Lake Wimauma

Methods

Study Area Analysis

The watershed containing Lake Wimauma was analyzed using ESRI ArcGIS 10.2. Using this software with 2014 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 Brown & Vivas 2003, 2005 (Brown & Vivas. 2003. A Landscape Development Intensity (LDI) Index. Center for Environmental Policy, Department of Environmental Engineering Sciences, University of Florida. Technical Report Submitted to the Florida Department of Environmental Protection) and (Brown & Vivas. 2005. Landscape development intensity index. Environmental Monitoring and Assessment 101: 289-309.) According to Brown and Vivas, "The intensity and aerial extent of human activities in a landscape may adversely affect the ecological processes of natural communities…the Landscape Development Intensity Index (LDI) functions as an objective measure of how human disturbance affects biological, chemical, and physical processes of aquatic systems. By incorporating non-renewable energy input expenditures… natural systems were assigned a non-renewable empowerment density of 0. The landscape development intensity (LDI) index is calculated as the percentage area within the catchment of a particular type of land use multiplied by the coefficient of energy use associated with that land use, summed over all land use types found in the catchment."

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 Wimauma is located south of highway 674, east of W Lake Dr. in Wimauma, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake Dan is dominated by Low Density, <2 dwelling units/acre (54%), Cropland and Pastureland (17.47%), and Stream and Lake Swamps (bottomland) (14.9%) land uses. The resulting LDI value for the 100 meter buffer around Lake Wimauma is 4.80. The LDI value calculated for the FDEP WBID containing Lake Wimauma was 2.83 with approximately 29.4% Other Open Lands (Rural), 13% Stream and Lake Swamps (bottomland), 12.1% Shrub and Brushland, and 11% Low Density, <2 dwelling units/acre natural landscapes.

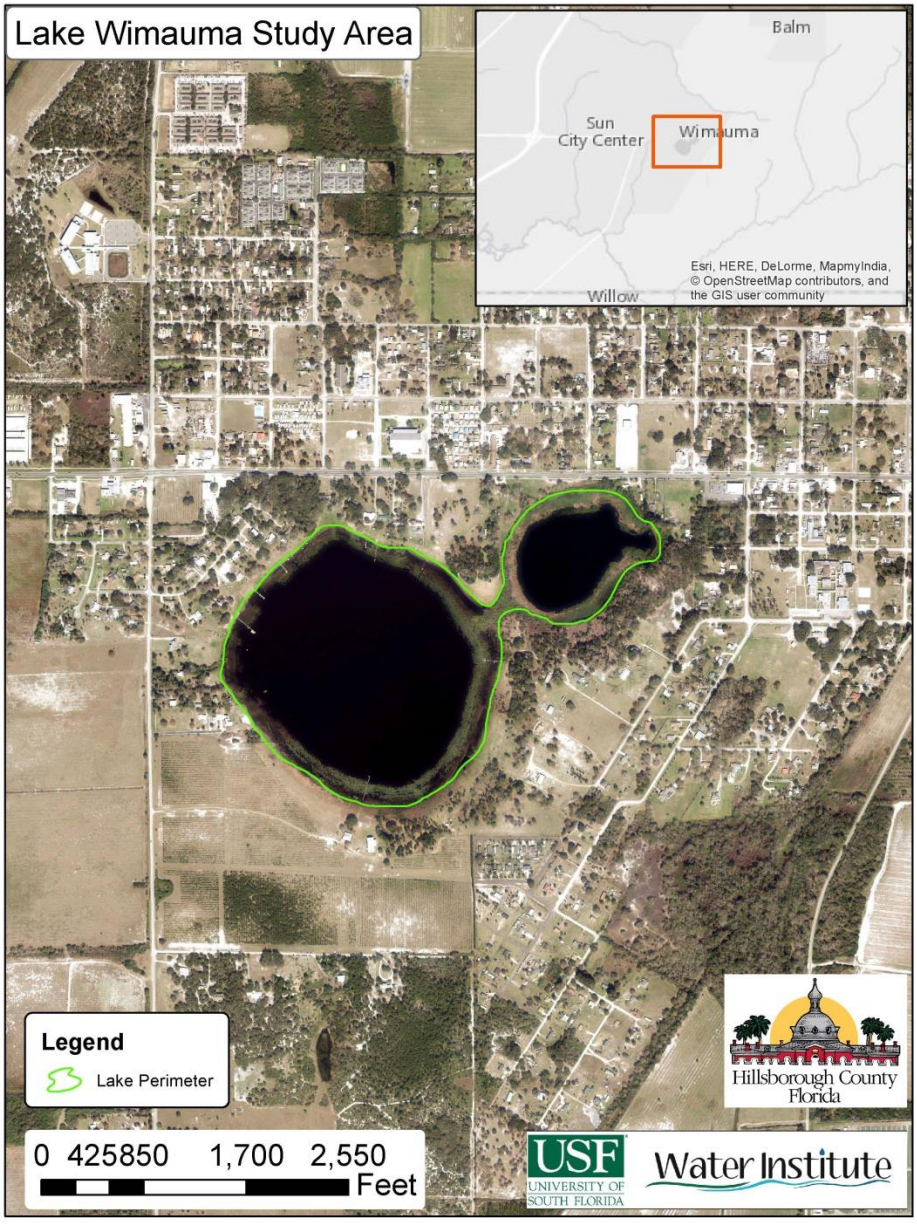

Figure 1 2016 Lake Wimauma Assessment Study Area Map

Lake Bathymetry and Morphological Characterization

Lake Wimauma depression system with intermittent connection between the two lobe . Lake Wimauma at the time of the assessment had a mean water depth of 10.79 feet and a maximum observed depth of 23.1 feet. The volume at this time was approximately 401,649,597 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Wimauma from data collected on July 12, 2016. The collected data has been overlain the 2016 Hillsborough County aerials.

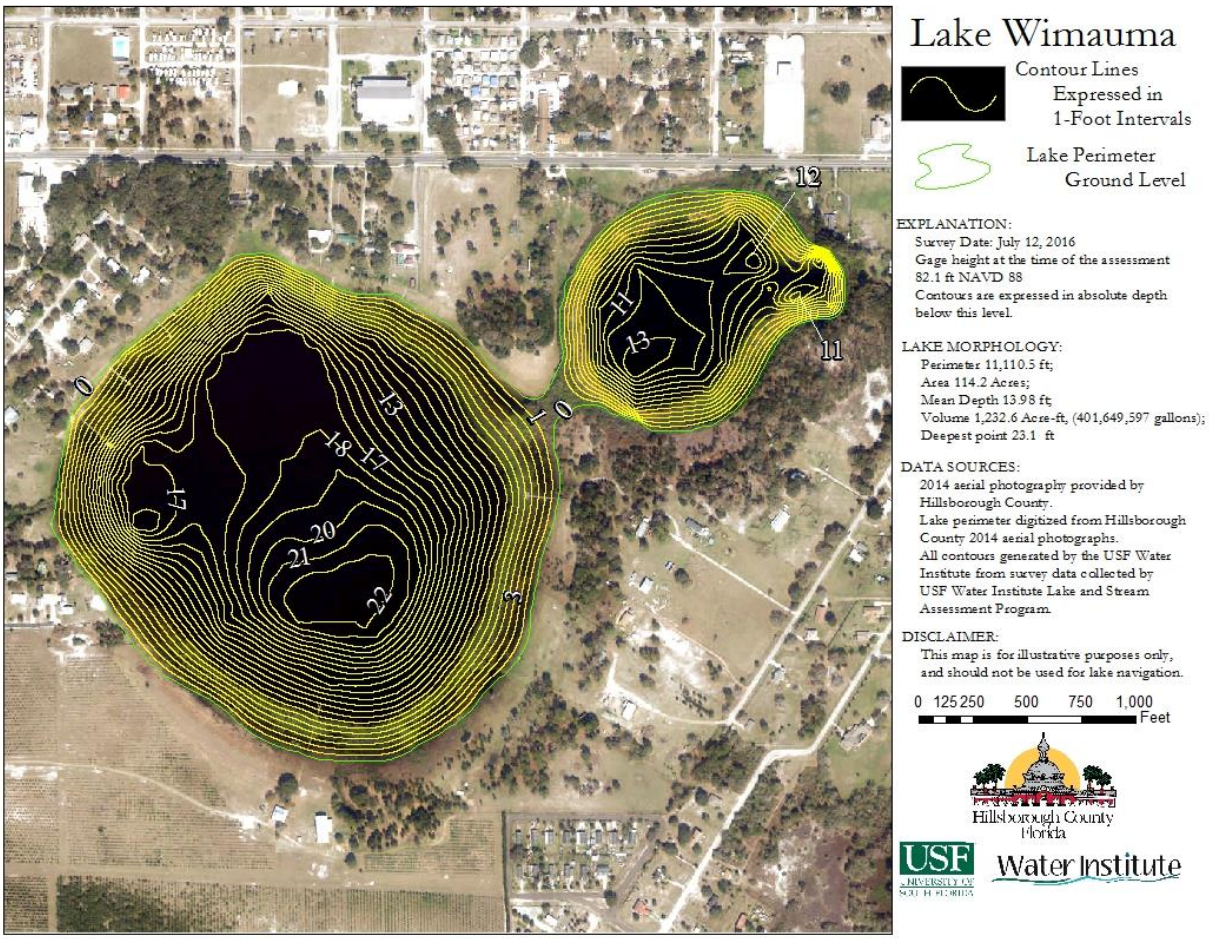

Figure 2 2016 1-Foot Bathymetric Contour Map for Lake Wimauma.

Table 1 Morphological Calculations for Lake Wimauma.

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	4,975,042	462,193	10.12	0	0
Mean Depth	10.79	3.29	0	0	0
Maximum Depth	23.1	7.03	0	0	0
Volume (cubic)	53,692,369	1,520,384	0	1,232.6	401,649,597
Gauge (relative)	82.1	25.02	0	0	0

Lake Vegetation Index Assessment

Figure 3 Overview photograph of Lake Wimauma.

The lake assessment for Lake Wimauma was conducted on July 12, 2016. Lake Wimauma received a lake habitat assessment (FEDP form FD 9000-6) score of 86 due to suboptimal scores for Secchi, Vegetation Quality, Stormwater Inputs, Bottom Substrate Quality, Lakeside Adverse Human Alterations and Adverse Watershed Land Use. Marginal scores were achieved for Upland Buffer Zone.

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

The Lake Vegetation Index identified 44 species of wetland vegetation growing in the four selected sections along Lake Wimauma. The majority of these species (33) are native species. The remaining 11 species (Shown in Bold on Table 2) are non-native and invasive to this region. Dominant and Co-dominant species are denoted with a "C" or a "D" in Table 2. The vegetation community along Lake Wimauma is dominated by a variety of emergent species including *Typha, Panicum repens* and *Ludwigia peruviana* (Figure 4). The water's surface in Lake Wimauma was dominated by *Nymphaea odorata* (Figure 6). The calculated LVI score for Lake Wimauma was 32, below the impairment threshold of 37. Figure 7 shows the map of Lake Wimauma 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. Submerged vegetation was sparsely observed during the assessment. By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 5% of the surface area of Lake Wimauma. This submerged vegetation inhabits an estimated 0.63% of the water volume in Lake Wimauma.

Figure 5 *Nymphaea odorata* on Lake Wimauma.

Figure 6 *Utricularia gibba* on Lake Wimauma.

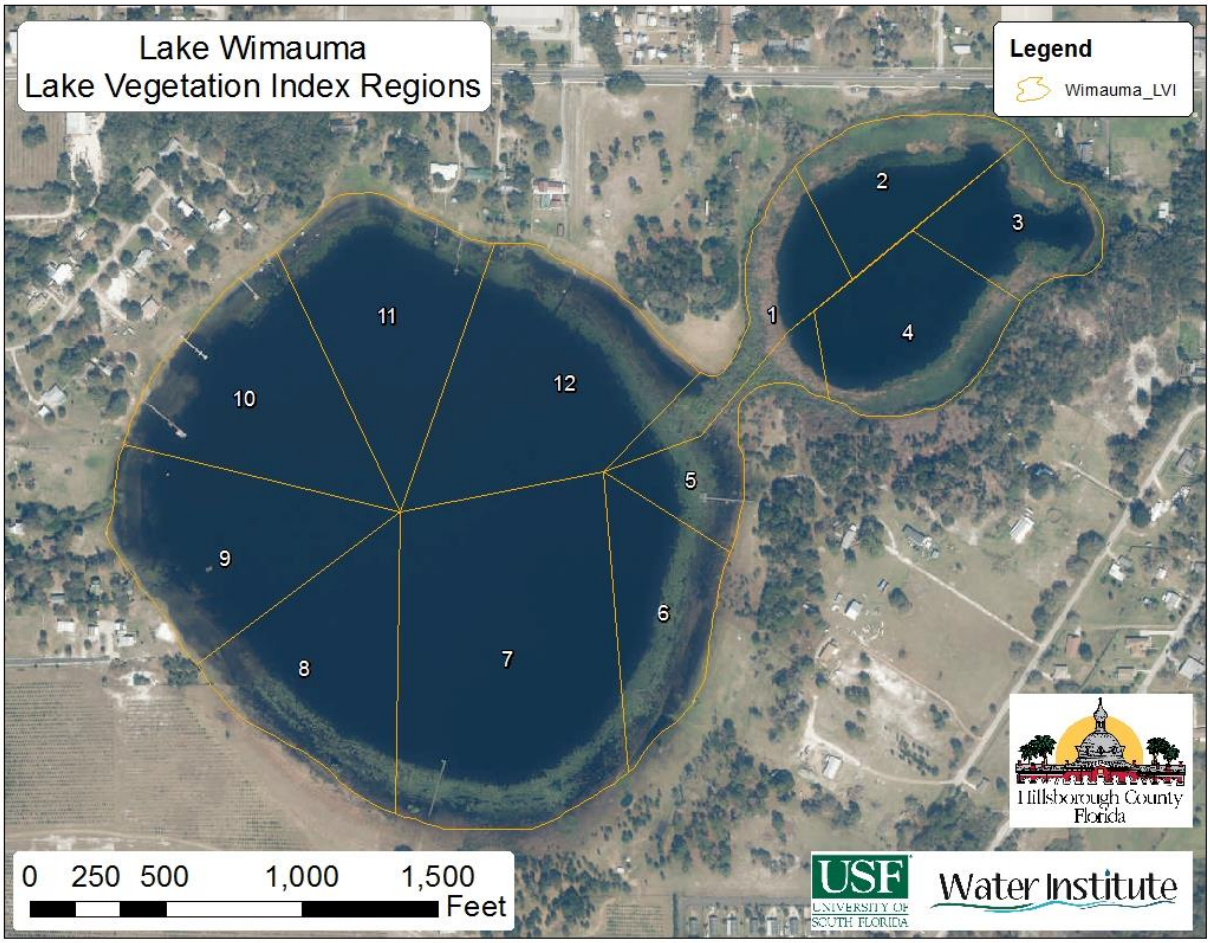

Figure 7 Lake Vegetation Index region map for Lake Wimauma.

Table 2 Lake Vegetation Index results for Lake Wimauma 7/12/2016.

SPECIES	Region				
	CofC	3	6	9	12
Alternanthera philoxeroides	0.00	**1**	**1**	**1**	**1**
Eleocharis baldwinii	2.82	**1**	**1**	**1**	**1**
Eupatorium capillifolium	0.83	**1**	**1**	**1**	**1**
Hydrocotyle	2.00	**1**	**1**	**1**	**1**
Nymphaea odorata	5.00	**1**	**D**	**1**	**D**
Oxycaryum cubense	0.50	**C**	**1**	**1**	**1**
Salvinia minima	0.00	**1**	**1**	**1**	**1**
Typha	1.00	**1**	**1**	**1**	**1**
Utricularia olivacea	3.33	**1**	**1**	**1**	**1**
Cephalanthus occidentalis	5.00	**1**	**1**		**1**
Fuirena scirpoidea	5.50		**1**	**1**	**1**
Ludwigia arcuata	3.50		**1**	**1**	**1**
Ludwigia peploides	4.00		**1**	**1**	**1**
Ludwigia peruviana	0.00	**C**	**1**	**1**	**1**
Mikania scandens	1.95		**1**	**1**	**1**
Myrica cerifera	2.00	**1**	**1**		**1**
Panicum hemitomon	5.82		**1**	**1**	**1**
Panicum repens	0.00		**1**	**D**	**1**
Pontederia cordata	5.38		**1**	**1**	**1**
Sacciolepis striata	5.35		**1**	**1**	**1**
Salix caroliniana	2.95	**1**		**1**	**1**
Acer rubrum	4.65	**1**	**1**		
Cyperus polystachyos	1.56			**1**	**1**
Cyperus prolifer	0.00		**1**		**1**
Cyperus surinamensis	2.03			**1**	**1**
Habenaria repens	3.50	**1**			**1**
Juncus marginatus	1.50			**1**	**1**
Ludwigia octovalvis	2.00	**1**		**1**	
Melaleuca quinquenervia	0.00		**1**		**1**
Nuphar	3.50			**1**	**1**
Taxodium	7.00		**1**	**1**	
Bacopa monnieri	3.50			**1**	
Blechnum serrulatum	5.50	**1**			
Casuarina equisetifolia	0.00	**1**			
Ceratopteris thalictroides	2.93	**1**			
Cyperus odoratus	3.00				**1**
Dryopteris ludoviciana	7.00		**1**		
Eichhornia crassipes	0.00	**1**			
Fuirena pumila	4.00				**1**
Ilex cassine	6.00				**1**
Ludwigia repens	3.20			**1**	
Schinus terebinthifolius	0.00				**1**
Utricularia gibba	6.37	**1**			
Xyris platylepis	5.32	**1**			

Table 3 Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	3	6	9	12
Total # of taxa in sampling unit	22	25	27	32
% Native taxa in sampling unit	68.18	72.00	81.48	75.00
% FLEPPC CAT 1 taxa in sampling unit	18.18	16.00	11.11	15.63
% Sensitive taxa in sample unit	0	8.00	3.70	0
Dominant CoC in sample unit	0.25	5.00	0	5.00

Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.058	0.206	0.572	0.322
Invasive FLEPPC 1 Score (1 - (x/30))=	0.394	0.467	0.630	0.479
Sensitive Score (x/(27.78 or 20)) =	0	0.400	0.185	0
Dominant CoC Score (x/(7.91 or 7)) =	0.036	0.714	0	0.714
Raw Score Total = N+I+S+D =	0.488	1.787	1.387	1.515
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.122	0.447	0.347	0.379
South				
LVI Score for sampling unit =	12	45	35	38
Total LVI SCORE =	32			

Water Quality Assessment

Long-term water quality data is not available for Lake Wimauma. 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 Wimauma.

Table 4 Lake Wimauma Water Quality (Field)

Depth (m)	Temp (C)	pH	DO (mg/L)	DO (% Sat)	Cond (umho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)	Location
0.49	31.47	5.96	5.1	67.8	116.5	0.05	74.6	2.44	Wimauma West
5.13	27.8	5.97	0	0	119.2	0.06	76.3		Wimauma West
2.44	31.36	6.19	5.43	72	116.3	0.05	74.4		Wimauma West
0.2	31.53	6.06	5.22	69.4	116.5	0.05	74.6		Wimauma West
0.21	32.71	6.16	3.78	51.4	137	0.06	87.7	1.37	Wimauma East
3.38	28.96	5.87	0	0	145.5	0.07	93.1		Wimauma East
1.5	31.06	6.24	3.59	47.5	136.3	0.06	87.2		Wimauma East
0.24	32.87	6.25	3.81	51.9	137.1	0.06	87.7		Wimauma East

The chemical water quality analysis for Lake Wimauma is shown in Table 5 for the sample taken on July 12, 2016. 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 above the nutrient threshold for clear acidic lakes with insufficient data developed by FDEP of 0.01 mg/l with a value of 0.025 mg/l. Total Nitrogen values were above the nutrient threshold for clear acidic lakes with insufficient data developed by FDEP of 0.51mg/l with a value of 0.563 mg/l. Chlorophyll-a values are below the nutrient threshold for clear acidic lakes developed by FDEP of 6.0 µg/l with a value of 5.66 µg/l.

Bacteria testing showed elevated levels of Fecal Coliform (220 colonies/100ml) above 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 Wimauma Water Quality Results from 7/12/2015 (Laboratory)

Parameter	Wimauma East	Wimauma West	Geomean
Alkalinity	22	10	14.832
Nitrates/Nitrites	0.003	0.003	0.003
Fecal Coliform	220	20	66.332
Enterococci	700	100	264.575
Chlorophyll a	7.6	5.6	6.524
Chlorophyll b	5	2.6	3.606
Chlorophyll c	0.5	1	0.707
Chlorophyll t	12.6	7.7	9.850
Chlorophylla Corr	6.4	5	5.657
Chlorophyll-pheo	6.6	6.6	6.600
Ammonia	0.006	0.006	0.006
Kjeldahl Nitrogen	0.468	0.67	0.560
Total Nitrogen	0.471	0.673	0.563
Total Phosphorus	0.025	0.025	0.025
Color(345)F.45	19.2	12.9	15.738

Table 6 Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	15.74
Number of Samples	2
Geometric Mean Alkalinity (mg/L CACO3)	14.83
Number of Samples	2
Lake Type	Clear Acidic
Chlorophyll a Criteria (ug/L)	6
Insufficient for Geomean Criteria then P mg/L	0.01
Insuffcient for Geomean Criteria then N mg/L	0.51
Geomean Chla ug/L	5.66
Geomean TP mg/L	0.025
Geomean TN mg/L	0.563
Number of Samples	2
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Impaired
Potential Impaired TN	Impaired

Conclusion

The results of the assessment of Lake Wimauma shows impairment based on Total Nitrogen and Total Phosphorous 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 shows impairment in the vegetation communities according to the Lake Vegetation Index with low overall species, high occurrences of non-native, invasive species and few sensitive plant species with an overall LVI score of 32. Bacteria sampling also revealed elevated biomass of Fecal Coliform bacteria present at the time of the assessment.