vegetation assessment sites were chosen for intensive sampling based on the *Lake Assessment Protocol* (copy available on request) for a lake of this size. The site positions are set using GPS and then loaded into a GIS mapping program (ArcGIS) for display. Each site is sampled in the three primary vegetative zones (emergent, submerged and floating)[iv]. The latest high resolution aerial photos are used to provide shore details (docks, structures, vegetation zones) and to calculate the extent of surface vegetation coverage. The primary indices of submerged vegetation cover and biomass for the lake, percent area coverage (PAC) and percent volume infestation (PVI), are determined by transiting the lake by boat and employing a fathometer to collect "hard and soft return" data. These data are later analyzed for presence and absence of vegetation and to determine the height of vegetation if present. The PAC is determined from the presence and absence analysis of 100 sites in the lake and the PVI is determined by measuring the difference between hard returns (lake bottom) and soft returns (top of vegetation) for sites (within the 100 analyzed sites) where plants are determined present.

Beginning with the 2010 Lake Assessments, the Water Atlas Lake Assessment Team has added the Florida Department of Environmental Protection (FDEP) Lake Vegetation Index (LVI)[v] method to the methods used to evaluate a lake. The LVI method was designed by DEP to be a rapid assessment of ecological condition, by determining how closely a lake's flora resembles that expected from a minimally disturbed condition.

The data collected during the site vegetation sampling include vegetation type, exotic vegetation, predominant plant species and submerged vegetation biomass. The total number of species from all sites is used to approximate the total diversity of aquatic plants and the percent of invasive-exotic plants on the lake (Table 2). The Watershed value in Table 2 only includes lakes sampled during the lake assessment project begun in May of 2006. These data will change as additional lakes are sampled.

Table 3 through Table 5 detail the results from the 2013 aquatic plant assessment for the lake. These data are determined from the 10 sites used for intensive vegetation surveys. The tables are divided into Floating Leaf, Emergent and Submerged plants and contain the plant code, species, common name and presence (indicated by a 1) or absence (indicated by a blank space) of species and the calculated percent occurrence (number sites species is found/number of sites) and type of plant (Native, Non-Native, Invasive, Pest). In the "Type" category, the codes N and E0 denote species native to Florida. The code E1

[iv] See end note 3.
[v] See end note 4.

denotes Category I invasive species, as defined by the Florida Exotic Pest Plant Council (FLEPPC); these are species "that are altering native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives." The code E2 denotes Category II invasive species, as defined by FLEPPC; these species "have increased in abundance or frequency but have not yet altered Florida plant communities to the extent shown by Category I species." Use of the term invasive indicates the plant is commonly considered invasive in this region of Florida. The term "pest" indicates a plant (native or non-native) that has a greater than 55% occurrence in the lake and is also considered a problem plant for this region of Florida, or is a non-native invasive that is or has the potential to be a problem plant in the lake and has at least 40% occurrence. These two terms are somewhat subjective; however, they are provided to give lake property owners some guidance in the management of plants on their property. Please remember that to remove or control plants in a wetland (lake shoreline) in Hillsborough County the property owner must secure an Application To Perform Miscellaneous Activities In Wetlands permit from the Environmental Protection Commission of Hillsborough County and for management of in-lake vegetation outside the wetland fringe (for lakes with an area greater than ten acres), the property owner must secure a Florida Department of Environmental Protection Aquatic Plant Removal Permit.

Table 2. Total Diversity, Percent Exotics, and Number of Pest Plant Species

Parameter	Lake	Watershed
Number of Vegetation Assessment Sites	10	138
Total Plant Diversity (# of Taxa)	63	164
% Non-Native Plants	27	21
Total Pest Plant Species	4	20

Figure 3. 2013 Bay Lake Vegetation Assessment Site Map

Table 3. List of Floating Leaf Zone Aquatic Plants Found

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
LEN	Lemna spp.	Duckweed	100%	N, E0
NLM	Nuphar advena	Spatterdock, Yellow Pondlily	100%	N, E0
SMA	Salvinia minima	Water Spangles, Water Fern	100%	E1
ECS	Eichhornia crassipes	Water Hyacinth	90%	E1, P
NOA	Nymphaea odorata	American White Water Lily, Fragrant Water Lily	30%	N, E0

Figure 4. Spadderdock, *nuphar advena*, dominated the floating leaved vegetation zone in Bay Lake

Table 4. List of Emergent Zone Aquatic Plants Found

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
APS	**Alternanthera philoxeroides**	**Alligator Weed**	**100%**	**E2, P**
PRS	**Panicum repens**	**Torpedo Grass**	**90%**	**E1, P**
TYP	**Typha spp.**	**Cattails**	**90%**	**N, E0**
HYE	**Hydrocotyle umbellata**	**Manyflower Marshpennywort, Water Pennywort**	**90%**	**N, E0**
QLA	**Quercus laurifolia**	**Laurel Oak; Diamond Oak**	**80%**	**N, E0**
PCA	**Pontederia cordata**	**Pickerel Weed**	**70%**	**N, E0**
ACE	**Acer rubrum**	**Southern Red Maple**	**70%**	**N, E0**
SLA	**Sagittaria lancifolia**	**Duck Potato**	**70%**	**N, E0**
LPA	**Ludwigia peruviana**	**Peruvian Primrosewillow**	**70%**	**E1, P**
WAX	**Myrica cerifera**	**Southern Bayberry; Wax Myrtle**	**60%**	**N, E0**
SCA	**Salix caroliniana**	**Carolina Willow**	**40%**	**N, E0**
SCI	**Scirpus spp.**	**Sedge**	**40%**	**E0**
TAS	**Taxodium acendens**	**Pond Cypress**	**40%**	**N, E0**
BLS	**Blechnum serrulatum**	**Swamp fern, Toothed Midsorus Fern**	**40%**	**N**
DVA	**Diodia virginiana**	**Buttonweed**	**40%**	**N, E0**
LLA	**Ludwigia leptocarpa**	**Anglestem Primrosewillow**	**40%**	**N, E0**
MSS	**Mikania scandens**	**Climbing Hempvine**	**40%**	**N, E0**
PEP	**Persea palustris**	**Swampbay**	**30%**	**N, E0**
MAM	**Myriophyllum aquaticum**	**Parrot Feather**	**30%**	**E0**
ICE	**Ilex cassine**	**Dahoon Holly**	**30%**	**N, E0**
VRA	**Vitis rotundifolia**	**Muscadine Grape**	**30%**	**N, E0**
SSM	**Sapium sebiferum**	**Chinese Tallow Tree**	**30%**	**E1**
IIA	**Ipomea indica**	**Oceanblue Morning Glory**	**20%**	**N, E0**
CCA	**Cinnamomum camphora**	**Camphor-tree**	**20%**	**E1**
BOC	**Boehmeria cylindrica**	**Bog Hemp, False Nettle**	**20%**	**N, E0**
COM	**Commelina spp.**	**Dayflower**	**20%**	**N, E0**
COS	**Cephalanthus occidentalis**	**Buttonbush**	**20%**	**N, E0**
DBA	**Dioscorea bulbifera**	**Air Potato**	**20%**	**E1**
LOP	**Ludwigia spp.**	**Water Primroses, Primrosewillow**	**20%**	**E0**
LOS	**Ludwigia octovalvis**	**Mexican Primrosewillow, Long-stalked Ludwigia**	**10%**	**N, E0**
LOA	**Ludwigia arcuata**	**Piedmont Primrosewillow**	**10%**	**N, E0**
MVA	**Magnolia virginiana**	**Sweetbay Magnolia**	**10%**	**N, E0**
NEA	**Nephrolepis exaltata**	**Sword Fern, Wild Boston Fern**	**10%**	**N, E0**
OCA	**Osmunda cinnamomea**	**Cinnamon Fern**	**10%**	**N, E0**
QNA	**Quercus nigra**	**Water Oak**	**10%**	**N, E0**

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
RF	**Osmunda regalis var. spectabilis**	**Royal Fern**	**10%**	**N, E0**
PHS	**Polygonum hydropiperoides**	**Mild Waterpepper; Swamp Smartweed**	**10%**	**N, E0**
PRA	**Pluchea baccharis**	**Rosy Camphorweed**	**10%**	**N, E0**
CPT	**Cyperus polystachyos**	**Flat Sedge**	**10%**	**N, E0**
CYO	**Cyperus odoratus**	**Fragrant Flatsedge**	**10%**	**N, E0**
CAA	**Centella asiatica**	**Asian Pennywort, Coinwort, Spadeleaf**	**10%**	**N, E0**
BHA	**Baccharis halimifolia**	**Groundsel Tree; Sea Myrtle**	**10%**	**N, E0**
CEA	**Colocasia esculenta**	**Wild Taro**	**10%**	**E1**
FSC	**Fuirena spp.**	**Umbrella-grasses**	**10%**	**N, E0**
GLS	**Gordonia lasianthus**	**Loblolly Bay**	**10%**	**N, E0**
JVA	**Juniperus virginiana**	**Red cedar**	**10%**	**N, E0**
LIQ	**Liquidambar styraciflua**	**Sweetgum**	**10%**	**N, E0**
STS	**Schinus terebinthifolius**	**Brazilian Pepper**	**10%**	**E1**
ULA	**Urena lobata**	**Caesar's-weed**	**10%**	**E1**

Figure 5. Portions of the emergent vegetation zone on Bay Lake were dominated by species such as torpedo grass, *panicum repens*, a non-native invasive species

Table 5. List of Submerged Zone Aquatic Plants Found.

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
CHA	Chara spp.	Muskgrass	90%	N, E0
UBA	Utricularia gibba	Humped Bladderwort	80%	N, E0
VAA	Vallisneria americana	Tapegrass	70%	N, E0
NGS	Najas guadalupensis	Southern Naiad	60%	N, E0
CAB	Cabomba caroliniana	Fanwort	50%	N, E0
CDM	Ceratophyllum demersum	Hornwort, Coontail	20%	N, E0
HVA	Hydrilla verticillata	Hydrilla, waterthyme	20%	E1
NIT	Nitella spp.	Stonewort	20%	N, E0
BCA	Bacopa caroliniana	Lemon Bacopa	20%	N, E0

Figure 6. The Water Atlas field boat on Bay Lake

Table 6. List of All Plants and Sample Sites

Plant Common Name	Found at Sample Sites	Percent Occurrence	Growth Type
Alligator Weed	**1,2,3,4,5,6,7,8,9,10**	**100**	**Emergent**
Duckweed	**1,2,3,4,5,6,7,8,9,10**	**100**	**Floating**
Spatterdock, Yellow Pondlily	**1,2,3,4,5,6,7,8,9,10**	**100**	**Floating**
Water Spangles, Water Fern	**1,2,3,4,5,6,7,8,9,10**	**100**	**Floating**
Cattails	**1,2,3,5,6,7,8,9,10**	**90**	**Emergent**
Manyflower Marshpennywort, Water Pennywort	**1,2,3,4,5,6,7,8,10**	**90**	**Emergent**
Muskgrass	**2,3,4,5,6,7,8,9,10**	**90**	**Submersed**
Torpedo Grass	**1,2,3,4,6,7,8,9,10**	**90**	**Emergent**
Water Hyacinth	**1,2,4,5,6,7,8,9,10**	**90**	**Floating**
Humped Bladderwort	**1,4,5,6,7,8,9,10**	**80**	**Submersed**
Laurel Oak; Diamond Oak	**1,4,5,6,7,8,9,10**	**80**	**Emergent**
Duck Potato	**1,2,6,7,8,9,10**	**70**	**Emergent**
Peruvian Primrosewillow	**1,2,4,5,6,9,10**	**70**	**Emergent**
Pickerel Weed	**1,2,4,6,8,9,10**	**70**	**Emergent**
Southern Red Maple	**1,3,4,5,7,9,10**	**70**	**Emergent**
Tapegrass	**2,3,4,6,7,9,10**	**70**	**Submersed**
Southern Bayberry; Wax Myrtle	**3,4,5,7,9,10**	**60**	**Emergent**
Southern Naiad	**2,4,7,8,9,10**	**60**	**Submersed**
Fanwort	**2,3,4,5,9**	**50**	**Submersed**
Anglestem Primrosewillow	**1,6,7,10**	**40**	**Emergent**
Buttonweed	**2,6,8,10**	**40**	**Emergent**
Carolina Willow	**2,4,5,10**	**40**	**Emergent**
Climbing Hempvine	**2,7,9,10**	**40**	**Emergent**
Pond Cypress	**5,7,8,10**	**40**	**Emergent**
Sedge	**1,6,7,9**	**40**	**Emergent**
Swamp fern, Toothed Midsorus Fern	**3,4,5,7**	**40**	**Emergent**
American White Water Lily, Fragrant Water Lily	**1,6,8**	**30**	**Floating**
Chinese Tallow Tree	**7,9,10**	**30**	**Emergent**
Dahoon Holly	**3,4,5**	**30**	**Emergent**
Muscadine Grape	**3,4,9**	**30**	**Emergent**
Parrot Feather	**1,2,10**	**30**	**Emergent**
Swampbay	**1,3,5**	**30**	**Emergent**

Plant Common Name	Found at Sample Sites	Percent Occurrence	Growth Type
Air Potato	**7,10**	**20**	**Emergent**
Bog Hemp, False Nettle	**3,10**	**20**	**Emergent**
Buttonbush	**3,10**	**20**	**Emergent**
Camphor-tree	**9,10**	**20**	**Emergent**
Dayflower	**4,10**	**20**	**Emergent**
Hornwort, Coontail	**7,9**	**20**	**Submersed**
Hydrilla, waterthyme	**6,10**	**20**	**Submersed**
Lemon Bacopa	**7,9**	**20**	**Submersed**
Oceanblue Morning Glory	**7,10**	**20**	**Terrestrial**
Stonewort	**8,9**	**20**	**Submersed**
Water Primroses, Primrosewillow	**1,6**	**20**	**Emergent**
Asian Pennywort, Coinwort, Spadeleaf	**6**	**10**	**Emergent**
Brazilian Pepper	**1**	**10**	**Emergent**
Caesar's-weed	**10**	**10**	**Emergent**
Cinnamon Fern	**10**	**10**	**Emergent**
Flat Sedge	**4**	**10**	**Emergent**
Fragrant Flatsedge	**1**	**10**	**Emergent**
Groundsel Tree; Sea Myrtle	**6**	**10**	**Emergent**
Loblolly Bay	**3**	**10**	**Emergent**
Mexican Primrosewillow, Long-stalked Ludwigia	**1**	**10**	**Emergent**
Mild Waterpepper; Swamp Smartweed	**8**	**10**	**Emergent**
Piedmont Primrosewillow	**6**	**10**	**Emergent**
Red cedar	**9**	**10**	**Terrestrial**
Rosy Camphorweed	**6**	**10**	**Emergent**
Royal Fern	**10**	**10**	**Emergent**
Sweetbay Magnolia	**5**	**10**	**Emergent**
Sweetgum	**7**	**10**	**Emergent**
Sword Fern, Wild Boston Fern	**3**	**10**	**Terrestrial**
Umbrella-grasses	**8**	**10**	**Emergent**
Water Oak	**10**	**10**	**Emergent**
Wild Taro	**3**	**10**	**Emergent**

Section 3: Long-term Ambient Water Chemistry

A critical element in any lake assessment is the long-term water chemistry data set. These data are obtained from several data sources that are available to the Water Atlas and are managed in the Water Atlas Data Download and graphically presented on the water quality page for lakes in Hillsborough County. The Bay Lake Water Quality Page can be viewed at http://www.hillsborough.wateratlas.usf.edu/lake/waterquality.asp?wbodyid=5177&wbodyatlas=lake).

Beginning with the 2012 Assessment Report, the long term Ambient Water Chemistry section of the report will include evaluations based on both the Trophic State Index (TSI) and the new Numeric Nutrient Criteria (NNC) for lakes. See the April 2013 report on the Implementation of Florida's NNC and other documents concerning the NNC rule in the Water Atlas Digital Library (hint: use key word "62-302", the rule Florida Administrative Code number). The long-term water chemistry will be first evaluated based on factors that go into the determination of the TSI and then based on the NNC. A primary source of lake water chemistry in Hillsborough County is the Florida LAKEWATCH volunteer lake monitor and the Florida LAKEWATCH laboratory at the University of Florida. Bay Lake does not have an active LAKEWATCH volunteer presently. The last LAKEWATCH volunteer water chemistry data was collected on July 24, 2011, so only limited trend analysis is possible. Other source data are used as available; however these data can only indicate conditions at time of sampling.

Evaluation of Lake Long Term Water Chemistry Based on Trophic State Index

These data are displayed and analyzed on the Water Atlas as shown in Figure 7, Figure 8, and Figure 9 for Bay Lake. The figures are graphs of: (1) the overall trophic state index (TSI), which is a method commonly used to characterize the productivity of a lake, and may be thought of as a lake's ability to support plant growth and a healthy food source for aquatic life; (2) the chlorophyll *a* concentration, which indicates the lake's algal concentration, and (3) the lake's Secchi Disk depth which is a measure of water visibility and depth of light penetration. These data are used to evaluate a lake's ecological health and to provide a method of ranking lakes and are indicators used by the US Environmental Protection Agency (USEPA) and the Florida Department of Environmental Protection (FDEP) to determine a lake's level of impairment. The chlorophyll a and Secchi Disk depth graphs include benchmarks which indicate the median values for the various parameters for a large number of Lakes in Florida expressed as percentiles.

Based on best available data and using the TSI methodology, Bay Lake has a color value determined as a platinum cobalt unit (pcu) value of 28.3 and is considered a Clear lake (has a mean color in pcu equal to or below 40). The FDEP and USEPA may classify a lake as impaired if the lake is a dark lake (has a mean color in pcu greater than 40) and has a TSI greater than 60, or is a clear lake and has a TSI greater than 40. Bay Lake is a clear lake and has a TSI of 52 and meets the FDEP Impaired Waters Rule (IWR) criteria for impairment (clear and a TSI greater than 40). Under this methodology it would be classified as impaired See also Table 7.

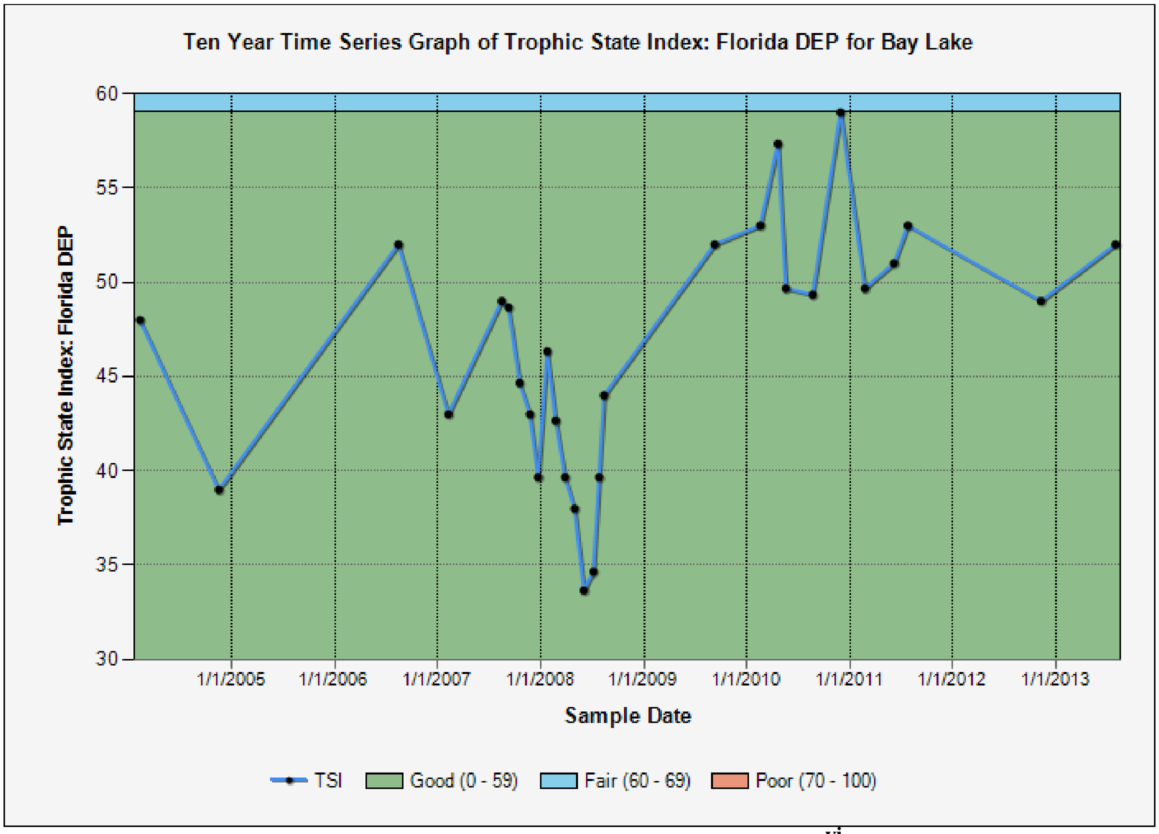

Figure 7. Recent Trophic State Index (TSI) graph for Bay Lake[vi]

[vi] Graph source: Hillsborough County Water Atlas. For an explanation of the Good, Fair and Poor benchmarks, please see the notes at the end of this report. For the latest data go to: http://www.hillsborough.wateratlas.usf.edu/graphs20/graph_it.aspx?wbodyid=5177&data=TSI&datatype=WQ&waterbodyatlas=lake&ny=10&bench=1

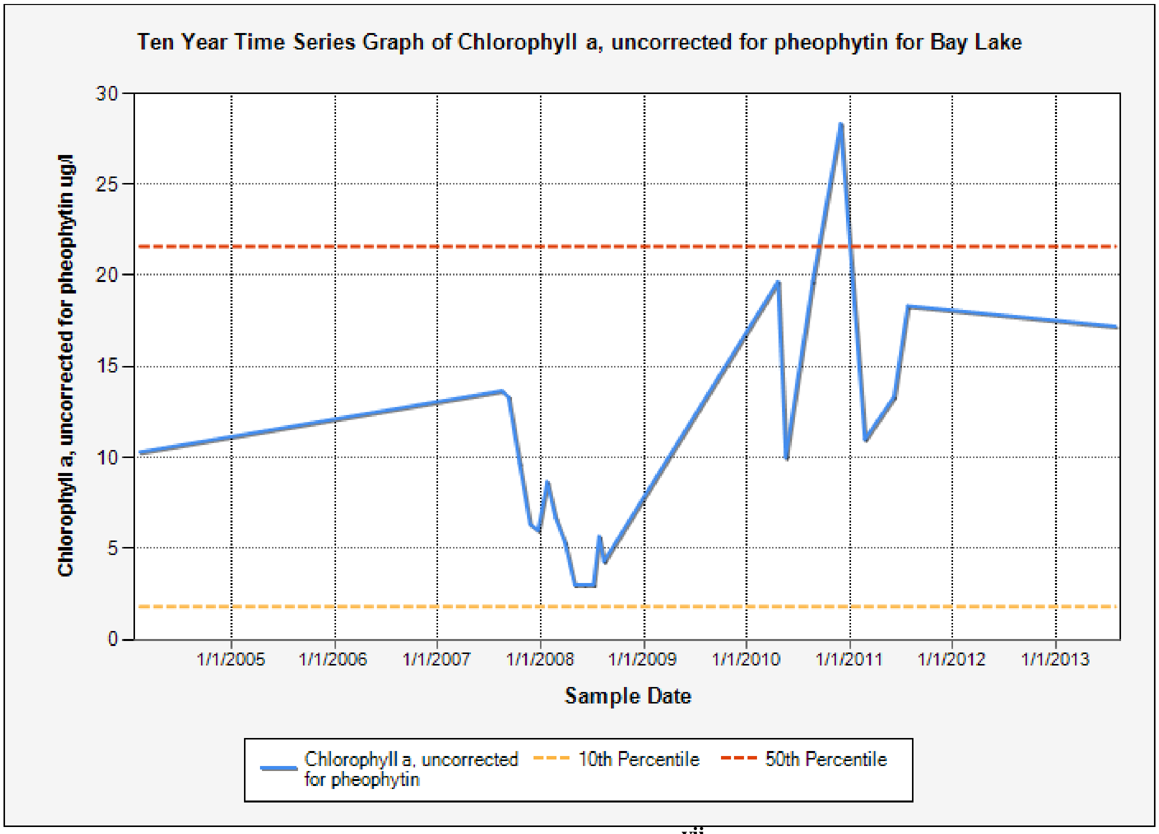

Figure 8. Recent Chlorophyll a graph for Bay Lake[vii]

[vii] Graph Source: Hillsborough County Water Atlas. For the latest data go to http://www.hillsborough.wateratlas.usf.edu/graphs20/graph_it.aspx?wbodyid=5177&data=Chla_ugl&datatype=WQ&waterbodyatlas=lake&ny=10&bench=1

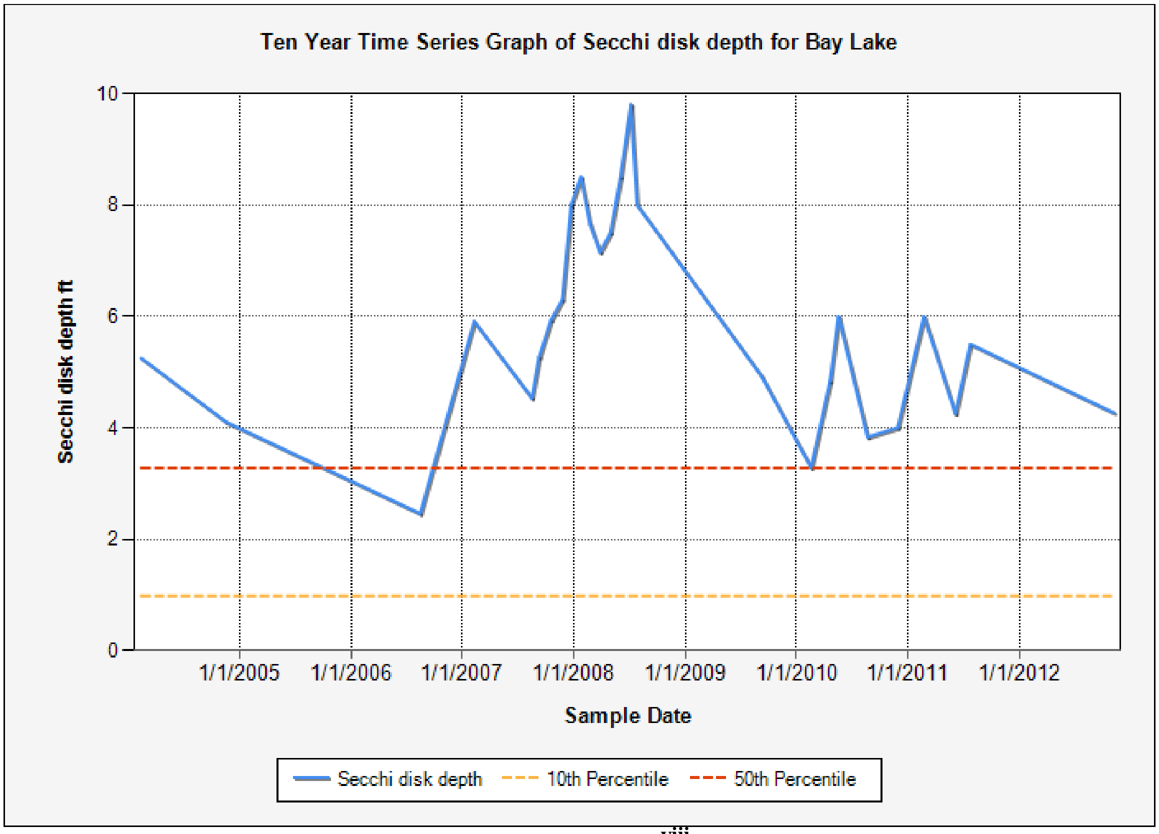

Figure 9. Recent Secchi Disk graph for Bay Lake[viii]

As part of the lake assessment the physical water quality and chemical water chemistry of a lake are measured. These data only indicate a snapshot of the lake's water quality; however they are useful when compared to the trend data available from LAKEWATCH or other sources. Table 7 contains the summary water quality data and index values and adjusted values calculated from these data. The total phosphorus (TP), total nitrogen (TN) and chlorophyll *a* water chemistry sample data are the results of chemical analysis of samples taken during the assessment and analyzed by the Hillsborough County Environmental Protection Commission laboratory.

The growth of plants (planktonic algae, macrophytic algae and rooted plants) is directly dependent on the available nutrients within the water column of a lake and to some extent the nutrients which are held in the sediment and the vegetation biomass of a lake. Additionally, algae and other plant growth are limited by the nutrient in lowest concentration relative to that needed by a plant. Plant biomass contains less phosphorus by weight than

[viii] Graph Source: Hillsborough County Water Atlas. For the latest data go to http://www.hillsborough.wateratlas.usf.edu/graphs20/graph_it.aspx?wbodyid=5177&data=secchi_ft&datatype=WQ&waterbodyatlas=lake&ny=10&bench=1

nitrogen so phosphorus is many times the limiting nutrient. When both nutrients are present at a concentration in the lake so that either or both may restrict plant growth, the limiting factor is called "balanced". The ratio of total nitrogen to total phosphorous, the "N to P" ratio (N/P), is used to determine the limiting factor. If N/P is greater than or equal to 30, the lake is considered phosphorus limited, when this ratio is less than or equal to 10, the lake is considered nitrogen limited and if between 10 and 30 it is considered balanced.

Table 7. Water Quality Parameters (Laboratory) for Bay Lake – TSI Critera
Value column provides the data based on lake assessment sampling. Mean Value is based

Parameter	Value	Mean Value
Parameter	**Lake Assessment**	**Long Term Data**
Lake Area (Acres)	**36.16**	
Lake Area (m2)	**146,334.00**	
Lake Volume (m3)	**320,392.00**	
Number of Vegetation Sites	**10**	
Average Station SAV Weight	**0.48**	
Wet Weight of Vegetation (g)	**34,973,904.43**	
Dry Weight of Vegetation (g)	**2,797,912.35**	
Total Phosphorus (ug/L)	**31.00**	**23.26**
Total Nitrogen (ug/L)	**641.00**	**810.99**
Chlorophyll a (ug/L)	**17.20**	**14.06**
TN/TP	**20.7**	**34.9**
Limiting Nutrient	**Balanced**	**Phosphorus**
Chlorophyll TSI	**57**	**54**
Phosphorus TSI	**45**	**50**
Nitrogen TSI	**47**	**51**
TSI	**52**	**52**
Color (PCU)	**28.30**	**28.66**
Secchi disk depth (ft)	**5.10**	**4.79**
Impaired TSI for Lake	**40**	**40**
Lake Status (Water Column)	**Impaired**	**Impaired**

on long-term sample values for the lake.

The color of a lake is also important to the growth of algae. Dark, tannic lakes tend to suppress algal growth and can tolerate a higher amount of nutrient in their water column; while clear lakes tend to support higher algal growth with the same amount of nutrients. The color of a lake, which is measured in a unit called the "cobalt platinum unit (PCU)" because of the standard used to determine color, is important because it is used by the State of Florida to determine lake impairment as explained earlier. A new rule which is being developed by USEPA and FDEP, will use alkalinity in addition to color to determine a second set of "clear-alkaline lakes" which will be allowed a higher TSI than a "clear-acid" lake. This is because alkaline lakes have been found to exhibit higher nutrient and algal concentrations than acid lakes. Additionally, lakes connected to a river or other "flow through" systems tend to support lower algal growth for the same amount of nutrient concentration. All these factors are important to the understanding of your lake's overall condition. Table 7 includes many of the factors that are typically used to determine the actual state of plant growth in your lake. These data should be understood and reviewed when establishing a management plan for a lake; however, as stated above other

factors must be considered when developing such a plan. Please contact the [Water Atlas Program]() if you have questions about this part or any other part of this report.
Nutrient trend data for Bay Lake is difficult to analyze due to the lack of recent sampling events. Of the 22 available nutrient samples since 2010, only 1 is from 2013 and only 3 are from 2012. LAKEWATCH volunteer collected data is available for portions of 2010 and 2011. Based on the available data, Bay Lake is Impaired using the TSI method for chlorophyll, phosphorous and nitrogen values. 8provides data derived from the vegetation assessment which is used to determine an adjusted TSI. This is accomplished by calculating the amount of phosphorus and nitrogen that could be released by existing submerged vegetation (Adjusted Nutrient) if this vegetation were treated with an herbicide or managed by the addition of Triploid Grass Carp (*Ctenopharyngodon idella*). The table also shows the result of a model that calculates the potential algae, as chlorophyll a (Adjusted Chlorophyll), which could develop due to the additional nutrients held within the plant biomass. While it would not be expected that all the vegetation would be turned into available phosphorus by these management methods, the data is useful when planning various management activities. Approximately 50.00 % of the lake has submerged vegetation present (PAC) and this vegetation represents about 4.67 % of the available lake volume (PVI). Please see additional parameters for adjusted values where appropriate in Table 8. The vegetation holds enough nutrients to add about 12.31 μg/L of phosphorus and 165.92 μg/L of nitrogen to the water column and increase the algal growth potential within the lake.
Bay Lake is a balanced lake, in terms of limiting nutrient, and an increase in either phosphorus or nitrogen could change the TSI and increase the potential for algal growth.

Table 8. Field parameters and calculations used to determine nutrients held in Submerged Aquatic Vegetation (SAV) biomass. TSI Criteria

Parameter	Value	Mean Value
% Area Covered (PAC)	**50.0 %**	
PVI	**4.7 %**	
Lake Vegetation Index	**32**	
Total Phosphorus - Adjusted (ug/L)	**12.31**	
Total Phosphorus - Combined (ug/L)	**43.31**	
Total Nitrogen - Adjusted (ug/L)	**165.92**	
Total Nitrogen - Combined (ug/L)	**806.92**	
Chlorophyll - Adjusted from Total Nutrients (ug/L)	**4.04**	
Chlorophyll - Combined (ug/L)	**21.24**	
Adjusted Chlorophyll TSI	**60**	
Adjusted Phosphorus TSI	**51**	
Adjusted Nitrogen TSI	**51**	
Adjusted TSI (for N, P, and CHLA)	**56**	
Impaired TSI for Lake	**40**	**40**

Table **9** contains the field data taken in the center of the lake using a multi-probe. We use either a YSI 6000 or a Eureka Manta probe which have the ability to directly measure the temperature, pH, dissolved oxygen (DO), percent DO (calculated from DO, temperature and conductivity. These data are listed for three levels in the lake and twice for the sur-

face measurement. The duplicate surface measurement is taken as a quality assurance check on measured data.
The geometric mean of percent DO for this sample event is 59.9 % and for the DO is 4.52 mg/L. which is within an acceptable range for oxygen. The pH is also within normal lake values for acidity. Conductivity indicates a slightly alkaline lake (>100 mS/cm3). All values indicate a reasonably well mixed system.

Table 9. Water Chemistry Data Based on Manta Water Chemistry Probe for Bay Lake

Sample Location	Sample Depth (m)	Time	Temp (deg C)	Conductivity (mS/cm3)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	pH
Mean Value	4.67	7/29/2012 11:44:00 AM	29.81	0.200	66.96	5.31	6.70
Surface-1	1.91	7/29/2013 11:33:34 AM	30.16	0.202	92.30	7.30	6.86
Middle-1	4.71	7/29/2013 11:34:45 AM	29.56	0.202	85.50	6.84	6.77
Bottom-1	10.49	7/29/2013 11:35:52 AM	19.00	0.195	41.60	3.36	6.38
Bottom	10.55	7/29/2013 11:37:41 AM	29.39	0.199	6.90	0.56	6.35
Middle	4.76	7/29/2013 11:39:46 AM	29.57	0.202	63.50	5.08	6.71
Middle-2	4.56	7/29/2013 11:40:18 AM	29.61	0.202	66.60	5.32	6.74
Surface	1.60	7/29/2013 11:41:50 AM	30.84	0.201	81.00	6.34	6.83
Surface-2	1.69	7/29/2013 11:42:05 AM	30.43	0.202	82.30	6.48	6.85
Surface-3	1.82	7/29/2013 11:42:33 AM	30.34	0.202	83.00	6.55	6.85

To better understand many of the terms used in this report, we recommend that the reader visit the Hillsborough County & City of Tampa Water Atlas and explore the "Learn More" areas which are found on the resource pages. Additional information can also be found using the Digital Library on the Water Atlas website.

Evaluation of Lake Long Term Water Chemistry Based on Numeric Nutrient Criteria

On September 26, 2013, the Florida Department of Environmental Protection (FDEP) announced that the US Environmental Protection Agency (USEPA) confirmed that the state had completed its obligations to USEPA related to the establishment of the Numeric Nutrient Criteria (NNC) for estuaries, lakes, and springs and flowing freshwater streams. These criteria are now required for use in the determination of a water body impairment, that is to determine if a waterbody such as a lake meets designated use or habitat health in terms of nutrients (phosphorus and nitrogen) and response variables (chlorophyll a and dissolved oxygen). Prior to this, the Trophic State Index (TSI) was the primary indicator of lake health as this health related to nutrients and the responses by lake biota (algae, emergent, floating and submerged plants, fish and other flora and fauna living within a lake). In 2012, the Water Atlas Lake Assessment program began using TSI and the NNC rule to help determine the assessed health of a lake, we will continue with this approach but it should be realized that the only official index of nutrient related impairment for a lake is the NNC.

The NNC rule is found in chapter 62-302, *Surface Water Quality Standards* of the Florida Administrative Code (FAC). In paragraph 62-302.531 of that rule the specific nutrient criteria as they relate to lakes, springs and streams is stated. A lake is defined by the rule as a lentic (still freshwater system) waterbody with a relatively long water residence time (time that a unit of water remains within the waterbody) and an open water area that is free from emergent vegetation under typical hydrologic and climate conditions. For lakes the applicable numeric interpretation of the NNC is shown in Table 10 below. There are several important aspects to the rule which are reflected important to understand this report. First, the NNC is calculated annually based on data collected over a twelve month period. The date the sample is taken must be distributed over the twelve month period so that at least one sample is taken between May 1 and September 30 and at least one other sample taken during the rest of the year. A total of four samples are required for an NNC to be calculated and to count samples must be separated by a minimum of one week. There are other important data related elements of the rule that must also be met for lakes. Lakes are classified as “dark” or “clear” based on the amount of color measured as “true color”. True color is measured based on a relationship to a platinum-cobalt dye and given a measure of platinum-cobalt unit or PCU. A dark lake has a true color greater than 40 PCU. Color must be recorded as “long term” true color which means that at least 10 samples have been taken over at least three years with at least one sample each year. The other type classification for lakes is a measure of the lakes “alkalinity”. An alkaline lake has a high concentration of calcium carbonate which acts as a buffer to prevent changes in pH. Alkalinity is determined by measuring calcium carbonate ($CaCO_3$) concentrations which is expressed as $CaCO_3$ Alkalinity in milligrams per liter (mg/L). Alkalinity has the same time related rule as color and an alkaline lake is one with a $CaCO_3$ Alkalinity greater than 20 mg/L.

The NNC rule then provides an acceptable concentration limit for chlorophyll a (response variable) and related nutrient concentrations. If a lake has adequate data to determine chlorophyll a concentration based on a statistic called the geometric mean. The geometric mean is similar to an average but based on the square root of the product of values instead of the sum of values divided by the number of values. If the chlorophyll a criteria in the table are met for a year then the NNC is based on the maximum value in the table. If it is not met, then the minimum table value must be used. A lake's annual mean for TN or TP cannot exceed the limit more than one time in a 3 year period. One final criterion is applied for lake and stream phosphorus concentration maximum for the West Central region which includes Hillsborough County (Figure 11) except for the Odessa lake region. This is for dark lakes in this region have a phosphorus maximum of 0.49 mg/L.

Table 10 . Lakes chlorophyll *a*, TN, and TP criteria.

Long Term Geometric Mean Lake Color and Alkalinity	Annual Geometric Mean Chlorophyll *a*	Minimum calculated numeric interpretation		Maximum calculated numeric interpretation	
		Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen	Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen
> 40 Platinum Cobalt Units	**20 µg/L**	**0.05 mg/L**	**1.27 mg/L**	**0.16 mg/L[1]**	**2.23 mg/L**
≤ 40 Platinum Cobalt Units 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 Platinum Cobalt Units 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**

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

Table 11 below provides an assessment based on the NNC rule. To have sufficient nutrient and chlorophyll samples to calculate a geometric mean the lake required 4 samples annually with at least one sample taken between May and September of the year and one or more samples in the other months with at least one week between samples. To determine if a lake is clear or dark "true color" must be used and a long term geometric mean calculated. At least 10 lake samples must be available which represent at least a 3 year period and at least one sample must be from each of the three years. To determine if a lake is alkaline or acid, the same numeric requirements are required as for color. Alkalinity must be expressed as $CaCO_3$ alkalinity; however if these data are not available, then conductivity can be used until adequate alkalinity is available. A conductivity of a value of <100 micromhos/cm used to estimate the 20 mg/L $CaCO_3$ alkalinity concentration until such time that alkalinity data are available.

A primary data source for lakes in Hillsborough County is LAKEWATCH and since the LAKEWATCH laboratory does not determine correct chlorophyll a this parameter does not meet NNC requirements. Since this will be the case for the majority of Hillsborough County Lakes, we are using modified criteria where uncorrected chlorophyll a is used. We also use data even when the number of sample criteria is not met, and indicate the actual number expected. The assessment NNC is not an official value, but does assist in understanding both the data needs and the expected NNC related evaluation.

Table 11. Estimate of potential impairment based on last 3 years of data and the NNC Rule

Lake	Bay Lake
Geometric Mean (Geomean) Color (pcu)	27.47
Number of Samples	6 (need 10)
Geometric Mean Specific Conductance umhos	217.91
Number of Samples	12 (need 10)
Lake Type	Clear Alkaline
Chlorophyll a Criteria (ug/L)	≤ 20 µg/l
Sufficient for Geomean & Geomean Chla meets Chla Criteria then P mg/L	0.03 – 0.09 mg/l
Insuffcient for Geomean or Geomean Chla does not meet Chla Criteria then P mg/L	≤ 0.03 mg/l
Sufficient for Geomean & Geomean Chla meets Chla Criteria then N mg/L	1.05 – 1.91
Insuffcient for Geomean or Geomean Chla does not meet Chla Criteria then N mg/L	≤ 1.05 mg/l
Geomean Chla ug/L	16.18
Geomean TP mg/L	0.028
Geomean TN mg/L	1.110
Number of Samples	22
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Impaired

The sample results given in Table 11 indicate that Bay Lake would be classified as a clear-alkaline lake with a chlorophyll a value below the NNC requirement for this type lake. By the rule criteria for nutrients (Table 10), the geometric mean of TP must be below 0.09 mg/L (or if insufficient data exists below or equal to 0.03 mg/L) and by Table 11, this criteria is met and the lake would be expected to pass the NNC for phosphorus. For nitrogen, the criteria is 1.91 mg/L (or if insufficient data exists below or equal to 1.05 mg/L) and the Table 11 value slightly above the insufficient data level and may be considered impaired; however if sufficient data were available and a similar geometric mean were to result then the lake would not be impaired for nitrogen. We must stress that this assessment only suggests that impairment exists or does not, based on the NNC rule. For an actual NNC based assessment to be performed, the sampling method for the lake would have to be changes to ensure that the NNC data requirements are fully met.

Section 4: Conclusion

Bay Lake is a medium area (36.16-acre) lake that would be considered in the Eutrophic category of lakes based on water chemistry. It has a plant diversity of 63 species relative to the total watershed plant diversity of 164 species with about 50.00 % percent of the open water areas containing submerged aquatic vegetation. Vegetation helps to maintain the nutrient balance in the lake as well as provide good fish habitat. The lake has many open water areas to support various types of recreation and has a fair diversity of plant species. The primary pest plants in the lake include Eichhornia crassipes, Alternanthera philoxeroides, Panicum repens, Ludwigia peruviana.

The lake vegetative assessment also was used to calculate a Lake Vegetative Index (LVI) for the lake (See Note 4). The LVI can be used to help determine if a lake is impaired in terms of types and quantities of vegetation found in and along the lake shore. An LVI threshold of 37 is used by FDEP to establish a point below which the lake could be considered heavily disturbed and possibly impaired. This threshold is intended to assist the analyst in classifying a lake as impaired when used with water quality data. For example, a clear water lake may have a TSI of 42 but have an LVI of 70. Since the LVI is significantly above the threshold and indicates low human disturbance, the analyst might declare the lake unimpaired even with a TSI slightly above the water quality threshold for a clear lake. Your lake has an LVI of 32 and would be considered impaired based on LVI alone.

By the lake nutrient impairment standards in place prior to November 2012 a clear water lake would require a TSI of 40 or below to not be considered impaired and if a dark water lake it would require a TSI of 60 or below to not be considered impaired. This lake is a clear lake and has a TSI of 52 and is considered impaired. By the new numeric nutrient standards if the lake is clear and acid then it must have chlorophyll a concentration of less than or equal to 6 µg/L and meet certain nitrogen and phosphorous concentration limitations and if a dark lake or an alkaline lake then it must have a chlorophyll a concentration below 20 µg/L and meet certain nitrogen and phosphorous concentration limitations. This lake is a clear and alkaline and would not be considered impaired for chlorophyll a and phosphorus and slightly impaired for total nitrogen by these criteria. The major difference for the two approaches is that alkalinity was not considered in determining lake type and lake criteria for the TSI approach as it was in the NNC approach. Using all the metrics (TSI, NNC and LVI) for determining impairment for this lake, we would consider this lake impaired. The determination relies heavily on the low LVI value and the TSI based impairment and lake of sufficient data for an actual NNC.

This assessment was accomplished to assist lake property owners to better understand and manage their lakes. Hillsborough County supports this effort as part of their [Lake Management Program (LaMP)] and has developed guidelines for lake property owner groups to join the LaMP and receive specific assistance from the County in the management of their lake. For additional information and recent updates please visit the Hillsborough County & City of Tampa Water Atlas website.

Lake Assessment Notes

1. The trophic state index is used by the Water Atlas to provide the public with an estimate of their lake resource quality. A "Good" quality lake is one that meets all lake use criteria (swimmable, fishable and supports healthy habitat). Based on the discussion above, lakes that are in the oligotrophic through low eutrophic range, for the most part, meet these criteria. A trophic state below 60 indicates lakes in this range and these lakes are given the "Good" descriptor. A trophic state above 60 but below 70 can be considered highly productive and a reasonable lake for fishing and most water sports. This lake is considered "Fair", while a lake in the Hypereutrophic range with a TSI greater than 70 will probably not meet the lake use criteria and these lakes are considered to be poor. Please see Table 12 below.

Table 12. Comparison of Classification Schemes

Trophic State Index	Trophic State Classification	Water Quality
0 – 59	Oligotrophic through Mid-Eutrophic	Good
60 – 69	Mid-Eutrophic through Eutrophic	Fair
70 – 100	Hypereutrophic	Poor

Also see the Florida LAKEWATCH publication, "Trophic State: A Waterbody's Ability to Support Plants Fish and Wildlife" and the Trophic State Index Learn More page on the Hillsborough County Water Atlas.

In recent years FDEP staff have encountered problems interpreting Secchi depth data in many tannic (tea or coffee-colored) waterbodies where transparency is often reduced due to naturally-occurring dissolved organic matter in the water. As a result, Secchi depth has been dropped as an indicator in FDEP's recent TSI calculations (1996 Water-Quality Assessment for The State of Florida Section 305(b) Main Report). This modification for black water TSI calculation has also been adopted by the Water Atlas.

Also, according to Florida LAKEWATCH use of the TSI is often misinterpreted and/or misused from its original purpose, which is simply to describe biological productivity. It is not meant to rate a lake's water quality. For example, higher TSI values represent lakes that support an abundance of algae, plants and wildlife. If you love to fish, this type of lake would not be considered to have "poor" water quality. However, if you are a swimmer or water skier, you might prefer a lake with lower TSI values.

The trophic state index is one of several methods used to describe the biological productivity of a waterbody. Two scientists, Forsberg and Ryding, 1980, developed another method that is widely used. It's known as the Trophic State Classification System. Using this method, waterbodies can be grouped into one of four categories, called trophic states:

Oligotrophic (oh-lig-oh-TROH-fik) where waterbodies have the lowest level of productivity;

Mesotrophic (mees-oh-TROH-fik) where waterbodies have a moderate level of biological productivity;
Eutrophic (you-TROH-fik) where waterbodies have a high level of biological productivity;
Hypereutrophic (HI-per-you-TROH-fik) where waterbodies have the highest level of biological productivity. The trophic state of a waterbody can also affect its use or perceived utility. Figure 10 illustrates this concept.

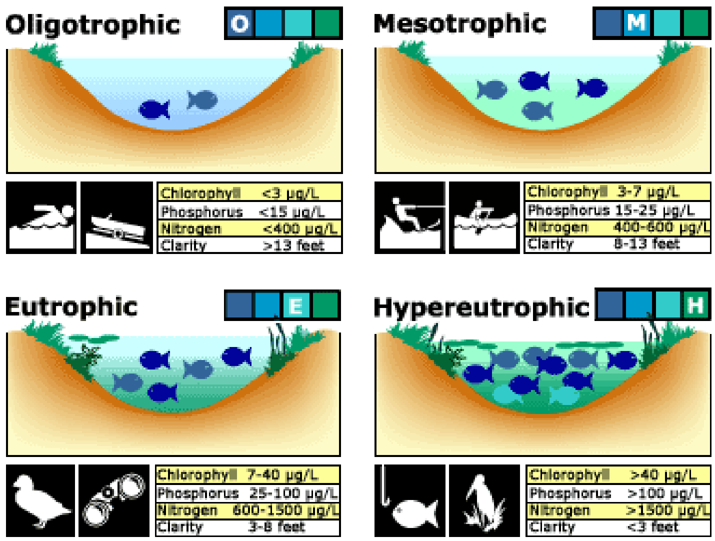

Figure 10. Tropic States

2. **Rule for Lake Nutrient Impairment prior to November 30, 2012:** "For the purposes of evaluating nutrient enrichment in lakes, TSIs shall be calculated based on the procedures outlined on pages 86 and 87 of the State's 1996 305(b) report, which are incorporated by reference. Lakes or lake segments shall be included on the planning list for nutrients if:(1) For lakes with a mean color greater than 40 platinum cobalt units, the annual mean TSI for the lake exceeds 60, unless paleolimnological information indicates the lake was naturally greater than 60, or (2) For lakes with a mean color less than or equal to 40 platinum cobalt units, the annual mean TSI for the lake exceeds 40, unless paleolimnological information indicates the lake was naturally greater than 40, or (3) For any lake, data indicate that annual mean TSIs have increased over the assessment period, as indicated by a positive slope in the means plotted versus time, or the annual mean TSI has increased by more than 10 units over historical values. When evaluating the slope of mean TSIs over time, the Department shall require at least a 5 unit increase in TSI over the assessment period and use a Mann's one-sided, upper-tail test for trend, as described in Nonparametric Statistical Methods by M. Hollander and D. Wolfe (1999 ed.), pages 376 and 724 (which are incorporated by reference), with a 95% confidence level."
3. **References: 62-303.352 F.A.C —Nutrients in Lakes**. Specific Authority 403.061, 403.067 FS. Law Implemented 403.062, 403.067 FS. History - New 6- 10-02, Amended 12-11-06. Please see page 12 of the [Impaired Waters Rule](). Updated activity regarding impaired waters may be tracked at: http://www.dep.state.fl.us/water/tmdl/
4. **New Numeric Nutrient Criteria in effect after November 30, 2012:** The following excerpt from the Florida Administrative Code (F.A.C.) Surface Water Quality Stand-

ard (62-302.531(b)-1) is provided as reference for the numeric nutrient criteria that will be used in all Lake Reports.

5. "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 the table below. 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.

Long Term Geometric Mean Lake Color and Alkalinity	Annual Geometric Mean Chlorophyll *a*	Minimum calculated numeric interpretation		Maximum calculated numeric interpretation	
		Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen	Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen
> 40 Platinum Cobalt Units	20 µg/L	0.05 mg/L	1.27 mg/L	0.16 mg/L[1]	2.23 mg/L
≤ 40 Platinum Cobalt Units and > 20 mg/L $CaCO_3$	20 µg/L	0.03 mg/L	1.05 mg/L	0.09 mg/L[1]	1.91 mg/L
≤ 40 Platinum Cobalt Units and ≤ 20 mg/L $CaCO_3$	6 µg/L	0.01 mg/L	0.51 mg/L	0.03 mg/L[1]	0.93 mg/L

[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.

6.

c. For the purpose of subparagraph 62-302.531(2)(b)1., F.A.C., color shall be assessed as true color and shall be free from turbidity. Lake color and alkalinity shall be the long-term geometric mean, based on a minimum of ten data points over at least three years with at least one data point in each year. If insufficient alkalinity data are available, long-term geometric mean specific conductance values shall be used, with a value of <100 micromhos/cm used to estimate the 20 mg/L CaCO3 alkalinity concentration until such time that alkalinity data are available."

d. For Hillsborough County, the Anclote River, Brooker and Rocky Brushy Creek lakes (Direct tributaries to Old Tampa Bay) are the only lake groups not considered West Central Nutrient Regions. Please see the map below of Nutrient Regions for Florida. Those lakes within the West Central nutrient region traditionally have higher background level of phosphorus and the standard is set at the higher 0.49 mg/L standard. All others will need to meet the table standard above.

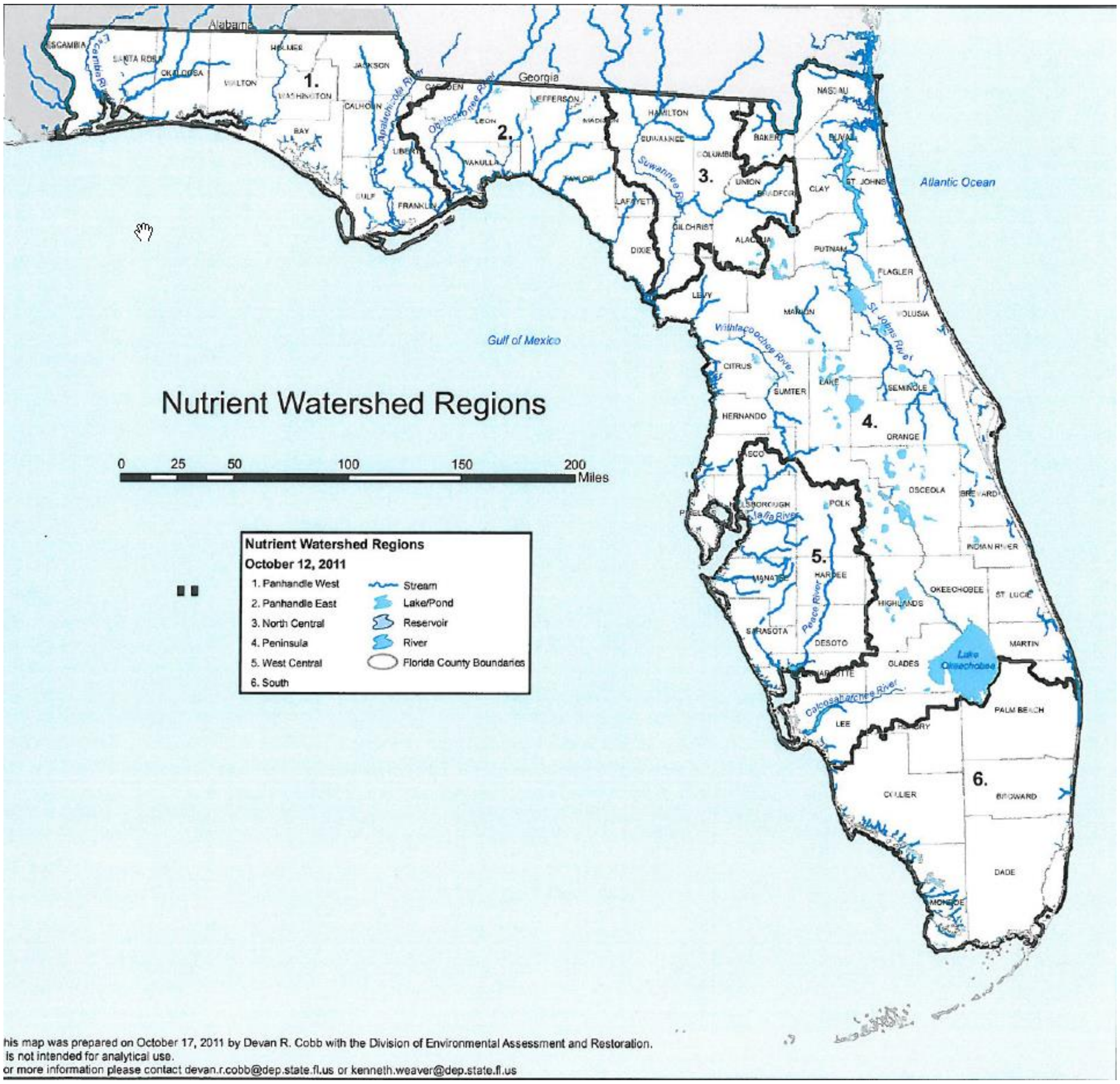

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Figure 11. Nutrient Regions for NNC Rule

Table 13. NNC for Lakes based on Lake Type and new rule (November 2012)

Numeric Nutrient Criteria (NNC) for Lakes	Clear_Alk	Clear	Colored
Chlorophyll a Criteria (µg/L)	LTE 20	LTE 6	LTE 20
Sufficient for Geomean & Geomean Chla meets Chla Criteria then P (mg/L)	0.03-0.09	0.01-0.03	0.05-0.16
Insuffcient for Geomean or Geomean Chla does not meet Chla Criteria then P (mg/L)	LTE 0.03	LTE 0.01	LTE 0.05
Sufficient for Geomean & Geomean Chla meets Chla Criteria then N (mg/L)	1.05-1.91	0.51-0.93	1.27-2.23
Insufficient for Geomean or Geomean Chla does not meet Chla Criteria then N (mg/L)	LTE 1.05	LTE 0.51	LTE 1.27
Lake Type: Lake Type Clear-Alk: (Alk .20 mg/L or >100µSiemens/cm or µmhos/cm , Color > 40 pcu) Lake Type Clear (Alk LTE 20 mg/L or 100µSiemens/cm or µmhos/cm, Color LTE 40 pcu) Lake Type Colored (Color > 40 pcu)			

Notes

1: LTE = Less than or equal to

2: 1 µmho (micromho) is equal to 1 µSI (microsiemens); both are measures of conductance.

g.

7. Additional Notes that apply to the NNC from FAC 62-302-Final November 2012.

8. (3) Except for data used to establish historical chlorophyll a levels, chlorophyll a data assessed under this Chapter shall be measured according to the DEP document titled "Applicability of Chlorophyll a Methods" (DEP-SAS-002/10), dated October 24, 2011, which is incorporated by reference herein. Copies of the chlorophyll a document may be obtained from the Department's internet site at http://www.dep.state.fl.us/water/wqssp/swq-docs.htm or by writing to the Florida Department of Environmental Protection, Standards and Assessment Section, 2600 Blair Stone Road, MS 6511, Tallahassee, FL 32399-2400. Chlorophyll a data collected after [effective date] shall be corrected for or free from the interference of phaeophytin.

9. (4) The loading of nutrients from a waterbody shall be limited as necessary to provide for the attainment and maintenance of water quality standards in downstream waters.

10. (5) To qualify as temporally independent samples, each SCI shall be conducted at least three months apart. SCIs collected at the same location less than three months apart shall be considered one sample, with the mean value used to represent the sampling period.

11. (6) To calculate an annual geometric mean for TN, TP, or chlorophyll a, there shall 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.

12. (7) The numeric interpretation of the narrative nutrient criterion shall be applied over a spatial area consistent with its derivation.

13. (a) For numeric interpretations based on paragraph 62-302.531(2)(a), F.A.C., the spatial application of the numeric interpretation is as defined in the associated order or rule.

14. (b) For lakes covered under subparagraph 62-302.531(2)(b)1., F.A.C., the numeric interpretation shall be applied as a lake-wide or lake segment-wide average. 8

15. (c) For spring vents covered under subparagraph 62-302.531(2)(b)2., F.A.C., the numeric interpretation shall be applied in the surface water at or above the spring vent.

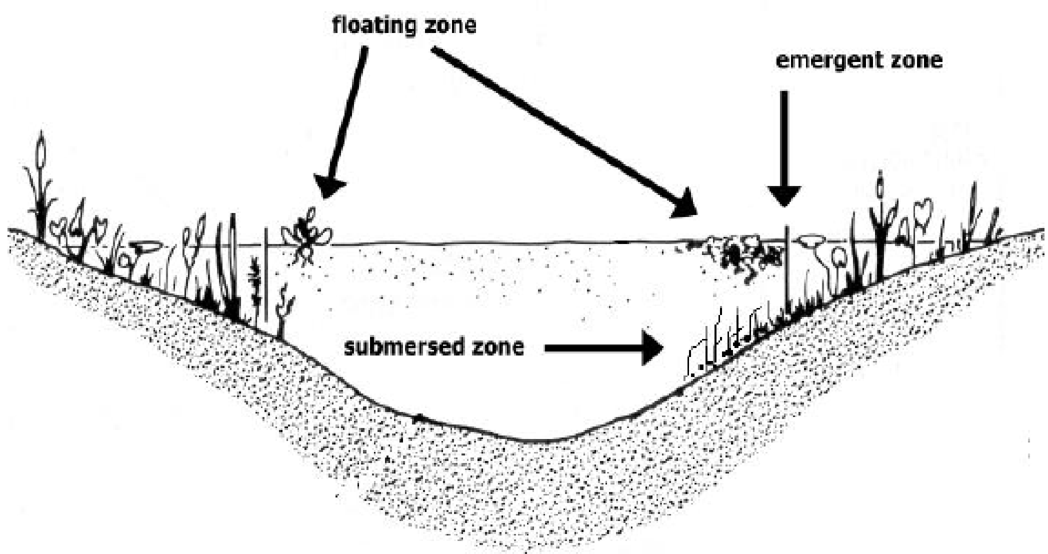
16. (d) For streams covered under paragraph 62-302.531(2)(c), F.A.C., the spatial application of the numeric interpretation shall be determined by relative stream homogeneity and shall be applied to waterbody segments or aggregations of segments as determined by the site-specific considerations.

17. (8) Load-based or percent reduction-based nutrient TMDLs or Level II Water Quality Based Effluent Limitations (WQBELs) pursuant to Chapter 62-650, F.A.C., do not need to be converted into concentration-based nutrient TMDLs or WQBELs to be used as the basis for the numeric interpretation of the narrative criterion. For percent reduction-based nutrient TMDLs, the associated allowable load or concentration is the numeric interpretation of the narrative criterion for the waterbody.

18. (9) The Commission adopts rules 62-302.200(4), .200(16)-(17), .200(22)-(25), .200(35)-(37), .200(39), 62-302.531, and 62-302.532(3), F.A.C., to ensure, as a matter of policy, that nutrient pollution is addressed in Florida in an integrated, comprehensive and consistent manner. Accordingly, these rules shall be effective only if EPA approves these rules in their entirety, concludes rulemaking that removes federal numeric nutrient criteria in response to the approval, and determines, in accordance with 33 U.S.C. § 1313(c)(3), that these rules sufficiently address EPA's January 14, 2009 determination. If any provision of these rules is determined to be invalid by EPA or in any administrative or judicial proceeding, then the entirety of these rules shall not be implemented.

19. Rulemaking Authority 403.061, 403.062, 403.087, 403.504, 403.704, 403.804 FS. Law Implemented 403.021, 403.061, 403.067, 403.087, 403.088, 403.141, 403.161, 403.182, 403.502, 403.702, 403.708 FS. History – New - -11.

20. **Lake Vegetation:** The three primary aquatic vegetation zones are shown below:



21. The Lake Vegetation Index (LVI) is a rapid assessment protocol in which selected sections of a lake are assessed for the presence or absence of vegetation through visual observation and through the use of a submerged vegetation sampling tool called a

Frodus. The assessment results provide a list of species presents and the dominant and where appropriate co-dominant species that are found in each segment. These results are then entered into a scoring table and a final LVI score is determined. LVI scores provide an estimate of the vegetative health of a lake. Our assessment team was trained and qualified by FDEP to conduct these assessment as an independent team and must prequalify each year prior to conducting additional assessments. The LVI method consists of dividing the lake into twelve pie-shaped segments (see diagram below) and selecting a set of four segments from the twelve to include in the LVI. The assessment team then travels across the segment and identifies all unique species of aquatic plant present in the segment. Additionally, a Frodus is thrown at several points on a single five-meter belt transect that is established in the center of the segment from a point along the shore to a point beyond the submerged vegetation zone. For scoring, the threshold score for impairment is 37. Below is a table of LVI scores recorded in Hillsborough County for comparison:

Lake Name	Sample Date	LVI Score
Lake Magdalene	5/26/2005	64
Lake Magdalene	10/20/2005	38
Burrell Lake, off Nebraska in Lutz area. Ambient Monitoring Program	8/4/2005	16
Silver lake just south of Waters between Habana and Himes Avenues, Tampa. Ambient Monitoring Program	7/29/2005	36
Unnamed lake on Forest Hills Drive south of Fletcher Avenue. Ambient Monitoring Program	8/3/2005	34
Hanna Pond, off Hanna Rd in Lutz. Ambient Monitoring Program	7/25/2005	38
Small lake, Lutz, just east pf Livingston. Ambient Monitoring Program	7/22/2005	39
Small lake, Lutz, adj to Lake Keene. Ambient Monitoring Program	8/5/2005	28
Unnamed small lake, Tampa, off Fowler behind University Square Mall. Ambient Monitoring Program	7/19/2005	16
Tiffany Lake, Lutz, north of Whittaker. Ambient Monitoring Program	7/25/2005	40
Cedar Lake, south of Fletcher, Forest Hills. Ambient Monitoring Program	7/22/2005	37
Unnamed small lake behind Natives Nursery, Lutz. Ambient Monitoring Program	8/5/2005	20
Unnamed lake on Curry Road off Livingston, Lutz. Ambient Monitoring Program	7/19/2005	46
Unnamed lake in Lutz. Ambient Monitoring Program	7/20/2005	45
Lake Josephine - HIL538UL	10/12/2006	40
Lake Magdalene - HIL546UL	10/18/2006	40
Starvation Lake - HIL540NL	9/28/2006	48
Egypt Lake - HIL556UL	10/31/2006	34
Unnamed Lake - HIL544UL	9/25/2008	58
Lake Rogers - L63P	7/22/2009	65
Lake Alice/Odessa, profundal zone	8/6/2009	71
Lake Carroll (Center)	7/15/2009	64
Unnamed Small Lake - Z4-SL-3011	7/21/2009	24
Unnamed Small Lake - Z4-SL-3020	7/21/2009	40
Lake Ruth - Z4-SL-3031	7/16/2009	71
Lake Juanita - Z4-SL-3036	7/20/2009	72

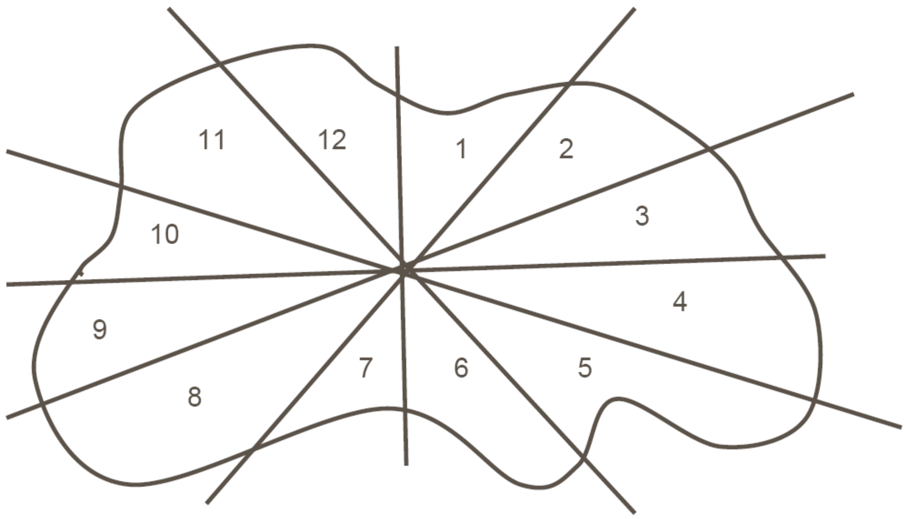
Lake Name	Sample Date	LVI Score
Chapman Lake	6/8/2009	42
Island Ford Lake	8/10/2010	50
Lake Magdalene	7/29/2010	56
Lake Stemper	7/13/2010	38
Lake Carroll	7/20/2010	57
Lake Virginia	5/17/2011	51
Lake Harvey	5/20/2011	48
Pretty Lake	5/24/2011	33
Cypress Lake	8/17/2011	66
Lake Armistead	6/3/2011	13
Little Lake Wilson	5/31/2011	48
Mill Lake	5/11/2011	37
Lake Taylor	6/24/2011	67
Lake Valrico	7/19/2011	25
Rogers Lake	7/22/2011	73
Lake Raleigh	7/29/2011	54
Lake Juanita	6/21/2011	63
Crescent Lake	7/26/2011	45
Lake Behnke	11/18/2011	41
Lake Alice	5/9/2012	68
Hog Island Lake	5/24/2012	55
East Lake	5/17/2012	46
Lake Weeks	5/15/2012	33
Lake Lipsey	5/22/2012	31
Lake Hanna	7/10/2012	41
Lake Wilson/ Thomas	7/5/2012	65
Lake Carroll	7/26/2012	57
Lake Estes	8/9/2012	44
Long Pond	8/15/2012	37
Sunset Lake	8/2/2012	50
White Trout Lake	7/1/2012	43
Lake George	11/7/2012	39
Horse Lake	11/16/2012	43
Lake Allen	5/24/2013	25
Church Lake	6/13/2013	64
Echo Lake	6/14/2013	49
Lake Thonotosassa	5/13/2013	38
Medard Reservoir	5/23/2013	29
Lake Williams	7/5/2013	30
Lake Thorpe	7/11/2013	43
Lake Carlton	7/25/2013	18
Bay Lake	7/26/2013	32
Platt Lake	8/1/2013	45
Lake Heather	10/24/2013	38
Egypt Lake	10/11/2013	40
Lake Helen	12/18/2013	38
Lake Zelma	12/18/2013	41
Lake Barbara	12/18/2013	31
Silver Lake	12/17/2013	22

Reference: "Assessing the Biological Condition of Florida Lakes: Development of the Lake Vegetation Index (LVI) Final Report", December, 2007, page 7. Prepared for: Florida Department of Environmental Protection, Twin Towers Office Building, 2600 Blair Stone Road, Tallahassee, FL 32399-2400, Authors: Leska S. Fore*, Russel Frydenborg**, Nijole Wellendorf**, Julie Espy**, Tom Frick**, David Whiting**, Joy Jackson**, and Jessica Patronis**

* Statistical Design

** Florida Department of Environmental Protection

Diagram showing the method used to divide a typical lake into 12 sections for replicate sampling:



22. Estimating nutrients held in submerged plants

23. An **adjusted chlorophyll a value** (µg/L) was calculated by modifying the methods of Canfield et al (1983). The total wet weight of plants in the lake (kg) was calculated by multiplying lake surface area (m^2) by PAC (percent area coverage of macrophytes) and multiplying the product by the biomass of submersed plants (kg wet weight m^2) and then by 0.25, the conversion for the 1/4 meter sample cube. The dry weight (kg) of plant material was calculated by multiplying the wet weight of plant material (kg) by 0.08, a factor that represents the average percent dry weight of submersed plants (Canfield and Hoyer, 1992) and then converting to grams. The potential phosphorus concentration (mg/m^3) was calculated by multiplying dry weight (g) by 1.41 mg TP g-1 dry weight, a number that represents the mean phosphorus (mg) content of dried plant material measured in 750 samples from 60 Florida lakes (University of Florida, unpublished data), and then dividing by lake volume (m^3) and then converting to µg/L (1000/1000). From the potential phosphorus concentration, a predicted chlorophyll a concentration was determined from the total phosphorus and chlorophyll a relationship reported by Brown (1997) for 209 Florida lakes. Adjusted chlorophyll a concentrations were then calculated by adding each lake's measured chlorophyll a concentration to the predicted chlorophyll a concentration.