Rock 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 Rock 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.

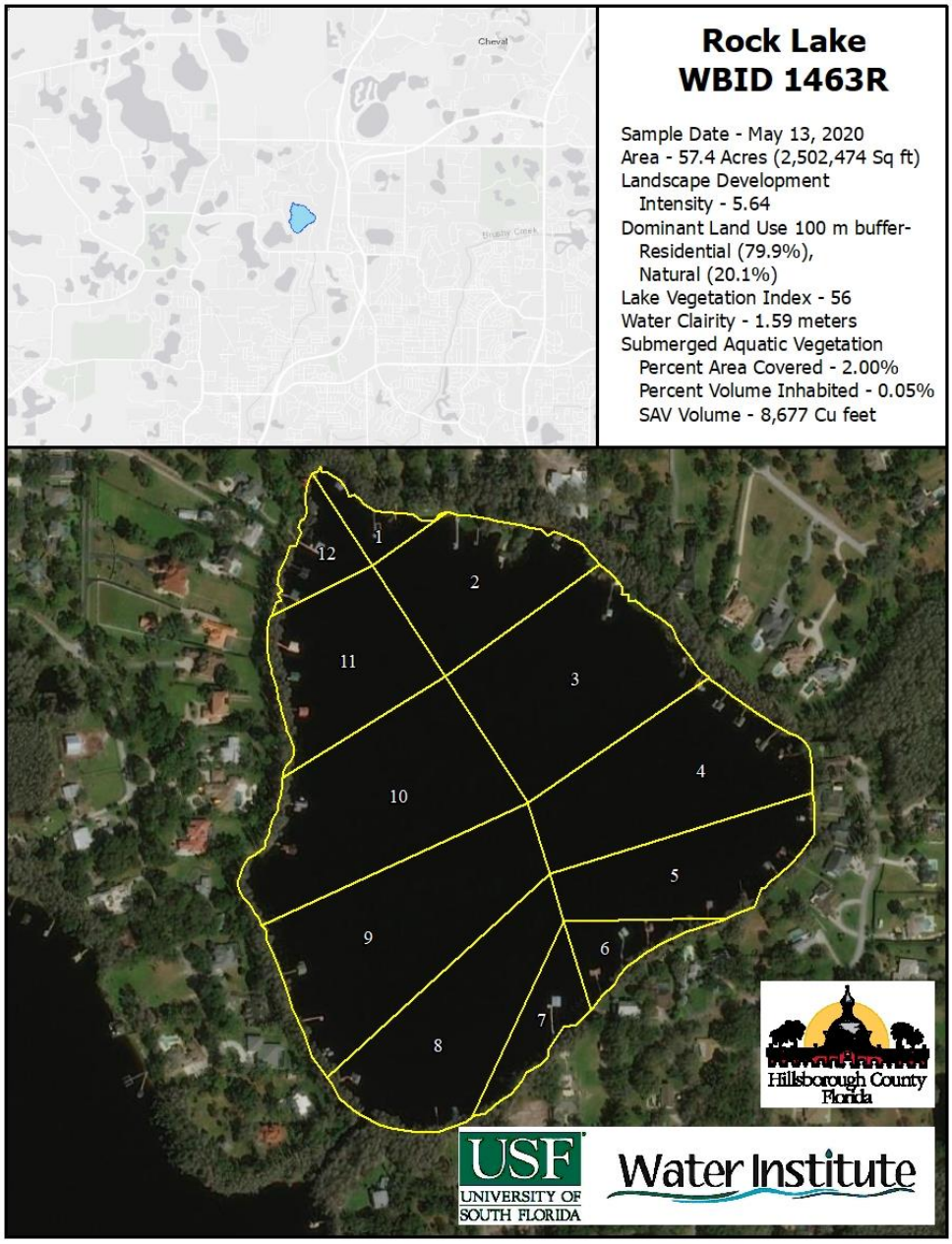
WATER QUALITY ASSESSMENT

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 Hillsborough County Public Utilities 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

Rock Lake is located in north-western Hillsborough County, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Rock Lake is dominated by Residential (79.9%) and Natural (20.1%) land uses. The resulting LDI value for the 100 meter buffer around Rock Lake is 5.64.

FIGURE 1: 2020 ROCK LAKE ASSESSMENT STUDY AREA MAP



Lake Bathymetry and Morphological Characterization

At the time of the assessment, Rock Lake was experiencing elevated water levels (42.88 feet above sea level NAVD 88) resulting in a 57.4 acre water body. Rock Lake at the time of the assessment had a mean water depth of 6.8 feet and a maximum observed depth of 19.96 feet. The volume at this time was approximately 127,369,693 gallons. Figure 2 shows the resulting bathymetric contour map for Rock Lake from data collected on May 13, 2020. The collected data has been overlain the 2020 Hillsborough County aerials.

Table 1: Morphological Calculations for Rock Lake

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	2,502,474	232,485	57.4		
Mean Depth	6.8	2.07			
Maximum Depth	19.96	6.08			
Volume (cubic)	17,026,733	482,139		390.9	127,369,693
Gauge (NAVD 88)	42.88	13.07			

Figure 2: 2020 1-Foot Bathymetric Contour Map for Rock lake

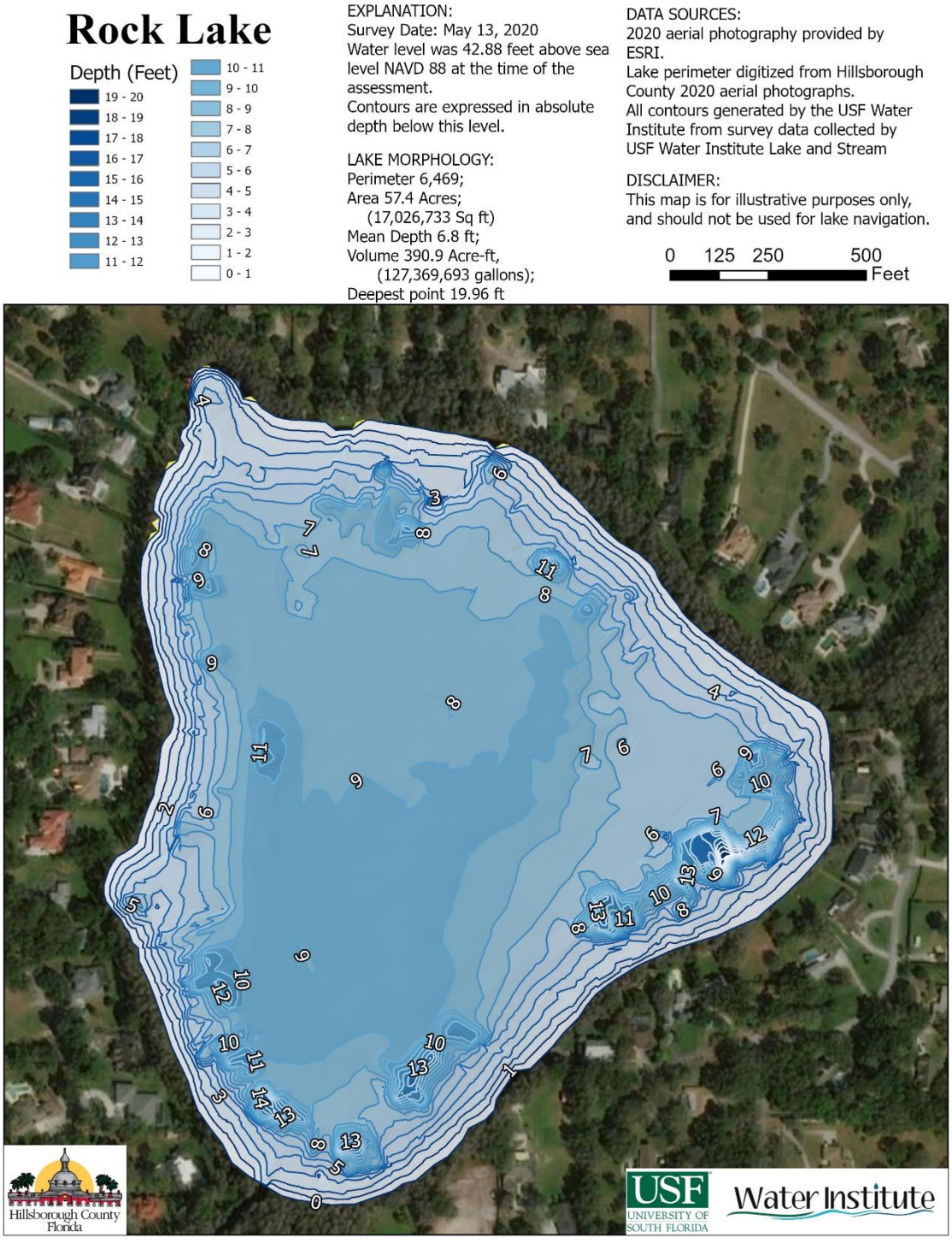


Figure 3 Panicum hemitomon, Maidencane, was a commonly occurring emergent grass in Rock Lake

Lake Habitat and Lake Vegetation Index Assessment

The lake assessment for Rock Lake was conducted on May 13, 2020. The water in Rock Lake was characterized as moderately tannic with a period of record color value of 122.6 PCU. The secchi disk depth was 5.2 feet in part due to the high tannins and turbidity. The vegetation quality of the plants in and buffering Rock Lake are predominantly native species with moderate growths of non-native nuisance species such as *Ludwigia peruviana, 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 79.9% 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 Taxodium, Cypress Tree, is common along the shoreline of Rock Lake and was co-dominant in the 4 regions of the Lake Vegetation Index Assessment.

The Lake Vegetation Index identified 40 species of wetland vegetation growing in the four selected sections along Rock Lake. The majority of these species (32) are native species. The remaining 8 species (*Panicum repens*, *Alternanthera philoxeroides, Eichhornia crassipes, Nymphoides cristata, Schinus terebinthifolius, Sapium sebiferum, Melaleuca quinquenervia* and *Ludwigia peruviana*) are non- native and invasive to this region. The vegetation community along Rock Lake is dominated by a variety of emergent species including *Taxodium, Acer rubrum* and *Cephalanthus occidentalis.* The water's surface in Rock Lake was dominated by *Nuphar*. A single species of submerged aquatic vegetation (*Eleocharis*) was identified in Rock Lake. 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 2.0% of the surface area of Rock Lake. This submerged vegetation inhabits an estimated 0.05% of the water volume in Rock 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 Rock Lake was 56, above the impairment threshold of 43 indicating that the vegetation community is “Healthy”. Figure 6 shows the map of Rock 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.

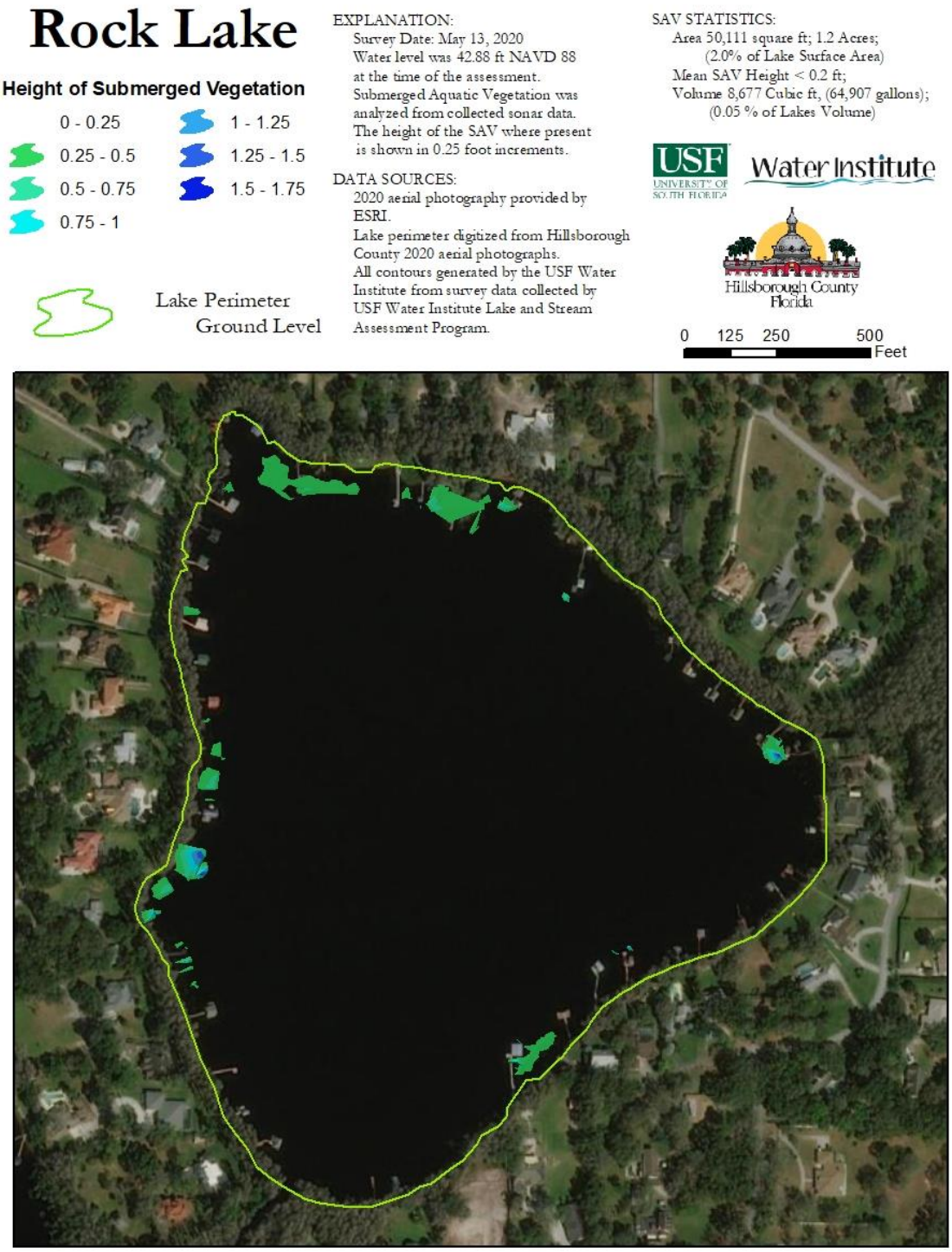


Figure 5 Rock Lake Submerged Aquatic Vegetation Assessment Results

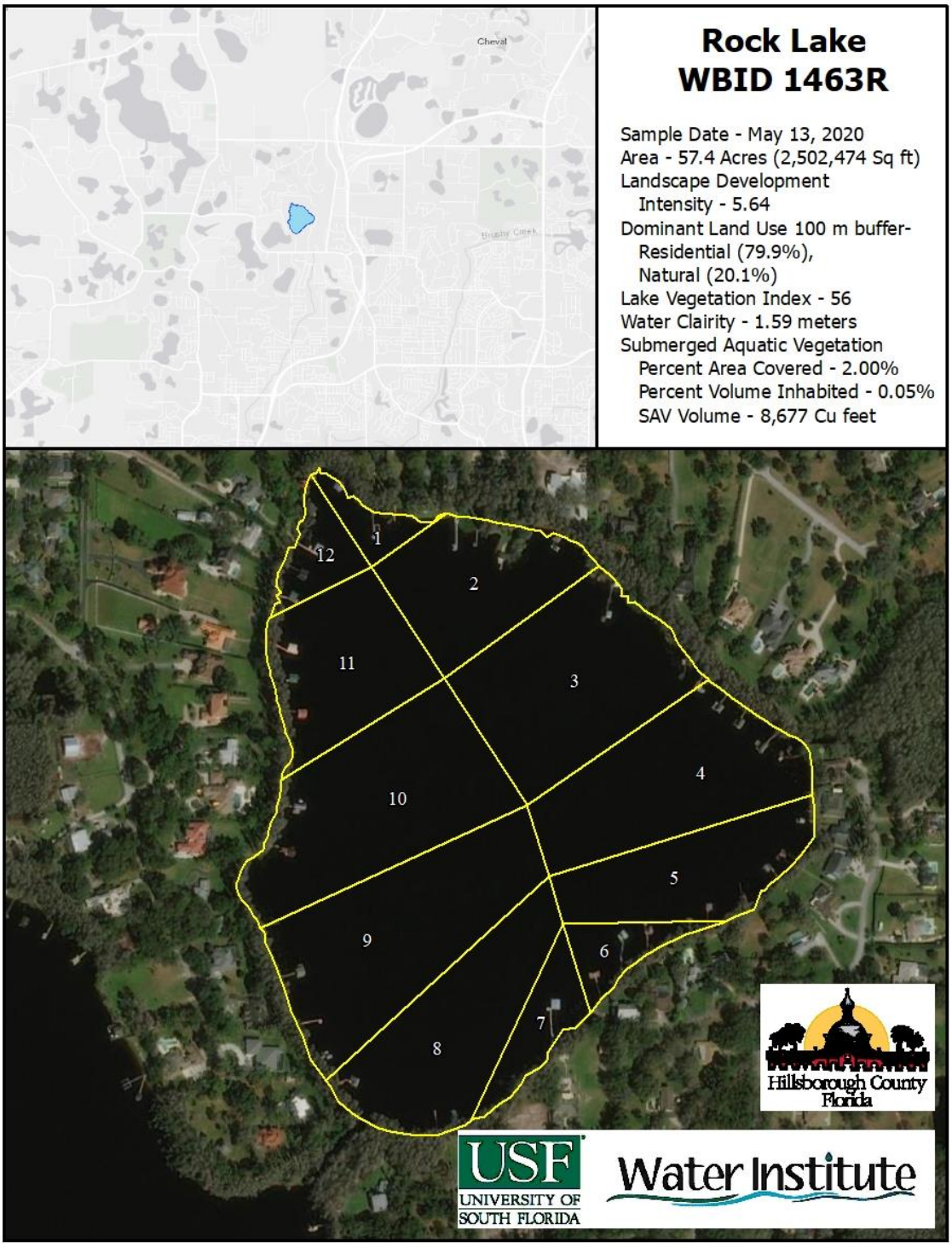


Figure 6: Lake Vegetation Index region map for Rock Lake

Table 2: Lake Vegetation Index results for Rock Lake May 13, 2020

SPECIES	CofC	Region			
		2	5	8	11
Acer rubrum	4.65	**1**	**1**	**1**	**1**
Alternanthera philoxeroides	0.00	**1**	**1**	**1**	**1**
Blechnum serrulatum	5.50	**1**	**1**	**1**	**1**
Boehmeria cylindrica	5.00	**1**	**1**	**1**	**1**
Cephalanthus occidentalis	5.00	**1**	**1**	**1**	**1**
Melaleuca quinquenervia	0.00	**1**	**1**	**1**	**1**
Nuphar	3.50	**C**	**C**	**C**	**C**
Osmunda regalis	7.60	**1**	**1**	**1**	**1**
Panicum repens	0.00	**1**	**1**	**1**	**1**
Sagittaria lancifolia	3.00	**1**	**1**	**1**	**1**
Taxodium	7.00	**C**	**C**	**C**	**C**
Cyperus haspan	4.00	**1**		**1**	**1**
Ilex cassine	6.00	**1**	**1**	**1**	
Ludwigia peruviana	0.00	**1**	**1**		**1**
Mikania scandens	1.95	**1**	**1**	**1**	
Pontederia cordata	5.38		**1**	**1**	**1**
Typha	1.00	**1**		**1**	**1**
Andropogon glomeratus	3.00	**1**			**1**
Baccharis halimifolia	2.53		**1**		**1**
Bacopa monnieri	3.50		**1**	**1**	
Eleocharis (submersed viviparous but unable to ID to species)	3.00	**1**	**1**		
Hydrocotyle	2.00	**1**		**1**	
Myrica cerifera	2.00	**1**		**1**	
Nymphoides cristata	0.00	**1**	**1**		
Persea palustris	7.00	**1**			**1**
Persicaria hydropiperoides	2.50	**1**	**1**		
Pluchea baccharis	5.45	**1**			**1**
Salix caroliniana	2.95	**1**	**1**		
Thalia geniculata	6.00		**1**	**1**	
Cyperus odoratus	3.00				**1**
Cyperus polystachyos	1.56				**1**
Eclipta prostrata	2.00		**1**		
Eichhornia crassipes	0.00	**1**			
Lemna	1.00		**1**		
Panicum hemitomon	5.82				**1**
Ptilimnium capillaceum	2.73				**1**
Sapium sebiferum	0.00			**1**	
Schinus terebinthifolius	0.00	**1**			
Symphyotrichum carolinianum	3.93			**1**	
Thelypteris interrupta	6.74	**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	24	22	23
% Native taxa in sampling unit	75	79.16667	81.81818	82.6087
% FLEPPC CAT 1 taxa in sampling unit	21.42857	16.66667	13.63636	13.04348
% Sensitive taxa in sample unit	10.71429	8.333333	9.090909	13.04348
Dominant CoC in sample unit	5.25	5.25	5.25	5.25
Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.321746	0.482683	0.585098	0.615631
Invasive FLEPPC 1 Score (1 - (x/30))=	0.285714	0.444444	0.545455	0.565217
Sensitive Score (x/(27.78 or 20)) =	0.535714	0.416667	0.454545	0.652174
Dominant CoC Score (x/(7.91 or 7)) =	0.75	0.75	0.75	0.75
Raw Score Total = N+I+S+D =	1.893174	2.093794	2.335098	2.583023
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.473294	0.523449	0.583774	0.645756
South				
LVI Score for sampling unit =	47.32936	52.34486	58.37744	64.57557
Total LVI SCORE =	56			

Water Quality Assessment

Limited long-term water quality data is available for Rock Lake. The available data was collected by FDEP, Hillsborough County and University of Florida LAKEWATCH program (1988-2019), however this dataset is incomplete with recent years having sparse data. There were no samples available for 2018 and only a single sample available for 2019. 2020 has four sample points available through August. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of the Rock Lake.

Table 4: Rock Lake Water Quality (Field)

Depth (m)	Temp °C	pH	DO (mg/L)	DO (%sat)	Cond (unho/cm)	Salinity (ppt)	Secchi Depth (m)
0.24	30.06	7.3	6.9	90.4	243.9	0.11	1.58
1.2	29.77	7.04	6.5	84.7	243.7	0.11	
2.25	28.74	6.56	0.92	11.7	245.8	0.11	
POR	22.28	6.90	3.99	57.91	226.8	0.09	0.91

The chemical water quality analysis for Rock Lake is shown in Table 5 for the sample taken on June 2, 2020. 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 colored lakes in the west central region with insufficient data developed by FDEP of 0.05 mg/l with a value of 0.036 mg/l for the POR and below the threshold for the most recent 3 years of samples with a value of 0.040 mg/l, however there were no sampeles in 2018 and only a single sample in 2019. If sampling were to be sufficient (previous three years of quarterly sampling) the threshold could be as high as 0.16 mg/L.

Total Nitrogen values were below the nutrient threshold for colored lakes with insufficient data developed by FDEP of 1.27 mg/l with a value of 1.029 mg/l for the POR data. The Total Nitrogen value for the most recent 3 years of data was 0.865 mg/l, however there were no samples in 2018 and only a single sample in 2019. If sampling were to be sufficient (previous three years of quarterly sampling) the threshold could be as high as 2.23 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 12.4 µg/l for the period of record. The UF LAKEWATCH data is for uncorrected chlorophyll-a and has a mean value for the period of record of 14.7 µg/l.

Bacteria testing showed low levels of E. Coli (3 colonies/100ml) and Enterococci (11.1 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: Rock Lake Water Quality Results from 6/2/20 (Laboratory)

Parameter	Rock Lake (Center)	POR Mean Value	Units
Alkalinity		42	mg/LCaCO3
E Coli	3.0	2.2	#/100ml
Nitrates/Nitrites			mg/L
Enterococci		10.9	#/100 ml
Chlorophyll a	7.3	14.7	ug/L
Chlorophyll b	1	1.1	ug/L
Chlorophyll c	1	1.5	ug/L
Chlorophyll t	7.3	8.4	ug/L
Chlorophylla Corr	5.8	12.4	ug/L
Chlorophyll-pheo	2.3	2.4	ug/L
Ammonia	0.072	0.022	mg/L
Kjeldahl Nitrogen	0.780	1.224	mg/L
Total Nitrogen	0.780	1.029	mg/L
Total Phosphorus	0.05	0.036	mg/L
Color(345)F.45		122.6	Pt/Co

Table 6: Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	122.6
Number of Samples	64
Geometric Mean Alkalinity (mg/L $CACO_3$)	42.0
Number of Samples	6
Lake Type	Colored
Chlorophyll a Criteria (ug/L)	20
Insufficient for Geomean Criteria then P mg/L	0.05
Insuffcient for Geomean Criteria then N mg/L	1.27
Geomean Chla Corrected ug/L	12.4
Geomean TP mg/L	0.040
Geomean TN mg/L	0.865
Number of Samples	514
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired

Conclusion

The results of the assessment of Rock Lake shows a healthy lake based on Chlorophyll-a, Total Nitrogen and Total Phosphorous 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 with a minimum of three samples per year for the previous three years. 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 56. The assessment also revealed some submerged aquatic vegetation community comprising 3 species occupying 2.0% of the surface area and 0.05% of the volume of Rock Lake.