

# LAKE ASSESSMENT REPORT FOR CHURCH LAKE IN HILLSBOROUGH COUNTY FLORIDA

Date Assessed: May 2, 2007

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Reviewed by: Jim Griffin, Ph.D.

## **INTRODUCTION**

This assessment was conducted to update existing physical and ecological data for Church Lake on the Hillsborough County Watershed Atlas (<http://www.hillsborough.wateratlas.usf.edu/>). 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's Northwest Hillsborough, Hillsborough River and Alafia River Basin Boards. 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 Church Lake taken on May 2, 2007.**

**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 your 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)<sup>i</sup> 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.

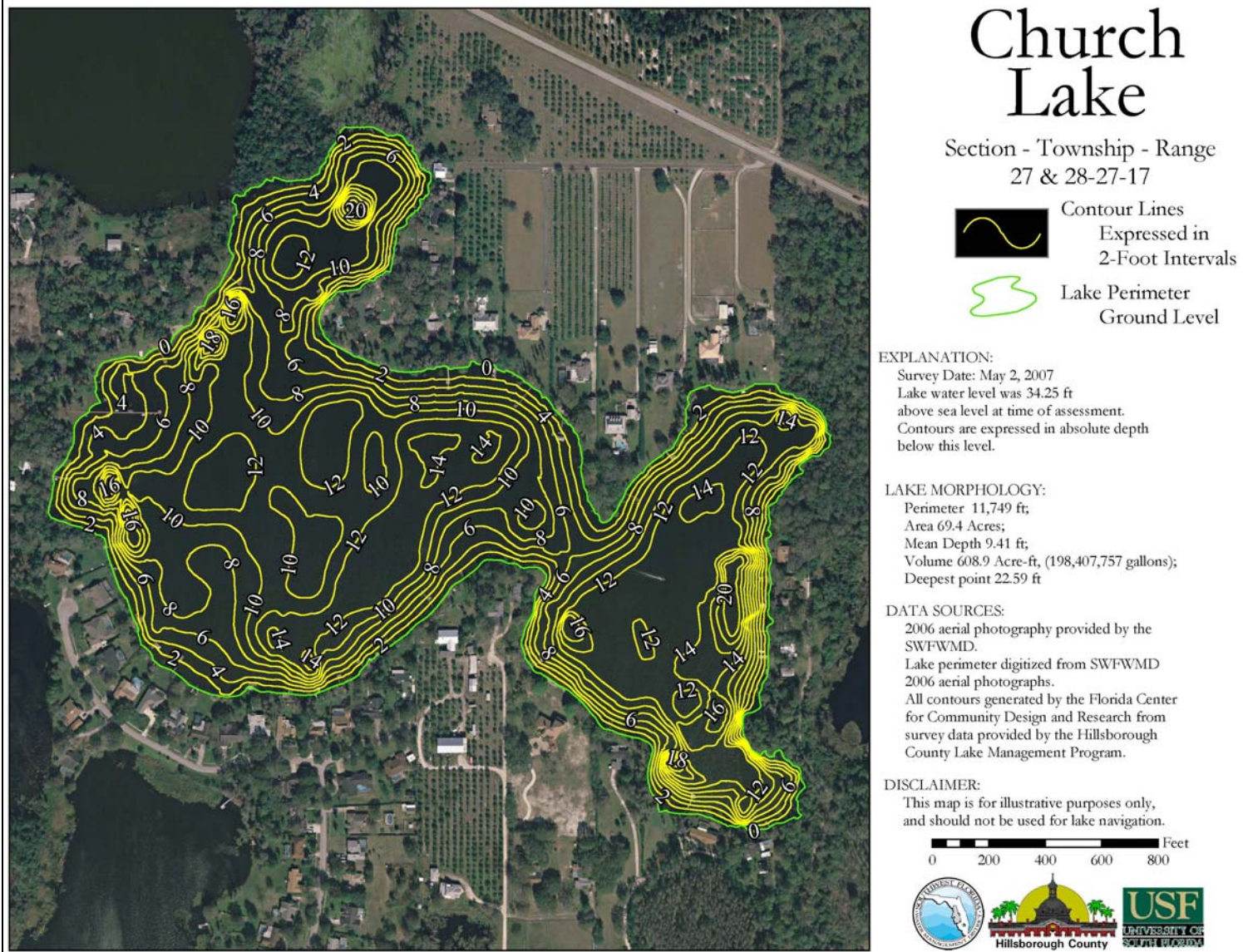
The intent of this assessment is to provide a starting point from which to track changes in your lake, and where previous comprehensive assessment data is available, to track changes in the lake's general health. These data can provide the information needed to determine changes and to monitor trends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

## **Section 1: Lake Morphology**

**Bathymetric Map<sup>ii</sup>**. The bottom of the lake was mapped using a Lowrance LCX 26C HD Wide Area Augmentation System (WAAS)<sup>iii</sup> enabled Global Positioning System (GPS) with fathometer (bottom sounder) to 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 provides the lake's morphologic parameters in various units.

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

Parameter	Feet	Meters	Acres	Acre-ft	Gallons
Surface Area (sq)	3021209.59	280,679.56	69.36		
Mean Depth	9.41	2.868168			
Maximum Depth	22.59	6.885432			
Volume (cubic)	26523075.39	751,049.87		608.89	198407757.1
Gauge (above datum)	34.25				



**Figure 2. Contour map for Church Lake. The mapping technique used in 2007 employs a standard DGPS for horizontal position and a fathometer for depth.**



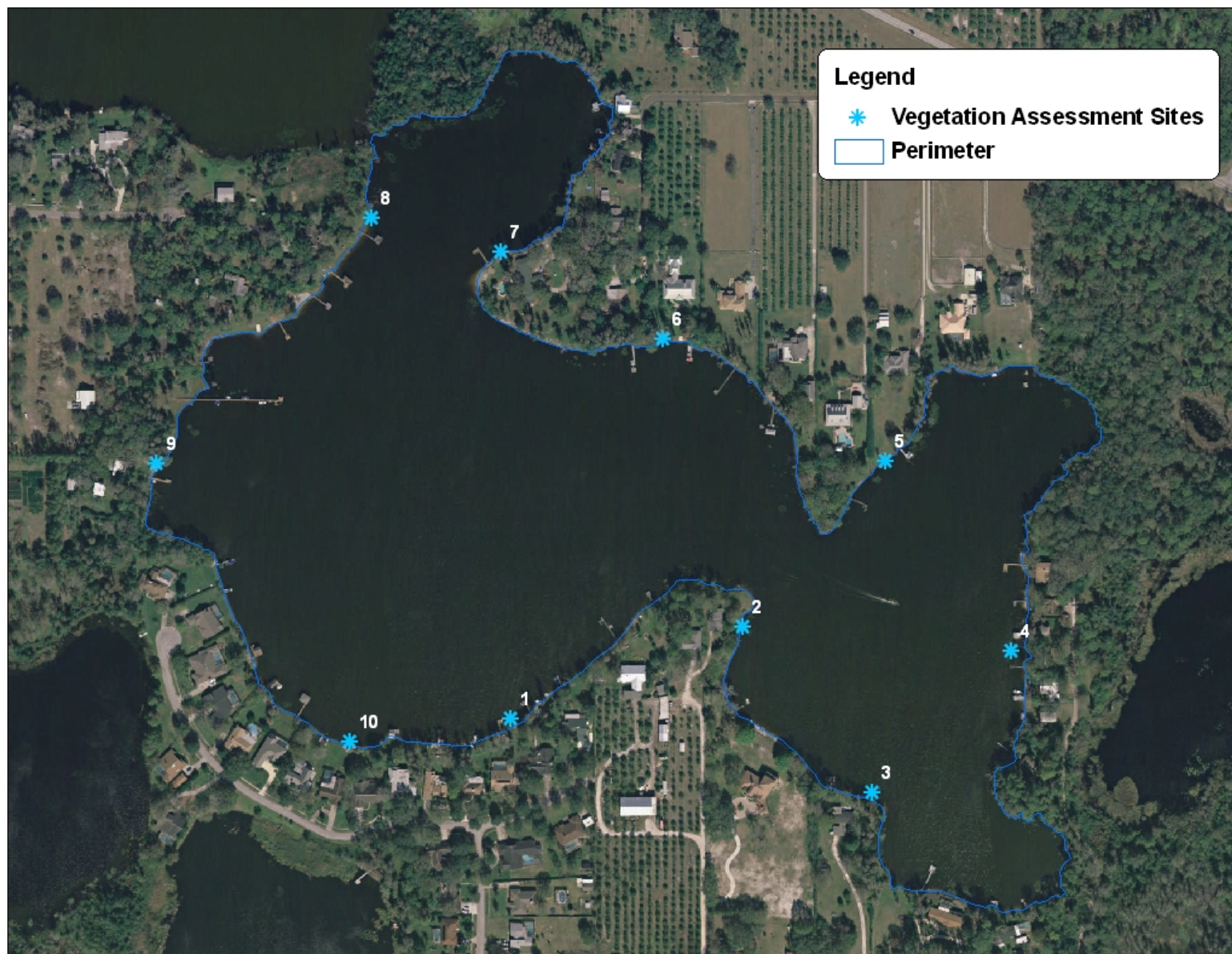
## Section 2: Lake Ecology (vegetation)

The lake's apparent vegetative cover and shoreline detail are evaluated using the latest lake aerial photograph as shown in Figure 3 and by use of WAAS enabled GPS. Submerged vegetation is determined from the analysis of bottom returns from the Lowrance 26c HD 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)<sup>iv</sup>. The latest aerials 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.

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. Tables 3 through 7 detail the results from the 2007 aquatic plant assessment for your 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 term invasive indicates the plant is commonly considered invasive in this region of Florida and the term "Pest" indicates that the plant has a greater than 55% occurrence in your lake and is also considered a problem plant for this region of Florida, or in a non-native invasive that is or has the potential to be a problem plant in your 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](http://www.epchc.org/forms_documents.htm) ([http://www.epchc.org/forms\\_documents.htm](http://www.epchc.org/forms_documents.htm)) permit from the Environmental Protection Commission of Hillsborough and for management of in-lake vegetation outside the wetland fringe (for lakes with an area greater than 10 acres), the property owner must secure a Florida Department of Environmental Protection permit (<http://www.dep.state.fl.us/lands/invaspec/>).

**Table 2 Total diversity, percent exotics, and number of EPPC pest plants**

Parameter	Lake	Watershed
Total Plant Diversity (# of Taxa)	67	84
% Non-Native Plants	17.91	17.86
Total Pest Plant Species	4	5



**Figure 3. 2006 six-inch resolution aerial photograph showing location of vegetation assessment sites on Church Lake. Major emergent and floating vegetation zones as well as structures such as docks are also observable in this aerial.**

Table 3. List of Floating Leaf Zone Aquatic Plants Found

Floating Leaved Vegetation														
Code	Native, Non-Native (NN), Invasive (I), Pest (P)	Plant Species	Common Name	1	2	3	4	5	6	7	8	9	10	% Occurrence
NLM	N,P	Nuphar lutea var. advena	Spatterdock, Yellow Pondlily	1	1	1		1	1	1	1			70%
NOA	N	Nymphaea odorata	American White Water lily, Fragrant Water Lily				1							10%



**Figure 4.** *Nuphar lutea* var. *advena*, Spatterdock, Yellow Pondlily, is a common plant in Florida lakes that provides shelter for developing fish and invertebrates, however when this species population reaches high levels in lakes it is considered a pest plant species due to the shading of submerged plant species and the increased difficulty for navigation for boaters.

**Figure 4**

Table 4 List of Emergent Zone Aquatic Plants Found

## Emergent Vegetation

Code	Native, Non- Native (NN), Invasive (I), Pest (P)	Plant Species	Common Name	1	2	3	4	5	6	7	8	9	10	% Occurrence
PRS	NN,I,P	Panicum repens	Torpedo Grass	1	1	1	1	1	1	1	1	1	1	100%
TAS	N	Taxodium ascendens	Pond Cypress	1	1	1	1	1	1	1	1	1	1	100%
EAA	N	Eclipta alba (prostrata)	False Daisy, Yerba De Tajo	1		1	1	1	1	1	1	1	1	90%
APS	NN,I,P	Alternanthera philoxeroides	Alligator Weed	1	1	1	1	1	1	1	1		1	90%
LOP	N,P	Ludwigia spp.	Water Primroses, Primrosewillow	1	1	1	1	1	1	1	1		1	90%
COM	N	Commelina spp.	Dayflower	1	1	1	1	1	1			1	1	80%
MSS	N	Mikania scandens	Climbing Hempvine		1	1		1		1	1	1		60%
BMI	N	Bacopa monnieri	Common Bacopa, Herb-Of-Grace	1		1		1			1		1	50%
CYP	N	Cyperus spp.	Sedge	1		1		1			1		1	50%
EBI	N	Eleocharis baldwinii	Baldwin's Spikerush, Roadgrass	1	1		1	1	1					50%
BOC	N	Boehmeria cylindrica	Bog Hemp, False Nettle	1	1		1			1	1			50%
CAA	N	Centella asiatica	Asian Pennywort, Coinwort, Spadeleaf		1		1	1	1					40%
PNA	N	Phyla nodiflora	Frog-fruit, Carpetweed, Turkey Tangle Fogfruit		1	1	1	1						40%
BLS	N	Blechnum serrulatum	Swamp Fern		1	1		1				1		40%
POL	N	Polygonum spp.	Smartweed, Knotweed		1					1		1	1	40%
PBA	N	Persea borbonia	Redbay	1		1		1			1			40%
BID	N	Bidens spp.	Bur Marigold			1		1			1			30%

**Table 5. List of Emergent Zone Aquatic Plants Found**

Emergent Vegetation

Code	Native, Non-Native (NN), Invasive (I), Pest (P)	Plant Species	Common Name	1	2	3	4	5	6	7	8	9	10	% Occurrence
PSQ	N	Parthenocissus quinquefolia	Woodbine					1		1		1		30%
UNK	N	UNKNOWN SPP	Unidentified Plant Species	1		1						1		30%
URL	NN,I	Urena lobata	Caesar's Weed		1						1	1		30%
CYO	N	Cyperus odoratus	Fragrant Flatsedge			1	1						1	30%
FSC	N	Fuirena spp.	Rush Fuirena		1						1		1	30%
JUN	N	Juncus spp.	Rush		1			1			1			30%
SCS	N	Scirpus cubensis	Burhead Sedge, Cuban Scirpus	1	1						1			30%
AST	N	Aster spp.	Aster spp., Elliot's Aster	1		1					1			30%
PIN	N	Pinus spp.	Pine Tree	1			1			1				30%
QPS	N	Quercus phellos	Willow Oak				1	1	1					30%
SAM	N	Sambucus canadensis	Elderberry		1				1			1		30%
ACE	N	Acer rubrum var. trilobum	Southern Red Maple	1			1						1	30%
MEL	NN,I	Melaleuca quinquenervia	Punk Tree, Melaleuca	1	1			1						30%
BCA	N	Bacopa caroliniana	Lemon Bacopa				1		1					20%
DMI	N	Desmodium incanum	Creeping Beggarweed	1		1								20%
PCA	N	Pontederia cordata	Pickereel Weed						1			1		20%
NSS	N	Nephrolepis spp.	Sword Fern				1					1		20%
OCA	N	Osmunda cinnamomea	Cinnamon Fern				1				1			20%
PHN	N	Panicum hemitomon	Maidencane		1						1			20%
WTA	NN,I	Sphagneticola (Wedelia) trilobata	Creeping Oxeye		1				1					20%
QLO	N	Quercus laurifolia	Laurel oak	1						1				20%
SAL	N	Salix spp.	Willow								1	1		20%



**Table 6. List of Emergent Zone Aquatic Plants Found**

Emergent Vegetation

Code	Native, Non-Native (NN), Invasive (I), Pest (P)	Plant Species	Common Name	1	2	3	4	5	6	7	8	9	10	% Occurrence
STS	NN,I	Schinus terebinthifolius	Brazilian Pepper				1		1					20%
CAM	N	Crinum americanum	Swamp lily				1							10%
PLU	N	Pluchea spp.	Marsh Fleabane, Camphorweed	1										10%
TGA	N	Thalia geniculata	Fireflag, Arrowroot									1		10%
IRI	N	Iris spp.	Flag			1								10%
CER	NN,I	Ceratopteris thalictroides	Water Sprite										1	10%
PGA	NN,I	Psidium guajava	Guava	1										10%
ELE	N	Eleocharis spp.	Roadgrass, Spikerushes	1										10%
RHY	N	Rhynchospora spp.	Beaksedge	1										10%
COS	N	Cephalanthus occidentalis	Common Buttonbush		1									10%
GLS	N	Gordonia lasianthus	Loblolly Bay									1		10%
MVA	N	Magnolia virginiana	Sweetbay Magnolia				1							10%
PEP	N	Persea palustris	Swampbay							1				10%
CLA	NN,I	Casuarina equisetifolia	Australian Pine				1							10%
CCA	NN,I	Cinnamomum camphora	Camphor-tree									1		10%
SSM	NN,I	Sapium sebiferum	Popcorn Tree, Chinese Tallow Tree								1			10%
SVS	N	Spiranthes vernalis	Spring Ladies Tresses	1										10%
PAA	N	Plantanthera nivea	Fringed Orchids	1										10%
EVS	N	Erigeron vernus	Early Whitetop Fleabean	1										10%
DRA	N	Drymaria cordata	Heartleaf Drymary	1										10%
DCA	N	Dichondra carolinensis	Ponyfoot			1								10%
OSA	N	Oxalis stricta	Yellow Woodsorrel			1								10%
CPS	NN,I	Cyperus papyrus	Papyrus									1		10%

Figure 5 *Taxodium ascendens*, Pond Cypress, is an important native tree in Florida. Nearly all of the Cypress forests in Florida have been harvested at some point for high end lumber for the flooring and furniture industries. They are a highly protected species and should not be removed from Florida wetlands as they serve as an important habitat for native birds and other organisms.



**Table 7. List of Submerged Zone Aquatic Plants Found**

Submerged Vegetation															
Code	Native, Non-Native (NN), Invasive (I), Pest (P)	Plant Species	Common Name	1	2	3	4	5	6	7	8	9	10	% Occurrence	
UTA	N	Utricularia spp.	Bladderwort				1			1		1		30%	
POT	N	Potamogeton spp.	Pond Weed					1			1			20%	
ALG	N	Algal Spp.	Algal Mats, Floating	1										10%	



**Figure 6**

Figure 6. *Utricularia* spp., Bladderwort, was observed in small amounts at 3 vegetation sites on Church Lake. This plant species are a submersed, carnivorous plant without true root structures. Most of the members of *Utricularia* bear small bladders that trap and ingest small plankton.



**Figure 7**

Figure 7. A fish kill was observed on Church Lake the day of our assessment.

### Section 3: Lake Water Chemistry

A critical element in any lake assessment is the long-term water chemistry data set. The primary source of water quality trend data for Florida Lakes is the Florida LAKEWATCH volunteer and the Florida LAKEWATCH water chemistry data. Hillsborough County is fortunate to have a large cadre of volunteers who have collected lake water samples for significant time period. These data are displayed and analyzed on the Water Atlas as shown in Figure 8 for Church Lake. Additional data, when available, is also included on the Water Atlas; however, the LAKEWATCH data remains the primary source. By the trend data shown in the figure, the lake may be considered good terms of the trophic state index. This lake is a clear (color < 40 pcu) water lake and as such it must maintain a TSI of below 40 to not be considered impaired by the State of Florida guidelines<sup>v</sup>. The lake's long term water quality data indicates enough violations of these criteria to be classified by Florida DEP as impaired. The more recent trends indicates similar conditions. At the present time, this lake is not listed as impaired as shown in Figure 9.

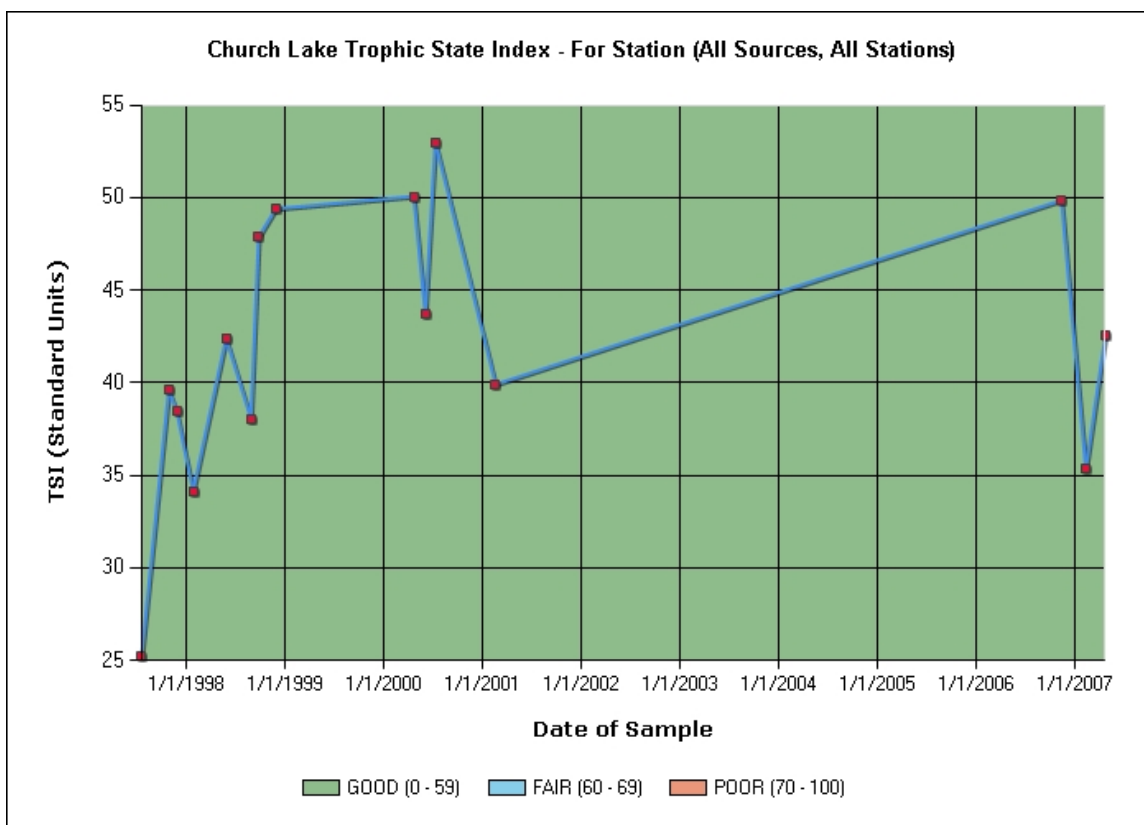


Figure 8

**Figure 8. Recent Trophic State Index (TSI) graph from Hillsborough Watershed Atlas.**  
For the latest date go to:

(<http://www.hillsborough.wateratlas.usf.edu/lake/waterquality.asp?wbodyid=5137&wbodyatlas=lake>)

Note: The graph above includes benchmarks for using verbal descriptors of "good", "fair" and "poor". The verbal descriptors for these benchmarks are based on an early determination by stakeholders of the generally acceptable and understood terms for describing the state of lakes. The same benchmarks are used for nutrient graphs (Nitrogen and Phosphorus), chlorophyll graphs and trophic state index (TSI) graphs. The TSI is a calculated index of lake condition based on nutrient and chlorophyll (a) concentrations (please see "Learn more about Trophic State Index"). The benchmarks are established based on the TSI range that relates to a specific descriptor. The source for the TSI concentration relationships is the Florida Water Quality Assessment, 1996, 305(b) (Table 2-8).





**Figure 9. Church Lake is not presently listed as impaired**

As part of the lake assessment the physical water quality and chemical water chemistry of a lake are measured. These data only indicate a snap shot of the lakes water quality; however they are useful when compared to the trend data available from LAKEWATCH or other sources. Table 8 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. These data is comparable with the mean data from the LAKEWATCH data set for the lake. The trophic state index (TSI) calculated from the sample data (48.53) is well within the values shown in the figure above.

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) which has the ability to directly measure the temperature, pH, dissolve oxygen (DO), percent DO (calculated from DO, temperature and conductivity) and Turbidity. These data are listed for three levels in the lake and twice for the surface measurement. The duplicate surface measurement was taken as a quality assurance check on measured data. Generally, these data show that the lake is well mixed and that, at the time of the observation the lake was reasonably productive (dissolved oxygen (DO) percentage greater than 100% and pH significantly greater than neutral (7.0).

**Table 8. Water Quality Parameters (Laboratory)**

Summary Table for Water Quality		
Parameter	Value	Comment
TP ug/L	26.00	
TN mg/L	0.52	
Chla ug/L	6.60	
Chla TSI	43.97	
TP TSI	53.09	
TN TSI	45.50	
Secchi Disk (SD)	6.67	
TSI	48.53	P limited based on long term N:P ratio
PAC	15%	
PVI	5%	
Adj TP	0.09	P from Veg Added
Adj TSI	48.57	With additional P

**Table 9. Water Quality Parameters (Field-YSI)**

Sample Location	Time	Temp (°C)	Conductivity (mS/cm3)	Dissolved Oxygen (%)	DO (mg/L)	PH (SU)	ORP (ORP)	Turbidity (NTU)	Secchi Depth (ft)
Surface	14:15	28.48	0.207	120.9	9.38	8.25	129.2	2.2	
Mid	14:25	26.93	0.206	113.6	9.07	7.57	151.6	2.3	
Bottom	14:27	26.06	0.206	63.5	5.32	6.32	187	2.5	
Surface	14:30	28.93	0.207	120.8	9.31	8.1	125.6	2.2	
Mean Value		27.6	0.2065	104.7	8.27	7.56	148.35	2.3	6.67

Table 8 also provides data derived from the vegetation assessment which is used to determine an adjusted TSI. This is accomplished by calculating the amount of phosphorus that could be released by existing submerged vegetation if this vegetation were treated with an herbicide or managed by the addition of Triploid Grass Carp (*Ctenopharyngodon idella*). 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 15 % of the lake has submerged vegetation present and this vegetation represents about 5 % of the available lake volume. The vegetation holds enough phosphorus to add about 07µg/L of the nutrient to the water column. Because the growth of algae in the water is regulated by the availability phosphorus (based on long term LAKEWATCH data although present values may indicate a shift to a balanced system) the release of this nutrient would stimulate algal growth. These changes in the water chemistry and biology would be indicated by an increased TSI. However, the lake does not contain adequate submerged vegetation to affect TSI or cause a significant change to water clarity if this vegetation were removed.

To better understand many of the terms used in this report, we recommend that you visit the Hillsborough Watershed Atlas (<http://www.hillsborough.wateratlas.usf.edu>) 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 website.

## Section 4: Conclusion

Church Lake is a medium area (69 acre) lake that would be considered in the mesotrophic or good category of lakes based on water chemistry. It has a slightly less than normal concentration of aquatic vegetation. About 15 % of the open water areas contain submerged 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 that support various types of recreation and has a good diversity of plant species. The primary Pest plants in the lake include *Nuphar lutea* var. *advena*, *Panicum repens*, *Alternanthera philoxeroides* and *Ludwigia* spp. For more information and recent updates please see the Hillsborough Watershed Atlas (water atlas) website at: <http://www.hillsborough.wateratlas.usf.edu>.

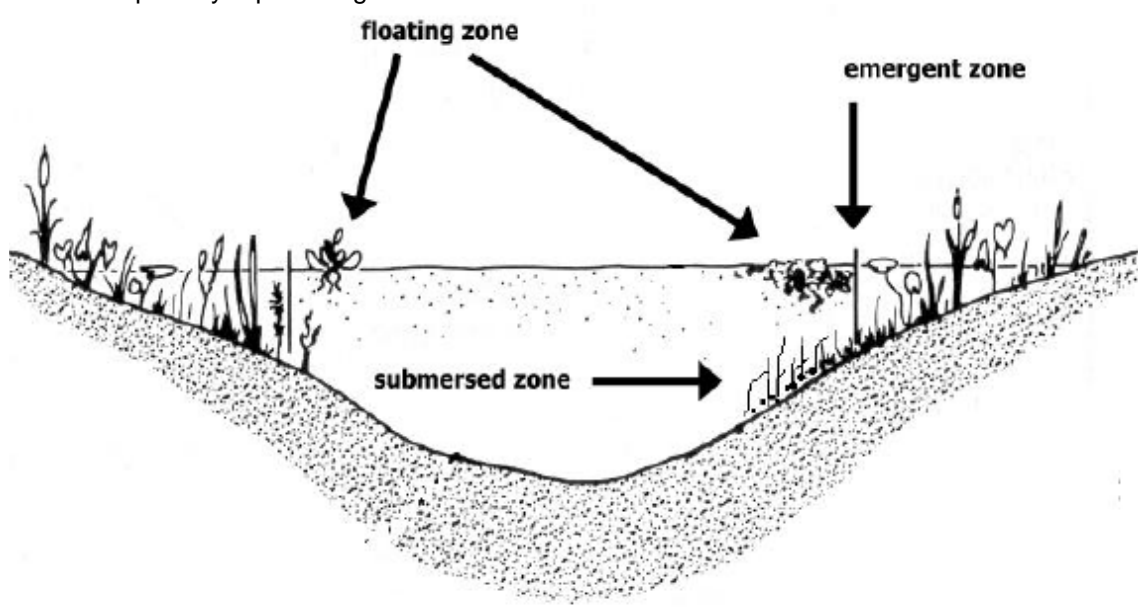
i "Trophic" means "relating to nutrition." The Trophic State Index (TSI) takes into account chlorophyll, nitrogen, and phosphorus, which are nutrients required by plant life. For more information please see *learn more at:*

<http://www.hillsborough.wateratlas.usf.edu/lake/default.asp?wbodyid=5137&wbodyatlas=lake>

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 from GPS satellites in view and retransmit these data to a master control site and then to geostationary satellites. The geostationary satellites broadcast the information to all WAAS-capable GPS receivers. The receiver decodes the signal to provide real time correction of raw GPS satellite signals also received by the unit. WAAS enabled GPS is not as accurate as standard DGPS which employs close by ground stations for correction, however; it was shown to be a good substitute when used for this type of mapping application. Data comparisons were conducted with both types of DGPS employed simultaneously and the positional difference was determined to be well within the tolerance established for the project.

iv The tree primary aquatic vegetation zones are shown below:



v A lake is impaired if " (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 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



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increased by more than 10 units over historical values. When evaluating the slope of mean TSIs over time, the Department shall 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."

Excerpt from Impaired Water Rule (IWR). Please see:

<http://www.dep.state.fl.us/water/tmdl/docs/AmendedIWR.pdf>