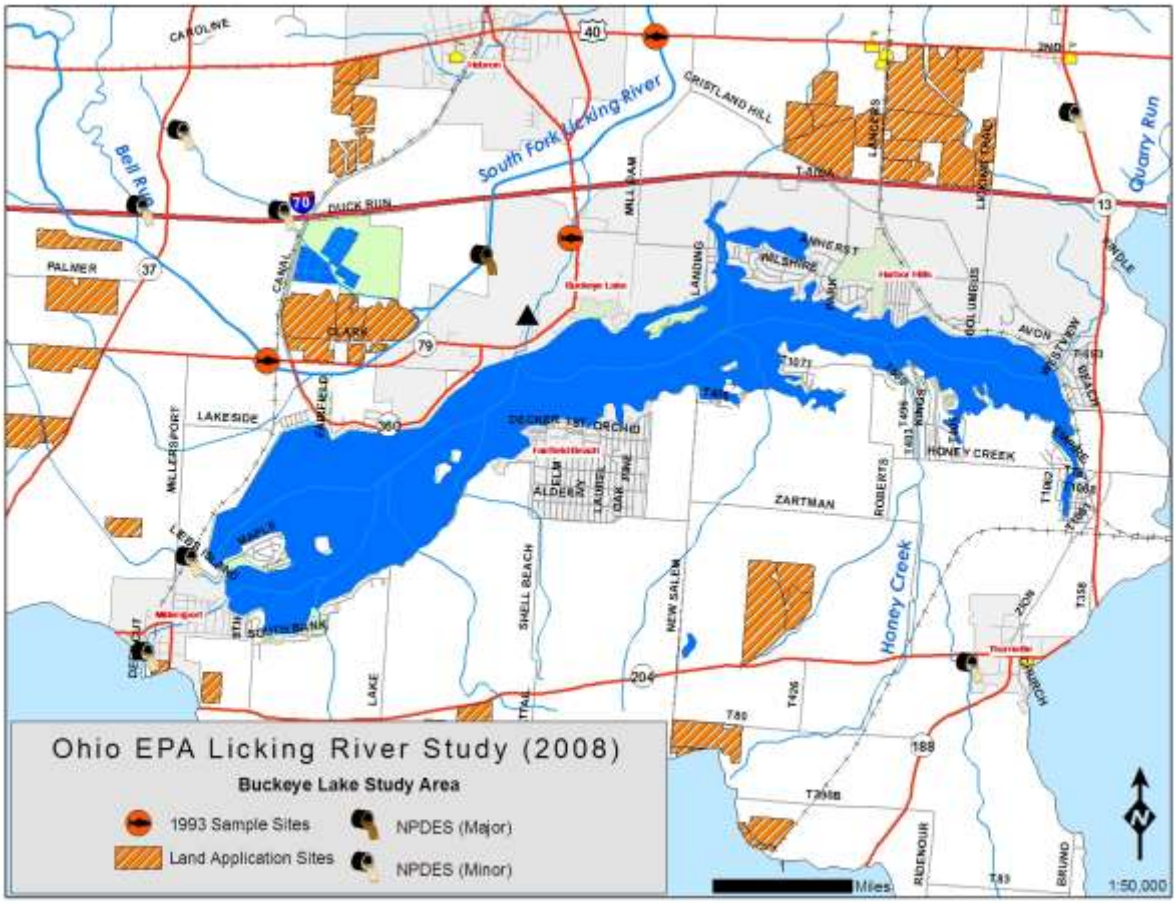
2014 Study Plan
Buckeye Lake

Hydrologic Unit Codes:
(504000600404, 504000600403)



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Project Description

The purpose of this project is to continue tracking the condition of Buckeye Lake, located in Licking, Perry and Fairfield Counties, in central Ohio. Additional sampling will solidify our understanding of nutrient cycling and fate in the Buckeye Lake watershed and will enable us to track improvements in water quality based on recommended nutrient reduction efforts.

Buckeye Lake basin drains approximately 45 square miles (28,340 acres). Buckeye Lake receives little, if any drainage from the northwest since there is a diked barrier along the shore, sending surface waters to the South Fork of the Licking River. Thus, almost all the flow into Buckeye Lake originates from the northeast, west and south sides of the lake. Much of the input drainage flows over land used primarily for agricultural purposes. A large percentage of agricultural activity in the Buckeye Lake basin involves row-crop production with limited farm animal production.

Field Measurements

Physical water quality will be continuously measured in the lake using two YSI® multi-parameter probes that are secured inside a flow through tube mounted to a wooden piling, powered by a solar charged battery, and will be located near L1 (GPS coordinates will be logged upon installation). These units are expected to be installed by the end of April and will take measurements near the surface, and near the bottom of the water column. The units activate every 15 minutes and measure depth (m), temperature (°C), pH (SU), conductivity (µS/cm), dissolved oxygen concentration (mg/L) and turbidity (NTU) and calculate dissolved oxygen saturation (%) and specific conductivity (µS/cm). Data is transmitted via telemetry and managed on a private website provided by the manufacturer. Data will be routinely monitored for drift to indicate when cleaning and calibration is needed. Past experience indicates that it is necessary to clean and calibrate the equipment about every 2-3 weeks.

Water Chemistry Sampling

Water chemistry sampling in 2014 will be conducted to track water quality trends in the lake. Samples will be taken from one historical location (L-1) and two recently established sites, one east (L-2) and one west (L-3), to represent impacts from western and southern drainage. The coordinates of the lake sampling sites and their station ID number are listed below. Sampling events will be conducted every month from May – September, with one additional sampling

event shortly after ice-out (mid-late March). Dates will be selected based on convenience for the field crew and sample load at the lab. Water column samples will be collected from the surface, mid-column and 0.5 meters off the bottom of the lake and composited at all three sampling locations. This sampling protocol is described in the Inland Lakes Sampling Procedure Manual (Ohio EPA, 2013). The exception will be orthophosphate – which will be sampled discretely at both 0.5M below water surface and 0.5 M above lake sediments at L-1.

Since nutrient enrichment is the overwhelming problem in the lake, metals will not be tested to save cost and to expedite lab analysis.

Lake Sampling Locations

L-1 (300412)	39.93055° N. Latitude	82.46449° W. Longitude
L-2 (203886)	39.92930° N. Latitude	82.43960° W. Longitude
L-3 (301483)	39.1150° N. Latitude	82.50859° W. Longitude

Water samples will be analyzed by the Ohio EPA, Division of Environmental Services (DES). They will be tested for the parameters listed in Table 1 1. A sample collected using a 2-m vertical integrated-tube sampler will be analyzed for whole water phytoplankton enumeration (WWPE). In situ measurements of temperature (°C), dissolved oxygen concentration (mg/L), pH (S.U.) and conductivity (µS/cm) will be made in the lake at 0.5 m increments using a multi-parameter field meter. The meter also calculates and records dissolved oxygen saturation (%) and specific conductance (µS/cm@25 °C). Secchi depth and total water depth will also be measured and recorded at each site.

Since it appears that internal nutrient cycling is a potentially important source of nutrients in the lake, it will be useful to collect sediment core samples to confirm the mass balance model. Sediment core samples will be collected once annually at each site. The desired core length is 30 cm. The cores will be sectioned and sub-sampled at 2 cm intervals in the top 10 cm and at 5 cm intervals for the remainder. This method will yield a total of 9 sub-samples and each will be analyzed for the following phosphorus fractions; total, organic, aluminum bound, iron bound phosphorus, biogenic phosphorus and labile phosphorus as well as total aluminum and total iron. The samples will be shipped to Aquatic Research Incorporated, 3927 Aurora Ave. N, Seattle, WA 98103 for analysis.

Tributary sampling will be conducted two to three times during high flow conditions to confirm and add to the data reflective of those conditions. The parameters to be analyzed for the tributary samples are alkalinity, ammonia, chloride, COD, conductivity, nitrate, nitrite, dissolved solids, suspended solids, sulfate, TKN, TP and orthophosphate (see Table 1 for methods and reporting limits of most parameters).

Special Phosphorus Study

To better understand phosphorus dynamics in the lake, L-1 will be sampled for both TP and orthophosphate during two diurnal events where wind is low to minimal. Discrete samples will be taken every 2 to 4 hours at both 0.5 meters below water surface and 0.25 meters above the bottom, in addition to sampling at mid- depth for both TP and orthophosphate. Low-level

orthophosphate collection and laboratory methods will be used for at least the bottom sample, and as appropriate for the top sample.

Quality Control

Field duplicates will be collected at a frequency of 5 percent. Field blanks and equipment blanks combined will also be collected at a frequency of 5 percent. An acid blank will be run on new lots of acids used to preserve samples. Field meters will be calibrated as specified using manufacturer guidelines. All field practices will follow guidelines in the *Ohio EPA Surface Water Field Sampling Manual* (Ohio EPA 2013).

OutFlow Monitoring Locations

The Modeling and Assessment section will evaluate the usefulness and practicality of installing a Diver® or HOBO® level recorders at the outflow sites. These submersible data loggers may be used to measure stream temperature and water level at 30 minute intervals (or more frequently if desired).

Table 1. Parameters to be analyzed in water column samples.

Parameter	Method	Reporting Limit	Container	Preservative
Alkalinity	SM 2320 B	5 mg/L	1 Gallon LDPE	cool to 4°C
Bicarbonate	SM 2320 B	5 mg/L		
Total Dissolved Solids	SM 2540 C	10 mg/L		
Total Suspended Solids	SM 2540 D	5 mg/L		
Volatile Suspended Solids	SM 2540 E	10 mg/L		
Sulfate	ASTM D516092	5 mg/L		
Ammonia	US EPA 350.1	0.05 mg/L	1L LDPE	2 ml H_2SO_4 cool to 4°C
Nitrate-Nitrite	SM 4500 NO_3 (H)	0.1 mg/L		
Total Kjeldahl Nitrogen	US EPA 351.2	0.2 mg/L		
Total Organic Carbon	SM 5310 B	2 mg/L		
Total Phosphorus	US EPA 365.4	0.01 mg/L		
Orthophosphate*	US EPA 365.1	0.01 mg/L*	1L LDPE	filtered cool to 4°C
Chlorophyll a + (Pheophytin)	US EPA 445.0	0.05 µg/L	45 mm GF/C	$MgCO_3$, freeze

* Low level orthophosphate laboratory methods achieve a Reporting Limit of 0.001 mg/l.

REFERENCES

Ohio EPA. 2009. DSW Field Data Uploading Application Instruction Manual. Division of Surface Water. Columbus, Ohio.

Ohio EPA. 2013. Surface Water Field Sampling Manual, Version 4.0. Division of Surface Water, Columbus, Ohio. http://epa.ohio.gov/dsw/document_index/docindx.aspx

Ohio EPA, 2013. Inland Lakes Sampling Procedure Manual (Appendix I of the 2013 Surface Water Field Sampling Manual). http://epa.ohio.gov/dsw/document_index/docindx.aspx