

# Boot Lake

---

## Methods

### Study Area Analysis

The watershed containing Boot 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.

---

<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.

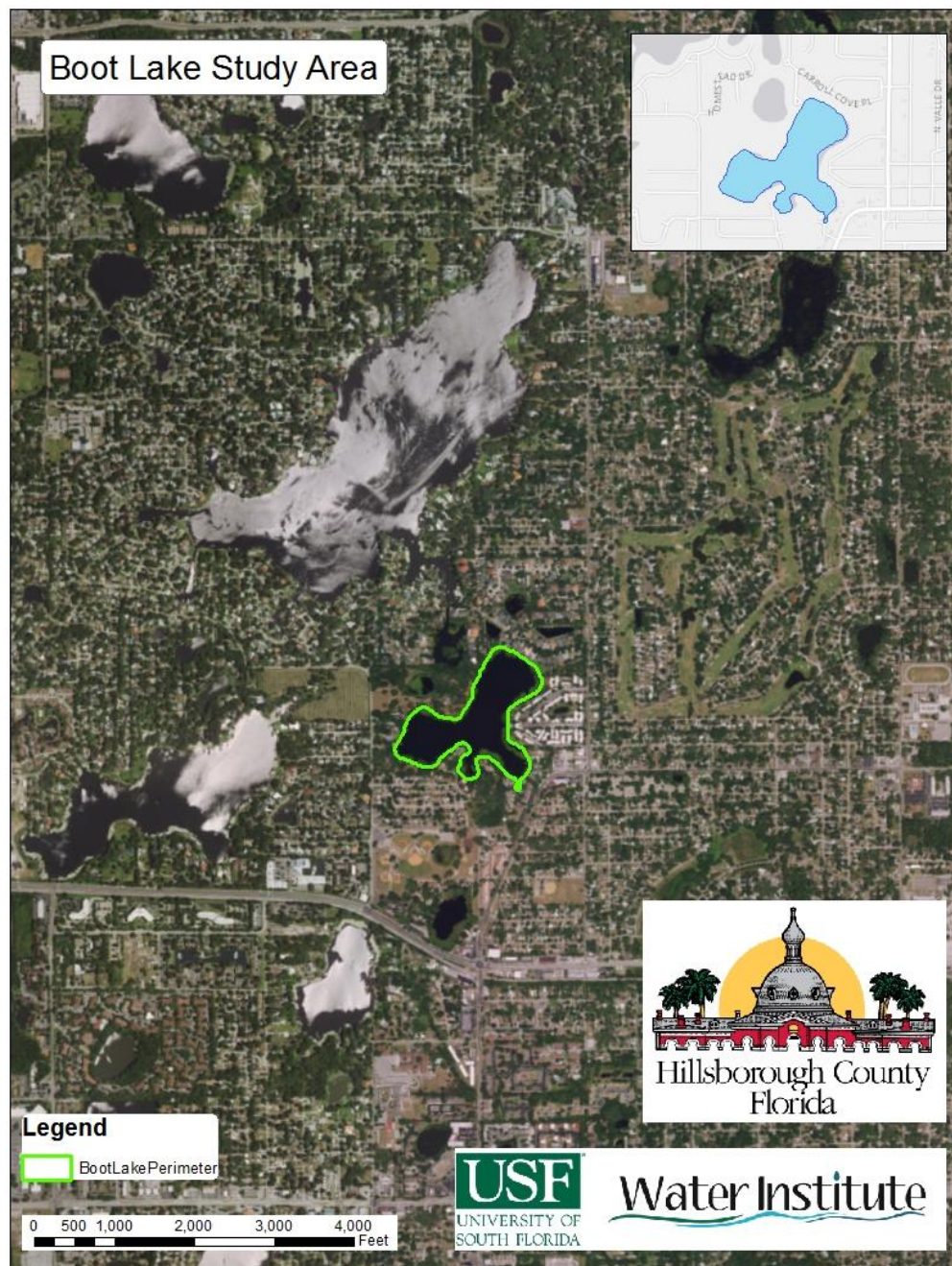
## **Water Quality Assessment**

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

Boot Lake is located west of N. Armenia Avenue in the Carrollwood area of Tampa, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Boot Lake is dominated by Residential land use (92%). The remaining areas within this buffer include Natural Lands (5%) and Commercial/Services (2%) land uses. The resulting LDI value for the 100 meter buffer around Boot Lake is 7.2.

Figure 1: 2017 Boot Lake Assessment Study Area Map





## Lake Bathymetry and Morphological Characterization

Boot Lake is a multi-lobed lake with isolated deeper holes in each lobe. At the time of the assessment, Boot Lake was experiencing moderately high water levels resulting in a 32.7 acre water body. Boot Lake at the time of the assessment had a mean water depth of 9.01 feet and a maximum observed depth of 17.8 feet. The volume at this time was approximately 96,029,596 gallons. Figure 2 shows the resulting bathymetric contour map for Boot Lake from data collected on July 6, 2017. The collected data has been overlain the 2016 Hillsborough County aerals.

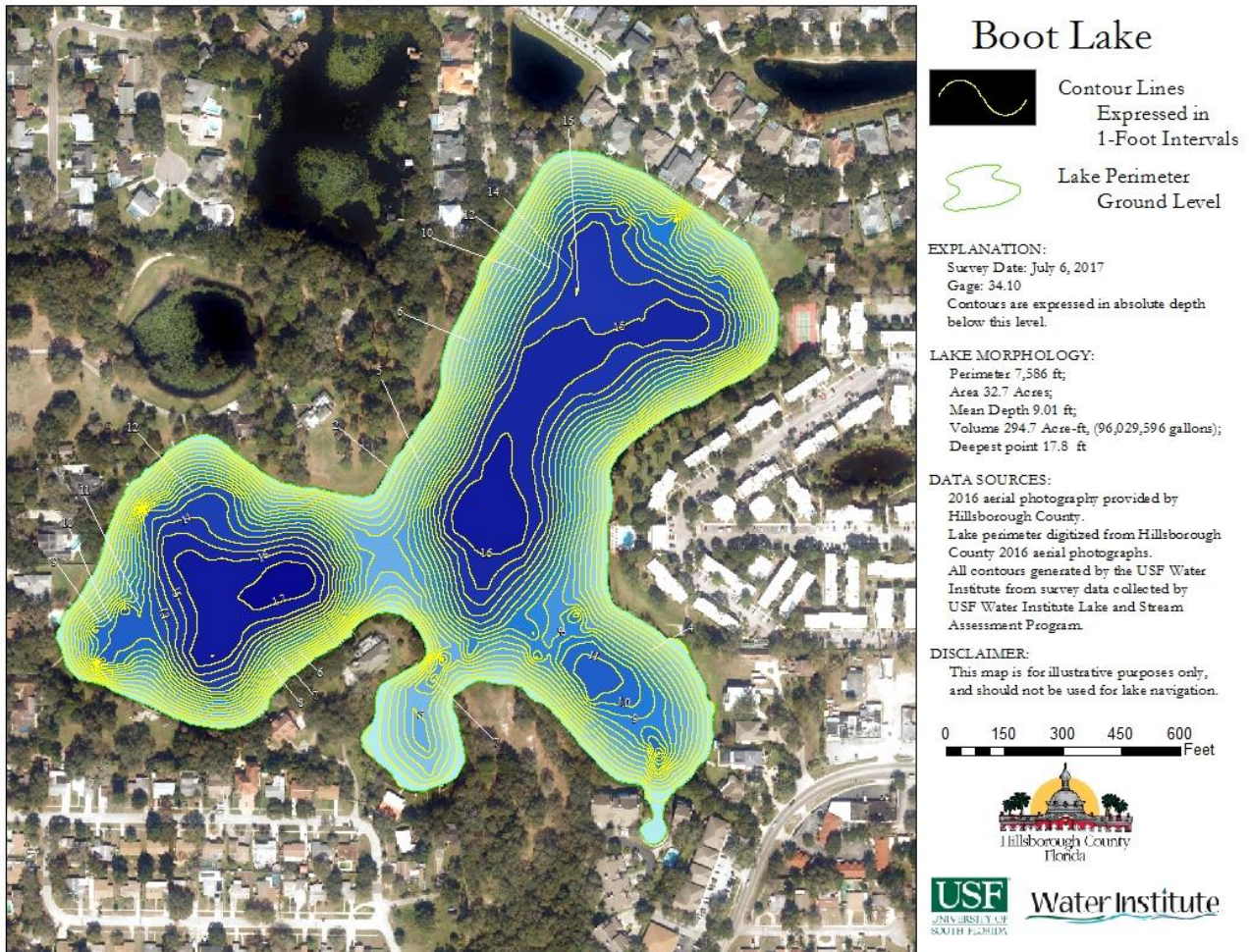


Figure 2: 2017 1-Foot Bathymetric Contour Map for Boot Lake

**Table 1: Morphological Calculations for Boot Lake**

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	1,424,026	132,295	32.7	0	0
Mean Depth	9.01	2.75	0	0	0
Maximum Depth	17.8	5.42	0	0	0
Volume (cubic)	12,837,201	363,506	0	294.7	96,029,596
Gauge (NGVD 88)	34.1	10.39	0	0	0

## Lake Vegetation Index Assessment



**Figure 3 Overview photograph of Boot Lake**

The lake assessment for Boot Lake was conducted on July 6, 2017. Boot Lake received a lake habitat assessment (FEDP form FD 9000-6) score of 77 due to suboptimal scores for Secchi, Vegetation Quality, Stormwater Inputs, Bottom Substrate Quality and Adverse Watershed Land Use. Marginal scores were achieved for Lakeside Adverse Human Alterations and Upland Buffer Zone received poor scores.





Figure 4 Boot Lake had a buffering zone of emergent vegetation surrounding the lake containing a mixture of native and invasive species.

The Lake Vegetation Index identified 46 species of wetland vegetation growing in the four selected sections along Boot Lake. The majority of these species (42) are native species. The remaining 4 species (*Panicum repens*, *Alternanthera philoxeroides*, *Melaleuca quinquenervia*, and *Ludwigia peruviana*) are non-native and invasive to this region. The vegetation community along Boot Lake is dominated by a variety of emergent species including *Typha*, *Pontederia cordata*, and *Hydrocotyle*. The water's surface in Boot Lake was dominated by *Nymphaea odorata* (Figure 5). A total of 6 species of submerged aquatic vegetation including *Eleocharis baldwinii*, *Najas guadalupensis*, *Nitella* sp., *Potamogeton illinoensis* (Figure 6), *Utricularia inflata* and *Utricularia radiata*. Submerged vegetation was readily observed during the assessment, and two of these species (*Nitella* and *Najas guadalupensis*) were considered codominant in three of the four LVI regions analyzed. By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 49.26% of the surface area Boot Lake. This submerged vegetation inhabits an estimated 4.43% of the water volume in Boot Lake. Figure 7 shows the results of the SAV analysis indicating the location and percent of the water column inhabited by SAV.

The calculated LVI score for Boot Lake was 53, above the impairment threshold of 37. Figure 8 shows the map of Boot 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* dominated the water surface in Boot Lake





Figure 6 *Potamogeton illinoensis* was observed on Boot Lake

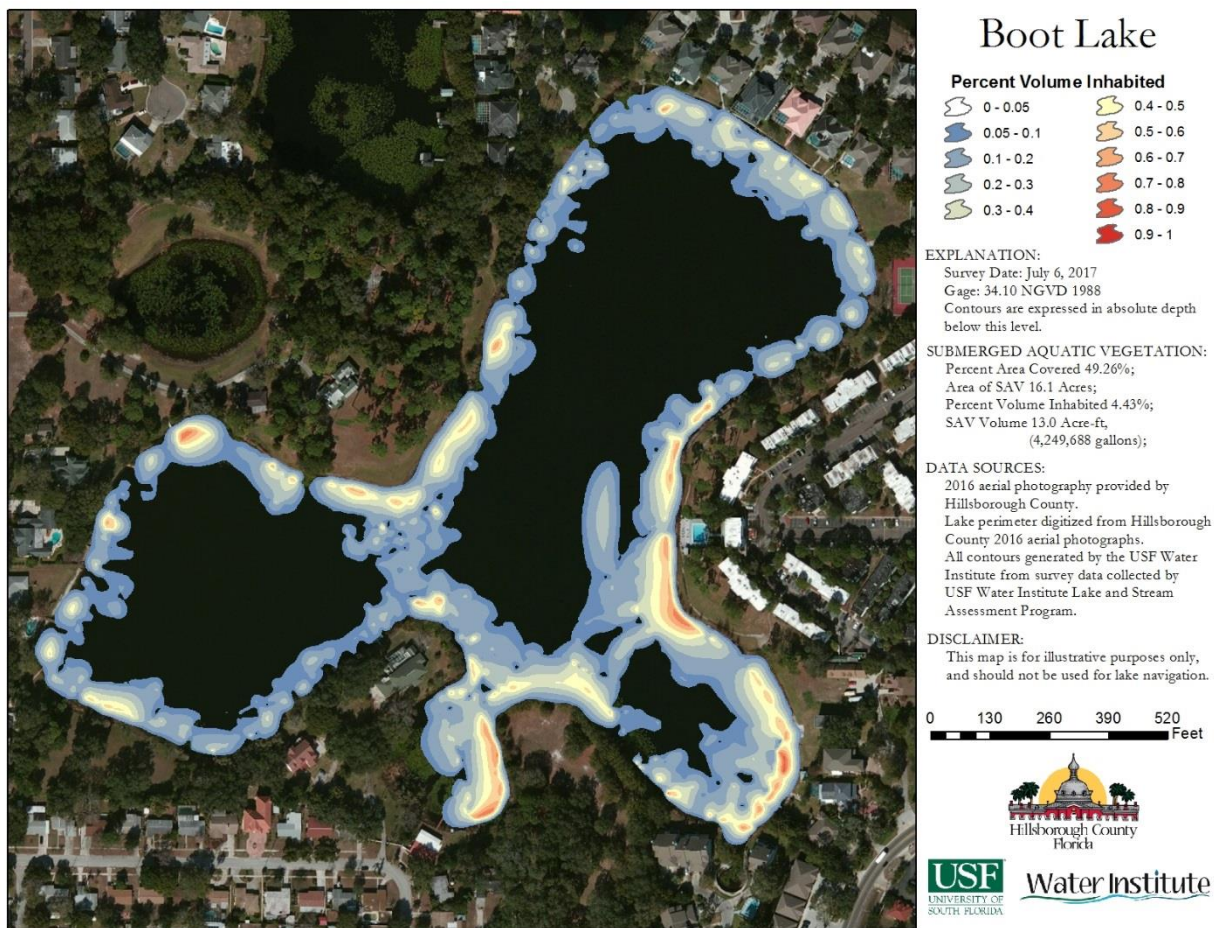


Figure 7 Boot Lake Submerged Aquatic Vegetation Assessment Results





Figure 8: Lake Vegetation Index region map for Boot Lake



Table 2: Lake Vegetation Index results for Boot Lake 7/6/17

SPECIES	CofC	Region			
		1	4	7	10
Acer rubrum	4.65			1	1
<b>Alternanthera philoxeroides</b>	0	1	1	1	1
Aster carolinianus	3.93			1	
Blechnum serrulatum	5.5		1	1	
Boehmeria cylindrica	5	1		1	
Casuarina equisetifolia	0	1		1	
Centella asiatica	1.92		1		
Cyperus articulatus	6.64				1
Cyperus odoratus	3	1	1	1	1
Cyperus polystachyos	1.92				1
Diodia virginiana	3		1		
Eclipta prostrata	2		1		1
Eleocharis baldwinii	2.82	1	1		1
Eleocharis cellulosa	7.8	1	1		1
Erechtites hieracifolia	1				1
Eupatorium capillifolium	0.83	1	1	1	1
Fuirena scirpoidea	5.5	1		1	1
Habenaria repens	3.5				1
Hydrocotyle	2	1	1	1	1
Liquidambar styraciflua	2.5			1	
Ludwigia leptocarpa	3	1		1	1
<b>Ludwigia peruviana</b>	0	1	1	1	1
Ludwigia repens	3.2		1		
<b>Melaleuca quinquenervia</b>	0		1	1	1
Mikania scandens	1.95	1	1	1	1
Myrica cerifera	2		1	1	1
Najas guadalupensis	5.07	1	C	1	1
Nitella	6	1	1	C	C
Nuphar	3.5			1	
Nymphaea odorata	5	D	C	C	C
<b>Panicum repens</b>	0	1	1	1	1
Phyla nodiflora	1.92		1		
Pluchea			1		
Polygonum hydropiperoides	2.5		1		
Pontederia cordata	5.38	1	1	1	1
Potamogeton illinoensis	6.64		1		1
Quercus laurifolia	4			1	
Sabatia grandiflora	6				1
Sagittaria lancifolia	3	1			1
Schinus terebinthifolius	0			1	
Taxodium	7	1			
Typha	1	1	1	1	1
Utricularia gibba	6.37	1	1		
Utricularia inflata	5.85			1	
Utricularia radiata	6.01	1	1	1	
Vitis rotundifolia	1.18			1	

Table 3: Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	1	4	7	10
Total # of taxa in sampling unit	22	27	28	27
% Native taxa in sampling unit	81.82	85.19	78.57	85.19
% FLEPPC CAT 1 taxa in sampling unit	13.64	11.11	17.86	11.11
% Sensitive taxa in sample unit	9.09	3.7	0	3.7
Dominant CoC in sample unit	5	5.04	5.5	5.5
Native Score $((x-62.5)/37.5)$ or $((x-66.67)/25.89)=$	0.585098	0.715148	0.459692	0.715148
Invasive FLEPPC 1 Score $(1 - (x/30))=$	0.545455	0.62963	0.404762	0.62963
Sensitive Score $(x/(27.78 \text{ or } 20)) =$	0.454545	0.185185	0	0.185185
Dominant CoC Score $(x/(7.91 \text{ or } 7)) =$	0.714286	0.719286	0.785714	0.785714
Raw Score Total = N+I+S+D =	2.299384	2.249249	1.650168	2.315677
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.574846	0.562312	0.412542	0.578919
South				
LVI Score for sampling unit =	57.48459	56.23122	41.25421	57.89193
<b>Total LVI SCORE = 53</b>				

## Water Quality Assessment

Limited long-term water quality data is not available for Boot Lake. The majority of the available data was collected as part of the University of Florida LAKEWATCH program. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of Boot Lake.

Table 4: Boot Lake Water Quality (Field)

Depth (m)	Temp °C	pH	DO (mg/L)	DO (%sat)	Cond (unho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)
0.29	32	7.48	6.89	91.4	211.6	0.1	135.4	
0.49	31.57	8.12	7.08	93.2	211.5	0.1	135.4	
3.36	30.18	7.52	0.64	8.2	212.4	0.1	135.9	
4.91	27.78	7.84	0	0	242	0.11	154.9	1.71
POR	23.91	7.12	5.1		204			

The chemical water quality analysis for Boot Lake is shown in Table 5 for the sample taken on July 6, 2017. Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment as well as the available LAKEWATCH geometric mean values for the period of record since complete data for the past three years for available parameters is not available. Total Phosphorous values were below the nutrient threshold for clear alkaline lakes with insufficient data developed by FDEP of 0.03 mg/l with a value of 0.015 mg/l for the POR and above the threshold for the single sample with a value of 0.044 mg/l. Total Nitrogen values were below the nutrient threshold for clear alkaline lakes with insufficient data developed by FDEP of 1.05 mg/l with a value of 0.015 mg/l for the POR data. The Total Nitrogen value associated with the sample for this assessment was 0.294 mg/l. Chlorophyll-a values are below the nutrient threshold for clear alkaline lakes developed by FDEP of 20.0 µg/l with a value of 8.3 µg/l.

Bacteria testing showed low levels of Fecal Coliform (24 colonies/100ml) and Enterococci (4 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: Boot Lake Water Quality Results from 7/6/2017 (Laboratory)

Parameter	Boot Lake (Center)	POR Mean Value	Units
Alkalinity	34.0	16.25	mg/LCaCO <sub>3</sub>
Nitrates/Nitrites	0.018		mg/L
Fecal Coliform	24	34.27	#/100 ml
Enterococci	4	47.52	#/100 ml
Chlorophyll a	9.5	6.20	ug/L
Chlorophyll b	2.6	1.67	ug/L
Chlorophyll c	0.7	1.61	ug/L
Chlorophyll t	10.2		ug/L
Chlorophylla Corr	8.3		ug/L
Chlorophyll-pheo	6.6		ug/L
Ammonia	0.006	0.014	mg/L
Kjeldahl Nitrogen	0.276	0.552	mg/L
Total Nitrogen	0.294	0.552	mg/L
Total Phosphorus	0.044	0.015	mg/L
Color(345)F.45	11.3	8	Pt/Co

**Table 6: Numeric Nutrient Criteria Framework**

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	9.54
Number of Samples	2
Geometric Mean Alkalinity (mg/L CaCO <sub>3</sub> )	20.78
Number of Samples	3
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	6.20
Geomean TP mg/L	0.015
Geomean TN mg/L	0.552
Number of Samples	296
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired

## Conclusion

The results of the assessment of Boot Lake shows a healthy lake based on Total Nitrogen, Total Phosphorous and Chlorophyll concentrations according to the FDEP numeric nutrient criteria using the single sample taken during this assessment and limited long term water quality record. The sampling data was insufficient to calculate proper FDEP Numeric Nutrient Criteria values. Consistent Long term sampling would be necessary to determine actual NNC values. The system also shows health in the vegetation communities according to the Lake Vegetation Index with moderate overall species (46), lower occurrences of non-native, invasive species and several sensitive plant species with an overall LVI score of 53. The assessment also revealed a significant submerged aquatic vegetation community comprising 6 species occupying 49.26% of the surface area and 4.43% of the volume of Boot Lake.