LAKE ECOSUMMARY

Lake Adelaide
WBID 2998E, Seminole County
Sampled 08/20/2018 and 05/21/2019

Figure 1. Lake Adelaide in Seminole County.

DEP conducted water quality and biological sampling at Lake Adelaide (WIN G2CE0151, SBIO ADLDECTR) in Seminole County on August 20, 2018 and May 21, 2019 to assess attainment of designated uses. This lake was sampled as part of DEP's Strategic Monitoring Program.

Overall, the water quality and plant community data indicated that the lake did not meet expectations for a healthy, well-balanced lake.

Background

Healthy, well-balanced lake communities may be maintained with some level of human activity, but excessive human disturbance may result in lake degradation. Human stressors include increased inputs of nutrients, sediments and/or pesticides from watershed runoff, undesirable removal of native shoreline and/or upland buffer vegetation, and introduction of nuisance (generally exotic) plants and animals. DEP has methods to evaluate if human activities have resulted in a specific waterbody exceeding water quality criteria (Chapter 62-302, Florida Administrative Code [F.A.C.]), including whether adverse impacts to biological communities have occurred. DEP water quality standards are designed to protect designated uses of the waters of the state (*e.g.,* recreation, aquatic life support), and exceedances of these standards are associated with interference with the designated use. DEP assesses the health of plant communities in Florida lakes, as one indication of whether adverse impacts to biological communities have occurred.

Site Description

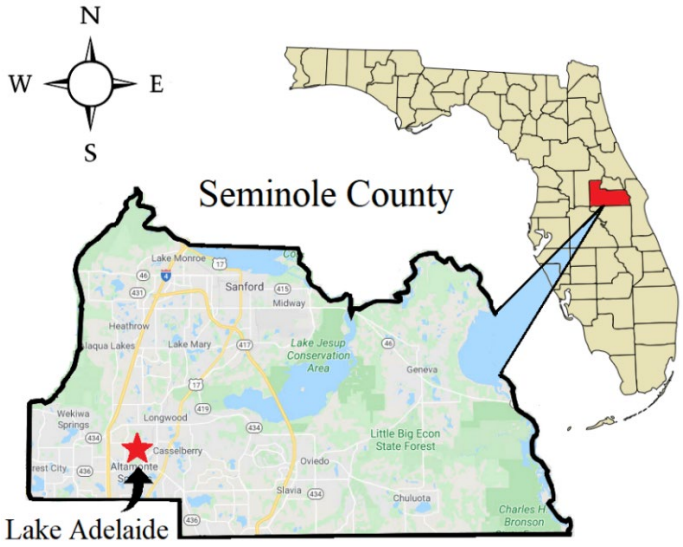

Figure 2. Location of Lake Adelaide in Seminole County.

Lake Adelaide (Figure 1) is in Seminole County (Figure 2) and is part of the Little Wekiva Watershed. The lake area is approximately 23 acres, and the depth is up to 3.6 m (12 feet). Lake Adelaide is located within the Wekiva Study area, a 473-acre area identified in the 2004 Wekiva Parkway and Protection Act (WPPA) for expedited assessment of waterbodies for Total Maximum Daily Loads (TMDLs). The predominant land uses surrounding Lake Adelaide are medium density residential and commercial with some natural wetland areas (Figure 3). This lake is currently listed for nutrients and chlorophyll on the Verified Impaired Waters List (11/15/2019). Additional information about this WBID is available in the Water Quality Assessments, TMDLs, and BMAPs map application (https://fdep.maps.arcgis.com/home/webmap/viewer.html?webmap=1b4f1bf4c9c3481fb2864a415fbeca77).

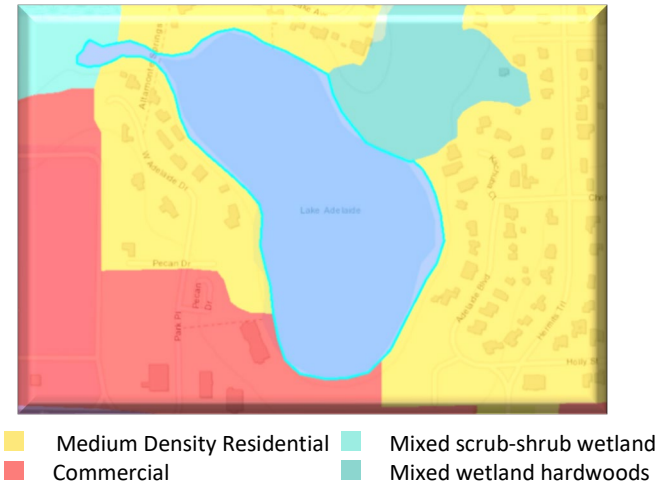

Figure 3. Predominant land uses surrounding Lake Adelaide.

Methods

Water Quality

This lake was sampled on August 20, 2018 and May 21, 2019 by the DEP Central Regional Operations Center (CEROC). Surface water samples were collected from the center of the lake for analysis of nutrients, chlorophyll *a*, color, alkalinity, total suspended solids, total dissolved solids, turbidity, chloride, fluoride, sulfate, and *Escherichia coli* (*E. coli)*, following DEP Standard Operating Procedures (SOPs; see https://floridadep.gov/dear/quality-assurance/content/dep-sops). Sampling and analyses met DEP quality assurance/quality control standards. Results were compared with applicable Class III water quality criteria contained in 62-302, F.A.C., including nutrients, dissolved oxygen, and other indicators.

Chlorophyll *a* is a measure of algal biomass in the water column. Chapter 62-302.531, F.A.C., provides numeric criteria for chlorophyll *a*, total nitrogen (TN), and total phosphorus (TP) in lakes, and is dependent upon the long term mean color and alkalinity of the lake (Table 1). If the annual geometric mean chlorophyll *a* (calculated with at least four samples, representing seasonal variability) does not exceed the chlorophyll *a* value for the lake type in Table 1, then the TN and TP criteria for that calendar year shall be the annual geometric means of lake TN and TP samples, subject to the minimum and maximum limits in Table 1. If there are insufficient data to calculate the annual geometric mean chlorophyll *a* for a given year or the annual geometric mean chlorophyll *a* exceeds the values in Table 1 for the lake type, then the applicable numeric interpretations for TN and TP shall be the minimum values in Table 1. Based on long-term results, Lake Adelaide is a high color, high alkalinity lake.

Table 1. Numeric nutrient criteria in lakes, 62-302.531 (2)(b)(1), F.A.C. AGM = annual geometric mean

Long Term Geometric Mean Lake Color and Alkalinity	AGM Chlorophyll *a*	AGM TP Range	AGM TN Range
> 40 Platinum Cobalt Units	**20 µg/L**	**0.05 to 0.16[1] mg/L**	**1.27 to 2.23 mg/L**
≤ 40 Platinum Cobalt Units and > 20 mg/L $CaCO_3$	**20 µg/L**	**0.03 to 0.09 mg/L**	**1.05 to 1.91 mg/L**
≤ 40 Platinum Cobalt Units and ≤ 20 mg/L $CaCO_3$	**6 µg/L**	**0.01 to 0.03 mg/L**	**0.51 to 0.93 mg/L**

[1] For lakes with color > 40 PCU in the West Central Region, the maximum TP limit is 0.49 mg/L

Dissolved Oxygen

Rule 62-302.533 (1), F.A.C., states that no more than 10 percent of the daily average percent dissolved oxygen (DO) saturation values shall be below 67 percent in the Panhandle West bioregion, 38 percent in the Peninsula and Everglades bioregions, or 34 percent in the Northeast and Big Bend bioregions. This site is in the Peninsula region for DO criteria assessment. Percent saturation incorporates factors such as temperature, atmospheric pressure, and salinity. For lakes, the daily average DO level shall be calculated as the average of measurements collected in the upper two meters of the water column at the same location on the same day.

The daily average freshwater DO criteria is preferentially assessed using daily average values calculated from full days of diel (collected over a 24 hour period) monitoring data. If diel monitoring data are not available, as was the case for this report, instantaneous samples are used to assess the DO criterion by comparing the instantaeous value with a time-of-day-specific translation of the daily average criterion (62-303.420(9), F.A.C.), and a spreadsheet calculator for this purpose is available at: https://floridadep.gov/dear/water-quality-standards-program/documents/do-saturation-calculator%C2%A0

Lake Vegetation Index

The Lake Vegetation Index (LVI) assesses how closely the plant community of a lake resembles a native undisturbed community. The LVI was sampled per DEP SOP LVI 1000 and calculated per DEP SOP LVI 2000. Species lists were developed for four of twelve sections of the lake (Figure 4), and the following information was derived from those lists: percent native species, percent Category 1 invasive exotic species as identified by the Florida Exotic Pest Plant Council, percent sensitive species, and the coefficient of conservatism (C of C; a measure of how tolerant a species is of disturbance) of the dominant or co-dominant species. Chapter 62-303.330 and 62-303.430, F.A.C., provide that a LVI score of 43 or greater meets the expectation of a healthy, well balanced community, and scores below 43 are considered impaired.

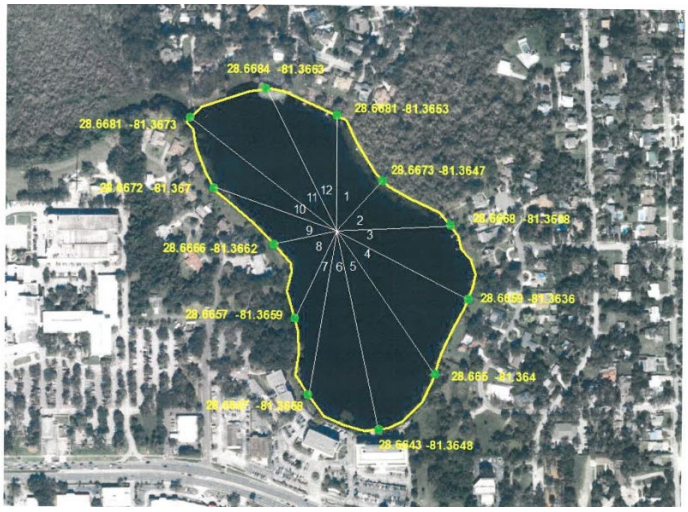

Figure 4. LVI sampling map of Lake Adelaide. Sections 3,6,9,12 were sampled in 2018, and sections 2,5,8,11 were sampled in 2019. The water quality samples were collected from the lake center.

Results

Water Quality

The water quality results are shown in Table 2.

While the 2019 color result was less than 40 PCU, the long-term color for this lake is consistent with the 2018 result, so the numeric nutrient thresholds for colored lakes will be assessed. Based on these two sampling events, the lake exceeded the chlorophyll *a* threshold for high color lakes; however, the TP and TN concentrations were near the minimum colored lake criteria for nutrients in cases where the chlorophyll *a* threshold is exceeded. The percent dissolved oxygen and pH results were high on the 5/21/2019 sampling date, which is consistent with greater phytoplankton production evidenced by the higher chlorophyll *a* measured on that day. Higher color in August 2018 was associated with lower chlorophyll *a*, when compared with the May 2019 results.

The chlorophyll and nutrient thresholds represent annual geometric mean concentrations (minimum of four samples) not to be exceeded more than once in any three-calendar year period, so DEP's Watershed

Assessment Section will evaluate the complete dataset for this lake to assess compliance with nutrient criteria.

Table 2. Water quality results from 05/21/2019 and 08/20/2018 at Lake Adelaide.

Analyte	Result 08/20/2018	Result 05/21/2019	Applicable Class III Water Quality Criteria
Field Temperature (°C)	30.6	29.0	N/A
Field pH (SU)	7.1	8.8	Within 1 unit of natural background
Field Dissolved Oxygen (% saturation)	78	147	*>34.94% for 5/21/2019, >34.08% for 8/20/2018
Field Specific Conductance (µmhos/cm)	164	199	50% above background or 1275, whichever is greater
Alkalinity (mg $CaCO_3$/L)	48	49	Shall not be depressed below 20
Color (PCU)	53 A	34 A	N/A
Chlorophyll *a* (µg/L)	34	41	≤ 20 for colored lakes
Total Phosphorus (mg/L) as P	0.042	0.054	≤0.05
Nitrate+Nitrite (mg/L) as N	0.004 U	0.004 U	N/A
Ammonia (mg/L) as N	0.005 I	0.006	**≤0.32 for 5/21/19, ≤2.28 for 8/20/18
Total Kjeldahl Nitrogen (mg/L) as N	0.93	1.2	N/A
Total Nitrogen (mg/L) as N	0.93	1.2	≤1.27

* Instantaneous DO criterion calculated per DO Saturation Calculator

** Total ammonia criterion calculated per https://floridadep.gov/dear/water-quality-standards-program/documents/total-ammonia-nitrogen-calculator%C2%A0

A: Value reported is the mean of two or more determinations.

I: The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

U: Material was analyzed for but not detected. The reported value is the method detection limit for the sample analyzed.

Lake Vegetation Index

The LVI score for this lake was 27 out of a possible 100 points on August 20, 2018, and 37 on May 21, 2019. Both scores correspond with a “Not Healthy" designation. Tables 3 and 4 contain the species lists and occurrence information for these sampling events. A total of 11 invasive exotic species were observed in the lake, 7 species in 2018 and 8 species in 2019.

Table 3. Species list for the August 20, 2018 LVI at Lake Adelaide. An asterisk (*) indicates an invasive exotic plant species. P = present, D = dominant, C = codominant.

Lake Adelaide, August 20. 2018		Sections			
Scientific Name	**Common Name**	**3**	**6**	**9**	**12**
Acer rubrum	RED MAPLE	P		P	P
Alternanthera philoxeroides*	ALLIGATORWEED	P	P	P	P
Bidens alba	BEGGARTICKS	P			
Boehmeria cylindrica	BOG HEMP	P	P	P	P
Cephalanthus occidentalis	COMMON BUTTONBUSH	P	P	P	P
Colocasia esculenta*	WILD TARO	P	P		
Cyperus odoratus	FRAGRANT FLATSEDGE		P	P	P
Diodia virginiana	VIRGINIA BUTTONWEED		P	P	
Eichhornia crassipes*	WATER HYACINTH	P	P	P	P
Eleocharis submersed viviparous (species unknown)	SPIKERUSH	P			
Eupatorium capillifolium	DOGFENNEL	P			P
Hydrocotyle	MARSHPENNYWORT	P	P	P	P
Ilex cassine	DAHOON HOLLY				P
Ludwigia leptocarpa	ANGLESTEM PRIMROSEWILLOW		P	P	P
Ludwigia peruviana*	PERUVIAN PRIMROSEWILLOW	P	P	P	P
Mikania scandens	CLIMBING HEMPVINE	P	P	P	P
Myrica cerifera	WAX MYRTLE				P
Najas guadalupensis	SOUTHERN WATERNYMPH				P
Nuphar	SPATTERDOCK	P	D	D	D
Panicum repens*	TORPEDOGRASS	P	P	P	P
Polygonum punctatum	DOTTED SMARTWEED				P
Pontederia cordata	PICKERELWEED			P	
Ptilimnium capillaceum	MOCK BISHOPSWEED		P		
Rumex hastatulus	HEARTWING DOCK				P
Sabal palmetto	CABBAGE PALM		P		
Sacciolepis striata	AMERICAN CUPSCALE		P		
Sagittaria lancifolia	BULLTONGUE ARROWHEAD				P
Salix caroliniana	CAROLINA WILLOW				P
Salvinia minima*	WATER SPANGLES	P	P	P	P
Sapium sebiferum*	CHINESE TALLOW				P
Taxodium	CYPRESS	P		P	
Typha	CATTAIL	P	P		P
Utricularia gibba	HUMPED BLADDERWORT				P
Vallisneria americana	EELGRASS	D			
Vigna luteola	HAIRYPOD COWPEA		P	P	
Wedelia trilobata*	CREEPING OXEYE	P			

Table 4. Species list for the May 21, 2019 LVI at Lake Adelaide. An asterisk (*) indicates an invasive exotic plant species. P = present, D = dominant, C = codominant. (No dominant or co-dominant was noted for sections 8 or 11 in the May 21, 2019 LVI).

Lake Adelaide, May 21, 2019		Sections			
Scientific Name	**Common Name**	**2**	**5**	**8**	**11**
Acer rubrum	RED MAPLE	C	P		P
Alternanthera philoxeroides*	ALLIGATORWEED	P	P	P	P
Baccharis	FALSEWILLOW		P		
Bacopa monnieri	HERB-OF-GRACE	P	P		P
Boehmeria cylindrica	BOG HEMP		P	P	P
Cephalanthus occidentalis	COMMON BUTTONBUSH	P	C	P	
Chara	MUSKGRASS				P
Cicuta maculata	SPOTTED WATER HEMLOCK		P	P	
Cinnamomum camphora*	CAMPHOR TREE		P	P	
Eclipta prostrata	FALSE DAISY			P	
Eichhornia crassipes*	WATER HYACINTH	P	P	P	
Eleocharis baldwinii	BALDWIN'S SPIKERUSH		P		
Eleocharis submersed viviparous (species unknown)	SPIKERUSH				P
Eupatorium capillifolium	DOGFENNEL				P
Habenaria repens	WATERSPIDER FALSE REINORCHID				P
Hydrocotyle	MARSHPENNYWORT	P	P	P	P
Ilex cassine	DAHOON HOLLY	P			
Lemna	LESSER DUCKWEED	P			
Liquidambar styraciflua	SWEET GUM			P	
Ludwigia leptocarpa	ANGLESTEM PRIMROSEWILLOW	P			P
Ludwigia peruviana*	PERUVIAN PRIMROSEWILLOW		P	P	
Mikania scandens	CLIMBING HEMPVINE	P	P		
Myrica cerifera	WAX MYRTLE	P		P	
Nuphar	SPATTERDOCK	C	P	P	P
Osmunda regalis	ROYAL FERN	P	P		
Panicum hemitomon	MAIDENCANE		P	P	
Panicum repens*	TORPEDOGRASS	P	P	P	P
Polygonum punctatum	DOTTED SMARTWEED	P			P
Pontederia cordata	PICKERELWEED			P	
Ptilimnium capillaceum	MOCK BISHOPSWEED	P		P	P
Rubus	BLACKBERRY		P		
Salix caroliniana	CAROLINA WILLOW	P	C		
Salvinia minima*	WATER SPANGLES	P	P		
Sapium sebiferum*	CHINESE TALLOW		P	P	
Scirpus cubensis*	CUBAN BULRUSH	P			P
Taxodium	CYPRESS	P		P	P
Typha	CATTAIL		P	P	
Urochloa mutica*	PARA GRASS			P	
Vallisneria americana	EELGRASS	P			P
Vigna luteola	HAIRYPOD COWPEA	P			P

Conclusions

Based on these two recent sampling events, Lake Adelaide did not meet applicable State Water Quality Criteria for chlorophyll *a* or the floral community. Total Nitrogen and Total Phosphorous concentrations were not exceeded for these two samples but were very close to the minimum thresholds that apply in colored lakes when the chlorophyll *a* threshold is exceeded. High chlorophyll *a* measured in Lake Adelaide suggests that phytoplankton has become the primary consumer of the lake's elevated nutrients instead of beneficial, native

aquatic plants. The LVI scores were less than expected for a healthy lake. While the high chlorophyll *a* is likely associated with plant community degradation, shoreline disturbance and other stressors related to residential and commercial land uses at Lake Adelaide are also contributors to the poor LVI scores.

Thank you for your interest in maintaining the water quality of Florida's lakes. Please contact us if you have any questions.

Contact and resources for more information

Natalie Ayala, 407-897-4178,
Natalie.Ayala@FloridaDEP.gov

or Kathryn March, 407-897-4174
Kathryn.W.March@FloridaDEP.gov

or Victoria Schwartz, 407-897-4180
Victoria.Schwartz@floridadep.gov

or Elizabeth Bates, 407-897-4183
Elizabeth.Bates@floridadep.gov

DEP biological assessment resources:
https://floridadep.gov/dear/bioassessment
FWCC Aquatic Plant Management:
http://myfwc.com/wildlifehabitats/invasive-plants/
Freshwater Algal Bloom information:
https://floridadep.gov/dear/algal-bloom