LAKE ECOSUMMARY

Lake Holden, July 7, 2010

DEP conducted chemical and biological sampling at Lake Holden in Orange County on July 7, 2010 in response to a home owner request concerning potential adverse effects from past and present use of alum to improve water clarity in the lake by reducing sediment nutrient availability. Overall, the water quality met the State of Florida's water quality standards, but plant community data indicated that the lake did not meet biological expectations for a healthy, well-balanced lake.

Background

Although healthy, well balanced lake communities may be maintained even with some level of human disturbance, human activities 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 the condition where a particular waterbody has exceeded water quality criteria (Chapter 62-302, Florida Administrative Code), 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. Chlorophyll *a* is a measure of algal biomass in the water column. In clear, low alkalinity lakes (lakes where color is < 40 PCU and alkalinity is < 20 mg/L $CaCO_2$), a healthy system is expected to have $\leq$ 6 µg/L of chlorophyll *a*. In colored ($\geq$ 40 PCU) lakes or clear, high alkalinity ($\geq$20 mg/L $CaCO_2$) lakes, healthy systems are expected to have $\leq$ 20 µg/L of chlorophyll *a*. Chlorophyll *a* values greater than those shown above may result in unwanted shading of aquatic plants and/or greater potential for harmful algal blooms. The Lake Vegetation Index (LVI) assesses how closely the plant community of a lake resembles a native undisturbed community. These tools are often used in conjunction with one another because it is possible to detect imbalance in the plant community while the algal community appears healthy (and vice versa).

Site Information

Lake Holden is an urban lake located within the Kissimmee River Basin in Orange County and the City of Orlando. Its surface area is approximately 265 acres (figure 1). Lake Holden was placed on the 303(d) List for nutrients and un-ionized ammonia. In 2006, the lake was included on the Adopted Verified List of Impaired Waters for nutrients and Trophic State Index (TSI). The Total Maximum Daily Load (TMDL) for Lake Holden is scheduled to be completed by September of 2011 to meet the State's Consent Decree deadline. Between April 2005 and March 2006, three alum applications were conducted as part of a sediment inactivation project to lessen the availability of phosphorus in the sediment to the water column. The alum treatment was repeated beginning in January, 2010. On July 7, 2010, Lake Holden had the appearance of a clear, healthy lake considering its urban watershed.

Methods

Lake Holden was sampled on July 7, 2010 by the DEP Central District Office. Surface water samples were collected for analysis of nutrients, chlorophyll *a*, color, alkalinity and metals following DEP Standard Operating Procedures (SOP; see http://www.dep.state.fl.us/water/sas/qa/sops.htm) and met DEP quality assurance/quality control standards (see http://www.dep.state.fl.us/water/sas/qa/index.htm).
For the LVI, species lists were developed for four of twelve sections of the lake (Figure 2), and the following information was derived from those lists: percent native species, percent invasive exotic species, percent sensitive species, and the coefficient of conservatism (C of C; a measure of how tolerant a species is to disturbance) of the dominant species. According to DEP SOP LT 7000, the LVI score ranges and categories are: (78-100) Exceptional; (38-77) Healthy; and (0-37) Impaired. DEP plans to propose a revised impairment threshold, in which scores of 46 and higher fully meet the expectation of a healthy, well balanced community, and scores below 46 are considered impaired. The LVI was sampled per DEP SOP FS7310 and calculated per DEP SOP LT7000.

Results

Water Quality

The July 7, 2010 water quality samples complied with water quality standards (Table 1). Since 2001, nutrients and chlorophyll concentrations have decreased. In 2001, total phosphorus values were as high as 0.05mg/L, total nitrogen reached 1.77mg/L, and chlorophyll *a* reached 45.78µg/L in 2003. Secchi depth, which was as low as 1.5 ft in 2002, was 8 ft during this sampling event.

Table 1. Water quality results July 7, 2010 at Lake Holden

Analyte	Result	Remark	Applicable Class III Water Quality Criteria
Field Temperature (°C)	29.8 C		
Field pH (SU)	7.58		Within Range
Field Dissolved Oxygen (mg/L)	7.5		≥ 5
Field Specific Conductance (µmhos/cm)	262		Not to exceed 50% of background or 1275
Alkalinity (mg $CaCO_3$/L)	33		>20
Color (PCU)	Non Detect		No Standard
Chlorophyll a (µg/L)	3.6		*≤ 20
Total Phosphorus (mg/L)	0.012		* 0.03-0.09
Nitrate+Nitrite (mg/L)	0.034		
Ammonia (mg/L)	Non Detect		
Total Kejldahl Nitrogen (mg/L)	0.43		
Total Nitrogen (mg/L)	0.464		*1.05-1.91

*Federally promulgated numeric nutrient criteria for Florida lakes will take effect in March 2012.

Phytoplankton

The algal community in the water column of Lake Holden was dominated by various species of green algae. Based on July 7, 2010 phytoplankton results, dominant algae groups were green (60%), blue-green (29%), and diatoms (5%). Dominance in algal groups varies naturally throughout the year, but prolonged dominance of blue-green algae, or cyanobacteria, may be associated with a higher risk for harmful algal blooms.

Lake Vegetation Index

The LVI score for Lake Holden was 30 out of a possible 100 points, corresponding with an "impaired" designation. Table 2 contains the species list and occurrence information for this sampling event. Although there were substantial stands of native, submersed, beneficial vegetation such as *Valliseneria* and *Najas guadalupensis*, the common occurrence of invasive exotic plants (nine in total) reduced the LVI score. The Lake Holden vegetation community would be improved by reducing the abundance of these invasive exotic plants. See Table 2.

Summary

Lake Holden is in a period of transition. The historic nutrient load from Lake Holden's watershed resulted in prominent algal growth and elevated chlorophyll *a*. (45.78µg/L on October 2, 2003) Elevated chlorophyll may cause unfavorable conditions for aesthetics, recreation and healthy biological function. The ongoing management plan to reduce the nutrient flow from Lake Holden's watershed and inactivate historical nutrients in the lake's sediments appears to be very effective, since current nutrient and chlorophyll concentrations were quite low. While these management activities are also attempting to reduce invasive plant species and promote native plant species, the LVI score indicates that additional exotic plant removal is still warranted. The Florida Department of Environmental Protection will continue to monitor Lake Holden, in conjunction with local agencies, through the TMDL process to gauge the success of future lake management, and to ensure the lake meets water quality and biological standards outlined in Chapter 62-302, Florida Administrative Code.

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

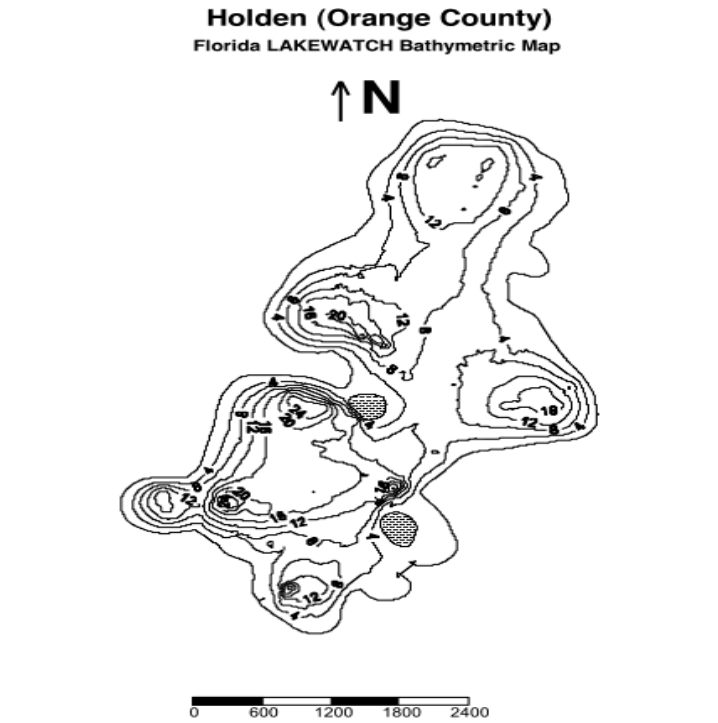


Figure 1. Bathymetric map of Lake Holden.

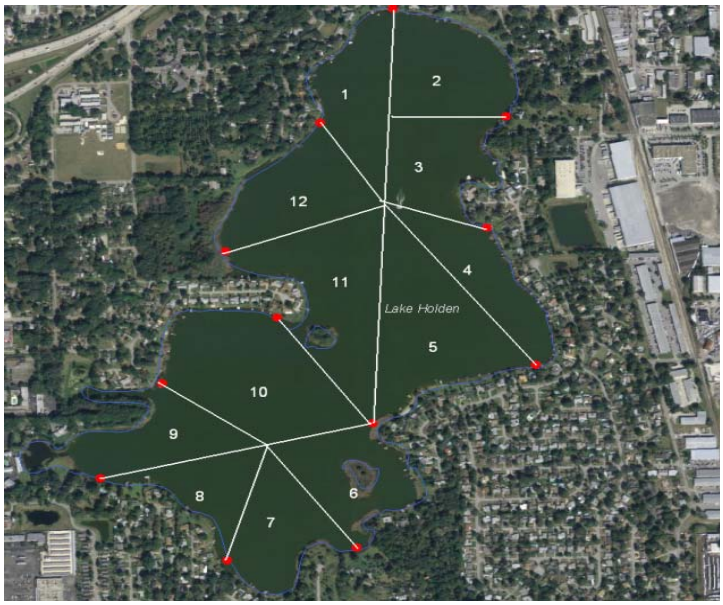


Figure 2. Sampling map of Lake Holden. Sections 1, 4, 7, and 10 were sampled for the Lake Vegetation Index. The water quality sample was collected from the lake center.

Table 2. Species list for the July 7, 2010 LVI at Lake Holden An asterisk (*) indicates an invasive exotic plant species. P = present, D = dominant, C = codominant.

Lake Holden July 7, 2010					
Species	Common Name Sections:	1	2	3	4
Alternanthera philoxeroides *	ALLIGATOR WEED			P	P
Baccharis glomeruliflora	SALT BUSH	P			
Canna	GOLDEN CANNA				P
Colocasia esculenta *	WILD TARO	P	P	P	P
Cyperus alternifolius *	UMBRELLA SEDGE			P	
Cyperus odoratus	FRAGRANT FLATSEDGE		P	P	P
Echinochloa crusgalli	BARNYARDGRASS		P		
Eleocharis interstincta	KNOTTED SPIKERUSH		P		
Eleocharis vivipara	SPROUTING SPIKERUSH	P		P	P
Fuirena scirpoidea	RUSH FUIRENA			P	P
Hydrilla verticillata *	HYDRILLA		P	P	P
Hydrocotyle	MARSHPENNYWORT	P	P	P	P
Iris hexagona	BLUE FLAG IRIS			P	
Ludwigia octovalvis	MEXICAN PRIMROSEWILLOW		P		
Ludwigia peruviana	PERUVIAN PRIMROSEWILLOW	P	P	P	P
Micranthemum glomeratum	MANATEE MUDFLOWER			P	P
Mikania scandens	CLIMBING HEMPVINE	P			P
Myrica cerifera	WAX MYRTLE	P			
Najas guadalupensis	SOUTHERN WATERNYMPH	P	D	D	D
Nelumbo lutea	AMERICAN LOTUS	P		P	
Nuphar	COW LILY		P		P
Nymphaea odorata	FRAGRENT WATERLILY		P	P	P
Panicum hemitomon	MAIDENCANE				P
Panicum repens *	TORPEDO GRASS	P	P	P	P
Pluchea odorata	SWEETSCENT			P	
Pontederia cordata	PICKERELWEED	P	P	P	P
Potamogeton illinoensis	ILLINOIS PONDWEED			P	P
Sagittaria lancifolia	ARROWHEAD DUCK POTATO	P	P	P	P
Sagittaria latifolia	DUCK POTATO			P	
Salix caroliniana	COROLINA WILLOW	P	P		P
Sambucus canadensis	ELDERBERRY	P		P	
Sapium sebiferum *	CHINESE TALLOW	P	P		P
Schinus terebinthifolius *	BRAZILIAN PEPPER	P		P	
Schoenoplectus californicus	GIANT BULLRUSH	P	P	P	P
Scirpus pungens	THREESQUARE BULRUSH			P	
Spirodela polyrhiza	COMMON DUCKWEED			P	
Taxodium	CYPRESS	P	P	P	P
Typha	CATTAIL	P	P	P	P
Urochloa mutica *	PARA GRASS	P	P	P	P
Utricularia gibba	TANGLED BLADDERWORT				P
Vallisneria americana	EEL GRASS	P	P	P	P
Wedelia trilobata *	CREEPING OXE EYE	P	P	P	P

Contact and resources for more information

David Scharr (407) 895-7555 david.scharr@dep.state.fl.us

DEP publications on Best Management Practices and Environmental Stewardship and Education:
http://www.dep.state.fl.us/water/nonpoint/pubs.htm

DEP biological assessment resources:
http://www.dep.state.fl.us/water/bioassess/index.htm

FWCC Aquatic Plant Management:
http://www.myfwc.com/WILDLIFEHABITATS/InvasivePlants_AquaticPlantManagement.htm

Freshwater Algal Bloom information:
http://www.dep.state.fl.us/labs/biology/hab/index.htm