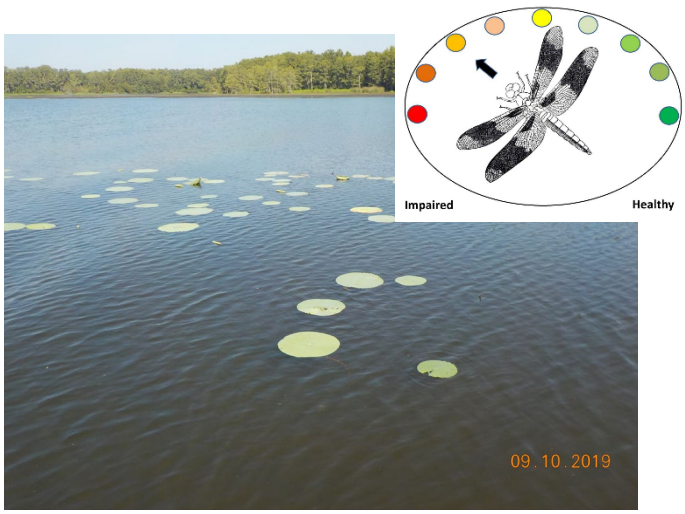
Waterbody: Lake Munson



Basin: Lake Munson

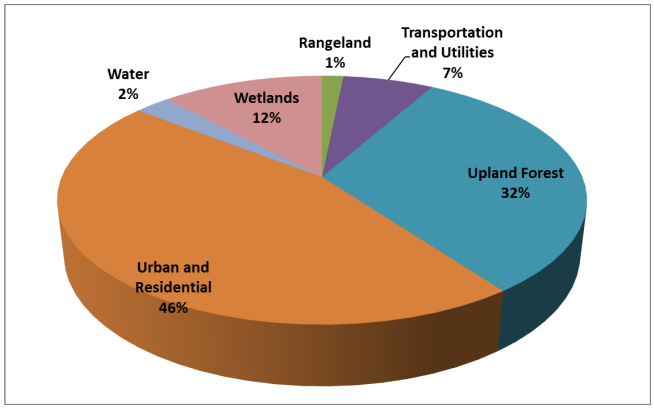
Lake Munson is an approximately 288-acre, cypress-rimmed, nitrogen-limited lake located south of the City of Tallahassee. The lake is believed to have originally been a cypress swamp but has since been impounded and now functions as a shallow man-made lake. Lake Munson receives the majority of its water from the heavily altered Munson Slough and its tributaries. Lake outflow continues southward via Munson Slough and finally drains into Ames Sink. Dye trace studies have confirmed a direct connection between Ames Sink and Wakulla Springs.

The lake has a history of severe water quality and ecological problems including fish kills, algal blooms, exotic vegetation and snails, high nutrient and bacterial levels, low game fish productivity, sediment contamination, and depressed oxygen levels.

As shown in the following pie chart, approximately 54% of land use in the 38,790-acre Lake Munson basin is rangeland, transportation, utilities, urban or residential. Increases in stormwater runoff and waterbody nutrient loads can often be attributed to these types of land uses.

Background

Healthy, well-balanced lake communities may be maintained with some level of human activity, but



excessive human disturbance may result in waterbody degradation.

Human stressors may include increased inputs of nutrients, sediments, and/or other contaminants from watershed runoff, adverse hydrologic alterations, undesirable removal of habitat or riparian buffer vegetation, and introduction of exotic plants and animals. Water quality standards are designed to protect designated uses of the waters of the state (e.g., recreation, aquatic life, fish consumption), and exceedances of these standards are associated with interference of the designated use.

The lake received a Total Maximum Daily Load (TMDL) by the Florida Department of Environmental Protection (FDEP) in 2013. The TMDL requires the lake to meet the dissolved oxygen criterion and nutrient TMDL concentrations, which, based on mean concentrations from the 2004-2008 period, will require a 50 percent reduction for Biological Oxygen Demand (BOD), a 32.5 percent reduction for Total Nitrogen (TN), a 76.7 percent reduction for Total Phosphorus (TP) and a 31.9 percent reduction in turbidity.

There has been a consensus that the organic and nutrient-rich sediments in Lake Munson are contributing to the poor water quality and that sediment removal would be the best way to improve the lake's water quality. Unfortunately, sediment removal would be logistically very difficult and extremely expensive. Another option is to periodically drain the lake. The lake drawdowns are expected to result in de-watering, compaction, and partial oxida-

tion of sediments thus creating a sediment "cap" that would serve to improve water quality and simultaneously generate suitable habitat for fish spawning.

On April 27, 2010, the Leon County Board of County Commissioners directed staff to implement the County's Science Advisory Committee lake drawdown recommendations. After additional meetings, which included staff and committee members from the Florida Fish and Wildlife Conservation Commission, FDEP, U.S. Forest Service, Leon County Science Advisory and Water Resource Committees, and the community surrounding the lake, it was decided to start the lake drawdown October 18, 2010. The drawdown continued until June 14, 2011. Sampling recommenced in the third quarter of 2011.

Methods

Surface water sampling, sediment sampling and a Lake Vegetation Index (LVI) were conducted and met the collection and analysis requirements of the FDEP.

Results

Nutrients

The nutrient thresholds and results are found in Table 1. According to FDEP requirements, Numeric Nutrient Criteria (expressed as an annual geometric mean) cannot be exceeded more than once in a three-year period.

Geometric means of chlorophyll-*a,* total nitrogen and total phosphorus exceeded the state criteria several times over the sampling period. The geometric mean for chlorophyll-a in 2013 (85.0 µg/L) was the highest reading on record. However, in 2017 there was a substantial drop in chlorophyll-*a* values. While total phosphorus values still exceeded the NNC values in 2017, total phosphorus, total nitrogen and chlorophyll-*a* values are at their lowest since the 2011 drawdown.

Table 1. FDEP's chlorophyll-a, total nitrogen and phosphorus criteria for lakes applied to Lake Munson. Due to the lake drawdown, staff could not collect samples for the first and second quarters of 2011. Results in bold signify exceedances of the State criteria.

Clear Lakes High Alkalinity	Chl-a 20 µg/L	Total Nitrogen 1.05-1.91 mg/L	Total Phosphorus 0.03-0.09 mg/L
2004	3.6	0.35	0.06
2005	13.8	0.62	**0.11**
2006	12.4	1.38	**0.19**
2007	10.9	1.49	**0.30**
2008	13.1	0.76	**0.20**
2009	5.5	0.88	**0.17**
2010	8.7	1.07	**0.16**
2011	-	-	-
2012	**39.0**	**1.08**	**0.18**
2013	**85.0**	**1.51**	**0.24**
2014	13.9	1.27	**0.24**
2015	**54.3**	**1.37**	**0.22**
2016	**24.9**	0.70	**0.15**
2017	8.0	0.50	**0.11**
2018	19.2	0.60	0.09
2019	11.1	0.52	**0.11**

In 2018 chlorophyll-*a* values had increased to 19.24 µg/L, that, while higher than values in 2017, did not exceed NNC values. Nutrient values also did not exceed NNC limits in 2018. In the case of total phosphorus, 2018 marks the first year since 2004 that phosphorus did not exceed the NNC. The 2019 phosphorus value (0.11 mg/L), while exceeding the NNC limits, is substantially lower than most previous years. Neither the 2019 chlorophyll-a nor nitrogen geometric means exceeded the NNC. Staff believe that due to a combination of upstream nutrient reduction and the re-establishment of aquatic vegetation are contributing to the reduction of chlorophyll-a and water column nutrients.

As shown in Figures 1 through 4, past levels of BOD, total nitrogen, total phosphorus and turbidity levels were consistently above the TMDL limits, but levels are slowly dropping. Algal blooms, represented by

chlorophyll-a (Figure 5), continue to be a problem in Lake Munson, but values in 2017 are substantially lower than in previous years. There was an increase in chlorophyll-a levels in 2018, but levels are considerably lower than they were in 2016.

Metals

Stations LMU7 and LMU8 exceeded Class III water quality criteria for lead during the 1st quarter of 2019. Relict anthropogenic sources (e.g., leaded gasoline) are most likely to be the cause of these exceedances.

Click here for more information on metal levels in Leon County waterbodies.

Floral Assessment

The Lake Vegetation Index score for Lake Munson was 56, placing the lake's vegetative community in the healthy category.

Fifty-seven species were found during the survey. The native species coontail (*Ceratophyllum demersum*) and southern waternymph (*Najas guadalupensis*) were the most dominant species in the lake. Both the coontail and southern waternymph are welcome additions to the aquatic vegetation community, since they have not been seen in substantial amounts in the lake for several years. Other native shoreline vegetation included; pond cypress (*Taxodium ascendens*) red maple (*Acer rubrum*), buttonbush (*Cephalanthus occidentalis*) and swamp tupelo (*Nyssa sylvatica biflora*).

Unfortunately, wild taro (*Colocasia esculenta*), water hyacinth (*Eichhornia crassipes*) and paragrass (*Urochloa mutica*), all listed as Category I Invasive Exotics (Florida Exotic Pest Control Council http://www.fleppc.org/), were found in the littoral zone of Lake Munson. Alligator weed (*Alternanthera philoxeroides*), is a Category II Invasive Exotic found in the lake. Other non-native species in and around the lake include parrot feather watermilfoil (*Myriophyllum aquaticum*) burhead sedge (*Oxycaryum cubense*) and water spangles (*Salvinia minima*).

Click here for more information on the Lake Munson LVI.

Click here for more information on common exotic and invasive plants in Leon County wetlands and waterbodies.

Fish Consumption Advisory

The Florida Department of Health has issued consumption limits for certain fish in Lake Munson due to elevated levels of mercury and PCBs.

Click here for more information about fish consumption advisories in Leon County.

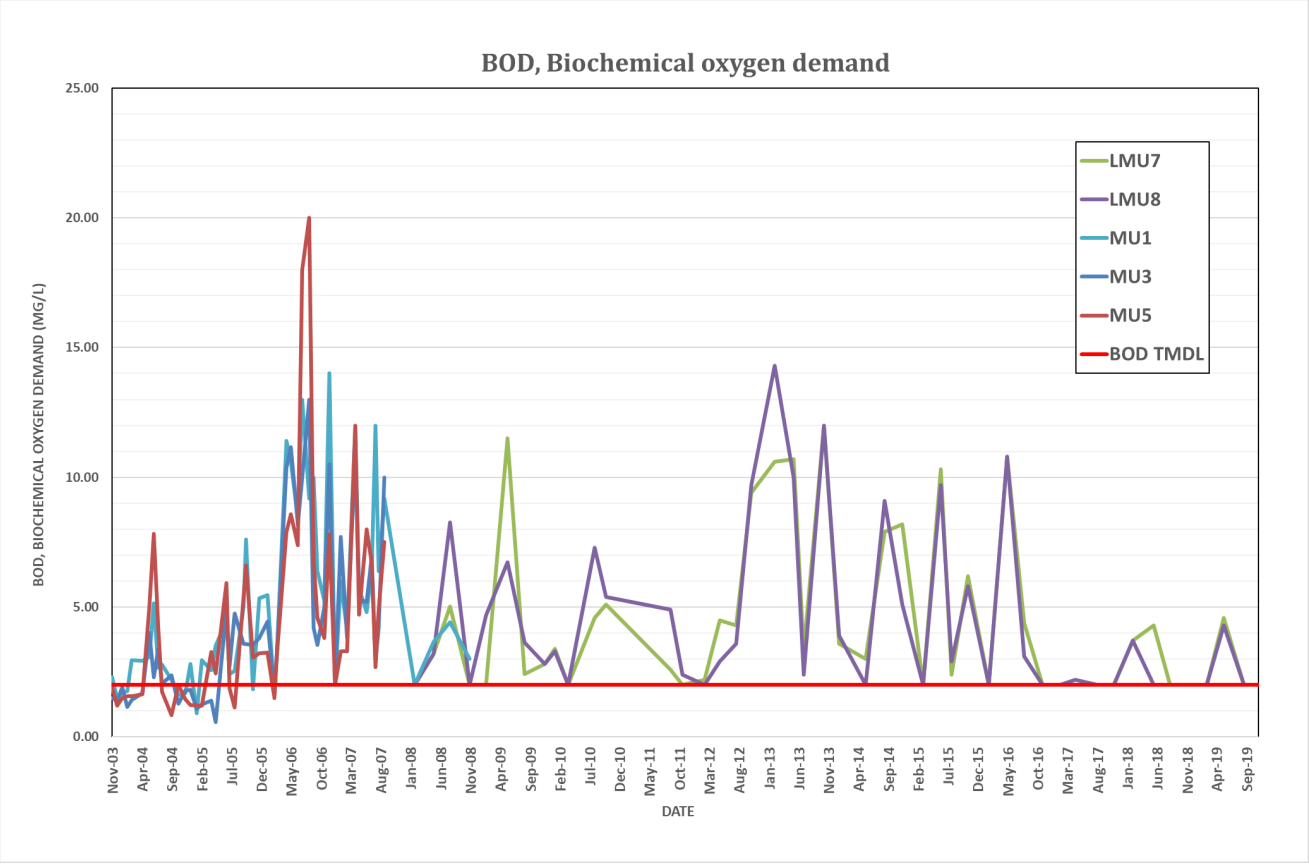


Figure 1. BOD results for Lake Munson.

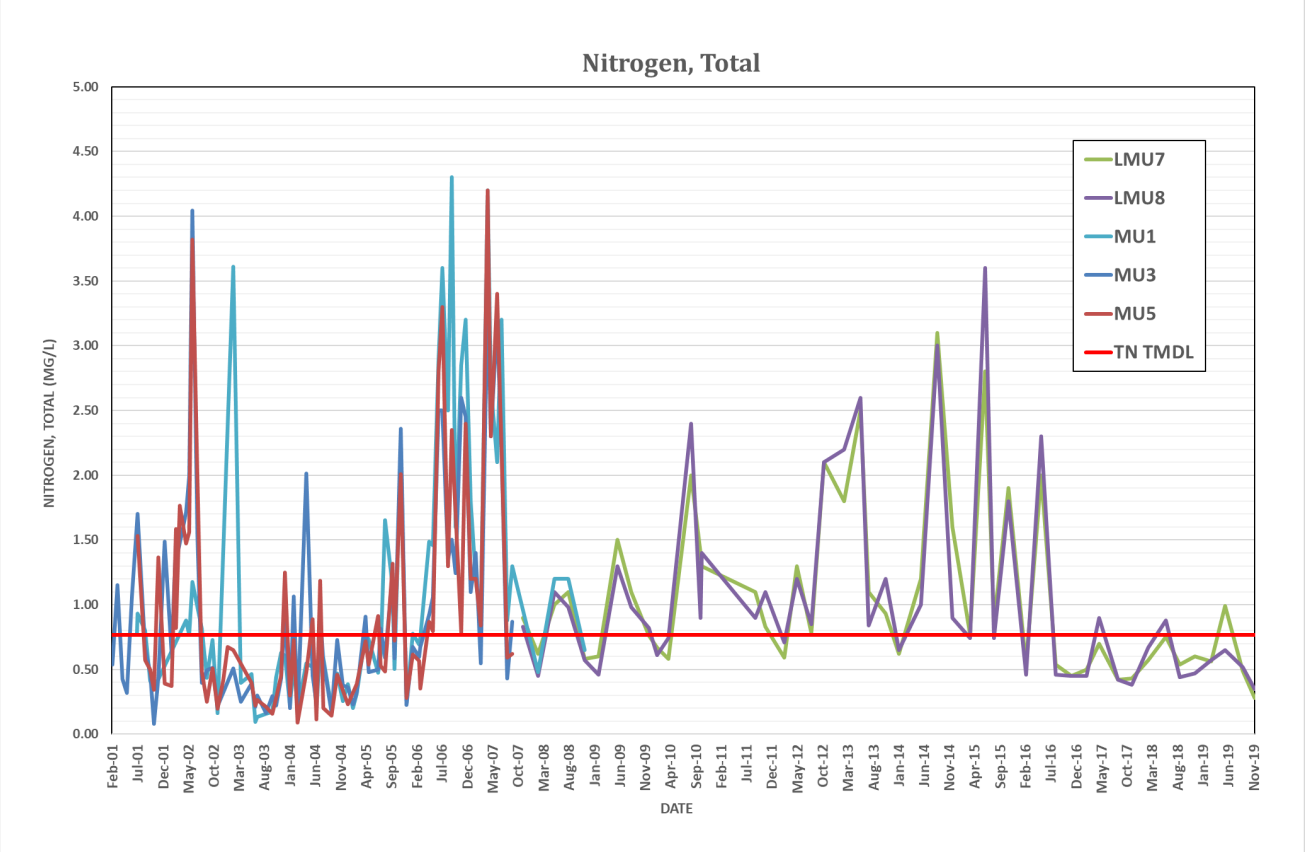


Figure 2. Total Nitrogen results for Lake Munson.

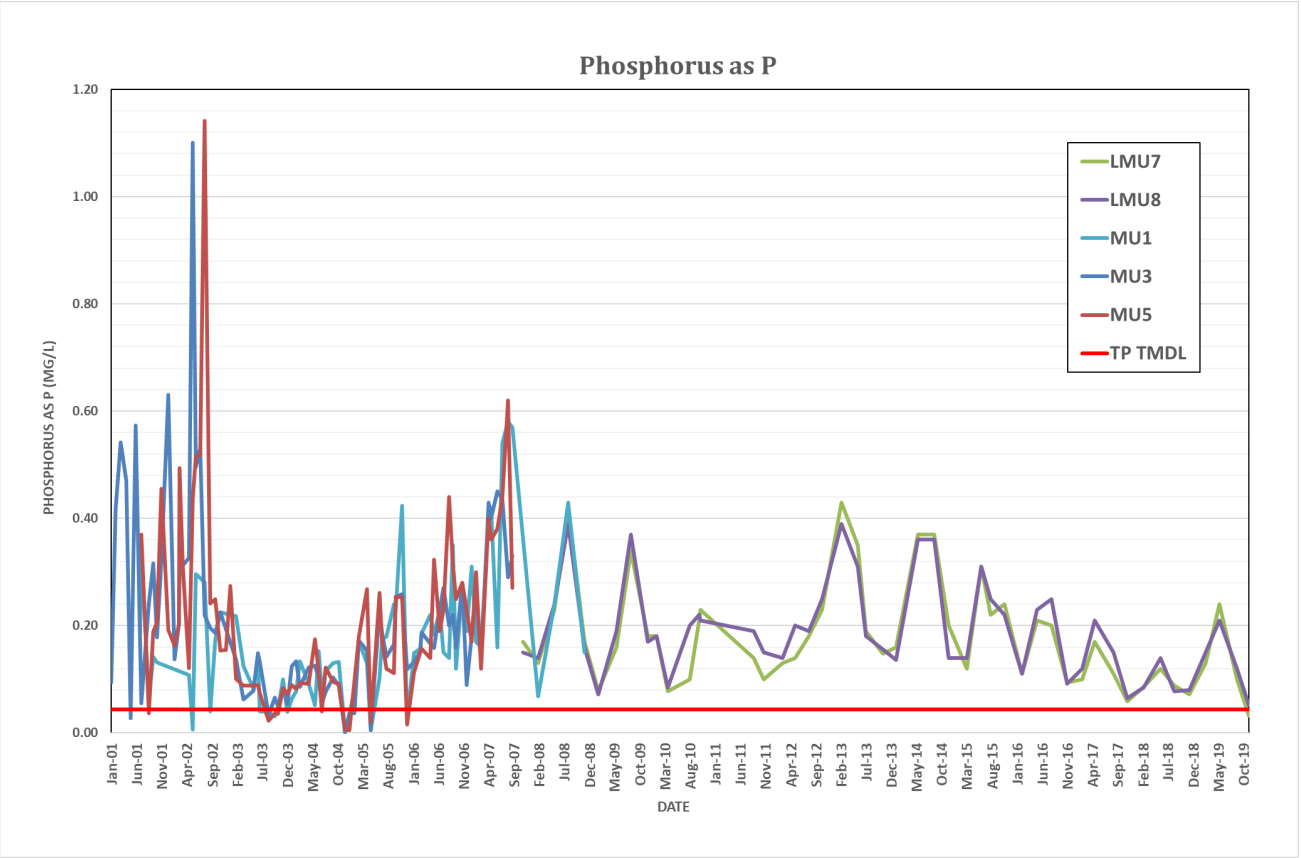


Figure 3. Total phosphorus results for Lake Munson.

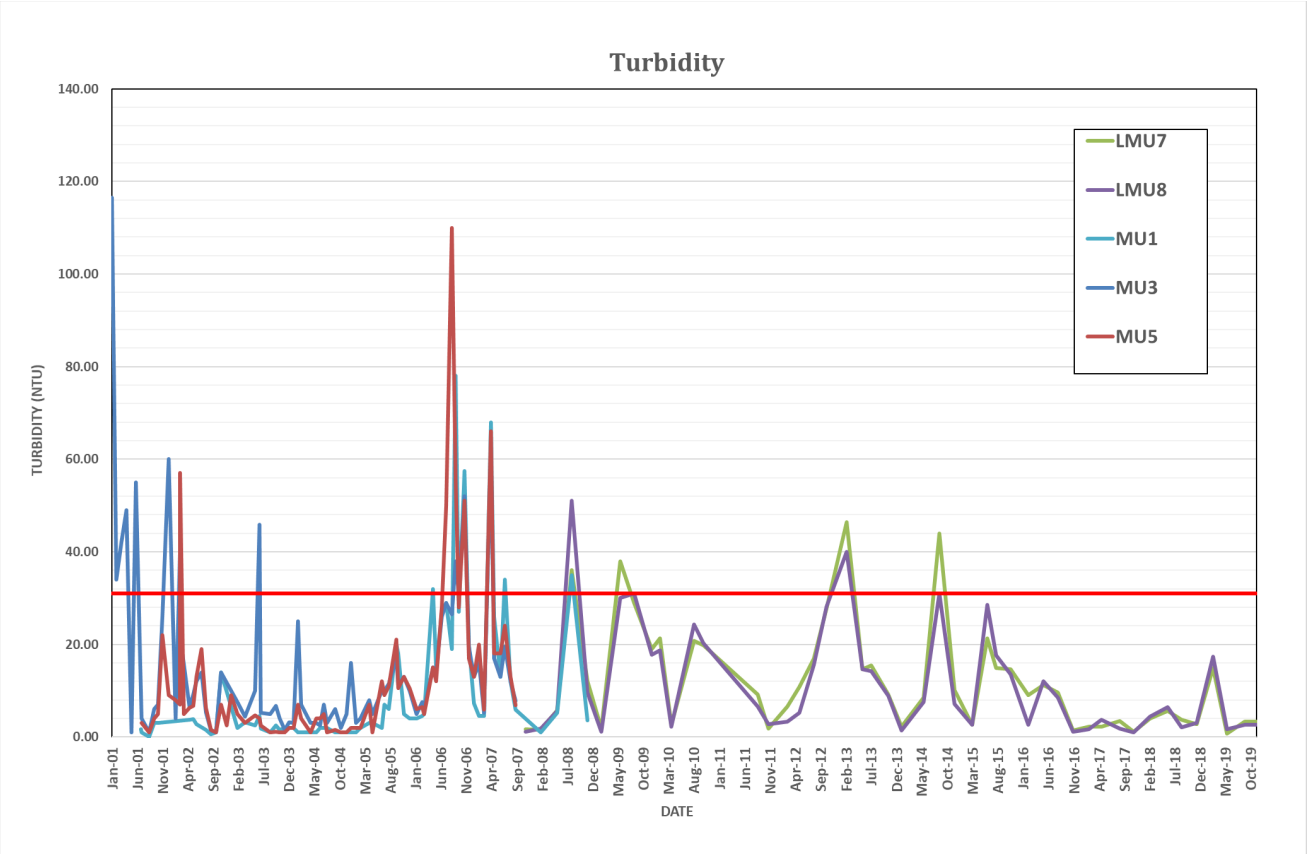


Figure 4. Turbidity results for Lake Munson.

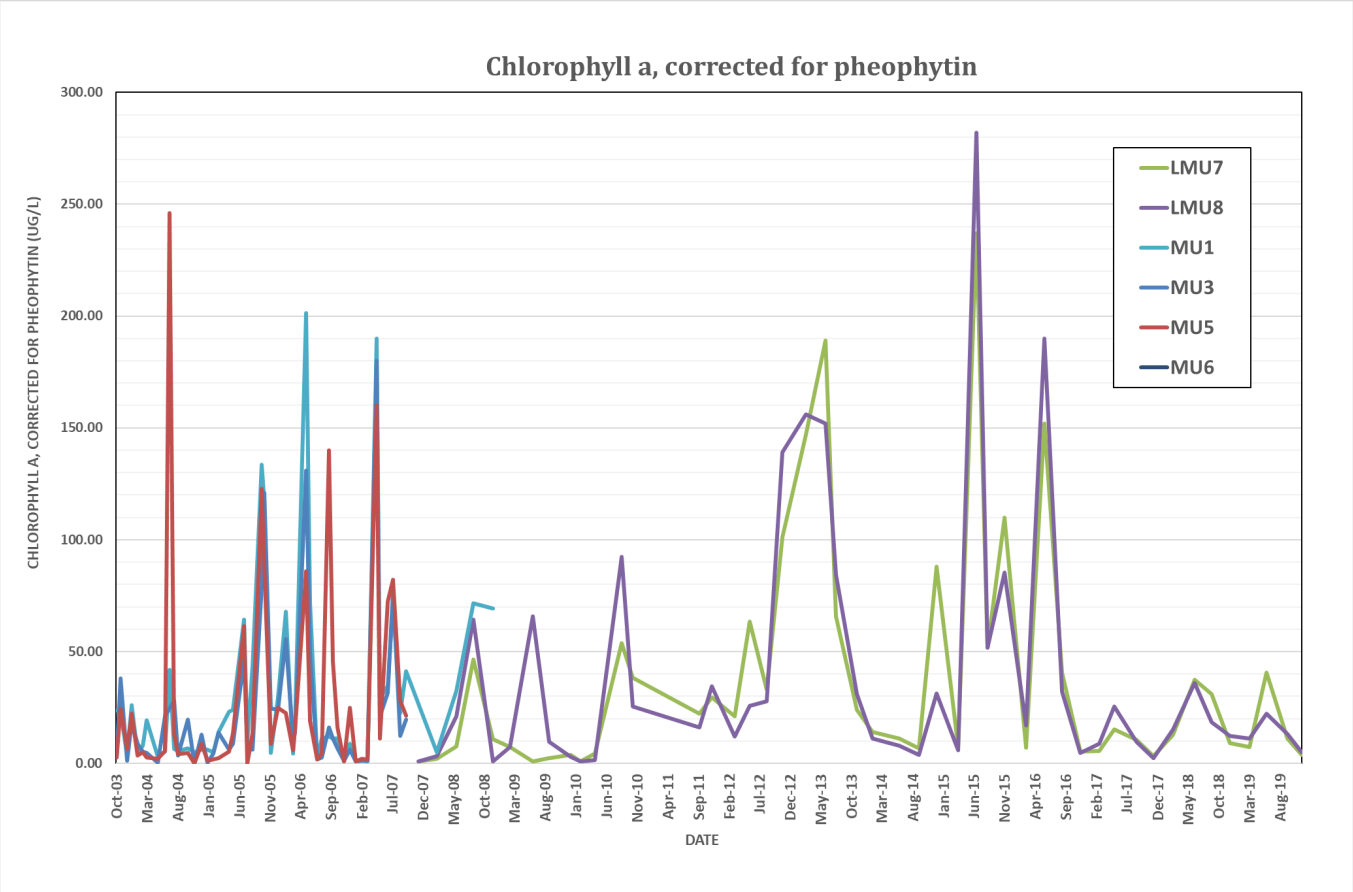


Figure 5. Chlorophyll-a results for Lake Munson.

Sediment

The Florida Department of Environmental Protection (FDEP)-Florida Geological Survey (FGS) was contracted by the Leon County Public Works Engineering Services Division (County) via an Interlocal Agreement to assess the sediments in Lake Munson, Lake Henrietta, and in the section of Munson Slough between these lakes. The purpose of the project was to obtain information to assist the County in its efforts to restore the ecology of Lake Munson. This information includes characterization of the sediment types, their distribution and thicknesses, and the concentrations of any contaminants found within the organic layer in these lakebed sediments. This was accomplished by conducting a ground penetrating radar (GPR) survey, sediment sample collection by vibracoring, and laboratory chemical analyses of collected sediment.

The GPR survey of Lake Munson was conducted in June 2018. A report containing the findings of the survey was transmitted to Leon County in September 2018. The sediment lithologies in the vibracores were compared with the GPR data and estimates of the thickness and volume of the organic sediments in Lake Munson were calculated.

Between September and November 2018, the FGS collected vibracores from 37 sample sites. Leon County provided 32 site locations in Lake Munson, two site locations in Lake Henrietta, and three site locations in Munson Slough. Two sediment samples were collected from each of the vibracores and provided to FDEP-Central laboratory for analysis. These samples were collected from the top and the bottom of the organic layer in each core.

The sediments in Lake Munson contain concentrations of benzo(a)pyrene equivalents, total recoverable hydrocarbons (TRPH), arsenic, barium, chromi-

um, lead, total polychlorinated biphenyls (PCBs), and dieldrin exceeding one or more of the residential, commercial or leachability Soil Cleanup Target Level (SCTL) standards. The concentrations of these contaminants in the sediment samples from Munson Slough do not exceed any of these standards. In Lake Henrietta, the sediment contains concentrations of benzo(a)pyrene equivalents, TRPH, arsenic, and barium that exceed residential or commercial SCTL standards. The SCTL standards for leachability for chromium and dieldrin were exceeded and the sediment also contains elevated levels of total PCBs.

Exceedances of SCTL standards in the Lake Munson and Lake Henrietta samples resulted in the need for additional analytical work. Ten samples containing the highest contaminant concentrations were analyzed using the EPA's Simulated Precipitation Leaching Procedure (SPLP). Results from these samples indicate none of the analyzed contaminants will leach at concentrations above groundwater standards under simulated precipitation conditions.

The SPLP analysis of the most heavily contaminated sediment samples in Lake Henrietta and Lake Munson indicated the detected contamination is tightly bound and does not leach above analytical method detection limits under simulated rainfall. This was anticipated as most of Lake Munson's exceedances of SCTL standards occur in clays and fine organic sediments in the upper portion of the lake's sediments. The lack of clays and fine organic sediments in the Munson Slough cores suggests that most of the contaminants found in Lake Henrietta and Lake Munson are being transported, adsorbed to these sediments, and/or adsorbed onto these sediments once in the lakes.

Conclusions

Nutrient and chlorophyll-*a* values did not exceed NNC limits in 2018. In the case of total phosphorus, 2018 marks the first year since 2004 that phosphorus did not exceed the NNC. The 2019 phosphorus value, while exceeding the NNC limits, is substantially lower than most previous years. Neither the 2019 chlorophyll-a and nitrogen geometric means exceeded the NNC. Staff believe that due to a combination of upstream nutrient reduction and the re-establishment of aquatic vegetation are contributing to the reduction of chlorophyll-a and water column nutrients.

Stations LMU7 and LMU8 exceeded Class III water quality criteria for lead during the 1st quarter of 2019. Relict anthropogenic sources (e.g., leaded gasoline) are most likely to be the cause of these exceedances.

The floral community is considered "healthy" by the LVI. Native floating and emergent vegetation are becoming more prevalent in the lake.

The sediments in Lake Munson contain concentrations of benzo(a)pyrene equivalents, total recoverable hydrocarbons (TRPH), arsenic, barium, chromium, lead, total polychlorinated biphenyls (PCBs), and dieldrin exceeding one or more of the residential, commercial or leachability SCTL standards. The SPLP analysis of the most heavily contaminated sediment samples in Lake Henrietta and Lake Munson indicate the detected contamination is tightly bound and does not leach above analytical method detection limits under simulated rainfall.

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

Contact and resources for more information

www.LeonCountyFL.gov/WaterResources

Click here to access the results for all water quality stations sampled in 2019.

Click here for a map of the watershed – Sample Sites LMU7 and LMU8.

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