Buckeye Lake HUC-12 (05040006 04 03)

Nine-Element Nonpoint Source Implementation Strategic Plan (NPS-IS Plan)

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Acknowledgements

The Perry Soil and Water Conservation District would like to thank its numerous partners committed to the quality of Buckeye Lake. The Buckeye Lake Region Corporation, Buckeye Lake 2036, Buckeye Lake for Tomorrow, the South Licking Conservancy District, the Fairfield County Soil and Water Conservation District, the Licking County Soil and Water Conservation District, the county commissioners for Fairfield, Licking and Perry Counties, Ohio Department of Agriculture, United States Department of Agriculture---Natural Resources Conservation Service, Buckeye Lake Area Chamber of Commerce, OSU Extension, and involved landowners in the watershed made this plan possible. This NPS-IS plan will be used as a basis for addressing nonpoint source impairment in Buckeye Lake.

The original version of this document has been revised in cooperation with Perry Soil and Water Conservation District and Buckeye Lake for Tomorrow to update information pertaining to Critical Area 3; specifically, to expand the long-term target area for addressing channel impairments along Honey Creek and describe a near-term goal of addressing a Phase 1 segment of the watercourse.

Chapter 1: Introduction

Buckeye Lake (HUC 05040006 04 03) is located approximately 30 miles east of Columbus at the intersection of three counties: Fairfield, Licking and Perry. It is one of two subwatersheds that drain into Buckeye Lake: a human-made reservoir with a surface area of approximately 3,200 acres. The lake is a popular tourist destination, supporting a variety of recreational opportunities, while the majority of the watershed is home to expansive crop fields.

With many parties invested in Buckeye Lake, there is a need to consolidate efforts to improve water quality in the lake. Increased nutrient input has become a cause for concern, not just for the quality of the water, but for recreational purposes too. A grant was obtained from the Ohio Department of Agriculture (ODA) to fund a watershed coordinator to improve water quality with one of the principal tasks of the position being to create a Nonpoint Source Implementation Strategic Plan (NPS-IS) for both the Buckeye Lake and Buckeye Lake Reservoir Feeder HUC-12s. It is the coordinator's goal to then use this NPS-IS as a platform for implementing projects that reduce pollutants flowing into Buckeye Lake.

1.1 Report Background

One of the primary studies on water quality in Buckeye Lake is the Buckeye Lake Nutrient Reduction Plan (Buckeye Lake for Tomorrow, 2013). Inventories were conducted in 2012-2013 and a report was compiled for the Ohio Environmental Protection Agency (EPA) which described nutrient control strategies that would prevent excessive harmful algal blooms and thereby minimize fish kills caused by low dissolved oxygen (DO) levels. Buckeye Lake for Tomorrow (BLT), a 501(c)(3) corporation that undertook the on-the-ground data collection in the Buckeye Lake watershed, took the lead on writing this document with assistance from Fairfield Soil and Water Conservation District. Buckeye Lake 2036, a committee dedicated to realizing the economic vision of the Buckeye Lake Region Corporation, was also instrumental in gathering support for water quality improvements in the lake. The Fairfield, Licking and Perry Soil and Water Conservation Districts (SWCDs) now carry the baton for planning project-specific goals with quantifiable targets for nonpoint-source pollution reduction.

Because the scope of the problem remains large and because the number of invested stakeholders has only increased since the Nutrient Reduction Plan was written, a new, more comprehensive, plan is needed. The Buckeye Lake NPS-IS will serve as this wide-reaching document, consolidating implementation strategies across all three counties.

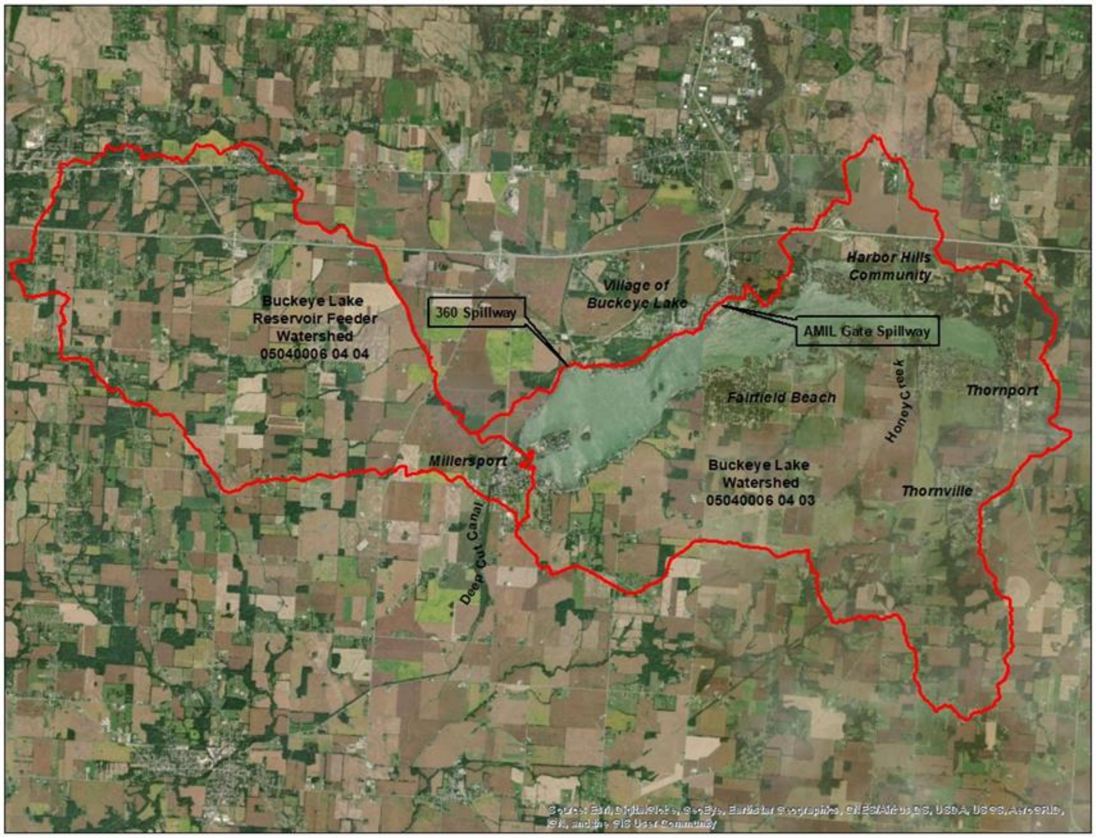

Figure 1. Map of Buckeye Lake and Reservoir Feeder watershed boundaries

1.2 Watershed Profile & History

The two watersheds that drain into Buckeye Lake - the Buckeye Lake Watershed (05040006 04 03) and the Buckeye Lake Reservoir Feeder Watershed (05040006 04 04) - drain an area of roughly 41 square miles. In the Buckeye Lake Watershed, which this plan focuses on, Honey Creek is the major contributor to the lake, while two spillways on the north side of the lake (the 360 spillway and the AMIL Gate spillway) serve as the principal lake outlets, flowing to the South Fork Licking River. The entirety of the lake falls within the Buckeye Lake watershed. In addition to the three counties that intersect at the lake (Fairfield, Licking, Perry), there are a number of municipalities that exist within the watershed boundaries: the Village of Millersport on the western side, the Village of Buckeye Lake and the Harbor Hills community on the northern edge, the Fairfield Beach community on the southern side of the lake, the Thornport community at the eastern side of the lake, and the Village of Thornville at the southeastern tip of the watershed (Figure 1).

(It should be noted that due to engineered drainage solutions, approximately 400 acres along the Deep Cut Canal, from the Walnut Creek watershed near Millersport, contributes water to Buckeye Lake. In addition, areas above the Pigeon Ditch in Licking County (the Reservoir Feeder watershed) are diverted from the Feeder Canal during low to normal rainfall conditions and the water does not flow to the lake).

Buckeye Lake has a varied history. The lake is an artificial structure, created in the 1820s as a reservoir for the Ohio and Erie Canal. This reservoir was made by constructing a "four-mile long earthen dike that blocked drainage into the South Fork Licking River" with a feeder diverting water from the South Fork subsequently added to enlarge the lake in the 1830s (EMH&T, 2016). Previously, the region was a swamp with large tracts of timber, brush and peat. Because these areas were not cleared before construction began, fallen trees within the lake remained an issue for boaters into the early 1900s. Additionally, a 50-acre mat of sphagnum moss detached from the bottom in the mid-1800s and became a floating island called Cranberry Bog. The mat still exists today, though it has been reduced in size to only a few acres. In the late 1800s, the canal system that utilized Buckeye Lake closed, and the area became a public park. Recreational use increased and urban development rose with it. In 1949, Buckeye Lake was named Ohio's first state park and the lake - and the dam built to retain its waters - became state-owned property managed by the Ohio Department of Natural Resources (ODNR). Seepage arising from structural issues and tree roots eventually made for potential dam failure, so ODNR initiated a three-year dam repair project, completed in 2018.

Increased sedimentation and nutrient input has become a cause for concern for many residents of Buckeye Lake (Buckeye Lake for Tomorrow, 2013). Because the lake is shallow, with a mean depth of five feet during summer, higher levels of sediment on the bottom of the lake result in less room for boats to navigate. During the winter, the lake is lowered, reducing depth even further. Nutrients also contribute to harmful algal blooms. Reducing sediment and nutrient input is necessary to improve water quality.

The primary land use in the Buckeye Lake HUC-12 is row crop agriculture (40.6%), followed by open water (16.6%), urban development (16.9%), deciduous forest (13.5%), and pasture (10.6%). Wetland areas make up 0.6% or roughly 107 acres (Buckeye Lake for Tomorrow, 2013) (Figure 2).

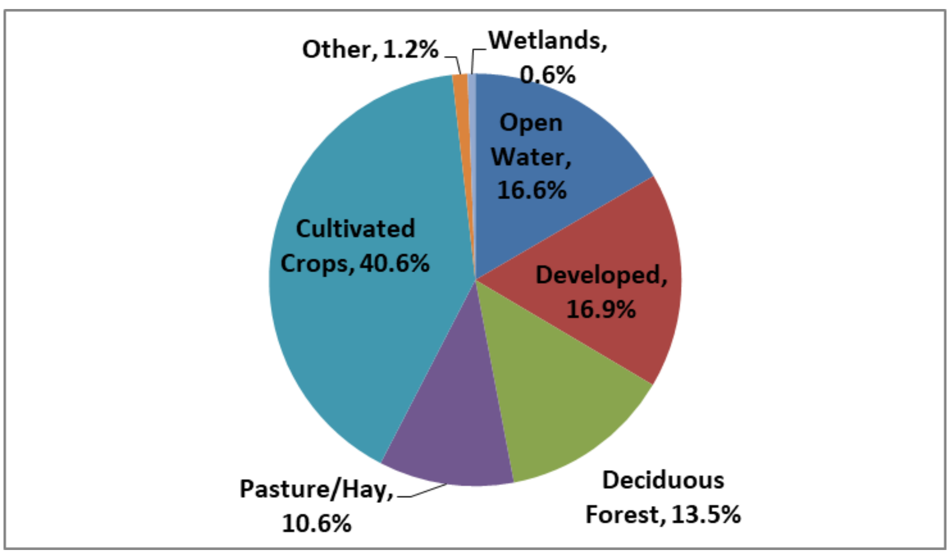

Figure 2. Land Use in the Buckeye Lake HUC-12

1.3 Public Participation & Involvement

Diverse involvement is necessary for any watershed restoration plan. Government organizations, businesses, non-profit groups and landowners all have distinct roles in bringing the plan into action. To facilitate connection between these groups, the Perry Soil and Water Conservation District obtained a grant from the Ohio Department of Agriculture to hire a watershed coordinator for Buckeye Lake. This NPS-IS Plan for the **Buckeye Lake HUC-12** serves as the first comprehensive action statement.

Preliminary work was done in 2011-2012 to assess the water quality in Buckeye Lake:

- Buckeye Lake for Tomorrow (BLT) conducted water quality sampling at 17 sites across the lake and its tributaries (Figure 3).
- The Fairfield County Soil and Water Conservation District, completed a comprehensive inventory of all streams in the watersheds, covering over 77 miles of waterways and documenting existing farm tiles, pipes, log jams, erosion sources, and riparian conditions.
- Ohio EPA conducted water quality monitoring at three in-lake locations at Buckeye Lake.

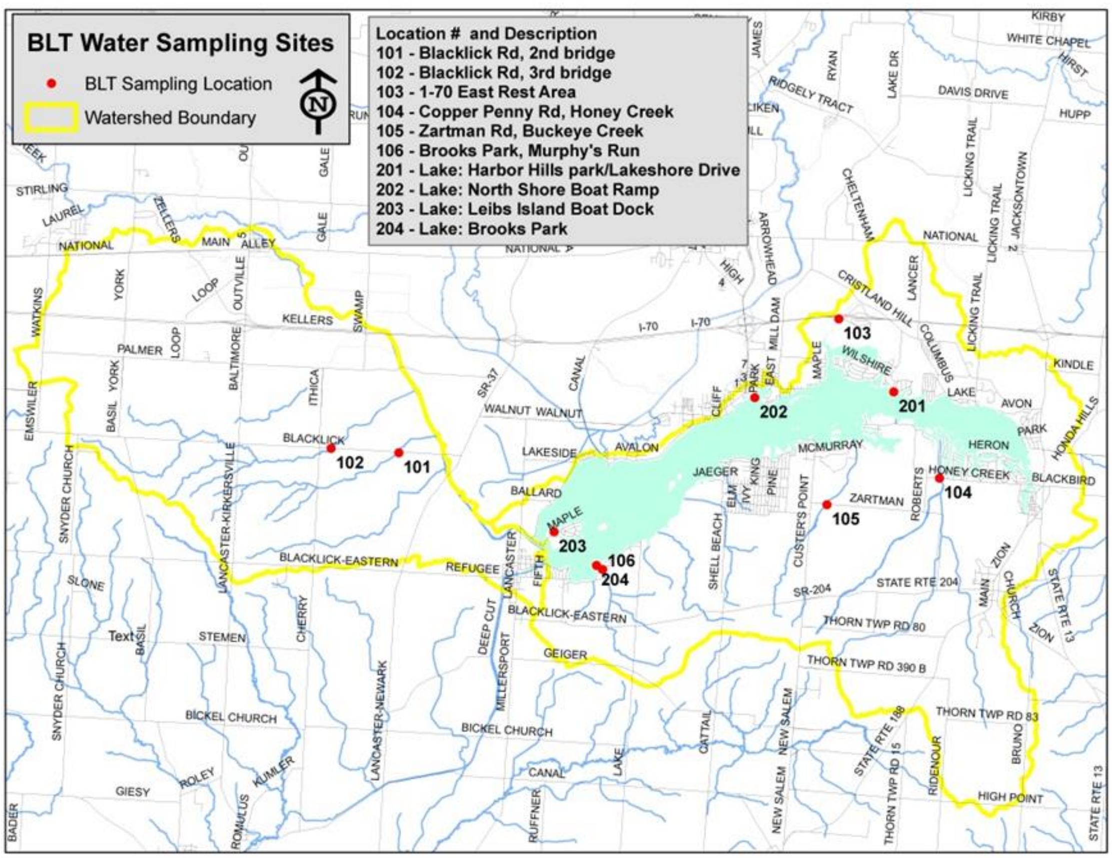

Figure 3. Established BLT water quality sampling sites

In 2013, BLT wrote a Nutrient Reduction Plan which identified potential nutrient reduction methods and served as guidance for this NPS-IS. Another document of significant value is the Buckeye Lake

Preliminary Investigation, conducted by EMH&T engineering consultants in 2016. The purpose of this report was to summarize existing data and suggest lake management strategies for sediment removal, pollutant load reduction, and recreational pool level maintenance.

Community engagement will be crucial to implementing the projects listed in this NPS-IS, especially engagement from local producers. To assist in setting up meetings with producers, Natural Resources Conservation Service (NRCS) has offered support through incentive programs, namely the Environmental Quality Incentives Program (EQIP). Farm Service Agency (FSA) also offers support to producers in the form of their Conservation Reserve Program (CRP), another incentive program that provides cost-share funding for farmers. Additionally, there are opportunities to engage shoreline residents in efforts to reduce nutrients pollution. One example would be assistance with Canada goose control, by which residents report areas that are overloaded with geese or nests to the Ohio Department of Natural Resources (ODNR). Generally, public education on efforts to reduce nutrient and sediment inputs would help gather support for successful reductions.

Listed below are the primary partners who helped develop the content of this NPS-IS and have provided input on the direction of the watershed.

- Buckeye Lake for Tomorrow, Inc. – a non-profit devoted to improving the water quality of Buckeye Lake by collecting data and advocating for better land management in the watershed. Buckeye Lake for Tomorrow has been instrumental in the development of this NPS-IS, having funded the nutrient reduction plan that formed the basis of many of the projects outlined here (Buckeye Lake for Tomorrow, 2013). The organization remains an invaluable source of information, on matters of both science and community.

- Buckeye Lake Region Corporation – a tri-county alliance dedicated to uniting political and civil entities across Buckeye Lake, with the goal of restoring the region's prominence and enhancing the economic prosperity of its residents. It too funded a preliminary investigation on Buckeye Lake (EMH&T, 2016) and offers a driving vision for the future of the lake.

- Fairfield, Licking and Perry Soil and Water Conservation Districts – the SWCDs of the three counties have contributed staff time and knowledge to developing the NPS-IS plan for Buckeye Lake and will continue to offer guidance to the watershed coordinator. Due to connections with landowners, the SWCDs will also provide contact with producers.

- Landowners, producers, and other private stakeholders – private landowners in the Buckeye Lake watershed serve as principal members of Buckeye Lake for Tomorrow and Buckeye Lake Region Corporation. They have been instrumental in organizing activities that improve the watershed, including securing funding to hire a coordinator and write a comprehensive plan.

- Natural Resources Conservation Service – an agency of the US Department of Agriculture, NRCS serves to promote best management practices for producers through expertise and cost-share programs. A relationship with NRCS has opened opportunities to develop conservation projects on private property in the watershed.

- Ohio Department of Agriculture – ODA has provided funding for a Buckeye Lake watershed coordinator. Engineering staff has also been made available for the development of projects.

- Ohio Department of Natural Resources – ODNR owns parcels of land on Buckeye Lake, including the Buckeye Lake State Park. By working with their Division of State Parks and Watercraft, several potential projects have been identified on public land.

- Ohio Environmental Protection Agency – data collected during the EPA's routine water monitoring was included in this document. The EPA had also funded its own study of the lake, in order to form a comprehensive nutrient management plan (Tetra Tech, 2014).

Chapter 2: Buckeye Lake HUC-12 Watershed Characterization and Assessment Summary

2.1 Summary Watershed Characterization for Buckeye Lake HUC-12

2.1.1 Physical and Natural Features

The South Fork Licking River HUC-10 watershed is made up of nine subwatersheds, two of which drain into Buckeye Lake: the Buckeye Lake watershed (05040006 04 03) and the Buckeye Lake Reservoir Feeder watershed (05040006 04 04). This document focuses on the Buckeye Lake watershed, located on the southeastern border of the South Fork Licking River HUC-10. The principal waterways which flow into Buckeye Lake from this watershed are Honey Creek, Zartman Creek, Murphy's Run and Deep Cut. Among these streams, Honey Creek has the largest drainage area at 6.9 square miles. It must be stated that the Reservoir Feeder Creek is the major contributor to the lake, with a drainage area of 11.9 square miles, but it is located in the Buckeye Lake Reservoir Feeder watershed (which again is not being addressed in this NPS-IS).

Agriculture accounts for more than half of the land use designation in the Buckeye Lake watershed, mostly in glacial till over Mississippian bedrock (Table 1). Development also plays a significant role in the identity of the watershed. Soils throughout the region are poorly drained to moderately well-drained.

Specific landmarks and features in this watershed include:

- Buckeye Lake
- Buckeye Lake State Park
- Commercial/business and residential housing in several municipalities around the lake
- Cranberry Bog State Nature Preserve
- Islands
- Deep Cut of the Licking Summit
- Lakewood High School
- Public beaches
- Several cemeteries

2.1.2 Land Use

Land Use Category	Buckeye Lake HUC-12 Total Acres	Buckeye Lake HUC-12 Percentage
Open Water	2,868.00	16.6%
Developed Open Space	1,787.61	10.3%
Developed Low Intensity	959.41	5.5%
Developed Medium Intensity	180.36	1.0%
Developed High Intensity	26.35	0.1%
Barren Land	3.11	0.0%
Deciduous Forest	2,339.37	13.5%
Evergreen Forest	39.59	0.2%
Mixed Forest	0.00	0.0%
Shrub/Scrub	100.52	0.6%
Grassland/Herbaceous	43.59	0.3%
Pasture/Hay	1,836.76	10.6%
Cultivated Crops	7,033.68	40.6%
Woody Wetlands	95.52	0.5%
Emergent Herbaceous Wetland	11.79	0.1%
Total Acreage	17,325.66	100.0%

Table 1. Land use by category (Buckeye Lake for Tomorrow, 2013)

2.2 Summary of Biological Trends for Buckeye Lake HUC-12

As reported in an *Integrated Water Quality Report* (2018), the Ohio EPA samples two locations in the Buckeye Lake watershed: one at Wasteweir Run near Buckeye Lake Overflow at St. Rt. 79 and the other at Honey Creek at Honey Creek Road (Table 2). Wasteweir Run is currently in non-attainment and is considered Modified Warmwater Habitat – Channel Modified, while Honey Creek met full attainment status and is considered Warmwater Habitat. Both locations are designated as Primary Contact B recreation use classes. Data was collected during the Ohio EPA's 2008 study of the Licking River basin.

Location	Drain. (miles^2)	IBI	MIwb	ICI	QHEI	Status
Wasteweir Run near Buckeye Lake Overflow @ ST. RT. 79	44.30	34.00 / FAIR	6.77 / FAIR	N/A	41.00	Non
Honey Creek @ Honey Creek Rd.	6.60	36.00 / Marginally Good	N/A	N/A	59.50	Full

Table 2. Summary of biological trends for Buckeye Lake. Data sampled in 2008.

2.3 Summary of NPS Pollution Causes and Associated Sources for Buckeye Lake HUC-12

For the past several years, Buckeye Lake for Tomorrow (BLT) has been responsible for data collection on the watershed's tributaries. Ohio EPA monitors the lake itself. BLT tests three nutrients - ammonia, phosphorus and nitrates - while recording standard water quality parameters (pH, DO, conductivity, temperature). According to EMH&T's Preliminary Investigation (2016), phosphorus was identified as the primary nutrient causing nuisance algal blooms.

Harmful algal blooms have become common at the lake and in some cases have produced toxins (microcystin). Weekly monitoring for algal toxins is conducted May through August at Crystal Beach and Fairfield Beach by ODNR in order to notify visitors when levels are unsafe for recreational activities. Average microcystin concentrations at the two beaches for 2019 were 20.40 µg/L and 31.91 µg/L, respectively. The Ohio Department of Public Health recommends posting a public health advisory when concentrations are above 6 µg/L and a no contact advisory when concentrations are at or exceed 20 µg/L.

In addition, Ohio EPA conducted water quality monitoring at three in-lake locations at Buckeye Lake in 2011 and 2012 (Figure 4, sampling sites are L-1, L-2 and L-3). Annual mean total phosphorus concentrations, averaging data from all three in-lake locations, was 109 µg/L in 2011 and 121 µg/L in 2012.

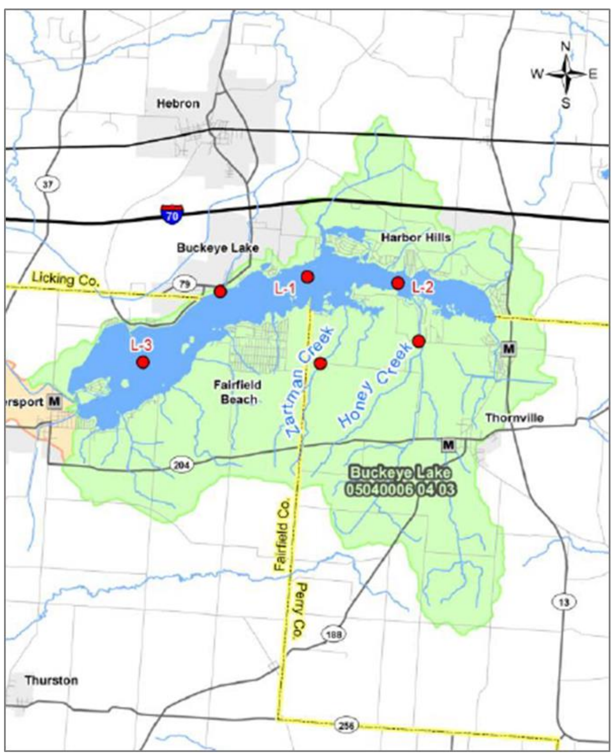

Figure 4. Ohio EPA water quality sampling locations

The table below compares this data to historical data collected at the lake in 1973.

Year	Summer mean TP (µg/L)	Summer mean chlorophyll (µg/L)	Summer mean Secchi Disk (m)
4/26/73	173	247	.2
7/30/73	165	141	.3
10/8/73	273	172	.3
2011	121	197	.3
2012	160	196	.3

Table 3. Comparison of historical water quality monitoring data. Historical data comes from a 1975 EPA report, cited in Tetra Tech's 2014 study on Buckeye Lake (Tetra Tech, 2014)

Fertilizer runoff from fields is a potential source of pollution from outside the lake, with other significant sources including failing home sewage treatment systems and stormwater runoff (Buckeye Lake for Tomorrow, 2013).

Internally, the lake's high volume of pre-existing nutrients may significantly outweigh the impact from external loading. Tetra Tech (2014), as cited in EMH&T's Preliminary Investigation, attributed 78% of 2012's summer phosphorus load to internal loading (90% in 2011). Organic matter within Buckeye Lake, due to the reservoir's initial impoundment, as well as two centuries of runoff, are the main components of internal loading.

2.4 Additional Information for Determining Critical Areas and Developing Implementation Strategies for Buckeye Lake HUC-12

Several organizations and agencies work in the Buckeye Lake HUC-12 to improve habitat and water quality, including the Ohio Department of Natural Resources, Ohio EPA, and Buckeye Lake for Tomorrow. Some of these organizations have created documents and/or plans to help identify the needs of the area. These documents were used to create this NPS-IS plan and are listed in the Works Cited section.

Chapter 3: Conditions and Restoration Strategies for Buckeye Lake HUC-12 Critical Areas

3.1 Overview of Critical Areas

The critical areas identified in the Buckeye Lake HUC-12 address the increasing harmful algal blooms (HABs) on the lake's surface. This watershed is primarily impacted by agricultural sources of impairment (fertilizer runoff, eroding streambanks), but urban sources are also prevalent (e.g. failing home sewage treatment systems). Additionally, internal loading from existing lake sediments contributes to HABs. The goal of this plan is to outline a strategy for reducing HABs through nutrient and sediment load reduction.

There are four critical areas: the urbanized shoreline, failing home sewage treatment systems, inadequate riparian corridors, and the agriculture-rich uplands of the watershed. A fifth critical area may be added in an updated version of the NPS-IS – the in-lake portion of the watershed, which would take internal loading into account.

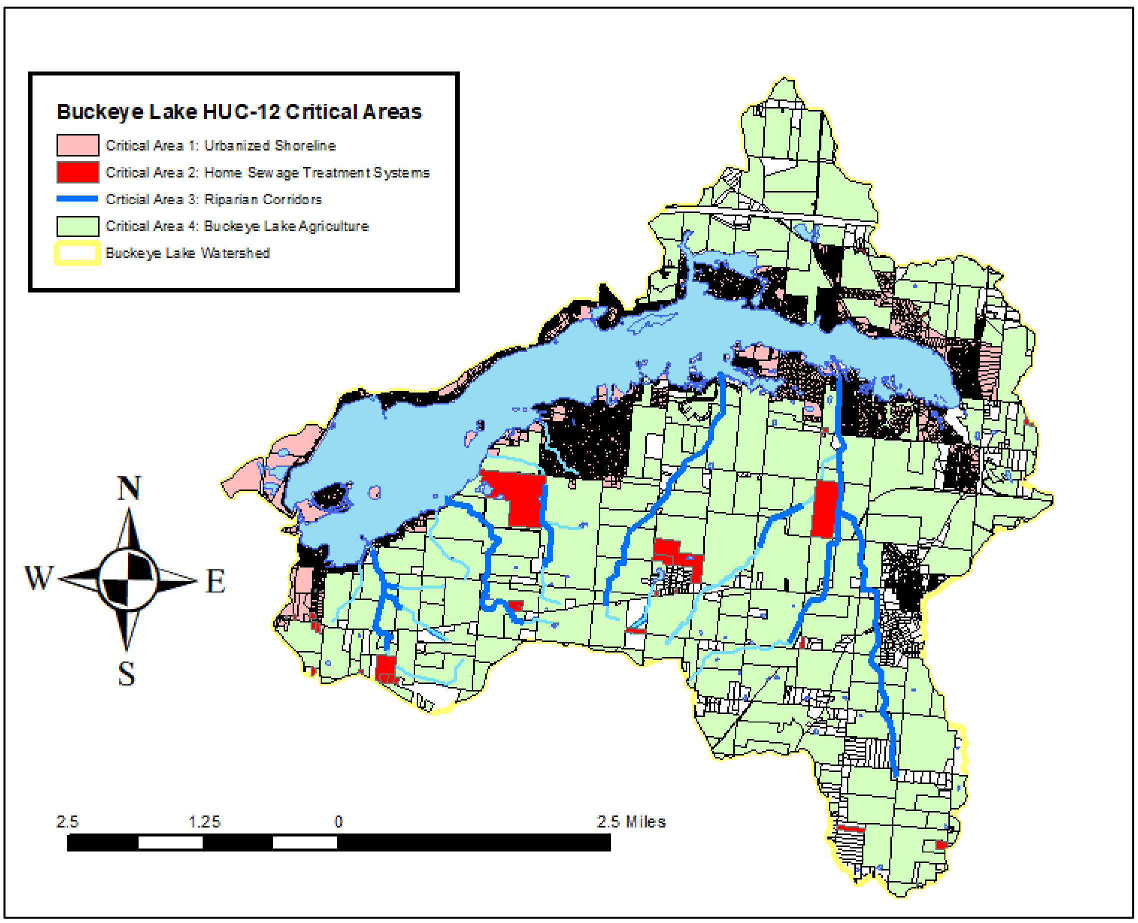

Figure 5. Map of Critical Areas

3.2 Critical Area 1: Conditions, Goals & Objectives for the Urbanized Shoreline

3.2.1 Detailed Characterization

Critical Area 1 contains the highly urbanized shoreline of Buckeye Lake, including the Millersport municipality, Fairfield Beach, Thornport, the Village of Buckeye Lake, and Harbor Hills. What makes this area critical is difficult to summarize because there are so many small sources of pollution near the lake waters. Firstly, there is a lot of development pressure, with houses built right up to the lake and a general disapproval of natural shorelines on private property. (The lack of a natural shoreline is one cause of poor habitat quality for macroinvertebrates). Some areas of the lake do not have detention basins either, including Harbor Hills, and with so many roofs and downspouts around the shore, but no buffer, storm water enters the lake unabated. Boat ramps and marinas also contribute small oil spills and runoff from asphalt. Storm water basins are needed to mitigate this issue, as well as water quality standards for new and post-construction development. Becoming certified through the Ohio Clean Marinas Program would also provide informational resources for marinas to establish best management practices. Existing canals need to be dredged or aerated as well, especially on the east side of the lake where stagnation encourages algal growth.

Second, the lack of native buffer is a major attraction for geese. Normally deterred by emergent and woody vegetation, geese congregate on the shorelines, making nests and living there year-round. It is estimated that over 4,000 pounds of annual phosphorus loading in the lake come from waterfowl feces alone (EMH&T, 2016). To counteract goose activity, planting native grasses and trees would effectively reduce their nesting space, while resident-led harassment techniques (i.e. green lasers) would scare off geese from resting on the shorelines (Buckeye Lake for Tomorrow, 2013).

Third, a trench on the west side known as “Deep Cut” has high sedimentation. Once used to increase water supply to the lake during the time of the Ohio and Erie Canal, the trench has built up soil to an extent that waters flowing toward the lake eventually back up and flood private property on the banks. This mix of soil and shallow water is further disturbed by passing boats. To make matters worse, geese are attracted to private aerators (used to keep water from freezing near docks) during the winter and their waste matter mixes with the increased suspended sediment, giving Deep Cut a high nutrient load. Algal blooms have, in turn, been found in the Deep Cut channel, washing out into the lake during rainfall events. Removing soil and increasing the water depth could partially address the issue (EMH&T, 2016).

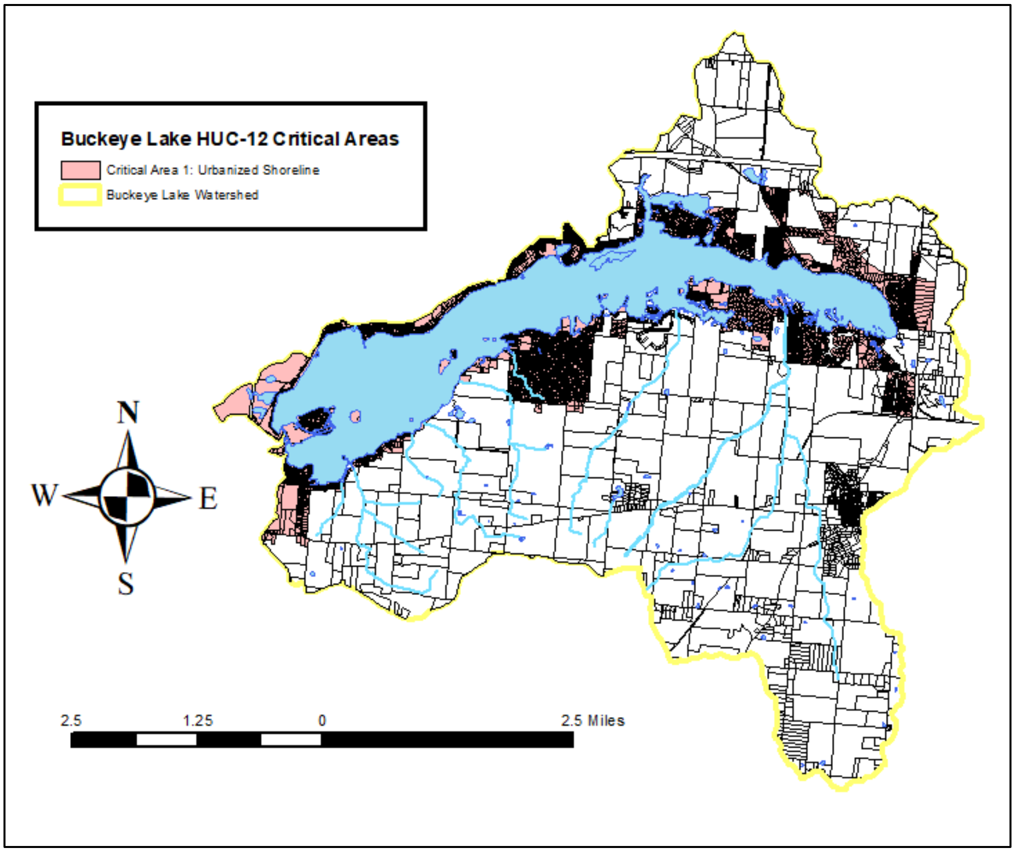

Figure 6. Critical Area 1 for Buckeye Lake

3.2.2 Detailed Biological Conditions

Sampling in 2008 by the Ohio EPA for EPA's 2012 Biological and Water Quality Study of the Licking River showed nonattainment in the Waste Weir Run (WWR) near Buckeye Lake overflow at St. Rt. 79, based on IBI scores of 34 (fair), QHEI score of 41 and an Mlwb score of 6.77 (fair).

Chemical and biological sampling occurred at one location in the WWR during EPA's 2012 Biological and Water Quality Study of the Licking River. The sampling occurred a few hundred yards downstream from the Buckeye Lake outlet structure.

"Effects of Buckeye Lake algal respiration were evident in the WWR water column samples…Initial D.O. concentrations were consistent with WWH expectations. Later summer values were well below aquatic life requirements (x=4.8 mg/l, n=5). Anoxic conditions were apparent as the summer progressed (ammonia-N x=0.13 mg/l, n=5). All organic nitrogen (TKN x=0.76 mg/l, n=5) and oxygen demand (COD x=26 mg/l, n=5) concentrations were elevated" (Ohio EPA, 2012).

The WWR is a rock lined trapezoidal low gradient ditch which offers poor habitat quality to aquatic communities. EPA's conclusion following the WWR 2008 sampling states that "the poor macroinvertebrate community will improve when Buckeye Lake water quality conditions improve. [In addition], allowing some water to continually flow through the channel will help stabilize habitat conditions" (Ohio EPA, 2012).

Honey Creek was sampled at RM 0.8, upstream from the Buckeye Lake backwater during EPA's 2012 Biological and Water Quality Study of the Licking River. "The modified stream had fair habitat quality (QHEI=59.5). Biological performance was good (IBI=36, ICI=Good). Nutrient concentrations were high in five samples at this site. The geometric mean bacteria value exceeded the PCR class B criterion (E. coli gmx=628 cfu/100ml)" (Ohio EPA, 2012).

"Buckeye Lake is impaired based on a median chlorophyll-a concentration (76.4 µg/L) greater than the recommended median criterion (14.0 µg/L) and a high percentage (70%) of average D.O. criterion excursions in the lake epilimnion. Median total nitrogen (1075 µg/L), total phosphorus (34 µg/L) and Secchi depth values all exceed the proposed median corresponding criterion and resulted in the lake being considered "Watch" for all three" (Ohio EPA, 2012).

All prior EPA studies of Buckeye Lake determined the shallow impoundment to be over productive, prone to DO concentration extremes, and a source of organic loading to the South Fork Licking River.

3.2.3 Detailed Causes and Associated Sources

The causes and sources of impairment for the Buckeye Lake shoreline are numerous but disparate. Causes include nutrient loading (nitrates and phosphates), sedimentation, habitat alteration, and urban runoff such as spilled oil and municipal waste water. The sources of impairment are fecal matter from geese, poor drainage out of Deep Cut with its high soil levels, lack of native vegetation along the shoreline, and heavy urbanization in areas without retention basins.

Causes	*Sources*
Nutrients: nitrates and phosphates	Waterfowl feces
Sedimentation	Deep Cut canal
Habitat alteration	Lack of native vegetation
Urban runoff	High development, lack of retention basins

Table 4. Causes and Sources for Critical Area 1

3.2.4 Outline Goals and Objectives for the Critical Area

Because Buckeye Lake is used for recreation, the primary goal of reducing harmful algal blooms is to ensure the safety of the public. Therefore, the quality of the lake must meet standards set for recreational waters.

Goals:

1. Reduce microcystin levels from an annual average of 22.35 µg/L to less than 6 µg/L.
    - According to the Ohio Department of Health's BeachGuard dataset, sampling takes place annually at Crystal Beach on the north side of Buckeye Lake, close to the outlet. In 2019, 20 samples were recorded, with an average microcystin concentration of 22.75 µg/L. In 2017, 16 samples were recorded with an average of 21.94 µg/L (no data was recorded in 2018). A three year average yields 22.35 µg/L annually. 6 µg/L is the limit set by the EPA before a Recreational Public Health Advisory must be posted (State of Ohio, 2016).

2. Bring aquatic life quality at the Waste Weir Run (WWR) into attainment by meeting Warmwater Habitat (WWH) standards: this means increasing the IBI score to 40, the QHEI score to 55 or above (Good), and the MIwb score to 7.9
    - The current scores at the Waste Weir Run, sampled in 2008, are all below their respective thresholds to meet WWH standards: the IBI score is 34 (fair), the QHEI is 41 (Poor), and the MIwb is 6.77 (fair). These reduced scores mean WWR is currently in non-attainment.

Objectives:

1. Plant 10 acres of 50-foot wide native vegetation and tree plantings along the shore line to deter geese from nesting, while educating the public on goose disturbance programs.
2. Install 10 bubbling aerator units in canals on the lake's perimeter. The aerators will break up algal growth and introduce dissolved oxygen into the water. Buckeye Lake for Tomorrow has identified 10 stagnant channels in need of maintenance. Since aerators attract geese during the winter, special care will have to be given to promoting goose disturbance programs in these areas.

3.3 Critical Area 2: Conditions, Goals & Objectives for Home Sewage Treatment Systems

3.3.1 Detailed Characterization

Buckeye Lake has several communities that are not connected to a centralized sewer system. Residents in these communities use a variety of home sewage treatment systems (HSTS) ranging in age from recently constructed to decades old. In conjunction with the county health departments, treatment systems need to be inventoried and their functionality assessed. Failing HSTS are a source of nutrient pollution. Phosphorus from wastewater can be absorbed and retained in the soil. But both unabsorbed phosphorus and nitrogen can travel in groundwater toward a water body and become a source of contamination. If there are many septic systems in a small area, the nutrients flowing through the groundwater can overload a water body, causing eutrophication. There are 31 permitted aerators within the Buckeye Lake watershed.

As stated in Ohio EPA's 2012 Biological and Water Quality Study of the Licking River, the "geometric mean bacteria value exceeded the PCR (Primary Contact Recreation) class B criterion (E. coli gmx=628 cfu/100ml)" at Honey Creek. According to a Total Maximum Daily Load (TMDL) report for the upper Scioto River watershed (2014), the criterion to meet the water quality standard for PCR Class B (Class B meaning that the lake can be used infrequently for recreation with intermediate to low risk of illness), is less than 161 cfu/100ml (A 'colony-forming unit' is a unit used to estimate the number of viable bacteria or fungal cells in a sample). If the sample results exceed 235 cfu, an advisory is posted to warn swimmers of the risk of illness associated with water contact (Ohio Department of Health, 2019). Summer 2019 E.coli sampling conducted by ODNR resulted in an average reading of 33.87 cfu/100ml at Fairfield Beach and 72.16 cfu/100ml at Crystal Beach, though there have historically been measurements above 161 cfu. Because the three previous years (2017-2019) have been so wet, E.coli concentrations have been low, and it is expected they will increase during dryer years.

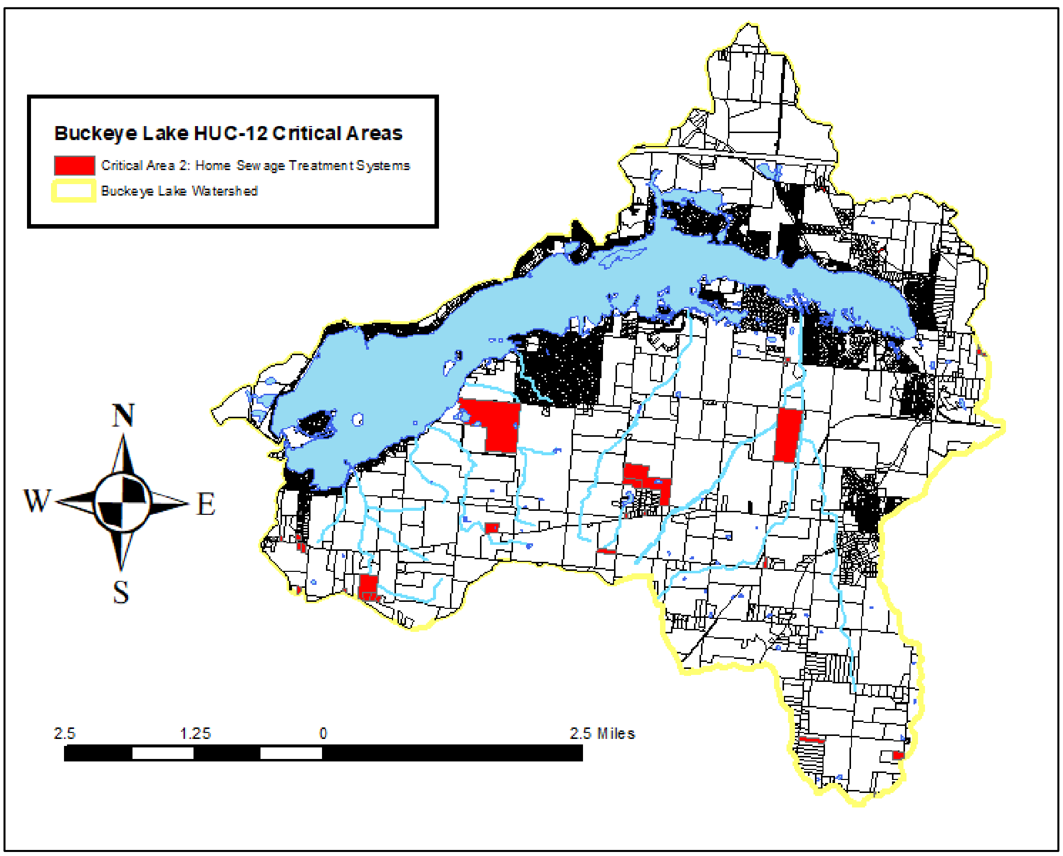

Figure 7. Critical Area 2 for Buckeye Lake

3.3.2 Detailed Biological Conditions

Because the Ohio EPA only took two samples in the Buckeye Lake HUC-12, representing Buckeye Lake as a whole, the Biological Conditions for Critical Area 2 are the same as for Critical Area 1 in section 3.2.2.

3.3.3 Detailed Causes and Associated Sources

The causes and sources associated with Critical Area 2 are straightforward. Failing septic tanks are contributing to organic enrichment in the lake, increasing E.coli and nutrient levels (EMH&T, 2016).

Causes	*Sources*
Organic enrichment	Failing home sewage treatment systems

Table 5. Causes and Sources for Critical Area 2

3.3.4 Outline Goals and Objectives for the Critical Area

Goals

1. Reduce E.coli from a geometric mean of 628 cfu/100ml to consistently less than 161 cfu/100ml at Honey Creek in order to meet PCR Class B criterion for recreational water quality.
2. Maintain E.coli concentrations below 161 cfu/100ml at Fairfield Beach and Crystal Beach.

Objectives

1. Identify 10 failing septic tank aerator systems in the Buckeye Lake HUC-12
    - Working in conjunction with the county health departments, a process of inspection will also be developed and maintained that will identify aerators as they begin to fail.

3.4 Critical Area 3: Conditions, Goals & Objectives for Riparian Corridors

3.4.1 Detailed Characterization

Further out into the watershed, sediment washes into waterways from eroded streambanks. Channelized streams send this sediment-rich runoff directly into the lake, leading to lower water levels and higher nutrient loads. In 2012, Fairfield Soil and Water Conservation District identified 80 locations within the Buckeye Lake watershed with moderate to severely eroded streambanks (with the most heavily impacted stretches shown in Figure 8). These locations account for an estimated 15,000 feet of eroded streambank out of a total of 228,522 feet of waterways in the whole watershed (Buckeye Lake for Tomorrow, 2013). One of the primary contributors of sediment is Honey Creek (Figure 9), which is the largest tributary in the eastern Buckeye Lake watershed and which has large sections of eroded streambank. Most of Honey Creek is on agricultural grounds, with the mouth located on a residential part of the shoreline. There is an old railroad running parallel to the stream which causes some of Honey Creek's erosion, especially where the railroad crisscrosses the stream over two separate bridges. The Fairfield SWCD estimates that this railroad destabilizes the streambank more so than agricultural production. Regardless, improving the streambank relies on a partnership with local producers – not just on Honey Creek but all Buckeye Lake tributaries. Streambank improvements would aid in decreasing sediment loads, but structural projects depend on the willingness of the landowners involved. Machinery would need to cross private grounds and streamside properties would need to be altered. In some cases, farming practices would undergo changes too, especially where fields are cultivated up to the bank. Cost-share programs and diligent understanding of landowner needs will go a long way in reestablishing riparian corridors.

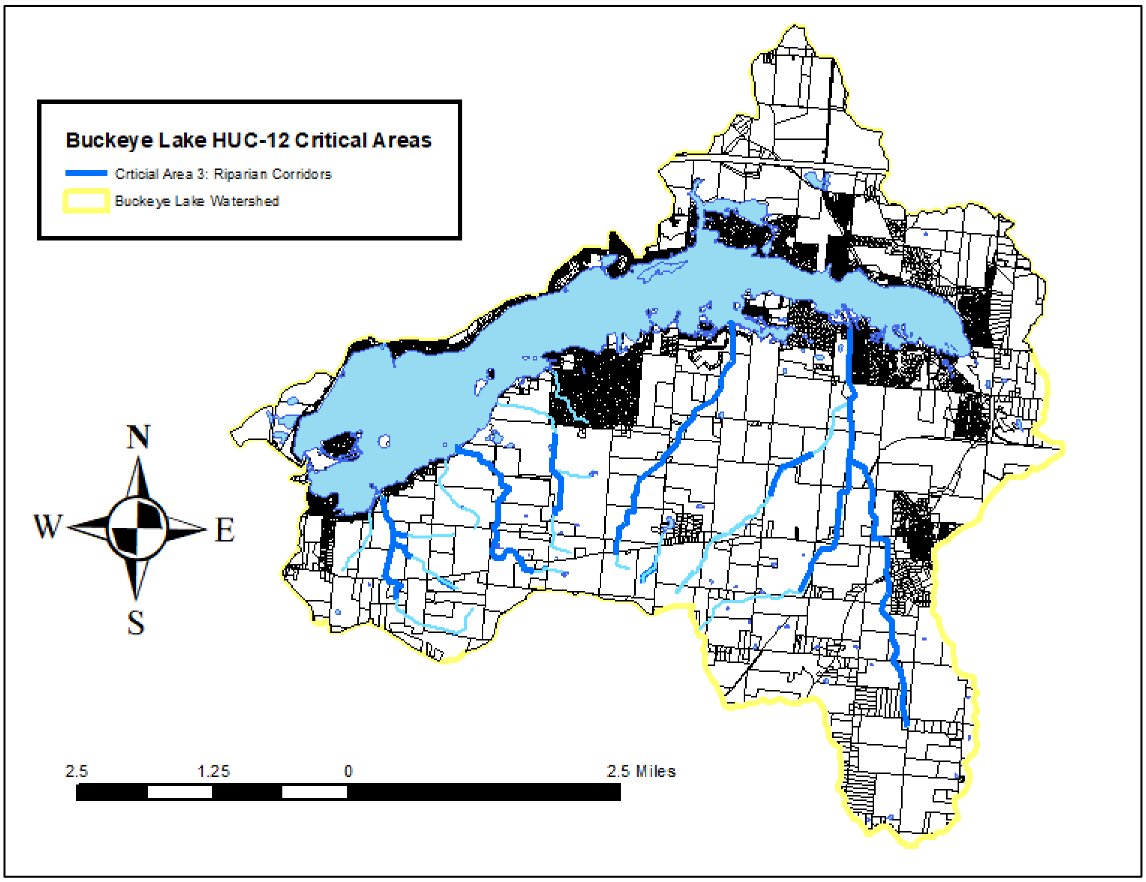

Figure 8. Critical Area 3 for Buckeye Lake

3.4.2 Detailed Biological Conditions

Because the Ohio EPA only took two samples in the Buckeye Lake HUC-12, representing Buckeye Lake as a whole, the Biological Conditions for Critical Area 3 are the same as for Critical Area 1 in section 3.2.2.

3.4.3 Detailed Causes and Associated Sources

Causes	*Sources*
Sedimentation	Eroded tributary streambanks
Habitat alteration	Lack of native vegetation

Table 6. Causes and Sources for Critical Area 3

Figure 9. Eroded streambank on Honey Creek

3.4.4 Outline Goals and Objectives for the Critical Area

Goals:

1. Reduce total suspended solids coming out of Honey Creek from 2,646 lbs/day to 1,587 lbs/day.
    - According to data from 2008-2012 EPA sampling, Honey Creek is the highest contributor of total suspended solids to Buckeye Lake in this HUC-12. By reducing current loads by 40%, this would yield an average of 1,587 lbs/day. A 40% reduction was chosen as a realistic ideal for decreasing tributary loads.

2. Reduce total suspended solids coming out of smaller tributaries, comparable in size to Zartman Creek, from an average of 33 lbs/day to 20 lbs/day.

- The only other site sampled in the Buckeye Lake HUC-12 by the EPA in 2008-2012 was on Zartman Creek. Because Zartman Creek is similar in size and has similar characteristics to other tributaries to the lake, the suspended solids coming out of it will have to serve as an average standard for the rest of the watershed, excluding Honey Creek. Attaining an average of 20 lbs/day for each tributary would satisfy a load reduction of 40%.

Objectives:

1. Improve 15,000 feet of eroded streambank in the watershed.
    - From observational data obtained from the Fairfield SWCD in 2012, 80 streambank locations were identified as suffering from erosion issues, stretching across an estimated average of 100 feet per site. Additional length of erosion along the Honey Creek channel has been identified since 2012. Improvements will be made through redirecting flow, re-establishing access to floodplains, and other natural restoration methods. The long-term goal is to apply floodplain/stream restoration methods to 8,000 feet along Honey Creek, extending both upstream and downstream of Honey Creek Road. Given the expansive nature of this goal, the restoration efforts along Honey Creek will occur in phases, with Phase 1 being an approximately 900 foot long segment just north of (downstream of) Honey Creek Road.

3.5 Critical Area 4: Conditions, Goals & Objectives for Buckeye Lake Agriculture

3.5.1 Detailed Characterization

Critical Area 4 covers the agricultural portion of Buckeye Lake. Agriculture is the most significant land use in this watershed with 51.2% made up of row crops and pasture/hay. For the sake of clarity, agricultural production is defined here as taking place on parcels greater than 10 acres even if they are not currently in active production. These parcels are mostly drained by southern tributaries: Murphy's Run, Zartman Creek, Honey Creek. Northern tributaries above the lake are small and unnamed. Because this still covers a lot of land, the critical area is further defined as farms within 50 feet of streams and ditches, farms with 20% or more highly-erodible-land (HEL), farms that need to draw down nutrients as verified through soil testing, and farms without current nutrient management plans.

Runoff from agricultural production is the largest source of nutrient loading to Buckeye Lake (Buckeye Lake for Tomorrow, 2013). Commercial fertilizers and to a limited extent, manure, are used to fertilize crops, contributing high levels of nitrates and phosphates to waterways. Anywhere from 25-75% of drainage passes through sub-surface tiles and discharges directly into streams, even with grassed filter strips in place (Buckeye Lake for Tomorrow, 2013). To mitigate field runoff, solutions include installing edge of field buffers, increasing cover crops to prevent soil loss during the winter, and creating wetlands to catch and filter water before it enters the lake.

Increased buffers would also be useful in reducing nutrients from animal waste. Livestock has historically contributed a minimal amount of pollution to the lake. Recently, however, several landowners have increased their livestock operations and introduced new sources of animal waste in the western part of the watershed, including mixed horses, cattle, and hogs (225 head across four operations). On the east side, there have been increases in horses and hogs, while sheep and cattle have remained the same over the past decade. NRCS currently estimates 2400 hog (with a majority of the manure falling within the watershed), 350 cattle, 40 mixed horses, sheep, goats, and other 4H livestock. There are still a small number of animals per acre in the total watershed.

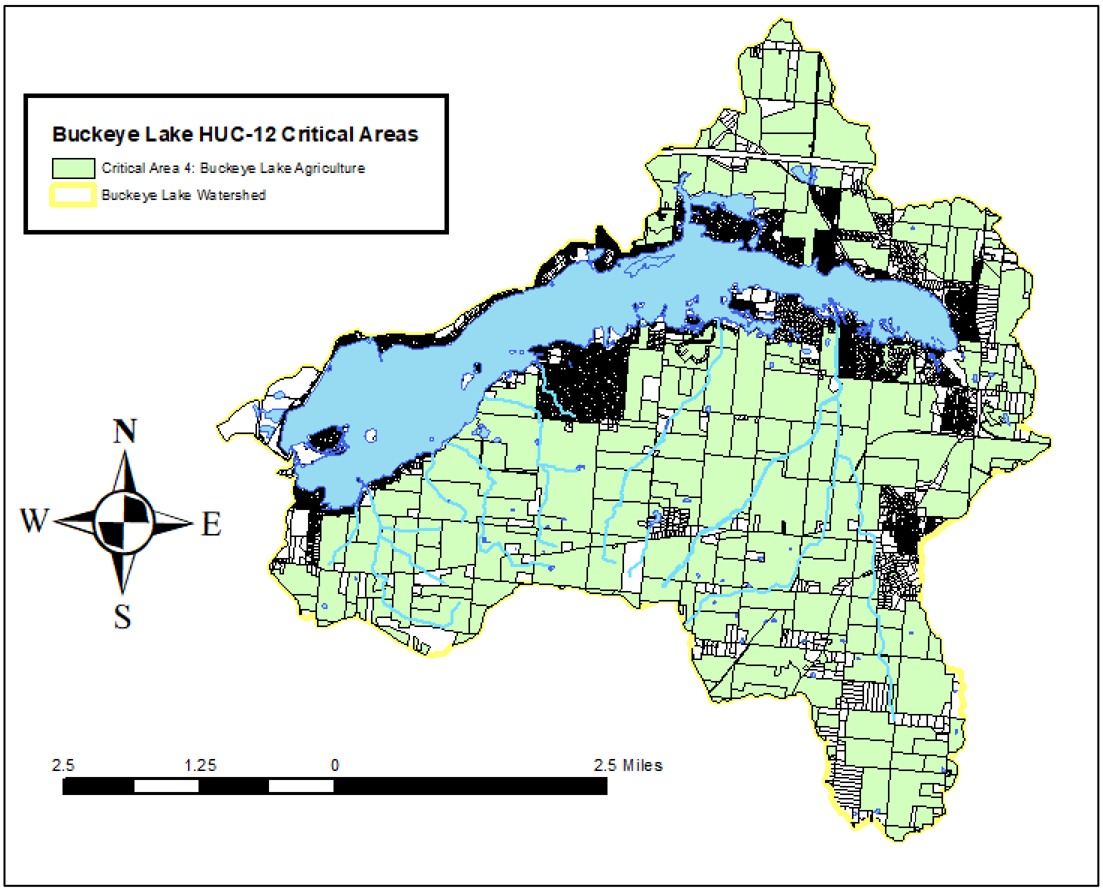

Figure 10. Critical Area 4 for Buckeye Lake

3.5.2 Detailed Biological Conditions

Because the Ohio EPA only took two samples in the Buckeye Lake HUC-12, representing Buckeye Lake as a whole, the Biological Conditions for Critical Area 4 are the same as for Critical Area 1 in section 3.2.2.

3.5.3 Detailed Causes and Associated Sources

The cause of impairment in Critical Area 4 is dominantly nutrient pollution, though sources vary. Fertilizer runoff is just one component, as livestock also contribute a small amount of nutrients, especially phosphorus. Lack of vegetative buffers at edge-of-field also contributes to impaired stream quality, while erosion on HEL and during the winter removes soil from bare fields and transports it downstream into the lake.

To the north of Buckeye Lake, near Lakewood High School, there is also an unknown source of high nitrates. Sampling has historically yielded the highest nitrate readings coming out of crop grounds near the school. The nitrates follow a waterway that runs southwest, across Interstate I-70, and into Maple Bay (Buckeye Lake for Tomorrow, 2013).

Causes	*Sources*
Nitrates	Fertilizer runoff, unknown source near Lakewood
Phosphates	Fertilizer runoff, livestock
Habitat alteration	Lack of riparian areas nearby streams and ditches
Sedimentation	Row-crop agriculture, stream bank erosion

Table 7. Causes and Sources for Critical Area 4

3.5.4 Outline Goals and Objectives for the Critical Area

Goals:

1. Reduce nitrate loading from **138,793.54 lbs/year to 83,276.13 lbs/year or less**.
    - Data collected from Ohio EPA during 2008-2012 (Figure 11) shows that the average nitrate loads of Honey Creek and Zartman Creek were 9.6 lbs/ac/year. Since only two sites were sampled during this time, multiplying this average by all relevant acres in the watershed yields 138,793.54 lbs/year N. A 40% reduction would mean reducing the current loads down to 83,2761.13 lbs/year. The Feeder Canal is by far the largest contributor of both nitrates and phosphates but was ignored in the calculations here since it will be discussed in the Reservoir Feeder NPS-IS.
2. Reduce phosphate loading from **2,168.65 lbs/year to 1,301.19 lbs/year or less**.
    - Data collected from Ohio EPA during 2008-2012 (Figure 12) shows that the average phosphate loads of Honey Creek and Zartman Creek were 0.15 lbs/ac/year. Since only two sites were sampled during this time, multiplying this average by all relevant acres in the watershed yields 2,168.65 lbs/year P. A 40% reduction would mean reducing the current loads down to 1,301.19 lbs/year.

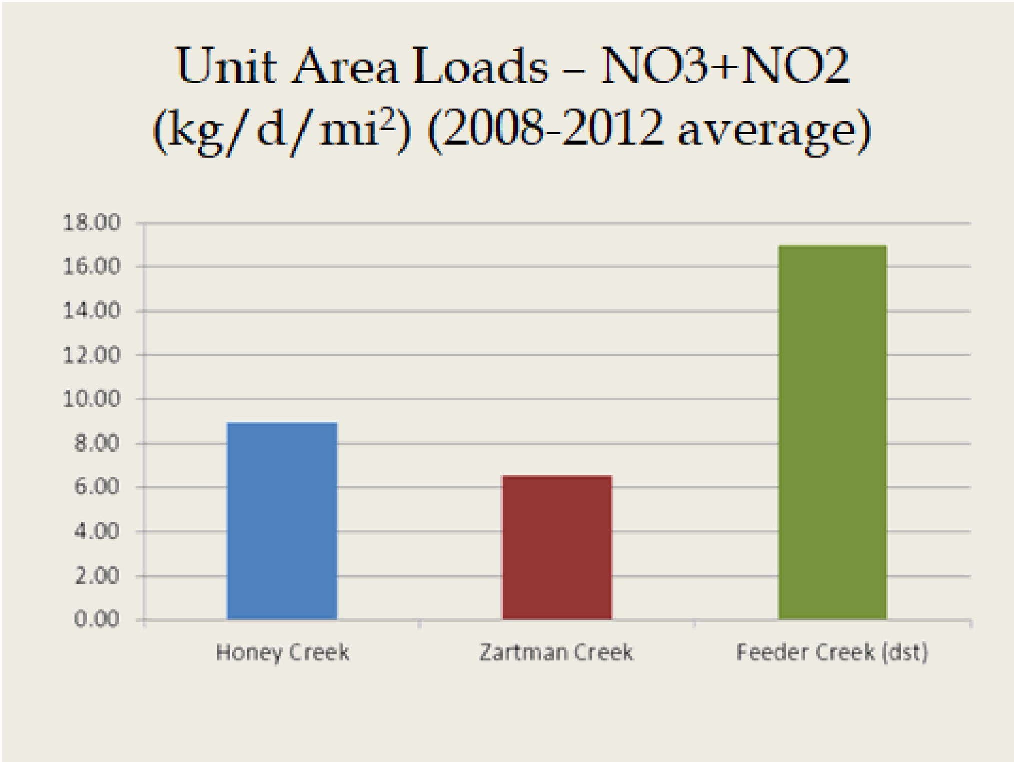

Figure 11. Nitrate Loads at Honey and Zartman Creeks (EPA Data)

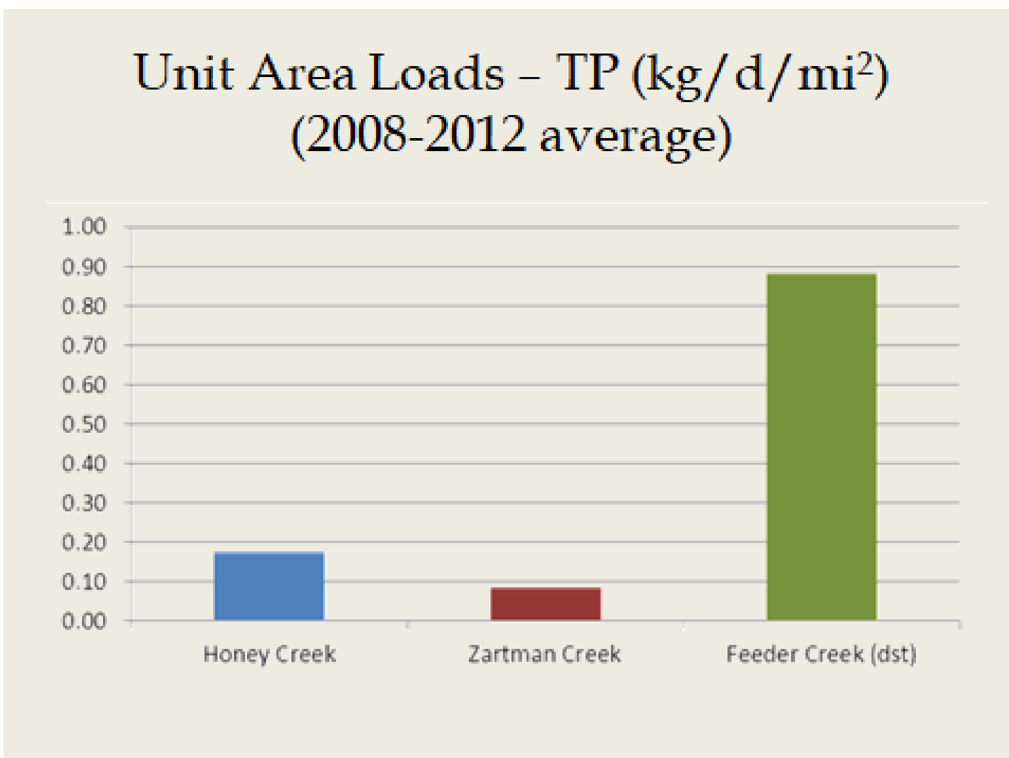

Figure 12. Phosphorus Loads at Honey and Zartman Creeks (EPA Data)

Objectives:

1. Enroll 1,000 acres of crop land in a nutrient management plan.
    - A nutrient management plan through NRCS will provide comprehensive guidance on best management practices, including planting native vegetation on agricultural waterways.
2. Plant 1,000 acres of cover crops annually.
    - To date, roughly 300 acres of cropland use cover crops in the winter. Expanding on this practice up to 1,000 acres would reduce nitrate loading by 4,500 lbs/year and phosphate loading by 2,200 lbs/year.
3. Construct 2 wetlands: near the I-70 W rest area to combat high Lakewood nitrates (Figure 13) and at Brooks Park to filter runoff coming out of Murphy's Run.
    - Additional wetlands will be considered when appropriate areas are identified and there is landowner willingness to implement them.

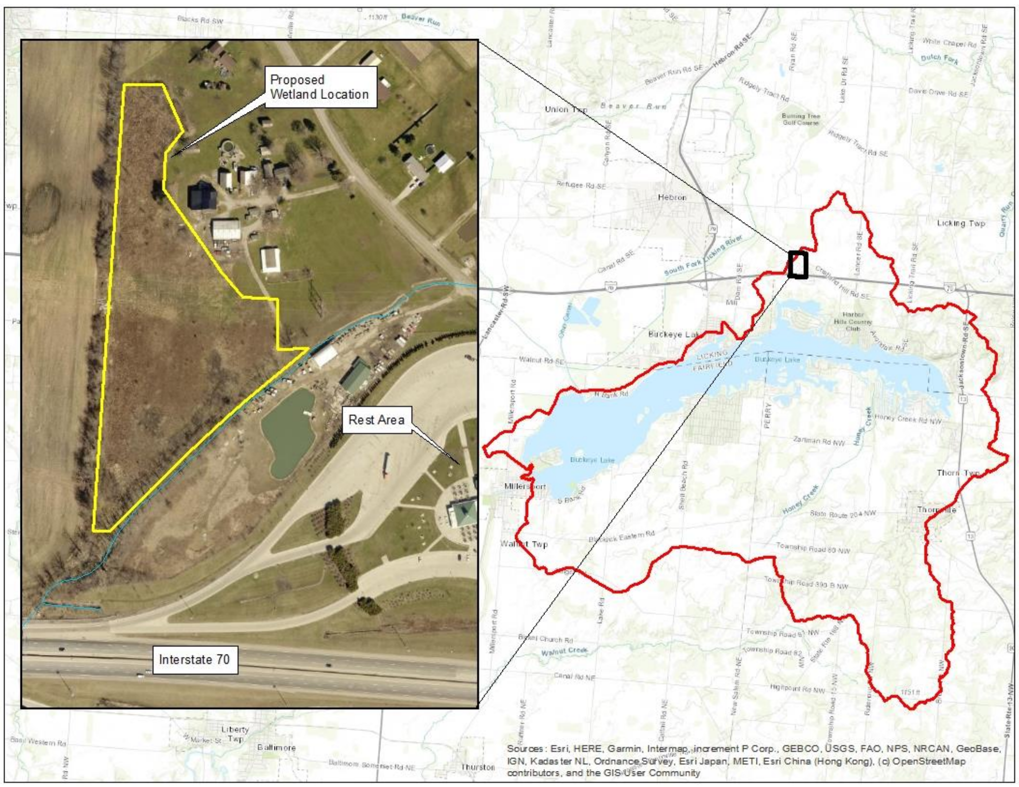

Figure 13. Proposed wetland to filter high nitrates near I-70

Chapter 4: Projects and Implementation Strategy

Overview Table and Project Sheets for Critical Areas

The table below shows the planned projects and evaluation strategies for removing impairments in the Buckeye Lake HUC-12. Periodic re-evaluation will be necessary to assess the impact of the implementation projects. Any causes of impairment other than nonpoint source pollution will need to be addressed under different initiatives, authorities or programs which may or may not be accomplished by the same implementers addressing the nonpoint source pollution issues.

For the Buckeye Lake HUC-12, there is one *Projects and Implementation Strategy Overview Table*, representing the critical areas listed above. Any nonpoint source impairments identified for one of the existing critical areas in the future will be added to the table. Priority is given to projects that specifically address the *Objectives* for a Critical Area, as listed in Chapter 3, projects where land-owner engagement makes the process of addressing impairment feasible, and projects that promote education among the public.

Project Summary Sheets are listed in order by Critical Area and project numbers. These summary sheets provide the essential nine elements for short-term and/or next step projects that are in development and/or in need of funding. As projects are implemented and new projects developed these sheets will be updated. Any new summary sheets created will be submitted to the state of Ohio for funding eligibility verification (i.e. all nine elements are included).

4.1 Overview Table for Critical Areas 1-4

For ***Buckeye Lake (HUC-12)*** (05040006 04 03)								
Applicable Critical Area	**Goal**	**Objective**	**Project #**	**Project Title** *(EPA Criteria g)*	**Lead Organization** *(criteria d)*	**Time Frame** *(EPA Criteria f)*	**Estimated Cost** *(EPA Criteria d)*	**Potential/Actual Funding Source** *(EPA Criteria d)*
Urban Sediment and Nutrient Reduction Strategies								
2	1,2	1	2	HSTS Replacements or Upgrades	County Health Departments	Short	$150,000	Local Sources
4	1	3	1	Grosse Wetland Creation	SWCDs, NRCS	Short	$42,350.71	H2Ohio EQIP, CRP Ohio EPA 319
1	1,2	2	8	Canal Maintenance	SWCDs	Varies	Varies	Local Sources
Altered Stream and Habitat Restoration Strategies								
3	1	1	3	Honey Creek Restoration	SWCDs, ODA	Short	$3.0 Million	EPA 319, USDA-NRCS
3	2	1	7	Tributary Improvement Projects	SWCDs, ODA	Long	Varies	EPA 319, USDA-NRCS
Agricultural Nonpoint Source Reduction Strategies								
1, 4	1,2 1,2	1	5	Watershed Nutrient Reduction Practices	NRCS, SWCDs	Varies	Varies	H2Ohio, EPA 319, USDA-NRCS, Local Sources
4	1,2	3	4	Treatment Train at Brooks Park	ODNR	Short	$560,000	H2Ohio
4	1,2	2	6	Cover Crop Program	SWCDs	Ongoing	$30,000, annually	USDA-NRCS, MWCD

4.2 Project Summary Sheets

Critical Area 1: Project 1		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	**Title**	**Grosse Wetland Creation**
criteria d	**Project Lead Organization & Partners**	Fairfield, Licking and Perry SWCDs ODA USDA-NRCS
criteria c	**HUC-12 and Critical Area**	Buckeye Lake HUC-12 Critical Area 4: Buckeye Lake Agriculture
criteria c	**Location of Project**	Buckeye Lake HUC-12, Cristland Hill Rd, North of I-70 West Rest Area
n/a	**Which strategy is being addressed by this project?**	Urban Sediment and Nutrient Reduction Strategies
criteria f	**Time Frame**	Short (1-3 years)
criteria	**Short Description**	A field north of I-70W will be converted into a wetland. The source of the water will be a soon-to-be constructed petition ditch. High nitrates are known to originate from land adjacent to the petition ditch. The wetland will filter these nitrates before reaching Buckeye Lake.
criteria g	**Project Narrative**	Because tests at Maple Bay have resulted in the highest levels of nitrates in the watershed, it has been deduced that there is an extensive source of runoff upstream, north of I-70 West. The exact source is unknown, but the area is predominantly agriculture with Lakewood High School being the only other notable feature. To address these high nitrates, a petition ditch was recently approved to conduct drainage into a proposed eight-acre wetland on private property near the I-70 W rest area. The wetland will filter the nitrates before conveying the water into Maple Bay.
criteria d	**Estimated Total Cost**	$42,350.71
criteria d	**Possible Funding Source**	H2Ohio, CRP, EPA 319, EQIP
criteria a	**Identified Causes and Sources**	Cause: High nitrate runoff Source: Unknown
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	The goal of this critical area is to reduce nitrate and phosphate loading to Buckeye Lake. To remove the impairment totally, nitrate loading must be decreased by 83,276.13 lbs/year and phosphate loading by 1,301.19 lbs/year.
	Part 2: How much of the needed improvement for the whole Critical Area is	It is estimated that a wetland north of Maple Bay would decrease nitrates by 6,939.68 lbs/year and phosphates by 108.49 lbs/year. This accounts for

	estimated **to be accomplished by this project?**	8.3% of the reductions necessary to remove Critical Area 4 as an impairment.
	Part 3: Load Reduced?	N: 6,939.68 lbs/year P: 108.49 lbs/year
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	The Perry SWCD will take water samples from the petition ditch and wetland every two weeks. These samples will test for nitrate and phosphate levels.
criteria e	**Information and Education**	The project will be promoted to producers and other stakeholders with public meetings, news releases, social media and personal contacts from the SWCDs and NRCS.

Critical Area 2: Project 2		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	**Title**	**HSTS Replacements or Upgrades**
criteria d	**Project Lead Organization & Partners**	Fairfield, Licking and Perry SWCDs Fairfield, Licking and Perry County Health Departments
criteria c	**HUC-12 and Critical Area**	Buckeye Lake HUC-12 Critical Area 2: Home Sewage Treatment Systems
criteria c	**Location of Project**	Buckeye Lake HUC-12 On parcels containing a septic tank system
n/a	**Which strategy is being addressed by this project?**	Urban Sediment and Nutrient Reduction Strategies
criteria f	**Time Frame**	Short (1-3 Years)
criteria	**Short Description**	Leaking septic tanks contribute to the lake's E.coli levels. Updating old units will prevent this source of nutrients from seeping into the watershed.
criteria g	**Project Narrative**	There are 31 permitted aerators in the Buckeye Lake HUC-12. Because these aerators are out-of-date, they leak waste water into the watershed, introducing a preventable source of nutrients to the lake, raising E.coli levels and to a lesser extent, contributing to algal growth. With the support of the county health departments, each aerator will be inspected for signs of failure and any found to be leaking will be upgraded to a newer model. It is estimated that at least 10 units need to be replaced currently, costing about $15,000 each, and it is likely that the process of inspection and replacement will need to be repeated a couple more times as more units continue to fail in the future.
criteria d	**Estimated Total Cost**	$150,000
criteria d	**Possible Funding Source**	County Health Departments, other local sources
criteria a	**Identified Causes and Sources**	Cause: Organic enrichment Source: Failing home sewage treatment systems
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	The goal of Critical Area 2 is to bring E.coli levels below recreational water quality limits (<161 cfu/100ml). To remove home sewage treatment systems as an impairment, all 31 aerators in the watershed will eventually need to be replaced with updated models. A process and schedule for inspection will also need to be designed to ensure that new models continue to work as intended.
	Part 2: How much of the needed improvement for the whole Critical Area is	In this project's current iteration, in which 10 of the 31 aerators are expected to be failing, 32% of the critical area will be addressed initially. In

	***estimated* to be accomplished by this project?**	the future, once the other aerators are inspected and updated, the critical area will be fully addressed.
	Part 3: Load Reduced?	This project has little impact on load reductions, but fixing the currently failing aerators is estimated to drop E.coli by 10-25%.
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	ODNR conducts bi-weekly E.coli sampling on Buckeye Lake during the summer. Concentrations will be measured and compared to past results. Additionally, the county health departments will continue doing routine inspections of home sewage treatment systems.
criteria e	**Information and Education**	The project will be promoted to producers and other stakeholders with public meetings, news releases, social media and personal contacts from the SWCDs and the county health departments.

Critical Area 3: Project 3		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	**Title**	**Honey Creek Restoration**
criteria d	**Project Lead Organization & Partners**	Perry SWCD NRCS ODA
criteria c	**HUC-12 and Critical Area**	Buckeye Lake HUC-12 Critical Area 3: Riparian Corridors
criteria c	**Location of Project**	Buckeye Lake HUC-12 Honey Creek – Main Branch
n/a	**Which strategy is being addressed by this project?**	Altered Stream and Habitat Restoration Strategies
criteria f	**Time Frame**	Short (1-3 Years)
criteria	**Short Description**	Honey Creek contributes the highest loads of suspended solids in the Buckeye Lake HUC-12. Parts of the creek are eroding rapidly and are in need of restoration. Up to 8,000 feet of Honey Creek is targeted for the application of long-term floodplain and stream restoration measures. Phase 1 is an approximately 900 feet segment downstream of Honey Creek Road.
criteria g	**Project Narrative**	The tributary with the highest loads of suspended solids in the Buckeye Lake HUC-12 is Honey Creek, accounting for 1200 kg/day. It is also the largest tributary on the east side and runs solely over agricultural grounds until it reaches the shoreline. The mid-section of Honey Creek has some of the worst erosion issues in the watershed because an old railway crosses over the stream in two separate places, and there is little native vegetation along the streambank. In the near term, approximately 900 feet of Honey Creek is targeted for restoration by re-establishing access to the floodplain, and applying natural restoration methods to stabilize the stream channel and provide a planted riparian corridor. Additional phases would be pursued as funding and land access becomes available.
criteria d	**Estimated Total Cost**	Long-term cost estimated to be $3.0 Million; the Phase 1 cost is estimated to be $320,000.
criteria d	**Possible Funding Source**	EPA 319, EQIP
criteria a	**Identified Causes and Sources**	Cause: Sedimentation Source: Eroded streambank
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	The goal of Critical Area 3 is to reduce the concentration of suspended solids coming out of Buckeye Lake's tributaries. To remove the NPS impairment for the whole area, a 40% reduction of suspended solids at the mouth of Honey Creek and Zartman Creek will have to be achieved.

	Part 2: How much of the needed improvement for the whole Critical Area is *estimated* to be accomplished by this project?	Since Honey Creek is the primary waterway on the east side of the lake, restructuring its banks will address much of the Critical Area's needs. But it is only a portion of the 15,000 or so feet of eroding streambanks in the whole watershed. It is estimated that improving 900 feet along the lower reach will resolve 11.0% of the total critical area (Honey Creek).
	Part 3: Load Reduced?	Suspended Solids: 386,535 lbs/year
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Perry SWCD will conduct regular water quality testing on Honey Creek, with suspended solid levels analyzed by a certified lab. If funded through a 319 grant, Ohio EPA will independently monitor for improvements.
criteria e	**Information and Education**	The project will be promoted to producers and other stakeholders with public meetings, news releases, social media and personal contacts from the SWCDs, NRCS, and ODA.

Critical Area 4: Project 4		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	**Title**	**Treatment Train at Brooks Park**
criteria d	**Project Lead Organization & Partners**	ODNR
criteria c	**HUC-12 and Critical Area**	Buckeye Lake HUC-12 Critical Area 4: Buckeye Lake Agriculture
criteria c	**Location of Project**	Buckeye Lake HUC-12 Brooks Park – Murphy's Run
n/a	**Which strategy is being addressed by this project?**	Agricultural Nonpoint Source Reduction Strategies
criteria f	**Time Frame**	Short (1-3 Years)
criteria	**Short Description**	A series of wetlands will be constructed at Brooks Park to capture agricultural runoff coming out of Murphy's Run.
criteria g	**Project Narrative**	To capture nutrient runoff coming out of Murphy's Run, on the west side of the lake, ODNR will be constructing a treatment train of wetlands to filter nutrients before they enter the lake. Brooks Park is a public ground, currently hosting a playground and expansive parking lot. Most of the parking lot will be removed and transformed into a series of wetlands that extend out onto an old dredge material relocation area. Murphy's Run will pass through these wetlands before discharging into the lake.
criteria d	**Estimated Total Cost**	$560,000
criteria d	**Possible Funding Source**	H2Ohio
criteria a	**Identified Causes and Sources**	Causes: Nitrates, phosphates Source: Fertilizer runoff
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	The goal of Critical Area 4 is to reduce nitrate and phosphate levels by 40%. To achieve this aim and remove the critical area as an impairment, nitrates must be reduced by 55,517.2 lbs/year and phosphates by 867.46 lbs/year.
	Part 2: How much of the needed improvement for the whole Critical Area is *estimated* to be accomplished by this project?	Filtering the nutrient pollution coming out of Murphy's Run through treatment cells will address 12.5% of the total runoff from agricultural grounds in the whole watershed.
	Part 3: Load Reduced?	N: 6,939.65 lbs/year P: 108.43 lbs/year

criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Perry SWCD will conduct regular water quality testing on the mouth of Murphy's Run, with nitrate and phosphate levels analyzed by a certified lab.
criteria e	**Information and Education**	The project will be promoted to producers and other stakeholders with public meetings, news releases, social media and personal contacts from the SWCDs and ODNR.

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Appendices

Appendix A: Acronyms and Abbreviation

The acronyms and abbreviations listed below are either common among organizations working to restore Ohio's watershed or were created for this NPS-IS plan.

<u>B</u>

BLT	Buckeye Lake for Tomorrow
BMP	Best Management Practice

<u>C</u>

COD	Chemical Oxygen Demand
CFU	Colony-forming unit
CRP	Conservation Reserve Program
CSP	Conservation Stewardship Program

<u>D</u>

DO	Dissolved Oxygen

<u>E</u>

EQIP	Environmental Quality Incentives Program
EWH	Exceptional Warmwater Habitat

<u>F</u>

FSA	Farm Service Agency

<u>H</u>

HAB	Harmful Algal Blooms
HEL	Highly Erodible Land
HSTS	Home Sewage Treatment Systems
HUC	Hydrologic Unit Code

<u>I</u>

IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index

<u>M</u>

Mg/L	Milligram per Liter
MIwb	Modified Index of Well Being
MWCD	Muskingum Watershed Conservancy District

MWH	Modified Warmwater Habitat

<u>N</u>

N	Nitrogen
NPS	Nonpoint Source
NPS-IS	Nonpoint Source Implementation Strategy
NRCS	Natural Resources Conservation Service

<u>O</u>

ODA	Ohio Department of Agriculture
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency

<u>P</u>

P	Phosphorus
PCR	Primary Contact Recreation
PNMP	Precision Nutrient Management Plan

<u>Q</u>

QHEI	Qualitative Habitat Evaluation Index

<u>R</u>

RM	River Mile

<u>S</u>

SWCD	Soil and Water Conservation District

<u>T</u>

TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load Limits
TP	Total Phosphorus

<u>U</u>

μg/L	Micrograms per Liter
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency

<u>W</u>

WWH	Warmwater Habitat
WWR	Waste Weir Run
WWTP	Wastewater Treatment Plant

Appendix B: Index of Figures and Tables

Index of Figures

Index of Tables