NINE-ELEMENT NONPOINT SOURCE IMPLEMENTATION STRATEGIC PLAN PADDYS RUN HUC-12 (050800020903)

PREPARED FOR THREE VALLEY CONSERVATION TRUST
PREPARED BY ENVIRONMENTAL SOLUTIONS AQ

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Acknowledgements

The Three Valley Conservation Trust would like to acknowledge the collaboration of multiple partners in the preparation of this Nonpoint Source Implementation Strategy (NPS-IS) for the Paddys Run HUC-12. Thank you to the individuals and organizations that contributed background information, insight into objectives and projects for inclusion in this NPS-IS. We would like to recognize the staff at Hamilton County and Butler Soil and Water Conservation Districts (SWCDs), and the Ohio Kentucky Indiana Regional Council of Governments (OKI) for their outreach, contributions, and reviews ensuring a comprehensive and accurate plan. Special recognition to the staff at Environmental Solutions AQ, LLC for the extensive work to source and analyze data, leading community meetings and site visits, and drafting the final plan. We also wish to thank the numerous community stakeholders who attended the public meeting, met with us individually to verify data in situ, and provided feedback to assist prioritizing future projects. Finally, we would like to express our great appreciation to the Fernald Preserve Trustee Council (Ohio Environmental Protection Agency, U.S. Department of Energy, and U.S. Department of the Interior) who provided the grant funding to develop this plan.

Chapter 1: Introduction

The Paddys Run Hydrologic Unit (050800020903) is primarily an agricultural watershed located in Butler and Hamilton counties in SW Ohio, and it encompasses a drainage area of approximately 16 mi^2. (Fig. 1).

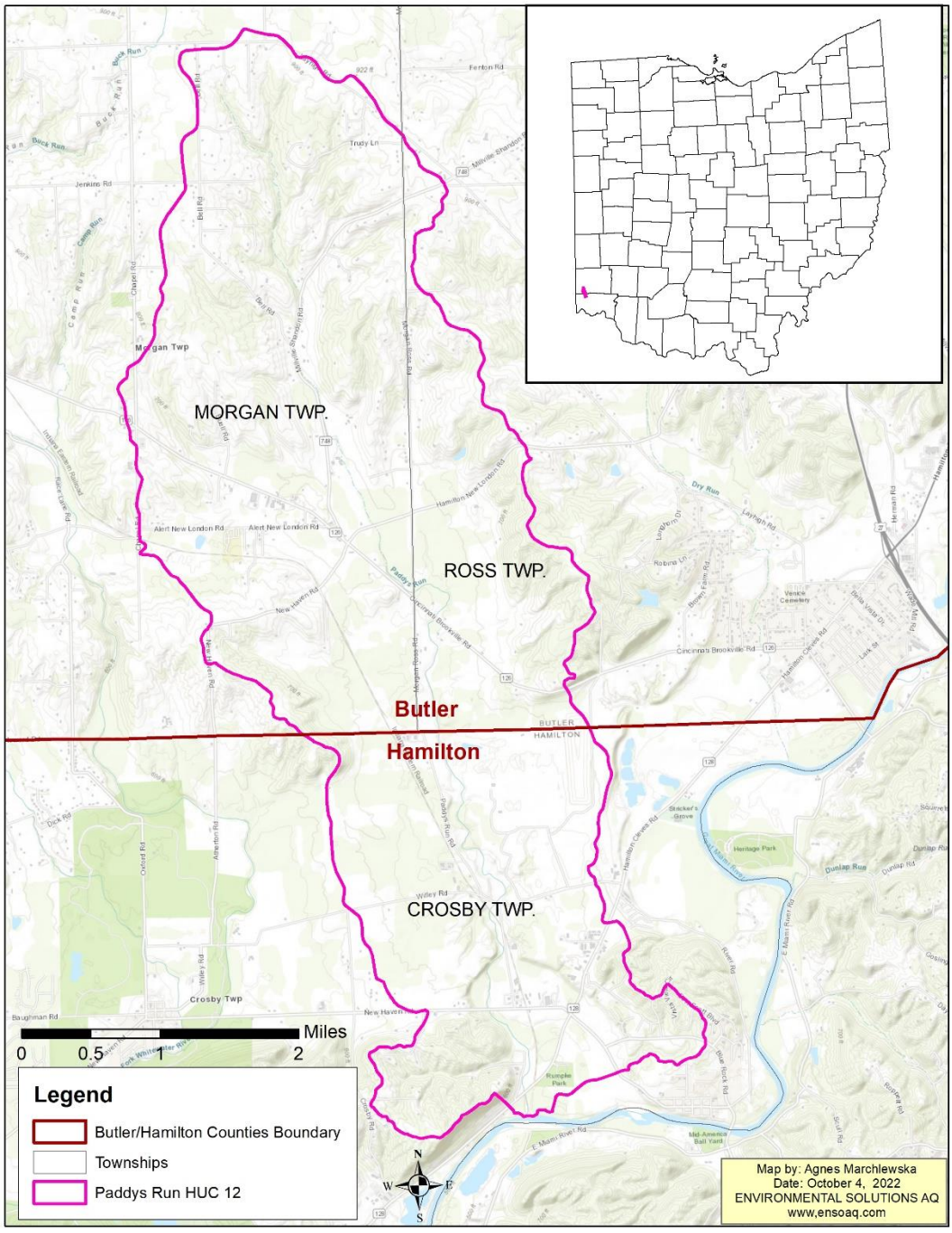

Figure 1 Paddys Run HUC-12 location

The Paddys Run HUC-12 is located within the Great Miami River Watershed (GMR) in the Ohio River Basin. The GMR watershed has recently been identified as high priority for addressing water quality impairment caused by excessive nutrient loss, especially from agricultural lands.

The developed plan will provide a road map to address the excess nutrient loads, sediments and other nonpoint sources of pollution, which impair water quality in Paddys Run HUC-12 and contribute to downstream impairment in the GMR, the Ohio River and consequently the Mississippi River and the Gulf of Mexico. Additionally, creating the plan will support the Mississippi River/Gulf of Mexico Hypoxia Task Force (HTF) efforts to reduce nutrients in the Mississippi River Basin by 20% by the year 2025 (EPA 2017). Also, the plan will allow identified projects to meet the eligibility criteria for Clean Water Act Section 319 Grants (319 Grants) and other federal and state resources designated to address nonpoint source impairments in the watershed.

The Paddys Run HUC-12 NPS-IS is sponsored by Three Valley Conservation Trust (TVCT) and developed in partnership with Environmental Solutions AQ (ENSOAQ), a local environmental consultant. The project is funded by Ohio Environmental Protection Agency (Ohio EPA) via the Fernald Natural Resource Damages Fund.

1.1. Report Background

The USEPA for many years has encouraged development of watershed plans to help protect and improve water resources in the United States. The earliest Watershed Action Plan (WAP) guidelines were released in 2001 and the first plans were endorsed in 2004. Initially the WAPs focused on larger size watersheds equivalent to HUC[1]-8 or HUC-10 hydrologic units. Over time, the planning efforts shifted to the smaller HUC-12s and focused on defining critical areas and individual projects in more detail. Each plan has to include "nine essential elements" for projects to be eligible for 319 Grants. In 2013 Ohio EPA released a new guide to address the watershed impairments caused by nonpoint source pollution and the first Nine-Element NPS-IS were approved in 2017. Over time the NPS-IS role has expanded to address not only local watershed impairments (near field) but also to help protect and improve waters downstream (far field).

The Ohio EPA 2022 Integrated Water Quality Monitoring and Assessment Report classified the Paddys Run watershed as "category 5 – impaired, TMDL needed" (Ohio EPA, 2022). The report indicates watershed impairment for aquatic life and human health. The potential recreation impairment has not been assessed.

This NPS-IS plan will identify causes and sources of nonpoint pollutants within the Paddys Run HUC-12. It will also determine watershed critical areas and outline strategic projects, which

Nine Elements of NPS-IS Plan
Source: Ohio EPA, 2016a

a) An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan.

b) An estimate of the load reductions expected for the management measures described under paragraph (c) below.

c) A description of the NPS management measures (solutions) that will need to be implemented to achieve the load reductions estimated under paragraph (b) above and an identification (using a map or a description) 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 the 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 management measures identified in this plan 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 and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.

i) A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

[1] USGS describes watersheds (AKA drainage basins) using a hierarchical system called hydrologic unit codes (HUCs). The number of digits in the HUC has an inverse relationship to the size of the land area. For example, the Lower Great Miami River Watershed is described by eight digits (05080002) and is referred to as a HUC-8 watershed. Subwatersheds within the Lower Great Miami have ten digits (HUC-10). Even smaller watersheds within HUC-10s, such as Paddys Run, are referred to as HUC-12 watersheds.

should be implemented to improve local water quality and help to reduce impairment in the Ohio River Basin and subsequently in the Mississippi River and the Gulf of Mexico. Additionally, identified projects described in the plan will be eligible for federal and state nonpoint source (NPS) funding.

1.2. Watershed Profile & History

The Paddys Run HUC-12 is located within the GMR watershed in SW Ohio and (Fig. 3).

The GMR watershed extends across 15 counties and drains approximately 5,367 square miles of land, which includes 3,942 square miles in Ohio and 1,425 square miles in Indiana. The GMR flows approximately 170 miles from its headwaters in SW Hardin County to its confluence with the Ohio River in SW Hamilton County near the border with Indiana. The GMR watershed is broken into three HUC-8 sub watersheds including Upper Great Miami, Lower Great Miami and Whitewater.

The Paddys Run HUC-12 is located in southwest part of the Lower Great Miami HUC-8. Its drainage area covers about 16 square miles. Paddys Run is 9 miles long and flows from its headwaters in Morgan Township, Butler County, Ohio to its confluence with GMR in Crosby Township, Hamilton County, Ohio.

There is only one National Pollutant Discharge Elimination System (NPDES) permitted facility operating within the Paddys Run HUC-12. The USDOE Fernald Closure Project in Hamilton County discharges the storm water and effluent from Fernald Preserve into Paddys Run, and is currently in compliance with the NPDES permit (USEPA, 2022).

Table 1 One NPDES permitted facility discharging into Paddys Run and its tributaries within the Paddys Run HUC-12 watershed

Facility Name	NPDES ID	Lat/Long	Industry	Receiving Stream	Qtrs with NC (of 12)*
USDOE FERNALD CLOSURE PROJECT	OH0009580	39.28801 84.68326	Federal Facility	Paddys Run	0

**Quarters with "Non Compliance" status from to 10/1/2019 to 09/30/2022*

The majority of the Paddys Run watershed is located in the Eastern Corn Belt Plains (ECBP) ecoregion and only a small southern portion of the watershed is classified as the Interior Plateau (IP) ecoregion. This region has a long agricultural history. The first European settlers cleared the deciduous forests and adapted the local lands for crops and pasture beginning in the early 1800s. Currently approximately 52% of the watershed area is in agriculture, 28% is covered by deciduous forest, and 15% is developed (NLCD, 2019). The largest communities in this watershed include Shandon in Butler County and Fernald in Hamilton County, both of these communities are unincorporated.

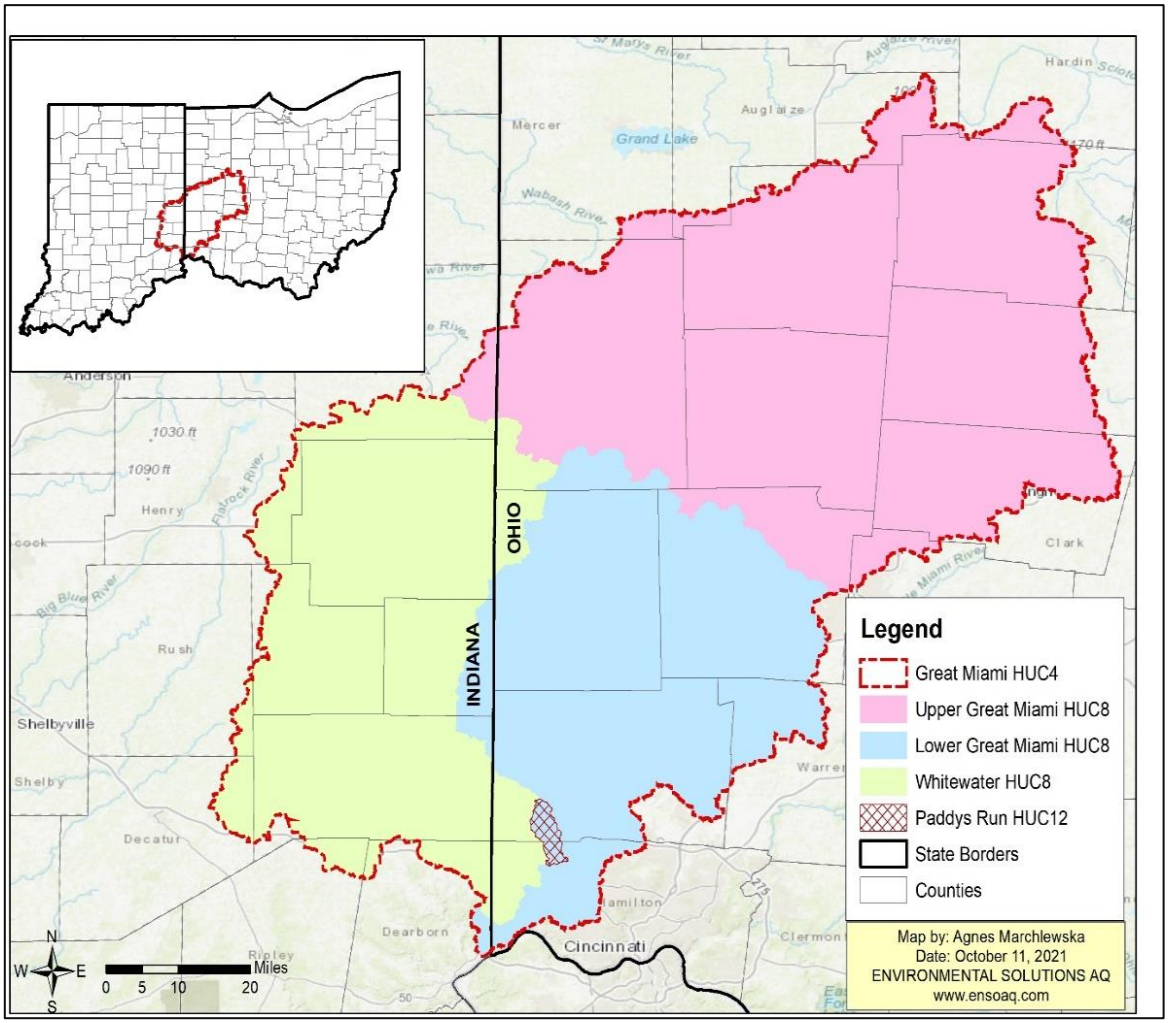

Figure 2 Great Miami River HUC-4 watershed and the location of the Paddys Run HUC-12 within Lower Great Miami River HUC-8 watershed

1.3. Public Participation and Involvement

To ensure the success of the NPS-IS, the Ohio EPA encourages collaboration with local stakeholders and communities who can help to develop watershed restoration and protection strategies and later start implementing these strategies.

Three Valley Conservation Trust (TVCT), which sponsored development of the NPS-IS for Paddys Run HUC-12 has been successfully leading conservation efforts in this region for nearly 30 years. The organization was established in Oxford, Ohio by Edward Wallace in 1993 and incorporated as an Ohio non-profit in 1994. The land trust's mission is to conserve natural habitats, waterways and agricultural lands in Southwestern Ohio, for the benefit of present and future generations, through partnerships with people and communities. TVCT's service area covers seven regional counties with a special focus on protecting land and natural resources in Butler, Preble and Montgomery counties.

The land trust's goals and objectives include:

- Setting standards for land conservation and water quality in our region.
- Protecting and enhancing waterways, woodlands, vistas and farmland in our region with conservation and agricultural easements by partnering with other nonprofit organizations, federal and state government agencies, local parks, community representatives and individual landowners.
- Initiating and promoting community conservation efforts.

Since 1994, TVCT has protected over 24,500 acres of important landscapes in southwest Ohio via conservation and/or agricultural easements. Currently TVCT holds easements on 219 properties with individual landowners and organization, including 24 in the Paddys Run HUC-12.

To engage stakeholders in the process of developing the NPS-IS for Paddys Run watershed, the TVCT partnered with Hamilton County and Butler SWCDs on the outreach activities. Both agencies advertised the project on their social media and invited the community members to the public meeting. Also, The Hamilton County SWCD mailed out 425 postcards to landowners in Hamilton County and the Butler SWCD sent 150 postcards to the landowners in Butler County. In addition, the TVCT published an article about this project in their quarterly newsletter, and invited members of the Trust, including the conservation easement owners, to the meeting.

Approximately twenty individuals attended the Paddys Run Watershed Nine-Element NPS-IS Public Input meeting on Saturday, January 28 at the Fernald Preserve Visitor's Center. About half of those in attendance were private landowners and the rest were partner agency representatives, including Butler and Hamilton County SWCDs, the Ohio-Kentucky-Indiana Regional Council of Governments (OKI), Miami Conservancy District (MCD) and the Fernald Residents For Environmental Safety and Health (FRESH).

ENSOAQ, the contractor completing the Nine-Element plan, presented the goals of the planning process and some preliminary findings. Also, the ENSOAQ presented results of the Agricultural Conservation Planning Framework (ACPF) analyses conducted for the Paddys Run HUC-12. The ACPF tool spatially combines high-resolution terrain, drainage, soils, land use and cropland data to determine potential locations for best management practices (BMPs) at the field scale and helps to engage farming communities in watershed conservation efforts (ARS, 2019). The ACPF model outputs were ground-truthed during visits at multiple easement properties in the watershed.

A short questionnaire was distributed at the beginning of the meeting to gather stakeholders' input on water quality issues in the Paddys Run watershed, identify critical areas and priorities. The landowners voiced their concerns about erosion problems, poor drainage and flooding on their personal properties. They identified agricultural runoff, fields and streambank erosion, narrow riparian buffers and invasive species as primary sources of the water quality and habitat impairments in the watershed. Some of the restoration and protection strategies as well as available funding opportunities to mitigate these impairments were discussed.

In summary, the stakeholders prioritized erosion problems, high runoff areas and landowners' willingness to conserve the land as the main criteria for conservation projects in the critical areas. If funding were available landowners stated they would be interested in implementing stream bank erosion, cover crops, grassed waterways, and livestock and farm equipment stream crossings.

Figure 3 Public input meeting at Fernald Preserve

The final version of this NPS-IS for Paddys Run HUC-12 was developed using individual inputs from the local stakeholder organizations including Butler SWCD, Natural Resources Conservation Service (NRCS) and OKI.

Chapter 2: Watershed Characterization and Assessment Summary

2.1. Summary of Watershed Characterization for Paddys Run HUC-12

2.1.1. Physical and Natural Features

The Paddys Run HUC-12 is one of the subwatersheds of the Lower GMR Watershed. Paddys Run mainstem is approximately 9 miles long, second order stream and it has several smaller, unnamed tributaries.

This watershed is located mostly within the Eastern Corn Belt Plains Ecoregion (ECBP) ecoregion and only a small southern portion of it transitions into the IP (Fig. 4). The ECBP ecoregion is defined as a primarily rolling plain with local end moraines and kames, extensively covered by Wisconsinan age glacial deposits. Originally, it was dominated by beech forests growing on the Wisconsinan soils. Whereas, less common wetter pre-Wisconsinan soils supported both the beech forests and elm-ash swamp forests. Today, most of these forests have been cleared to give way to highly productive corn, soybean and livestock farms, which has degraded stream habitats and water quality (USEPA, 2013).

The Interior Plateau (IP) ecoregion is a deeply dissected, moderately rolling plain, mostly covered by pre-Wisconsinan till and discontinuous losses. Originally, in Ohio this region was dominated by mixed mesophytic forest, mixed oak forest and bottomland hardwood forest. Today, this ecoregion is mostly agricultural with forest growing on the steeper terrains. Urban – industrial activity occurs near Cincinnati, along the Ohio River.

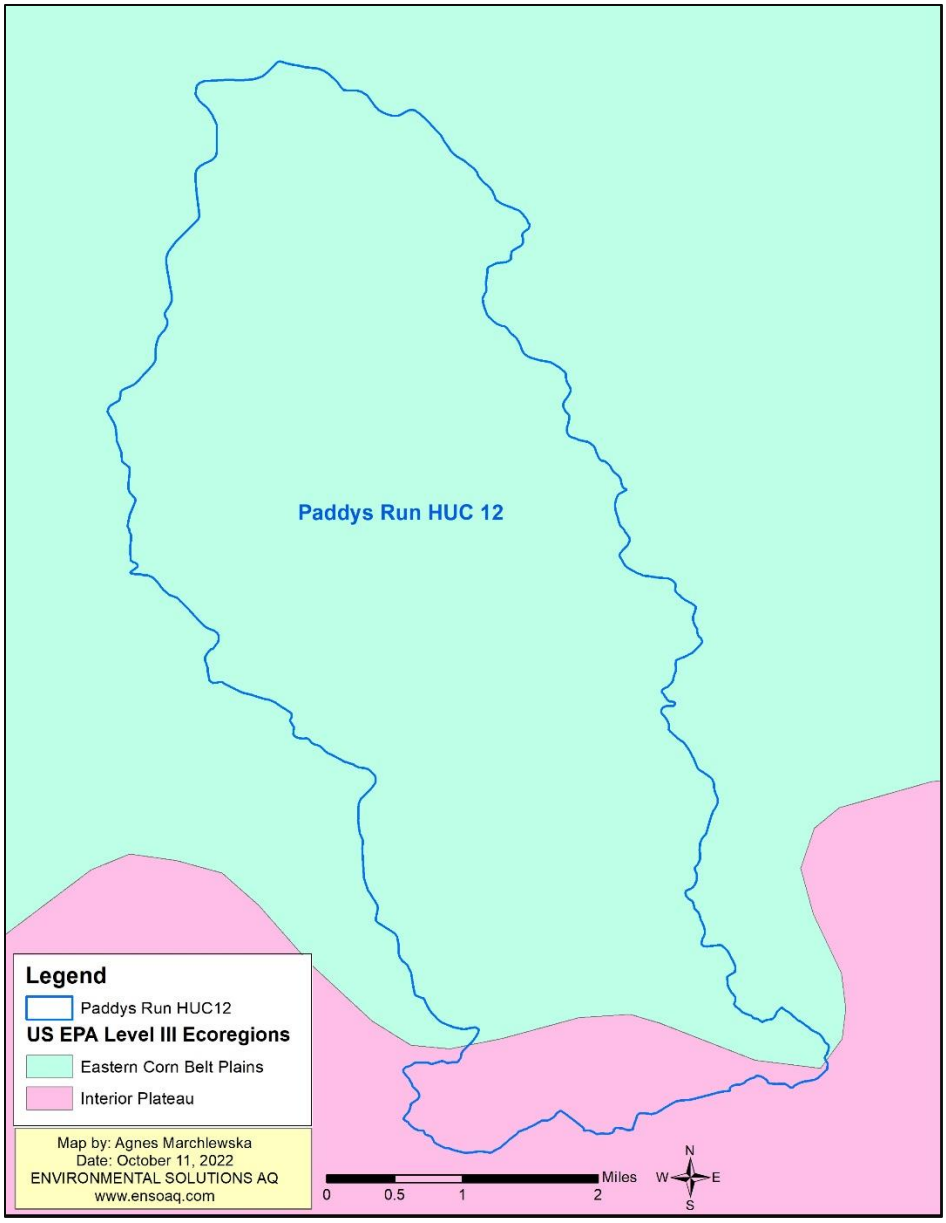

Figure 4 Ecoregions of Paddys Run HUC-12

The Paddys Run watershed is almost completely contained within Southern Ohio Loamy Till Plains Region of the Central Lowland physiographic province. Only the southern tip of the watershed is located in the Outer Bluegrass Region of the Interior Low Plateaus province. (Ohio Geological Survey, 1998).

The topography of this area was shaped by the Pleistocene Epoch glaciation. The upstream portion of the watershed is characterized by gentle rolling hills with 0-to-12-degree slopes, occasionally cut by narrow and steeper stream valleys with slopes up to 60- degree. The steeper narrows are a place where often active stream bank erosion sites observed in the watershed. The central and southern part of the watershed is mostly formed by flat, broad floodplains with 0-to-3-degree slopes. (Fig. 5).

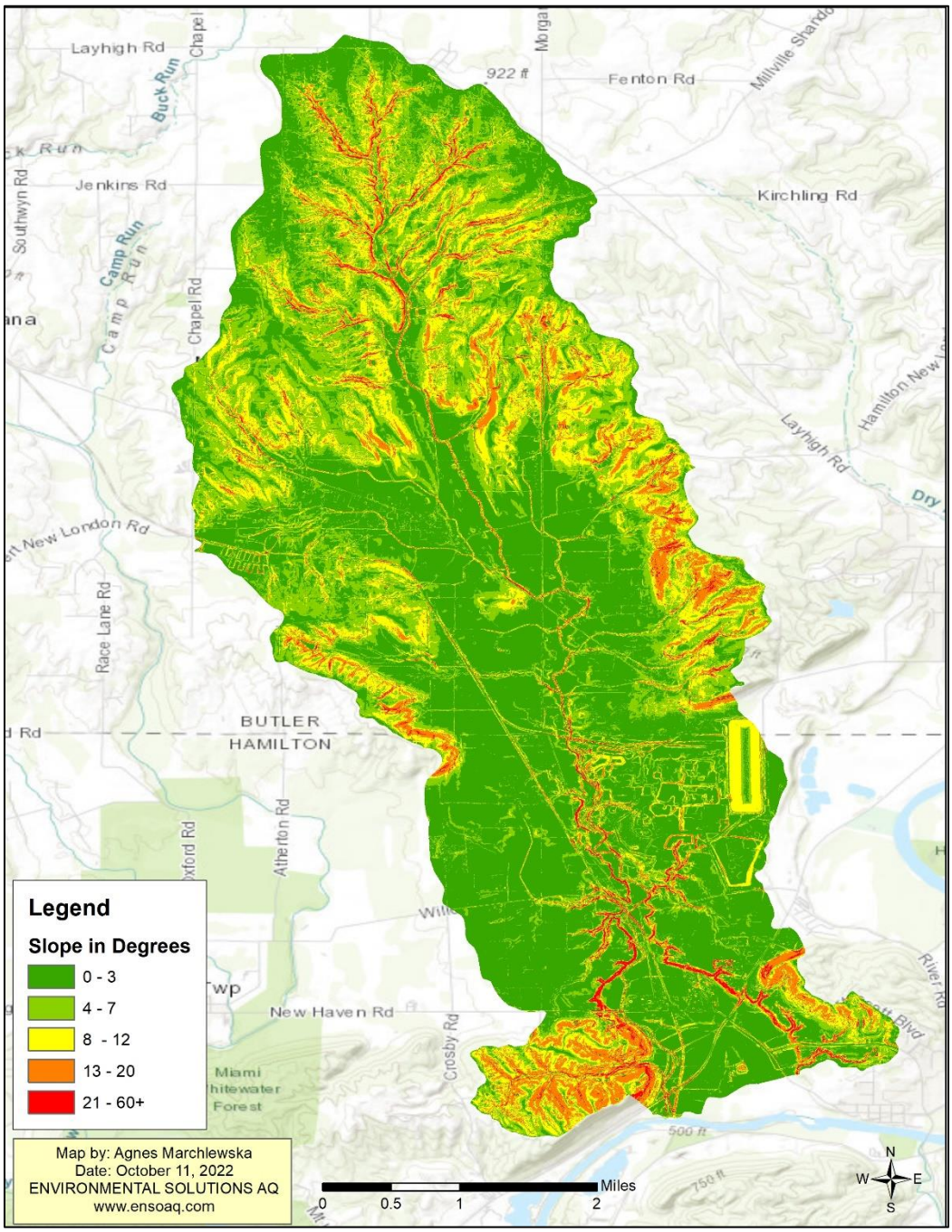

Figure 5 Slope classification within the Paddys Run HUC-12

The geologic units within the Paddys Run watershed are Ordovician bedrock, glacial till and outwash primarily associated with the Wisconsinan glaciation, and latest Pleistocene and Holocene alluvium (Ohio Geological Survey, 2005a and 2005b. Bedrock is comprised of interbedded fossiliferous limestone and shale.

The Waynesville and the Arnheim Formations, and the Grant Lake and Fairview Formations, Miamitown Shale, both undivided, comprise the majority of upland portion of the watershed (USGS, 2018). Whereas, the Kope Formation and the Point Pleasant Formation are exposed in the Paddys Run Valley (Fig. 6). The Wisconsinan Epoch ground moraines, comprise most of the unconsolidated sediments in the watershed (Ohio Geological Survey, 2005). Clayey glacial till, which overlays the Ordovician age bedrock in the upland portions of the watershed is often less than 35 feet thick. Outwash and alluvial materials, which filled ancient stream and river valleys in the region, are associated with a very productive Great Miami Buried Valley Aquifer (GMBVA) system. The thickness of buried valley aquifer deposits in the Paddys Run watershed vary to a considerable extent (Ohio Geological Survey, 1993).

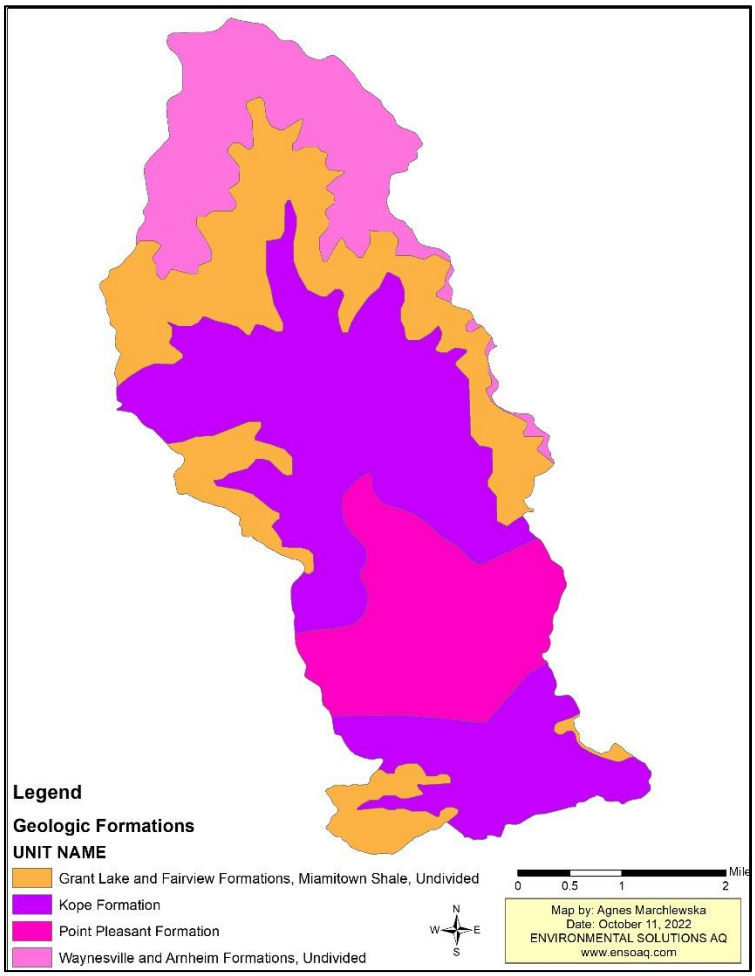

Figure 6 Geologic formations of Paddys Run HUC-12

According to the USDA NRCS Web Soil Survey (WSS), the Paddys Run watershed is comprised of 95 different types of soil (Fig. 7). The most common soil series are: Eden, Xenia, Russell – Miamian, and Genesee loams. A detailed summary of the soil types is included in Appendix A. Approximately 5577.3 acres (53.20% of total watershed area) are classified as prime or locally important soils. An additional 1268.1 acres (12.00%) are classified as prime farmland if drained or protected from flooding.

A total of 419.6 acres (4%) are rated as hydric soils on the NRCS Hydric Soils List. However, according to the National Land Cover Data (NLCD 2019) less than 0.05% (4.9 acres) of the total watershed area is currently covered by wetlands. The U.S. Fish & Wildlife Service, National Wetland Inventory database, which also includes historical wetlands data, shows significantly higher acreage than the NLCD for areas designated as wetlands (86.55 acres or 0.86% of total watershed area) (Fig. 9). Most of natural wetlands within the Paddys Run watershed are drained by tiles commonly installed on the agricultural fields as early as at the beginning of 19th century. The presence of hydric soils shows a potential for wetland restoration opportunities within the watershed. Wetland restoration on declining agricultural land can improve habitat for native species, reduce flooding, and improve water quality.

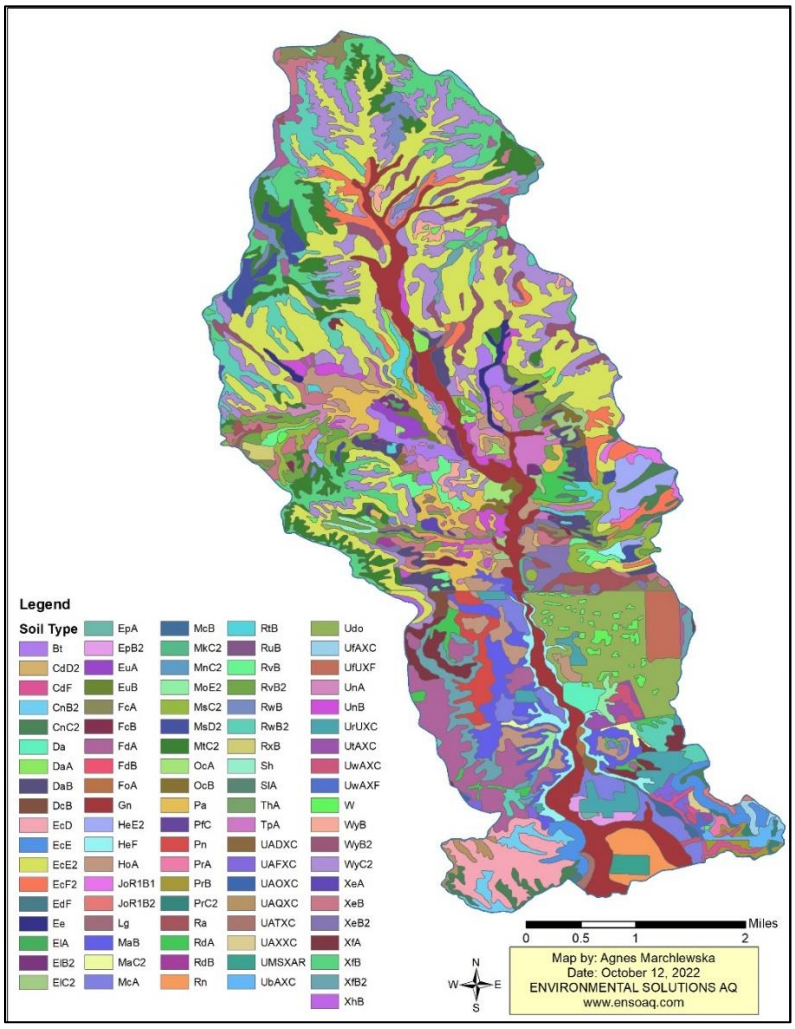

Figure 7 Soil types within the Paddys Run HUC-12

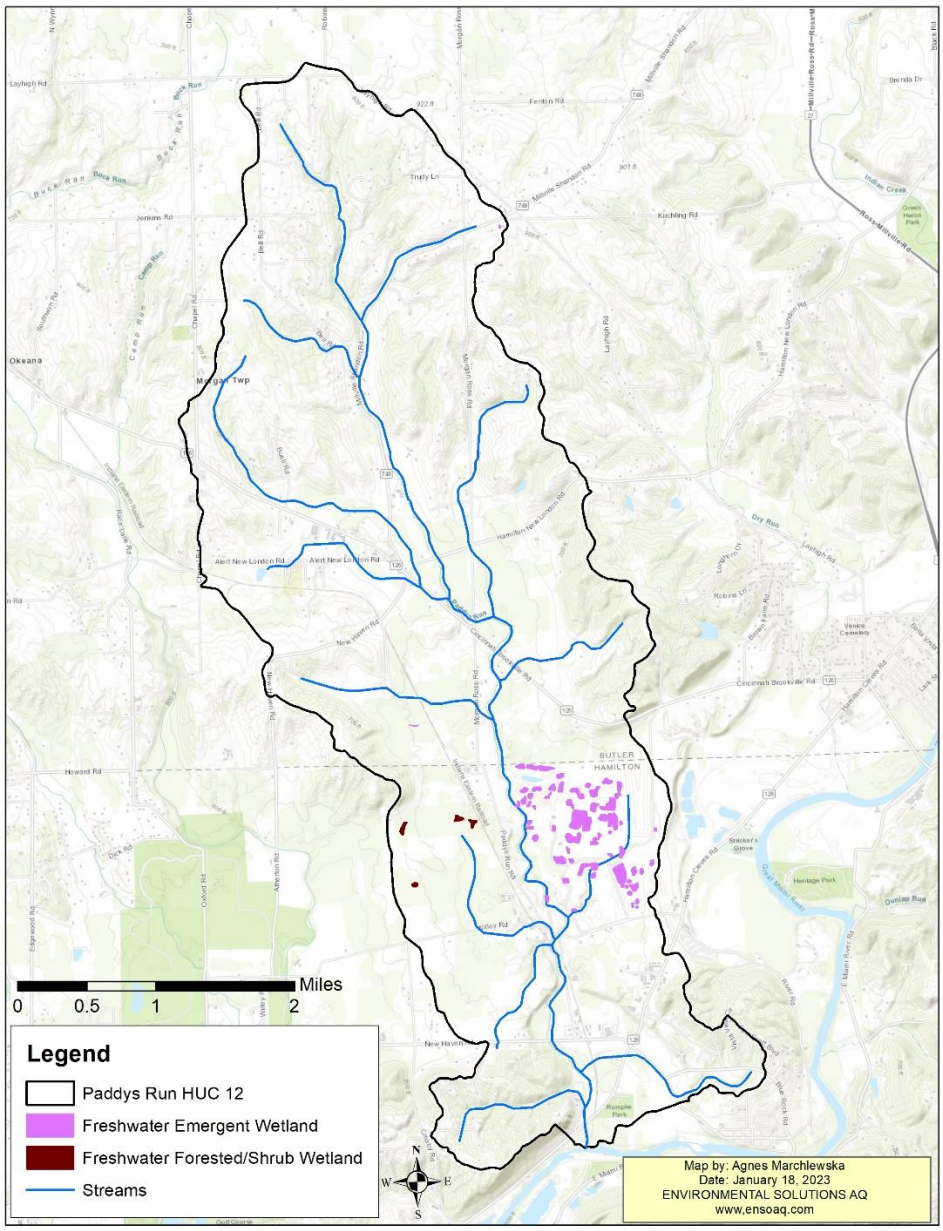

Figure 8 Wetlands within the Paddys Run HUC-12

Table 2 summarizes soils in the watershed based on their hydrologic characteristics. The categories listed as “unclassified” describe areas covered by water bodies.

The vast majority of soils within this HUC-12 are classified as well-drained (6,474.1 acres or 61.90% of the watershed area) or moderately well-drained (1,674.1 acres or 16.00% of the watershed area) (Fig. 9). The poorly drained soils (416.2 acres or 3.90% of the watershed area) and somewhat poorly drained soils (956 acres or 9.10% of the watershed) are mostly located in the central and western part of the watershed. These soils are present in the areas which are usually very flat (0 – 3 degrees of slope) and frequently experience seasonal shallow water table.

Approximately 4,025.5 acres of soils (38.40% of total watershed area) and 2,503.30 acres (24.00% of total watershed area) are classified as C and D in the hydrologic group classification. These soils, when wet, have slow to very slow infiltration and water transmission rates, therefore, they have higher potential for runoff. The agricultural character of the Paddys Run HUC-12, combined with a high runoff potential of the local soils, might contribute to the watershed impairment caused by the excess nutrients loads. In addition, most of the soils in this watershed have high to moderate erodibility (3,229.3 acres or 30.70% of total watershed area and 6,110.9 acres or 58.40%, respectively). The high runoff potential of the soils and increased soil erodibility makes this watershed especially susceptible to erosion problems and excessive sedimentation, which can degrade water quality of the local streams.

Table 2 Soil classifications for Paddys Run Watershed

Soil Classification System	**Acres**	**Percent Coverage**
Drainage Class* - Well drained	6,474.1	61.90%
Drainage Class* - Moderately well drained	1674.1	16.00%
Drainage Class* - Somewhat poorly drained	956	9.10%
Drainage Class* - Poorly Drained	416.2	3.90%
Drainage Class* - Very Poorly Drained	1.7	0.00%
Drainage Class* - Not classified	911.50	9.00%
Hydrologic Soil Group** - A	28.4	0.30%
Hydrologic Soil Group** - B	1,443.4	13.70%
Hydrologic Soil Group** - B/D	822.4	7.80%
Hydrologic Soil Group** - C	4,025.5	38.40%
Hydrologic Soil Group** - C/D	609.3	5.80%
Hydrologic Soil Group** - D	2,503.30	24.00%
Soil Erodibility*** - High	3,229.3	30.70%
Soil Erodibility*** - Moderate	6110.9	58.40%
Soil Erodibility*** - Low	95.9	0.90%
Soil Erodibility*** - Unclassified	1001.3	9.90%

**Drainage classification range from "Somewhat excessively drained" to "Poorly Drained"*

*** Hydrologic Soil Groups classification based on estimates of runoff potential. (Rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms). "A", relatively high infiltration rates; "B", relatively moderate infiltration rate; "C", relatively slow infiltration rates, "D", relatively very slow infiltration rates. "B/D", "C/D" - the first letter is for drained areas and the second is for undrained areas.*

**** Soil Erodibility classification based on erosion factor K that indicates the susceptibility of a soil to sheet and rill erosion by water. Values of K range from 0.02 to 0.69.*

"Low", K-factor < 0.23; "Moderate", K-factor ≥ 0.23 and < 0.4; "High", K-factor ≥ 0.4

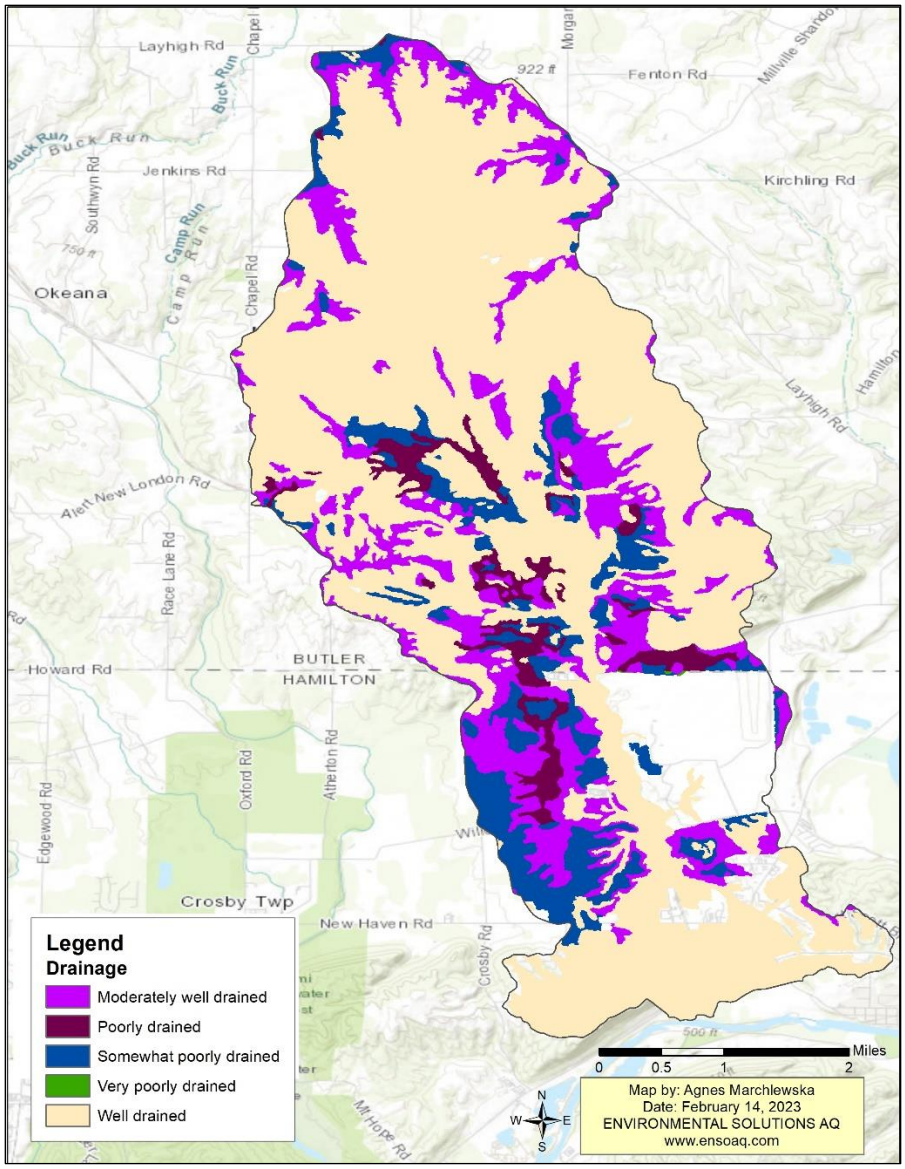

Figure 9 Drainage classification of the soils within the Paddys Run HUC-12

Furthermore, the USDA NRCS Web Soil Survey (WSS) classified approximately 9,139 acres of soils (87.6% of the watershed area) as “very limited” for septic system absorption fields. This rating indicates that the vast majority of soils within the watershed are not naturally inclined to properly disperse and absorb liquid sewage effluents in a conventional septic drain field, and modifications to the site or septic system itself might be expensive or impossible. Although the Ohio EPA has not assessed the Paddys Run watershed for recreation, the Midwest Biodiversity Institute (MBI) study conducted in 2013 showed presence of the *E. coli* bacteria in the local waters, indicating non-attainment status for recreation. The potential sources of this impairment are agricultural runoff, livestock and improperly functioning home sewage treatment systems (HSTS).

In 2018 and 2019, OKI conducted a study to identify and prioritize areas within multiple counties in southwest Ohio, including Butler and Hamilton counties, where HSTS might impact water quality the most (OKI, 2020). The HSTS were evaluated using available water resource, water quality and HSTS density data. According to a heat map developed for the Paddys Run watershed, there are three high priority areas and five areas designated as medium – high priority identified (Fig. 10). The medium to high priority areas include communities of Shandon in Morgan Township, and Layhigh in Ross Township, both in Butler County. The OKI study did not report the number of failing home systems in this watershed. Also, HSTS management in the Paddys Run watershed is not a priority for the Butler or Hamilton counties' health departments. The HSTS load estimates and reductions will be added in the future version of the plan, once more data is available.

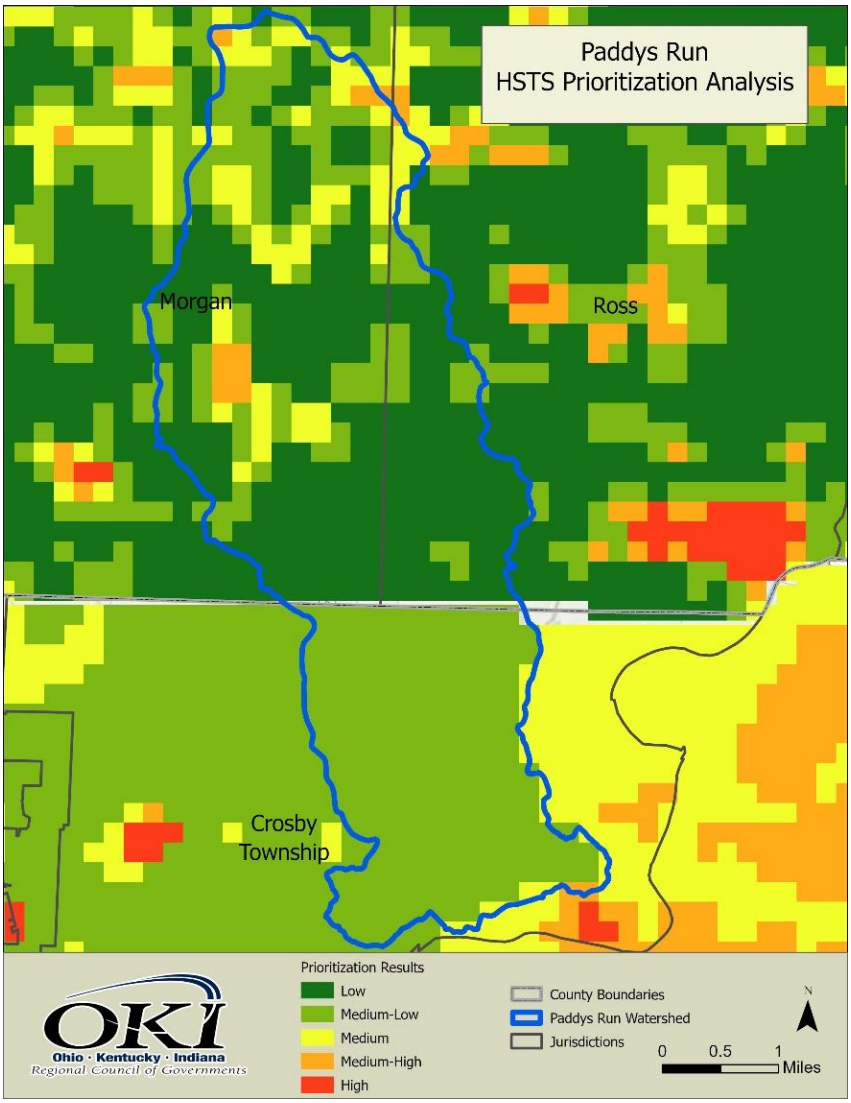

Figure 10 HSTS Priority Analysis for Paddys Run HUC-12 (Source OKI)

2.1.2. Land Use and Protection

The Paddys Run HUC-12 is predominantly an agricultural watershed (Fig. 12). Approximately 2,574.19 acres (24.70% of watershed area) are in cultivated crops and 2,794.19 acres (26.81% of watershed area) are in hay/pasture (Table 3).

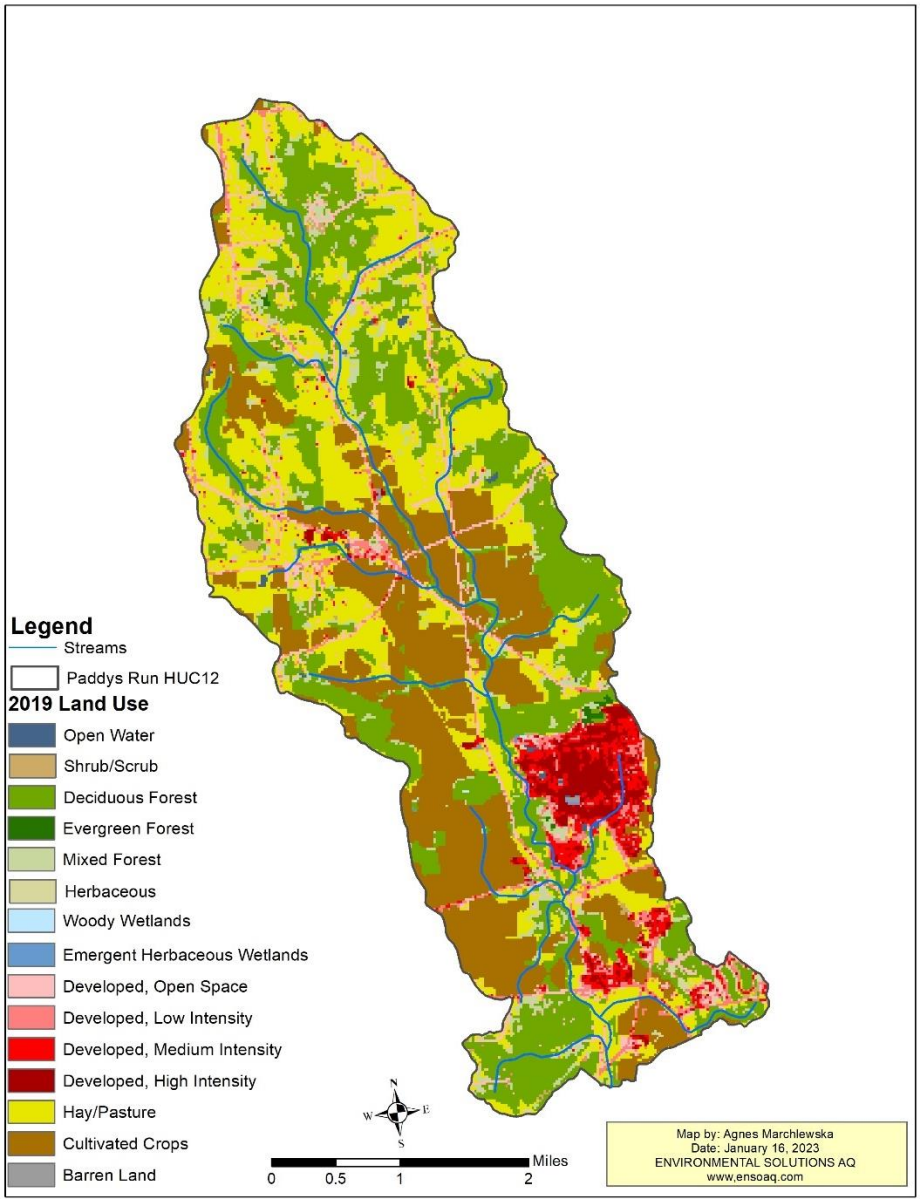

Figure 11 Land use within the Paddys Run HUC-12 (Source NLCD, 2019)

Table 3 Land use within the Paddys Run HUC-12

Land Use	**Area (Acres)**	**%**
Open Water	21.46	0.21
Developed, Open Space	576.26	5.53
Developed, Low Intensity	408.35	3.92
Developed, Medium Intensity	316.91	3.04
Developed, High Intensity	295.38	2.83
Barren Land	9.57	0.09
Deciduous Forest	2945.98	28.26
Evergreen Forest	17.14	0.16
Mixed Forest	386.89	3.71
Shrub/Scrub	33.64	0.32
Herbaceous	37.88	0.36
Hay/Pasture	2794.19	26.81
Cultivated Crops	2574.92	24.70
Woody Wetlands	1.78	0.02
Emergent Herbaceous Wetlands	3.11	0.03
Total	10423.46	100.00

Source: NLCD 2019

The main crops growing in this watershed are corn and soybeans (Table. 4). On average in the last five years 1269.56 acres of land were in corn production and 1442.28 acres were in soybeans. The crop rotation practice frequently used within the watershed helps to improve and protect local soils and increase crop yields.

Table 4 Cropland types and acreage within Paddys Run HUC-12

	2022	**2021**	**2020**	**2019**	**2018**
Corn	1321.9	1205.4	1318.6	1306.1	1195.8
Soybeans	1386.2	1492	1478.3	1484.5	1370.4
Winter Wheat	6.9	30.7	18.9	5.3	21.3
Grass/Pasture	2582.2	2537.1	2037.1	2141	2576.4
Alfalfa	19.1	27.1	52	23.8	19.3
Other Hay/Non Alfalfa	41.8	56.7	133.4	103.4	45.4

Source: USDA NASS CropScape, 2023

No concentrated animal feeding facilities (CAFFs) and no permitted concentrated animal feeding operations (CAFOs) are in the Paddys Run HUC-12. According to the Natural Resources Conservation Service in Butler County, there are just a few small to medium livestock operations (mostly cattle farms with less than 50 heads) in the watershed. However, no detailed data is currently available. Once available, this information will be added in the next version of the plan.

Deciduous forest covers the next largest portion of the watershed (2945.98 acres or 28.26% watershed area). Its presence is mostly limited to the steeper portions of the watershed forming the riparian areas of Paddys Run and its tributaries. The forest is represented by a diverse group of moderate to high quality native trees, and it is heavily impacted by the presence of invasive species, including bush honeysuckle (*Lonicera* species) and Japanese honeysuckle (*Lonicera japonica*). Other invasives commonly found within the Paddys Run HUC-12 are: multiflora rose (*Rosa multiflora*), garlic mustard (*Alliaria petiolata*) and Callery pear (*Pyrus calleryana*).

According to the USGS 2019 National Land Cover Dataset (NLCD), over 15 % (1596.9 acres) of the watershed is developed. The major communities in Paddys Run HUC-12, include an unincorporated community of Shandon in Morgan Township, Butler County and Fernald located in Crosby Township, Hamilton County. A large portion of the watershed (1,050 acres or 10%) is covered by the Fernald Preserve located in southern part of the Ross Township in Butler County and in the northern part of Crosby Township, in Hamilton County. This property is a former uranium-processing facility that underwent extensive remediation in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations, and it is now managed by the US Department of Energy, Office of Legacy Management. The 2019 NLCD classifies the Fernald Preserve as medium to high intensity developed lands. However, since 2006, approximately 900 acres of the site have undergone ecological restoration. The property is now open as a public park, which includes wetlands, forests and prairies that provide habitats for a variety of animals and plants and improve water quality in the watershed. In addition, in 2014, approximately 475 feet of the Paddys Run streambed was relocated and stabilized to address the potential threat to the Paddys Run water quality caused by an eroding east bank of Paddys Run into an area of known surface water- contamination site called “Pit 3 Swale”. To assure long term protection of the

public health and conservation functions, the entire Fernald Preserve (1,050 acres) is secured by environmental covenants.

Protected lands within the Paddys Run watershed also include 24 conservation easements on private and public properties held by TVCT (Fig. 12). These easements are part of the Paddys Run Conservation Project (PRCP) and protect approximately 1925 acres (about 18.5% of the total watershed area) of prime farmland and natural areas from development in perpetuity. In 2022, the TVCT signed a 50-year lease with one of the easement owners and will convert 11-acre parcel from the active farmland into wooded wetland buffered by the pollinator habitat and restore the forested riparian habitat along Paddys Run.

The TVCT also manages 44-acre property located in the northern part of the watershed, that encompasses the Paddys Run headwaters. In the recent years, the TVCT has conducted extensive restoration to remove the invasive species from the property.

More details about the Paddys Run Project can be found at:
https://storymaps.arcgis.com/stories/36f845960d61474595f79c226afe6dee

In addition, multiple properties within the watershed are protected by the local park districts. These properties are public lands and include Salamander Run Preserve administrated by MetroParks of Butler County, and Hamilton Woods parcels preserved by the Great Parks of Hamilton County.

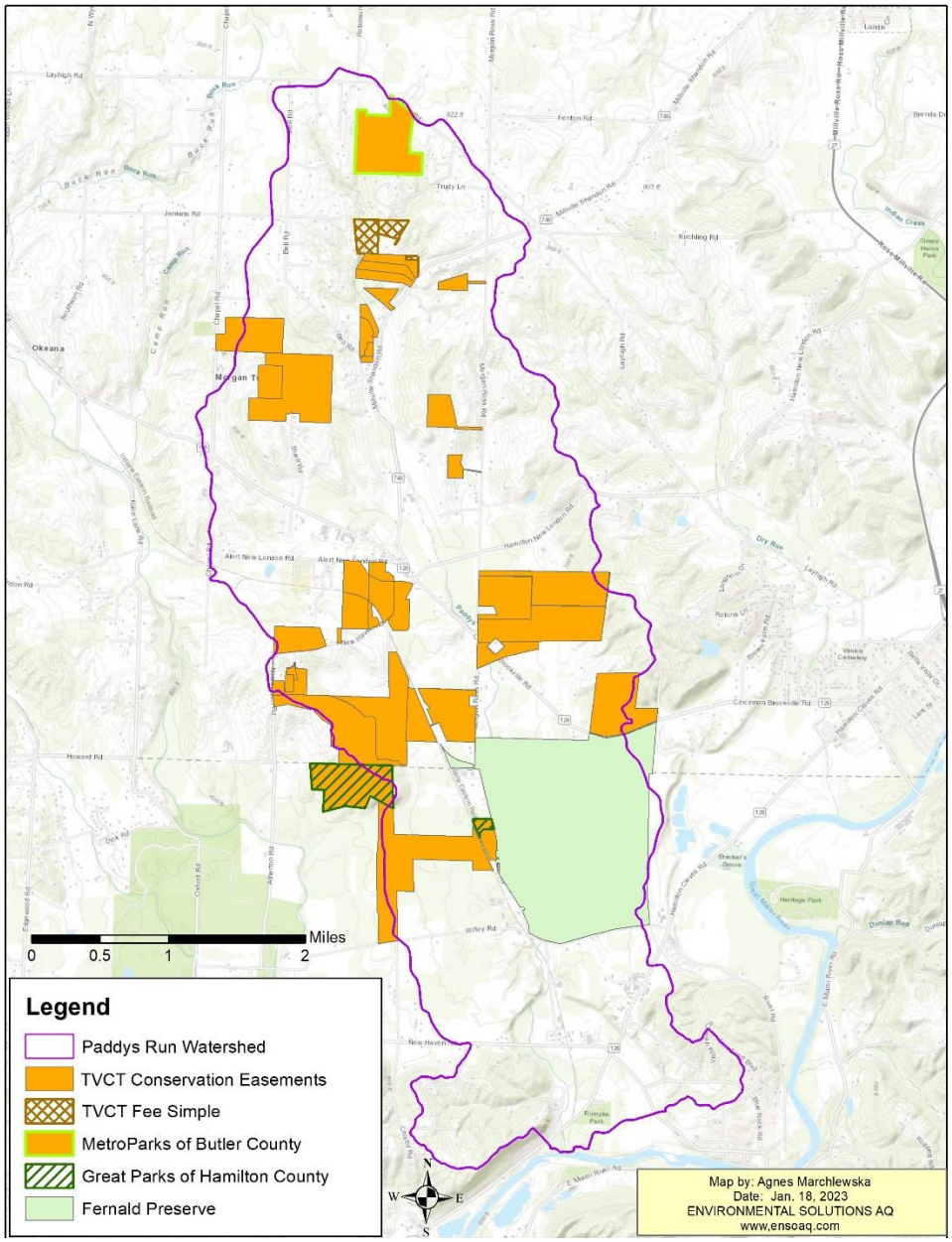

Figure 12 Protected lands within the Paddys Run HUC-12

Seven threatened or endangered species of wildlife and plants are federally listed for Butler and Hamilton counties by the US Fish and Wildlife Service (USFWS) (Table 5). The federally endangered Indiana Bat has been recently found in Fernald Preserve, in the riparian woodlands along Paddys Run. (2022, USDOE OLM).

The herpetological survey conducted on the PRCP properties between 2018 and 2020 for the TVCT and the Fernald Natural Resource Trustees (Ohio EPA, U.S. Department of Energy, and U.S. Fish and Wildlife Service) identified a diverse group of amphibians and reptiles in the Paddys Run watershed. The survey confirmed presence of the Ohio Endangered cave

salamanders, which were found at Hamilton Woods administrated by the Great Parks of Hamilton County, Salamander Run Preserve managed by the MetroParks of Butler County and on four privately owned conservation easements. Four Ohio Species of Concern, which include Blanchard's Cricket Frog, Queensnake, Eastern Gartersnake and Woodland Box Turtles were also identified in streams and ponds, and in the riparian forest within the Paddys Run watershed on multiple private properties. The properties where these species were identifed are permanently protected with conservation easements by the TVCT.

The local streams and the deciduous forest growing in the riparian areas of Paddys Run and its tributaries provide or might provide habitats for many threatened and/or endangered species. Therefore, it is critical to protect these areas from further habitat degradation caused by invasive species, agriculture activities and increasing residential development.

Table 5 Federally Listed Threatened and Endangered Species in Butler and Hamilton Counties

Species	Status	Habitat
Indiana bat *(Myotis sodalis)*	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well-developed riparian woods; upland forests
Fanshell Mussel (*Cyprogenia stegaria*)	Endangered	Medium to large streams. Prefer relatively deep water in gravelly substrate with moderate current.
Snuffbox Mussel *(Epioblasma triquetra)*	Endangered	Small to medium sized creeks. Prefer areas with a swift current.
Sheepnose *(Plethobasus cyphyus)*	Endangered	Shallow areas in larger rivers and streams
Rayed bean *(Villosa fabalis)*	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
Northern long-eared bat *(Myotis septentrionalis)*	Threatened	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests
Running buffalo clover *(Trifolium stoloniferum)*	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day

Source: Federally Listed Endangered and Threatened Wildlife and Plant Species by County, Ohio Department of Natural Resources

Agricultural Conservation Practices

Most of the land in the Paddys Run watershed is privately owned; therefore, knowledge of conservation practices may be limited. Table 6 provides a summary of the conservation practices installed within the Paddys Run HUC-12 over the last 5 years (2017 – 2022).

Table 6 Estimates of Conservation Practices within the Paddys Run Watershed

Conservation Practice	Estimated Acreage Treated	Estimated Nitrogen Load Reduction (lb/yr)*	Estimated Phosphorous Load Reduction (lb/yr)*
Conservation Tillage** (no till, reduced till)	2,000	12,470	1,419
Cover Crops**	257	1,572	44

**Estimates calculated using Spreadsheet Tool for Estimating Pollutant Loads (STEPL), Version 4.4 (USEPA, 2019)*
***Estimated by Butler SWCD office based on the field experience*

In addition to the listed conservation practices, multiple grassed waterways are in the planning stage and will be constructed on private farms in Butler County in summer/fall of 2023. This practice is sponsored by the Environmental Quality Incentive Program (EQIP) (Personal Communication: Butler SWCD).

Future nutrient reduction projects implemented through this NPS-IS and available state and federal programming will be compiled to track progress made towards nutrient reduction and conservation goals in the Paddys Run HUC-12**.**

Watershed Development Pressure

Land development has a significant impact on quantity and quality of water resources. As the area urbanizes, it generates more sewage, and increases pollutant and pathogen loading in the watershed. Greater development might increase runoff intensity, stream fluctuation, flashiness, and frequency and severity of flooding. Also, it can increase streambank erosion and sedimentation, degrading water quality of local streams and rivers. Based on the studies conducted by the Center for Watershed Protection (CWP), most streams experience decline in their water quality and habitats when watershed impervious cover (IC) exceeds 10%, with severe degradation expected beyond 25% IC (CWP, 1993).

In 2014, OKI conducted a study to evaluate the impact of development on the water quality of 82 watersheds in southwest Ohio, including the Paddys Run HUC-12 (OKI, 2014).

The Impervious Cover Model (ICM), a widely accepted watershed management-planning tool, was used to analyze the relationship between impervious surface and slope, soil erodibility, riparian buffers and the underlying aquifer within each watershed. The analyses were conducted using imagery data from 2007 (Personal Communication, OKI). According to the ICM, in 2007 approximately 6.9% of the Paddys Run HUC-12 was covered by impervious surfaces. The IC rating put this watershed in the “sensitive but should have acceptable water quality and habitat” category (OKI, 2014).

A detailed summary of the relationships between IC and environmentally sensitive areas within the Paddys Run watershed are presented in Table 7.

Table 7 Impervious Cover vs. Slope, Soil Erodibility, Riparian Corridors and Aquifer Area in Paddys Run

Impervious Acres with 0-10% slopes	**Impervious Acres with 11-20% slopes**	**Impervious Areas with > 20% slopes**
570.9 (5.5% of the watershed area)	104.1 (1.0% of the watershed area)	41.8 (0.40% of the watershed area)
Impervious Acres on Highly Erodible Soils	**Impervious Acres on Not Highly Erodible Soils**	**Impervious Acres on Potentially Highly Erodible Soils**
98.1 (0.94% of the watershed area)	332.8 (3.2% of the watershed area)	270.7 (2.6% of the watershed area)
Impervious Acres Outside of Riparian Corridors*	**Impervious Acres Inside of Riparian Corridors***	
657.1 (6.3% of the watershed area)	59.6 (0.57% of the watershed area)	
Impervious Acres Not Over an Aquifer Area	**Impervious Acres Over an Aquifer Area**	
299.9 (2.9% of the watershed area)	416.7 (3.99% of the watershed area)	

Data Source: OKI
** 200 ft wide riparian corridor*

Currently over 15% of the Paddys Run watershed is developed. With the growing population, the residential development and the IC will also increase – negatively affecting the water quality and habitats within the watershed. Therefore, protecting sensitive environments – especially riparian corridors – from further development is critical for keeping the Paddys Run watershed healthy.

2.2. Summary of Biological Trends for Paddys Run HUC-12

In 2010, the Ohio EPA conducted the Biological and Water Quality Study of the Lower Great Miami River and Selected Tributaries, which also included an assessment of the Paddys Run watershed (Ohio EPA, 2012). In 2013, MBI also evaluated this HUC-12 as a part of a larger, 2013 Water Quality Assessment of the Great Miami River and Tributaries study (MBI, 2014).

One sampling location along Paddys Run was selected in the Paddys Run HUC-12 during the 2012 Ohio EPA sampling event. In 2013, the MBI selected five sampling locations within this watershed; four locations along Paddys Run and one at the mouth of its unnamed tributary.

This section summarizes the major findings included in the 2012 Ohio EPA and 2014 MBI reports (Fig. 13, Table 8).

Table 8 Sampling locations within Paddys Run HUC-12

Stream Mile	Drainage Area (mi^2)	Sample Type	Location	Latitude	Longitude
Paddys Run					
4.73	6.7	C, FHW, QL	Upst. Fernald D.O.E. at Morgan Ross Rd.	39.3192	-84.7033
4.6	6.8	C, N, H, O, B, FHW, QL	Upst. D.O.E Fernald	39.31987	-84.70229
3.85	9.6	C, N, H, O, B, FHW, HD	Dst. D.O.E. Fernald	39.23102	-84.70177
1.79	12.9	S, N, H, O, B, FHW, QL	Dst. Pilot Plat Drainage Ditch	39.28664	-84.69341
0.24	16.3	C, N, H, B, FHW, QL	Upst. Mouth	39.26682	-84.69017
Unnamed Tributary to Paddys Run					
0.3	0.7	FHW, QL, PHW	Dst. New Haven/HWY 128	39.27393	-84.68596

Sources: Ohio EPA, 2012; MBI, 2014;
QL – macroinvertebrate qualitative; FHW = fish headwater; C= conventional water chemistry; N= nutrients; H= heavy metals; O= organics water chemistry; B= bacterial; S= sediment chemistry, PHW = primary headwater

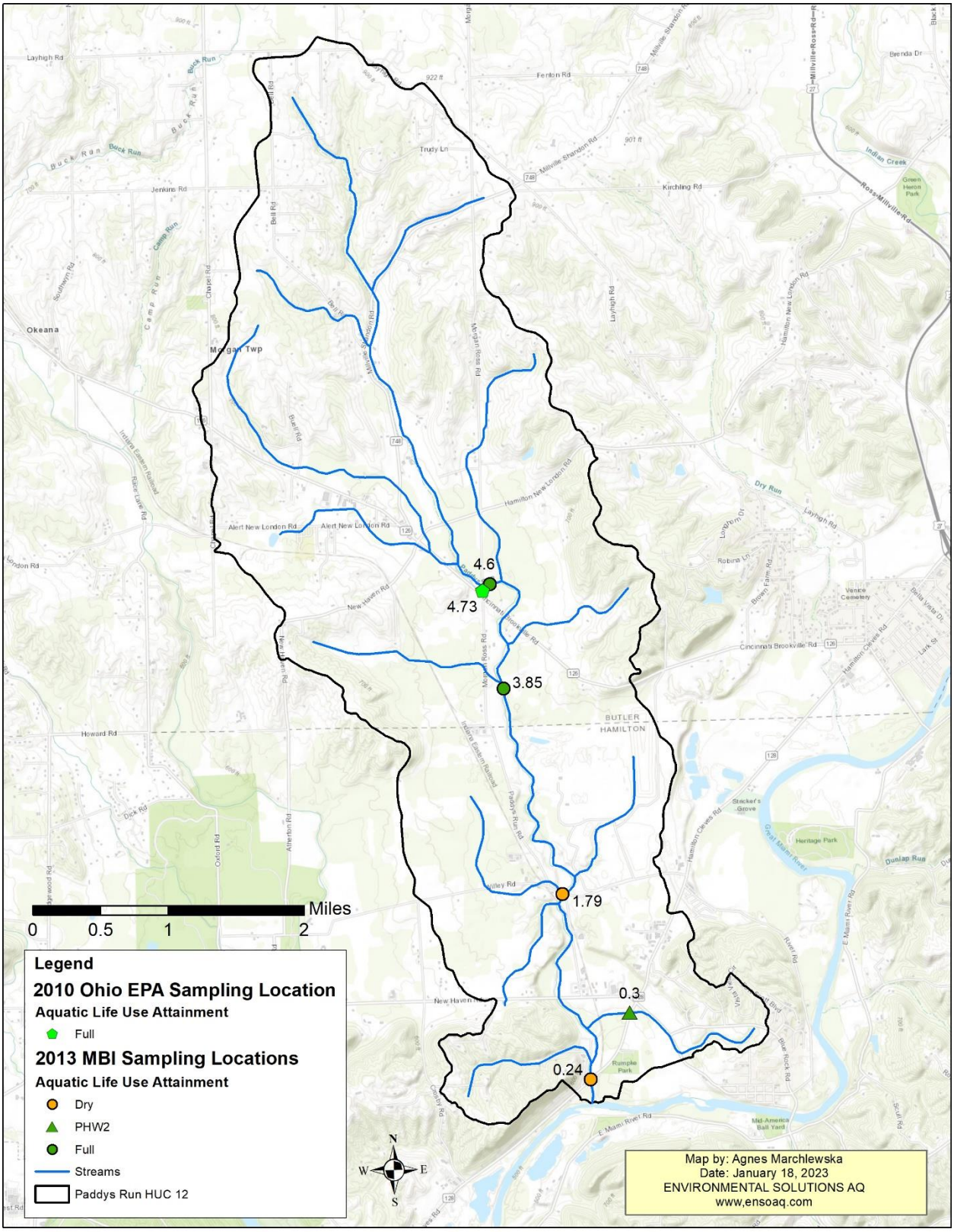

Figure 13 Sampling locations in Paddys Run HUC-12

A summary of the biological trends indicating the quality of near and in-stream habitats at six sampling locations within the Paddys Run watershed is provided in Table 9.

The biological assemblages evaluated in 2010 by the Ohio EPA at one selected sampling location within the Paddys Run HUC-12 were good and supported existing WWH Aquatic Life Use (ALU) designation.

In 2013, the MBI sampled two streams in this watershed. The variation in flow between sites was relatively great with the two upstream sites along Paddys Run having flow and supporting the WWH for the ALU criteria, while the two downstream sites with larger drainage areas (12.9-16.8 mi.^{2}) being dry. The lower reach of Paddys Run has eroded through the clay-rich glacial overburden into the underlying Great Miami Aquifer. This results in the stream being intermittent in nature during the low flow conditions from June to October and is likely the reason why the 2013 sampling locations were dry and couldn't be evaluated.

A primary headwater (PHW) tributary that enters Paddy's Run at River Mile (RM) 0.65 was also affected by the ephemeral flow conditions. This Paddys Run tributary was too small to support the WWH use, lacked key salamander species, and sufficient cold-water and EPT macroinvertebrate taxa, but had suitable habitat to be classified as a PHW 2 stream. EPT refers to the "pollution sensitive" orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).

Table 9 Biological indices scores for the sampling sites

Stream Mile	Ecoregion	IBI	MIwb[a]	ICI[b]	QHEI	ALU Designation[c]	Attainment Status	Causes
Paddys Run								
4.73	ECBP	52	-	G	65.5	WWH	Full	
4.6	ECBP	40	-	G	67.5	WWH	Full	
3.85	ECBP	46	-	44	69.0	WWH	Full	
1.79	ECBP	Dry	-	Dry	-	WWH	-	Flow issues
0.24	IP	Dry	-	Dry	-	WWH	-	Flow issues
Unnamed Tributary to Paddys Run								
0.30	IP	Dry	-	NA	33	PHW2	-	Flow issues

Sources: Ohio EPA, 2012; MBI, 2014
ECBP – Eastern Corn Belt Plains Ecoregion
IP – Interior Plateau Ecoregion
a MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
b A narrative evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition was used when quantitative data was not available or considered unreliable due to current velocities less than 0.3 fps flowing over the artificial substrates. VP=Very Poor, P=Poor, LF=Low Fair, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional
c Attainment status is given for the existing or, if a change is proposed, the recommended use designation.
ns Nonsignificant departure from biocriterion (<4 IBI or ICI units, or <0.5 MIwb units).

** Indicates significant departure from applicable biocriterion (>4 IBI or ICI units, or >0.5 MIwb units).*
QHEI - Qualitative Habitat Evaluation Index
WWH - Warmwater Habitat
EWH - Exceptional Warmwater Habitat
PHW2 – Primary Headwater Class II Stream

2.2.1. Biological Assessment: Fish Assemblages

The fish assemblages of Paddys Run were surveyed and assessed as a part of two independent studies of the Lower GMR and selected tributaries. These studies were conducted in 2010 by the Ohio EPA and in 2013 by the MBI (Table 10).

The Ohio EPA collected a total of 2,714 fish comprising 18 species from the sampling site along Paddys Run located at Morgan-Ross Road. The numerically predominant species at this site included: Central Stoneroller (49.11%), Western Blacknose Dace (9.43%), Southern Redbelly Dace (8.57%), Striped shiner (5.01%), Green Sunfish (4.69%), Creek Chub (3.29%), Johnny Darter (2.91%), Fantail Darter (2.86%) and Rainbow Darter (2.32%). The IBI score evaluated by the Ohio EPA for this sampling site was 52 and exceeded the existing EWH ALU criterion.

The fish assemblage results in two of the four Paddy's Run sites assessed by the MBI met the WWH criteria for the ALU with IBI score of 40 at RM 4.6 and an IBI score of 46 at RM 3.85. A total of 5032 fish were collected at these sites, including 14 different species at RM 4.6 and 19 at RM 3.85. The numerically predominant species were: Central Stoneroller (28.13% at RM 4.6 and 19.29% at RM 3.85), Creek Chub (19.76% at RM 4.6 and 16.50% at RM 3.85), Bluntnose Minnow (15.70% at RM 4.7 and 14.73% at RM 3.85), Southern Redbelly Dace (14.32% at RM 4.7 and 5.87% at RM 3.85 and Striped Shiner (7.16% at RM 4.6 and 12.21% at RM 3.85).

The two downstream sites along Paddys Run and one site along an unnamed tributary to Paddys Run were dry during the sampling season.

Table 10 Fish Community and Descriptive Statistics

Stream Mile	Ecoregion	Cumulative Species	Sensitive Species	Rel. Number	IBI	MIwb	QHEI	Narrative Evaluation
Paddys Run								
4.73	ECBP	18	2	2714	52	-	65.5	Exceptional
4.6	ECBP	14	1	2318	40	-	67.5	Good
3.85	ECBP	19	3	2146	46	-	69.0	Good
1.79	ECBP	-	-	-	Dry	-	-	-
0.24	IP	-	-	-	Dry	-	-	-
Unnamed Tributary to Paddys Run								
0.30	IP	-	-	-	Dry	-	-	-

Source: *Ohio EPA, 2012; MBI, 2014*
ECBP – Eastern Corn Belt Plains Ecoregion
IP – Interior Plateau Ecoregion

2.2.2. Biological Assessment: Macroinvertebrate Community

The macroinvertebrate assemblages in the Paddys Run HUC-12 were surveyed as part of larger studies of the GMR and its tributaries conducted in 2010 by the Ohio EPA and again in 2013 by the MBI.

The Ohio EPA sampled one location along Paddys Run at Morgan-Ross Road. The macroinvertebrate communities at the selected site were found in good condition and met the WWH criteria for the ALU. They were dominated by the helicopsychid caddisflies, which are common for enriched streams in the ECBP ecoregion.

The MBI evaluated the macroinvertebrate communities at two upstream sites along Paddys Run. Both of them met the WWH criteria for the ALU, one with a narrative rating of good and the other with an ICI score of 44. The two downstream sites and one along the Paddys Run tributary were not assessed due to lack of flow during the sampling season.

Table 11 Macroinvertebrate Sampling Results

Stream River Mile (RM)	Dr. Area (Sq. mi.)	ICI[a]	ALU
Paddys Run			
4.73	6.7	G	WWH
4.6	6.8	G	WWH
3.85	9.6	44	WWH
1.79	12.9	Dry	-
0.24	16.3	Dry	-
Tributary to Paddys Run			
0.3	0.7	Dry	PHW2

Source: Ohio EPA, 2010; MBI, 2014
RM - River Mile
ICI - Invertebrate Community Index
ICI[a] -- Qualitative narrative evaluation based on community composition, EPT taxa richness, and QCTV scores are given letter scores (e.g., E – Exceptional, VG – Very Good, etc.).

2.2.3. Physical Habitat - Qualitative Habitat Evaluation Index QHEI

Ohio EPA assessed the habitat characteristics through the Qualitative Habitat Evaluation Index (QHEI), which provides an understanding of existing habitat features important to fish communities and is based upon methodologies established by Rankin's habitat assessments (Rankin 1989, Rankin 1995, Ohio EPA 2006). During this evaluation, several habitat characteristics were assessed on the stream reach, such as type/quality of substrate, amount/quality of in-stream vegetative cover, channel morphology, extent/quality of riparian vegetation, pool/run/riffle quality, etc. Mean QHEI values from rivers or river segments equal to or greater than 60.0 generally indicate a level of macrohabitat quality sufficient to support an assemblage of aquatic organisms fully consistent with the WWH ALU designation. Average reach values at greater than 75.0 are generally considered adequate to support fully exceptional (EWH) communities (Rankin 1989 and Rankin 1995). Values between 55 and 45 indicate limiting components of physical habitat are present and may exert a negative influence upon ambient biological performance. However, due to the potential for compensatory stream features (e.g., strong ground water influence) or other watershed variables, QHEI scores within this range do not necessarily exclude WWH or even EWH assemblages. Values below 45 indicate a higher probability of habitat derived ALU impairment.

In the 2010 Ohio EPA report, the QHEI evaluated at one sampling location within the Paddys Run HUC-12 showed the QHEI score of 65.5 indicating the habitat features capable of supporting typical warmwater stream faunas. The habitat in two upstream sampling sites along Paddys Run assessed in 2013 by the MBI was also good with the QHEI scores of 67.5 and 69 (Table 12).

The most limiting factors influencing the QHEI scores at the sampling sites located in the upstream section of Paddys Run were low flow, lack of fast current, fair to poor development of channel morphology and high to moderate embeddedness.

The sampling sites selected by the MBI along downstream section of Paddys Run and its unnamed tributary were dry during the sampling season and therefore not assessed.

Table 12 QHEI Matrix and Scores

Key QHEI Components			WWH Attributes											MWH Attributes														
River Mile	QHEI	Narr.	Not Channelized or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrate	Good/Excellent Development	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Embeddedness	Max Depth > 40 cm	Low/Normal Riffle Embeddedness	**WWH Attributes**	Channelized/No Recovery	Silt/Muck Substrate	No Sinuosity	Sparse/No Cover	Max Depth > 40 cm	**High-Influence Modified Attributes**	Recovering Channel	Heavy/Moderate Substrate	Sand Substrate (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1 or 2 Cover Types	Intermittent/Poor Pools	No Fast Current	High/Moderate Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Mod. Influence Modified Attributes**	MWH Hl. + 1/ WWH +1 Ratio	MWH M.I./WWH Ratio
Paddys Run (Year: 2010 and 2013)																																		
4.9	**65.5**	G	x	x		x	x	x		x	x	x	8						0		x			x				x	x	x		5	0.11	0.78
4.68	**67.5**	G	x	x			x	x		x	x	x	7						0					x				x				2	2.67	0.38
3.8	**69**	G	x	x		x	x	x		x	x	x	8						0									x				1	4.5	0.22

Source: Ohio EPA, 2010; MBI, 2014

2.2.4. Water Quality

In addition to biological assessment, the Ohio EPA also collected surface water samples from one location along Paddys Run at Morgan Ross Road. The samples were analyzed for conventional chemistry. No exceedances of water quality standards were found in the inorganic chemistry sampling results.

The MBI collected in 2013 continuous measurements of D.O. at four selected sampling sites along Paddys Run. Three of these sites: RM 4.72, RM 3.82 and RM 0.1 showed D.O. below the minimum water quality criteria (Table 13). The identified D.O. exceedances were likely related to low stream flow during summer months.

The water grab samples collected at RM 3.82 and RM 1.79 showed slightly elevated concentrations of lead and cadmium, which exceeded the WWH criteria. These metals are often associated with industrial pollution and found in urban and agricultural runoff.

Table 13 2013 Dissolved oxygen exceedances

Stream River Mile (use designation)	**Parameter (value) – units are in mg/L for dissolved oxygen**
Paddys Run (WWH)	
4.72	D.O. (2.57), (2.63), (3.98)
3.82	D.O. (3.95), (3.12); Cd (5.90); Pb (19.00)
1.79	Cd (5.40)
0.10	D.O. (2.56), (3.12), (2.62)

Source: MBI 2014

WWH – Warmwater Habitat
D.O. – Dissolved Oxygen (mg/L)

The nutrient parameters measured by the MBI were mostly below or close to the regional reference targets which the MBI study defined as “the biologically derived thresholds relating concentrations to levels associated with attainment of fish IBIs and macroinvertebrate ICIs for appropriate aquatic life uses in Interior Plateau (IP) or Eastern Corn Belt Plains (ECBP) ecoregions” (MBI, 2014).

Table 14 2013 Nutrient sampling results

RM	Total Ammonia (mg/L)		Nitrate (mg/L)		TKN (mg/L)		Total Phosphorous (mg/L)		Benthic Chlorophyll (mg/m^3)*
	Median	Target	Median	Target	Median	Target	Median	Target	Median
4.72	BD	0.064	0.850	1.180	0.540	0.500	BD	0.130	92.600
3.82	BD	0.064	0.250	1.180	0.440	0.500	BD	0.130	58.600
1.79	BD	0.064	0.250	1.180	BD	0.500	BD	0.130	68.900
0.10	BD	0.064	0.920	1.180	BD	0.500	0.510	0.130	68.900

Source (MBI, 2014)
TKN – Total Kjeldahl Nitrogen
BD – Below the detection limit
**Shading ranges for Benthic Chlorophyll on the Ohio EPA Trophic Criterion Scores – low (empty) - =< 107 mg/m3, typical 108 -183 mg/m3, elevated 184 -320 mg.m3, >320 - 50% change of biological impairment.*

Bacterial data were collected in 2013 by the MBI at four sampling locations within the Paddys Run HUC-12 (Table 15). The *E. coli* results from each sampling location exceeded both; the seasonal geometric mean of 126 cfu/100 ml, and the single sample maximum criteria (298 cfu/100 ml) for the Primary Contact Recreational Use designation. The potential sources of this impairment maybe agricultural runoff and failing onsite HSTS.

Table 15 A summary of E. coli data for Paddys Run 2013 sampling locations

Stream RM	# Samples	Geometric Mean	Maximum Value	Recreational Use Status
4.72	9	400.1	2420.0	Non
3.82	8	730.6	2420.0	Non
1.79	5	660.8	2420.0	Non
0.10	5	313.9	2420.0	Non

Source: (MBI, 2014)

2.3. Summary of TMDL

No TMDL has been prepared for the Paddys Run watershed but the Ohio EPA listed this HUC-12 as impaired waters, which need a TMDL restoration plan. The Paddys Run HUC-12 aquatic life beneficial use was determined to be WWH. One sampling location evaluated in 2010 by the Ohio EPA along Paddys Run at Morgan Ross Road was in full attainment. The watershed is also impaired for human health – fish consumption. The recreational use for this watershed has not been assessed by the Ohio EPA, but the MBI study published in 2014 assigned nonattainment status to all four sampling sites selected along Paddys Run, where high level of bacteria (*E. coli*) were detected.

2.4. Summary of Pollution Causes and Sources

Paddys Run HUC-12 was surveyed as a part of two larger studies of GMR and its tributaries. First study was conducted by the Ohio EPA in 2010 and second was conducted in 2013 by the MBI. Total five sampling locations selected along Paddys Run and one selected along its unnamed tributary were evaluated. The results showed that Paddys Run had generally good water quality and was able to support an assemblage of aquatic organisms consistent with WWH. The lower values of dissolved oxygen measured by the MBI in 2013 at three sampling locations along Paddys Run were associated with low flow conditions during summer. Two sampling locations showed slightly elevated concentrations of cadmium and lead often associated with the agricultural (cadmium) or urban runoff pollution. In addition, the MBI listed *E. coli* as a cause of recreational impairment.

The agricultural and residential runoff, channelization and streambank and fields erosion, and failing onsite HSTS are the primary causes of impairments in the Paddys Run HUC-12. The row crop agriculture has been determined to be one of the main sources of excessive nutrient loads, and siltation/sedimentation in rural watersheds, and a major contributor to Gulf of Mexico hypoxia. Additionally, increasing development pressure and agricultural and residential encroachments, especially in the riparian corridors may be the source of habitat impairment, nutrient enrichment from wastewaters, and drainage and storage capacity impairments.

Estimated baseline nutrient loads and estimated target load reduction for the Paddys Run HUC-12 were calculated using a mass balance equation provided by Rick Wilson, Ohio EPA (Table 16). The goal loads presented are 20 percent of the total estimated baseline loads for annual nitrogen contribution in the Paddys Run watershed.

The 2020 report on management of onsite systems did not report the number of failing home systems at this watershed (OKI, 2020). Information about urban loading is limited since there are just three small communities in this agricultural watershed. This version of the Nine-Element Paddys Run HUC-12 will be focusing on reducing agricultural nutrient loads. Once more information is available for the urban loading, the next version of the plan will be updated to include them.

Table 14 Estimated nitrogen and phosphorus loadings from contributing NPS sources in Paddys Run HUC-12

	Agricultural Load (lbs Nitrogen/acre)	Agricultural Load (lbs Phosphorus/acre)	Development Load (lbs Nitrogen/acre)	Development Load (lbs Phosphorus/acre)
Current Estimates*	102,637	3,451	15,720	6,499
Target Reduction Goals	20,527	690	3,144	1,300

*Estimates provided by Rick Wilson, Ohio EPA in March 2023

2.5. Additional Information for Determining Critical Areas and Developing Implementation Strategies

2.5.1. Agricultural Conservation Planning Framework

The Agricultural Conservation Planning Framework (ACPF) is an agricultural watershed management tool using high-resolution spatial data and ArcGIS to identify opportunities for installing conservation practices within a watershed (Tomer et al., 2013). Developed by the US Department of Agriculture, the ACPF is being used in hundreds of watersheds to inform and engage local communities in agricultural conservation. The program spatially combines high resolution terrain, drainage, soils, land use and crop land data, and identifies and prioritizes potential areas for conservation (ARS, 2019). ACPF can engage stakeholders in the watershed planning process by proposing conservation solutions. The program is not prescriptive but provides various options and scenarios that can be evaluated at watershed and farm levels including conservation practices within fields, below fields and in riparian zones (Tomer et al., 2013). The following ACPF conservation practices are found applicable in our region:

Grassed Waterway – NRCS Practice code 412
Buffer Contour Strip – NRCS Practice code 332
Nutrient Removal Wetlands – NRCS Practice code 658
Water and Sediment Control Basin (WASCOB) – NRCS Practice code 638
Riparian Buffer – NRCS Practice code 391
Streambank Stabilization – NRCS Practice code 580

Filter Strip – NRCS Practice code 393 - Filter Strips are not specifically identified in the ACPF but they are very applicable in this region. This practice would be situated parallel to a perennial stream and consists of a strip of dense perennial cool-season or warm-season grasses, often with additional broadleaf species mixed in. The thick vegetation removes nutrients and sediment from overland flow and stabilizes floodplains when out-of-bank-flow occurs. This can be very effective for nutrient removal and treatment and will replace the Contour Buffer Strips identified in the ACPF.

The ACPF riparian assessment (riparian buffer and streambank stabilization) utilizes a matrix of two variables: the width of the riparian zone and runoff delivery. The output further provides

specific riparian design types based on a cross-classification matrix. These design types include critical zones for sensitive sites, multi-species buffer for water uptake, nutrient and sediment trapping, stiff-stemmed grasses for trapping runoff and sediment, deep-rooted vegetation tolerant of saturated soil, and sections emphasizing streambank stability because of the narrow buffer width. The purpose of this riparian management assessment is to provide the most water quality benefits by identifying segments to install permanent vegetation specifically designed to intercept surface runoff, protect shallow groundwater in low-lying areas and stabilize stream banks. This is especially applicable in this watershed since the riparian zone is steep (Figure 5) and many bare and exposed banks are the source of streambank erosion and siltation/sedimentation.

2.5.2. ACPF modeling for Paddys Run HUC-12

The ACPF model was performed for the Paddys Run HUC-12 using a 2.5 ft LIDAR DEM from Ohio Geographically Referenced Information Program (OGRIP) and a file geodatabase provided by ARS (USDA, 2020). The tool was run using cropland data layers representing the years 2015 through 2020.

The ACPF model identified a number of possible in-field conservation practices, below-field practices and also riparian zone designs in the Paddys Run watershed (Table 16). As estimated by the ACPF model, 32.4% of analyzed agricultural fields (4499.8 acres of crops and pasture) at Paddys Run HUC-12 are considered high or very high runoff risk and at least 58.5% of the crop fields are tile-drained. Figures 14 to 16 depict the ACPF model results.

Outputs from the ACPF model were presented and discussed with the stakeholders at the NPS-IS public meeting on January 28, 2023 as well as during field visits and ground verification at selected locations. The output has been beneficial in engaging discussions with landowners about potential conservation practices. The ACPF maps provide a visual tool for the landowners, making field visits and discussions more effective and efficient.

Table 17 Conservation Practices at Paddys Run HUC-12 Suggested by the ACPF

The ACPF Maps and estimates are only for planning purposes

Practice	Unit	Length (Miles)	Area (Acres)
In-Field Practices			
Grassed Waterways	282 sites	26.2	95.3*
Contoured Buffer Strips/Filter Strips	114 sites	25.7	93.6*
Below-Field Practices			
Nutrient Removal Wetlands	12 wetlands	NA	3162.7** Pools:36.3 Buffers: 41.3
WASCOBs	30 sites	NA	189.1**
Depressions	3 sites	NA	70.9**
Riparian Zone			
Riparian Buffers (various plants)	NA	43.8	NA
Streambank Stabilization	NA	59.9	NA

**Assuming 30 feet wide*
*** Contributing area*
NA – Not applicable

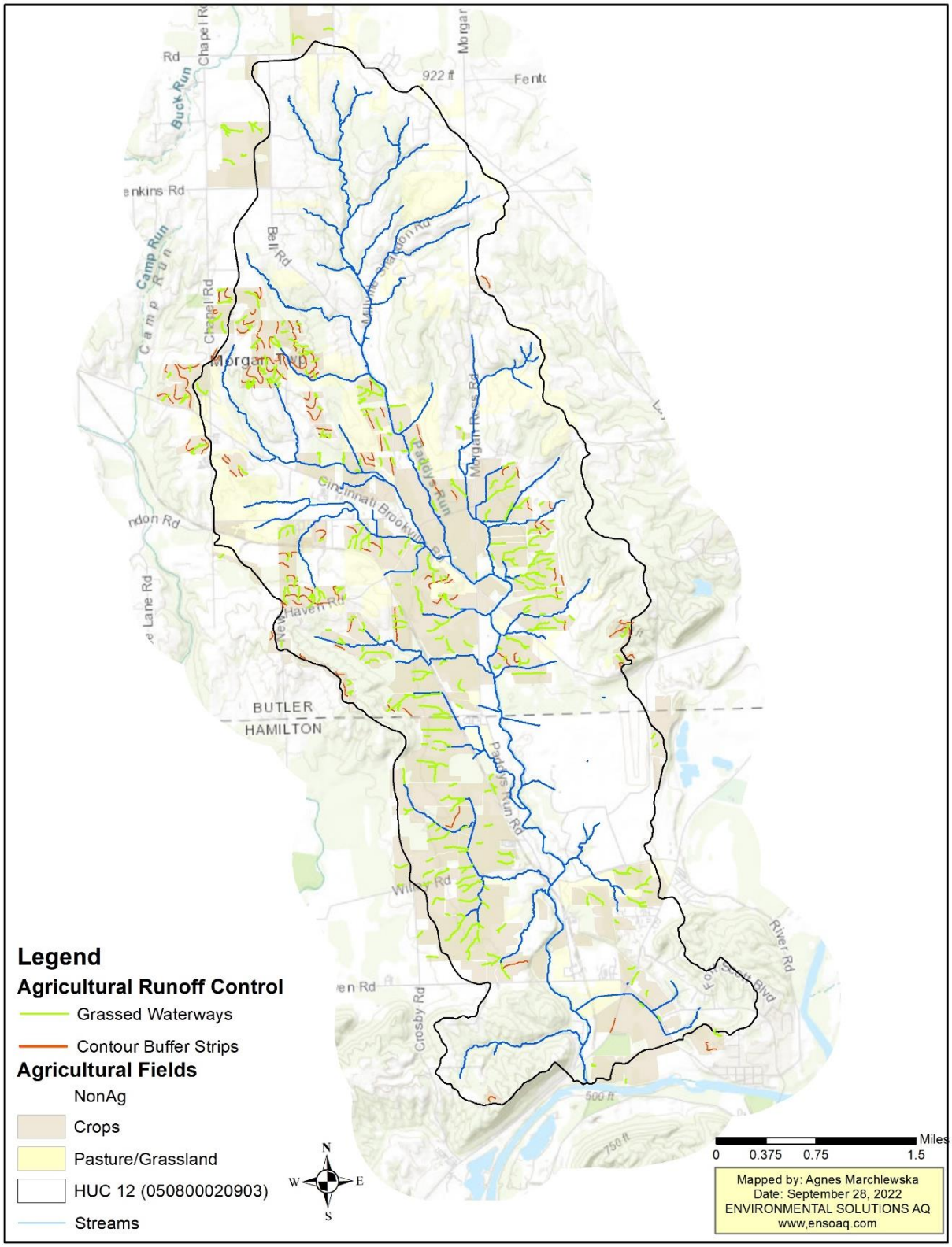

Figure 14 ACPF In-Field Agricultural Conservation Practice Opportunities in Paddys Run HUC-12: Runoff Control

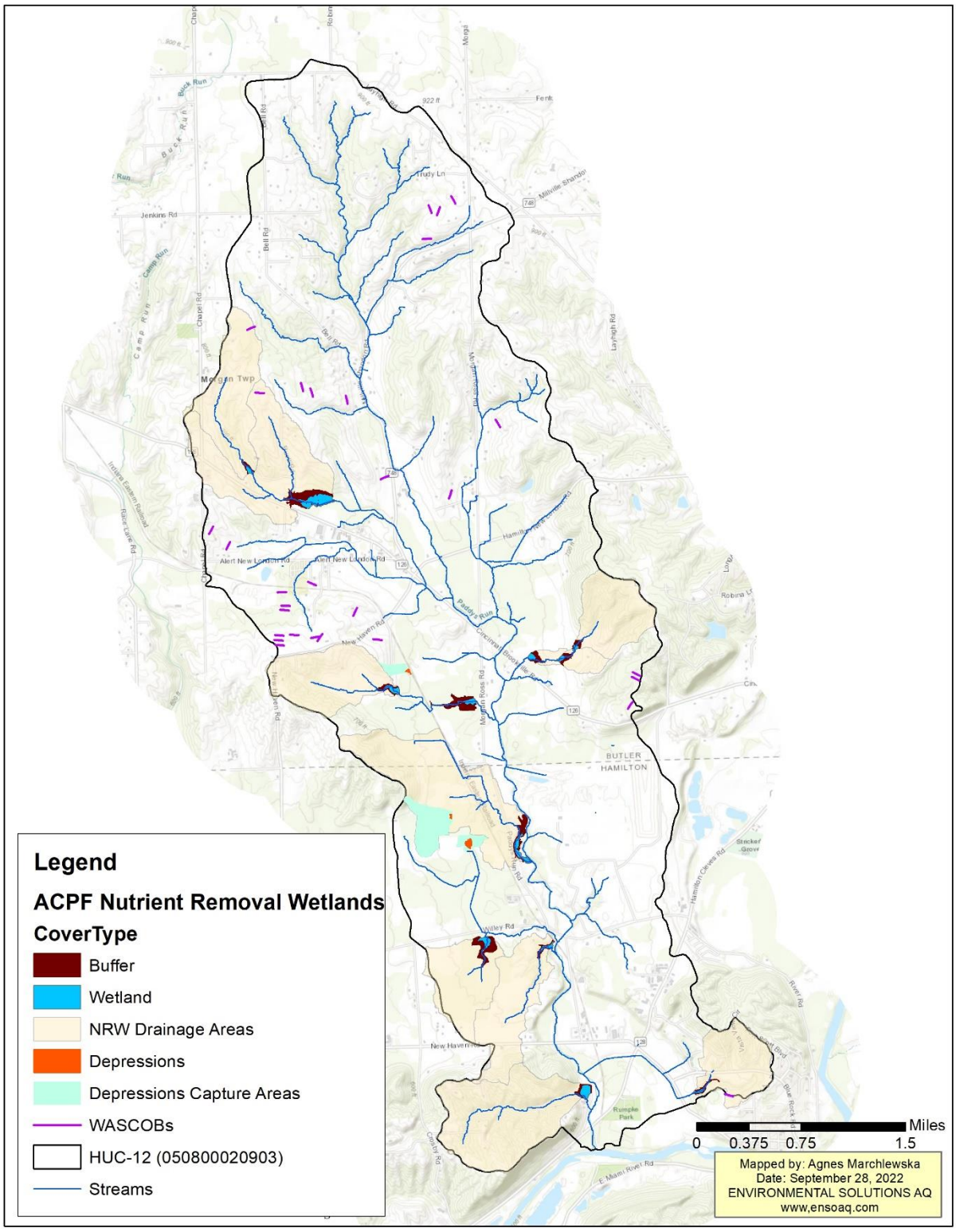

Figure 15 ACPF Below-Field Agricultural Conservation Practice Opportunities in Paddys Run HUC-12: Water Retention and Storage

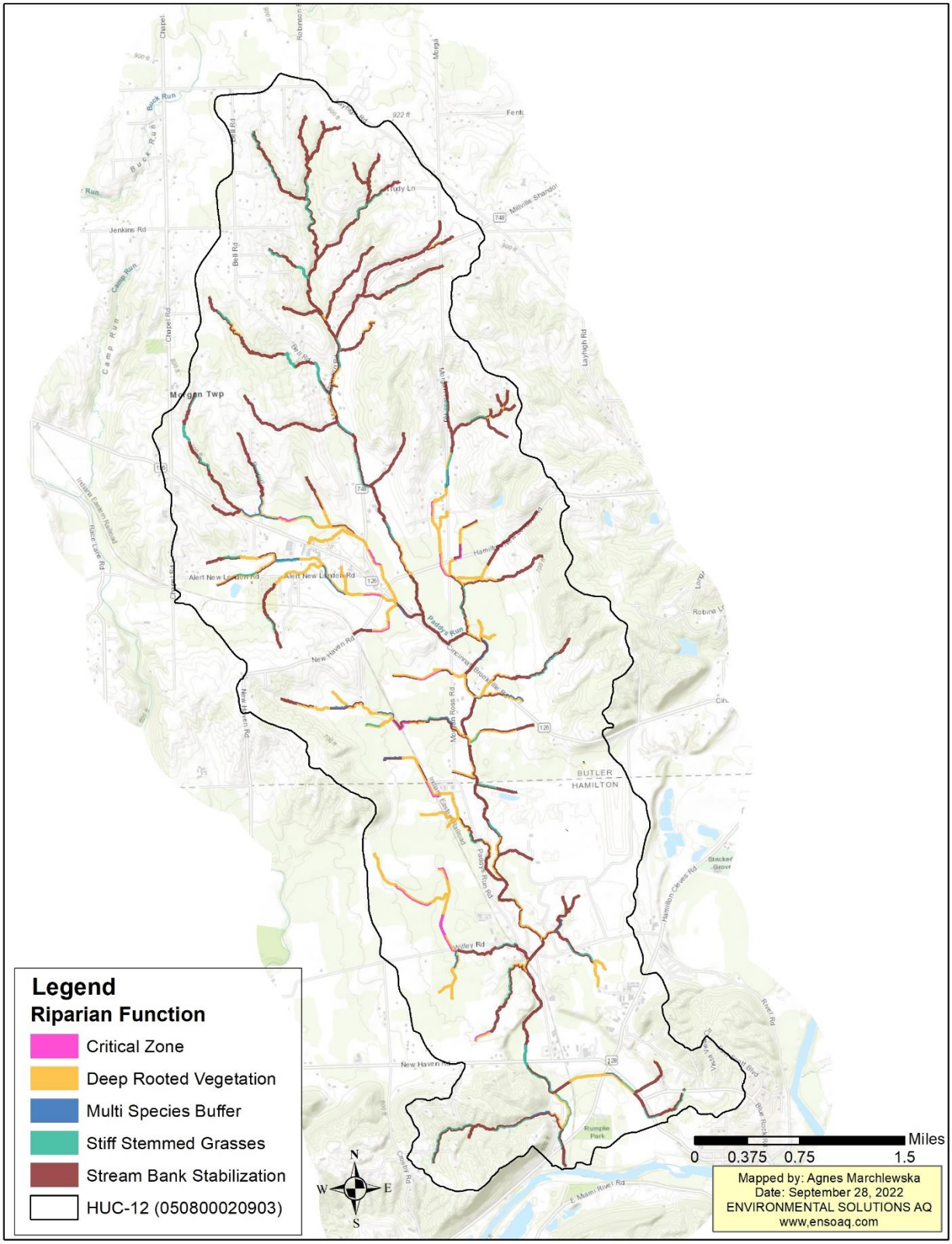

Figure 16 Riparian Function Management Suggested by ACPF in Paddys Run

Chapter 3: Conditions & Restoration Strategies for Paddys Run HUC-12 Critical Areas

3.1 Overview of Critical Areas

The Paddys Run watershed was assessed during Ohio EPA's Biological and Water Quality Study of the Lower GMR and Selected Tributaries (Ohio EPA, 2012). The Ohio EPA limited the sampling activities in this HUC-12 to just one location selected along Paddys Run, which at the time was in full attainment for its designated ALU. In 2013, the MBI conducted the Biological and Water Quality Assessment of the GMR and Tributaries (MBI, 2014). During this study four monitoring sites were selected along Paddys Run and one along its unnamed tributary. Two upstream sampling locations were in full attainment for the ALU. The remaining two sites located along downstream section of Paddys Run and one site located along the Paddys Run tributary were dry during the sampling season and couldn't be evaluated.

Three of the monitoring sites evaluated by the MBI exceeded water quality values for dissolved oxygen caused likely by low flow conditions during summer. Two of the sites (RM 3.82 and RM 1.79) also showed slightly elevated concentrations of heavy metals; including cadmium and lead, which are often found in the urban and agricultural runoff.

The 2022 Integrated Water Quality Monitoring and Assessment Report (Ohio EPA, 2022) listed the Paddys Run HUC-12 as impaired waters for the ALU and the Human Health – Fish Consumption. The Ohio EPA has not assessed this watershed for the Recreation Attainment.

The excessive nutrients, sedimentation and *E. coli* caused by agricultural runoff from cropland and pastures, narrow or non-existent riparian buffers, streambank erosion, farmland with highly erodible soils, and residential runoff and faulty HSTSs have been identified as main sources of the Paddys Run watershed impairments.

The recommended actions to mitigate these impairments included implementing a wide range of agricultural best management practices: grassed waterways, filter strips, cover crops, manure and nutrient management, conservation tillage or no till, drainage water management and protection from further development and restoration of environmentally sensitive lands; including riparian habitat, floodplain and wetlands.

Two critical areas have been identified within Paddys Run HUC-12 (Fig. 17). Critical Area 1 will address the far-field (Gulf of Mexico) and near-field (local waterways) effects of nutrient enrichment, siltation and sedimentation from agricultural fields and activities. Critical Area 2 will focus on improving and protecting environmentally sensitive riparian habitats of Paddys Run and its tributaries (Table 18). Additional critical areas such as failed HSTS may be identified in subsequent versions of this Nine-Element NPS-IS when more information about HSTS becomes available.

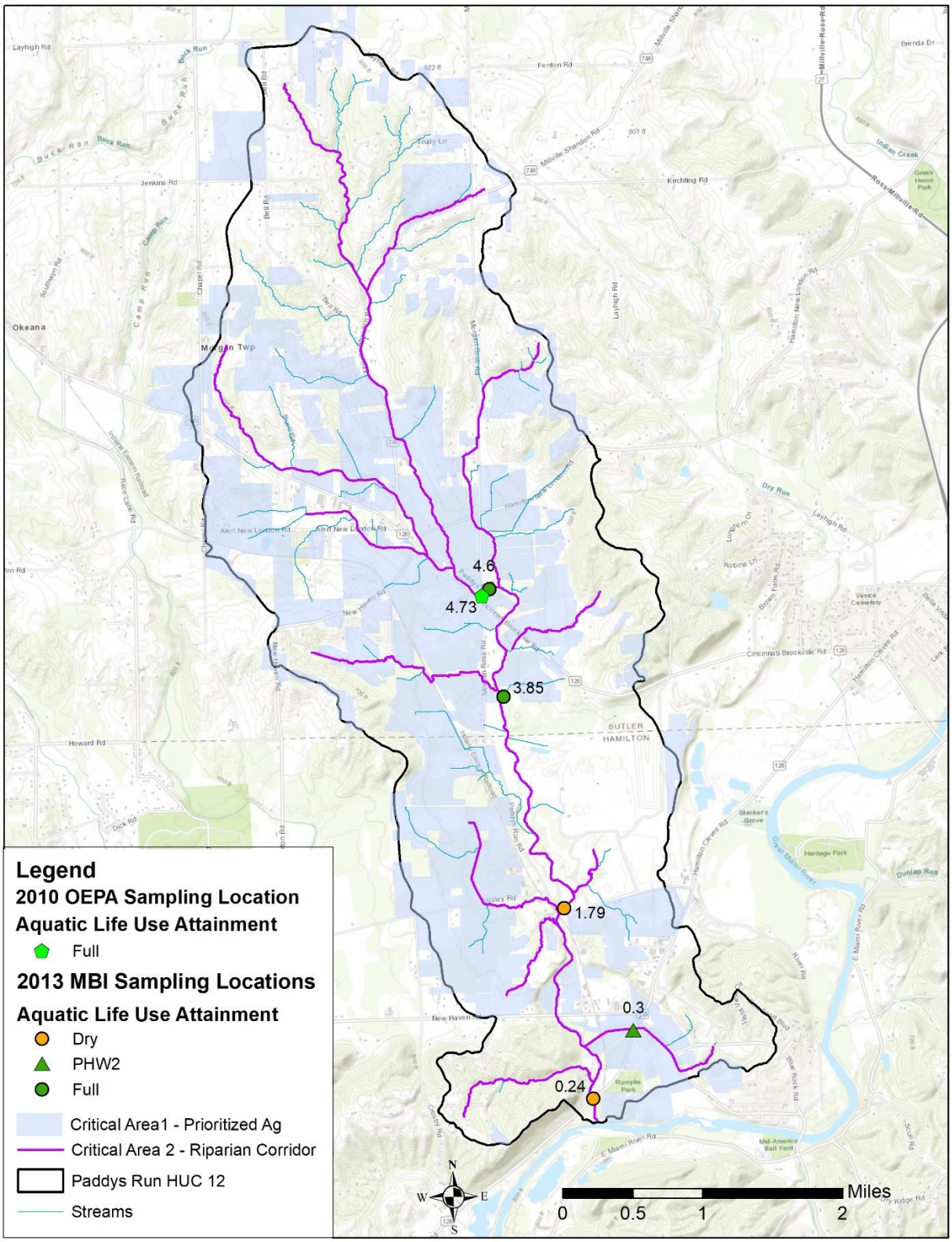

Figure 17 Paddys Run HUC-12 Critical Areas Overview

Table 18 Critical Areas of Paddys Run HUC-12

Critical Area	Critical Area Description	Addressed Impairments	Area (Acres)
1	Prioritized Agricultural fields (row crops and pastures) as determined by the ACPF	Nutrient Management in Prioritized Agricultural Lands *(Near-Field and Far-Field Impairment – Gulf of Mexico hypoxia – N and P Reduction))*	4,516
2	Paddys Run Riparian Corridor (100 ft buffer at each stream side)	Maintain or improve high quality habitats scores in IBI, ICI, QHEI and stream health by reducing nutrients and siltation/sedimentation *(Near-Field and Far-Field Impairment – Gulf of Mexico Hypoxia*)	2,086

3.2. Critical Area 1: Conditions, Goals, & Objectives for Nutrient Reduction and Management in Paddys Run HUC-12 Agricultural Fields

3.2.1. Detailed Characterization

Given the dominance of agricultural land use throughout the Paddys Run watershed, use of BMPs targeting nutrient loss from local farm fields and agricultural activities is recommended. In addition, employment of BMPs may help to reduce siltation and sedimentation in local streams. Although BMPs are encouraged on all agricultural lands, certain lands are more susceptible to nutrient loss and erosion than others are; and therefore, they need to be prioritized for BMP implementation.

Critical Area # 1 is comprised of all agricultural lands throughout the Paddys Run HUC-12 and prioritized based on the criteria set by the local stakeholders (Fig. 18). The ACPF model was used to identify 56 high runoff fields covering 1,458.9 acres of the agricultural land (32.4%) within the Paddys Run watershed.

Based on stakeholders' input and/or determined by the ACPF analyses, the prioritized areas and potential projects should meet at least one of the following criteria:

- Lands identified as high-runoff fields;
- Lands directly adjacent to Paddys Run or its main tributaries;
- Lands experiencing gully erosion;
- Lands currently under conventional tillage regimes and/or underutilizing cover crops;
- Lands without current nutrient management plan or current soil test results (< 3 years).

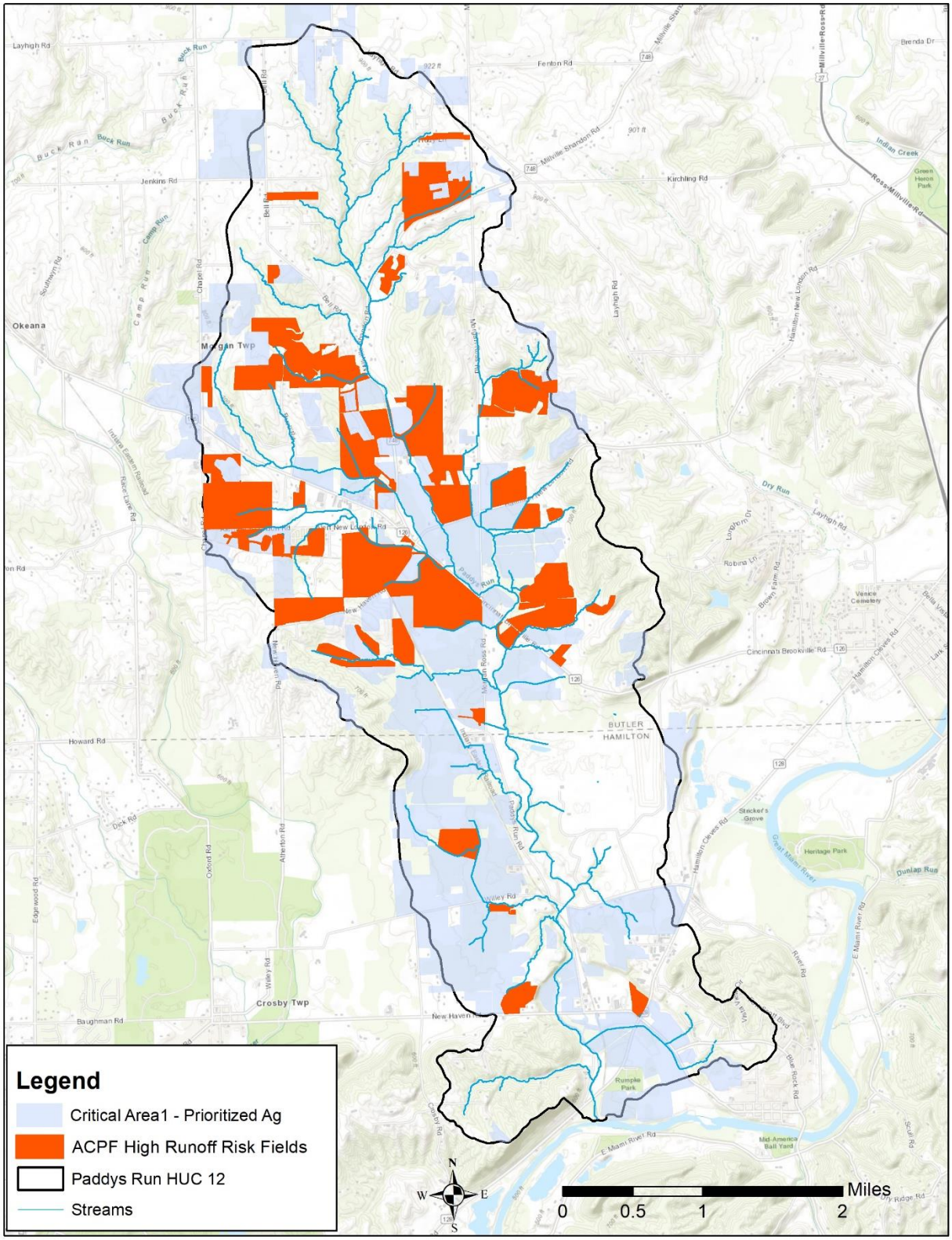

Figure 18 Paddys Run HUC-12 Critical Area #1

3.2.2. Detailed Biological Conditions

The biological conditions in Paddys Run watershed were assessed in 2010 by the Ohio EPA at only one selected sampling site (RM 4.73) along Paddys Run. The fish communities at this location were exceptional with the IBI score at 52.

The additional sampling in the Paddys Run HUC-12 was conducted in 2013 by the MBI. Out of five selected sampling sites only two had flow during the sampling season. Both evaluated sampling sites were located along the upstream section of Paddys Run. The biological indices at these sites were good with the IBI scores ranging from 40 to 46.

All sampling locations assessed by the Ohio EPA and the MBI along upstream section of Paddys Run met the WWH WQS for the IBI (minimum IBI = 40 for headwater sampling) and showed a high quality of fish assemblage. However, no fish species classified as rare, threatened, endangered, or otherwise recognized for special conservation status by the Ohio Department of Natural Resources (ODNR) were observed.

In 2010, the Ohio EPA also evaluated the physical stream features and riparian conditions within the Paddys Run watershed (Table 19). The QHEI score for the sampling site along Paddys Run (RM 4.73) was 65.5.

In addition, two sampling locations along Paddys Run at RM 4.6 and RM 3.85, evaluated in 2013 by the MBI showed QHEI scores of 67.5 and 69, respectively.

All three sampling locations indicated a level of macrohabitat quality sufficient to support aquatic communities consistent with WWH ALU designation.

The habitat deficiencies observed within this watershed were associated with low flow conditions, streambank erosion and riparian encroachments.

Table 15 Fish Community and Habitat Data

RM	QHEI	Drainage Area (mi^2)	Cumulative Species	Predominant species (% of catch)*	Mean MIwb	IBI	Narratives
4.73	65.5	6.7	18	Central Stoneroller (49.11%), Western Blacknose Dace (9.43%), Southern Redbelly Dace (8.57%), Striped shiner (5.01%), Green Sunfish (4.69%), Creek Chub (3.29%), Johnny Darter (2.91%), Fantail Darter (2.86%) and Rainbow Darter (2.32%)	-	52	Exceptional
4.6	67.5	6.8	14	Central Stoneroller (28.13%), Creek Chub (19.76%), Bluntnose Minnow (15.70%), south. Redbelly Dace (14.32%) and Striped Shiner (7.16%)	-	40	Good
3.85	69	9.6	19	Central Stoneroller (19.29%), Creek Chub (16.50%), (14.73%), Southern Redbelly Dace (5.87%) and Striped Shiner (12.21%)	-	46	Good

Ohio EPA, 2010; MBI, 2014
QHEI Qualitative Habitat Evaluation Index
MIwb Modified Index of Well Being
IBI Index of Biotic Integrity

Macroinvertebrate community performance within Paddys Run HUC-12 was evaluated in 2010 by the Ohio EPA at one sampling location along Paddys Run at RM 4.73. The ICI at this location was good and the sampling sites supported the WWH and was in full attainment for the ALU designation.

Due to low flow conditions during the 2013 sampling season, and the intermittent nature of the downstream section of Paddys Run, the MBI was able to assess the macroinvertebrate communities only at two out of five selected sampling sites within the Paddys Run HUC-12. The ICI at RM 4.6 was good and the ICI score at RM 3.85 was 44. Both sites supported the WWH and were in full attainment for the ALU.

Table 20 Macroinvertebrate Community

Stream RM	Dr. Area (Sq. mi.)	No. QI. Taxa	Qualitative EPT	Sensitive Taxa	CW Taxa	ICI/ Narrative Evaluation
4.73	6.7	49	10	13	1	G
4.6	6.8	35	7	5	0.0	G
3.85	9.6	50	6	6	1.0	44

Sources: Ohio EPA, 2010; MBI, 2014

RM: River Mile.
Dr. Ar.: Drainage Area
EPT: Benthic macroinvertebrates from the Ephemeroptera, Plecoptera, and Trichoptera (mayflies, stoneflies, and caddisflies)
Sensitive Taxa: Taxa listed on the Ohio EPA Macroinvertebrate Taxa List as MI (moderately intolerant) or I (intolerant).
CW: Coolwater/Coldwater
ICI - Invertebrate Community Index
ICI Narrative Evaluation - Qualitative narrative evaluation based on community composition, EPT taxa richness, and QCTV scores are given letter scores (e.g., E – Exceptional, VG – Very Good, etc.).

The water quality data evaluated within Paddys Run watershed were generally good and met water quality standards, except for dissolved oxygen at three sampling locations along Paddys Run: RM 4.72, RM 3.02 and RM 0.1. These exceedances were attributed to low flow conditions. In addition, two sampling locations (RM 3.82 and RM 1.9) showed elevated concentrations of heavy metals: cadmium and lead which can be found in agricultural runoff (cadmium) and urban runoff (cadmium and lead).

The nutrient concentrations evaluated in 2013 by the MBI at four sampling locations along Paddys Run were below or close to recommended thresholds for total ammonia, nitrate, TKN and total phosphorus. Only sampling location at RM 4.72 had the TKN concentration slightly above the target (TKN = 0.540 mg/L, target TKN = 0.50 mg/L) and the total phosphorus at RM 0.10 was also elevated (TP =0.510 mg/L, target TP = 0.13 mg/L). These impairments were likely caused by high agricultural and residential runoff near the sampling locations. Also, the MBI study showed that each evaluated sampling site along Paddys Run was impaired with E. coli bacteria from the agricultural production and failing HSTSs.

3.2.3. Detailed Causes and Associated Sources

The 2010 Ohio EPA survey and the 2013 MBI study demonstrated that the Paddys Run mainstem was in full attainment for its ALU designation at the selected sampling locations. No

Paddys Run tributaries were evaluated. Protecting and maintaining health of the streams within this watershed is critical for sustaining and improving its aquatic biodiversity, therefore, nutrient management is necessary.

Agricultural land use and activities in the GMR basin along with discharges from wastewater treatment facilities and failing septic systems have been found to be a leading cause of nutrient enrichment in local streams and rivers. Also, these excessive nutrient loads ultimately contribute to Gulf of Mexico hypoxia. Practical and property-specific BMPs can help reduce the amount and concentration of nutrient-laden surface runoff. These BMPs can also address the loss of sediment/topsoil from agricultural lands and retain and maximize the nutrients in the fields. In addition, the implementation of BMPs on agricultural lands can address the causes of sediment/topsoil and nutrient loss in the fields and reduce the sources of these excess nutrients and sediments into the waterways.

3.2.4. Outline Goals and Objectives for the Critical Area

The primary purpose of NPS-IS is to improve water quality, meet nutrient reduction goals and remove impairment status for the waterbodies. Cropland activities in Critical Area #1 contribute to far-field impairment through excessive nutrient loss to local waterways that flow to the GMR, Ohio River and ultimately add to Gulf of Mexico hypoxia. To address this impairment, the nutrient reduction goal is set at levels 20% of the current estimated nutrient loadings for the agricultural watersheds within the GMR basin, including the Paddys Run HUC-12. To achieve the nutrient loading goals at the Paddys Run HUC-12, the following goal and objectives have been established:

Goal 1 – Reduce nitrogen loading contributions in Critical Area 1 by 20%.

NOT ACHIEVED

Current total nitrogen load for the agricultural lands is estimated to be 102,637 lbs. and the reduction goal is 20,527 lbs.

Goal 2 – Reduce phosphorus loading contributions in Critical Area 1 by 20%.

NOT ACHIEVED

Current total phosphorus load for the agricultural lands is estimated to be 3,451 lbs. and the reduction goal is 690 lbs.

OBJECTIVES

In order to reach the load reduction goal of 20% within the Paddys Run HUC-12, the effort will include implementing a variety of appropriate BMPs within Critical Area 1. However, the effort must also balance resources and willing landowners. With the ACPF output, a number of in-field and below-field practices are identified that are applicable in this region (Table 17).

Objective 1: Plant at least 1,000 acres of cover crops in addition to the 257 acres that have already been planted.

Objective 2: Implement nutrient management planning (plan development, soil testing and variable rate fertilization) on at least 1,000 acres.

Objective 3: Reduce erosion and nutrient loss through the installation of grassed waterways (as a standalone practice or coupled with erosion control structures/other drainage management practices) on at least 25 acres at locations suggested by the ACPF model results.

Objective 4: Reduce nutrient loss from subsurface tile drainage or below-field practices through the installation of drainage water management structures such as WASCOBs and nutrient removal wetlands at locations suggested by the ACPF model results on at least 45 acres.

Objective 5: Protect at least 500 acres of farmland; including flooded cropland, farmed wetland, riparian areas, and pastures with permanent conservation easements, in addition to 1,778 acres already protected by TVCT; and enroll at least 5% of these lands in the Conservation Reserve Program (CRP) or other suitable program to retire crop production.

Objective 6: Implement at least 2000 acres of conservation tillage annually.

Table 16 Estimated Nutrient Loading Reductions from Each Objective

Objective Number	Best Management Practice	Acreage Treated Each Year	Estimated Nitrogen (N)/Phosphorus (P) Load Reduction (lbs/yr)*
1	Cover Crops	1,000	6,104 lb/yr(N)/169 lb/yr (P)
3	Nutrient Management (Soil Sampling and variable rate)	1,000	4,463.4 lb/yr (N)40.1 lb/yr (P)
3	In-field BMPs: Grassed Waterway	25	301 lb/yr (N)/22.7lb/yr (P)
4	Below-field BMPs: Nutrient removal wetlands and WASCOBs	45**	5,622.7 lb/yr(N)/ 15.6 lb/yr (P)
5	Conservation Easements and CRP	500/20***	603.5 lb/yr(N)/32.6 lb/yr (P)
6	Conservation Tillage	2,000	12,470 lb/yr(N)/1,419 lb/yr (P)
TOTAL			29,524 lb/yr (N)/ 1,699 lb/yr (P)

**Estimates calculated using Spreadsheet Tool for Estimating Pollutant Loads (STEPL), Version 4.4 (USEPA, 2019)*
*** **Estimated using the Controlled Drainage function in STEPL with assumed 500 acres of catchment area*
****20 acres of land retirement is used for this estimate*

These objectives will be directed towards implementation on prioritized agricultural lands using the stakeholder/landowner-agreed criteria. The implementation of BMPs included in these objectives, as well as BMPs implemented through federal and state programs and other voluntary efforts will be recorded to track progress towards nutrient reduction goals within Paddys Run HUC-12.

Conservation easements have been successfully used in the region to protect local water resources and prime farmland from degradation caused by overdevelopment and unsuitable land management. This legal tool limits the impervious surface cover permitted on agricultural lands, encourages implementation of BMPs and permanently protects sensitive areas including

prairies, forested stream buffers and wetlands filtering agricultural runoff. The TVCT will continue to promote conservation easements to help farmers permanently protect their land and improve overall health of Paddys Run watershed.

The future project-specific monitoring efforts will be conducted by Ohio EPA or another qualified organization, and will verify progress towards meeting the goals identified in the plan. The objectives, projects and implementation strategies presented herein will be reevaluated and modified if determined necessary, as several versions of this NPS-IS are expected. This NPS-IS presents an adaptive and living watershed planning approach and is anticipated to be dynamic as critical areas are identified and objectives are implemented, and other objectives recognized. The objectives listed above will be reevaluated, fine-tuned and modified as necessary when more information becomes available or conditions change. Additional objectives may also be included to make progress towards further reduction goals, as new and additional BMPs can improve nutrient reduction.

The Ohio EPA Nonpoint Source Management Plan Update, which includes a full list of nonpoint source management strategies, will be utilized. Strategies, as presented in the overview tables of Chapter 4, include the following:

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

3.3. Critical Area 2: Conditions, Goals, & Objectives for Nutrient Reduction and Management in Paddys Run and Tributaries' Riparian Zones.

3.3.1. Detailed Characterization

Critical Area # 2 contains approximately 2,086 acres of riparian corridors, including 4.9 acres of freshwater forested/shrub wetlands, and 26.2 miles of Paddys Run and its main tributaries (Fig. 19). The 2010 Ohio EPA assessment of the watershed was limited by biological and water quality data collected only from one selected sampling site in the upstream section of Paddys Run, which at the time was in full attainment (previously presented). The lower section of the Paddys Run as well as its tributaries were not evaluated during this study.

The additional four sampling locations along Paddys Run and one along its unnamed tributary were selected during the MBI study in 2013. However, only two upstream locations along Paddys Run could be evaluated due to low flow conditions during sampling season. Both, these locations were in full attainment for the ALU designation.

The landowners participating in the public meeting voiced their concerns for erosion and flooding on their personal properties. They listed the runoff pollution, especially from agricultural production and poorly designed and/or maintained drainage ditches, narrow or nonexistent riparian buffers, overwhelming presence of invasive species, and streambank erosion as primary sources of habitat and water quality impairments in the watershed.

The high-quality riparian habitats including riparian buffers, wetlands and floodplains connected to the streams are critical for mitigating the negative impacts of nutrients, sediments, and excessive runoff volume from the surrounding landscapes. These habitats also support a wide range of wildlife, including some threatened or endangered species identified in the watershed. Therefore, it is critical to protect these areas from further habitat degradation caused by invasive species, agriculture activities and increasing residential development.

In this critical area, the ACPF model identified 60 miles of eroding stream banks and 44 miles of banks suitable for enhancing or restoring riparian buffers along Paddys Run mainstem and its tributaries. Stakeholders recognize a need for restorative actions in strategic places; therefore, the following criteria have been set to prioritize areas and restoration projects:

- Riparian area of Paddys Run and its main tributaries near the high runoff fields
- Riparian area with severe encroachment by agricultural or residential activities
- Riparian area with extremely severe erosion threatening land and properties
- Riparian areas with narrow or nonexistent buffers
- Riparian areas suitable for floodplain/wetland enhancement or/and restoration

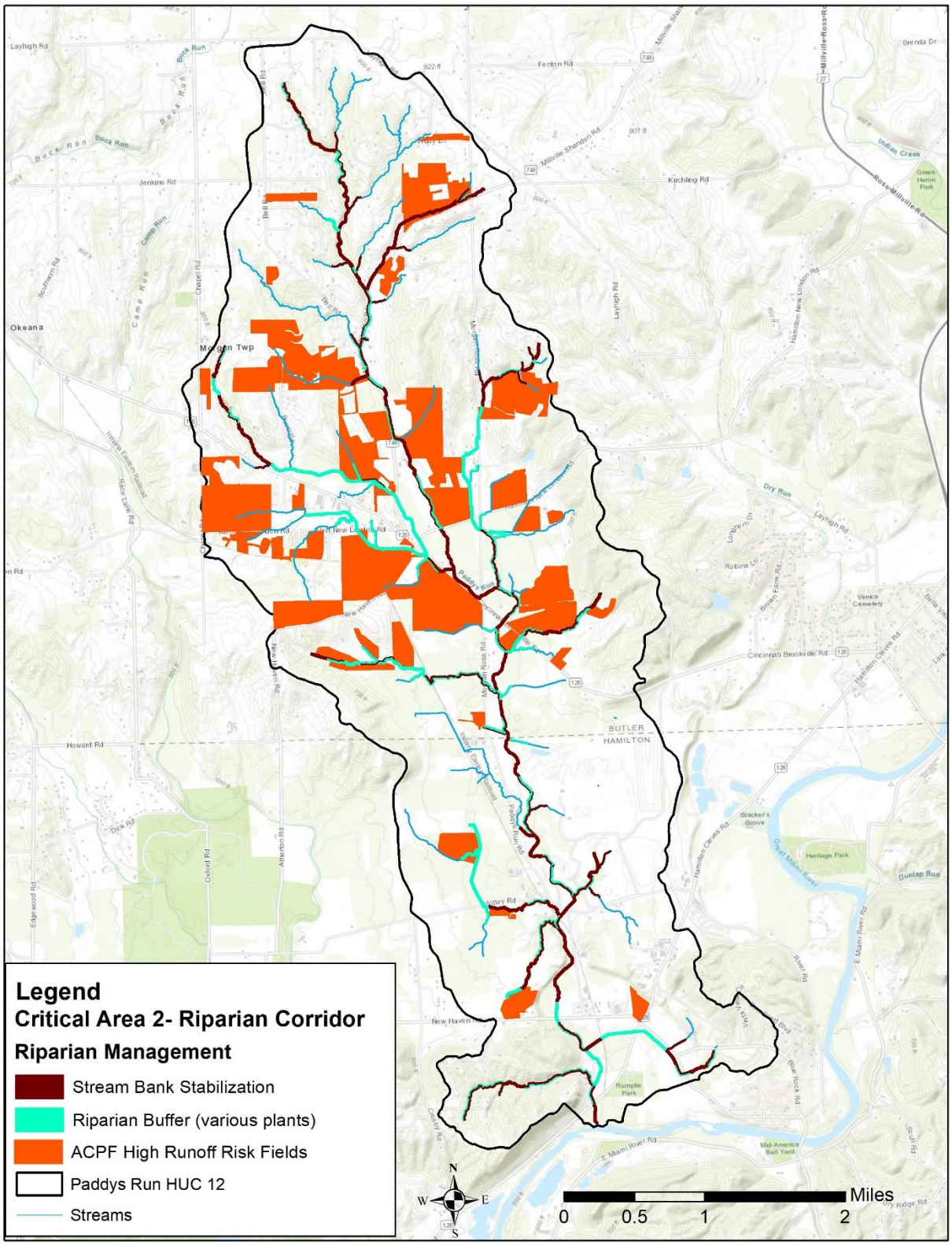

Figure 19 Paddys Run HUC-12 Critical Area #2

3.3.2 Detailed Biological Conditions

As previously presented in tables.19 and 20, the biological indices were assessed in 2010 by the Ohio EPA at one sampling site along Paddys Run and two additional sites were evaluated by the MBI in 2013. All three locations supported the WWH and were in full attainment for the ALU designation. Fish community indices at these sites ranged from exceptional to good (IBI = 52 to IBI= 40) and the macroinvertebrate community performance was good. The QHEI scores ranged from 65.5 to 69.5 and supported WWH communities.

3.3.3 Detailed Causes and Associated Sources

The 2010 Ohio EPA survey and the MBI study conducted in 2013 showed that the upstream section of Paddys Run mainstream was in full attainment for its ALU designation. The downstream section of the Paddys Run as well as its tributaries were not assessed for biological conditions. The QHEI scores evaluated at the selected sampling locations ranged from 65.5 to 69.5 indicating good quality habitats able to support aquatic organisms consistent with the WWH ALU designation. However, many sections of Paddys Run and its tributaries have very narrow or nonexistent riparian buffers, and are affected by severe erosion due to agricultural and residential encroachments.

For these high-quality riparian corridors, it is important to maintain the quality level by ensuring the riparian area is protected, wetlands and floodplains are restored or enhanced, and buffers are vegetated with the appropriate plant species. For areas with severe streambank erosion, large amounts of sediments are washed down from the banks during and after intense storms. Many of the banks are bare, steeply cut and not protected. The implementation of streambank stabilization and planting of riparian buffers can reduce erosion and siltation/sedimentation in the streams.

3.3.4 Outline Goals and Objectives for the Critical Area

Narrow stream buffers and severe stream erosion and siltation/sedimentation, which are common in the Paddys Run watershed, might cause water quality degradation and contribute to Gulf of Mexico hypoxia. The Critical Area # 2 focuses on protection and management of riparian corridors, including wetlands and floodplains and improving water quality and aquatic life in both near-field and far-field waterways.

Currently riparian BMPs are underutilized in most of the Paddys Run HUC-12. The floodplain and wetland restoration, stabilization of severely eroding banks and planting the riparian buffers will provide great benefits to maintain and improve stream health and aquatic life attainment.

Goal 1 – To maintain or achieve an IBI score at or above 40 at all –2010-2013 sampling locations within this watershed;

ACHIEVED – The IBI at Paddys Run sampling sites ranged from 40 to 52.

Goal 2 – To maintain or achieve an ICI score at or above 36 (ECBP)/ 30 (IP) for the 2010-2013 sampling currently meeting the WWH criterium.

ACHIEVED – The ICI values evaluated at the sampling locations along Paddys Run were good (narrative evaluation good at RM 4.73 and RM 4.6 and ICI = 44 at RM 3.85)

Goal 3 – To maintain or achieve a QHEI score at or above 65.5 at all 2010 – 2013 sampling locations

ACHIEVED - The QHEI scores at sampling locations along Paddys Run ranged from 65.5 to 69.

Objectives

The implementation of these objectives, coupled with implementation in Critical Area #1 will help ameliorate negative impacts from excessive nutrients and sediments and improve aquatic life in the near-field and far-field waterways.

Objective 1: Implement the natural channel design or two-stage ditch design stabilization techniques to at least 1 mile of the severerly eroding sections of Paddys Run and its main tributaries. [2]

Objective 2: Create, enhance and/or restore floodplain/riparian wetlands for habitat restoration and/or sediment attenuation on at least 20 acres.

Objective 3: Create, enhance and/or restore floodplain/riparian buffer along impacted or barren stretches of Paddys Run and its main tributaries within *Critical Area #2* (at least 50 feet wide) by establishing and enhancing at least 6 acres of riparian habitats. [1]

Objective 4: Protect with conservation easements or via land acquisitions at least 2 miles of Paddys Run and its main tributaries. -

[2] *Stakeholders recognize a need for restorative actions in strategic places; however, objectives are set low to realistically reflect the anticipated amount of land available for restoration.*

Table 17 Nutrient Reductions from Each Objective

Objective Number	Best Management Practice	Total Length/Acreage Treated	Estimated Load Reduction using STEPL*
1	Streambank stabilization/restoration	1 miles/ 6 Acres (avg 50 feet wide)	70.6 lb/yr (N)/3.7 lb/yr (P) and sediment of 2.8 tons/yr
2	Floodplain/Wetland enhancement/restoration	20 acres**	1618.5 lb/yr (N)/ 4.5 lb/yr (P)
3	Riparian Buffer as designed using ACPF modeling based on the width of the riparian zone and runoff delivery (see Section 2.5.1).	1 miles/6 Acres (avg 50 feet wide)	25.2 lb/yr (N)/ 1.5 lb/yr (P) and sediment of 7.7 tons/yr
4	Protecting riparian areas and wetland with conservation easements and retire 20 acres.	20 Acres*** (riparian corridor width: 100 feet at each side of the stream)	349 lb/yr (N)/61 lb/yr (P) and sediment of 25.2 tons/yr

**Estimated using Spreadsheet Tool for Estimating Pollutant Loads (STEPL), Version 4.4 (USEPA, 2019) N-Nitrogen; P-Phosphate and sediment*
***Estimated using the Controlled Drainage function in STEPL with assumed 300 acres of catchment area*
****20 acres of land retirement is used for this estimate*

The future project-specific monitoring efforts will be conducted by Ohio EPA or other qualified organization and will verify progress towards meeting the goals identified in the plan. The objectives, projects and implementation strategies presented herein will be reevaluated and modified if determined necessary, as several versions of this NPS-IS are expected. This NPS-IS will employ an adaptive management process. As objectives and implementation projects are reevaluated, objectives listed above will be reevaluated, fine-tuned and modified as necessary when more information becomes available or conditions change. Additional objectives may also be included to make progress towards further reduction goals or water quality improvement goals, as new and additional BMPs can improve nutrient reduction and sedimentation in streams.

The Ohio EPA Nonpoint Source Management Plan Update, which includes a full list of nonpoint source management strategies, will be utilized. Strategies, as presented in the overview tables of Chapter 4, include the following:

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

Chapter 4: Projects and Implementation Strategy

The GMR Basin is one of the major nutrient contributors to Ohio River and Gulf hypoxia (Ohio EPA, 2020). It is important and beneficial for the NPS-IS initiatives to be implemented in this region as soon as possible. Paddys Run HUC-12 is an agricultural watershed and implementation of proposed conservation practices is targeted to reduce the nutrient load by 20%.

The Project and Implementation Strategy of the Paddys Run HUC-12 NPS-IS includes an action plan based on the causes and sources of NPS pollution which are described in the previous chapter. Chapter 3 presented the two critical areas and their goals, objectives, and potential projects. These critical areas will be reevaluated through time to monitor progress towards meeting their NPS goals and objectives. Some of the positive impacts may be slow and take years to show progress towards recovery.

4.1 Overview Tables and Project Sheets for Critical Areas

Project and Implementation Strategy Overview tables and associated project summary sheets for each of the critical areas (Agricultural fields and riparian corridor of Paddys Run and its main tributaries) are presented in this Chapter. The presented opportunities provide a general concept and will be further evaluated as landowners provide additional feedback on the projects and each project is adequately funded. The estimated project costs and the time frame are both dependent upon funding opportunities and coordination with landowners and project partners.

In addition to the detail provided in previous chapters, the project summary sheets outline how the nine minimum elements of watershed planning are being met by each opportunity, as shown in the first column of each table. Moreover, this NPS-IS will be updated periodically to address stakeholder input and additional project opportunities may be added. If a future critical area is identified (e.g. Critical Area for addressing faulty HSTSs) within the Paddys Run HUC-12, supplemental information will be provided as funding allows.

The Project Overview Tables present a summary of each strategy identified for each critical area. BMP strategies are divided into several categories, including urban storm water runoff management, altered stream and habitat restoration strategies, and other nonpoint source causes and associated sources of impairment.

Table 18 Projects and Implementation Strategy Overview - Critical Area 1

For Paddys Run HUC-12 (050800020903) Critical Area 1							
Goal	**Objective**	**Project**	**Project Title (EPA Criteria g)**	**Lead Organization (EPA Criteria f)**	**Time Frame (EPA Criteria f)**	**Estimated Cost (EPA Criteria d)**	**Funding/Actual Sources (EPA Criteria d)**
Urban Sediment and Nutrient Reduction Strategies							
Altered Stream and Habitat Restoration Strategies							
Agricultural Nonpoint Source Reduction Strategies							
1	1, 2	1	Agricultural BMPs – 500 Acres Cover Crops and 250 Acres Nutrient Management (Plan Development, Soil Testing and Variable Rate Technology (VRT) Implementation)	Butler SWCD	Short (1-3 years)	$35,250	Ohio EPA §319, H2Ohio, USDA-NRCS EQIP
1	3	2	Agricultural BMPs – 10 Acres Grassed Waterways	Butler SWCD	Short to Medium (1-7 years)	$150,000	Ohio EPA §319, H2Ohio, USDA-NRCS EQIP
High Quality Waters Protection Strategies							
Other NPS Causes and Associated Sources of Impairment							

The Project Summary Sheets provided below were developed based on the objectives set to achieve nutrient reduction targets in the Paddys Run HUC-12. These projects are considered next step or priority/short term projects and are ready to be implemented. The projects, which need more outreach and thorough planning, will have the Project Summary Sheets developed and added to the plan when they are ready for implementation.

Table 24 Critical Area #1 - Project #1

Project #1 – Paddys Run HUC-12 Critical Area 1		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	Title	Agricultural BMPs – Cover Crops and Nutrient Management
criteria d	Project Lead Organization & Partners	Butler Soil and Water Conservation District
criteria c	HUC-12 and Critical Area	Paddys Run HUC-12 (050800020903) – Critical Area 1
criteria c	Location of Project	Private landowner – exact location not disclosed
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	Administer cost-share program for cover crop plantings and nutrient management Implementation (soil testing and VRT)
criteria g	Project Narrative	Butler SWCD will administer a cost-share program to local landowners in prioritized agricultural lands to plant cover crops on at least 500 acres annually. Landowners will enroll no less than 10 acres, and the maximum amount enrolled by one operation will not exceed 400 acres. Cost-share will pay out at $50 per acre. In addition, the Butler SWCD develop nutrient management plans and enroll at least 250 acres for soil testing and VRT application. Cost share for nutrient management plan development will be up to $2,000 per plan (estimated 100 to 150 acres). Soil testing will pay $9 per acre, VRT cost-share will be $24 per acre. Butler SWCD has a list of willing landowners prepared to implement this project if funds are available.
criteria d	Estimated Total cost	$35,250
criteria d	Possible Funding Source	H_2Ohio, USDA-NRCS EQIP
criteria a	Identified Causes and Sources	Cause: Nutrient loadings leading to far-field impacts Source: Agricultural land use activities

Table 19 continued on following page

Table 24 continued from previous page

Project #1 – Paddys Run HUC-12 Critical Area 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?	Objective #1: Plant at least 1,000 acres of cover crops in addition to the 257 acres that have already been planted. Objective # 2: Implement nutrient management planning (develop plans, soil testing and variable rate fertilization) on at least 1,000 acres. The overall goal in Critical Area #1 is to reduce estimated total nitrogen and phosphorous loads for agricultural lands by 20%. In order to meet the Gulf of Mexico hypoxia reduction goals, the total nitrogen and phosphorous loadings must be reduced by 20,527 lb/year and 690 lb/year, respectively.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	This project is expected to achieve 20.3% of the total nitrogen reduction goal and 13.7% of the total phosphorous reduction goal
	Part 3: Load Reduced?	**Cover crops**: estimated 3,052 lb/yr(N)/84.6 lb/yr (P)/66 tons sediment per year of load reduction based on STEPL 4.4. **Nutrient management**: estimate of 1,115.8 lb/yr (N)/10 lb/yr (P)/sediment reduction not applicable - load reduction based on STEPL 4.4.
criteria i	How will the effectiveness of this project in addressing the NPS impairment be measured?	In general, a monitoring of the load reductions from the individual agricultural practices is not realistic; however, some agencies such as the Ohio EPA periodically conduct sampling of the local streams to track the load reductions. Also, the Butler SWCD will conduct follow-up activities with landowners -,to document and track progress of installing the in-field practices.
criteria e	Information and Education	Project information will be shared at the Butler SWCD annual meeting and at applicable field days. Project highlights will also be shared on social media and/or Butler SWCD's website.

Table 19 Critical Area #1 - Project #2

Project #2– Paddys Run HUC-12 Critical Area 1		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	Title	Agricultural BMPs – Grassed Waterways
criteria d	Project Lead Organization & Partners	ButlerSoil and Water Conservation District
criteria c	HUC-12 and Critical Area	Paddys Run HUC-12 (050800020903) – Critical Area 1
criteria c	Location of Project	Private landowner – exact location not disclosed
n/a	Which strategy is being addressed by this project?	Agricultural Nonpoint Source Reduction
criteria f	Time Frame	Short to Medium (1-7 years)
criteria g	Short Description	Administer cost-share program for grassed waterways installation
criteria g	Project Narrative	Butler SWCD will administer a cost-share program to local landowners in prioritized agricultural lands to install about 10 acres of grassed waterways to capture sediment and nutrients and prevent further gully erosion within their cropland. Grassed waterways will receive cost share according to the current CRP cost list. The proposed project will include design and construction of the grassed waterway to provide adequate sediment/nutrient capture and erosion reduction. The Butler SWCD has been contacted by a several landowners interested in implementing this practice on their farms if funds are available.
criteria d	Estimated Total cost	$150,000
criteria d	Possible Funding Source	Ohio EPA §319, H2Ohio, NRCS-USDA, CRP, EQIP
criteria a	Identified Causes and Sources	Cause: Nutrient loadings Source: Agricultural land use activities
criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	**Objective #3:** Reduce erosion and nutrient loss through the installation of grassed waterways - on at least 25 acres at locations suggested by the ACPF model results. The overall goal in Critical Area #1 is to reduce estimated total nitrogen load for agricultural lands by 20% (20,527 lb). In order to meet the Gulf of Mexico hypoxia reduction goals, the total nitrogen and phosphorous loadings must be reduced by 20,527 lb/year and 690 lb/year, respectively.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	This project is expected to achieve 0.6% of the total nitrogen reduction goal and 1.3% of the total phosphorous reduction goal.
	Part 3: Load Reduced?	Estimate of 121 lb/yr (N)/9.1 lb/yr (P) load reduction based on STEPL 4.4b Spreadsheet Model for 10 Watersheds.

Table 19 continued on following page

Table 25 continued from previous page

Project #2– Paddys Run HUC-12 Critical Area 1		
Nine Element Criteria	**Information needed**	**Explanation**
criteria i	How will the effectiveness of this project in addressing the NPS impairment be measured?	In general, a monitoring of the load reductions from the individual agricultural practices is not realistic; however, some agencies such as the Ohio EPA periodically conduct sampling of the local streams to track the load reductions. Also, theButler SWCD will conduct follow-up activities with landowners -, to document and track progress of installing the in-field practices.
criteria e	Information and Education	Project information will be shared at the Butler SWCD annual meeting and at applicable field days. Project highlights will also be shared on social media and/or Butler SWCD's website.

Table 26 Projects and Implementation Strategy Overview - Critical Area #2

For Paddys Run HUC-12 (050800020903) Critical Area 2							
Goal	**Objective**	**Project**	**Project Title (EPA Criteria g)**	**Lead Organization (EPA Criteria f)**	**Time Frame (EPA Criteria f)**	**Estimated Cost (EPA Criteria d)**	**Funding/Actual Sources (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							

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APPENDIX

Summary by Map Unit — Butler County, Ohio						
Map unit symbol	**Map unit name**	**Drainage Rating**	**Hydrologic Soils Groups Rating**	**Farmland Classification Rating**	**Acres in AOI**	**Percent of AOI**
Bt	Brenton silt loam	Somewhat poorly drained	C	All areas are prime farmland	105.8	1.00%
CdD2	Casco and Rodman gravelly loams, 6 to 18 percent slopes, moderately eroded	Well drained	B	Farmland of local importance	8.9	0.10%
CnC2	Cincinnati silt loam, 6 to 12 percent slopes, eroded	Well drained	C	Farmland of local importance	44.5	0.40%
DaA	Dana silt loam, 0 to 2 percent slopes	Moderately well drained	B	All areas are prime farmland	35.3	0.30%
DaB	Dana silt loam, 2 to 6 percent slopes	Moderately well drained	C	All areas are prime farmland	163.9	1.60%
EcE2	Eden silty clay loam, 15 to 25 percent slopes, moderately eroded	Well drained	D	Not prime farmland	1,502.00	14.40%
EcF2	Eden silty clay loam, 25 to 50 percent slopes, moderately eroded	Well drained	D	Not prime farmland	188.3	1.80%

Ee	Eel silt loam, 0 to 2 percent slopes, occasionally flooded	Moderately well drained	B	All areas are prime farmland	47.9	0.50%
ElA	Eldean loam, 0 to 2 percent slopes	Well drained	B	All areas are prime farmland	3.6	0.00%
ElB2	Eldean loam, 2 to 6 percent slopes, eroded	Well drained	B	All areas are prime farmland	41.3	0.40%
ElC2	Eldean loam, 6 to 12 percent slopes, moderately eroded	Well drained	B	Farmland of local importance	41.6	0.40%
EuA	Eldean-Urban land complex, nearly level	Well drained		Not prime farmland	30.1	0.30%
EuB	Eldean-Urban land complex, gently sloping	Well drained	B	Not prime farmland	13.8	0.10%
FcA	Fincastle silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Somewhat poorly drained	B/D	Prime farmland if drained	90.1	0.90%
FcB	Fincastle silt loam, Southern Ohio Till Plain, 2 to 4 percent slopes	Somewhat poorly drained	C/D	Prime farmland if drained	14.1	0.10%
FdA	Fincastle silt loam, bedrock substratum, 0 to 2 percent slopes	Somewhat poorly drained	C	Prime farmland if drained	44.5	0.40%

FdB	Fincastle silt loam, bedrock substratum, 2 to 6 percent slopes	Somewhat poorly drained	C	Prime farmland if drained	6.2	0.10%
Gn	Genesee loam	Well drained	B	All areas are prime farmland	329.9	3.20%
HeE2	Hennepin-Miamian silt loams, 18 to 25 percent slopes, moderately eroded	Well drained	C	Not prime farmland	102.9	1.00%
HeF	Hennepin-Miamian silt loams, 25 to 50 percent slopes	Well drained	C	Not prime farmland	9.5	0.10%
HoA	Henshaw silt loam, 0 to 2 percent slopes	Somewhat poorly drained	C/D	Prime farmland if drained	150.6	1.40%
JoR1B1	Jonesboro-Rossmoyne silt loams, 2 to 6 percent slopes	Moderately well drained	C	All areas are prime farmland	36.2	0.30%
Lg	Lanier fine sandy loam	Well drained	A	All areas are prime farmland	28.4	0.30%
MaB	Markland silty clay loam, 2 to 6 percent slopes	Moderately well drained	C	All areas are prime farmland	12.6	0.10%
McA	Martinsville silt loam, 0 to 2 percent slopes	Well drained	B	All areas are prime farmland	3.9	0.00%
MkC2	Miamian silt loam, 8 to 15 percent slopes, eroded	Well drained	C	Not prime farmland	6.3	0.10%

MsC2	Miamian-Russell silt loams, 6 to 12 percent slopes, eroded	Well drained	C	Farmland of local importance	196.7	1.90%
MsD2	Miamian-Russell silt loams, 12 to 18 percent slopes, moderately eroded	Well drained	C	Farmland of local importance	119.5	1.10%
MtC2	Miamian-Russell silt loams, bedrock substratum, 6 to 12 percent slopes, eroded	Well drained	C	Farmland of local importance	405.3	3.90%
OcA	Ockley silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Well drained	B	All areas are prime farmland	20.3	0.20%
OcB	Ockley silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	Well drained	B	All areas are prime farmland	44.8	0.40%
Pa	Patton silty clay loam, 0 to 2 percent slopes	Poorly drained	B/D	Prime farmland if drained	242.1	2.30%
Ra	Ragsdale silty clay loam, 0 to 2 percent slopes	Poorly drained	B/D	Prime farmland if drained	78.2	0.70%
RdA	Raub silt loam, 0 to 2 percent slopes	Somewhat poorly drained	D	Prime farmland if drained	47.2	0.50%

RdB	Raub silt loam, 2 to 6 percent slopes	Somewhat poorly drained	D	Prime farmland if drained	5.2	0.00%
Rn	Ross loam, 0 to 2 percent slopes, occasionally flooded	Well drained	B	All areas are prime farmland	10.7	0.10%
RtB	Russell silt loam, 2 to 6 percent slopes	Well drained	B	All areas are prime farmland	62.6	0.60%
RvB	Russell-Miamian silt loams, 2 to 6 percent slopes	Well drained	C	All areas are prime farmland	88.5	0.80%
RvB2	Russell-Miamian silt loams, 2 to 6 percent slopes, moderately eroded	Well drained	C	All areas are prime farmland	171.2	1.60%
RwB	Russell-Miamian silt loams, bedrock substratum, 2 to 6 percent slopes	Well drained	D	All areas are prime farmland	95.4	0.90%
RwB2	Russell-Miamian silt loams, bedrock substratum, 2 to 6 percent slopes, moderately eroded	Well drained	D	All areas are prime farmland	312.3	3.00%
RxB	Russell-Urban land complex, gently sloping	Well drained	C	Not prime farmland	17.5	0.20%
Sh	Shoals silt loam, 0 to 2 percent slopes,	Somewhat poorly drained	B/D	Prime farmland if drained and either protected from flooding or not frequently	13.4	0.10%

	frequently flooded, brief duration			flooded during the growing season		
SlA	Sleeth silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Somewhat poorly drained	B/D	Prime farmland if drained	3.9	0.00%
ThA	Thackery silt loam, 0 to 2 percent slopes	Moderately well drained	C	All areas are prime farmland	23.3	0.20%
TpA	Tippecanoe silt loam, 0 to 2 percent slopes	Moderately well drained	B	All areas are prime farmland	85.1	0.80%
UnA	Uniontown silt loam, 0 to 2 percent slopes	Well drained	C	All areas are prime farmland	80.3	0.80%
UnB	Uniontown silt loam, 2 to 6 percent slopes	Well drained	C	All areas are prime farmland	115.5	1.10%
W	Water			Not prime farmland	16.1	0.20%
WyB	Wynn silt loam, 2 to 6 percent slopes	Well drained	C	All areas are prime farmland	46.1	0.40%
WyB2	Wynn silt loam, 2 to 6 percent slopes, eroded	Well drained	C	All areas are prime farmland	153.6	1.50%
WyC2	Wynn silt loam, 6 to 12 percent slopes, eroded	Well drained	C	Farmland of local importance	805.5	7.70%
XeA	Xenia silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Moderately well drained	C/D	All areas are prime farmland	11	0.10%

XeB	Xenia silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	Moderately well drained	C	All areas are prime farmland	181.2	1.70%
XeB2	Xenia silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes, eroded	Moderately well drained	C/D	All areas are prime farmland	78.3	0.80%
XfA	Xenia silt loam, bedrock substratum, 0 to 2 percent slopes	Moderately well drained	C	All areas are prime farmland	4.2	0.00%
XfB	Xenia silt loam, bedrock substratum, 2 to 6 percent slopes	Moderately well drained	C	All areas are prime farmland	432.5	4.10%
XfB2	Xenia silt loam, bedrock substratum, 2 to 6 percent slopes, moderately eroded	Moderately well drained	C	All areas are prime farmland	45.7	0.40%
Subtotals for Soil Survey Area					7,075.50	67.80%

Summary by Map Unit — Hamilton County, Ohio (OH061)

Map unit symbol	Map unit name	Rating	Rating	Rating	Acres in AOI	Percent of AOI
CdF	Casco loam, 35 to 70 percent slopes	Well drained	B	Not prime farmland	35.1	0.30%

CnB2	Cincinnati silt loam, 3 to 8 percent slopes, eroded	Well drained	C	Not prime farmland	59.7	0.60%
CnC2	Cincinnati silt loam, 8 to 15 percent slopes, eroded	Well drained	C	Not prime farmland	52.5	0.50%
Da	Dumps, ash			Not prime farmland	37.6	0.40%
DcB	Dana silt loam, 2 to 6 percent slopes	Moderately well drained	C	All areas are prime farmland	16.5	0.20%
EcD	Eden silty clay loam, 15 to 25 percent slopes	Well drained	D	Not prime farmland	215.4	2.10%
EcE	Eden silty clay loam, 25 to 40 percent slopes	Well drained	D	Not prime farmland	107.7	1.00%
EcE2	Eden silty clay loam, 15 to 25 percent slopes, moderately eroded	Well drained	D	Not prime farmland	17.5	0.20%
EdF	Eden flaggy silty clay loam, 40 to 60 percent slopes	Well drained	D	Not prime farmland	3.8	0.00%
EpA	Eldean loam, 0 to 2 percent slopes	Well drained	B	All areas are prime farmland	3.6	0.00%
EpB2	Eldean loam, 2 to 6 percent slopes, eroded	Well drained	B	All areas are prime farmland	23.8	0.20%

FdA	Fincastle silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Somewhat poorly drained	B/D	Prime farmland if drained	298.8	2.90%
FoA	Fox loam, 0 to 2 percent slopes	Well drained	B	All areas are prime farmland	7.7	0.10%
Gn	Genesee loam, occasionally flooded	Well drained	B	All areas are prime farmland	259.5	2.50%
HeF	Hennepin silt loam, 35 to 60 percent slopes	Well drained	C	Not prime farmland	107.9	1.00%
HoA	Henshaw silt loam, 0 to 2 percent slopes	Somewhat poorly drained	C/D	Prime farmland if drained	117.5	1.10%
JoR1B2	Jonesboro-Rossmoyne silt loams, 2 to 6 percent slopes, eroded	Moderately well drained	D	All areas are prime farmland	8.4	0.10%
MaB	Markland silty clay loam, 2 to 6 percent slopes	Moderately well drained	C	All areas are prime farmland	232.8	2.20%
MaC2	Markland silty clay loam, 6 to 12 percent slopes, eroded	Moderately well drained	C	Not prime farmland	16	0.20%
McA	Martinsville silt loam, 0 to 2 percent slopes	Well drained	B	All areas are prime farmland	154.8	1.50%
McB	Martinsville silt loam, 2 to 6 percent slopes	Well drained	B	All areas are prime farmland	18.9	0.20%

MnC2	Miamian silt loam, 8 to 15 percent slopes, eroded	Well drained	C	Not prime farmland	7.5	0.10%
MoE2	Miamian-Hennepin silt loams, 25 to 35 percent slopes, eroded	Well drained	C	Not prime farmland	36.2	0.30%
MsC2	Miamian-Russell silt loams, bedrock substratum, 6 to 12 percent slopes, eroded	Well drained	C	Not prime farmland	0.7	0.00%
PfC	Pate silty clay loam, 8 to 15 percent slopes	Well drained	D	Not prime farmland	0.1	0.00%
Pn	Patton silty clay loam, 0 to 2 percent slopes	Poorly drained	B/D	Prime farmland if drained	95.9	0.90%
PrA	Princeton sandy loam, 0 to 2 percent slopes	Well drained	B	All areas are prime farmland	9.4	0.10%
PrB	Princeton sandy loam, 2 to 6 percent slopes	Well drained	B	All areas are prime farmland	30.8	0.30%
PrC2	Princeton sandy loam, 6 to 12 percent slopes, eroded	Well drained	B	Not prime farmland	14.6	0.10%
Ra	Ragsdale silty clay loam	Very poorly drained	C/D	Prime farmland if drained	1.7	0.00%
RdA	Raub silt loam, 0 to 2 percent slopes	Somewhat poorly drained	C	Prime farmland if drained	58.7	0.60%

Rn	Ross loam, rarely flooded	Well drained	B	All areas are prime farmland	74.1	0.70%
RuB	Russell-Miamian silt loams, 2 to 6 percent slopes	Well drained	C	All areas are prime farmland	0.4	0.00%
RwB2	Russell silt loam, 3 to 8 percent slopes, eroded	Well drained	B	Not prime farmland	61.4	0.60%
UADXC	Urban land-Alfic Udarents-Eldean complex, 0 to 12 percent slopes	Well drained		Not prime farmland	8	0.10%
UAFXC	Urban land-Alfic Udarents-Fincastle complex, 0 to 12 percent slopes			Not prime farmland	28.6	0.30%
UAOXC	Urban land-Alfic Udarents-Princeton complex, 0 to 12 percent slopes	Well drained		Not prime farmland	1.6	0.00%
UAQXC	Urban land-Alfic Udarents-Cincinnati complex, 0 to 12 percent slopes			Not prime farmland	26.6	0.30%
UATXC	Urban land-Alfic Udarents-Pate complex, 0 to 12 percent slopes	Well drained		Not prime farmland	11.3	0.10%

UAXXC	Urban land-Alfic Udarents-Xenia complex, 0 to 12 percent slopes			Not prime farmland	7.5	0.10%
UbAXC	Urban land-Alfic Udarents complex, loamy substratum over bedrock, 0 to 12 percent slopes			Not prime farmland	31.8	0.30%
Udo	Udorthents			Not prime farmland	385	3.70%
UfAXC	Urban land-Alfic Udarents complex, fragipan substratum over till, 0 to 12 percent slopes			Not prime farmland	17.8	0.20%
UfUXF	Urban land-Udorthents complex, refuse substratum, 0 to 50 percent slopes			Not prime farmland	95.2	0.90%
UMSXAR	Urban land-Mollic Udarents-Ross complex, 0 to 2 percent slopes, rarely flooded	Well drained		Not prime farmland	30.3	0.30%
UrUXC	Urban land-Udorthents complex, 0 to 12 percent slopes			Not prime farmland	144.3	1.40%
UtAXC	Urban land-Alfic Udarents complex,			Not prime farmland	38.2	0.40%

	loamy substratum over till, 0 to 12 percent slopes					
UwAXC	Urban land-Alfic Udarents complex, loamy substratum over outwash, 0 to 12 percent slopes			Not prime farmland	28.9	0.30%
UwAXF	Urban land-Alfic Udarents complex, loamy substratum over outwash, 25 to 70 percent slopes	Well drained		Not prime farmland	8.5	0.10%
W	Water			Not prime farmland	53.9	0.50%
WyC2	Wynn silt loam, 6 to 12 percent slopes, eroded	Well drained	C	Not prime farmland	10.5	0.10%
XfA	Xenia silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Moderately well drained	C/D	All areas are prime farmland	99.7	1.00%
XfB2	Xenia silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes, eroded	Moderately well drained	C/D	All areas are prime farmland	136.4	1.30%
XhB	Xenia silt loam, bedrock substratum, 2 to 6 percent slopes	Moderately well drained	C	All areas are prime farmland	7.1	0.10%

Subtotals for Soil Survey Area					3,357.70	32.20%
Totals for Area of Interest					10,433.20	100.00%