

# Lake Dan

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## Methods

### Study Area Analysis

The watershed containing Lake Dan 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**<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.

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<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

Lake Dan is located between Trinity Blvd and Keystone Rd, east of East Lake Rd North in Keystone, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake Dan is dominated by Cropland and Pastureland (55.6%), Upland Mixed – Coniferous/Hardwood (22.17%), and Freshwater Marshes (10.28%) land uses. The resulting LDI value for the 100 meter buffer around Lake Dan is 2.39. The LDI value calculated for the FDEP WBID containing Lake Dan was 2.78 with approximately 53.5% Natural, 26.8% Cropland and Pastureland and 8.3% Residential land uses.

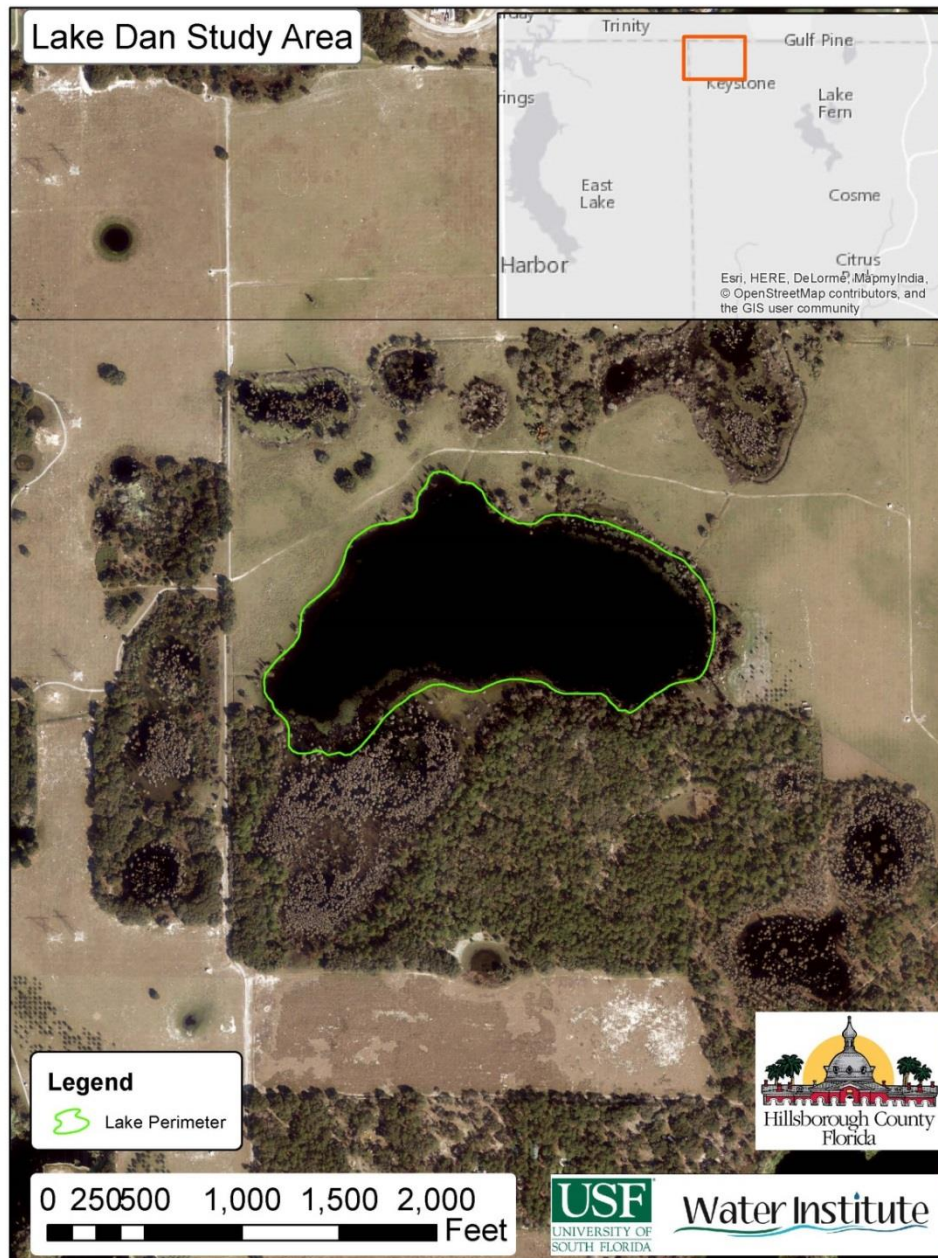


Figure 1 2016 Lake Dan Assessment Study Area Map



## Lake Bathymetry and Morphological Characterization

Lake Dan is a shallow 41 acre lake in a non-developed preserve managed by Hillsborough County. Lake Dan at the time of the assessment had a mean water depth of 6.6 feet and a maximum observed depth of 13.34 feet. The volume at this time was approximately 84,046,884 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Dan from data collected on June 28, 2016. The collected data has been overlain the 2014 Hillsborough County aerals.

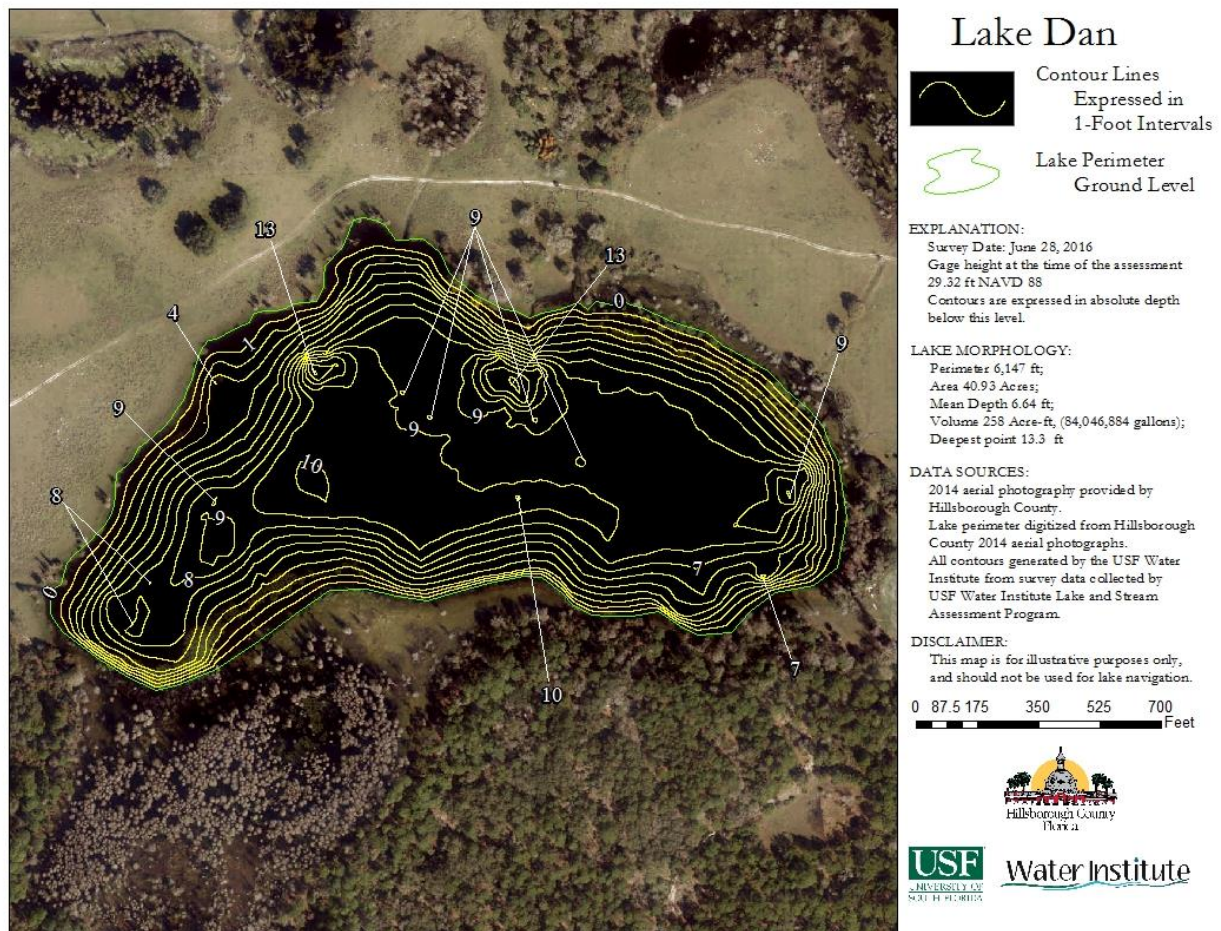
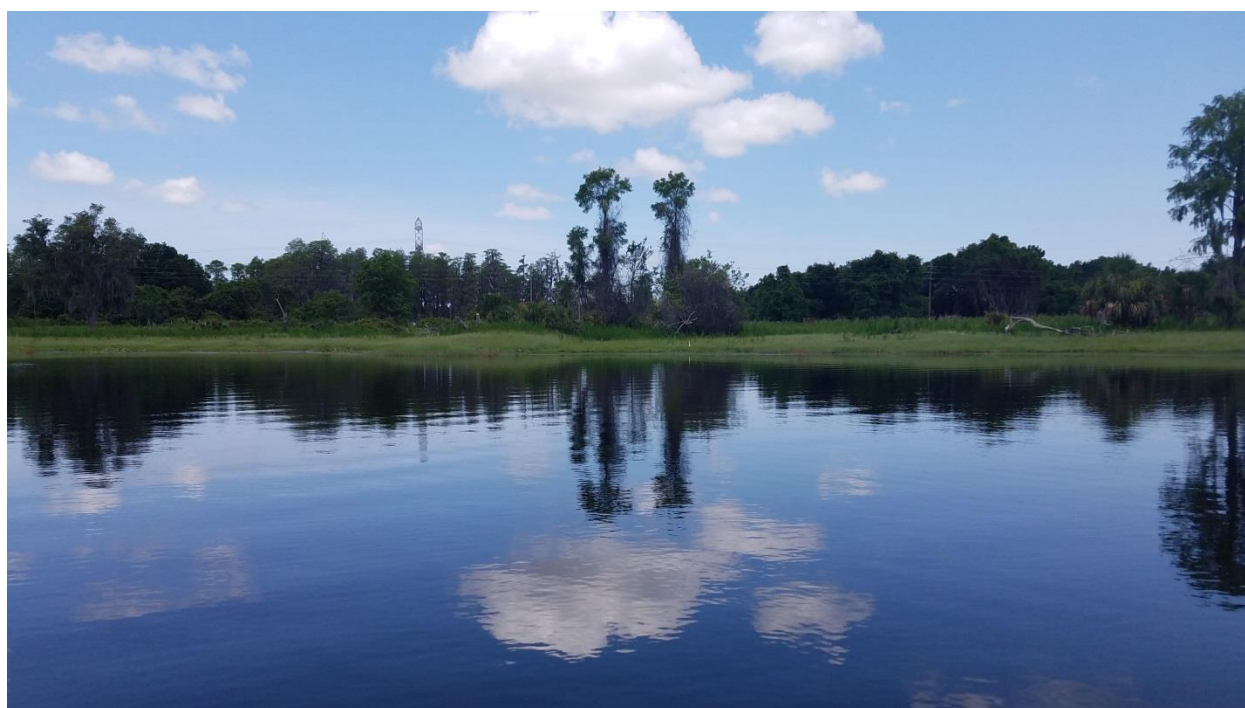


Figure 2 2016 1-Foot Bathymetric Contour Map for Lake Dan.

**Table 1 Morphological Calculations for Lake Dan.**

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	1,782,915	165,637	40.9	0	0
Mean Depth	6.3	1.92	0	0	0
Maximum Depth	13.3	4.07	0	0	0
Volume (cubic)	11,235,356	318,147	0	257.9	84,046,884
Gauge (relative)	29.32	8.94	0	0	0

## Lake Vegetation Index Assessment



**Figure 3 Overview photograph of Lake Dan.**

The lake assessment for Lake Dan was conducted on June 28, 2016. Lake Dan received a lake habitat assessment (FEDP form FD 9000-6) score of 116 due to optimal scores for Stormwater Inputs, Adverse Watershed Land Use, Lakeside Adverse Human Alterations and Upland Buffer Zone. Suboptimal scores for Secchi, Vegetation Quality and Bottom Substrate Quality.



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

The Lake Vegetation Index identified 38 species of wetland vegetation growing in the four selected sections along Lake Dan. The majority of these species (34) are native species. The remaining 4 species (*Panicum repens*, *Alternanthera philoxeroides*, *Schinus terebinthifolius* and *Salvinia minima*, shown in bold on Table 2) are non-native and invasive to this region. The vegetation community along Lake Dan is dominated by a variety of emergent species including *Panicum hemitomon*, *Taxodium* and *Panicum repens* (Figure 5). The water's surface in Lake Dan was dominated by *Nuphar*. (Figure 6). The calculated LVI score for Lake Dan was 56, above the impairment threshold of 37. Figure 7 shows the map of Lake Dan 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. Four species of submerged vegetation were observed during the assessment. By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 8% of the surface area of Lake Dan. This submerged vegetation inhabits an estimated 1.04% of the water volume in Lake Dan. The deepest observed submerged vegetation was at 5.8 feet.





Figure 5 Emergent vegetation zone on Lake Dan



Figure 6 Nuphar on Lake Dan



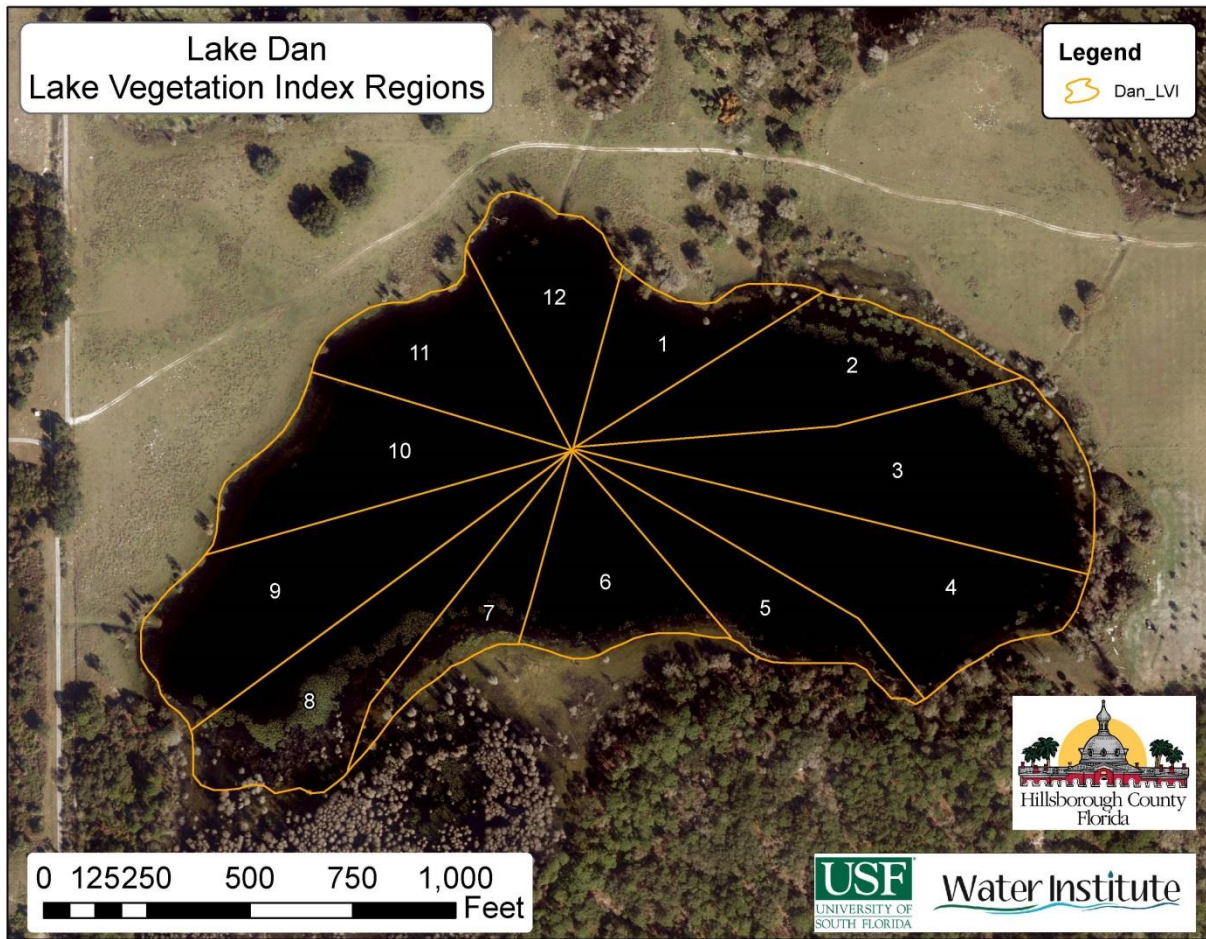


Figure 7 Lake Vegetation Index region map for Lake Dan.

Table 2 Lake Vegetation Index results for Lake Dan 6/28/2016.

SPECIES	Region				
	CofC	1	4	7	10
Acer rubrum	4.65	1	1		1
<b>Alternanthera philoxeroides</b>	0.00	1	1	1	1
Bacopa monnieri	3.50	1	1		1
Boehmeria cylindrica	5.00			1	
Cephalanthus occidentalis	5.00	1		1	
Chara	3.90		1		
Cyperus odoratus	3.00	1	1		
Cyperus polystachyos	1.56	1			
Eleocharis baldwinii	2.82	1			1
Erechtites hieracifolia	1.00	1	1		
Eupatorium capillifolium	0.83	1	1	1	1
Fuirena pumila	4.00				1
Gordonia lasianthus	7.00		1		
Habenaria repens	3.50			1	1
Hydrocotyle	2.00	1		1	1
Ilex cassine	6.00	1	1		
Juncus effusus	2.00		1		
Lipocarpa maculata	4.55	1			1
Liquidambar styraciflua	2.50				
Ludwigia arcuata	3.50	1	1	1	1
Ludwigia repens	3.20	1	1	1	1
Luziola fluitans	4.00	1	1	1	1
Lycopus rubellus	4.00			1	
Magnolia virginiana	7.00		1		
Mikania scandens	1.95	1	1	1	
Myrica cerifera	2.00		1		
Najas guadalupensis	5.07	1	c	1	1
Nuphar	3.50	1	1	1	1
Panicum hemitomon	5.82	1	1	c	1
<b>Panicum repens</b>	0.00	d	c	c	d
Phyla nodiflora	1.92	1			
Potamogeton illinoensis	6.64	1	1		1
Potamogeton pectinatus	7.80	1	1	1	
Sacciolepis striata	5.35	1	1	1	1
Salix caroliniana	2.95			1	
<b>Salvinia minima</b>	0.00			1	
<b>Schinus terebinthifolius</b>	0.00		1		
Taxodium	7.00	1	1	1	
Woodwardia virginica	3.50			1	

Table 3 Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	1	4	7	10
Total # of taxa in sampling unit	25	25	21	18
% Native taxa in sampling unit	92.00	88.00	85.71	88.89
% FLEPPC CAT 1 taxa in sampling unit	4.00	8.00	9.52	5.56
% Sensitive taxa in sample unit	8.00	16.00	9.52	0
Dominant CoC in sample unit	0	2.54	2.91	0

Native Score $((x-62.5)/37.5)$ or $((x-66.67)/25.89)=$	0.978	0.824	0.736	0.858
Invasive FLEPPC 1 Score $(1 - (x/30))=$	0.867	0.733	0.683	0.815
Sensitive Score $(x/(27.78 \text{ or } 20)) =$	0.400	0.800	0.476	0
Dominant CoC Score $(x/(7.91 \text{ or } 7)) =$	0	0.362	0.416	0
Raw Score Total = $N+I+S+D =$	2.245	2.719	2.310	1.673
Division Factor = $(3 \text{ D}=0 \text{ or } 4) =$	4	4	4	4
Average LVI dividend = $\text{Raw} / \text{DF}$	0.561	0.680	0.578	0.418
South				
LVI Score for sampling unit =	56	68	58	42
Total LVI SCORE =	56			



## Water Quality Assessment

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

Table 4 Lake Dan Water Quality (Field)

Depth (m)	Temp (C)	pH	DO (% Sat)	DO (mg/L)	Cond (umho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)
0.24	32.1	8.63	95.4	7.1	196.1	0.09	125.5	1.6
2.43	30.47	7.95	49.6	3.79	198.6	0.09	127.1	
1.07	31	8.5	89.7	6.8	195.8	0.09	125.3	
0.05	32.16	8.5	95.7	7.11	196.1	0.09	125.5	

Lake Dan has the benefit of having long term water quality sampling record by having the Hillsborough County Natural Lands staff collect samples for analysis through LAKEWATCH. The chemical water quality analysis for Lake Dan is shown in Table 5 for the sample taken on June 28, 2016. Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment with geometric mean values for the past three years for available parameters where 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 0.021 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 0.701 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 9.7 µg/l.

Bacteria testing showed very low levels of Fecal Coliform (<10colonies/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 Dan Water Quality Results from 6/28/2015(Laboratory)

Parameter	Value	Units
Alkalinity	81.0	mg/LCaCO <sub>3</sub>
Nitrates/Nitrites	0.003	mg/L
Fecal Coliform	<10	#/100 ml
Enterococci	50	#/100 ml
Chlorophyll a	10.8	ug/L
Chlorophyll b	2.6	ug/L
Chlorophyll c	1.5	ug/L
Chlorophyll t	13.0	ug/L
Chlorophylla Corr	9.7	ug/L
Chlorophyll-pheo	6.6	ug/L
Ammonia	0.006	mg/L
Kjeldahl Nitrogen	0.698	mg/L
Total Nitrogen	0.701	mg/L
Total Phosphorus	0.021	mg/L
Color(345)F.45	5.0	Pt/Co

Table 6 Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	43.1
Number of Samples	6
Geometric Mean Alkalinity (mg/L CaCO <sub>3</sub> )	81.0
Number of Samples	1
Lake Type	Colored Alkaline
Chlorophyll a Criteria (ug/L)	20
Insufficient for Geomean Criteria then P mg/L	0.05
Sufficient for Geomean Criteria then P mg/L	0.16
Insufficient for Geomean Criteria then N mg/L	1.27
Sufficient for Geomean Criteria then N mg/L	2.23
Geomean Chla ug/L	13.39
Geomean TP mg/L	0.022
Geomean TN mg/L	0.906
Number of Samples	29
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired



Yearly Geomeans	Chlorophyll a (ug/L)	Total Phosphorous (mg/L)	Total Nitrogen (mg/L)	Number of Samples
2014	8.45	0.017	0.909	12
2015	14	0.024	0.884	12
2016	20.31	0.027	0.925	5
3-Year Geomean	13.39	0.022	0.906	

Table 7 3 year Geomean Values for NNC

## Conclusion

The results of the assessment of Lake Dan shows no 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 from the LAKEWATCH dataset also indicates no impairment for concentrations of Chlorophyll-a, Nitrogen or Phosphorous based on the calculated NNC values. The system also shows no impairment in the vegetation communities according to the Lake Vegetation Index with moderate overall species and occurrences of non-native, invasive species as well multiple sensitive plant species with an overall LVI score of 56. *Panicum repens* was a dominant species along a majority of the shoreline that should be managed. Bacteria sampling also revealed low biomass of Fecal Coliform bacteria present at the time of the assessment.