



Lake Armistead

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

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Methods

STUDY AREA ANALYSIS

The watershed containing the Lake was analyzed using ESRI ArcGIS Pro. Using this software with 2022 ESRI Basemaps aerial, 2017 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 FDEP (<https://floridadep.gov/dear/bioassessment/content/bioassessment-ldi-hdg-bcg>). “The Landscape Development Intensity index (LDI) is an estimate of how much humans have altered an area of interest around a waterbody. Various land use types (low density residential, row crops, industrial, natural) are assigned coefficients of land use intensity based on estimates of the amount of human energy that is put into those land use types. 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. For streams and rivers, DEP typically uses a LDI calculated for the 100 m buffer of the waterbody for 10 km upstream of the point of interest. For lakes and isolated wetlands, DEP typically uses a LDI calculated for the 100 m buffer around the waterbody. 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 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 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-dominant 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, E Coli, 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. Due to the lack of public access to the majority of lakes in Hillsborough County, the majority of available water quality samples are from the resident volunteer LAKEWATCH program. This data is being included in the analysis of Hillsborough County lakes.

Study Area

Lake Armistead is located in the Coastal Old Tampa Bay Watershed in north-western Hillsborough County, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake Armistead is dominated by residential (73%) and natural (27.4%) land uses. The resulting LDI value for the 100 meter buffer around Lake Armistead is 5.63.

FIGURE 1: 2024 LAKE ARMISTEAD ASSESSMENT STUDY AREA MAP



Lake Bathymetry and Morphological Characterization

At the time of the assessment, Lake Armistead was experiencing normal water levels (40.26 feet NAVD88 on staff gauge) resulting in a 37.1 acre water body. Lake Armistead at the time of the assessment had a mean water depth of 7.5 feet and a maximum observed depth of 26.05 feet. The volume at this time was approximately 90,641,522 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Armistead from data collected on July 22, 2024. The collected data has been overlain the 2023 ESRI Basemap aerials.

Table 1: Morphological Calculations for Lake Armistead

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	1,615,809	150,112	37.1		
Mean Depth	7.5	2.29			
Maximum Depth	26.05	7.94			
Volume (cubic)	12,116,925	343,110		278.2	90,641,522
Gauge (NAVD 88)	40.26	12.27			

Figure 2: 2024 2-Foot Bathymetric Contour Map for Lake Armistead

Lake Armistead

- Perimeter
- 12
- Contour (ft)**
- 2
- 4
- 6
- 8
- 10
- 12
- 14
- 16
- 18
- 20
- 22
- 24
- 26

EXPLANATION:
 Survey Date: July 23, 2024
 Water level was 40.26 ft NAVD88 at the time of the assessment.
 Contours are expressed in absolute depth below this level.

LAKE MORPHOLOGY:
 Perimeter 5,328 ft;
 Area 37.1 Acres;
 (1,615,809 Sqft)
 Mean Depth 7.5 ft;
 Volume 278.2 Acre-ft,
 (90,641,522 gallons);
 Deepest point 26.05 ft

DATA SOURCES:
 2023 aerial photography provided by ESRI.
 Lake perimeter digitized from Hillsborough County 2023 aerial photographs.
 All contours generated by the USF Water Institute from survey data collected by USF Water Institute Lake and Stream

DISCLAIMER:
 This map is for illustrative purposes only, and should not be used for lake navigation.

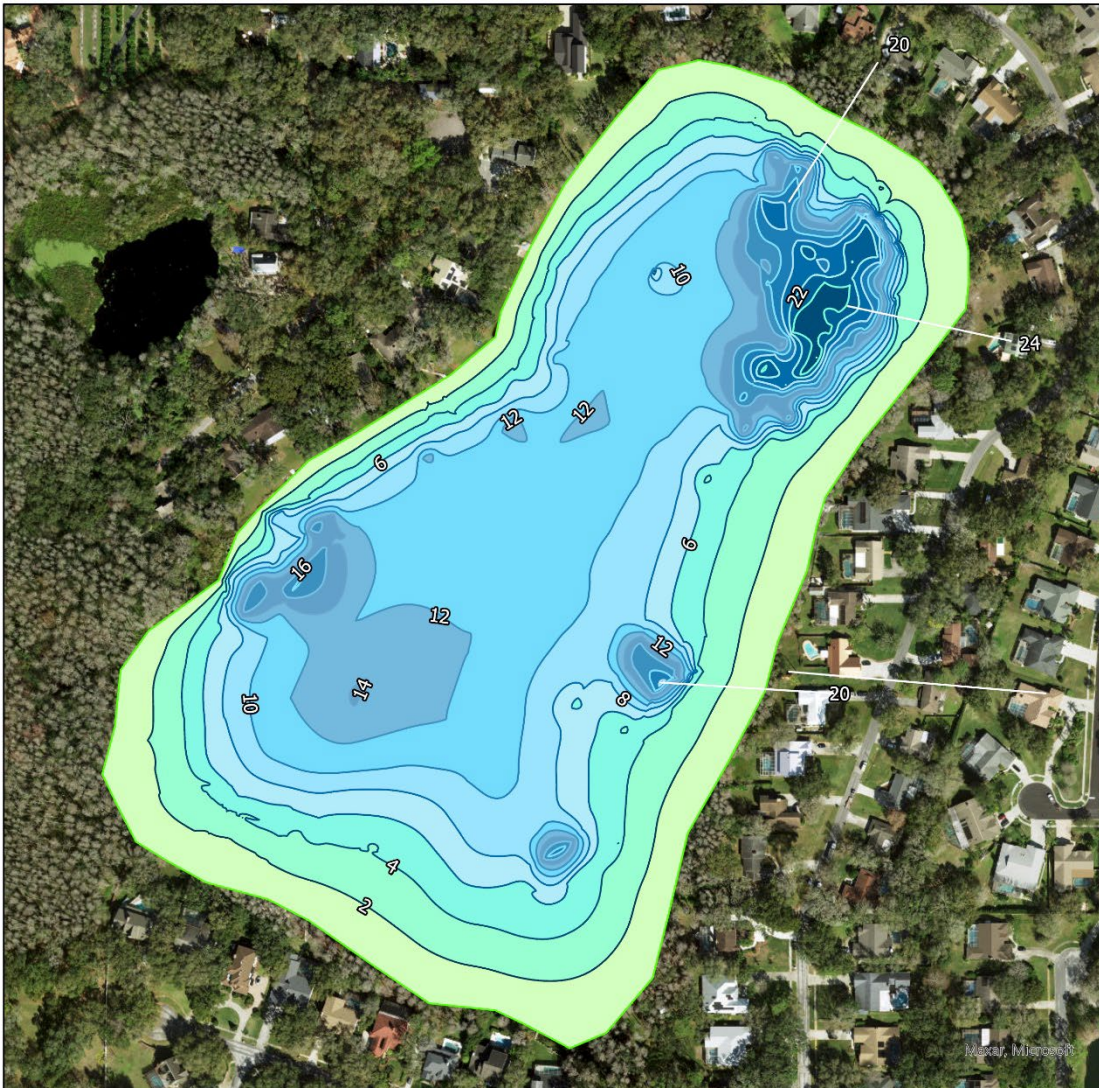
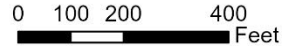




Figure 3 Overview photograph of Lake Armistead showing the dominate invasive species *Nymphoides cristata*.

Lake Habitat and Lake Vegetation Index Assessment

The lake assessment for Lake Armistead was conducted on July 23, 2024. The water in Lake Armistead was characterized as clear with low turbid. The secchi disk depth was 2.59 meters. The vegetation quality of the plants in and buffering Lake Armistead are predominantly native species with extensive growths of non-native invasive species *Nymphoides cristata* and moderate growth of non-native invasive species such as *Oxycaryum cubense* and *Panicum repens*. The percentage of non-native FLEPPC 1 species ranged from 22.22% (region 4) to 36.84% (region 1). Stormwater reaches the lake predominately via ditches, pipes, and cultivated vegetation, and there are either ineffective or no BMPs in place. The development along the shoreline has maintained the nearshore *Taxodium* however the shrub and native ground cover communities have largely been maintained for residential turf grasses. The bottom substrate quality was dominated by sandy material that submersed vegetation.

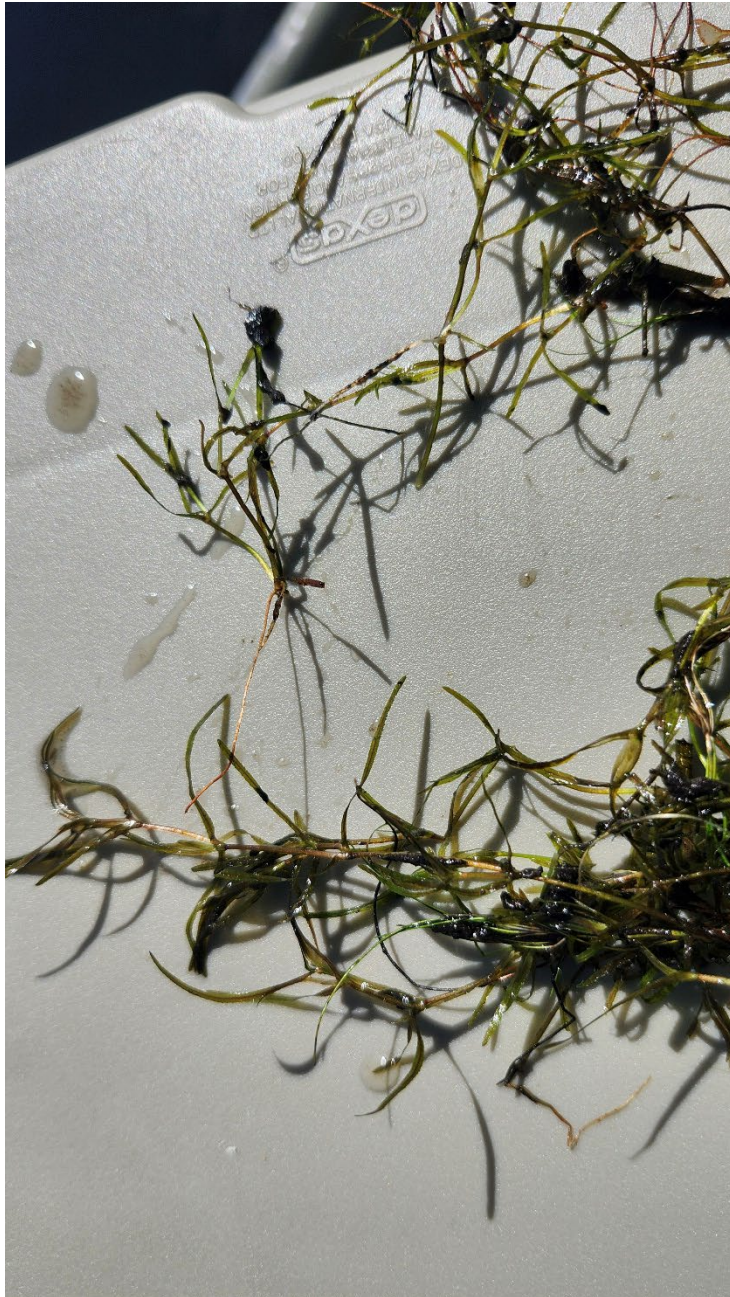


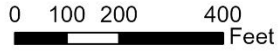
Figure 4 Najas guadalupensis was present in region 7 of the Lake Vegetation Index on Lake Armistead

The Lake Vegetation Index identified 30 species of wetland vegetation growing in the four selected sections along Lake Armistead. The majority of these species (19) are native species. The remaining 11 species (*shown in Table 2*) are non- native or invasive to this region. The vegetation community along the shorelines of Lake Armistead has been altered by lawn maintenance activities leaving a *Taxodium* canopy with a sparse shrub and ground cover community. The edges of the lake are dominated by species able to rapidly colonize following the frequent disturbance of mowing, such as *Panicum repens*. At the time of the assessment the water transparency was 2.59 m (8.5 ft). High annual average secchi disk depths allow for an extensive littoral zone with establishment of floating leaved and submerged aquatic vegetation. Four species of submersed aquatic vegetation were observed during the lake vegetation index, these species include *Najas guadalupensis*, *Nitella*, *Potamogeton pusillus*, and *Vallisneria americana*. The floating leaved vegetation community had 3 species present, the dominate species in all four regions being *Nymphoides cristata* and the other two species present being *Nuphar* and *Hydrocotyle*.

By analyzing the collected sonar chart, submerged aquatic vegetation potentially covered approximately 1.2% of the surface area of Lake Armistead. This submerged vegetation inhabits an estimated 0.03% of the water volume in Lake Armistead. Figure 5 shows the results of the SAV analysis indicating the location and height of SAV estimated from collected sonar readings.

The calculated LVI score for Lake Armistead was 21, below the impairment threshold of 43 indicating the vegetation community is showing evidence of being “Impaired”. Figure 6 shows the map of Lake Armistead detailing the LVI regions used for the assessment (Regions 1, 4, 7, 10). Table 2 details the species list results of the Lake Vegetation Index. Table 3 details the scoring result for the Lake Vegetation Index.

Lake Armistead



EXPLANATION:

Survey Date: July 23, 2024
 Water level was 40.26 ft NAVD88 at the time of the assessment. Submerged Aquatic Vegetation was analyzed from collected sonar data. The height of the SAV where present is shown in 1 foot increments.

DATA SOURCES:

2023 aerial photography provided by ESRI.
 Lake perimeter digitized from Hillsborough County 2023 aerial photographs.
 All contours generated by the USF Water Institute from survey data collected by USF Water Institute Lake and Stream Assessment Program

SAV STATISTICS:

Area 19,403 square ft; 0.4 Acres;
 (1.20% of Lake Surface Area)
 Mean SAV Height 0.2 ft;
 Volume 3,215 Cubic ft, (24,054 gallons);
 (0.03% of Lakes Volume)



Water Institute



Figure 5 Lake Armistead Submerged Aquatic Vegetation Assessment Results

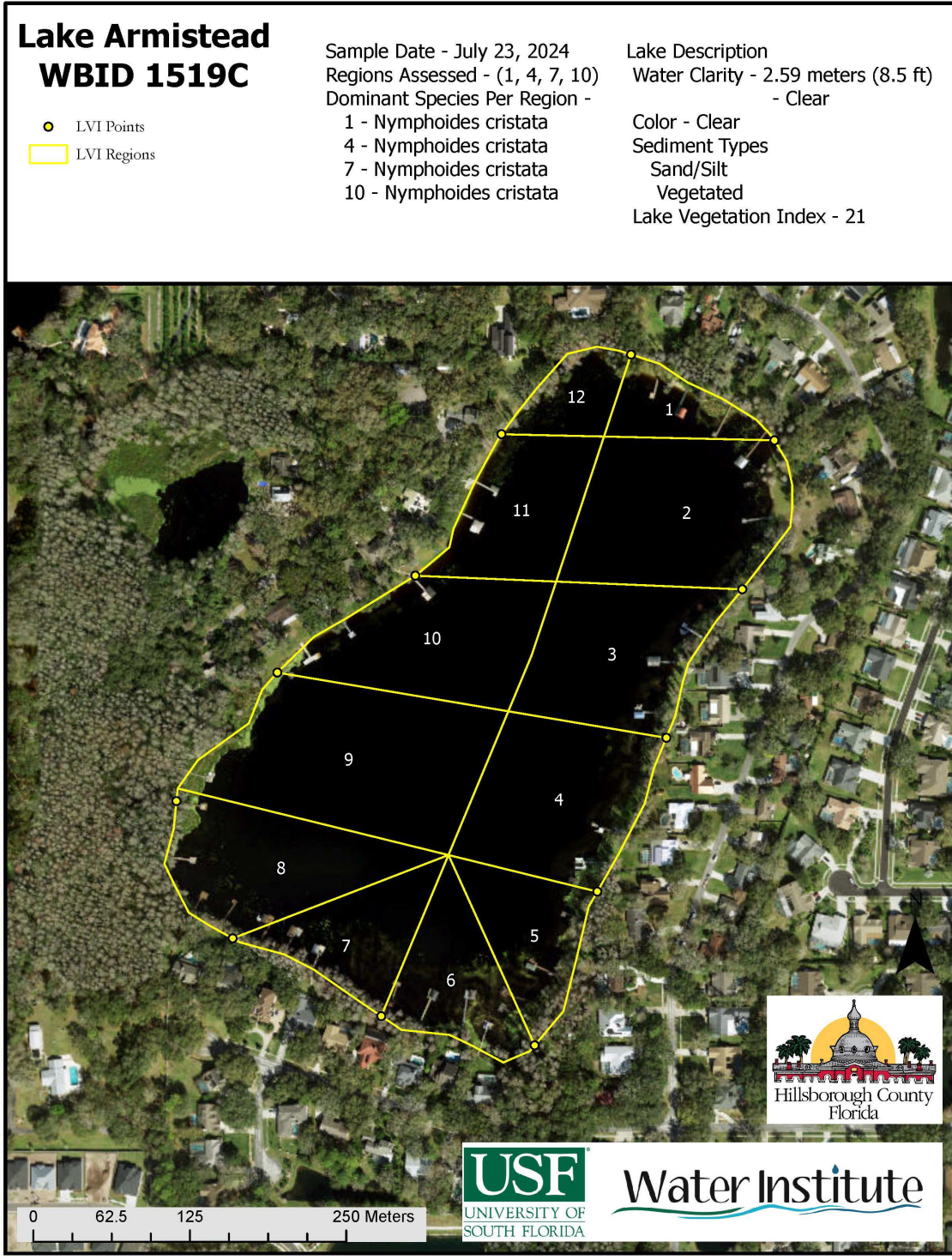


Figure 6: Lake Vegetation Index region map for Lake Armistead

Table 2: Lake Vegetation Index results for Lake Armistead July 23, 2024. In this table, “p” represents the taxa was present in the region while “c” and “d” denotes the taxa as being co-dominant or dominant in the vegetation region.

Taxon	Region				Occurrences	C of C Score	FLEPPC Status	Wetland Status	Nativity
	1	4	7	10					
<i>Acer rubrum</i>	p		p		2	4.65	Not Listed	FACW	Native
<i>Alternanthera philoxeroides</i>	p	p	p	p	4	0.00	Category 2	OBL	Exotic
<i>Casuarina equisetifolia</i>	p				1	0.00	Category 1	FAC	Exotic
<i>Cephalanthus occidentalis</i>			p		1	5.00	Not Listed	OBL	Native
<i>Cyperus odoratus</i>	p		p		2	3.00	Not Listed	FACW	Native
<i>Echinochloa walteri</i>	p				1	2.50	Not Listed	FACW	Native
<i>Eleocharis baldwinii</i>				p	1	2.82	Not Listed	OBL	Native
<i>Eleocharis interstincta</i>	p				1	7.80	Not Listed	OBL	Native
<i>Hydrocotyle</i>				p	1	2.00	Not Listed	FACW	Native
<i>Hymenachne amplexicaulis</i>	p				1	0.00	Category 1	OBL	Exotic
<i>Imperata cylindrica</i>				p	1	0.00	Category 1		Exotic
<i>Ludwigia arcuata</i>	p				1	3.50	Not Listed	OBL	Native
<i>Ludwigia octovalvis</i>	p	p		p	3	2.00	Not Listed	OBL	Native
<i>Ludwigia peruviana</i>	p		p		2	0.00	Category 1	OBL	Exotic
<i>Melaleuca quinquenervia</i>	p		p		2	0.00	Category 1	FAC	Exotic
<i>Micranthemum glomeratum</i>	p			p	2	5.85	Not Listed	OBL	Native
<i>Najas guadalupensis</i>			p		1	5.07	Not Listed	OBL	Native
<i>Nitella</i>	p				1	6.00	Not Listed	OBL	Native
<i>Nuphar</i>		p			1	3.50	Not Listed	OBL	Native
<i>Nymphoides cristata</i>	d	d	d	d	4	0.00	Category 1	OBL	Exotic
<i>Oxycaryum cubense</i>	p	p	p	p	4	0.00	Not Listed	OBL	Exotic

Taxon	Region				Occurrences	C of C Score	FLEPPC Status	Wetland Status	Nativity
	1	4	7	10					
<i>Panicum repens</i>	p	p	p	p	4	0.00	Category 1	FACW	Exotic
<i>Pontederia cordata</i>		p			1	5.38	Not Listed	OBL	Native
<i>Potamogeton pusillus</i>	p	p	p		3	7.80	Not Listed	OBL	Native
<i>Salix caroliniana</i>			p		1	2.95	Not Listed	OBL	Native
<i>Salvinia minima</i>			p	p	2	0.00	Category 1	OBL	Exotic
<i>Taxodium</i>	p		p	p	3	7.00	Not Listed	OBL	Native
<i>Typha</i>		p			1	1.00	Not Listed	OBL	Native
<i>Urochloa mutica</i>	p			p	2	0.00	Category 1	FACW	Exotic
<i>Vallisneria americana</i>			p	p	2	7.00	Not Listed	OBL	Native

Table 3: Scoring Summary for the Lake Vegetation Index

LVI Sample Result: 21				
Region		South		
Metric / Section	1	4	7	10
Total # Taxa	19	9	15	13
% Native Taxa	52.63%	55.56%	53.33%	46.15%
% FLEPPC 1 Taxa	36.84%	22.22%	33.33%	30.77%
% Sensitive Taxa	15.79%	11.11%	20%	15.38%
Dom Taxa Count	1	1	1	1
CofC Dom Taxa	0.00	0.00	0.00	0.00
Section LVI	19.74	20.37	25	19.23

Water Quality Assessment

Long-term water quality data is available for Lake Armistead. The available data was collected by Lakewatch, Florida Department of Environmental Protection and Hillsborough County Environmental Services. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of Lake Armistead during the University of South Florida/ Hillsborough County Environmental Services assessment in 2024.

Table 4: Lake Armistead Water Quality 7/23/2024 (Field)

Meter Readings:	Depth (M)	Temp (°C)	pH (SU)	D.O (MG/L)	D.O Sat. (%)	Cond. (UMHO/CM)	Salinity (PPT)
Top:	0.14	31.1	6.95	6.56	82.8	225.8	0.1
Mid-Depth:	2	30.82	6.88	5.55	69.52	225.8	0.1
Bottom:	3.52	27.93	6.82	1.11	11.8	262.2	0.12

The chemical water quality analysis for Lake Armistead is shown in Table 5. These values are the geometric mean value of available data for each annual period as well as the period of record. The FDEP Numeric Nutrient Criteria splits lakes into separate types based on color at 40 PCU. The “clear” water lakes below this value are further split into alkaline and acidic based on an alkalinity value of 20mg/L CaCO₃. The long term color data have a geometric mean value of 116 PCU, classifying it as a colored water lake (greater than or equal to 40 PCU). Total Alkalinity period of record geometric mean value is 26 mg/L. The NNC thresholds for a colored lake with sufficient data to calculate NNC (Previous three years with at least 4 samples per year in separate seasons) are 20 µg/L for Chlorophyll-a Corrected for Phaeophytin, 0.05-0.16 mg/L for Total Phosphorous and 1.27-2.23 mg/L for Total Nitrogen.

Geometric mean Chlorophyll-a corrected values for the past three years are below the threshold with annual geometric means of 4.55 µg/L (2022), 8.14 µg/L (2023) and 3.47 µg/L (2024). The period of record geometric mean for chlorophyll-a corrected is 5.67 µg/L. Total Phosphorous geometric mean values for the most recent data were below the nutrient threshold for colored lakes in the peninsula region with sufficient data with a value of 0.025 mg/l (2022), 0.017 mg/L (2023) and 0.044 mg/L (2024). Total Nitrogen values were below the nutrient threshold for colored lakes with sufficient data with a value of 0.662 mg/l (2022), 0.670 mg/L (2023) and 0.794 mg/L (2024). Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment and the previous 3 years of data collected by Hillsborough County and Lakewatch.

Bacteria testing showed low levels of E. Coli (201 colonies/100ml) and elevated levels of Enterococci (4,280 colonies/100ml) exceeding 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 Armistead FDEP, Lakewatch and Hillsborough County Environmental Services Water Quality Results Laboratory Results

Parameter	2022	2023	2024	POR Mean Value	Units
Alkalinity	No data	No data	33.8	26	mg/LCaCO3
Color	No data	No data	No data	116	PCU
E Coli	No data	No data	7.14	7.34	#/100ml
Enterococci	No data	No data	4.56	5.48	#/100 ml
Chlorophyll a	8.49	8.20	4.38	8.84	ug/L
Chlorophyll b	No data	No data	2.5	2.51	ug/L
Chlorophyll c	No data	No data	2.5	2.43	ug/L
Chlorophyll a Corrected	4.55	8.14	3.47	5.67	ug/L
Ammonia	No data	No data	0.073	0.023	mg/L
Nitrates/Nitrites	No data	No data	0.043	0.019	mg/L
Kjeldahl Nitrogen	No data	No data	0.816	0.817	mg/L
Total Nitrogen	0.662	0.670	0.794	0.769	mg/L
Total Phosphorus	0.025	0.017	0.044	0.028	mg/L

Table 6: Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean Color (pcu)	116
Number of Samples	19
Geometric Mean Alkalinity (mg/L CaCO ₃)	26
Number of Samples	19
Lake Type	Colored

Year (# of Samples)	Geomean Chla Corrected (µg/L)	Chlorophyll a Criteria (µg/L)	Geomean Total Phosphorous (mg/L)	Total Phosphorous Criteria (mg/L)	Geomean Total Nitrogen (mg/L)	Total Nitrogen Criteria (mg/L)
2022 (5)	4.55	< 20	0.025	< 0.16	0.662	< 2.23
2023 (3)	8.14	< 20	0.017	< 0.16	0.670	< 2.23
2024(9)	3.47	< 20	0.044	< 0.16	0.794	< 2.23

Conclusion

Lake Armistead is a predominately residential lake in the Coastal Old Tampa Bay Watershed of Hillsborough County, Florida. The results of the assessment of Lake Armistead shows healthy lake based on Chlorophyll-a, Total Nitrogen and Total Phosphorous concentrations according to the FDEP numeric nutrient criteria using a combination of Lakewatch and Hillsborough County Environmental Services datasets for the past three years.

The system does show impairment in the vegetation communities according to the Lake Vegetation Index with abundant invasive species (11) and an overall LVI score of 21. The non-native, invasive species *Nymphoides cristata* is largely responsible for the low LVI score due to being dominant in each of the four regions assessed. This species also shades out the littoral zone below, reducing submersed aquatic vegetation. The assessment revealed a submerged aquatic vegetation community comprising 5 species currently occupying only 1.2% of the surface area and 0.03% of the volume of Lake Armistead.