# LAKE ASSESSMENT REPORT FOR LAKE ALICE IN HILLSBOROUGH COUNTY FLORIDA

Date Assessed: June 28, 2006
Assessed by: Sarah Koenig and David Eilers
Reviewed by: Jim Griffin

## INTRODUCTION

This assessment was conducted to update existing physical and ecological data for Lake Alice 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 photo of Lake Alice (6/28/06).

**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) [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 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.

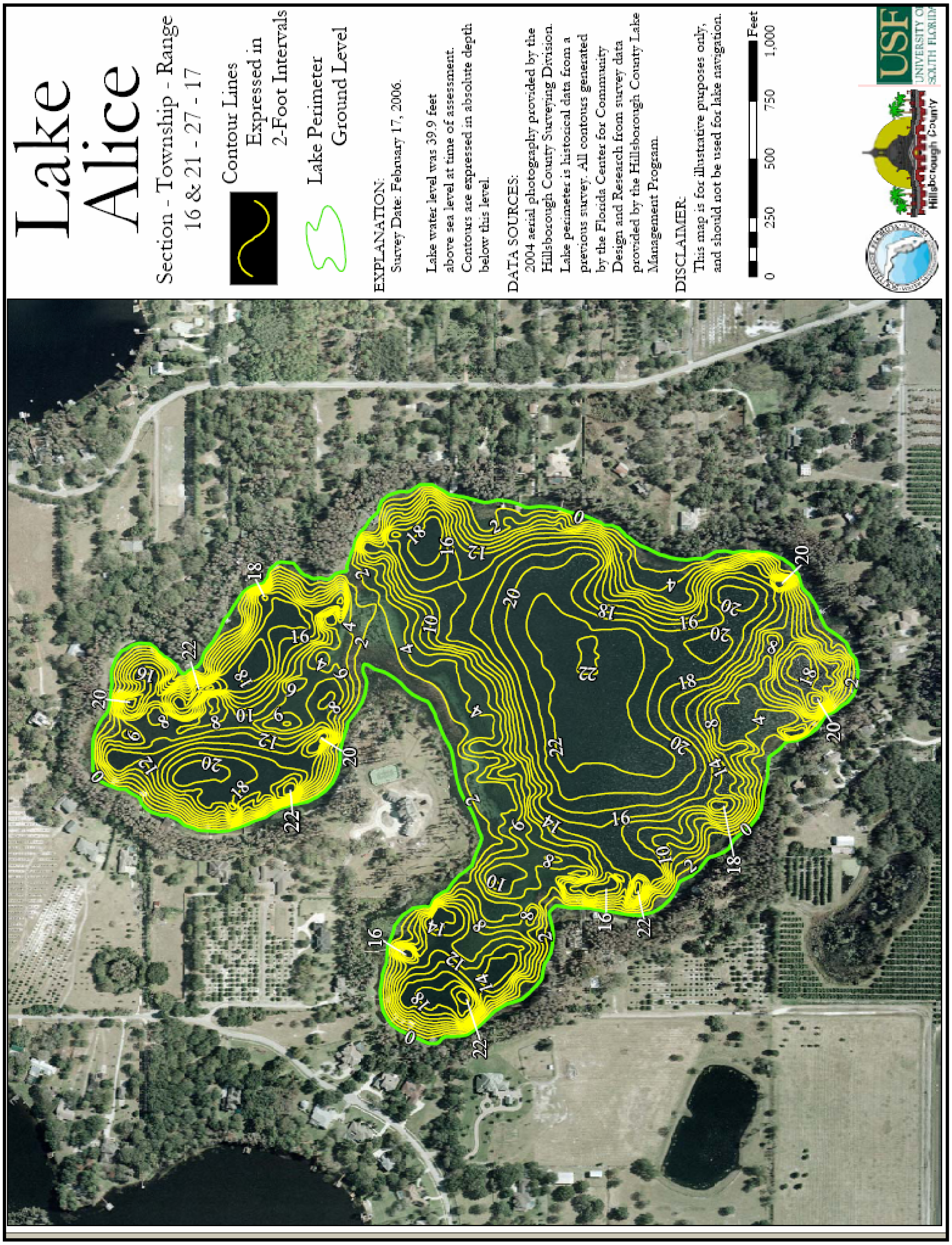
## Section 1: Lake Morphology

Bathymetric Map[ii]. The bottom of the lake was mapped using a Lowrance LCX 26C HD Wide Area Augmentation System (WAAS)[iii] enabled Global Positioning System (WAAS-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 Area Depth and Volume**

| Parameter | Feet | Meters | Acres | Gallons |
|---|---|---|---|---|
| Surface Area (sq) | 3,792,536.14 | 352,338.13 | 87.07 | |
| Mean Depth | 11.8 | | | |
| Maximum Depth | 25 | | | |
| Volume (cubic) | 44,575,203.32 | 1,262,229 | | 333,445,777 |
| Gauge Reading (feet above datum) | 39.9 | | | |

**Figure 2. Contour map for Lake Alice.**
**The lake was mapped during the 2006 lake assessment project. A differential global positioning system and fathometer combination instrument was used to obtain simultaneous horizontal and vertical measurements.**



## Section 2: Lake Ecology (vegetation)

The lake's apparent vegetative cover and shoreline detail are evaluated using the aerial shown in Figure 3 and by use of GPS. Submerged vegetation is determined from evenly spaced contours sampled using a Lowrance 26c HD, combined DGPS/fathometer described earlier. Ten vegetation assessment sites were used for Lake Alice (Figure 3) as dictated by the *Lake Assessment Protocol* (copy available on request) for a lake of this size. The site positions are set using a DGPS and then loaded into a GIS mapping program (ArcGIS) for display. Each site is field sampled in the three primary vegetative zones (emergent, submerged and floating). The latest aerials (2005, 6 inch resolution, SWFWMD aerials) 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 index is determined from the presence and absence analysis of 100 sites in the lake and the PVI index 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 total non-native 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 5 detail the results from the 2006 aquatic plant assessment for you 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 (1) or absence (blank) 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) 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, Total Non-Native, and number of EPPC pest plants**

| Parameter | Lake | Watershed |
|---|---|---|
| Total Plant Diversity (# of Taxa) | 46 | 116 |
| Total Non-Native Plants | 9 | 16 |
| Total Pest Plant Species | 5 | 14 |

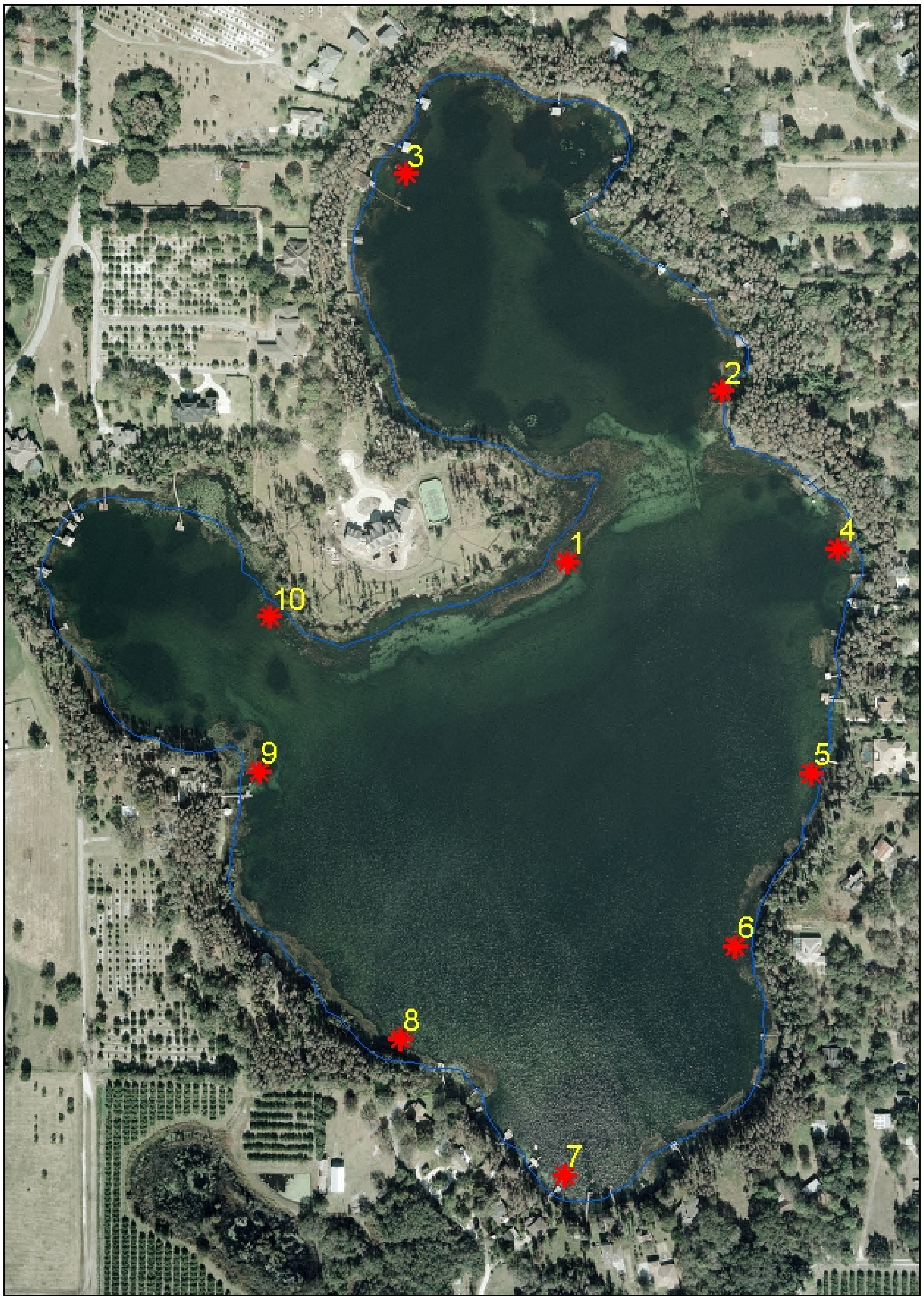



**Figure 3. 2004 six inch resolution aerial and vegetation assessment sites on Lake Alice.**

**Table 3. List of Floating Leaf Zone Aquatic Plants Found in Lake Alice.**

| Code | Plant Species | Common Name | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | % Occurrence | Native, Non-Native (NN), Invasive (I), Pest (P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NOA | Nymphaea odorata | American White Water lily, Fragrant Water lily | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | | 1 | 80% | Native |
| HYE | Hydrocotyl umbellata | Manyflower Marsh pennywort, Water pennywort | | 1 | 1 | 1 | | 1 | 1 | 1 | | 1 | 70% | Native |
| NLM | Nuphar lutea var. advena | Spatterdock, Yellow Pond lily | | | | | | | | | | 1 | 10% | Native |

**Figure 4.  Fragrant Water Lily on Lake Alice**

**Table 4 List of Emergent Zone Aquatic Plants Found in Lake Alice.**

| Code | Plant Species | Common Name | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | % Occurrence | Native, Non-Native (NN), Invasive (I), Pest (P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAS | Taxodium ascendens | Pond Cypress | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 100% | Native |
| PRS | Panicum repens | Torpedo Grass | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 90% | NN-I-P |
| BLS | Blechnum serrulatum | Swamp Fern | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 90% | Native |
| FSC | Fuirena spp. | Rush Fuirena | 1 | | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 80% | Native |
| PHN | Panicum hemitomon | Maidencane | | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 80% | Native |
| EBI | Eleocharis baldwinii | Baldwin's Spikerush, Roadgrass | | 1 | 1 | 1 | | | 1 | 1 | 1 | 1 | 70% | Native |
| MEL | Melaleuca quinquenervia | Punk Tree, Melaleuca | | 1 | | | 1 | 1 | | 1 | | | 40% | NN-I-P |
| URL | Urena lobata | Caesar's Weed | | | | | 1 | 1 | | 1 | | 1 | 40% | NN-I-P |
| PCA | Pontederia cordata | Pickerel Weed | 1 | 1 | | | | 1 | | | | 1 | 40% | Native |
| LRS | Ludwigia repens | Creeping Primrosewillow, Red Ludwigia | | | 1 | | | 1 | | 1 | | | 30% | Native |
| LOP | Ludwigia spp. | Water Primroses, Primrosewillow | 1 | | | | 1 | | | | | 1 | 30% | Native |
| MSS | Mikania scandens | Climbing Hempvine | | | | 1 | 1 | | | 1 | | | 30% | Native |
| PAN | Panicum spp. | Panic grasses | | | 1 | 1 | | 1 | | | | | 30% | Native |
| APS | Alternanthera philoxeroides | Alligator Weed | | | | 1 | | | | 1 | | | 20% | NN-I |
| CEA | Colocasia esculenta | Wild Taro, Dasheen, Coco Yam | | 1 | 1 | | | | | | | | 20% | NN-I |
| ACE | Acer rubrum var. trilobum | Southern Red Maple | | 1 | | | | | | | | 1 | 20% | Native |
| AST | Aster spp. | Aster spp., Elliot's Aster | | | | 1 | 1 | | | | | | 20% | Native |
| CAA | Centella asiatica | Asian Pennywort, Coinwort, Spadeleaf | | | | | | | 1 | | | 1 | 20% | Native |
| COM | Commelina spp. | Dayflower | | | 1 | | | | 1 | | | | 20% | Native |
| CYP | Cyperus spp. | Sedge | | | 1 | 1 | | | | | | | 20% | Native |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DVA | Diodia virginiana | Buttonweed | | | | 1 | | | | | | 1 | 20% | Native |
| EAA | Eclipta alba (prostrata) | False Daisy, Yerba De Tajo | | | | 1 | | | 1 | | | | 20% | Native |
| HFM | Hypericum fasciculatum | Sandweed, Peelbark St. John's-wort | | 1 | | | | | | 1 | | | 20% | Native |
| MVA | Magnolia virginiana | Sweetbay Magnolia | | | | | | 1 | | 1 | | | 20% | Native |
| WAX | Myrica cerifera | Wax Myrtle | 1 | 1 | | | | | | | | | 20% | Native |
| CCA | Cinnamomum camphora | Camphor-tree | | | | | | 1 | | | | | 10% | NN-I |
| STS | Schinus terebinthifolius | Brazilian Pepper | | | | 1 | | | | | | | 10% | NN-I |
| CJE | Cladium jamaicense | Jamaica Swamp Saw Grass | 1 | | | | | | | | | | 10% | Native |
| CYO | Cyperus odoratus | Fragrant Flatsedge | | | | 1 | | | | | | | 10% | Native |
| ELE | Eleocharis spp. | Roadgrass, Spikerushes | | | | | 1 | | | | | | 10% | Native |
| GLS | Gordonia lasianthus | Loblolly Bay | 1 | | | | | | | | | | 10% | Native |
| IRI | Iris spp. | Flag | | | | | | | | | | 1 | 10% | Native |
| PBA | Persea borbonia | Redbay | | | | | | | | | | 1 | 10% | Native |
| POL | Polygonum spp. | Smartweed, Knotweed | | | | 1 | | | | | | | 10% | Native |
| SLA | Sagittaria lancifolia | Bulltongue Arrowhead, Duck Potato | | | | | 1 | | | | | | 10% | Native |
| SAL | Salix spp. | Willow | | | | | | | | | 1 | | 10% | Native |
| TYP | Typha spp. | Cattails | | | | 1 | | | | | | | 10% | Native |

**Figure 5.  Torpedo grass in Lake Alice.**

**Figure 6.  Swamp Fern in Lake Alice.**

**Table 5 List of Submerged Zone Aquatic Plants Found in Lake Alice**.

| Code | Plant Species | Common Name | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | % Occurrence | Native, Non-Native (NN), Invasive (I), Pest (P) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NIT | Nitella spp. | Nitella | 1 | 1 | | 1 | 1 | 1 | | 1 | 1 | 1 | 80% | Native-I-P |
| MMH | Myriophyllum heterophyllum | Water milfoil | 1 | 1 | 1 | | 1 | 1 | | 1 | 1 | 1 | 80% | Native-I-P |
| MAF | Mayaca fluviatilis | Stream Bog Moss | | | | | 1 | | | 1 | 1 | | 30% | Native |
| POT | Potamogeton spp. | Pond Weed | | 1 | | | | 1 | | | | | 20% | Native |
| EDA | Egeria densa | Common Waterweed | 1 | | | | | | | | | | 10% | Native |
| UTA | Utricularia spp. | Bladderwort | | | | | | | | | | 1 | 10% | Native |

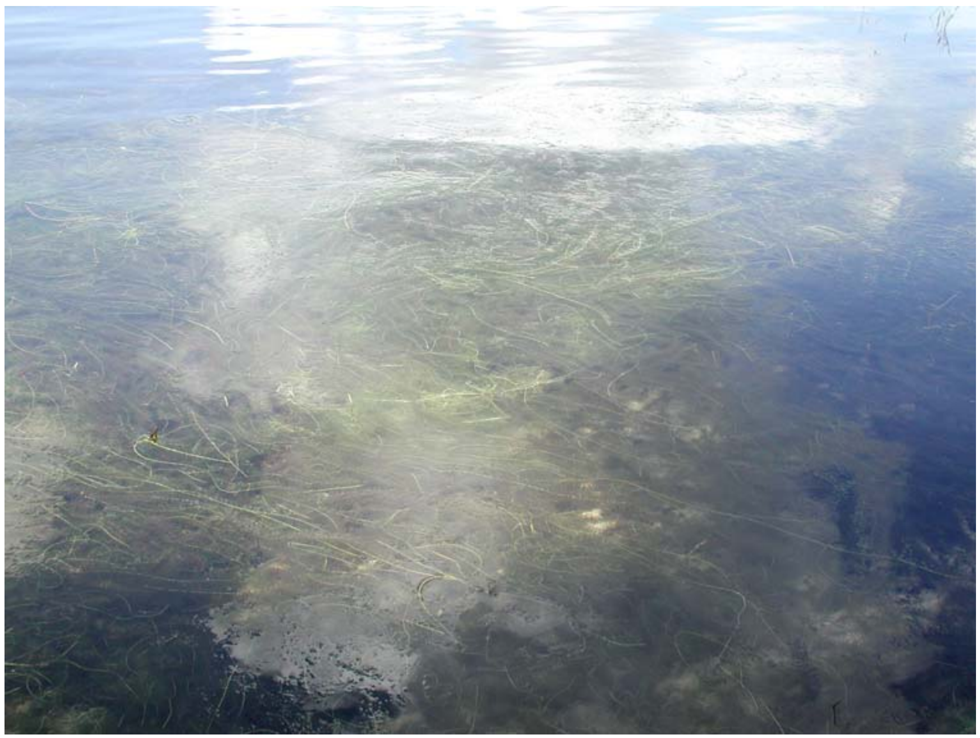
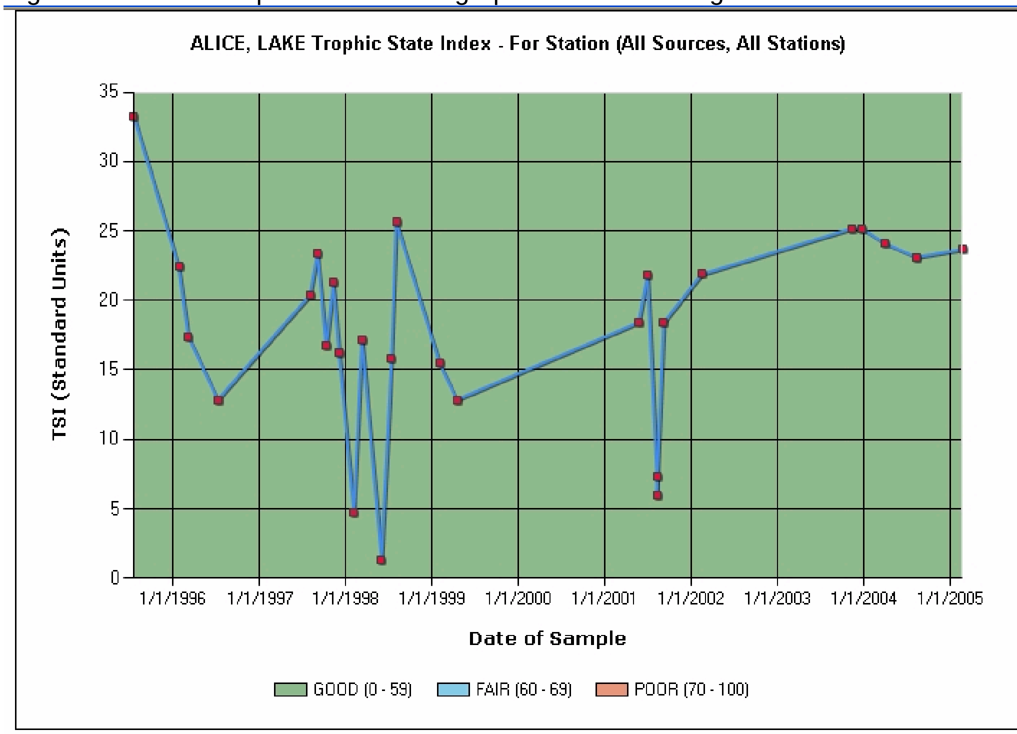


**Figure 7. Water Milfoil in Lake Alice.**

## 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 Lake Alice. 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 Figure 8, the lake may be considered good health in terms of the trophic state index. Lake Alice is a clear water lake and as such it must maintain a TSI of below 40 to not be considered impaired by the State of Florida guidelines[iv]. Lake Alice's long term water quality data indicates no violations of these criteria. The more recent sample data indicate a significant increase in TSI between 1999 and 2004. This was probably the result of aquatic weed harvesting that occurred during this period. Unfortunately, the sampling data from LAKEWATCH ends in early 2005 and no trend data exists for the last two years. As will be discussed below, our sample indicates a continuation of the trend that began in 1999. Significant change in the shoreline of the lake occurred in 2005 due to construction on the east shore. This may have caused the decrease in water quality indicated by our data.

Figure 8. Recent Trophic State Index graph from Hillsborough Watershed Atlas.




**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). For many lakes there is more than a single source of water quality data. You have the option with the "Select Data Source" drop down to select any available data source and create the graph using that source or you may select "All" to graph all available data. The graph header will also change to reflect the source used.

As part of the lake assessment, the physical water quality and water chemistry of a lake are measured. These data only indicate a snap shot of the lakes water quality; however they are useful to comparing to the trend data. Table 6A 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 indicate a nutrient balanced lake (the growth of algae is affected by both the concentration of nitrogen and phosphorus). The trophic state index (TSI) calculated from the sample data (27.9) is about 3 TSI units above the most recent data mean (24.75). This may indicate an increasing trend in TSI and a worsening of water quality. If this trend continues the lake could become impaired by FDEP standards. Added to this observation is the high percentage of vegetation coverage (PAC) found in Lake Alice. Please see the discussion on the next page.

Table 6B contains the field data taken in the center of the lake using a YSI Corporation – 6000 multi-probe 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. The lake pH is below the State Water Quality standard for the pH of Natural Waters (6.0 to 8.0). Lake Alice has historically been a low alkalinity, low pH lake and the low pH is not a concern for this waterbody. The water clarity as represented by Secchi Depth is outstanding for Florida Lakes. The lake remains a very clear lake although antidotal data indicates a decrease in water clarity.

**Table 6A. Water Quality Parameters (Laboratory)**

| Summary Table for Water Quality | | |
|---|---|---|
| Parameter | Value | Comment |
| TP ug/L | 19.00 | |
| TN mg/L | 0.37 | |
| Chla ug/L | 1.20 | |
| Chla TSI | 19.43 | |
| TP TSI | 36.37 | |
| TN TSI | 36.37 | |
| Secchi Disk (SD) | 21.50 | |
| TSI | 27.90 | Balanced |
| PAC | 85% | |
| PVI | 41% | |
| Adj TP | 5.49 | P from Veg Added |
| Adj TN | 0.07 | |
| Adj Chla | 0.16 | |
| Adj TSI | 30.89 | With additional P |

**Table 6B. Water Quality Parameters (Field - YSI)**

| Sample | Time | Temp (°C) | Conductivity (mS/cm3) | Dissolved Oxygen (%) | DO (mg/L) | PH (SU) | ORP (ORP) | Turbidity (NTU) | Secchi Depth (ft) |
|---|---|---|---|---|---|---|---|---|---|
| Surface | 14:32 | 31.64 | 0.15 | 104.7 | 7.7 | 5.29 | 237.7 | -0.4 | |
| Middle | 14:35 | 30.83 | 0.15 | 100.8 | 7.51 | 5.19 | 249.5 | -0.3 | |
| Bottom | 14:39 | 30.68 | 0.15 | 99 | 7.39 | 5.18 | 259.8 | -0.3 | |
| Surface | 14:43 | 31.67 | 0.15 | 101.5 | 7.45 | 5.2 | 258.7 | -0.4 | |
| Mean | | 31.21 | 0.15 | 101.5 | 7.5125 | 5.22 | 251.4 | -0.35 | 21.5 |

Table 6A 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, nitrogen and chlorophyll that could be released by existing submerged vegetation, if this vegetation were treated with a herbicide or managed by the addition of Triploid Grass carp (*Ctenopharyngodon idella*),and then calculating a new TSI based on the addition of these values to the original water sample chemistry[v vi vii]. While not all the vegetation would be turned into available phosphorus and nitrogen by these management methods, the data is useful when planning various management activities. Approximately 85% of the lake's surface area has submerged vegetation present (percent area coverage - PAC) and this vegetation represents about 41% of the available lake volume (percent volume infestation - PVI). The vegetation holds enough phosphorus and nitrogen to add about 5.49 μg/L and 0.074 mg/L of these nutrients and 0.16 ug/L of chlorophyll to the water column. Because the growth of algae in the water is regulated by the availability of phosphorus and nitrogen (the lake is nutrient balanced), the release of these nutrients would stimulate algal growth. These changes in the water chemistry and biology would be indicated by an increased TSI from 27.9 to about 30.9. The lake water clarity which is indicated by the Secchi Disk (SD) value at 21.5 feet would be reduced under these conditions. Also, the increase in nutrients would place the lake right on the mesotrophic/eutrophic[viii] line.

## Section 4: Conclusion

Lake Alice is a medium sized (91acre) lake that would be considered in the mesotrophic (good) category of lakes based on water chemistry. The lake nutrient balance has changed from phosphorus limited to a nutrient balanced lake. This is because a significant increase in the concentration of phosphorus in the water column in the last three years (Figure 9). Additional water chemistry samples should be taken to monitor this trend. If this trend in confirmed, then changes in the watershed like the one shown in Figures 10 and 11 should also be reviewed to determine specific impacts. The lake has a higher than normal concentration of aquatic vegetation and one of the few lakes in Hillsborough County with water clarity greater than 15 feet. About 85% of the open water areas contain submerged vegetation and this vegetation helps to maintain the nutrient balance in the lake as well as provide good fish habitat. However, the vegetation coverage is so high that it can limit lake use and its management should be considered in any future lake planning. The lake has many open water areas that support various types of recreation and has a good diversity of plant species. The primary nuisance plants in the lake include Punk tree (Melaleuca) Two-leaf water milfoil (Myriophyllum heterophyllum) and Torpedo Grass (Panicum repens). For more information and recent updates please see the Hillsborough Watershed Atlas (water atlas) website at:
**http://www.hillsborough.wateratlas.usf.edu/lake/waterquality.asp?wbodyid=5075&wbodyatlas=lake**

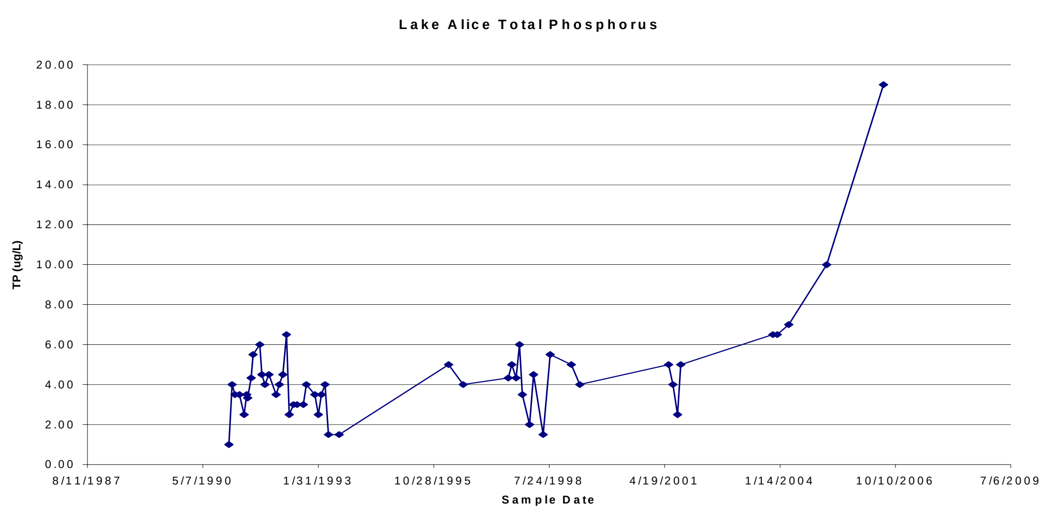



**Figure 9. Total phosphorus trend data (Combination of LAKEWATCH, SWFWMD and Hillsborough County Stormwater data**

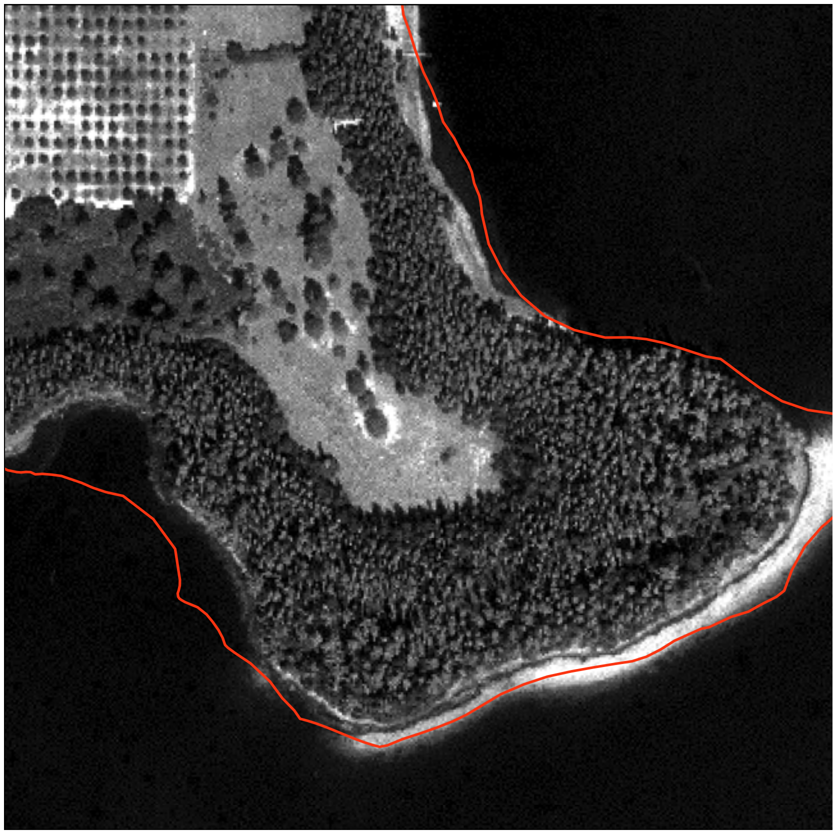


**Figure 10. 1973 Aerial shows peninsula in Lake Alice with healthy stand of Cypress.**

**Figure 11. 2005 color Aerial shows peninsula above after construction of a private home and removal of Cypress fringe.**

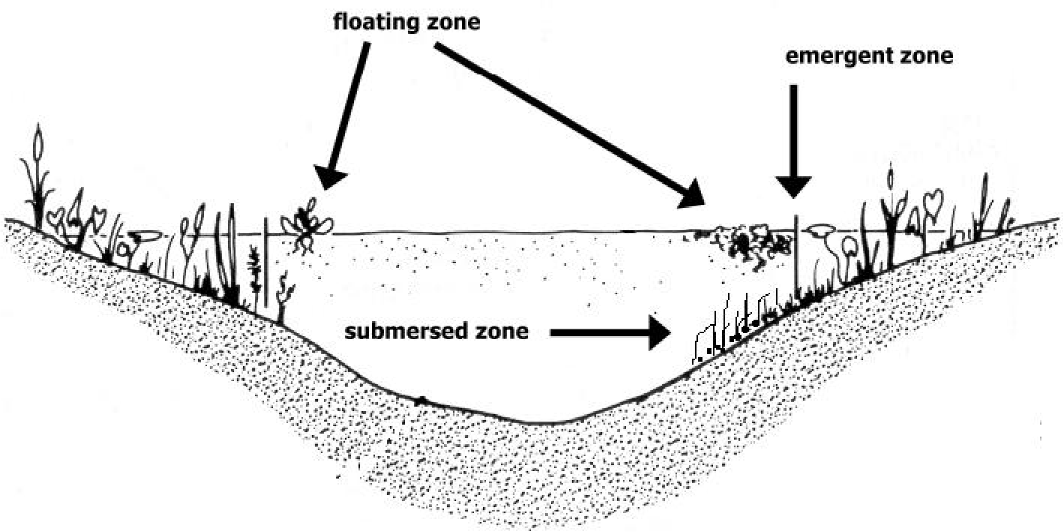
End Notes

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=5075&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 form 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 three 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 increased by more than10 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**

[v] Brown et. al., Nutrient-chlorophyll relationships: and evaluation of empirical nutrient-chlorophy models using Florida and north-temperate lake data, Can. J, Fish. Aquat. Sci. 1574-1583.

[vi] Canfield, D.E., Jr., Prediction of chlorophyll a concentrations in Florida lakes; the importance of phosphorus and nitrogen, Water Res. Bull. 19, 255-262.

[vii] Hanlon, S.G., Hoyer, M.V., Cichra, C.E., Canfield, D.E., Jr. 1983. Evaluation of macrophyte control in 38 Florida lakes using triploid grass carp, J. Aquat. Plant Manage.38: 48-54
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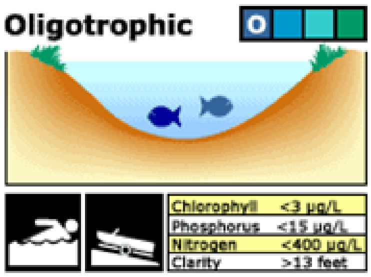
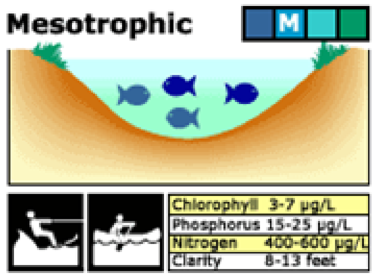
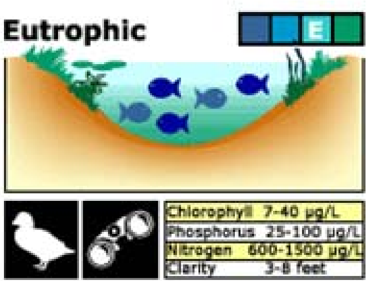
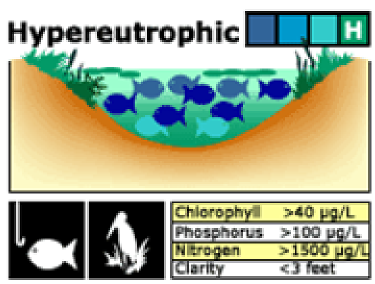

Oligotrophic
O
Chlorophyll <3 µg/L
Phosphorus <15 µg/L
Nitrogen <400 µg/L
Clarity >13 feet


Mesotrophic
M
Chlorophyll 3-7 µg/L
Phosphorus 15-25 µg/L
Nitrogen 400-600 µg/L
Clarity 8-13 feet


Eutrophic
E
Chlorophyll 7-40 µg/L
Phosphorus 25-100 µg/L
Nitrogen 600-1500 µg/L
Clarity 3-8 feet


Hypereutrophic
H
Chlorophyll >40 µg/L
Phosphorus >100 µg/L
Nitrogen >1500 µg/L
Clarity <3 feet

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