Lake Grace

Methods

Study Area Analysis

The watershed containing Lake Grace 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.

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[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 Grace is located near Citrus Park in Northwestern Hillsborough County, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake Grace is dominated by Medium Density Single Family Residential (91.36%) and Natural Land (87.6) land uses. The resulting LDI value for the 100 meter buffer around Lake Grace is 24.82.
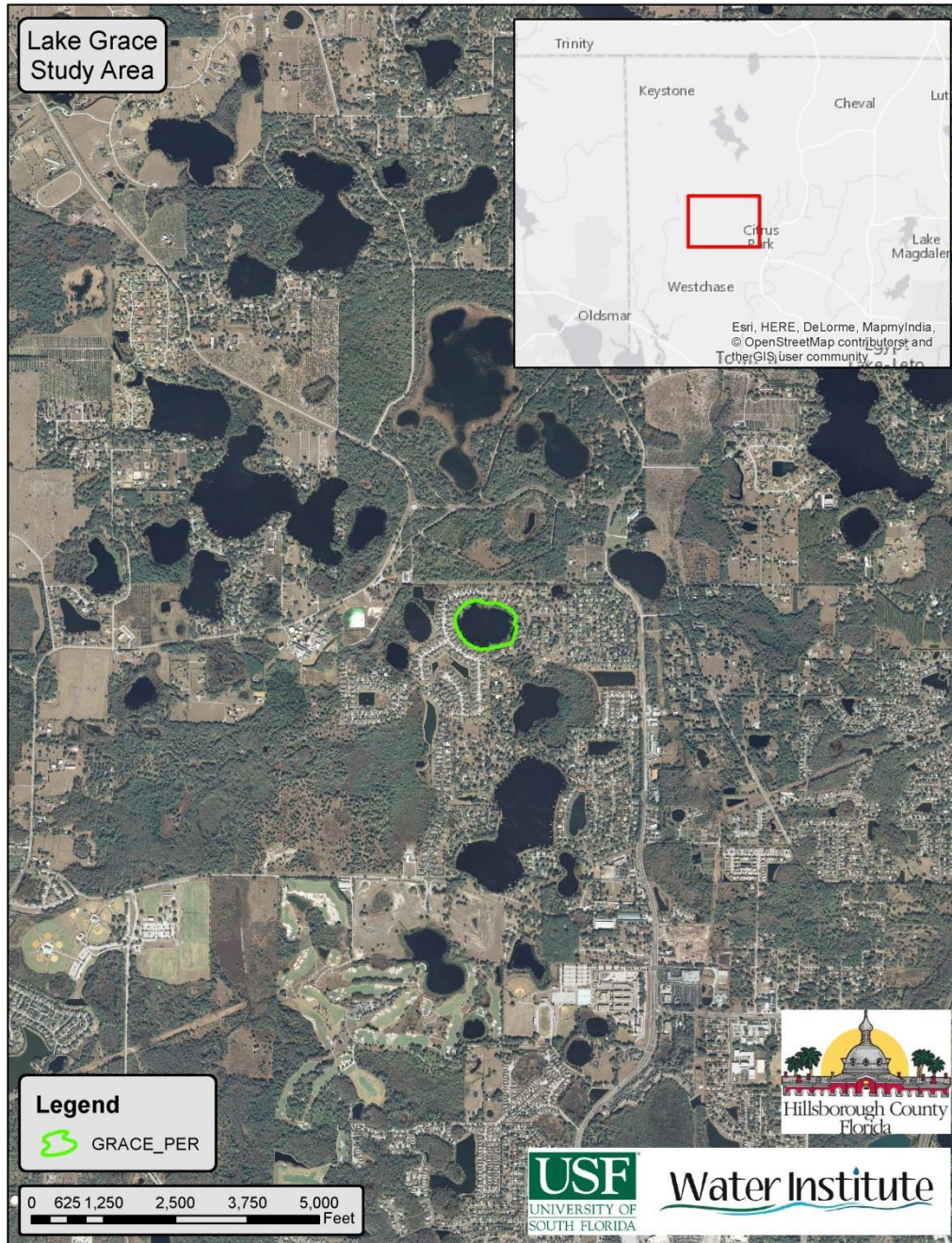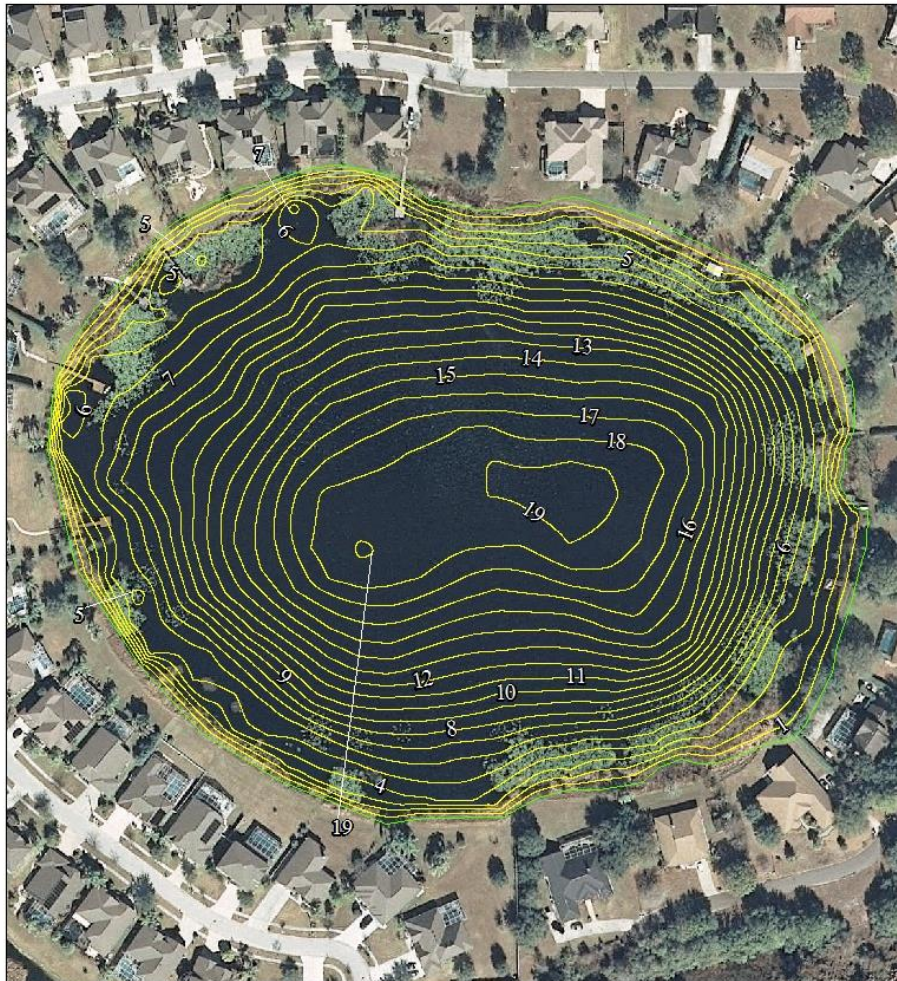

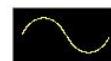**Figure 1 2015 Lake Grace Assessment Study Area Map**

Lake Bathymetry and Morphological Characterization

Lake Grace is an isolated lake that is relatively deep system for its size. At the time of the assessment, Lake Grace was experiencing moderately high water levels resulting in a 16.28 acre water body. Lake Grace at the time of the assessment had a mean water depth of 9.84 feet and a maximum observed depth of 19.74 feet. The volume at this time was approximately 52,189,828 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Grace from data collected on August 13, 2015. The collected data has been overlain the 2011 Hillsborough County aerials.

Figure 2 2015 1-Foot Bathymetric Contour Map for Lake Grace

Table 1 Morphological Calculations for Lake Grace

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	709,319	65,898	16.28	0	0
Mean Depth	9.84	3.01	0	0	0
Maximum Depth	19.74	6.02	0	0	0
Volume (cubic)	6,974,717	197,502	0	160.2	52,189,828
Gauge (relative)	unknown	unknown	0	0	0

Lake Vegetation Index Assessment

Figure 3 Overview photograph of Lake Grace

The lake assessment for Lake Grace was conducted on August 13, 2015. Lake Grace received a lake habitat assessment (FEDP form FD 9000-6) score of 54 due to suboptimal scores for Vegetation Quality. Marginal scores were achieved for Secchi, Stormwater Inputs, Bottom Substrate Quality and Adverse Watershed Land Use. Lakeside Adverse Human Alterations and Upland Buffer Zone received poor scores.

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

The Lake Vegetation Index identified 28 species of wetland vegetation growing in the four selected sections along Lake Grace. The majority of these species (22) are native species. The remaining 6 species (*Panicum repens*, *Alternanthera philoxeroides, Oxycaryum cubense, Salvinia minima, Eichhornia crassipes* and *Ludwigia peruviana*) are non-native and invasive to this region. The vegetation community along Lake Grace is dominated by a variety of emergent species including *Typha, Fuirena scirpoidea and Panicum hemitomon* (Figure 5). The water's surface in Lake Grace was dominated by *Nuphar* (Figure 6) and *Nymphaea odorata*. The calculated LVI score for Lake Grace was 39, above the impairment threshold of 37. Figure 7 shows the map of Lake Grace 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. The submerged vegetation of Lake Grace was dominated by *Eleocharis baldwinii.* Some *Chara* and *Najas guadalupensis*, two species of submerged vegetation were also observed during the assessment. By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 40% of the surface area of Lake Grace. This submerged vegetation inhabits an estimated 7.97% of the water volume in Lake Grace.

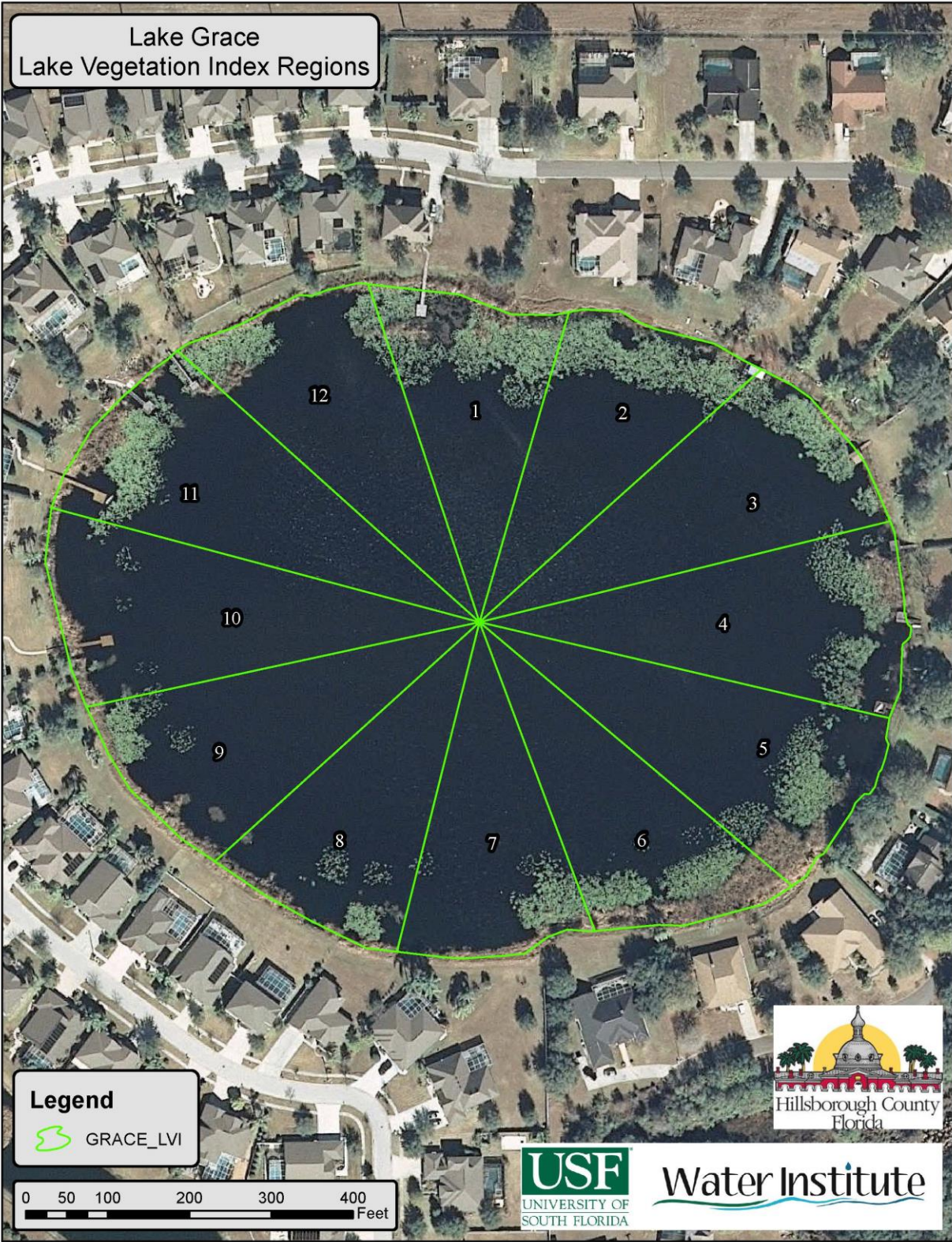**Figure 5 Emergent Vegetation on Lake Grace**

Figure 6 *Nuphar* on Lake Grace

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Figure 7 Lake Vegetation Index region map for Lake Grace

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Table 2 Lake Vegetation Index results for Lake Grace August 13, 2015

SPECIES	CofC	Region			
		3	6	9	12
Bacopa monnieri	3.50	1	1	1	1
Chara	3.90	1	1	1	1
Eleocharis baldwinii	2.82	D	D	D	D
Ludwigia peruviana	0.00	1	1	1	1
Najas guadalupensis	5.07	1	1	1	1
Nuphar	3.50	1	1	1	1
Nymphaea odorata	5.00	1	1	1	1
Oxycaryum cubense	0.50	1	1	1	1
Panicum repens	0.00	1	1	1	1
Pontederia cordata	5.38	1	1	1	1
Sagittaria lancifolia	3.00	1	1	1	1
Typha	1.00	1	1	1	1
Hydrocotyle	2.00	1		1	1
Panicum hemitomon	5.82		1	1	1
Alternanthera philoxeroides	0.00	1			1
Ludwigia octovalvis	2.00			1	1
Salvinia minima	0.00	1		1	
Xyris brevifolia	7.20			1	1
Acer rubrum	4.65	1			
Blechnum serrulatum	5.50				1
Eichhornia crassipes	0.00		1		
Eleocharis cellulosa	7.80				1
Eleocharis interstincta	7.80			1	
Eupatorium capillifolium	0.83	1			
Fuirena scirpoidea	5.50			1	
Polygonum hydropiperoides	2.50				1
Taxodium	7.00	1			
Xyris platylepis	5.32		1		

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Table 3 Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	3	6	9	12
Total # of taxa in sampling unit	18	15	19	20
% Native taxa in sampling unit	72.22222	73.33333	78.94737	80
% FLEPPC CAT 1 taxa in sampling unit	16.66667	20	15.78947	10
% Sensitive taxa in sample unit	5.555556	0	10.52632	10
Dominant CoC in sample unit	2.82	2.82	2.82	2.82
Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.214454	0.257371	0.474213	0.514871
Invasive FLEPPC 1 Score (1 - (x/30))=	0.444444	0.333333	0.473684	0.666667
Sensitive Score (x/(27.78 or 20)) =	0.277778	0	0.526316	0.5
Dominant CoC Score (x/(7.91 or 7)) =	0.402857	0.402857	0.402857	0.402857
Raw Score Total = N+I+S+D =	1.339534	0.993561	1.87707	2.084394
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.334883	0.24839	0.469267	0.521099
South				
LVI Score for sampling unit =	33.48834	24.83904	46.92675	52.10986
Total LVI SCORE =	39			

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Water Quality Assessment

Long-term water quality data is not available for Lake Grace. The available data was collected as part of this lake assessment. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of Lake Grace.

Table 4 Lake Grace Water Quality (Field)

Depth (m)	Temp (c)	pH	DO (mg/L)	DO (% Sat)	Cond (umho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)
0.12	31.79	7.44	7.91	106.7	172.4	0.08	110.3	1.2
0.22	31.67	7.4	8.15	109.6	172.4	0.08	110.3	
2.14	29.77	6.82	5.72	74.5	171.3	0.08	109.6	
5.21	27.29	6.63	0	0	160.2	0.07	102.5	

The chemical water quality analysis for Lake Grace is shown in Table 5 for the sample taken on August 13, 2015. Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment since geometric mean values for the past three years for available parameters are not available. Total Phosphorous values were at the nutrient threshold for clear alkaline lakes with insufficient data developed by FDEP of 0.03 mg/l with a value of 0.030 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 0.534 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 (less than 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 Grace Water Quality Results from 8/13/2015(Laboratory)

Parameter	Value	Units
Alkalinity	30.0	mg/LCaCO3
Nitrates/Nitrites	0.003	mg/L
Fecal Coliform	<10	#/100 ml
Enterococci	240	#/100 ml
Chlorophyll a	10.0	ug/L
Chlorophyll b	2.6	ug/L
Chlorophyll c	2.0	ug/L
Chlorophyll t	13.5	ug/L
Chlorophylla Corr	8.3	ug/L
Chlorophyll-pheo	2.5	ug/L
Ammonia	0.078	mg/L
Kjeldahl Nitrogen	0.531	mg/L
Total Nitrogen	0.534	mg/L
Total Phosphorus	0.030	mg/L
Color(345)F.45	14.7	Pt/Co

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Table 6 Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	14.7
Number of Samples	1
Geometric Mean Alkalinity (mg/L CACO3)	30
Number of Samples	1
Lake Type	Clear Alkaline
Chlorophyll a Criteria (ug/L)	20
Insufficient for Geomean Criteria then P mg/L	0.03
Insuffcient for Geomean Criteria then N mg/L	1.05
Geomean Chla ug/L	8.3
Geomean TP mg/L	0.030
Geomean TN mg/L	0.534
Number of Samples	1
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired

Conclusion

The results of the assessment of Lake Grace does not show impairment based on Total Nitrogen, Total Phosphorous and Chlorophyll concentrations according to the FDEP numeric nutrient criteria using the single sample taken during this assessment. Long term sampling would be necessary to determine actual NNC values. The system also does not show impairment in the vegetation communities according to the Lake Vegetation Index with moderate overall species, moderate occurrences of non-native, invasive species and four sensitive plant species with an overall LVI score of 39. Bacteria sampling also revealed a low biomass of Fecal Coliform bacteria present at the time of the assessment.

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