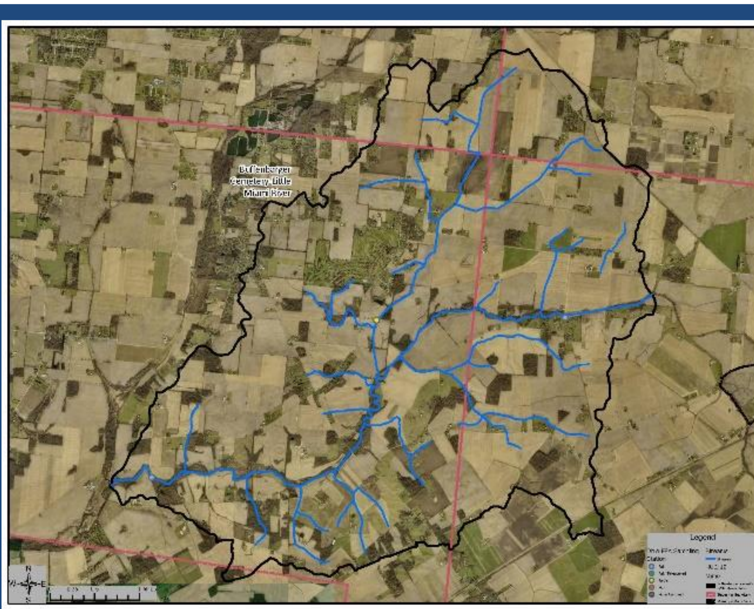
Nine-Element Nonpoint Source Implementation Strategy (NPS-IS) for the Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)



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Acronyms and Abbreviations

The acronyms and abbreviations below are commonly used by organizations working to restore Ohio's watersheds and are found throughout this NPS-IS document.

Numbers

§319	Section 319 of the Clean Water Act

A

ACPF	Agricultural Conservation Planning Framework
ALU	Aquatic Life Use

B

BMP	Best Management Practice

C

CAFF	Confined Animal Feeding Facility
CAFO	Confined Animal Feeding Operation
CDL	Crop Data Layer
CRP	Conservation Reserve Program

D

DEM	Digital Elevation Model

E

E. coli	*Escherichia coli*
ECBP	Eastern Corn Belt Plains
EPT	*Ephemeroptera, Plecoptera and Trichoptera* – sensitive macroinvertebrate species
EQIP	Environmental Quality Incentives Program
EWH	Exceptional Warmwater Habitat

F

FLS	Federally Listed Species
FOTG	Field Office Technical Guide
FSA	Farm Service Agency

G

GIS	Geographic Information Systems

H

HTF	Hypoxia Task Force
HSTS	Home Sewage Treatment System
HUC	Hydrologic Unit Code

I

IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index

M

MARB	Mississippi/Atchafalaya River Basin
MIwb	Modified Index of Well Being
MWH	Modified Warmwater Habitat

N

NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NPS-IS	Nonpoint Source-Implementation Strategy
NRCS	Natural Resources Conservation Service

O

ODA	Ohio Department of Agriculture
ODH	Ohio Department of Health
ODNR	Ohio Department of Natural Resources
Ohio EPA	Ohio Environmental Protection Agency
OLEC	Ohio Lake Erie Commission
OpTIS	Operational Tillage Information System
ORB	Ohio River Basin
ORBA	Ohio River Basin Alliance

P

PAD-US	Protected Areas Database of the United States
PCR	Primary Contact Recreation
PLET	Pollutant Load Estimation Tool
PSS	Project Summary Sheet

Q

QHEI	Qualitative Habitat Evaluation Index

R

RM	River Mile

S

SWCD	Soil and Water Conservation District

T

TLT	Tecumseh Land Trust
TMDL	Total Maximum Daily Load

U

USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

V

VRT	Variable Rate Technology

W

WASCOB	Water and Sediment Control Basin
WAP	Watershed Action Plan
WQS	Water Quality Standards (Ohio Administrative Code 3745-1)
WRP	Wetlands Reserve Program
WSRA	Wild and Scenic Rivers Act
WWH	Warmwater Habitat

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CHAPTER 1: INTRODUCTION

The **Buffenbarger Cemetery-Little Miami River Hydrologic Unit Code (HUC)-12 (05090202 01 03)** is located in southeastern Clark County and contains an area of 22.06 square miles (Figure 1). The **Buffenbarger Cemetery-Little Miami River HUC-12** contains an approximate 8.4 mile segment of the Little Miami River. The Little Miami River is Ohio's first designated National and State Scenic River and is a direct tributary to the Ohio River (ODNR, 2012). The watershed is primarily agricultural (~84%). The **Buffenbarger Cemetery-Little Miami River HUC-12** has been identified as an area of focus within the Ohio River Basin (ORB) due to the estimated loading of total nitrogen and total phosphorus that flows into the tributaries of the Ohio River, to the Mississippi River and its end-receiving waterbody, the Gulf of Mexico.

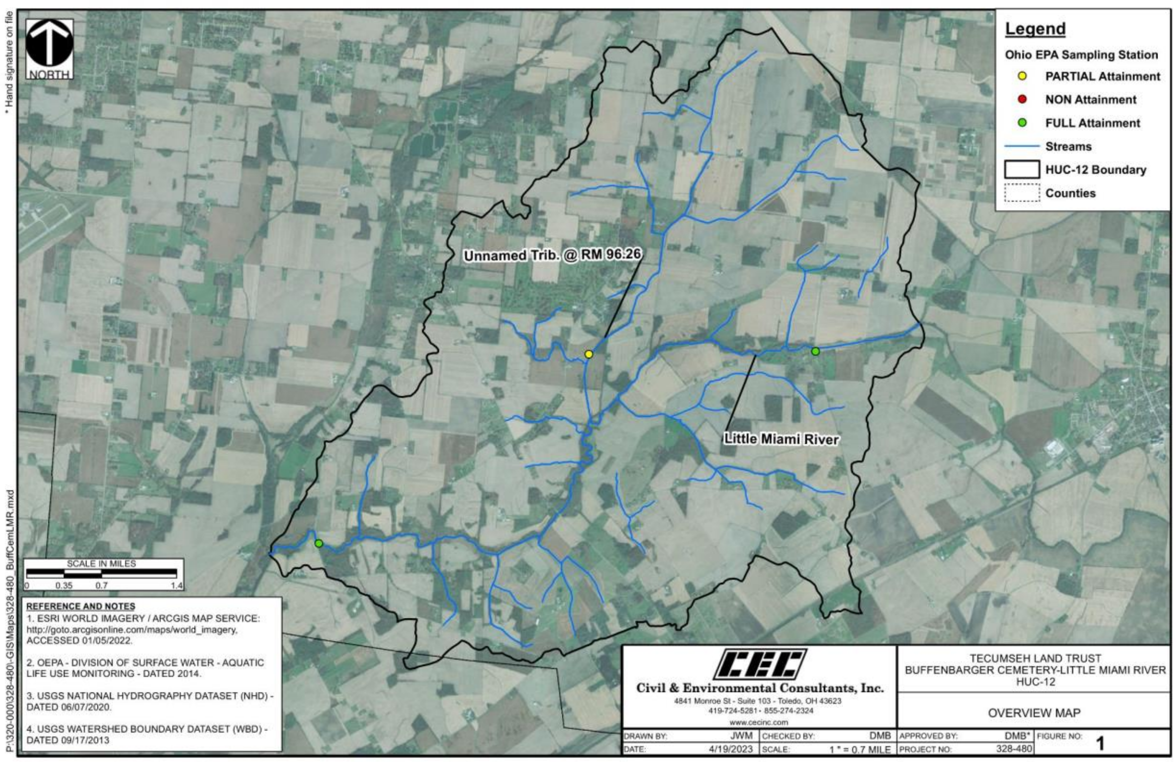

Figure 1: Buffenbarger Cemetery-Little Miami River HUC-12 Overview

1.1 Report Background

While watershed plans could be all-inclusive inventories, the US Environmental Protection Agency (USEPA) identified nine critical elements to include in strategic planning documents for impaired waters (Table 1). To ease implementation of projects addressing nonpoint source (NPS) management and habitat restoration, current federal and state NPS and habitat restoration funding opportunities require strategic watershed plans incorporate these nine key elements, concisely to HUC-12 watersheds. The Ohio Environmental Protection Agency (Ohio EPA) has historically supported watershed-based planning in many forms (Ohio EPA, 2016).

Table 1: Nine Elements for Watershed Plans and Implementation Projects

Element	Description
a	Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve load reductions
b	Load reductions expected from management measures described under element (c) below
c	Description of the NPS measures that need to be implemented to achieve load reductions estimated under element (b) above and an identification of the critical areas in which those measures will be needed to implement this plan
d	An estimate of the amounts of technical and financial assistance needed, associated costs and/or sources and authorities that will be relied upon to implement this plan
e	An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing and implementing the NPS management measures that will be implemented
f	A schedule for implementing the NPS measures identified in this plans that is reasonably expeditious
g	A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented
h	A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards
i	A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under element (h) above

(Source: USEPA, 2008)

In 1997, Ohio EPA issued guidance for the development of Watershed Action Plans (WAPs), which typically covered larger watersheds (HUC-10 to HUC-8 size). The WAPs included an outline and checklist to ensure USEPA's nine elements were included within each plan. The USEPA issued new guidance in 2013 and concluded Ohio's interpretation for WAP development did not adequately address critical areas, nor did it include an approach that detailed the nine elements at the project level (Ohio EPA, 2016). In response, Ohio EPA developed a new template for watershed planning in the form of a Nonpoint Source-Implementation Strategy (NPS-IS), ensuring NPS pollution is addressed at a finer resolution and that individual projects listed within each plan include each of the nine elements. The first NPS-IS plans were approved in 2017. Over time, these plans have evolved to not only address in-stream (near-field) water quality impairment from NPS pollution, but they also address reductions in nutrient loadings to larger bodies of water (far-field).

Hypoxia Task Force

The State of Ohio is an active participant in the Mississippi River/Gulf of Mexico Hypoxia Task Force (HTF), a multi-state agency effort established in 1997 to understand the causes and effects of eutrophication in the Gulf of Mexico and coordinate activities throughout the Mississippi/Atchafalaya River Basin (MARB) to reduce the size, severity and duration and ameliorate the effects of hypoxia within the Gulf (USEPA, 2020). The 2007 Mississippi River Basin Science Advisory Committee recommended a reduction in total nitrogen and total phosphorus from baseline values calculated from 1980 to 1996 by 45% to reduce the hypoxic zone within the Gulf of Mexico to a five year running average of 5,000 km^2 (USEPA, 2007). The HTF has accepted this recommendation and outlined an interim goal to reduce nutrient loading from major sources of nitrogen and phosphorus in the MARB by

20% by 2025 and 45% by 2035 (HTF, 2014; USEPA, 2017). Ohio EPA's *Nutrient Mass Balance Study for Ohio's Major Rivers* (2022) has identified high nitrogen and phosphorus loads within the Ohio portion of the ORB, particularly from the Little Miami River watersheds, citing 68% of the nitrogen load and 77% of the phosphorus load in this watershed is from NPS contributions (Ohio EPA, 2022b).

Through the *State of Ohio's Domestic Action Plan*, state agencies modeled and estimated nutrient loads for NPS classifications (agricultural, home sewage treatment system (HSTS) and urban contributions) at the HUC-12 level within the northwestern portion of the state, underlining the state's commitment to nutrient reduction from all landscapes (OLEC, 2020). While this level of modeling has not yet occurred within the ORB, approximate loads from agricultural and urban landscapes, based upon nutrient loss literature and *Mass Balance* results, have been estimated for select HUC-12s within the ORB, including those in the Upper Scioto, Great Miami River, Little Miami River and Paint Creek watersheds as a beginning step in setting reduction targets to make progress towards HTF goals (Ohio EPA, 2021).

The Little Miami Scenic River

The Wild and Scenic Rivers Act (WSRA) was created by Congress in 1968 to preserve rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations (National Wild and Scenic Rivers System, 2022). Rivers classified as Scenic River Areas are those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped. Prior to legislation that created wild, scenic, and recreational rivers, there was state and local interest in protecting the Little Miami River. The Ohio Department of Natural Resources (ODNR) asked the Ohio University Planning Institute in 1966 to study the Little Miami and the proposed legislation (ODNR, 2012).

Since then, the Little Miami River has achieved both Scenic and Recreational status within the National Wild and Scenic Rivers System. Approximately 94 miles of the Little Miami River was designated between the years of 1973 and 1981 with 18.0 miles designated as Scenic and 76.0 miles as Recreational. In the state Scenic River system, approximately 105 miles have been designated as scenic, from the headwaters (including North Fork) to the confluence with the Ohio River (ODNR, 2023a).

Historical planning efforts in the Little Miami watershed have focused on the East Fork of the river, and with the transition from WAPs to NPS-IS, efforts in the watershed have been mainly led in the Caesar Creek watershed (upper section) and in the East Fork sub-basin. However, stakeholders within the region hope to focus planning efforts in every HUC-12 within the Little Miami watershed, in order to best protect this high-quality water.

Buffenbarger Cemetery-Little Miami River HUC-12 NPS-IS

The development of NPS-IS in watersheds contained within the ORB is critical to the efforts focused on implementing the HTF's goal to reduce nutrient loadings from major sources of nitrogen and phosphorus to the Gulf, as well as to meet state water quality standards and local goals. Development of NPS-IS within Ohio's portion of the ORB also aligns with goals established by the Ohio River Basin Alliance (ORBA) for abundant clean water and healthy and productive ecosystems in the Ohio River

(USACE, 2020). The *Buffenbarger Cemetery-Little Miami River HUC-12 NPS-IS* will address NPS pollution by accounting for both near-field (within stream/watershed) and far-field (loadings to the Ohio River) effects. The development of this NPS-IS is one of two sponsored by the Tecumseh Land Trust (TLT) in collaboration with local partners under an Ohio EPA subgrant from the HTF.

Removal of NPS impairments and reduction in overall sediment and nutrient loss, particularly in the rural environment; restoration and reconnection of streambanks, floodplains and wetlands; and management and treatment of stormwater within the **Buffenbarger Cemetery-Little Miami River HUC-12** is crucial to the attainment of aquatic life use (ALU) standards within the Little Miami River and its headwater tributaries, but also within the greater Little Miami watershed, and on a grander scale, within the context of the Ohio River watershed, the Mississippi River and its end-receiving waterbody, the Gulf of Mexico. Within the **Buffenbarger Cemetery-Little Miami River HUC-12**, three biological sample locations were established (two in the Little Miami River and one in an Unnamed Tributary to the Little Miami River @River Mile (RM) 96.26) during the sampling study conducted in 2011-2012.

The two sampling locations within the Little Miami River were found to be in *Full Attainment* of the Warmwater Habitat (WWH) designation. The Unnamed Tributary to the Little Miami River @RM 96.26 was found to be in *Partial Attainment* of its WWH designation at one location due to habitat alterations from channelization and flow or habitat conditions from natural sources. Additionally, two sample locations in the Little Miami River were found to be in *Non-Attainment* of the Primary Contact Recreation (PCR) use designation for Class A streams due to agricultural runoff and biosolids applications.

This NPS-IS will be used to strategically identify and outline key projects that should be implemented within the **Buffenbarger Cemetery-Little Miami River HUC-12** to address management of NPS pollution to not only attain Water Quality Standards (WQS) within the sub-watershed boundaries, but to also make progress towards far-field watershed goals on a larger scale within the greater ORB, MARB and Gulf of Mexico.

1.2 Watershed Profile & History

The land area contained within the **Headwaters Little Miami River HUC-12** is part of the larger Little Miami watershed (05090202) (Figure 2). The Little Miami watershed is located in the southwestern region of Ohio and drains approximately 1,758 square miles (1,125,044 acres). The Little Miami River is approximately 107.6 miles in length[1], flowing from its headwaters in southeastern Clark County southwesterly through five counties to empty into the Ohio River near Cincinnati. Along its course, the watershed is broken into three main basins: the Upper Little Miami, the Lower Little Miami and the East Fork Miami River. The Upper Little Miami River watershed includes tributary sub-basins for the North Fork Little Miami River, Massies Creek, Beaver Creek, Little Beaver Creek, Shawnee Creek and Caesar Creek.

[1] The *Ohio Gazetteer of Streams* (ODNR, 2001) lists the Little Miami River as 105.5 miles in length; however, the *River Mile Index* (Ohio EPA, 2022c) shows the Little Miami River with a length of ~107.6 miles.

The **Buffenbarger Cemetery-Little Miami River HUC-12** is located within the *Headwaters Little Miami River HUC-10* and contains approximately 8.36 miles of the Little Miami River from its confluence with Lisbon Fork at RM 100.0 to its confluence with the North Fork Little Miami River at RM 91.64 (Table 2).

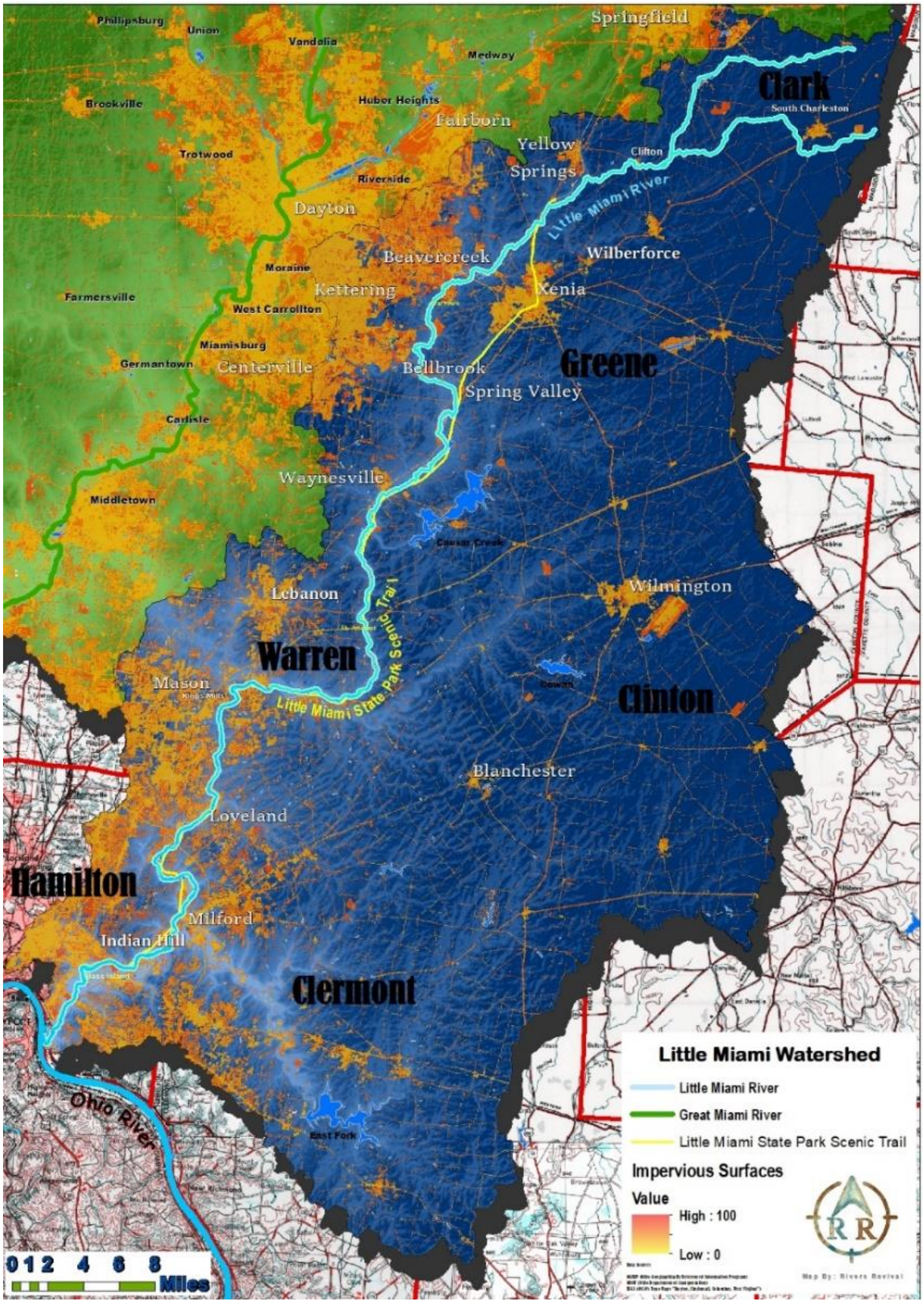

Figure 2: Little Miami Watershed[2]

[2] Map provided by the Little Miami Watershed Network.

Table 2: Sub-watersheds in the Headwaters Little Miami River HUC-10

Headwaters Little Miami River HUC-10 (05090202 01)		
HUC-12	**Area (Square miles)**	**Area (Acres)**
Headwaters Little Miami River HUC-12 (01)	31.25	20,003
North Fork Little Miami HUC-12 (02)	35.70	22,848
Buffenbarger Cemetery-Little Miami River HUC-12 (03)	22.06	14,115
Yellow Springs Creek-Little Miami River HUC-12 (04)	39.60	25,341

(Source: Ohio EPA, 2020a)

1.3 Public Participation and Involvement

Watershed planning is best accomplished by collaboration and input from a diverse group of entities, including governmental agencies, private businesses, academia, non-profit groups, neighborhood organizations and the public at large. The TLT is a non-profit conservation organization that preserves farmland, water resources, and natural areas in Clark and Greene counties. TLT's mission is to conserve rich, fertile agricultural land, protect the viability of agriculture and maintain a diverse environment by protecting natural habitat for plants and wildlife. Since 1990, TLT has preserved over 35,000 acres with conservation easements and works to engage the public about natural habitats, agriculture, and water protection.

The TLT brought organizational stakeholders together for a planning meeting on April 20, 2023. Attendees represented the following organizations:

- Clark County Engineers Office;
- Clark Soil and Water Conservation District (SWCD);
- United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS);
- ODNR Division of Forestry; and,
- ODNR Scenic Rivers.

Additionally, TLT hosted landowners enrolled in its internal conservation network for an informational meeting on June 23, 2023. Input and feedback was solicited from these stakeholders to help guide and formulate critical areas and potential projects within the **Buffenbarger Cemetery-Little Miami River HUC-12**. Chapters 1, 2 and 3 were primarily prepared using the *2022 Ohio Integrated Report* (Ohio EPA, 2022a), the *Biological and Water Quality Study of the Upper Little Miami River, 2011, EAS/2013-05-06* (Ohio EPA, 2014) and the *Water Quality and Hydrologic Units in Ohio Interactive Map* (Ohio EPA, 2023c). Project information for Chapter 4 was compiled by collaborative outreach with organizational stakeholders and community partners.

CHAPTER 2: HUC-12 WATERSHED CHARACTERIZATION AND ASSESSMENT SUMMARY

2.1 Summary of HUC-12 Watershed Characterization

2.1.1 Physical and Natural Features

The *Headwaters Little Miami River HUC-10* is comprised of four HUC-12 watersheds; this document focuses on the #03 hydrologic unit—the **Buffenbarger Cemetery-Little Miami River HUC-12**. The Little Miami River is the primary stream within the sub-watershed, flowing from its confluence with Lisbon Fork at RM 100.0 southwesterly to the confluence with the North Fork Little Miami River at RM 91.64. The Little Miami River is approximately 107.6 miles long, has an average gradient of 6.5 feet/mile, drains 1,758 square miles and eventually drains into the Ohio River at RM 519.93 (ODNR, 2001; Ohio EPA, 2023b). Within the **Buffenbarger Cemetery-Little Miami River HUC-12**, the Little Miami River drains an area of 22.06 square miles (14,115 acres). In addition, approximately 36.2 miles (191,136 linear feet) of stream segments flow throughout the sub-watershed. The Unnamed Tributary of the Little Miami River @RM96.26 is small – approximately four miles long with a gradient of 11.5 ft/mi and draining an area of 7.7 square miles (ODNR, 2001; Ohio EPA, 2023b; USGS, 2023).

The **Buffenbarger Cemetery-Little Miami River HUC-12 12** is located in the Eastern Corn Belt Plains (ECBP) ecoregion (Ohio EPA, 2014). The ECBP consists of a rolling till plain with local end moraines (USEPA, 2013). The Upper Little Miami Watershed has been influenced by glaciation which left distinctive landforms and thick deposits of silt, sand, and gravel. Wisconsinan glacial deposits are extensive across the ecoregion and supported beech forests prior to settlement. Drift thicknesses occur in deposits of over 400 feet in some areas and overlay bedrock of Ordovician and Silurian age (ODNR, 2022). Deviations from this pattern occur locally as a result of the Niagara Escarpment, a distinct geological feature that creates a break in topography that can be seen in waterfalls over dolomite cliffs on Massies Creek, Anderson Fork, and the mainstem of the Little Miami River (Ohio EPA, 2014). Above this escarpment the land is more level with soils typical of glacial till, and below this break the landform has more relief with an increase in stream gradients.

Most of the Upper Little Miami watershed lies within the Loamy High Lime Till Plains, a transitional area between the Clayey High Till Plains, an area where soils are poorly drained and subject to high amounts of artificial drainage, and the Pre-Wisconsinan Drift Plains, where soils are extensively leached, acidic and nutrient poor. Soils within the Upper Little Miami Watershed are a combination of loamy glacial till, outwash deposits, thin loess over loamy glacial till, and moderately thick loess over weathered loamy glacial till (Debrewer *et al.*, 2000). Major soil series within the **Buffenbarger Cemetery-Little Miami River HUC-12** include the Kokomo and Miamian (Figure 3) (USDA-NRCS, 2019).

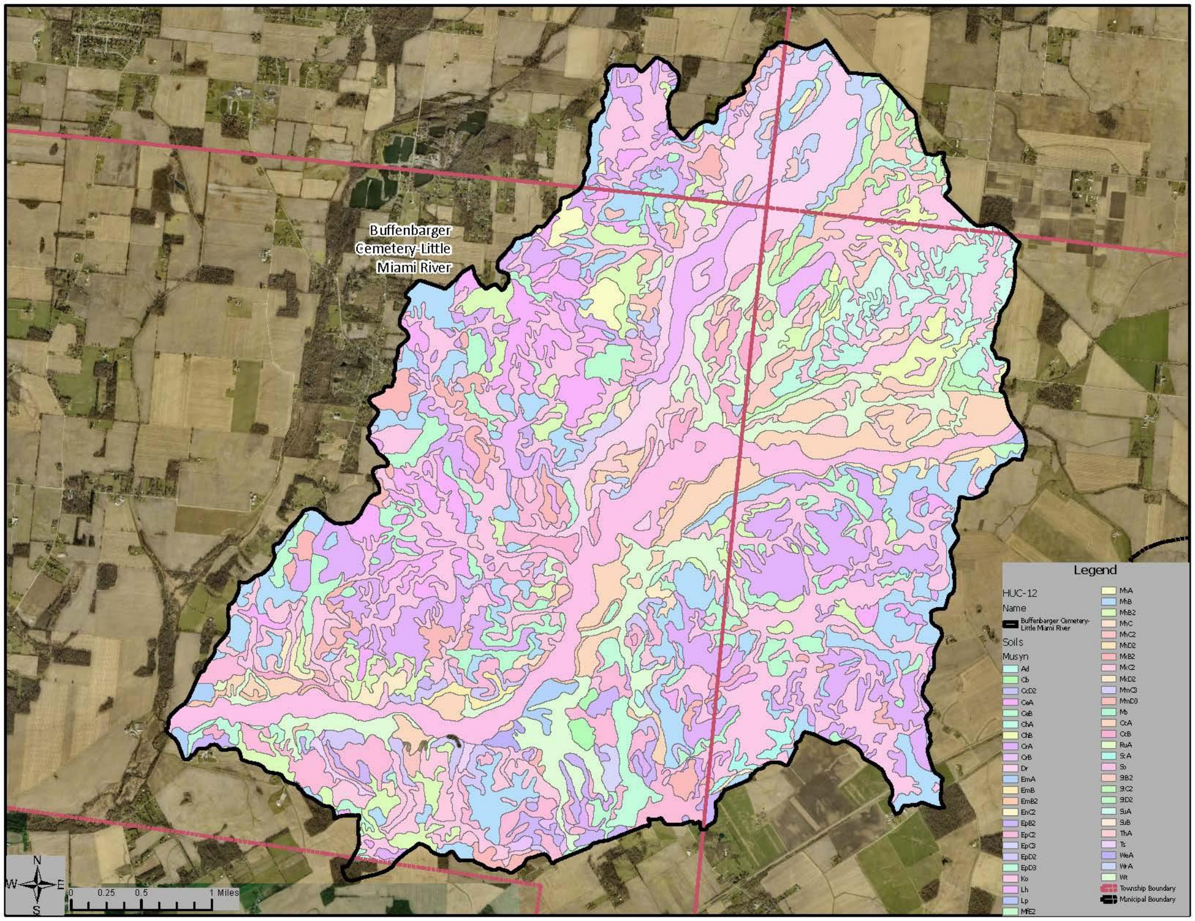

Figure 3: Soils in the Buffenbarger Cemetery-Little Miami River HUC-12

2.1.2 Land Use and Protection

Land use within the **Buffenbarger Cemetery-Little Miami River HUC-12** is fairly homogeneous, with the majority of the sub-watershed reflecting rural land uses of cultivated cropland (~78%) and hay/pasture (~6%) (Table 3). The 2017 USDA Census of Agriculture lists soybeans as the largest field crop harvested in Clark County (≥ 45%), while corn accounts for 35-44% of crops (USDA, 2019). The average farm size ranges from 180 – 499 acres. In general, livestock operations are small, and livestock inventories within Clark County have remained consistent from 2012-2017 (USDA, 2019) (Table 4). No large Concentrated Animal Feeding Operations (CAFOs) or Confined Animal Feeding Facilities (CAFFs) are currently permitted through the Ohio EPA or Ohio Department of Agriculture (ODA) within the sub-watershed (PRR, 2023).

Table 3: Land Use Classifications in the Buffenbarger Cemetery-Little Miami River HUC-12

Land Use	Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)		
	Area (mi^2)	Area (acres)	% Watershed Area
Barren Land	0.00	0.22	<0.01%
Cultivated Crops	17.31	11,083.96	78.47%
Deciduous Forest	1.73	1109.40	7.87%

Land Use	Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)		
	Area (mi^2)	Area (acres)	% Watershed Area
Developed, High Intensity	0.01	3.09	0.03%
Developed, Low Intensity	0.29	186.27	1.32%
Developed, Medium Intensity	0.07	44.88	0.32%
Developed, Open Space	1.21	775.89	5.50%
Emergent Herbaceous Wetlands	0.01	3.17	0.02%
Evergreen Forest	0.00	1.51	0.01%
Hay/Pasture	1.27	812.35	5.76%
Herbaceous	0.13	79.61	0.57%
Mixed Forest	0.02	13.90	0.10%
Open Water	0.01	4.15	0.03%
Woody Wetlands	0.00	0.00	<0.01%
Total	**22.06**	**14,118.40**	**100.00%**

(Source: Homer et al., 2020)

Table 4: Estimated Animal Counts in the Buffenbarger Cemetery-Little Miami River HUC-12

Livestock Type	Animal Units
Beef	48
Dairy	0
Swine	942
Sheep	13
Horse	68
Chicken	123
Turkey	6
Duck	8

(Source: USDA Census of Agriculture, 2012, as presented in the PLET Input Data Server (USEPA, 2023b))

Urban land use is limited in the sub-watershed (~7%), with no concentrated populations in villages or cities. The sub-watershed spans four townships in Clark County: Green, Madison, Harmony, and Springfield. A negligible portion of the sub-watershed extends into Cedarville Township in Greene County. Only a small amount of forested land (~8%) and wetlands (< 1%) are found within the **Buffenbarger Cemetery-Little Miami River HUC-12** (Figure 4 and Figure 5). There are no National Pollutant Discharge Elimination System (NPDES)-permitted facilities are located within the sub-watershed (Ohio EPA, 2023b). In the rural landscape, residences and small businesses use HSTS, which are a potential source of NPS pollution for bacteria and nutrients. Using National Small Flows Clearinghouse Data from 1992 and 1998, 49 HSTS were estimated to be within the **Buffenbarger Cemetery-Little Miami River HUC-12** (USEPA, 2023b). Studies conducted by the Ohio Department of Health (ODH) across Ohio have shown an average HSTS failure rate of 31% (ODH, 2013). Though the amount of NPS pollution from HSTS in the **Buffenbarger Cemetery-Little Miami River HUC-12** is relatively small, repair or replacement of failing HSTS or connection to sanitary sewer lines reduces the potential for NPS pollution from this source.

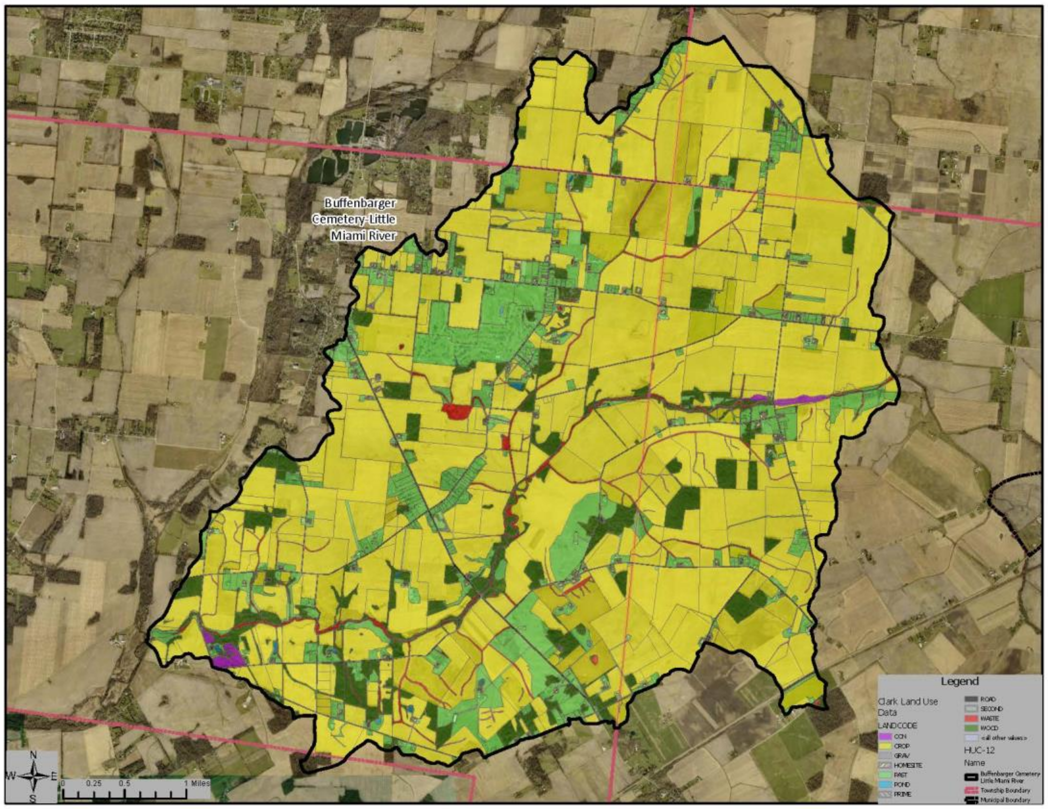

Figure 4: Land Use in the Buffenbarger Cemetery-Little Miami River HUC-12

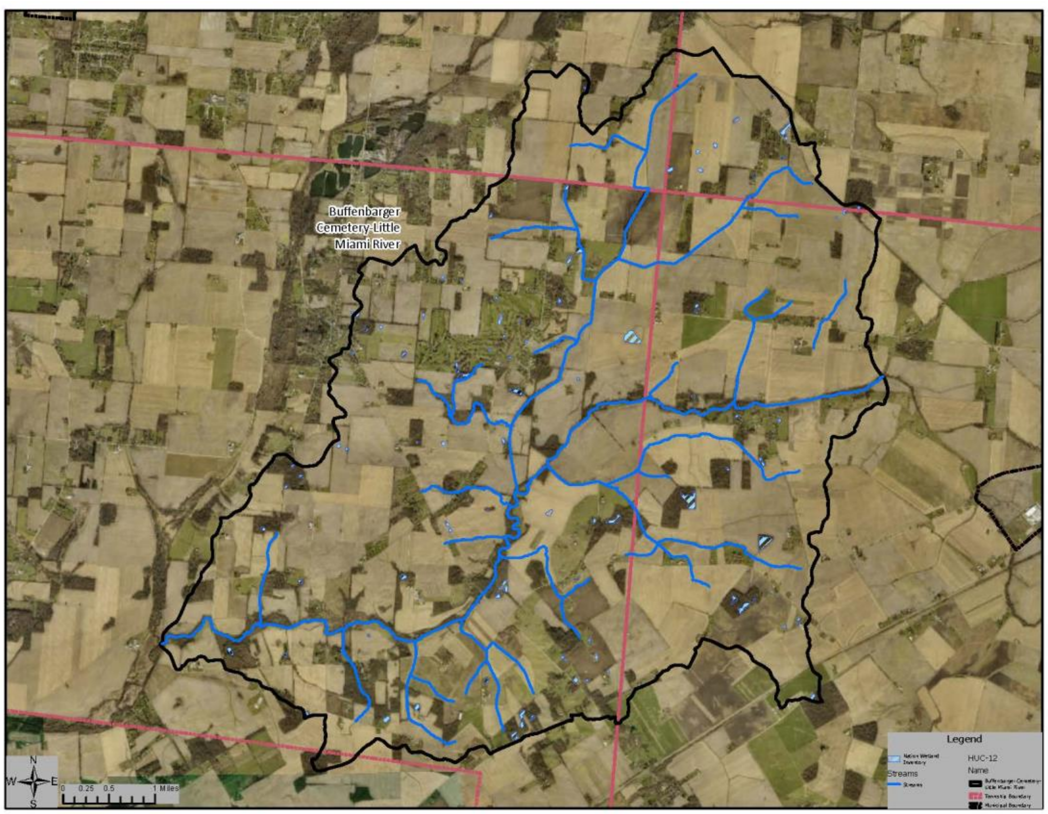

Figure 5: Wetlands in the Buffenbarger Cemetery-Little Miami River HUC-12

Some current conservation practices on agricultural lands, such as the use of conservation tillage, can be estimated at a larger watershed scale (HUC-8) from remote sensing techniques used within the Operational Tillage Information System (OpTIS) (Table 5). Summary data provided by Ohio EPA regarding the use of the Environmental Quality Incentives Program (EQIP) within the **Buffenbarger Cemetery-Little Miami River HUC-12** indicated no practices were certified or installed between March 30, 2017 and the end of 2018 (USDA-NRCS, 2018). Additional data provided by the Farm Service Agency (FSA) on current contracts within the counties of the Little Miami River watershed are found in Table 6.

Table 5: OpTIS Countywide Conservation Practice Averages for 2014-2018 for the Little Miami Watershed

Conservation Practice	% Usage
No-till conditions	37.6
Reduced till conditions	84.8
Conventional till	15.2
Winter commodity cover crop	1.7
Winter cover crop	8.2

(Source: Dagan, 2019)

Table 6: Conservation Reserve Program (CRP) Contract Acreage in Clark County

Practice	Acres*
Establishment of Permanent Introduced Grasses and Legumes	23.40
Shelterbelt Establishment	0.20
Establishment of Permanent Native Grasses	94.74
Filter Strips	170.16
Riparian Buffer	12.70
Wetland Restoration, Non-Floodplain or Tree Planting	22.21
Upland Habitat Buffers	24.23
Wildlife Habitat for Pheasants	184.10
Pollinator Habitat	20.25
Grass Waterways, Noneasement	350.96
Shallow Water Areas for Wildlife	20.00

(Source: USDA-NRCS, 2018)

NOTES

**Acres reported at the county level and may not necessarily fall within the Buffenbarger Cemetery-Little Miami River watershed boundaries.*

Parklands and recreational areas are sparse throughout the sub-watershed. The Locust Hills Golf Club, a 36-hole course, covers 300 acres within the sub-watershed. Over 2,600 acres of land are listed within the United States Geological Survey's (USGS) Protected Areas Database of the United States (PAD-US) within the **Buffenbarger Cemetery-Little Miami River HUC-12** (USGS, 2019). Most of these parcels are agricultural easements (Table 7). Those managed by TLT are shown in Figure 6.

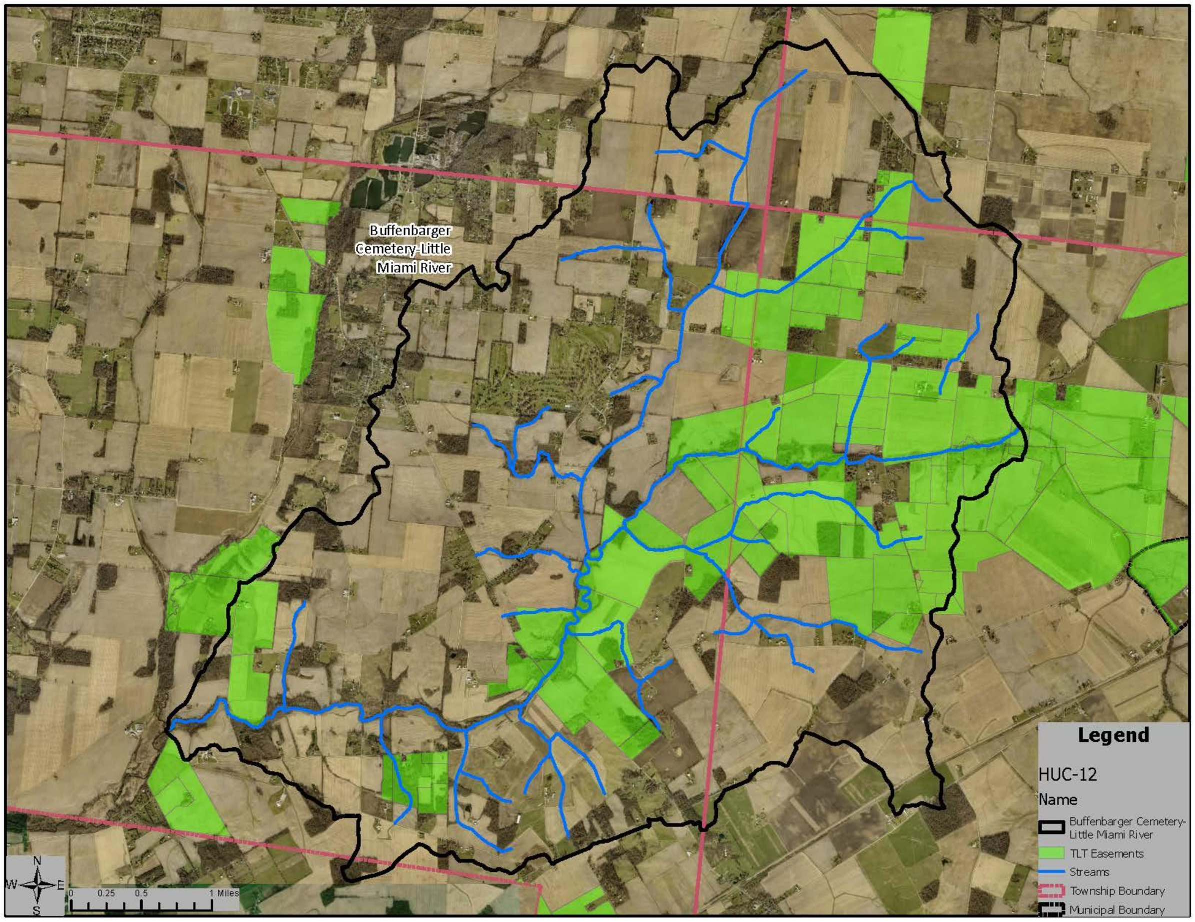

Figure 6: TLT Easements within the Buffenbarger Cemetery-Little Miami River HUC-12

Table 7: Parks and Protected Lands in the Buffenbarger Cemetery-Little Miami River HUC-12

Name	Acreage	Description
Recreation or Education Easement	24	Beavercreek Protection Project East
Agricultural Easement	61	Clean Ohio Farmland 81
Agricultural Easement	2	FRPP
Agricultural Easement	90	FRPP
Agricultural Easement	2	Clean Ohio Farmland 77
Agricultural Easement	168	Clean Ohio Farmland 69
Agricultural Easement	175	Clean Ohio Farmland 86
Conservation Easement	12	WRP
Agricultural Easement	198	FRPP
Private Park	200	Locust Hills Golf Club
Agricultural Easement	20	Clean Ohio Farmland 80
Agricultural Easement	241	FRPP
Agricultural Easement	339	FRPP
Agricultural Easement	451	Clean Ohio Farmland 78
Agricultural Easement	20	FRPP
Agricultural Easement	5	Clean Ohio Farmland 96

Name	Acreage	Description
Agricultural Easement	601	Clean Ohio Farmland 95

(Source: USGS, 2019)

NOTES
FRPP Farm and Ranch Lands Protection Program
WRP Wetlands Reserve Program

These limited amount of protected parkland inhibits habitat availability for the six federally threatened or endangered species listed by the United States Fish and Wildlife Service (USFWS) for Clark County (Table 8). The Little Miami River in Clark County is currently listed as a Group 2 stream in Appendix A of the *Ohio Mussel Survey Protocol*, indicating that the stream has the potential for mussels and the Federally Listed Species (FLS) on USFWS's listing are expected to be found. The Unnamed Tributary @RM 96.26 is not currently listed, but the drainage area of this stream is greater than five square miles. Thus, it has the potential for mussels to be present, but FLS are not expected (ODNR, 2023a).

Table 8: Threatened and Endangered Species in Clark County

Species	Status	Habitat Characteristics
Indiana bat *(Myotis sodalis)*	Endangered	Hibernates in caves and mines and forages in small stream corridors with well-developed riparian woods, as well as upland forests
Northern long-eared bat *(Myotis septentrionalis)*	Endangered*	Hibernates in caves and mines and swarms in surrounding wooded areas in autumn; roosts and forages in upland forests during late spring and summer
Eastern massasauga *(Sistrurus catenatus)*	Threatened	Wetlands and adjacent uplands
Rayed bean *(Villosa fabalis)*	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
Snuffbox Mussel *(Epioblasma triquetra)*	Endangered	Found in sand, gravel, or cobble substrates in small and medium-sized rivers
Eastern prairie fringed orchid *(Platanthera leucophaea)*	Threatened	Found in grass- and sedge-dominated plant communities ranging from mesic prairies to wetland communities.

(Source: ODNR, 2023b)

NOTES
**Listed as Threatened in the Environmental Conservation Online System (USFWS, 2023); elevated to Endangered on a national level.*

Additional points of interest throughout the **Buffenbarger Cemetery-Little Miami River HUC-12** include:

- Locust Hill Golf Course;
- Buffenbarger Cemetery;
- Vallery Family Show Pigs; and,
- Wags Inn.

2.2 Summary of HUC-12 Biological Trends

Ohio EPA sampled the Upper Little Miami River watershed in 1998 as the basis for a Total Maximum Daily Load (TMDL) study. TMDL targets were calculated for total phosphorus, ammonia and dissolved oxygen (DO). Additionally, pathogens were found to be elevated, but were not included in the TMDL report (Ohio EPA, 2002). Sampling throughout the Upper Little Miami watershed was again conducted in 2011-2012 and serves as the basis for this NPS-IS. Samples were obtained for ALU analysis from two sample locations in the Little Miami River and one location in the Unnamed Tributary to the Little Miami River @RM 96.26. A summary of sample locations is provided in Table 9. For reference, WQS for the ECBP ecoregion are presented in Table 10.

Table 9: Biological Indices Scores for Sites in Buffenbarger Cemetery-Little Miami River HUC-12

Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)							
River Mile	Drainage Area (mi²)	IBI	MIwb[a]	ICI[b]	QHEI	Attainment Status	Location
Little Miami River (WWH)							
98.98[W]	33.0	43	8.0[ns]	48	72.5	Full	Dolly Varden Road
92.27[W]	53.0	40	8.0[ns]	52	75.8	Full	Pitchin Road
Unnamed Tributary to the Little Miami River @ RM 96.26 (WWH)							
0.60[H]	6.0	30*	N/A	MG[ns]	55.5	Partial	Buffenbarger Road

(Ohio EPA, 2014)

NOTES

IBI Index of Biotic Integrity

a The Modified Index of Well Being (MIwb) is not applicable to headwater sites (drainage ≤20 mi²).

ICI Invertebrate Community Index

b Narrative evaluation used in lieu of ICI (E=Exceptional; G=Good; MG=Marginally Good; H Fair =High Fair; F=Fair; L Fair=Low Fair; P=Poor; VP=Very Poor).

QHEI Qualitative Habitat Evaluation Index

H Headwater site

W Wading site

ns Nonsignificant departure from ecoregion biocriteria (≤4 IBI or ICI units, ≤0.5 MIwb units).

** Significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units).*

N/A Not applicable

RM River Mile

WWH Warmwater Habitat

Table 10: Water Quality Standards for the Eastern Corn Belt Plains (ECBP) Ecoregion

ECBP Ecoregion	EWH WQS			WWH WQS			MWH WQS		
	Headwater	Wading	Boat	Headwater	Wading	Boat	Headwater	Wading	Boat
IBI	50	50	48	40	40	42	24	24	24
MIwb	N/A	9.4	9.6	N/A	8.3	8.5	N/A	6.2	5.8
ICI	46	46	46	36	36	36	22	22	22
QHEI[a]	75	75	75	55	60	60	43.5	43.5	43.5

(Source: Ohio EPA, 2014)

NOTES

EWH	*Exceptional Warmwater Habitat*
WWH	*Warmwater Habitat*
MWH	*Modified Warmwater Habitat*
WQS	*Water Quality Standards*
a	*QHEI is not criteria included in Ohio WQS; however, it has been shown to be highly correlated with the health of aquatic communities. In general, sites scoring 60 or above (or above 55 for headwater sites) support healthy aquatic assemblages indicative of WWH (Ohio EPA, 2013). Sites scoring 75 or above support EWH assemblages (Ohio EPA, 1999).*
N/A	*MIwb not applicable to headwater sampling locations with drainage areas ≤ 20 mi^2.*

Fishes (Modified Index of Well-Being (MIwb] & Index of Biotic Integrity [IBI])

In general, fish assemblages across the greater Little Miami River watershed improved significantly in 2011 from historical sampling conducted in 1998. However, the headwaters segment of the Little Miami River has remained mostly unchanged, due to historical channelization. In 1998, fish assemblages in this reach were either poor or marginal of the WWH biocriteria (Ohio EPA, 2014). Although the condition of the basin showed an improving trend, localized impairments caused by poor habitat were noted. Lack of riffle habitat and channelization compounded organic or nutrient enrichment signatures at some locations. Fish communities within the Unnamed Tributary to the Little Miami River @RM 96.26 were impaired by habitat alterations from channelization (Ohio EPA, 2014). Physical habitat conditions restricted this stream from supporting WWH fauna, spurred from historic modifications at the site and continued maintenance upstream (Ohio EPA, 2014).

Macroinvertebrates (Invertebrate Community Index [ICI])

Generally, benthic communities showed signs of improvement across the greater Little Miami River watershed (including in the headwaters). In 1998, six of 21 sites within the mainstem of the Little Miami River failed to meet ICI thresholds, while all sites met expectations in 2011 (Ohio EPA, 2014). An increase in qualitative *Ephemeroptera, Plecoptera and Trichoptera* (EPT) taxa by 34% spurred this improvement. Benthic communities within the Unnamed Tributary to the Little Miami River @RM 96.26 met attainment thresholds, they did so only marginally. This stream was characterized by slow flow conditions and coarse bottom substrates that allowed adequate colonization of species, including rheophilic hydropsychid caddisflies and *Baetis* mayflies (Ohio EPA, 2014).

Habitat (via Qualitative Habitat Evaluation Index [QHEI])

Ohio EPA sampling crews documented various water quality and habitat attributes during the QHEI assessment in 2011 (Table 11). Within the Upper Little Miami watershed, stream habitat was generally of higher quality, exhibiting Exceptional Warmwater Habitat (EWH) attributes at many locations, despite surrounding land use (Ohio EPA, 2014). The greater Little Miami River watershed, including the **Buffenbarger Cemetery-Little Miami River HUC-12,** is predominantly agricultural.

Generally, streams that have QHEI scores of at least 60 (55 for headwater locations) are capable of supporting WWH assemblages, and those with QHEI scores of at least 75 tend to support EWH assemblages. The presence of certain attributes is shown to have a larger negative impact on fish and macroinvertebrate communities. Streams designated as WWH should exhibit no more than four total Modified Warmwater Habitat (MWH) attributes; additionally, no more than one of those four should be of high-influence (Ohio EPA, 2014). Within the boundaries of the **Buffenbarger Cemetery-Little Miami River HUC-12**, MWH attributes were present in abundance at the Dolly Varden Road (RM 98.98) sampling location and within the Unnamed Tributary to the Little Miami River @RM 96.26, despite QHEI scores that exceed the recommended threshold for WWH streams.

In the headwaters reach of the Little Miami River, where it is designated as WWH, positive QHEI attributes outnumbered negative attributes. Negative QHEI attributes in this stretch are from channelization/impounding, landscape-level modification, and a history of in-stream modifications. Improved QHEI scores have come from recovery from historical channelization, which is largely a result of stream power (gradient and flow volume) and available bed material. Despite low sinuosity in the headwaters locations, further, passive recovery is possible (Ohio EPA, 2014). Akin to the Little Miami River, a history of modification exists for the Unnamed Tributary to the Little Miami River @RM 96.26, specifically at the sample site, along with maintenance that continues upstream today (Ohio EPA, 2014).

Table 11: QHEI Matrix with WWH and MWH Attribute Totals for Sites in the Buffenbarger Cemetery-Little Miami River HUC-12

Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)																																	
Key QHEI Components			WWH Attributes											MWH Attributes																			
														High Influence						Moderate Influence													
River Mile	QHEI Score	Gradient (ft/mi)	Not Channelized or Recovered	Boulder/Cobble/Gravel Substrate	Silt Free Substrates	Good/Excellent Development	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Embeddedness	Max Depth >40 cm	Low/No Riffle/Run Embeddedness	WWH Attributes	Channelized/No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth <40 cm	High-Influence MWH Attributes	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrate (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1 or 2 Cover Types	Intermediate/Poor Pools	No Fast Current	High/Moderate Embeddedness	High/Moderate Riffle Embeddedness	No Riffle	Moderate-Influence MWH Attributes
Little Miami River (WWH)																																	
98.98^{W}	72.5	8.47	•	•		•	•	•	•	•	•	•	**9**						**0**	•	•								•	•		**4**
92.27^{W}	75.8	5.59	•	•		•	•	•	•	•	•	•	**9**						**0**										•	•		**2**
Unnamed Tributary to the Little Miami River @ RM 96.26 (WWH)																																	
0.60^{H}	55.5	5.81						•			•		**2**						**0**	•	•			•	•			•	•	•		**7**

(Ohio EPA, 2014)

NOTES

QHEI Qualitative Habitat Evaluation Index
H Headwater site
W Wading site
WWH Warmwater Habitat

2.3 Summary of HUC-12 Pollution Causes and Associated Sources

As shown in the 2011 *Biological and Water Quality Study of the Upper Little Miami River*, two biological sampling sites in the Little Miami River in the **Buffenbarger Cemetery-Little Miami River HUC-12** are in *Full Attainment* of the WWH designation, while one sampling location in the Unnamed Tributary to the Little Miami River @RM 96.26 is in *Partial Attainment* due to direct habitat alterations from channelization, with some impairment attributed to flow or habitat conditions from natural sources (Table 12). Continued excessive sedimentation from channelization and the stream's inability to assimilate nutrient loss from land use practices within the sub-watershed's boundaries is a concern that could potentially impede progress towards attainment of WQS.

Loss of sediment from the surrounding landscape also implies loss of nutrients, including nitrogen and phosphorus, as a fraction of these nutrients introduced to the landscape through fertilization techniques and other sources bind to soil particles. As soil particles are lost to local waterways, nutrients can become available for microorganism uptake, and in situations where nutrients concentrate and are overabundant, the risk of HAB formation increases. In addition to adsorbed nutrients, water soluble factions, particularly nitrates from the nitrification process, are prone to leaching or denitrification in saturated soil conditions (OSU Extension, 2018). Actions taken to manage nutrient-laden water by retaining it and promoting assimilation help reduce the influx of nutrients to local waterways.

Table 12: Causes and Sources of Impairments for Sampling Locations in the Buffenbarger Cemetery-Little Miami River HUC-12

Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)				
River Mile	**Primary Cause(s)**	**Primary Source(s)**	**Attainment Status**	**Location**
Little Miami River (WWH)				
98.98[W]	--	--	Full	Dolly Varden Road
92.27[W]	--	--	Full	Pitchin Road
Unnamed Tributary to the Little Miami River @ RM 96.26 (WWH)				
0.60[H]	Direct habitat alterations; natural conditions (flow or habitat)	Channelization; natural sources	Partial	Buffenbarger Road

(Ohio EPA, 2014)

NOTES
H Headwater site
W Wading site
WWH Warmwater Habitat

In addition to the near-field impairments that exist in this sub-watershed, the presence and persistence of the hypoxic zone within the Gulf of Mexico has shown the need for reduced NPS pollution, particularly in regard to nitrogen, and to a lesser extent phosphorus, throughout the entire MARB, of which the Ohio River is a main tributary. Nitrogen and phosphorus loss within the **Buffenbarger Cemetery-Little Miami River HUC-12** contribute to this far-field impairment. Sampling conducted in

2011-2012 yielded elevated nitrate-nitrite levels at all three sampling locations in the **Buffenbarger Cemetery-Little Miami HUC-12,** exceeding statewide targets (Table 13).

Table 13: Nutrient Concentrations in 2011-2012 Sampling

Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)					
River Mile	Nitrate-nitrite (mg/L)		Total Phosphorus (mg/L)		
	Geometric mean	Statewide Target	Geometric Mean	Statewide Target	TMDL Target
Little Miami River (WWH)					
98.98	3.476	1.000	0.068	0.100	0.11
92.27	3.316	1.00	0.049	0.100	0.11
Unnamed Tributary to the Little Miami River (WWH)					
0.60	1.211	1.000	0.026	0.080	0.007

(Ohio EPA, 2014)

NOTES
Values highlighted in yellow are above applicable statewide targets.

Ohio EPA has estimated nitrogen and phosphorus loadings from watersheds in targeted areas of the ORB. These estimates include a breakdown of estimated loads from contributing sources of NPS pollutants, including agricultural lands/activities and developed/urban lands (Table 14). Efforts to reduce nutrients from each of these contributing sources will focus on reaching the 20% reduction goal by 2025, as outlined by the HTF in 2014.

Table 14: Estimated Nutrient Loadings from Contributing NPS Sources in the Buffenbarger Cemetery-Little Miami River HUC-12

	Developed/Urban Load (lbs/yr)		Agricultural Load (lbs/yr)	
	Total Nitrogen	Total Phosphorus	Total Nitrogen	Total Phosphorus
Current Estimates*	7,200	450	170,000	11,000
Target Loadings	5,800	360	140,000	8,800

(Source: Ohio EPA, 2021)

NOTES
**Estimated using two significant figures*

Additionally, the **Buffenbarger Cemetery-Little Miami HUC-12** has been given a PCR designation, for which it is impaired (Table 15). Results from both sampling locations in the Little Miami indicate the 90-day geometric mean for *Escherichia (E.coli)*, a bacterial indicator organism, exceeds the WQS for PCR Class A streams. For reference, recreational use WQS are shown in Table 16.

Table 15: Recreational Water Quality Data

Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)					
River Mile	**Number of Samples**	**Geometric Mean***	**Max Value***	**Attainment Status**	**Suspected Sources**
Little Miami River (PCR-Class A)					
98.98	9	410	6,600	Non	Agricultural runoff, biosolids application
92.27	8	602	4,500	Non	Agricultural runoff, biosolids application

(Ohio EPA, 2014)

NOTES
* *Values are expressed as colony forming units or most probable number per 100 mL of water*
Values in red are above the WQS criteria
N/A Not sampled

Table 16: Recreational Use Water Quality Standards

Recreation Use	Seasonal Geometric Mean*	Single Sample Maximum*
Bathing Water	126	235
Class A Primary Recreation Contact	126	298
Class B Primary Recreation Contact	161	523
Class C Primary Recreation Contact	206	940
Secondary Recreation Contact	1,030	1,030

(Source: Ohio EPA, 2014)

NOTES
* *Values are expressed as colony forming units or most probable number per 100 mL of water*

2.4 Additional Information for Determining Critical Areas and Developing Implementation Strategies

Assessment data from the 2011-2012 study and data referenced in the 2014 *Biological and Water Quality Study of the Upper Little Miami River, 2011, Technical Report EAS/2013-05-06*, the *2022 Integrated Report* and the *Water Quality and Hydrologic Units in Ohio Interactive Map* were used in the development of this NPS-IS (Ohio EPA, 2014; Ohio EPA, 2022a; Ohio EPA, 2023c). Any additional documents and/or studies created by outside organizations that were used as supplemental information to develop this NPS-IS are referenced in Chapter 5 (Works Cited), as appropriate.

CHAPTER 3: CRITICAL AREA CONDITIONS AND RESTORATION STRATEGIES

3.1 Overview of Critical Areas

Three sampling locations are within the **Buffenbarger Cemetery-Little Miami River HUC-12**. Two sampling locations in the Little Miami River are in *Full Attainment* of the WWH designation. One sampling location in the Unnamed Tributary to the Little Miami River @RM 96.26 is in *Partial Attainment* of the WWH designation due to direct habitat alterations from channelization, and some flow or habitat conditions from natural sources. Two critical areas have been identified within the **Buffenbarger Cemetery-Little Miami River HUC-12**. One critical area will address far-field impacts of nutrients and sediments eventually flowing to Little Miami River, as well as to the Ohio River, Mississippi River and Gulf of Mexico, the end receiving waterbody of drainage from the **Buffenbarger Cemetery-Little Miami River HUC-12**. A second critical area will address habitat alterations and channelization effects that contribute to near-field impairment (Figure 7)[3].

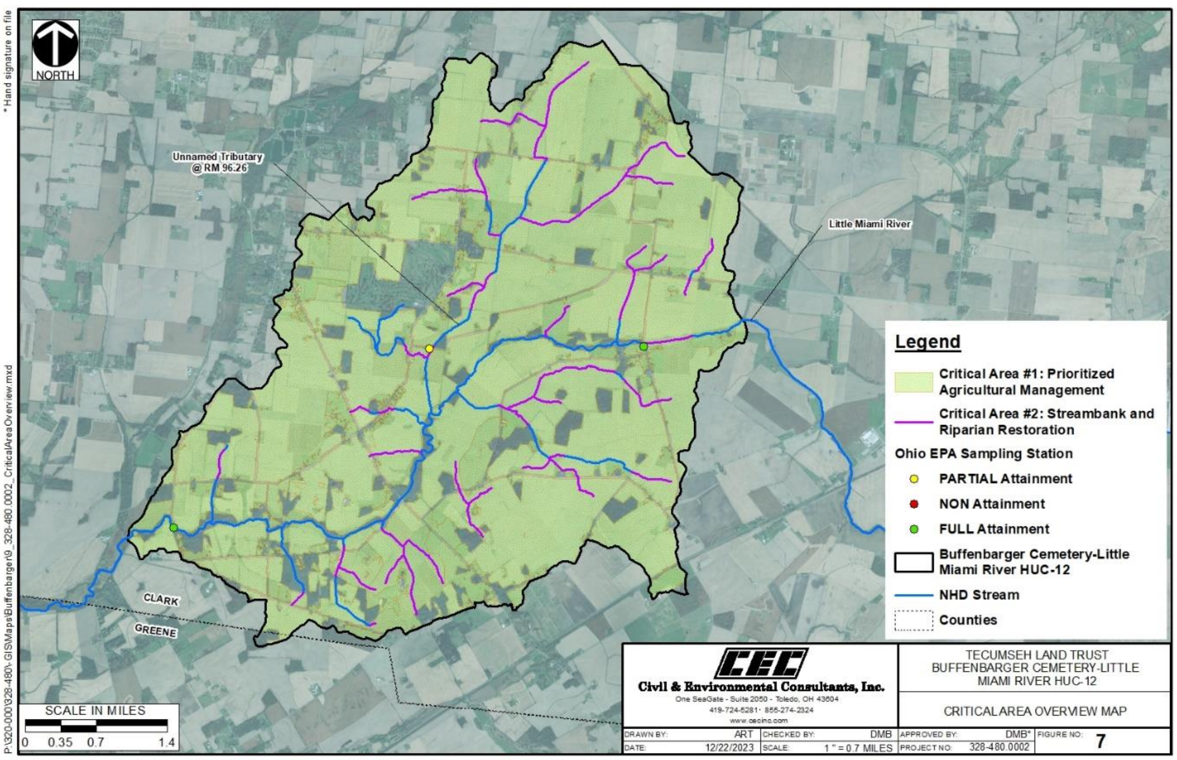

Figure 7: Buffenbarger Cemetery-Little Miami River HUC-12 Critical Area Overview

Many agricultural BMP implementation activities nested within this sub-watershed also simultaneously benefit near-field effects in Little Miami River and its tributaries through sediment reduction. Because many of these BMPs offer dual benefits of nutrient and sediment reduction and agricultural land prioritization is not substantially different for nutrient and sediment reduction within this sub-watershed, the critical area for this land use category addresses both near-field and far-field impacts

[3] Critical area maps developed with the most recently available digital geographic data and may not reflect current land use or existing conditions that have changed since digital publication.

(Table 17). Subsequently, the critical area designated for near-field impairment offers benefits to far-field receiving waterbodies through nutrient (and associated sediment) reduction opportunities. Additional critical areas may be developed in subsequent versions of this NPS-IS.

Table 17: Buffenbarger Cemetery-Little Miami River HUC-12 Critical Area Descriptions

Critical Area	Critical Area Description	NPS Pollutant Addressed	Focus Area
1	Prioritized Agricultural Lands	Sediment and nutrients	Far-field (with near-field effects)
2	Streambank and Riparian Restoration	Sediment and nutrients	Near-field

3.2 Critical Area #1: Conditions, Goals & Objectives for Prioritized Agricultural Lands

3.2.1 Detailed Characterization

Ohio's *Nutrient Mass Balance Study* (Ohio EPA, 2022b) estimated 68% of the nitrogen nutrient loading and 77% of the phosphorus nutrient loading to the Ohio River via the Little Miami River was primarily from nonpoint sources, related to land use activities, with much smaller contributions from failing HSTS and NPDES-permitted facilities. Given the dominance of agricultural land use throughout the greater Little Miami River watershed, the use of best management practices (BMPs) are recommended for agricultural operations to minimize nutrient and associated sediment loss to local waterways and drainage ditches through surface and tile flow. While BMPs are encouraged on all agricultural lands, certain lands are more prone to nutrient loss than others and are prioritized for BMP implementation. Lands maintained under conventional agricultural production or managed as pasture are prone to contribute excessive sediment and nutrient loadings to adjacent waterways that eventually flow to the ORB. Lands that are proximal to streams and ditches or do not currently implement specific BMPs are most vulnerable to excessive nutrient and sediment loss, and these lands are also prioritized as critical within this watershed. *Critical Area #1* contains prioritized agricultural lands throughout the **Buffenbarger Cemetery-Little Miami River HUC-12** (Figure 9).

An Agricultural Conservation Planning Framework (ACPF) database was assembled for the **Buffenbarger Cemetery-Little Miami River HUC-12**. The Geographic Information System (GIS)-based tool utilizes input data including a high resolution digital elevation model (DEM), the National Cropland Data Layer (CDL), parcel boundary details and detailed soil surveys to identify potential areas for conservation practices. Results from this tool informed the prioritization of critical lands and objective building (Table 18). The ACPF identified 3,512 acres of high-runoff risk fields (very high + high), which accounts for approximately 32% of all agricultural lands within the sub-watershed.

Table 18: Agricultural Conservation Planning Framework Results

Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)			
Critical Runoff Risk (acres)*			
Very High	**High**	**Moderate**	**Low**
511	3,001	4,223	4,304
Best Management Practice Output			
Best Management Practice	**Number of Potential Locations**	**Total Size**	**Treated Acreage**
Grassed waterways	--	--	--
Saturated buffers	6	--	92
Drainage water management structures	1	--	88
Bioreactors	--	--	--
Nutrient removal wetlands	27	104 acres (pool) 232 (vegetated buffer)	8,354^
Water and sediment control basin	36	--	325
Riparian Function			
Type	**Linear Feet**		
Critical Zone	6,640		
Deep Rooted Vegetation	76,791		
Multi Species Buffer	41,499		
Stiff Stemmed Grasses	1,703		
Streambank Stabilization	22,903		

(Source: ACPF model developed by Sakthi Subburayalu, Ph.D., Central State University)

NOTES

* *The ACPF model analyzes drainage area based upon high-resolution imagery. Watershed boundaries may be redrawn based upon drainage patterns and extend beyond current USGS HUC-12 boundaries; therefore, acreage may not be equal to acreage calculated for the USGS HUC-12s.*

^ *Treated wetland acres may overlap, based on placement of nutrient removal wetlands or may contain acreage outside of the HUC-12 watershed boundaries.*

-- *Data not available*

Of the 11,074 agricultural acres in the **Buffenbarger Cemetery-Little Miami River HUC-12**, prioritized lands are operations that meet one or more of the following criteria:

- Lands directly adjacent to streams or drainage waterways;
- Lands identified as high or very critical run-off risk areas by the ACPF;
- Lands in need of surface water management for runoff retention or erosion reduction, including those lands identified in the ACPF for Water and Sediment Control Basins (WASCOBs) and nutrient removal wetlands;
- Lands with uncontrolled or unfiltered subsurface drainage water, including those lands identified in the ACPF for implementation of saturated buffers, drainage water management structures and bioreactors;
- Lands without a current (<3 years) nutrient management plan or soil test; and,

- Lands in need of pasture, livestock and manure management.

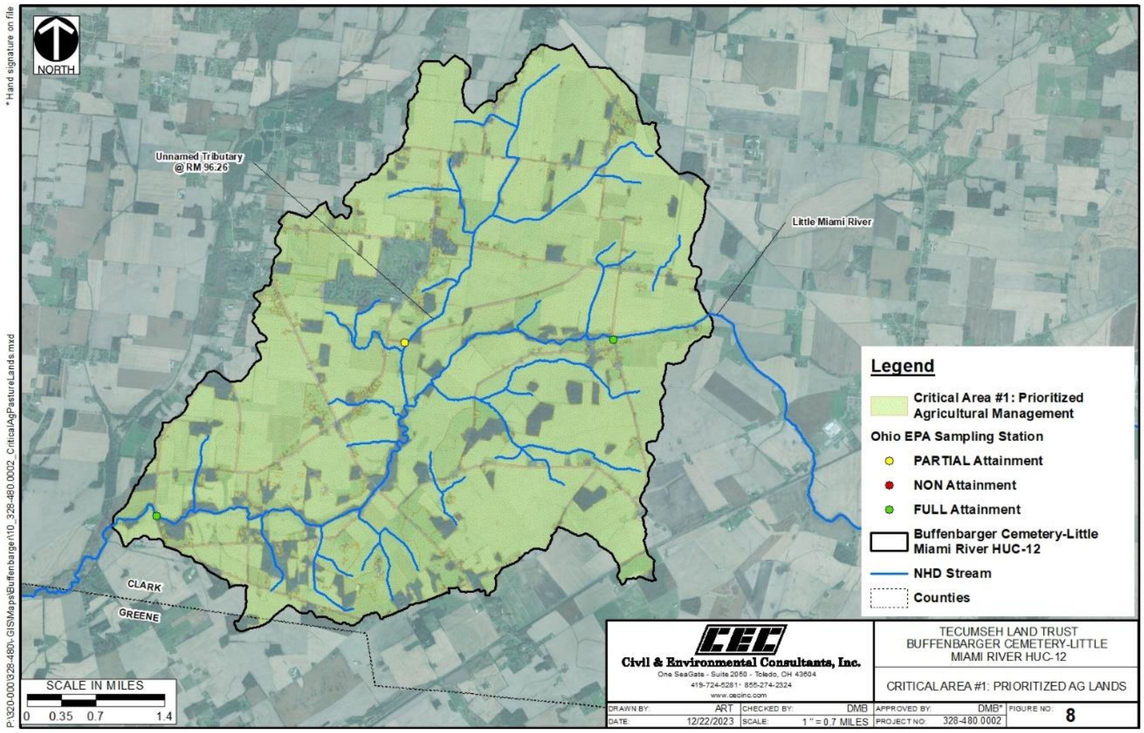

Figure 8: Buffenbarger Cemetery-Little Miami River HUC-12 Critical Area #1

3.2.2 Detailed Biological Conditions

Fish community data for the **Buffenbarger Cemetery-Little Miami River HUC-12** sampling locations are summarized below (Table 19). Analysis of the abundance, diversity and pollution tolerance of existing fish species found by Ohio EPA at each sampling location, in relation to the corresponding QHEI score, aids in the identification of causes and sources of impairment. Fish community performance in this sub-watershed has remained mostly consistent throughout historic sampling. Recovery from channelization in the headwater region of the river is in progress, but still has an impact on the river's ability to assimilate organic and nutrient loads, as evidenced at the Dolly Varden Road sampling location (RM 98.98). Reduction in discharges from upstream agribusiness and general agricultural runoff within the headwaters segment of the Little Miami is recommended to protect against further degradation caused by eutrophication (Ohio EPA, 2014).

Table 19: Critical Area #1 - Fish Community and Habitat Data

River Mile	Drainage Area (mi^2)	Total Species	QHEI	IBI	MIwb[a]	Predominant Species (Percent of Catch)	Narrative Evaluation
Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)							
Little Miami River (WWH)							
98.98[W]	33.0	21	72.5	43	8.0[ns]	Creek chub (23%), rainbow darter (18%), green sunfish (12%)	Good – Marginally Good
92.27[W]	53.0	17	75.8	40	8.0[ns]	Central stoneroller (39%), rainbow darter (21%), creek chub (14%)	Good – Marginally Good
Unnamed Tributary to the Little Miami River @ RM 96.26 (WWH)							
0.60[H]	6.0	12	55.5	30*	N/A	Creek chub (27%), white sucker (22%), orangethroat darter (21%)	Fair

(Ohio EPA, 2014)

NOTES

IBI	*Index of Biotic Integrity*
a	*The Modified Index of Well Being (MIwb) is not applicable to headwater sites (drainage ≤20 mi^2).*
QHEI	*Qualitative Habitat Evaluation Index*
H	*Headwaters site*
W	*Wading site*
ns	*Nonsignificant departure from ecoregion biocriteria (≤4 IBI or ICI units, ≤0.5 MIwb units).*
***	*Significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units).*
RM	*River Mile*
WWH	*Warmwater Habitat*

Characteristics of the aquatic macroinvertebrate community for the **Buffenbarger Cemetery-Little Miami River HUC-12** are summarized below (Table 20). Analysis of the abundance, diversity, and pollution tolerance of existing aquatic macroinvertebrates found by Ohio EPA at these sampling locations, related to QHEI scores, can aid in the identification of causes and sources of impairment. Benthic communities performed at the Exceptional threshold, showing a substantial improvement over Little Miami River sampling locations upstream. Communities within the Unnamed Tributary to the Little Miami River @RM 96.26 did not meet the WWH expectations, related to the physical attributes of the stream and active maintenance upstream (Ohio EPA, 2014).

Table 20: Critical Area #1 - Macroinvertebrate Community Data

River Mile	ICI Score-Narrative[a]	Notes (Density of Ql./Qt.)	Predominant Species
Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)			
Little Miami River (WWH)			
98.98[W]	48 – Exceptional 18 sensitive taxa	Quantitative: 2,341 organisms per square foot	Hydropsychid caddisflies, baetid mayflies, midges, heptageniid mayflies and pleurocerid snails
92.27[W]	52 – Exceptional 26 sensitive taxa	Quantitative: 3,173 organisms per square foot	Hydropsychid caddisflies, heptageniid mayflies, *Isonychia* mayflies, waterpenny beetles and burrowing mayflies

Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)			
River Mile	ICI Score-Narrative[a]	Notes (Density of Ql./Qt.)	Predominant Species
Unnamed Tributary to the Little Miami River @ RM 96.26 (WWH)			
0.60[H]	N/A – Marginally Good[ns] 8 sensitive taxa	Moderate – low density	Snails

(Ohio EPA, 2014)

NOTES

W *Wading site*

H *Headwater site*

a *Narrative evaluation used in lieu of ICI*

ns *Nonsignificant departure from ecoregion biocriteria (≤4 IBI or ICI units, ≤0.5 MIwb units)*

N/A *Not applicable*

3.2.3 Detailed Causes and Associated Sources

Two sampling sites within the Little Miami River in the **Buffenbarger Cemetery-Little Miami River HUC-12** are currently in *Full Attainment* of the WWH designation. The Unnamed Tributary to the Little Miami River @RM 96.26 is currently in *Partial Attainment* of the WWH designation due to direct habitat alterations from channelization and habitat or flow conditions from natural sources. The data summarized previously in Table 11 (p.16) may reveal a direct link between the presence of attributes in the watershed that have influence on the aquatic communities throughout the Little Miami River and its tributaries in *Critical Area #1*. These contributing attributes in *Critical Area #1* include:

- Recovering Channel;
- Heavy/Moderate Silt Cover;
- High/Moderate Substrate Embeddedness; and,
- High/Moderate Riffle Embeddedness.

Many of the habitat attributes found during the QHEI sampling event (i.e., low sinuosity, substrate embeddedness, etc.) are likely a result of land use activities, which includes impacts from agricultural operations within the watershed. From a far-field perspective, agricultural land use activities contribute to excessive nutrient loadings to the Ohio River, eventually reaching the Mississippi River and then the Gulf of Mexico, contributing to its extensive hypoxic zone. The use of a variety of BMPs on private agricultural lands, at both in-field and edge-of-field locations can help reduce the amount and concentration of nutrient-laden surface runoff and tile drainage. Many BMPs can not only address the reduction of nutrients in surface and drainage water, but they can also simultaneously address the loss of sediment from agricultural lands, which contributes to sediment-covered substrates in local waterways. In addition, a reduction of sediment loss to local waterways can also reduce nutrient loss to near-field and far-field waterbodies, as nutrients will also adsorb to sediment particles, potentially becoming dissolved at a later time. The implementation of BMPs on agricultural lands that are prone to sediment and nutrient loss serves as a benefit for both near-field and far-field waterbodies.

3.2.4 Outline Goals and Objectives for the Critical Area

The overarching goal of any NPS-IS is to improve water quality scores in order to remove a waterbody's impairment status or protect quality areas to maintain attainment status. Agricultural land use activities in *Critical Area #1* contribute to not only near-field impairment and stressed aquatic communities in the Little Miami River and its tributaries, but also far-field impairment through excessive nutrient loss to local waterways that flow to the Ohio River. The Ohio EPA has estimated nutrient loadings associated with various land uses and sources within targeted HUC-12s in the ORB, and has set nitrogen and phosphorus reduction goals for agricultural and urban sources. To achieve the desired nutrient reductions from agricultural land use in the **Buffenbarger Cemetery-Little Miami River HUC-12**, the following interim goals have been established:

Goal 1. Reduce nitrogen loading contributions in the **Buffenbarger Cemetery-Little Miami River HUC-12** to a level at or below 140,000 lbs/year (20% reduction).
NOT ACHIEVED: Current estimated load contribution is 170,000 lbs/year.

Goal 2. Reduce phosphorus loading contributions in the **Buffenbarger Cemetery-Little Miami River HUC-12** to a level at or below 8,800 lbs/year (20% reduction).
NOT ACHIEVED: Current estimated load contribution is 11,000 lbs/year.

Simultaneous goals relate to the improvement of in-stream conditions within Little Miami River and its tributaries, in order to improve the health of aquatic communities. Implementation of BMP objectives geared towards nutrient reduction efforts will generally also help make incremental progress towards the following goals:

Goal 3. Maintain IBI score at or above 40 at Dolly Varden Road in the Little Miami River (RM 98.98).

✓ ACHIEVED: Site currently has a score of 43.

Goal 4. Achieve MIwb score at or above 8.3 at Dolly Varden Road in the Little Miami River (RM 98.98).

NOT ACHIEVED: Site currently has a score of 8.0.

Goal 5. Maintain ICI score at or above 36 (Good) at Dolly Varden Road in the Little Miami River (RM 98.98).

✓ ACHIEVED: Site currently has a score of 48.

Goal 6. Maintain QHEI score at or above 60 at State Route 41 in Dolly Varden Road in the Little Miami River (RM 98.98).

✓ ACHIEVED: Site currently has a score of 72.5.

Goal 7. Maintain IBI score at or above 40 at Pitchin Road in the Little Miami River (RM 92.27).

✓ ACHIEVED: Site currently has a score of 40.

Goal 8. Achieve MIwb score at or above 8.3 at Pitchin Road in the Little Miami River (RM 92.27).

NOT ACHIEVED: Site currently has a score of 8.0.

Goal 9. Maintain ICI score at or above 36 (Good) at Pitchin Road in the Little Miami River (RM 92.27).

✓ ACHIEVED: Site currently has a score of 52.

Goal 10. Maintain QHEI score at or above 60 at Pitchin Road in the Little Miami River (RM 98.27).

✓ ACHIEVED: Site currently has a score of 75.8.

Goal 11. Achieve IBI score at or above 40 at Buffenbarger Road in the Unnamed Tributary to the Little Miami River @ RM 96.26 (RM 0.60).

NOT ACHIEVED: Site currently has a score of 30.

Goal 12. Achieve ICI score at or above 36 (Good) at Buffenbarger Road in the Unnamed Tributary to the Little Miami River @ RM 96.26 (RM 0.60).

NOT ACHIEVED: Site currently has a score of Marginally Good (~32).

Goal 13. Maintain QHEI score at or above 55 at Buffenbarger Road in the Unnamed Tributary to the Little Miami River @ RM 96.26 (RM 0.60).

✓ ACHIEVED: Site currently has a score of 55.5.

Objectives

In order to make substantive progress toward the achievement of the annual nutrient load reduction goals of 30,000 lbs of total nitrogen and 2,200 lbs of total phosphorus for the **Buffenbarger Cemetery-Little Miami River HUC-12**, efforts must commence on more widespread implementation, according to the following objectives within *Critical Area #1.* Additionally, actions taken to address nutrient reduction will also help reduce stressors on aquatic communities within the Little Miami River and its tributaries.

Objective 1: Implement nutrient management (planning and implementation through soil testing and Variable Rate Technology (VRT)) on at least 1,000 additional acres.

Objective 2: Plant cover crops on at least 1,000 additional acres annually[4].

Objective 3: Implement conservation tillage (of at least 30% residue) on at least 500 additional acres[5].

Objective 4: Reduce nutrient loss from subsurface tile drainage through the installation of drainage water management structures that drain at least 310 acres.

Objective 5: Reduce nutrient loss from subsurface tile drainage through the installation of blind inlets that drain at least 60 acres.

Objective 6: Install nitrogen bioreactors to treat subsurface drainage from at least 30 acres.

[4] Cover crop usage is estimated to occur on approximately 375 acres, based upon OpTIS data (Dagan, 2019). Cover crop plantings may be implemented in the absence of grant funding.

[5] Current estimates indicate reduced tillage occurs on approximately 5,700 acres, based upon OpTis data (Dagan, 2019).

Objective 7: Reduce erosion and nutrient loss through the installation or rehabilitation of grassed waterways (as a standalone practice or coupled with erosion control structures/other drainage management practices) that receive/treat surface water from at least 2,500 acres.

Objective 8: Reduce erosion and nutrient loss through the installation of filter strips/buffers (of at least a 50 ft setback) or saturated buffers that receive/treat surface water from at least 250 acres.

Objective 9: Reduce erosion and nutrient loss through the installation of forested riparian buffers that receive/treat surface water from at least 20 acres.

Objective 10: Reduce erosion and nutrient loss through the installation of water and sediment control basins (WASCOBs) that receive/treat surface water from at least 400 acres.

Objective 11: Create, enhance and/or restore at least 10 acres of wetlands and/or water retention basins for treatment of agricultural runoff and/or nutrient reduction purposes from 250 total agricultural acres.

Objective 12: Reduce erosion from agricultural streambanks and drainage conveyances through natural bank stabilization or two-stage ditch design stabilization techniques on at least 4,000 linear feet (0.75 miles).

Objective 13: Increase the retirement of marginal and highly vulnerable lands by enrolling at least 10 acres into programs such as CRP and the Wetlands Reserve Program (WRP).

These objectives will be directed towards implementation on prioritized agricultural lands and are estimated to make progress towards the HTF's interim and final nutrient reduction goals (Table 21). Additional conservation activities within the **Buffenbarger Cemetery-Little Miami HUC-12**, both on priority and secondary lands, may also make incremental progress towards nutrient reduction goals. The implementation of BMPs included in these objectives, as well as BMPs implemented through federal and state programs and other voluntary efforts may be tracked to monitor progress towards nutrient reduction goals within the watershed.

Table 21: Estimated Annual Nutrient Load Reductions from Each Objective

Objective Number	Best Management Practice	Total Acreage Treated*	Estimated Annual Nitrogen Load Reduction (lbs)	Estimated Annual Phosphorus Load Reduction (lbs)
1	Nutrient Management (Planning and Implementation through Soil Testing and VRT)[a]	1,000	1,880	30
2	Cover Crops	1,000	2,600	90
3	Conservation Tillage (at least 30% residue)	500	1,340	180
4	Drainage Water Management Structures	310	1,460	10
5	Blind Inlets[b]	60	530	40
6	Bioreactors	30	170	0

Objective Number	Best Management Practice	Total Acreage Treated*	Estimated Annual Nitrogen Load Reduction (lbs)	Estimated Annual Phosphorus Load Reduction (lbs)
7	Grassed Waterways[c]	2,500	12,590	1,380
8	Filter Strips/Buffers (of at least 35 ft)[d]	250	1,310	120
9	Forested Buffers	20	140	10
10	WASCOBs	400	4,150	100
11	Wetlands[e] and/or Water Retention Basins	250[f]	1,790	110
12	Streambank Stabilization and/or Two-Stage Ditch	290[g]	2,090	170
13	Land Retirement	10	130	10
TOTAL		**6,620***	**30,180**	**2,250**

(Source Model: Pollutant Load Estimation Tool, Version 1.0, (USEPA, 2023b))

NOTES

a *Nutrient Management consists of "managing the amount (rate), source, placement (method of application) and timing of plant nutrients and soil amendments to budget, supply and conserve nutrients for plant production; to minimize agricultural nonpoint source pollution of surface and groundwater resources; to properly utilize manure or organic byproducts as a plant nutrient source; to protect air quality by reducing odors, nitrogen emissions (ammonia, oxides of nitrogen) and the formation of atmospheric particulates; and/or to maintain or improve the physical, chemical and biological condition of soil," as defined by the PLET guidance documents (USEPA, 2023a).*

b *Blind inlet phosphorus reduction efficiency estimated from values listed in Gonzalez, Smith and Livingston, 2016.*

c *Grassed waterway nitrogen reduction efficiency estimated from urban grass swale efficiency in PLET and phosphorus reduction efficiency from Ohio State University Extension, 2018.*

d *Concentrated flow must be distributed so the area can slow, filter, and/or soak in runoff. Design specifications will be Field Office Technical Guide (FOTG) 393 Filter strips/area, and/or CRP CP-11 or CP2 Filter recharge areas. Conservation Cover (FOTG 327 and CRP CP-21) would not be designed to treat contributing runoff.*

e *Nitrogen load reduction for wetlands was calculated using estimates of 14.35 lbs/acre nitrogen and 0.89 lbs/acres phosphorus for the Great Miami River watershed (Ohio EPA, 2021).*

f *If drainage water is routed through restored/created wetlands, it is assumed a 50% reduction in nitrogen and phosphorus from total nutrient yield for the drainage area, with a 25:1 ratio of drainage area to receiving wetland (Hoffmann et al., 2012; Woltemade, 2000). For this objective of 10 wetland acres, total drainage area is 250 acres.*

g *One linear foot of stream is estimated to drain 0.07 acres in this sub-watershed.*

* *More than one BMP may be implemented within fields.*

Water quality monitoring is an integral part of the project implementation process. Both project-specific and routinely scheduled monitoring will be conducted to determine progress towards meeting the goals (i.e., water quality standards and nutrient reduction targets). Through an adaptive management process, the aforementioned objectives will be reevaluated and modified as necessary. Objectives may be added to make further progress towards attainment or reduction goals, or altered, as a systems approach of multiple BMPs can accelerate the improvement of water quality conditions. The *Nonpoint Source Management Plan Update* (Ohio EPA, 2020) will be utilized as a reevaluation tool for its listing of all eligible NPS management strategies to consider including:

- Urban Sediment and Nutrient Reduction Strategies;
- Altered Stream and Habitat Restoration Strategies;

- Nonpoint Source Reduction Strategies; and,
- High Quality Waters Protection Strategies.

3.3 Critical Area #2: Conditions, Goals & Objectives for Streambank and Riparian Restoration

3.3.1 Detailed Characterization

As suggested in the 2002 TMDL study, riparian corridor restoration should occur throughout the Little Miami watershed at a rate of approximately 20 acres per year (Ohio EPA, 2002). In the absence of forested riparian corridors, streams erode downward and develop a narrow, steeply sloped bed (Montgomery County, 2006). The changing of the natural channel shape not only reduces habitat for aquatic ecosystems and causes water chemistry stress within the stream (i.e., rising temperatures within the stream due to lack of shade, DO regime swings, promotion of algal growth, etc.), but downcutting combined with large flow events often causes bank undercutting, exacerbating bank failure and streambank erosion. Habitat within the Little Miami River and its tributaries reached expected thresholds for the respective wading and headwater sampling sites; however, attributes of the streams that have a negative impact to aquatic communities include recovering channels, heavy/moderate silt cover and substrate and riffle embeddedness.

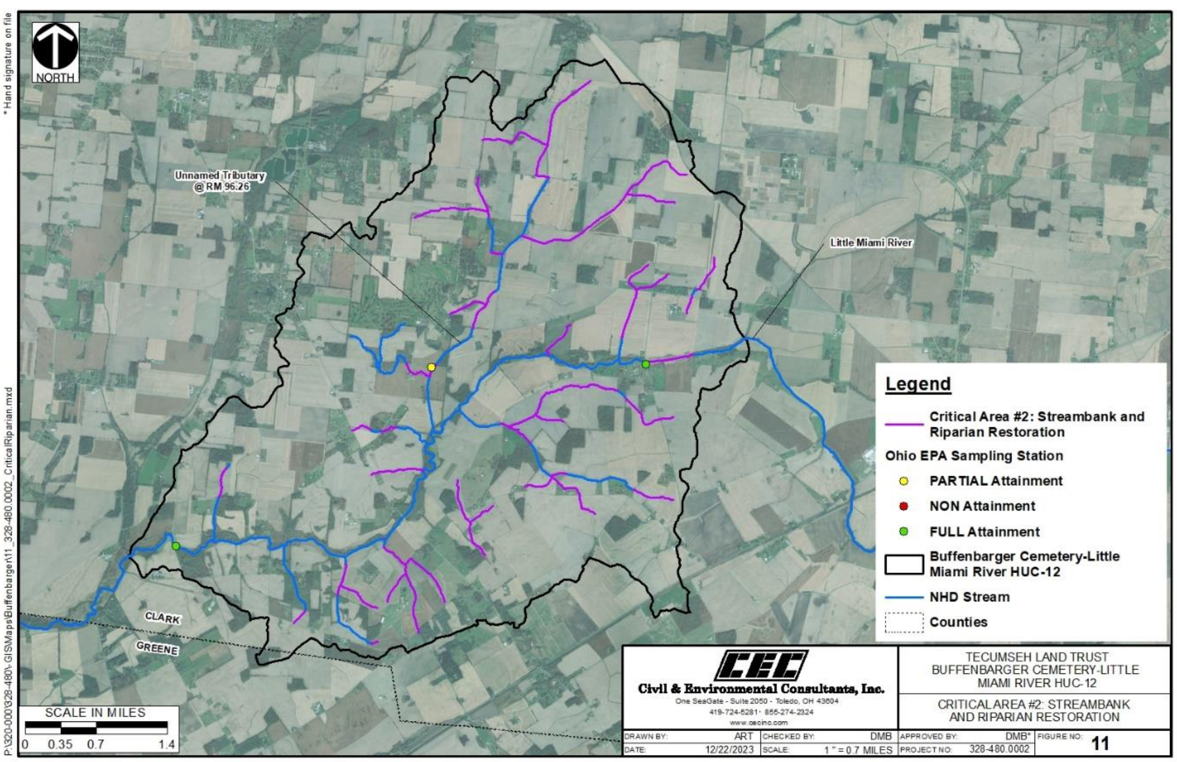

Figure 9: Buffenbarger Cemetery-Little Miami River HUC-12 Critical Area #2

in areas where land use has resulted in bare/denuded banks that are now susceptible to erosion and perennial streams have been disconnected from their floodplains. Specific actions suggested for this sub-watershed include restoring streambanks by planting native grasses, trees and shrubs throughout riparian areas; restoring floodplains and stream channels; installing in-stream structures; constructing two-stage channels; reconnecting wetlands to streams and constructing and restoring riparian wetlands. Using the rationale described in the *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (USEPA, 2008) (Section 10.3.4): "In general, management practices are implemented immediately adjacent to the waterbody or upland to address the sources of pollutant loads", *Critical Area #2* includes approximately 102,432 linear feet (19.4 miles) of stream length and a 75-foot buffer width on each side (Figure 9). The potential for restoration of approximately 350 acres of riparian corridor and floodplain exists in *Critical Area #2*.

3.3.2 Detailed Biological Conditions

Fish community data for the **Buffenbarger Cemetery-Little Miami River HUC-12** sampling locations are summarized below (Table 22). Analysis of the abundance, diversity and pollution tolerance of existing fish species found by Ohio EPA at each sampling location, in relation to the corresponding QHEI score, aids in the identification of causes and sources of impairment. Fish community performance in this sub-watershed has remained mostly consistent throughout historic sampling. Recovery from channelization in the headwater region of the river is in progress, but still has an impact on the river's ability to assimilate organic and nutrient loads, as evidenced at the Dolly Varden Road sampling location (RM 98.98). Reduction in discharges from upstream agribusiness and general agricultural runoff within the headwaters segment of the Little Miami is recommended to protect against further degradation caused by eutrophication (Ohio EPA, 2014).

Table 22: Critical Area #2 - Fish Community and Habitat Data

Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)							
River Mile	**Drainage Area (mi^2)**	**Total Species**	**QHEI**	**IBI**	**MIwb[a]**	**Predominant Species (Percent of Catch)**	**Narrative Evaluation**
Little Miami River (WWH)							
98.98[W]	33.0	21	72.5	43	8.0[ns]	Creek chub (23%), rainbow darter (18%), green sunfish (12%)	Good – Marginally Good
92.27[W]	53.0	17	75.8	40	8.0[ns]	Central stoneroller (39%), rainbow darter (21%), creek chub (14%)	Good – Marginally Good
Unnamed Tributary to the Little Miami River @ RM 96.26 (WWH)							
0.60[H]	6.0	12	55.5	30*	N/A	Creek chub (27%), white sucker (22%), orangethroat darter (21%)	Fair

(Ohio EPA, 2014)

NOTES

IBI *Index of Biotic Integrity*

a *The Modified Index of Well Being (MIwb) is not applicable to headwater sites (drainage ≤20 mi^2).*

QHEI *Qualitative Habitat Evaluation Index*

H *Headwaters site*

W *Wading site*

ns *Nonsignificant departure from ecoregion biocriteria (≤4 IBI or ICI units, ≤0.5 MIwb units).*

* *Significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units).*

RM River Mile
WWH Warmwater Habitat

Characteristics of the aquatic macroinvertebrate community for the **Buffenbarger Cemetery-Little Miami River HUC-12** are summarized below (Table 23). Analysis of the abundance, diversity, and pollution tolerance of existing aquatic macroinvertebrates found by Ohio EPA at these sampling locations, related to QHEI scores, can aid in the identification of causes and sources of impairment. Benthic communities performed at the Exceptional threshold, showing a substantial improvement over Little Miami River sampling locations upstream. Communities within the Unnamed Tributary to the Little Miami River @RM 96.26 did not meet the WWH expectations, related to the physical attributes of the stream and active maintenance upstream (Ohio EPA, 2014).

Table 23: Critical Area #2 - Macroinvertebrate Community Data

Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03)			
River Mile	**ICI Score-Narrative[a]**	**Notes (Density of Ql./Qt.)**	**Predominant Species**
Little Miami River (WWH)			
98.98[W]	48 – Exceptional 18 sensitive taxa	Quantitative: 2,341 organisms per square foot	Hydropsychid caddisflies, baetid mayflies, midges, heptageniid mayflies and pleurocerid snails
92.27[W]	52 – Exceptional 26 sensitive taxa	Quantitative: 3,173 organisms per square foot	Hydropsychid caddisflies, heptageniid mayflies, *Isonychia* mayflies, waterpenny beetles and burrowing mayflies
Unnamed Tributary to the Little Miami River @ RM 96.26 (WWH)			
0.60[H]	N/A – Marginally Good[ns] 8 sensitive taxa	Moderate – low density	Snails

(Ohio EPA, 2014)
NOTES
W Wading site
H Headwater site
a Narrative evaluation used in lieu of ICI
ns Nonsignificant departure from ecoregion biocriteria (≤4 IBI or ICI units, ≤0.5 MIwb units)
N/A Not applicable

3.3.3 Detailed Causes and Associated Sources

Two sampling sites within the Little Miami River in the **Buffenbarger Cemetery-Little Miami River HUC-12** are currently in *Full Attainment* of the WWH designation. The Unnamed Tributary to the Little Miami River @RM 96.26 is currently in *Partial Attainment* of the WWH designation due to direct habitat alterations from channelization and habitat or flow conditions from natural sources. The data summarized previously in Table 11 (p.16) may reveal a direct link between the presence of attributes in the watershed that have influence on the aquatic communities throughout the Little Miami River and its tributaries in *Critical Area #2*. These contributing attributes in *Critical Area #2* include:

One sampling site in the **Buffenbarger Cemetery-Little Miami River HUC-12** is currently in *Partial Attainment* of the WWH designation due to direct habitat alterations and natural conditions caused by channelization and natural sources. The data summarized previously in Table 14 (p.23) may reveal a direct link between the presence of attributes in the watershed that have influence on the aquatic communities throughout Little Miami River and its tributaries in *Critical Area #2*. These contributing attributes in *Critical Area #2* include:

- Recovering Channel;
- Heavy/Moderate Silt Cover;
- High/Moderate Substrate Embeddedness; and,
- High/Moderate Riffle Embeddedness.

Despite relatively good habitat across this sub-watershed (QHEI = 55.5 – 75.8), fish and macroinvertebrate under performance and marginal performance was observed in both the Little Miami River and its Unnamed Tributary. Channelization and denuded riparian corridors in agricultural headwaters expose streambanks, exacerbating silt cover and riffle/substrate embeddedness. Floodplain reconnection and/or the restoration of a floodplain bench would allow for nutrients and associated sediments to attenuate on the land, and stabilizing streambanks and replanting riparian corridors would reduce nutrients and excess sediments from entering the aquatic ecosystem. Habitat, as scored by the QHEI, is not a WQS; however, habitat is highly correlated with the performance of aquatic communities. In general, sites that score at least 60 (or 55 for headwater streams) are successful at supporting WWH aquatic assemblages; sites scoring at least 75 are generally supporting EWH aquatic assemblages. Projects that address the above described habitat-related attributes (e.g., low sinuosity, substrate/riffle development, etc.) through streambank stabilization and in-stream and riparian restoration will have a positive effect in the QHEI scoring index. As the habitat score (QHEI) becomes better, IBI, MIwb and ICI index scores are also expected to improve.

3.3.4 Outline Goals and Objectives for the Critical Area

The overarching goal of any NPS-IS is to improve water quality scores or meet nutrient reduction goals in order to remove a waterbody's impairment status. For *Critical Area #2,* addressing streambank and riparian habitat conditions within the Little Miami River and its contributing tributaries will help ameliorate stresses from land use and boost index values for aquatic communities.

The remaining goals for *Critical Area #2* of the **Buffenbarger Cemetery-Little Miami River HUC-12** are to reduce sedimentation (and associated nutrient) effects to improve the aquatic scores through stabilizing streambanks and restoring floodplains and riparian corridors. These goals are to specifically:

Goal 1. Maintain IBI score at or above 40 at Dolly Varden Road in the Little Miami River (RM 98.98).

✓ ACHIEVED: Site currently has a score of 43.

Goal 2. Achieve MIwb score at or above 8.3 at Dolly Varden Road in the Little Miami River (RM 98.98).

NOT ACHIEVED: Site currently has a score of 8.0.

Goal 3. Maintain ICI score at or above 36 (Good) at Dolly Varden Road in the Little Miami River (RM 98.98).

✓ ACHIEVED: Site currently has a score of 48.

Goal 4. Maintain QHEI score at or above 60 at State Route 41 in Dolly Varden Road in the Little Miami River (RM 98.98).

✓ ACHIEVED: Site currently has a score of 72.5.

Goal 5. Maintain IBI score at or above 40 at Pitchin Road in the Little Miami River (RM 92.27).

✓ ACHIEVED: Site currently has a score of 40.

Goal 6. Achieve MIwb score at or above 8.3 at Pitchin Road in the Little Miami River (RM 92.27).

NOT ACHIEVED: Site currently has a score of 8.0.

Goal 7. Maintain ICI score at or above 36 (Good) at Pitchin Road in the Little Miami River (RM 92.27).

✓ ACHIEVED: Site currently has a score of 52.

Goal 8. Maintain QHEI score at or above 60 at Pitchin Road in the Little Miami River (RM 98.27).

✓ ACHIEVED: Site currently has a score of 75.8.

Goal 9. Achieve IBI score at or above 40 at Buffenbarger Road in the Unnamed Tributary to the Little Miami River @ RM 96.26 (RM 0.60).

NOT ACHIEVED: Site currently has a score of 30.

Goal 10. Achieve ICI score at or above 36 (Good) at Buffenbarger Road in the Unnamed Tributary to the Little Miami River @ RM 96.26 (RM 0.60).

NOT ACHIEVED: Site currently has a score of Marginally Good (~32).

Goal 11. Maintain QHEI score at or above 55 at Buffenbarger Road in the Unnamed Tributary to the Little Miami River @ RM 96.26 (RM 0.60).

✓ ACHIEVED: Site currently has a score of 55.5.

Objectives

The implementation of these objectives, partnered with implementation throughout other identified critical areas will help ameliorate negative impacts from sedimentation and excessive nutrient loss within the **Buffenbarger Cemetery-Little Miami River HUC-12**, and positive gains will be made towards removing both near-field and far-field impairments. In order to achieve the overall NPS restoration goals of reaching *Full Attainment* at all sites within the Little Miami River and its tributaries, the following objectives need to be achieved within *Critical Area #2:*

Objective 1: Stabilize at least two miles (10,560 linear feet) degraded or downcut streambanks through a two-stage ditch or natural channel design approach and/or bio-engineering techniques[6].

Objective 2: Restore at least one and a half miles (7,920 linear feet) of in-stream channel habitat through natural channel design methods and bioengineering, including, but not limited to, constructed riffles, habitat rocks/boulders, root wads, mud sills and tree revetments.

Objective 3: Create, enhance or restore at least 20 acres[7] of woody riparian corridor and/or riparian floodplain wetlands in tributary locations.

Water quality monitoring is an integral part of the project implementation process. Both project-specific and routinely scheduled monitoring will be conducted to determine progress towards meeting the goals (i.e., water quality standards and nutrient reduction targets). Through an adaptive management process, the aforementioned objectives will be reevaluated and modified as necessary. Objectives may be added to make further progress towards attainment or reduction goals, or altered, as a systems approach of multiple BMPs can accelerate the improvement of water quality conditions. The *Nonpoint Source Management Plan Update* (Ohio EPA, 2020) will be utilized as a reevaluation tool for its listing of all eligible NPS management strategies to consider including:

- Urban Sediment and Nutrient Reduction Strategies;
- Altered Stream and Habitat Restoration Strategies;
- Nonpoint Source Reduction Strategies; and,
- High Quality Waters Protection Strategies.

[6] Stabilization may be independent of in-channel work; however, bank armoring and excessive use of stone, concrete or other unnatural hardening agents is discouraged (Ohio EPA, 2020b).

[7] With a 100 foot buffer on one river side, this equates to riparian corridor restoration along ~11,620 linear feet (~2.2 miles).

CHAPTER 4: PROJECTS AND IMPLEMENTATION STRATEGY

Projects and evaluation needs identified for the **Buffenbarger Cemetery-Little Miami River HUC-12** are based upon identified causes and associated sources of NPS pollution. Over time, these critical areas will need to be reevaluated to determine progress towards meeting restoration, attainment and nutrient reduction goals. Time is an important variable in measuring project success and overall status when using biological indices as a measurement tool. Some biological systems may show fairly quick response (i.e., one season), while others may take several seasons or years to show progress towards recovery. In addition, reasons for the impairment other than those associated with NPS sources may arise. Those issues will need to be addressed under different initiatives, authorities or programs that may or may not be accomplished by the same implementers addressing the NPS issues.

Implementation of practices described in this NPS-IS may also contribute to nutrient load reduction (specifically the interim 20% reduction in nitrogen and phosphorus loading in the MARB). Nutrient load reduction efforts are consistent with the HTF Action Plan and New Goal Framework (HTF, 2014).

For the **Buffenbarger Cemetery-Little Miami River HUC-12** there are two *Project and Implementation Strategy Overview Tables* (subsection 4.1 and 4.2). Future versions of this NPS-IS may include subsequent sections as more critical areas are refined and more projects become developed to meet the requisite objectives within a critical area. The projects described in the *Overview Table* have been prioritized using the following three-step prioritization method:

Priority 1 Projects that specifically address one or more of the listed Objectives for the Critical Area.

Priority 2 Projects where there is land-owner willingness to engage in projects that are designed to address the cause(s) and source(s) of impairment or where there is an expectation that such potential projects will improve water quality in the **Buffenbarger Cemetery-Little Miami River HUC-12**.

Priority 3 In an effort to generate interest in projects, an information and education campaign will be developed and delivered. Such outreach will engage citizens to spark interest by stakeholders to participate and implement projects like those mentioned in Priority 1 and 2.

Project Summary Sheets (PSS) follow the *Overview Tables*, if projects were identified; these 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 PSS created will be submitted to the state of Ohio for funding eligibility verification (i.e., all nine elements are included).

4.1 Critical Area #1 Project and Implementation Strategy Overview Table

Table 24: Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03) — Critical Area #1							
Goal	**Objective**	**Project #**	**Project Title (EPA Criteria g)**	**Lead Organization (EPA 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							
Altered Stream and Habitat Restoration Strategies							
Agricultural Nonpoint Source Reduction Strategies							
1-6	7, 10	1	HF Grassed Waterway Rebuilds and WASCOB Installation	Clark SWCD	Short (1-3 years)	$259,000	Ohio EPA §319
High Quality Waters Protection Strategies							
Other NPS Causes and Associated Sources of Impairment							

4.1.1 Project Summary Sheet(s)

The Project Summary Sheets provided below were developed based on the actions or activities needed to achieve nutrient reduction targets in the **Buffenbarger Cemetery-Little Miami River HUC-12**. These projects are considered next step or priority/short term projects and are considerably ready to implement. Medium and longer-term projects will not have a Project Summary Sheet, as these projects are not ready for implementation or need more thorough planning.

Table 25: Critical Area #1 – Project #1

Nine Element Criteria	Information needed	Explanation
n/a	**Title**	HF Grassed Waterway Rebuilds and WASCOB Installation
criteria d	**Project Lead Organization & Partners**	Clark SWCD
criteria c	**HUC-12 and Critical Area**	Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03) – *Critical Area #1*
criteria c	**Location of Project**	Private fields near Dolly Varden Road and Old Springfield Road (39.842836, -83.693448)
n/a	**Which strategy is being addressed by this project?**	Agricultural Nonpoint Source Reduction
criteria f	**Time Frame**	Short (1-3 years)
criteria g	**Short Description**	Rebuilding of three grassed waterways and installation of one WASCOB
criteria g	**Project Narrative**	The project will rebuild three grassed waterways and install one new WASCOB in two fields owned by a single landowner. The project fields are adjacent to the Little Miami River. The grassed waterway rebuilds include the installation of subsurface drainage, inlets and outlets, erosion control blankets and critical area planting. The WASCOB installation includes inlets, outlets and a drop box, subsurface drainage, WASCOB construction, erosion control blankets and critical area planting. Design services will be supported by the Clark SWCD. Grassed Waterway Rebuild #1 = ~1,800 feet long, draining an area of 49 acres Grassed Waterway Rebuild #2 = ~1,500 feet long, draining an area of 74 acres Grassed Waterway Rebuild #3 = ~2,700 feet long, draining an area of 375 acres WASCOB = ~900 feet long, draining an area of 375 acres
criteria d	**Estimated Total cost**	$259,000
criteria d	**Possible Funding Source**	Ohio EPA §319
criteria a	**Identified Causes and Sources**	Cause: Nutrient loadings, leading to far-field impacts Source: Agricultural land use activities

Table 25: Critical Area #1 – Project #1		
Nine Element Criteria	**Information needed**	**Explanation**
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	The overall goal in *Critical Area #1* is to reduce estimated annual total nitrogen and total phosphorus loads. Current estimates indicate the agricultural contribution to the annual load is 170,000 lbs. of nitrogen and 11,000 lbs. of phosphorus. In order to meet the HTF nutrient reduction goals, annual loads must be reduced by 20%, or 30,000 lbs. of nitrogen and 2,200 lbs. of phosphorus.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	It is expected that this project will cause a decrease in annual nitrogen loadings by 6,413 lbs. (21.4% progress) and annual phosphorus loadings by 373 lbs. (17.0% progress) through incremental progress towards fulfillment of Objective #7: Reduce erosion and nutrient loss through the installation or rehabilitation of grassed waterways (as a standalone practice or coupled with erosion control structures/other drainage management practices) that receive/treat surface water from 498 acres of at least 2,500 acres (20.0%) and Objective #10: Reduce erosion and nutrient loss through the installation of water and sediment control basins (WASCOBs) that receive/treat surface water from at least 375 of 400 acres (93.8%).
	Part 3: Load Reduced?	Estimated annual reduction: 6,413 #N/year; 373 #P/year; 291.2 tons sediment/year
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	It is generally unrealistic to monitor load reduction from individual agricultural practices; however, ambient monitoring is conducted throughout the ORB by organizations such as Ohio EPA and Heidelberg University. These entities will continue long term monitoring on various tributaries in the ORB to track load reduction trends.
criteria e	**Information and Education**	The Clark SWCD will promote the project through fact sheet development, a press release and dissemination about the project on the SWCD website, social media channels and at field days/annual meetings. Signage will be installed at the project site.

4.2 Critical Area #1 Project and Implementation Strategy Overview Table

Table 26: Buffenbarger Cemetery-Little Miami River HUC-12 (05090202 01 03) — Critical Area #2							
Goal	**Objective**	**Project #**	**Project Title (EPA Criteria g)**	**Lead Organization (EPA 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							
Altered Stream and Habitat Restoration Strategies							
Agricultural Nonpoint Source Reduction Strategies							
High Quality Waters Protection Strategies							
Other NPS Causes and Associated Sources of Impairment							

At this time, no short-term projects have been identified for *Critical Area #2*; therefore, no Project Summary Sheets are included.

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