# Lake Flynn

## Methods

### Study Area Analysis

The watershed containing Lake Flynn was analyzed using ESRI ArcGIS 10.2. Using this software with 2011 Hillsborough County aerial, Land Use/ Land Cover (LULC), Landscape Development Intensity (LDI) Index values were calculated for the 100 meter buffer surrounding the lake following the procedures of Reiss & Brown 2012(Reiss & Brown. 2012. Landscape Development Intensity (LDI) Index User's Manual. H.T. Odum Center for Wetlands, University of Florida. March 2012). According to Reiss and Brown "The LDI represents a human disturbance gradient for wetland systems. The LDI is an integrated measure of human activity, combining the effects from air and water pollutants, physical damage, changes in the suite of environmental conditions … on the structure and processes of landscapes and ecosystems… Natural , undeveloped LU/LC classes have a LDI index value of zero. In the Florida framework, the maximum LDI index score is approximately 42."

### Lake Bathymetry and Morphological Characteristics Assessment

The **Bathymetric Map**[i] provides the lake's morphologic parameters in various units. The bottom of the lake was mapped using a Lowrance HDS 5 Gen 2 Wide Area Augmentation System (WAAS)[ii] 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. 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.

[i] 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.

[ii] 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. For more information, see end note 2.

## Lake Vegetation Index Assessment

Hillsborough County requested the implementation of the Florida Department of Environmental Protection methods for Lake Vegetation Index (LVI 1000) (http://www.dep.state.fl.us/water/sas/sop/sops.htm) using forms FD 9000-03 (Physical/Chemical Characterization), FD 9000-06 (Lake Habitat Assessment) FD 9000-27 (LVI Field Sheet) and FD 9000-31 (Lake Observation Field Sheet).

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.

Four metrics are utilized in the Lake Vegetation Index Survey; Dominant Coefficient of Conservatism (CoC), Percent Florida Exotic Pest Plant Council Type 1 (% FLEPPC), Percent Native Taxa, Percent Sensitive Taxa.

The Dominant Coefficient of Conservatism (CoC) metric for the dominant or co-dominate species in each section. The CoC applies a score of 0-10 to each species based on its ecological tolerances and fidelity to pre-settlement conditions. Species with higher scores show a high fidelity to native, undisturbed habitats and are typically sensitive to alterations. Available CoC scores can be obtained from LT 7000 from the Florida Department of Environmental Protection at: http://www.dep.state.fl.us/water/sas/sop/sops.htm.

The percent FLEPPC (Florida Exotic Pest Plant Council) Category 1 invasive exotic taxa in a single sampling unit (pie slice) by dividing the number of FLEPPC Category I taxa by the total number of taxa in that sampling unit. Multiply result times 100. Refer to Appendix LVI 1000-1 to determine which plants are on the FLEPPC Category 1 list. Note that not all exotic taxa should be included in this metric, only those listed in Appendix LVI 1000-1 as Category 1 FLEPPC. If the FLEPPC updates their list of Category 1 exotics, those updates shall not be reflected in this calculation until they are included in Appendix LVI 1000-1.

The percent native taxa in a single sampling unit (pie slice) is calculated by dividing the number of native taxa by the total number of taxa in that sampling unit. Multiply result times 100. Nativity status is determined by the Plant Atlas from the Institute for Systematic Botany, and is listed in

Appendix LVI 1000-1. For informational purposes, visit the website http://www.florida.plantatlas.usf.edu/. Taxa that are native according to the Plant Atlas from the Institute for Systematic Botany but are not on the list in Appendix LVI 1000-1 may be included in this metric calculation, but inclusion of these additional taxa is not required.

The percent sensitive taxa in a single sampling unit by summing the number of taxa with a C of C (Coefficient of Conservatism) score >= 7 and then dividing by the total number of taxa in that sampling unit. Multiply result times 100. Refer to Appendix LVI 1000-1 for a list of C of C scores.

The collected bathymetric data is analyzed for submerged aquatic vegetation (SAV) calculations including the percentage of the surface area of the lake inhabited by SAV as well as an estimate of the percent volume of the lake inhabited by SAV. SAV is an important component to a lakes nutrient cycling as well as chlorophyll concentrations due to the SAV and phytoplankton competing for available nutrients in the water column. In addition SAV serves a vital role as habitat for many species of macroinvertebrates and fish as well as substrate for epiphytic algae.

## Water Quality Assessment

Physical water quality samples were taken using a Eureka Manta Sub-2 multiprobe pre and post calibrated on the day of the assessment. Measurements taken with this device include: depth, conductivity, pH, Dissolved Oxygen (mg/l and % Saturation) and salinity. Chemical water parameters were collected and preserved on ice by USF Water Institute staff and analyzed at the Environmental Protection Commission of Hillsborough County Laboratory. Analysis include; Chlorophyll (a, b, c, t and corrected), Alkalinity, Color, Fecal Coliform, Enterococci, Ammonia, Nitrates/Nitrites, Total Phosphorous, Kjeldahl Nitrogen and Total Nitrogen. The results of the water quality sampling effort will be discussed in the framework of the FDEP Numeric Nutrient Criteria

## Study Area

Lake Flynn is located in the Violet Cury Nature Preserve, a 160-acre preserve of pine flatwoods, sandhill, marshes, oak hammock and freshwater lake in Lutz, Hillsborough County, Florida. The surface area of Lake Flynn fluctuates with seasonal rainfall patterns and as such Lake Flynn may be seen as a single waterbody or a collection of isolated pools. The Landscape Development Intensity Index of the 100 meter buffer around Lake Flynn is dominated by natural land 74% and single family residential (13%) land uses. The resulting LDI value for the 100 meter buffer around Lake Flynn is 14.19.

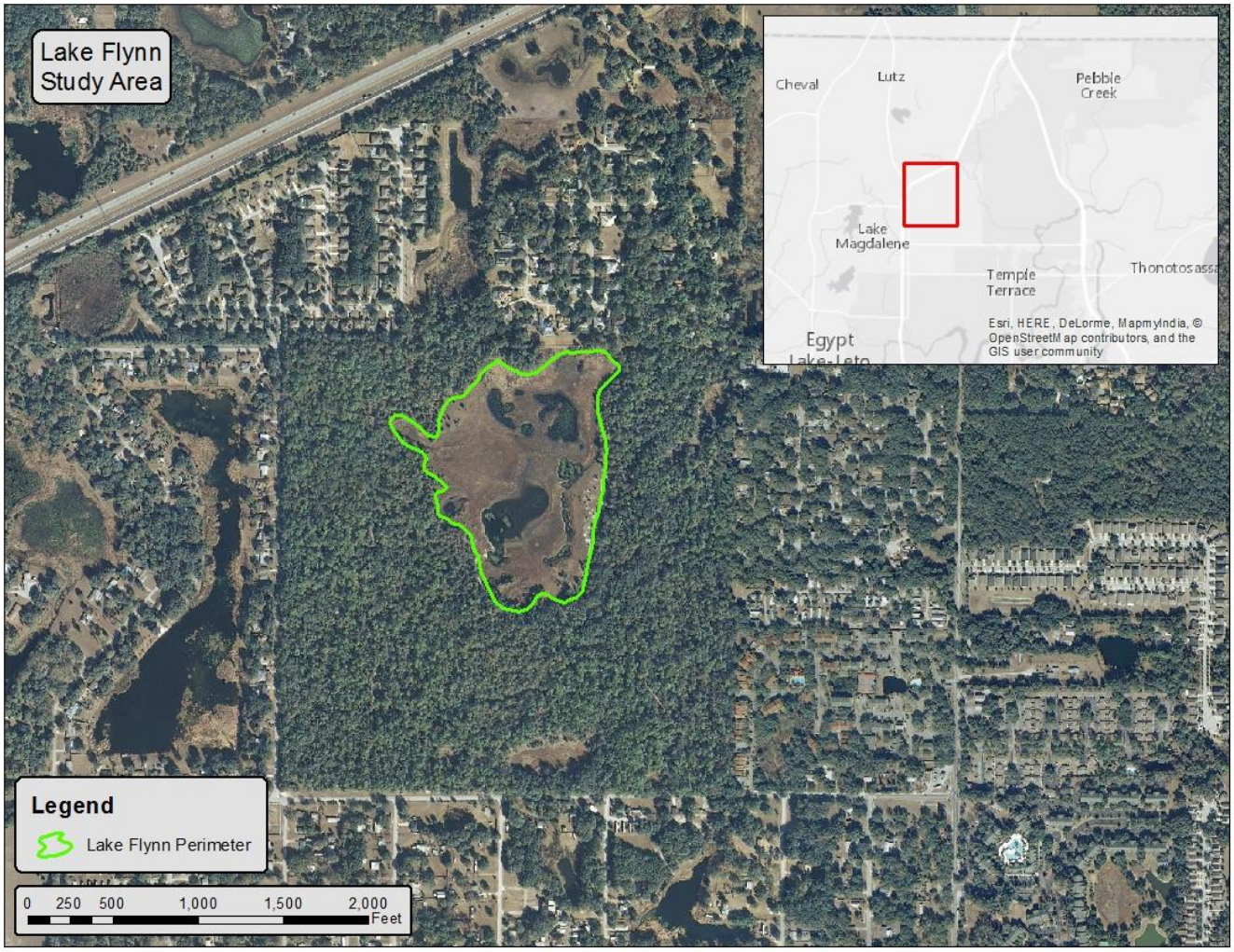


Figure 1 2015 Lake Flynn Assessment Study Area Map

## Lake Bathymetry and Morphological Characterization

Flynn Lake is a shallow system of wetland depressions. During times of low water Flynn Lake is a collection of shallow isolated pools surrounded by emergent marshes. During high water, Flynn Lake's isolated pools are connected by surface water to form a larger lake. At the time of the assessment, Flynn Lake was experiencing moderately high water levels resulting in a single 20 acre water body. Flynn Lake at the time of the assessment had a mean water depth of 1.93 feet and a maximum observed depth of 13.65 feet. The volume at this time was approximately 12,642,996 gallons. Figure 2 shows the resulting bathymetric contour map for Flynn Lake from data collected on June 23, 2015. The collected data has been overlain the 2011 Hillsborough County aerials. At the time the aerials were imaged, Flynn Lake was in a period of low water. The isolated deeper pools of Flynn Lake are visible on this aerial.

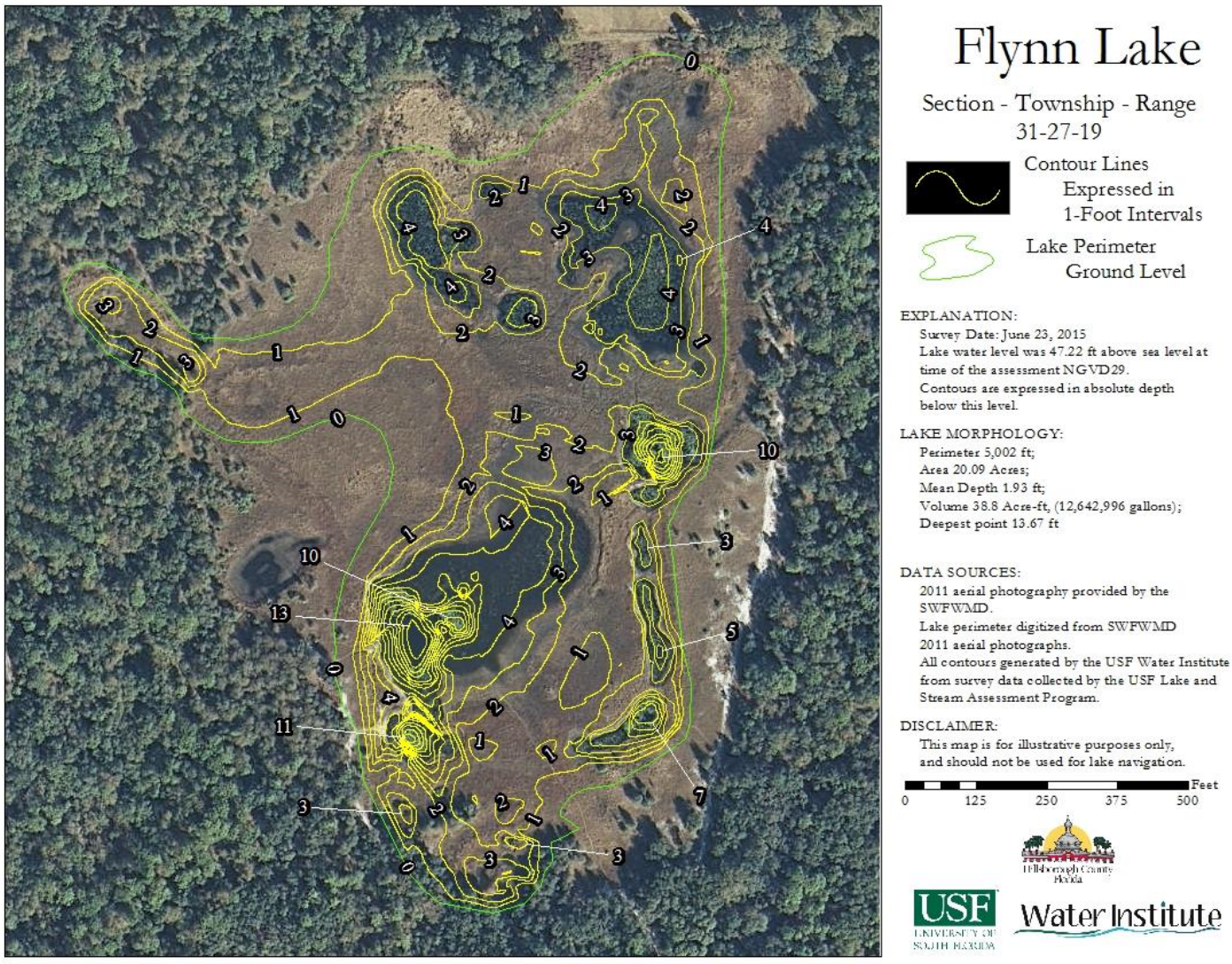


Figure 2 2015 Bathymetric Contour Map for Flynn Lake

Table 1 Morphological Calculations for Flynn Lake

| Parameter | Feet | Meters | Acres | Acre-Ft | Gallons |
|---|---|---|---|---|---|
| Surface Area (sq) | 875,219 | 81,311 | 20.09 | 0 | 0 |
| Mean Depth | 1.93 | 0.59 | 0 | 0 | 0 |
| Maximum Depth | 13.65 | 4.16 | 0 | 0 | 0 |
| Volume (cubic) | 1,690,111 | 47,859 | 0 | 38.8 | 12,642,996 |
| Gauge (relative) | 47.22 | 14.39 | 0 | 0 | 0 |

## Lake Vegetation Index Assessment

Figure 3 Overview photograph of Lake Flynn

The lake assessment for Lake Flynn was conducted on June 23, 2015. Flynn Lake received a lake habitat assessment (FEDP form FD 9000-6) score of 124 due to optimal scores for Vegetation Quality, Stormwater Inputs, Lakeside Adverse Human Alterations, Upland Buffer Zone and Adverse Watershed Land Use. Suboptimal scores were recorded for Secchi and Bottom Substrate Quality. No Marginal or Poor scores were recorded for Flynn Lake.

**Figure 4 the emergent vegetation community surrounding Lake Flynn was dominated by native grasses, sedges and rushes.**

The Lake Vegetation Index identified 39 species of wetland vegetation growing in the four selected sections along Lake Flynn. The majority of these species (37) are native species. The remaining 2 species (*Panicum repens* and *Ludwigia peruviana*) are non-native and invasive to this region. The vegetation community along Lake Flynn is dominated by herbaceous emergent species (*Panicum hemitomon*, *Rynchospora tracyii* and *Fuirena scirpoidea*)as shown in Figure 4. The water's surface in Lake Flynn was dominated by *Nymphaea odorata* (Figure 5) with *Nuphar advena* and *Brasenia schreberi* (Figure 6) present as well. The water column of the lake was dominated by *Eleocharis baldwinii* and two species of bladderworts (*Utricularia floridana* and *Utricularia purpurea*). By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 49% of the surface area of Flynn Lake. This submerged vegetation inhabits an estimated 11.62% of the water volume in Flynn Lake. Figure7 shows the map of Lake Flynn detailing the LVI regions used for the assessment. Table 2 details the species list results of the Lake Vegetation Index. Table 3 details the scoring result for the Lake Vegetation Index.

Figure 5 *Nymphaea odorata* on Lake Flynn

Figure 6 *Brasenia schreberi* on Lake Flynn

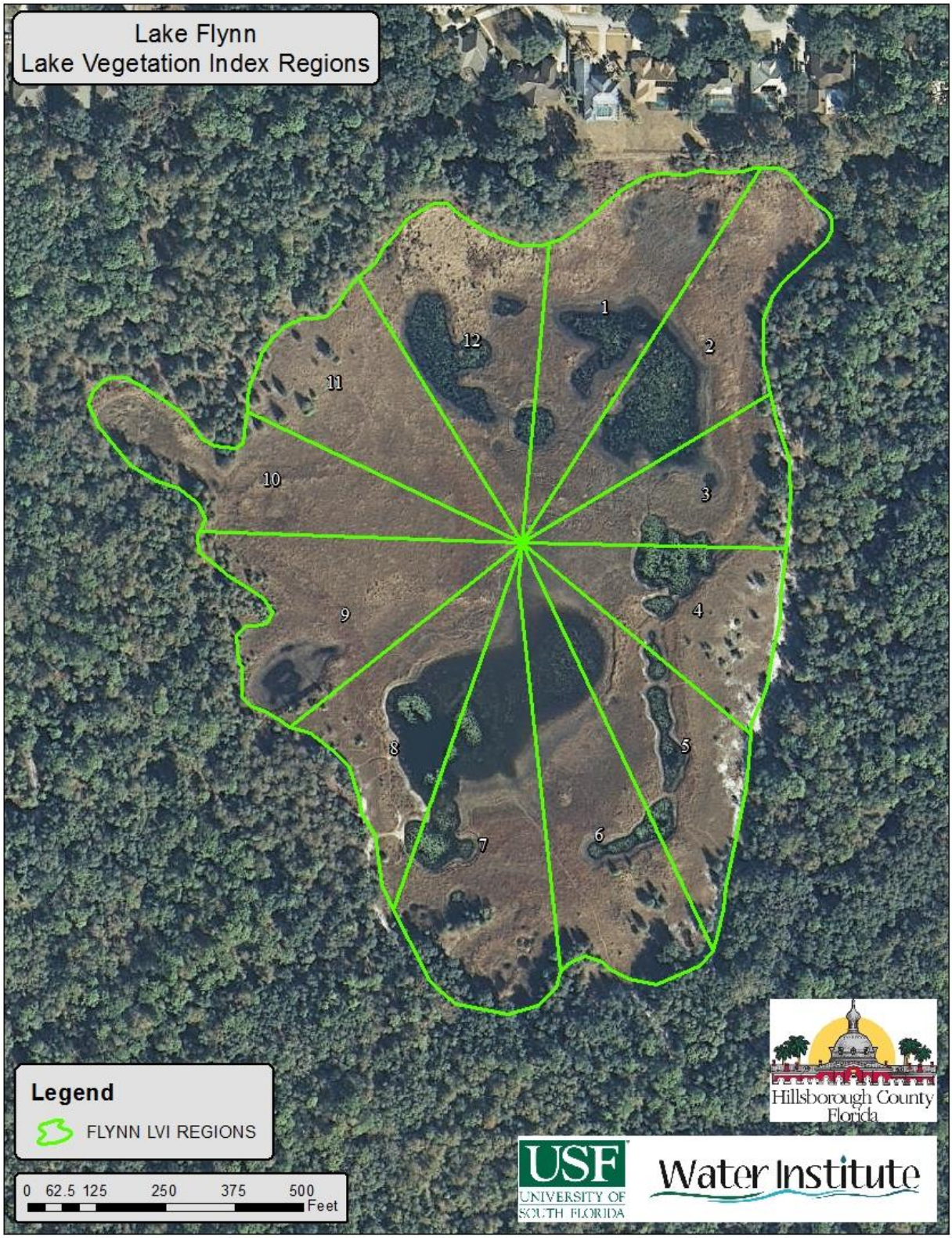


Figure 7 Lake Vegetation Index region map for Lake Flynn

Table 2 Lake Vegetation Index results for Lake Flynn 6/23/2015

| SPECIES | Region | | | | |
|---|---|---|---|---|---|
| | CofC | 1 | 4 | 7 | 10 |
| Brasenia schreberi | 8.79 | 1 | 1 | 1 | 1 |
| Cephalanthus occidentalis | 5.00 | 1 | 1 | 1 | 1 |
| Fuirena scirpoidea | 5.50 | 1 | 1 | 1 | 1 |
| Ilex cassine | 6.00 | 1 | 1 | 1 | 1 |
| Lachnanthes caroliniana | 3.76 | 1 | 1 | 1 | 1 |
| Myrica cerifera | 2.00 | 1 | 1 | 1 | 1 |
| Panicum hemitomon | 5.82 | 1 | 1 | 1 | 1 |
| Rhynchospora tracyi | 8.00 | 1 | 1 | 1 | 1 |
| Sagittaria graminea | 5.53 | 1 | 1 | 1 | 1 |
| Xyris platylepis | 5.32 | 1 | 1 | 1 | 1 |
| Eleocharis baldwinii | 2.82 | C | 1 | C | 1 |
| Utricularia floridana | 6.34 | 1 | C | C | 1 |
| Nymphaea odorata | 5.00 | C | C | 1 | D |
| Acer rubrum | 4.65 | 1 | 1 | | 1 |
| Andropogon | | | 1 | 1 | 1 |
| Eleocharis cellulosa | 7.80 | 1 | | 1 | 1 |
| Hypericum fasciculatum | 8.00 | | 1 | 1 | 1 |
| Leersia hexandra | 5.61 | 1 | | 1 | 1 |
| Nuphar | 3.50 | 1 | 1 | 1 | |
| Quercus laurifolia | 4.00 | | 1 | 1 | 1 |
| Rhynchospora microcephala | 3.50 | | 1 | 1 | 1 |
| Eupatorium capillifolium | 0.83 | | 1 | 1 | |
| Hydrocotyle | 2.00 | | | 1 | 1 |
| Juncus marginatus | 1.50 | | | 1 | 1 |
| Rhexia cubensis | 7.22 | | 1 | 1 | |
| Sabatia grandiflora | 6.00 | | 1 | 1 | |
| Typha | 1.00 | | 1 | 1 | |
| Utricularia gibba | 6.37 | | 1 | 1 | |
| Utricularia purpurea | 6.50 | | | 1 | 1 |
| Baccharis | | | 1 | | |
| Blechnum serrulatum | 5.50 | 1 | | | |
| Cyperus odoratus | 3.00 | | 1 | | |
| Ludwigia octovalvis | 2.00 | | 1 | | |
| **Ludwigia peruviana** | 0.00 | | 1 | | |
| Osmunda regalis | 7.60 | | | | 1 |
| **Panicum repens** | 0.00 | | | 1 | |
| Persea palustris | 7.00 | | | | 1 |
| Pontederia cordata | 5.38 | 1 | | | |
| Quercus nigra | 2.50 | | | 1 | |

Table 3 Scoring Summary for the Lake Vegetation Index

| LVI Score Summary | Region | | | |
|---|---|---|---|---|
| | 1 | 4 | 7 | 10 |
| Total # of taxa in sampling unit | 19 | 28 | 30 | 25 |
| % Native taxa in sampling unit | 100 | 96.43 | 96.666667 | 100 |
| % FLEPPC CAT 1 taxa in sampling unit | 0 | 3.571429 | 3.3333333 | 0 |
| % Sensitive taxa in sample unit | 16 | 14.28571 | 16.666667 | 24 |
| Dominant CoC in sample unit | 4 | 5.67 | 4.58 | 5 |
| | | | | |
| Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)= | 1 | 1 | 1 | 1 |
| Invasive FLEPPC 1 Score (1 - (x/30))= | 1 | 0.8809524 | 0.8888889 | 1 |
| Sensitive Score (x/(27.78 or 20)) = | 0.7894737 | 0.7142857 | 0.8333333 | 1 |
| Dominant CoC Score (x/(7.91 or 7)) = | 0.5585714 | 0.81 | 0.6542857 | 0.7142857 |
| Raw Score Total = N+I+S+D = | 3.3480451 | 3.4052381 | 3.3765079 | 3.7142857 |
| Division Factor = (3 D=0 or 4) = | 4 | 4 | 4 | 4 |
| Average LVI dividend = Raw /DF | 0.8370113 | 0.8513095 | 0.844127 | 0.9285714 |
| South Region | | | | |
| LVI Score for sampling unit = | 83.701128 | 85.130952 | 84.412698 | 92.857143 |
| | | | | |
| **Total LVI SCORE =** | **87** | | | |

## Water Quality Assessment

Long-term water quality data is available for Lake Flynn spanning the present to 1999. The available data was collected as part of the Lakewatch program. Table 4 provides a summary of the Physical/Chemical conditions recorded at the center of the lake.

**Table 4 Lake Flynn Water Quality (Field)**

| Depth (m) | Temp ( C ) | pH | DO mg/L | DO % Sat | Cond (umho/cm) | Salinity (ppt) | TDS (mg/L) | Secchi Depth (m) |
|---|---|---|---|---|---|---|---|---|
| 0.33 | 30.18 | 4.47 | 2.87 | 37.6 | 21.1 | 0.01 | 13.5 | 2.93 |
| 1.29 | 29.65 | 4.56 | 1.33 | 17.2 | 21.7 | 0.01 | 13.9 | |
| 3.67 | 25.28 | 5.44 | 0.1 | 1.3 | 41.9 | 0.02 | 26.8 | |

The chemical water quality analysis for Lake Flynn is shown in Table 5 for the sample taken on June 23, 2015. Table 6 includes this data in the numeric nutrient criteria framework using geometric mean values for the past three years for available parameters. Total Phosphorous values were below the nutrient threshold for clear acidic lakes developed by FDEP of 0.03 mg/l. Total Nitrogen values were slightly above the nutrient threshold for clear acidic lakes developed by FDEP of 0.93 mg/l with a three year geometric mean concentration of 1.039 mg/l which also exceeded the threshold in each of the three years (1.012 mg/l in 2012, 1.017 mg/l in 2013 and 1.107 mg/l in 2014. Chlorophyll-a values fall below the nutrient threshold for clear acidic lakes developed by FDEP of 6.0 µg/l with a three year geometric mean value of 4.02 µg/l.

Bacteria testing showed low levels of Fecal Coliform (10 colonies/100ml) below the rules set forth in FDEP 62-302.530 (https://www.flrules.org/gateway/RuleNo.asp?title=SURFACE%20WATER%20QUALITY%20STANDARDS&ID=62-302.500) "Most Probable Number (MPN) or Membrane Filter (MF) counts shall not exceed a monthly average of 200, nor exceed 400 in 10% of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30 day period."

Table 5 Lake Flynn Water Quality Results from 6/23/2015(Laboratory)

| Parameter | Value | Units |
|---|---|---|
| Alkalinity | 4.0 | mg/LCaCO3 |
| Nitrates/Nitrites | 0.003 | mg/L |
| Fecal Coliform | 10 | #/100 ml |
| Enterococci | <10 | #/100 ml |
| Chlorophyll a | 5.8 | ug/L |
| Chlorophyll b | 2.6 | ug/L |
| Chlorophyll c | 1.4 | ug/L |
| Chlorophyll t | 7.7 | ug/L |
| Chlorophylla Corr | 5.0 | ug/L |
| Chlorophyll-pheo | 1.8 | ug/L |
| Ammonia | 0.011 | mg/L |
| Kjeldahl Nitrogen | 0.762 | mg/L |
| Total Nitrogen | 0.765 | mg/L |
| Total Phosphorus | 0.021 | mg/L |
| Color(345)F.45 | 13.5 | Pt/Co |

| | |
|---|---|
| Lake | |
| Geometric Mean (Geomean) Color (pcu) | 13.5 |
| Number of Samples | 1 |
| Geometric Mean Alkalinity (mg/L CACO3) | 4.0 |
| Number of Samples | 1 |
| Lake Type | Clear Acidic |
| Chlorophyll a Criteria (ug/L) | 6 |
| Sufficient for Geomean Criteria then P mg/L | 0.03 |
| Suffcient for Geomean Criteria then N mg/L | 0.93 |
| Geomean Chla ug/L | 4.02 |
| Geomean TP mg/L | 0.009 |
| Geomean TN mg/L | 1.039 |
| Number of Samples | 33 |
| Potential Impaired Chlorophyll a | Not Impaired |
| Potential Impaired TP | Not Impaired |
| Potential Impaired TN | Impaired |

## Conclusion

The results of the assessment of Lake Flynn shows impairment based on Total Nitrogen concentrations according to the FDEP numeric nutrient criteria. The system shows excellent conditions in the vegetation communities according to the Lake Vegetation Index with very few occurrences of non-native, invasive species and a high occurrence of sensitive plant species with an overall LVI score of 87.