

# George Lake

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## Methods

### Study Area Analysis

The watershed containing George Lake 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**<sup>i</sup> 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)<sup>ii</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. 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.

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<sup>i</sup> 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.

<sup>ii</sup> 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. 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  $\geq 7$  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

George Lake is located in the Coastal Old Tampa Bay Watershed near Carrollwood, Hillsborough County, Florida. The surface area of George Lake was approximately 27 acres at the time of the assessment. The Landscape Development Intensity Index of the 100 meter buffer around George Lake is dominated by Multi-Family Residential (97.4%) with Natural Land comprising 2.4% of land use. The resulting LDI value for the 100 meter buffer around George Lake is 33.14.

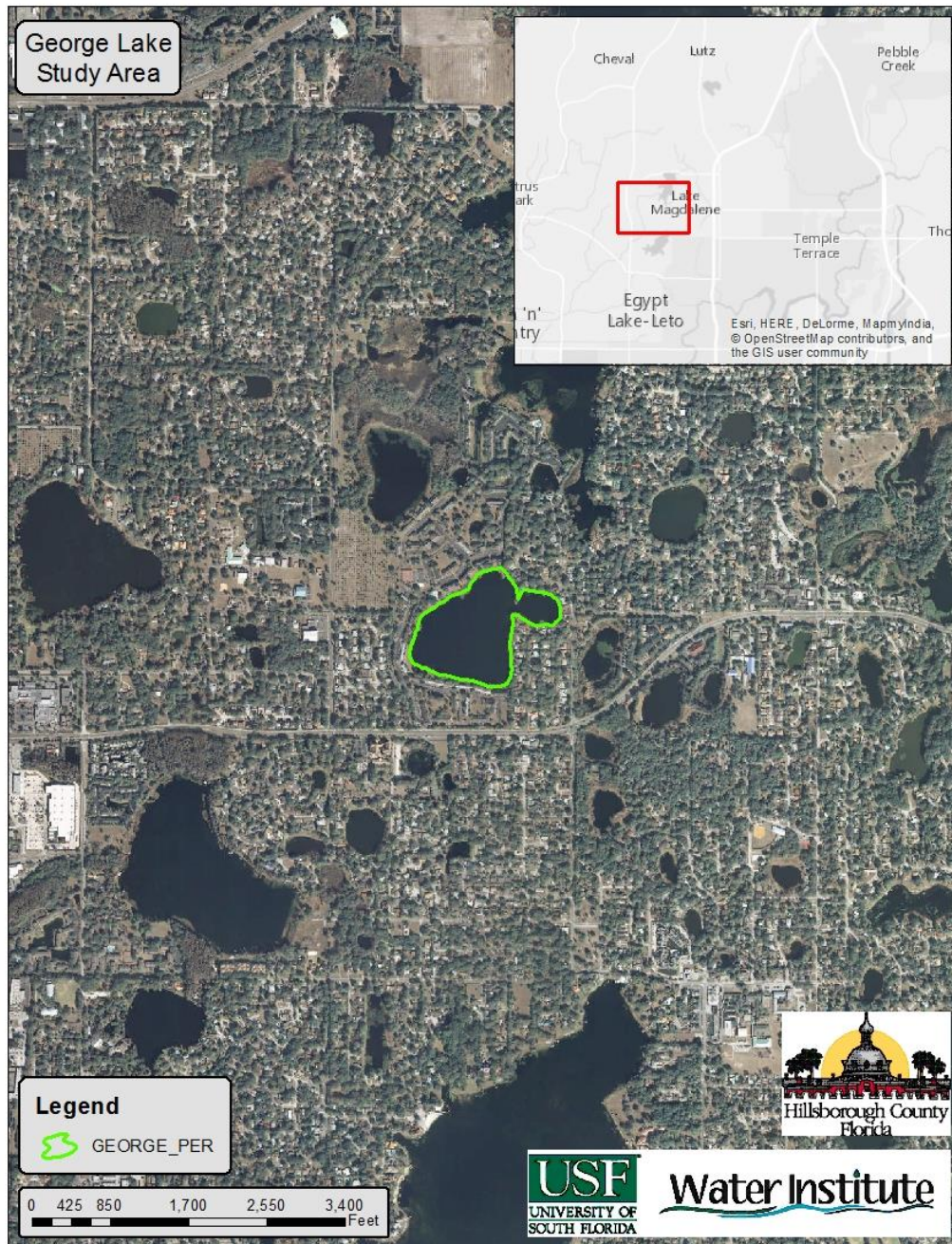


Figure 1 2015 George Lake Assessment Study Area Map



## Lake Bathymetry and Morphological Characterization

George Lake is a system of multiple depressions. At the time of the assessment, George Lake was experiencing moderately high water levels resulting in a 27 acre water body. George Lake at the time of the assessment had a mean water depth of 12.17 feet and a maximum observed depth of 25.99 feet. The volume at this time was approximately 107,142,444 gallons. Figure 2 shows the resulting bathymetric contour map for George Lake from data collected on August 12, 2015. The collected data has been overlain the 2011 Hillsborough County aerals.

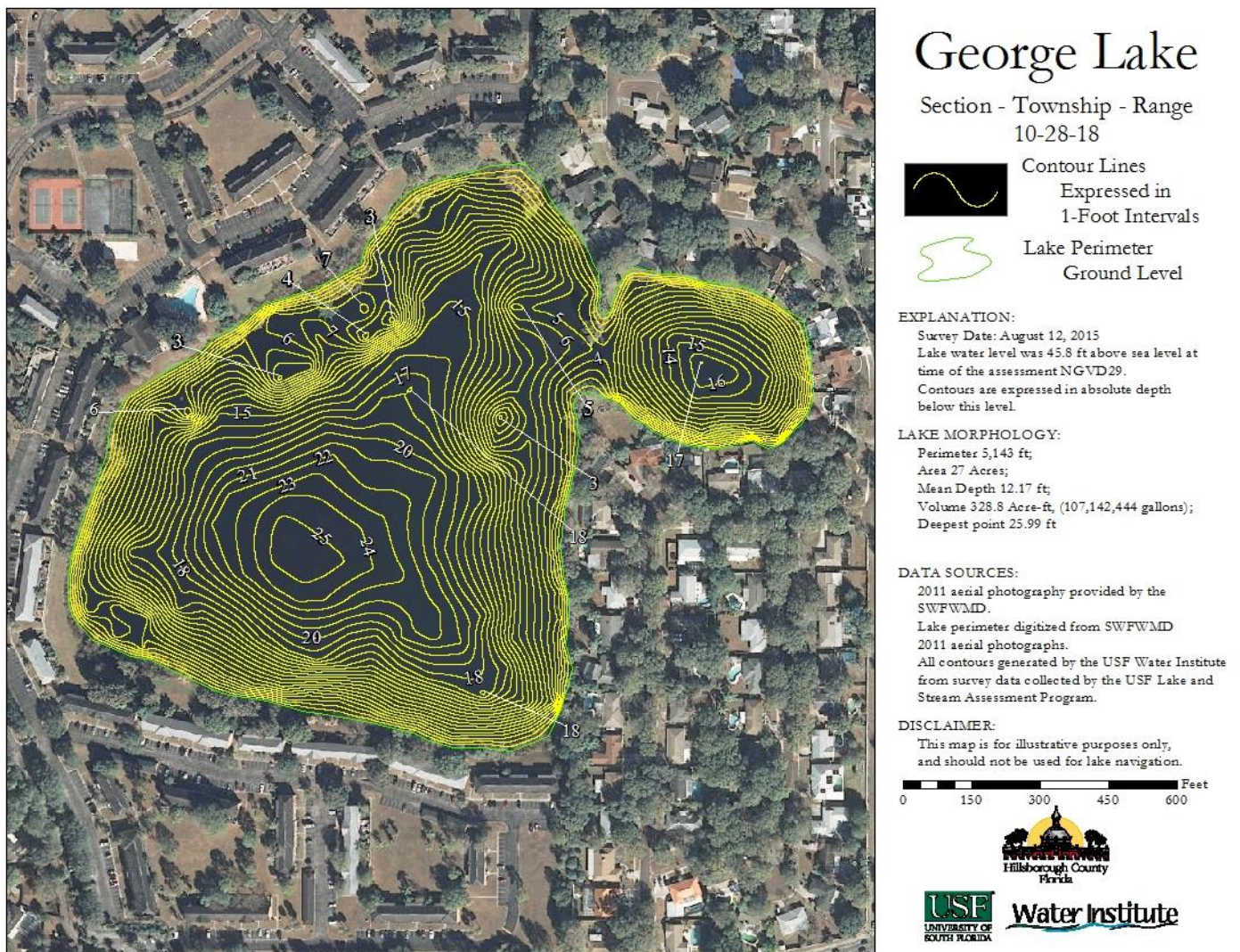


Figure 2 2015 Bathymetric Contour Map for George Lake

**Table 1 Morphological Calculations for George Lake**

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	1,176,465	109,297	27.01	0	0
Mean Depth	12.17	3.71	0	0	0
Maximum Depth	25.99	7.92	0	0	0
Volume (cubic)	14,322,762	405,575	0	328.8	107,142,444
Gauge (relative)	45.8	13.96	0	0	0

## Lake Vegetation Index Assessment



**Figure 3 Overview photograph of George Lake**

The lake assessment for George Lake was conducted on August 12, 2015. George Lake received a lake habitat assessment (FEDP form FD 9000-6) score of 56 due to suboptimal scores for Secchi and Stormwater Inputs. Marginal scores were recorded for Vegetation Quality and Adverse Watershed Land Use. Poor scores were observed for Lakeside Adverse Human Alterations, Upland Buffer Zone and Bottom Substrate Quality.





**Figure 4** The emergent vegetation community surrounding George Lake was dominated by *typha*.

The Lake Vegetation Index identified 33 species of wetland vegetation growing in the four selected sections along George Lake. The majority of these species (23) are native species. The remaining 10 species in bold in Table 2 are non-native and invasive to this region. The emergent vegetation community along George Lake is dominated by herbaceous species (*Panicum repens* and *Typha*) as shown in Figure 4. The water's surface in George Lake was dominated by *Nymphaea odorata* (Figure 5) with *Nuphar advena* present as well. The water column of the lake was dominated by *Hydrilla verticillata* and *Chara*. *Vallisneria americana* (Figure 6), a sensitive native species was also present in the submerged vegetation community. George Lake obtained a LVI score of 20 at the time of the assessment, below the threshold of 37 set by FDEP primarily due to the dominance of *hydrilla verticillata*. By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 62% of the surface area of George Lake. This submerged vegetation inhabits an estimated 25.71% of the water volume in George Lake. The submerged vegetation community ends at approximately 17.5 feet of depth by analysis of the sonar chart. Figure 7 shows the map of George Lake 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 George Lake

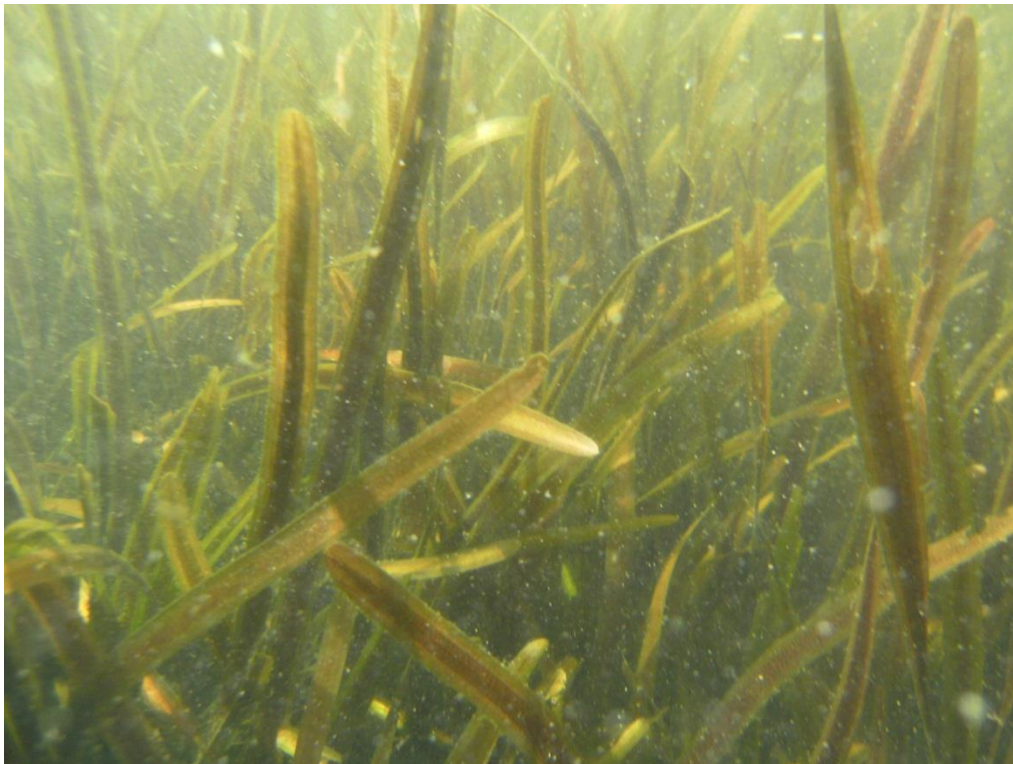


Figure 6 *Vallisneria Americana* on George Lake



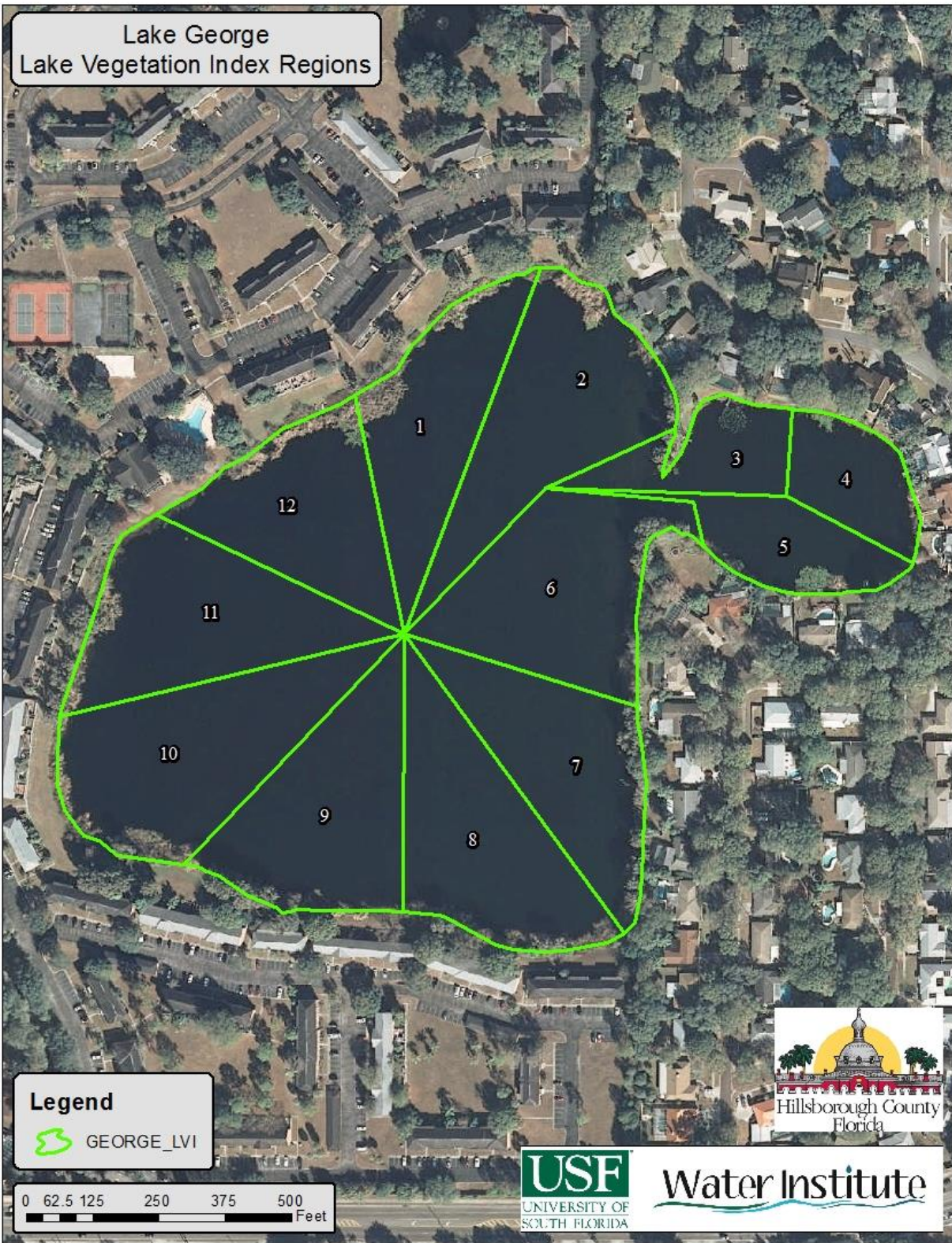


Figure 7 Lake Vegetation Index region map for George Lake

Table 2 Lake Vegetation Index results for George Lake 8/12/2015

SPECIES	Region				
	CofC	2	5	8	11
<b>Alternanthera philoxeroides</b>	0.00	1	1	1	1
<b>Hydrilla verticillata</b>	0.00	D	C	C	D
<b>Panicum repens</b>	0.00	1	1	1	1
Potamogeton illinoensis	6.64	1	1	1	1
Quercus laurifolia	4.00	1	1	1	1
Typha	1.00	1	1	1	1
Vallisneria americana	7.00	1	1	1	1
Chara	3.90	1	1	C	1
<b>Colocasia esculenta</b>	0.00		1	1	1
Hydrocotyle	2.00	1	1		1
<b>Ludwigia peruviana</b>	0.00	1	1	1	
<b>Melaleuca quinquenervia</b>	0.00	1	1	1	
Mikania scandens	1.95	1		1	1
Acer rubrum	4.65	1		1	
Bacopa monnieri	3.50	1			1
Boehmeria cylindrica	5.00	1	1		
Ludwigia leptocarpa	3.00	1			1
Myrica cerifera	2.00	1	1		
Sambucus nigra	1.48		1		1
Blechnum serrulatum	5.50		1		
Lindernia grandiflora	3.60				1
Najas guadalupensis	5.07		1		
Nuphar	3.50		1		
Nymphaea odorata	5.00	1	C		
<b>Oxycaryum cubense</b>	0.50	1			
Panicum hemitomon	5.82		1		
Salix caroliniana	2.95			1	
<b>Sapium sebiferum</b>	0.00		1		
<b>Schinus terebinthifolius</b>	0.00			1	
<b>Sphagneticola trilobata</b>	0.00				1
Taxodium	7.00		1		
Utricularia floridana	6.34	1			
Utricularia gibba	6.37		1		

Table 3 Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	2	5	8	11
Total # of taxa in sampling unit	20	23	15	16
% Native taxa in sampling unit	70	69.56522	53.33333	68.75
% FLEPPC CAT 1 taxa in sampling unit	20	26.08696	40	18.75
% Sensitive taxa in sample unit	5	8.695652	6.666667	6.25
Dominant CoC in sample unit	0	2.5	1.95	0
Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.128621	0.111828	0	0.08034
Invasive FLEPPC 1 Score (1 - (x/30))=	0.333333	0.130435	0	0.375
Sensitive Score (x/(27.78 or 20)) =	0.25	0.434783	0.333333	0.3125
Dominant CoC Score (x/(7.91 or 7)) =	0	0.357143	0.278571	0
Raw Score Total = N+I+S+D =	0.711954	1.034188	0.611905	0.76784
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.177989	0.258547	0.152976	0.19196
South				
LVI Score for sampling unit =	17.79886	25.8547	15.29762	19.196
<b>Total LVI SCORE =</b>	20			



## Water Quality Assessment

Long-term water quality data is available for George Lake spanning the present to 1985. Unfortunately the data is very inconsistent in terms of sampling interval containing only 11 sampling events in this time period and only 3 since 2000. Table 4 provides a summary of the Physical/Chemical conditions recorded at the center of the lake.

Table 4 George Lake Water Quality (Field)

Depth (m)	Temp ©	pH	DO (mg/L)	DO (% Sat)	Cond (umho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)
0.18	30.73	7.82	7.89	104.5	150.1	0.07	96.1	2.62
2.9	28.78	6.74	3.81	48.8	153.1	0.07	98	
6.23	24.83	6.99	0.03	0.4	207.6	0.1	132.8	

The chemical water quality analysis for George Lake is shown in Table 5 for the sample taken on August 12, 2015. Table 6 includes this data in the numeric nutrient criteria framework using geometric mean values for the past three years for available parameters, however due to the lack of available data the sample data for the assessment is used to compare to the numeric nutrient criteria standards. Total Phosphorous values were below the nutrient threshold for clear alkaline lakes developed by FDEP of 0.03 mg/l with a concentration of 0.025 mg/l. Total Nitrogen values were below the nutrient threshold for clear alkaline lakes developed by FDEP of 1.05 mg/l with a concentration of 0.387 mg/l. Chlorophyll-a values fall below the nutrient threshold for clear alkaline lakes developed by FDEP of 20 µg/.

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 George Lake Water Quality Results from 8/12/2015(Laboratory)

Parameter	Value	Units
Alkalinity	34	mg/LCaCO <sub>3</sub>
Nitrates/Nitrites	0.003	mg/L
Fecal Coliform	10	#/100 ml
Enterococci	80	#/100 ml
Chlorophyll a	4.8	ug/L
Chlorophyll b	2.6	ug/L
Chlorophyll c	0.9	ug/L
Chlorophyll t	6.3	ug/L
Chlorophylla Corr	4.6	ug/L
Chlorophyll-pheo	1.8	ug/L
Ammonia	0.021	mg/L
Kjeldahl Nitrogen	0.384	mg/L
Total Nitrogen	0.387	mg/L
Total Phosphorus	0.025	mg/L
Color(345)F.45	7.2	Pt/Co

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	6.72
Number of Samples	3
Geometric Mean Alkalinity (mg/L CaCO <sub>3</sub> )	34
Number of Samples	1
Lake Type	Clear Alkaline
Chlorophyll a Criteria (ug/L)	20
Insufficient for Geomean Criteria then P mg/L	0.03
Insufficient for Geomean Criteria then N mg/L	1.05
Geomean Chla ug/L	4.6
Geomean TP mg/L	0.025
Geomean TN mg/L	0.387
Number of Samples	1
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired

## Conclusion

The result of the assessment of George Lake does not show impairment based on Total Nitrogen, Total Phosphorous or Chlorophyll-a concentrations according to the FDEP numeric nutrient criteria. The system shows impaired conditions in the vegetation communities according to the Lake Vegetation Index with dominance by non-native invasive species such as *hydrilla verticillata* and an overall LVI score of 20.