Pretty Lake

LAKE HABITAT ASSESSMENT, LAKE VEGETATION IDEX, SUBMERGED VEGETATION SURVEY AND WATER QUALITY

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Methods

STUDY AREA ANALYISIS

The watershed containing the Pretty Lake was analyzed using ESRI ArcGIS 10.6. Using this software with 2020 Hillsborough County aerial, 2014 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 one. In the Florida framework, the maximum LDI index score is approximately 42."

The LDI is calculated by multiplying each land use coefficient by the percentage of the area of interest occupied by that land use, and then summing the results. The Florida Department of Environmental Protection (DEP) uses the LDI as a tool to estimate potential land use impacts on streams, lakes, and wetlands. LDI values less than two (≤ 2) can be considered minimally disturbed."

LAKE BATHYMETRY AND MORPHOLOGICAL CHARACTERISTICS ASSESSMENT

The Bathymetric Map[1] provides the lake's morphologic parameters in various units. The bottom of the lake was mapped using a Lowrance Elite 7 Ti Wide Area Augmentation System (WAAS)[2] enabled Global Positioning System (GPS) with Totalscan transducer (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.

[1] 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.

[2] 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 43.

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.

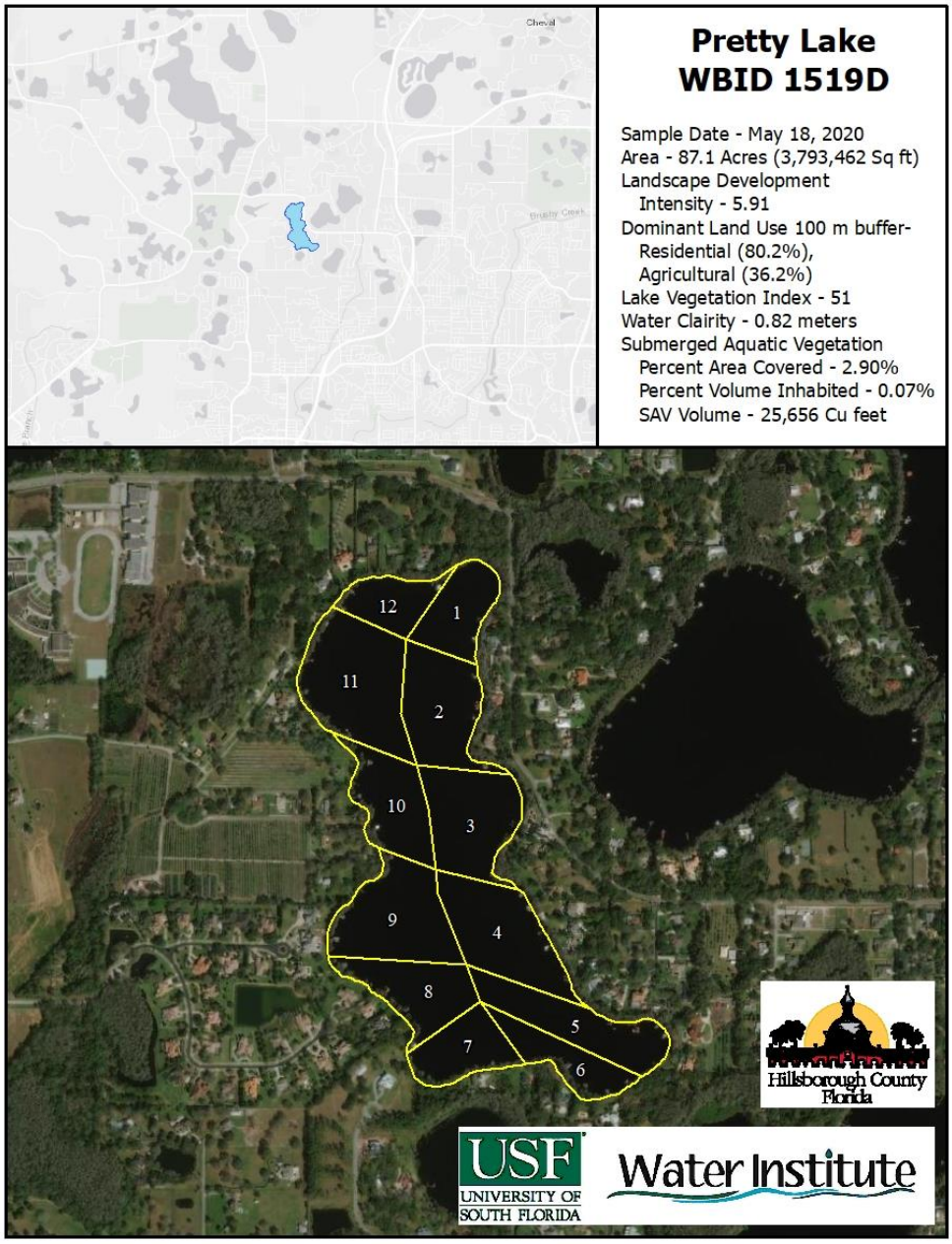
WATER QUALITY ASSESSMENT

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, EColi, 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

Pretty Lake is located in north-western Hillsborough County, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Pretty Lake is dominated by Residential (80.2%), Agricultural (36.2%) and Natural (11.4%) land uses. The resulting LDI value for the 100 meter buffer around Pretty Lake is 5.91.

FIGURE 1: 2020 Pretty Lake ASSESSMENT STUDY AREA MAP



Lake Bathymetry and Morphological Characterization

At the time of the assessment, Pretty Lake was experiencing elevated water levels (42.77 feet above sea level NAVD 88) resulting in a 87.1 acre water body. Pretty Lake at the time of the assessment had a mean water depth of 10.3 feet and a maximum observed depth of 24.9 feet. The volume at this time was approximately 292,848,766 gallons. Figure 2 shows the resulting bathymetric contour map for Pretty Lake from data collected on May 18, 2020. The collected data has been overlain the 2020 Hillsborough County aerials.

Table 1: Morphological Calculations for Pretty Lake

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	3,793,462	352,421	87.1		
Mean Depth	10.3	3.15			
Maximum Depth	24.9	7.59			
Volume (cubic)	39,147,914	1,108,535		898.7	292,848,766
Gauge (NAVD 88)	42.77	13.04			

Figure 2: 2020 2-Foot Bathymetric Contour Map for Pretty Lake

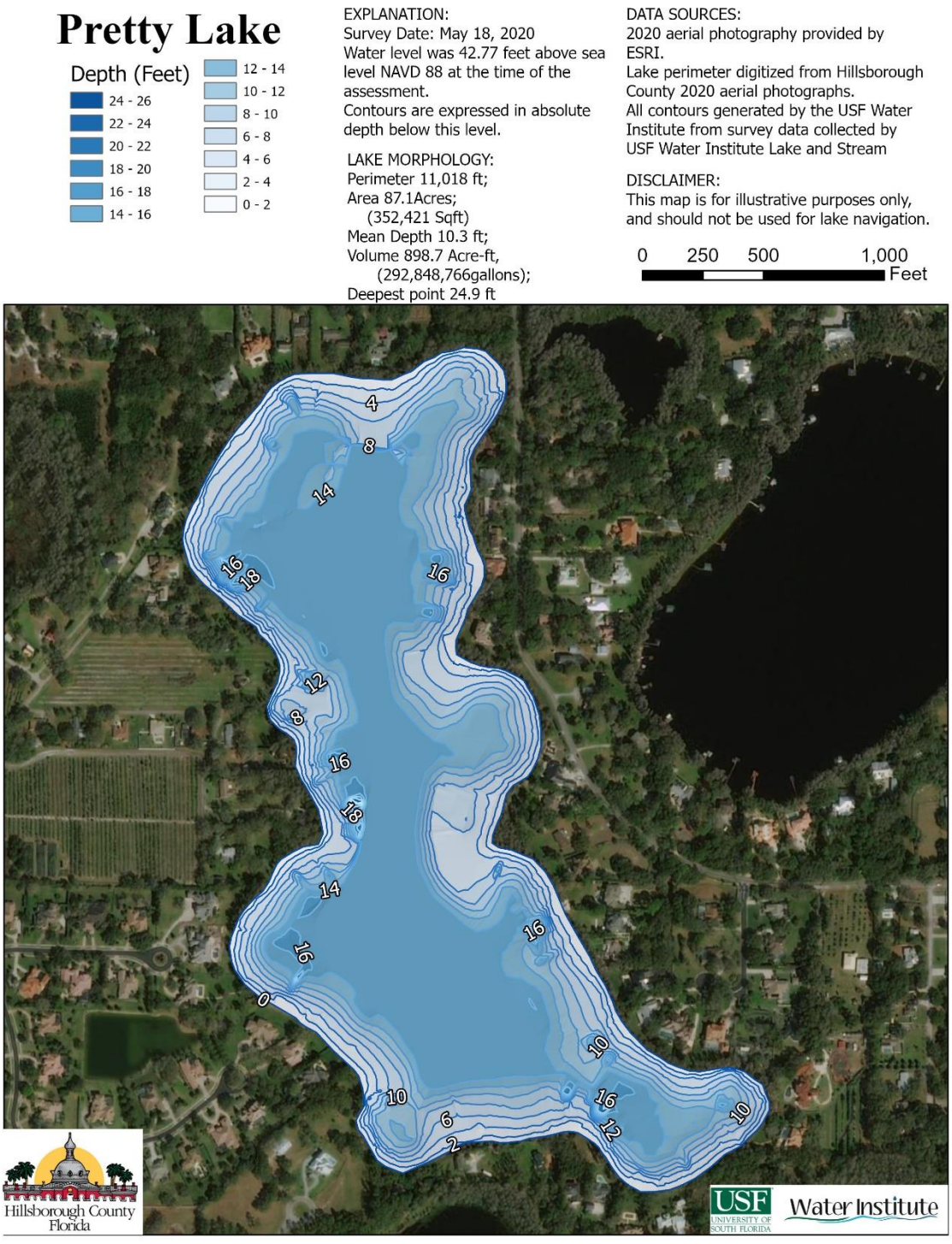


Figure 3 Overview photograph of Pretty Lake showing the typical shoreline vegetation communities and development.

Lake Habitat and Lake Vegetation Index Assessment

The lake assessment for Pretty Lake was conducted on May 18, 2020. The water in Pretty Lake is characterized as highly tannic with a mean color value of 96.2 PCU. The secchi disk depth was 2.7 feet in part due to the high tannins. The vegetation quality of the plants in and buffering Pretty Lake are predominantly native species with moderate growths of non-native nuisance species such as *Colocasia esculenta, Panicum repens and Melaleuca quinquenervia*. Some direct inputs of stormwater were noted through pipes and ditches to the lake, but most stormwater reaches the lake via sheet flow. The bottom substrate quality was dominated by sand with coarse particulate organic matter near shore and some accumulation of muck. Approximately 80.2% of the surrounding land has been developed for residential housing including several docks and seawalls. Some homeowners have maintained a vegetated buffer zone along the shoreline.

Figure 4 Cephalanthus occidentalis (Common Buttonbush) and Taxodium (Cypress) along *a residential section of Pretty Lake shoreline.*

The Lake Vegetation Index identified 40 species of wetland vegetation growing in the four selected sections along Pretty Lake. The majority of these species (30) are native species. The remaining 10 species (*Panicum repens, Alternanthera philoxeroides, Sacciolepis indica, Ruellia simplex, Schinus terebinthifolius, Urochloa mutica, Sphagneticola trilobata, Colocasia esculenta, Melaleuca quinquenervia* and *Ludwigia peruviana*) are non- native and invasive to this region. The vegetation community along Pretty Lake is dominated by *Taxodium* with undergrowth of *Cephalanthus* and several grasses. The water's surface in Pretty Lake was dominated by *Nuphar*. No species of submerged aquatic vegetation were observed during the assessment, however sparse occurrences may be present. Submerged vegetation was limited in the lake due to the low water visibility and tanins blocking available light. By analyzing the collected sonar chart, submerged aquatic vegetation potentially covered approximately 2.9% of the surface area of Pretty Lake. This submerged vegetation inhabits an estimated 0.05% of the water volume in Pretty Lake. Figure 5 shows the results of the SAV analysis indicating the location and percent of the water column inhabited by SAV.

The calculated LVI score for Pretty Lake was 51, above the impairment threshold of 43 indicating that the vegetation community is "Healthy". Figure 6 shows the map of Pretty Lake detailing the LVI regions used for the assessment (Regions 2, 5, 8, 11). Table 2 details the species list results of the Lake Vegetation Index. Table 3 details the scoring result for the Lake Vegetation Index.

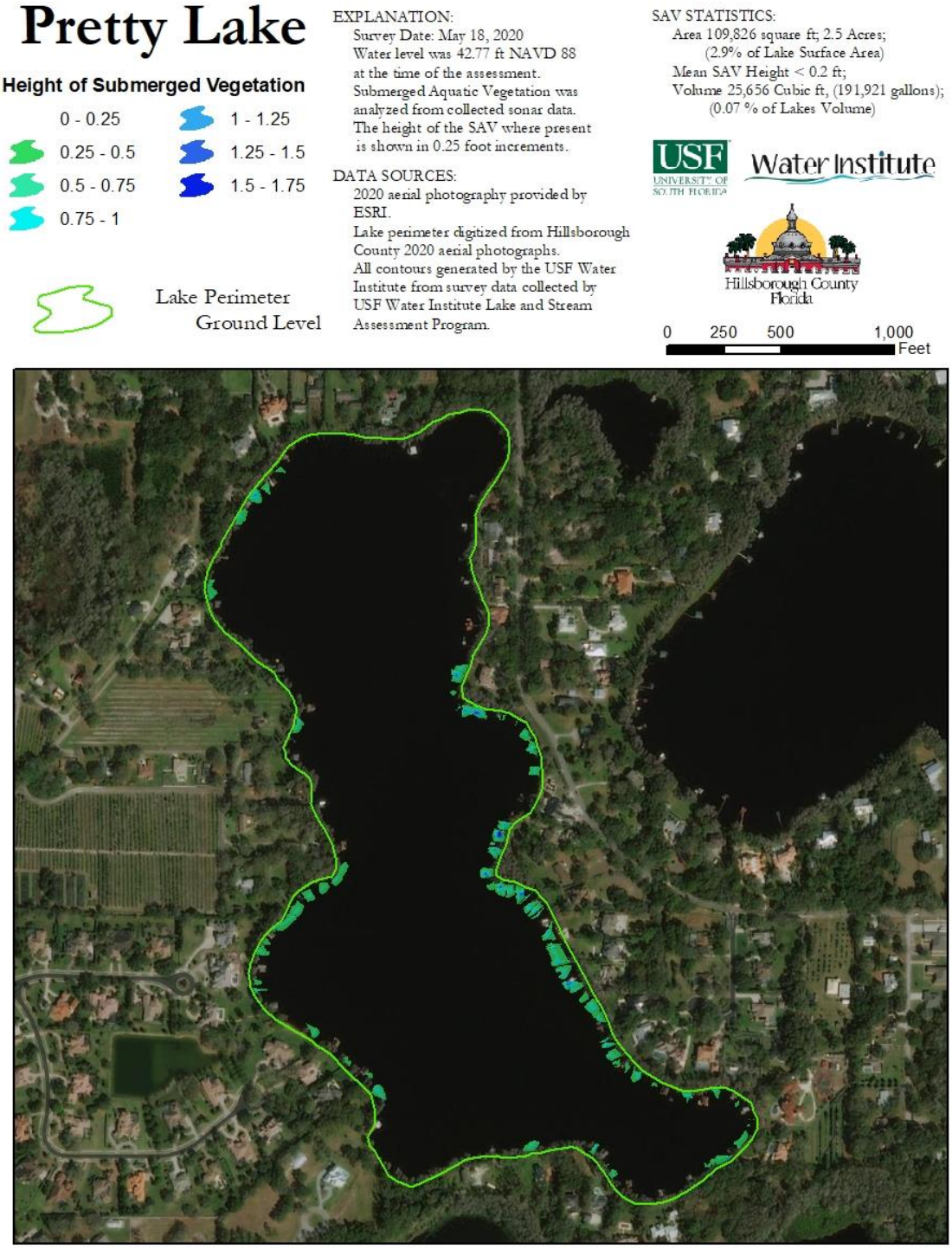


Figure 5 Pretty Lake Submerged Aquatic Vegetation Assessment Results

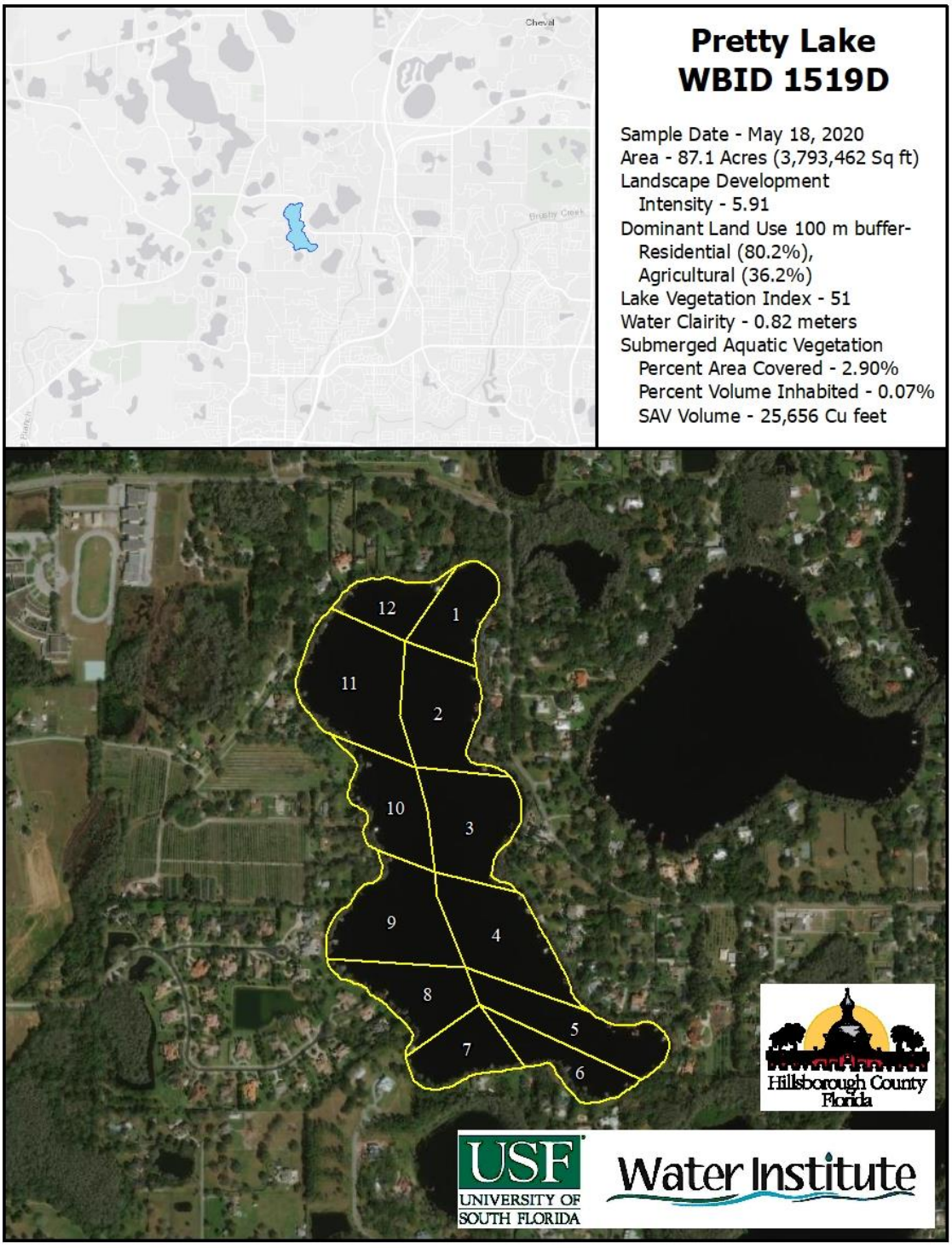


Figure 6: Lake Vegetation Index region map for Pretty Lake

Table 2: Lake Vegetation Index results for Pretty Lake May 18, 2020

SPECIES	CofC	Region			
		2	5	8	11
Alternanthera philoxeroides	0.00	**1**	**1**	**1**	**1**
Blechnum serrulatum	5.50	**1**	**1**	**1**	**1**
Boehmeria cylindrica	5.00	**1**	**1**	**1**	**1**
Hydrocotyle	2.00	**1**	**1**	**1**	**1**
Nuphar	3.50	**C**	**1**	**C**	**C**
Panicum repens	0.00	**1**	**1**	**1**	**1**
Sagittaria lancifolia	3.00	**1**	**1**	**1**	**1**
Symphyotrichum carolinianum	3.93	**1**	**1**	**1**	**1**
Taxodium	7.00	**C**	**D**	**C**	**C**
Acer rubrum	4.65	**1**	**1**	**1**	
Andropogon glomeratus	3.00	**1**		**1**	**1**
Colocasia esculenta	0.00	**1**	**1**	**1**	
Cyperus haspan	4.00	**1**		**1**	**1**
Melaleuca quinquenervia	0.00	**1**		**1**	**1**
Mikania scandens	1.95	**1**	**1**	**1**	
Myrica cerifera	2.00	**1**	**1**	**1**	
Osmunda regalis	7.60	**1**	**1**	**1**	
Pontederia cordata	5.38	**1**	**1**	**1**	
Urochloa mutica	0.00	**1**		**1**	**1**
Cephalanthus occidentalis	5.00	**1**	**1**		
Schinus terebinthifolius	0.00	**1**	**1**		
Typha	1.00	**1**			**1**
Baccharis halimifolia	2.53			**1**	
Bacopa monnieri	3.50				**1**
Cyperus polystachyos	1.56	**1**			
Fuirena scirpoidea	5.50				**1**
Ilex cassine	6.00		**1**		
Ludwigia octovalvis	2.00	**1**			
Ludwigia peruviana	0.00	**1**			
Lycopus rubellus	4.00	**1**			
Magnolia virginiana	7.00				**1**
Micranthemum glomeratum	5.85				**1**
Persea palustris	7.00			**1**	
Quercus laurifolia	4.00			**1**	
Quercus nigra	2.50		**1**		
Ruellia simplex	0.00	**1**			
Sacciolepis indica	0.92		**1**		
Sacciolepis striata	5.35		**1**		
Schoenoplectus tabernaemontani	5.55	**1**			
Sphagneticola trilobata	0.00				**1**

Table 3: Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	2	5	8	11
Total # of taxa in sampling unit	28	21	22	19
% Native taxa in sampling unit	71.42857	76.19048	77.27273	73.68421
% FLEPPC CAT 1 taxa in sampling unit	25	14.28571	18.18182	15.78947
% Sensitive taxa in sample unit	7.142857	9.52381	13.63636	10.52632
Dominant CoC in sample unit	5.25	7	5.25	5.25
Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.1838	0.367728	0.40953	0.270924
Invasive FLEPPC 1 Score (1 - (x/30))=	0.166667	0.52381	0.393939	0.473684
Sensitive Score (x/(27.78 or 20)) =	0.357143	0.47619	0.681818	0.526316
Dominant CoC Score (x/(7.91 or 7)) =	0.75	1	0.75	0.75
Raw Score Total = N+I+S+D =	1.457609	2.367728	2.235287	2.020924
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.364402	0.591932	0.558822	0.505231
South				
LVI Score for sampling unit =	36.44023	59.1932	55.88219	50.52309

Total LVI SCORE = 51

Water Quality Assessment

Long-term water quality data is available for Pretty Lake. The available data was collected by USGS, FDEP, Hillsborough County and University of Florida LAKEWATCH program (1972-2020). The most recent three years of data are from LAKEWATCH, Hillsborough County and FDEP. There were only Lakewatch samples available for 2018, FDEP for 2019 and Hillsborough County for 2020. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of the Pretty Lake.

Table 4: Pretty Lake Water Quality (Field)

Depth (m)	Temp °C	pH	DO (mg/L)	DO (%sat)	Cond (unho/cm)	Salinity (ppt)	Secchi Depth (m)
0.15	30.4	7.2	7.46	98.4	198	0.09	0.82
2.26	29.54	7.12	6.27	81.5	197.3	0.09	
4.52	25.1	6.82	0	0	202.3	0.09	
POR	23.57	6.72	5.46	81.81	184.7	0.09	1.16

The chemical water quality analysis for Pretty Lake is shown in Table 5 for the sample taken on May 18, 2020. Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment as well as the available FDEP and LAKEWATCH data. Total Phosphorous values were below the nutrient threshold for colored lakes in the west central region with sufficient data developed by FDEP of 0.05 mg/l – 0.16 mg/l with a value of 0.027 mg/l for the POR and below the threshold for the most recent 3 years of samples with a value of 0.034 mg/l. The geometric mean value for the 2020 data is 0.054 as a result of using the minimum detection limit of the laboratory Total Phosphorous method.

Total Nitrogen values were below the nutrient threshold for colored lakes with sufficient data developed by FDEP of 1.27 mg/l – 2.23 mg/l with a value of 0.856 mg/l for the POR data. The Total Nitrogen value for the most recent 3 years of data was 0.783 mg/l. Chlorophyll-a corrected values are below the nutrient threshold for colored lakes developed by FDEP of 20.0 µg/l with a value of 6.52 µg/l for the period of record and 5.48 µg/l. The UF LAKEWATCH data is for uncorrected chlorophyll-a and has a mean value for the period of record of 9.57 µg/l.

Bacteria testing showed low levels of E. Coli (1.6 colonies/100ml) and Enterococci (15.1 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: Pretty Lake Water Quality Results from 5/23/19 (Laboratory)

Parameter	Pretty Lake (Center)	POR Mean Value	Units
Alkalinity		7.92	mg/LCaCO3
E Coli	1.0		#/100ml
Nitrates/Nitrites	.004	0.014	mg/L
Enterococci	17	15.0	#/100 ml
Chlorophyll a	7.6	9.58	ug/L
Chlorophyll b	1	1.30	ug/L
Chlorophyll c	1.3	1.66	ug/L
Chlorophyll t	8.9		ug/L
Chlorophylla Corr	6.1	6.52	ug/L
Chlorophyll-pheo	2.2		ug/L
Ammonia	0.017	0.022	mg/L
Kjeldahl Nitrogen	0.004	0.020	mg/L
Total Nitrogen	0.640	0.856	mg/L
Total Phosphorus	0.050	0.027	mg/L
Color(345)F.45		96.2	Pt/Co

Table 6: Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	96.2
Number of Samples	3
Geometric Mean Alkalinity (mg/L $CACO_3$)	32.0
Number of Samples	164
Lake Type	Colored
Chlorophyll a Criteria (ug/L)	20
Sufficient for Geomean Criteria then P mg/L	0.16
Suffcient for Geomean Criteria then N mg/L	2.23
Geomean Chla Corrected ug/L	5.48
Geomean TP mg/L	0.034
Geomean TN mg/L	0.783
Number of Samples	64
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired

Conclusion

The results of the assessment of Pretty Lake shows a healthy lake based on Total Nitrogen and Total Phosphorous concentrations according to the FDEP numeric nutrient criteria using the previous three-years of data and limited long term water quality record. The sampling data was Sufficient to calculate proper FDEP Numeric Nutrient Criteria values.
The most recent three years of data for Total Phosphorous and Total Nitrogen are below the nutrient thresholds. The system also shows health in the vegetation communities according to the Lake Vegetation Index with moderate overall species (40), moderate occurrences of non-native, invasive species and few sensitive plant species with an overall LVI score of 51. The assessment also revealed some submerged aquatic vegetation community potentially occupies 2.90%of the surface area of Pretty Lake and 0.05% of the volume.