NINE-ELEMENT NONPOINT SOURCE IMPLEMENTATION STRATEGIC PLAN (NPS-IS)

MILLERS FORK WATERSHED

HUC-12
(050800020201)

PREPARED FOR THREE VALLEY CONSERVATION TRUST

PREPARED BY ENVIRONMENTAL SOLUTIONS AQ

VERSION 1.0: NOVEMBER 9, 2023
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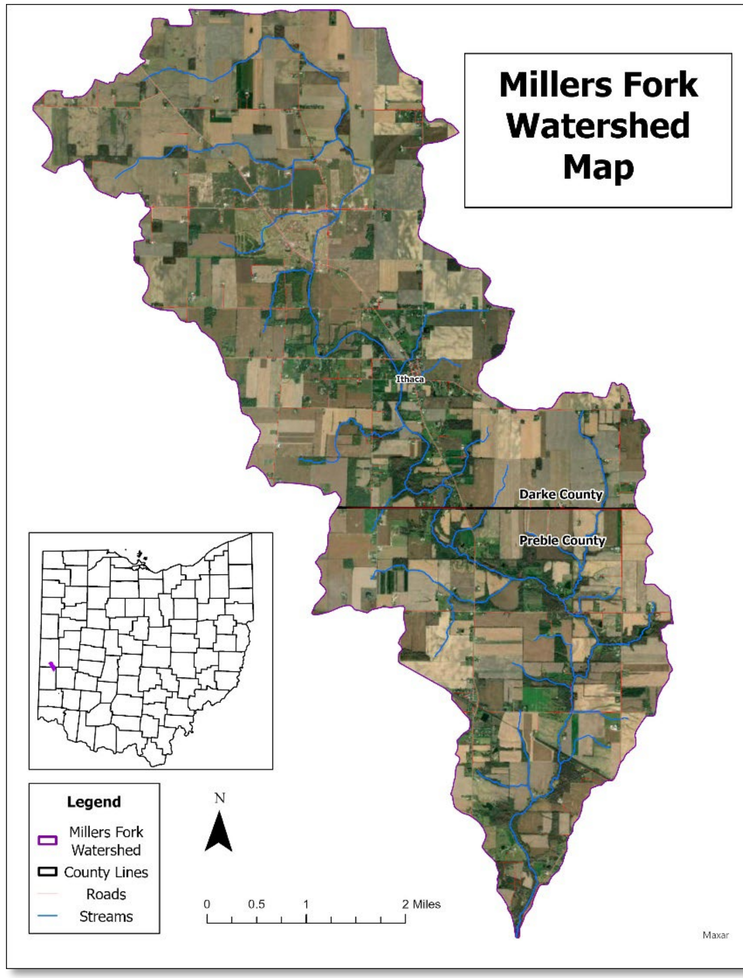
Chapter 1: Introduction



The Nine-Element Nonpoint Source Implementation Strategies Plan (NPS-IS) is a strategic document that provides assurance to nonpoint source grant programs and institutions (i.e., U.S. EPA) that a proposed water quality improvement project meets the nine essential elements per U.S. EPA §319 Program Guidance (April 2013). The NPS-IS ensures that potentially funded projects are scientifically evaluated, that they are located in areas that will address the worst problems; and that that they have the administrative, evaluation, and educational components needed to ensure that the water resources will achieve as much long-term benefit as possible. The NPS-IS is a living strategic planning document that summarizes causes and sources of impairment, establishes critical areas, identifies quantifiable objectives to address causes and sources of impairment, and describes projects designed to meet those objectives.

The Millers Fork HUC-12 (050800020201) (Figure 1-1) has been identified as one of the priority watersheds where USDA models suggest there is high contribution of nutrient loading from agricultural lands. Millers Fork is located within the Great Miami River watershed which is a major contributor of nutrients to the Gulf of Mexico (OEPA, 2020a; Goolsby et al., 1999). The Great Miami River basin watershed had the highest soluble reactive phosphorus concentrations and the highest time-weighted average total P concentration amongst 10 streams studied in Ohio (Baker, 2006).

Three Valley Conservation Trust (TVCT) has partnered with Environmental Solutions AQ, a local environmental consultant, for the preparation of this Nine-Element NPS-IS for Millers Fork HUC-12 watershed.

One important element of Nine-Element NPS-IS is the education and outreach activities that will be conducted while implementing the plan. TVCT is dedicated to engaging the public and informing them of important events and projects as well as educating them about the existing condition of the streams. Key partners the soil and water conservation districts of Darke and Preble counties are also dedicated to educating landowners and agricultural producers about managing nutrient loads by implementing BMPs and about improving and preserving the quality of streams. In addition, partners including Miami Valley Regional Planning Commission, Miami Conservancy District and health departments of Darke and Preble counties are all willing partners to engage the communities to address drinking water source protection and Home Sewage Treatment Systems (HSTS) in unsewered communities.

FIGURE 1-2 HEADWATERS OF MILLERS FORK. THE HUC-12 WATERSHED IS LOCATED IN SOUTHERN DARKE AND NORTHERN PREBLE COUNTIES

1.1. Report Background

Ohio has been leading Watershed-Based Planning (WBP) for a long time. It is a process that often results in a document used to guide projects within a geographic area defined by the flow of water. WBP is used to coordinate activities related to water resources including: water quality and/or quantity management, ecological protection and restoration, or the strategic guidance of development, infrastructure improvement, transportation, and recreation among others. WBP is an effective approach to solving difficult water-related problems because it is locally led, collaborative, data driven, and consensus based (OEPA, 2016a).

Ohio Environmental Protection Agency (OEPA) developed the Ohio Guide for Development of Watershed Action Plans in 1997 and in 2016, in collaboration with Ohio Department of Agriculture, the Nine-Element NPS-IS template was issued to guide the completion of a state and federal approvable Nine-Element NPS-IS (OEPA, 2016b).

A Nine-Element NPS-IS is a specific type of watershed-based planning that will allow local entities to effectively propose and implement nonpoint source pollution projects utilizing funding made available through the Clean Water Act Section 319 (§319), H2Ohio or the Great Lakes Restoration Initiative. In Ohio, eligibility for these grant programs is strongly preferred or restricted to projects delineated within a critical area of an approved NPS-IS.

Millers Fork Watershed (a subwatershed of Twin Creek) was

Nine Elements of NPS-IS
Source: OEPA, 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.

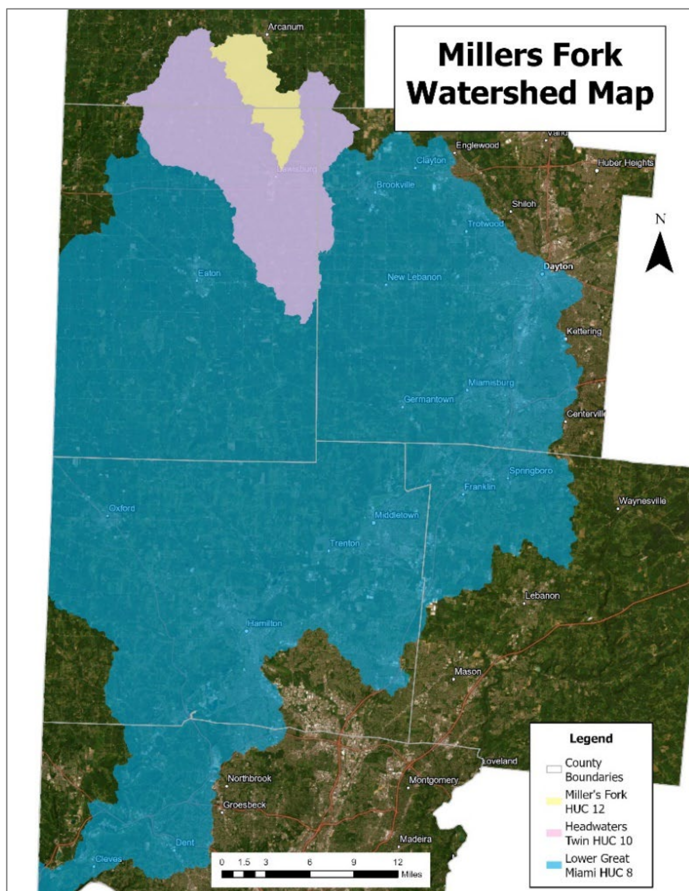
i) A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

characterized in the 2010 endorsed Twin Creek Watershed Action Plan (WAP). The Twin Creek WAP concluded that although much of the watershed was very high quality, portions of Twin Creek and its tributaries were not fully attaining aquatic life and recreational use standards (IES, 2010). During OEPA's 2005 study reported in the Biological and Water Quality Study of Twin Creek and Selected Tributaries, Millers Fork was only partially attaining its Exceptional Warmwater Habitat (EWH) Aquatic Life Use (ALU) designations at the two downstream sampling sites, and partially attaining a recommended Warmwater Habitat (WWH) ALU designation at Grubbs-Rex Road, the upstream sampling site. In the 2010 Twin Creek Watershed TMDL report, the sources of impairment included channelization, loss of riparian habitat, crop production with subsurface drainage, sewage discharge from unsewered area. The causes of impairment to aquatic life and primary recreation use at Millers Fork HUC-12 included sedimentation, low DO, ammonia, *E. coli*, and fecal coliform (OEPA, 2007).

Chapters 1 and 2 of the Millers Fork HUC-12 Nine-Element NPS-IS have been prepared based on knowledge from the Twin Creek WAP, OEPA's 2007 report, TMDL documents, and other published water quality documents. Chapters 3 and 4 were developed via engagement with stakeholders, including partner organizations, agricultural producers, and landowners. The NPS-IS follows the OEPA Nine-Element NPS-IS template (OEPA, 2016b).

1.2. Watershed Profile & History

The Millers Fork HUC-12, located in Preble and Darke counties, Ohio is one of the subwatersheds of the Twin Creek Basin located in southwest Ohio (Figure 1-3).. Twin Creek, 47.03 miles long, originates in Darke County and flows southeast into Preble County and generally south through the eastern portion of the county, then southeast through the southwest corner of Montgomery County, and then into Warren County, Franklin Township, where it meets the Great Miami River. The Millers Fork and Twin Creek watersheds are part of the Lower Great Miami Watershed HUC 05080002 (Figure 1-4).



The main stem of Millers Fork is 10.6 miles long, approximately 5.5 miles of which has been modified through channelization, riparian removal or leveed (Twin Creek WAP, 2010). The HUC-12 watershed is 15,718 acres in size. Significant tributaries in the Millers Fork HUC-12 watershed includes several named ditches and unnamed tributaries.

A path taken by indigenous people is known and it is called the "Wabash Trail." Shawnee and Miami tribes populated the region during the American colonial period. Wolves, panther, and dense forests of walnut, oak, ash, elm, and maple impeded travel in this section of the Northwest Territory during the early days of white settlement (Wilson, 1914).

Though the 1795 Treaty of Greenville technically opened the Twin Creek watershed – and all of the southern two-thirds of Ohio -- to white settlement, skirmishes with the natives as well as sickness and other difficulties of frontier life discouraged much permanent white settlement until the end of the War of 1812 and the death of Tecumseh. This local Shawnee had united numerous tribes to resist the settlers' western expansion (Ohio Historical Society).

The National Road (also known as the Cumberland Road), authorized by the US Congress in 1806 during the Jefferson Administration, meant white settlers could travel to western Ohio from as far east as Baltimore, Maryland. Completed all the way to Illinois by the 1830s and now known as US Route 40, the road passes through the southern edge of the watershed. It brought business and families to the area early in the 1800s and continued to be a busy interstate route until the parallel Interstate Route 70 was completed during the middle of the 20th century.

Today, the Millers Fork watershed is primarily a rural, agricultural watershed in Preble and Darke counties. Most of the watershed is composed of farmland that is owned by private landowners. Agricultural production is focused on row crops. Swine are raised in a handful of facilities in the upstream or Darke County portion of the watershed.

The Village of Ithaca (81 people, according to the 2020 U.S. Census) is the only incorporated village within the Millers Fork HUC-12, though there is a smaller unincorporated community at West Sonora. There are only a few small housing developments outside of that, and no industrial or large-scale commercial facilities within the watershed. There is one large golf course, Beechwood Golf Course, upstream of the Village of Ithaca. There are no permitted National Pollutant Discharge Elimination System (NPDES facilities) within the Millers Fork HUC-12 watershed.

Biological performance for Millers Fork was determined to be good to marginally good communities, except the most upstream sampling site at Grubbs-Rex Road, which was low fair. Millers Fork above State Route 503 was channelized and much of the riparian cover removed sometime in the past. In 2005, Millers Fork was in partial attainment of EWH ALU from its confluence with Twin Creek upstream to about stream mile 8.0. Above that, biological index scores were low enough to prompt a recommendation to alter the ALU to WWH. See Section 2 for further details.

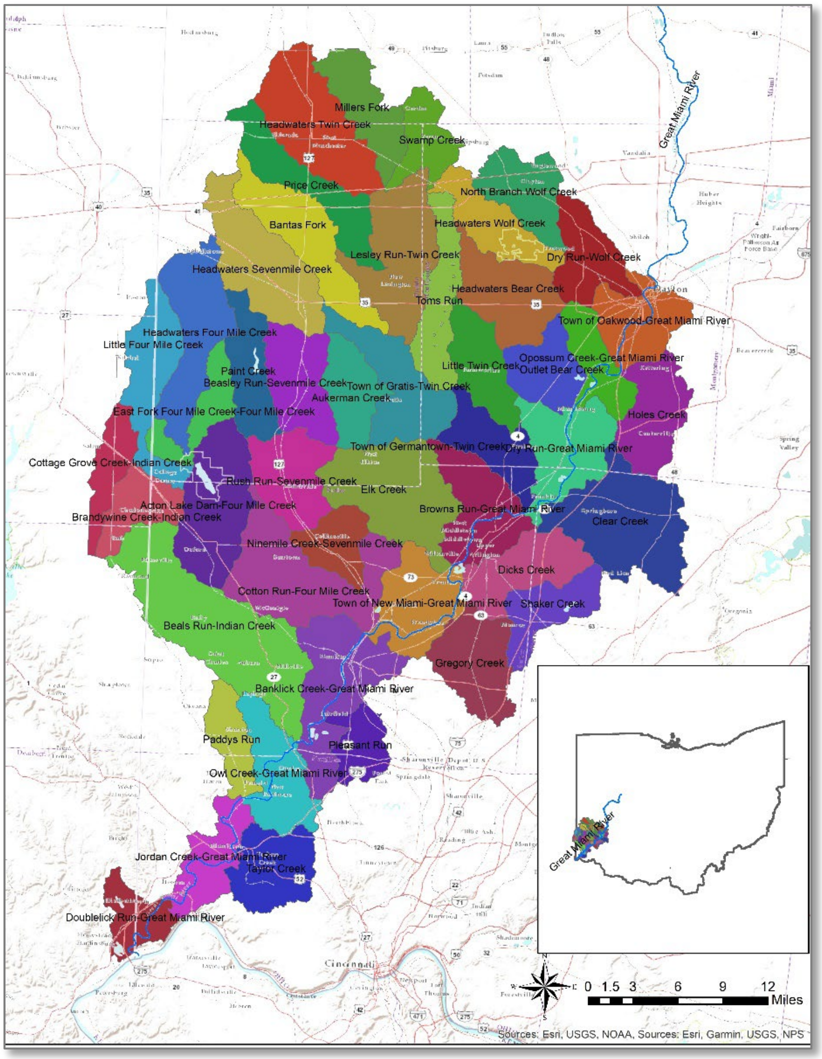


FIGURE 1-4 LOWER GREAT MIAMI RIVER WATERSHED HUC-12S

1.3. Public Participation and Involvement

Public participation and involvement are critical to the success implementing the recommendations of any NPS-IS. In 2007, the Twin Creek Advisory Committee was formed, and meetings were held regularly to collaborate in the preparation of the Twin Creek WAP and review of the OEPA prepared Twin Creek TMDL. The Twin Creek watershed projects were operated as a collaborative group of organizations, individuals, and agencies with a goal of protecting and improving water quality in Twin Creek and its tributaries. Various partners engaged in the decision-making process, documentation and plan strategy endorsements, and events including education, public outreach, and stream monitoring. The decision-making process was informal, but consensus driven. The public involvement for the Millers Fork HUC-

12 Nine-Element NPS-IS development is built on this already established working relationship and trust.

In April, 2023, TVCT and its partners, the Preble and Darke soil and water conservation districts (SWCDs) issued the first press release regarding the Millers Fork HUC-12 NPS-IS development in the local newspaper. An invitation postcard or letter was sent to 491 landowners who reside in the Headwaters Twin Creek, Millers Fork, or Swamp Creek HUC-12 watersheds and who own properties larger than 5 acres. NPS-IS for Headwaters Twin and Swamp Creek HUC-12 watersheds are also currently being prepared. TVCT contacted the owners of easements they hold, to inform them of the project and invite them to the public meeting. TVCT and other partners also posted to social media (Figure 1-5). The announcement and invitation received immediate positive responses. TVCT and its partners received emails and phone calls inquiring about the project. The progress of the plan preparation was posted on social media and TVCT's website.

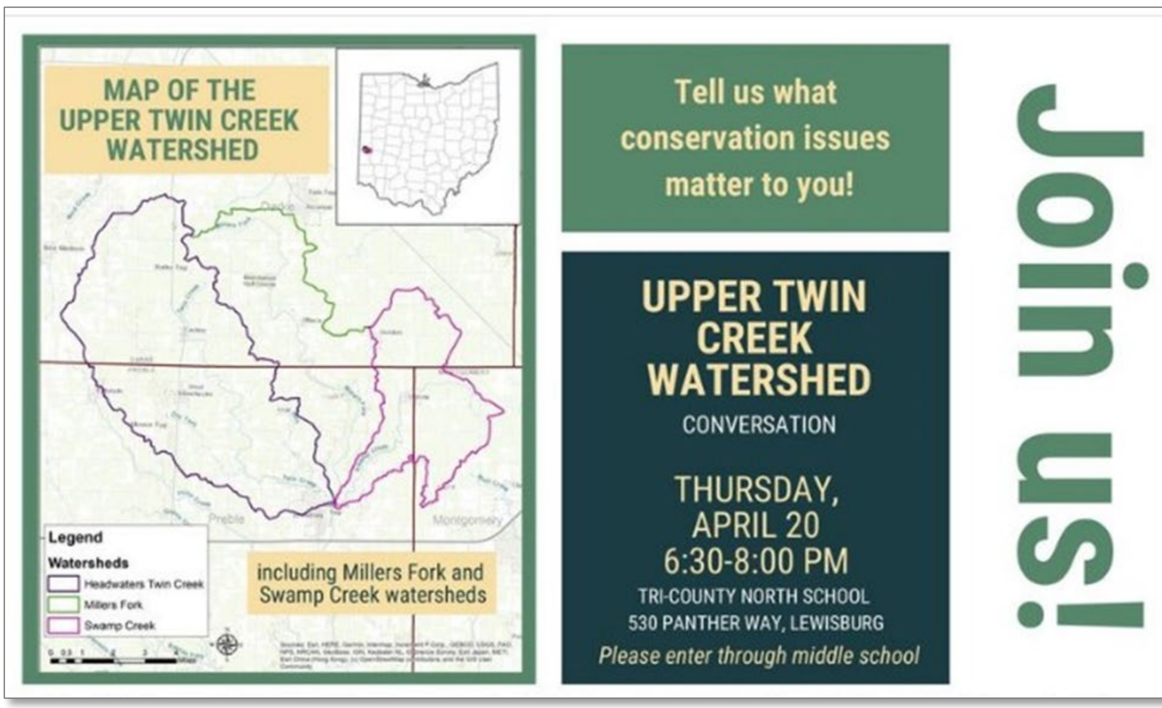


FIGURE 1-5 DESIGN OF THE POSTCARD SENT TO LANDOWNERS

On April 20, 2023, a public meeting was held in the lecture room of Tri-County North High School in Lewisburg. About 30 landowners participated in the in-person public meeting. During the meeting, a presentation was given and then the public discussed the scope of the Nine-Element NPS-IS. The meeting presentation and discussion included three HUC-12 watersheds adjacent to one another because the partners are working on these plans simultaneously. Also, many local agricultural producers own or farm land in two or more of these adjacent watersheds. The Miami Conservancy District, as a major stakeholder interested in water conditions, also sent a staff person to the meeting. Representatives from all three county health departments and the Preble County Park District were also present.

At the public meeting, landowners asked questions and discussed the water quality issues at Millers Fork HUC-12 as wells as potential funding opportunities for implementing conservation and restoration projects. In addition, landowners were invited to complete a 10-item questionnaire. Three completed questionnaires were collected after the meeting. In summary, the landowners were most concerned about failing septic systems, flooding, and agricultural runoff. If funding were available, the landowners would participate in repairing subsurface drainage systems and restoring stream banks.

On May 11, 2023 an interview was held with the Darke County Economic Development Director to discuss water resource needs in the watershed as related to development plans. None of the communities in the watershed appear to be seeking new commercial, industrial, or residential development. The Darke County Comprehensive Land Use Plan is under development at the time of publication, Preble County has a published comprehensive land use plan. According to the Board of Preble County Commissioners' plan, additional plans are needed that focus on sewer and water infrastructure to attract development.

On May 25, 2023 a discussion was held with health department environmental staff members from Preble, Darke and Montgomery counties and Matt Lindsay of the Miami Valley Regional Planning Commission (MVRPC) regarding the problem of failing septic systems and unsewered communities. The Darke County General Health District (DCGHD) staff members provided data about suspected noncompliant Home Sewage Treatment Systems (HSTS) in an unsewered community. An unsewered community is a populated place where small lot size prevents conventional replacement strategies for failing HSTS. The Preble County Public Health (PCPH) staff members provided a general overview of complaints, conditions, and possible solutions for failing HSTS in their respective jurisdictions. MVRPC requested assistance from the health departments in contacting leadership of the unsewered communities. MVRPC has offered free planning assistance to these communities to develop customized wastewater treatment options in the form of a General Plan. The plan would look at potential solutions and recommend the most effective option for solving the problem. The plan, which includes preliminary engineering estimates, would lay the groundwork for funding opportunities and will be the first and important step toward possibly building a new or connecting to a nearby wastewater treatment plant.

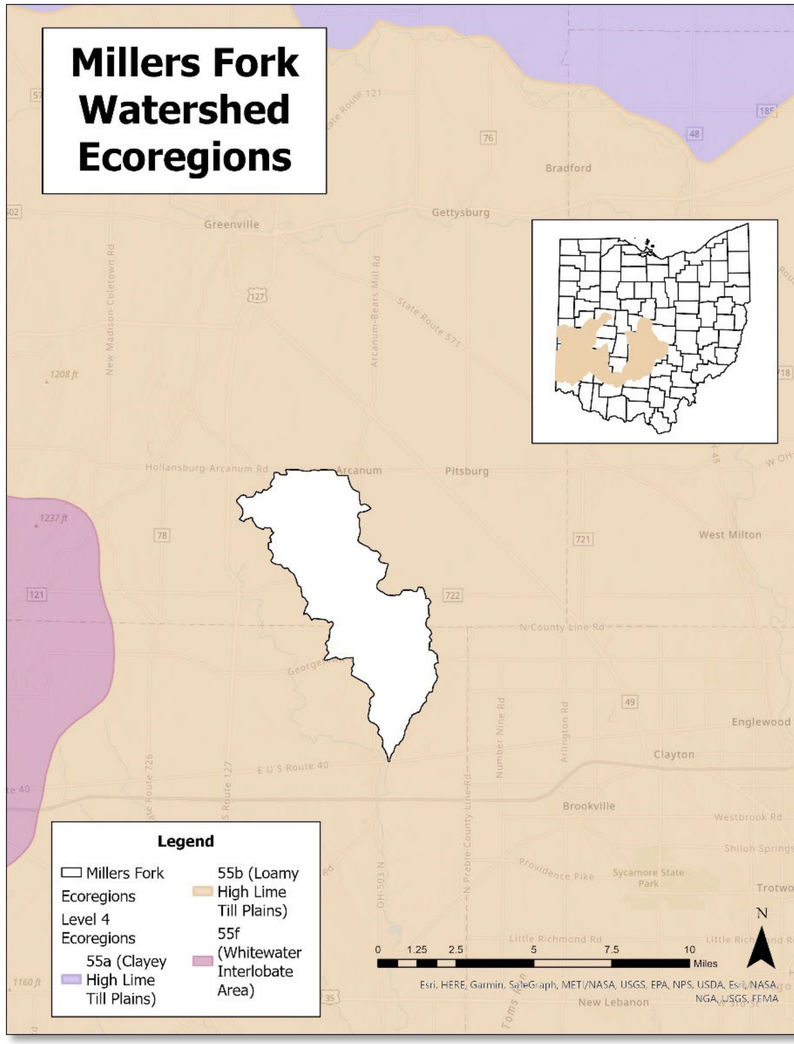
The announcement of the project and the April public meeting have prompted more landowners' interest and inquiries about implementing conservation practices. Field visits were conducted on June 20, 27, and 30, 2023, to observe conservation practices within the watershed. During the site visits, the NPS-IS core team met with agricultural producers with large row-crop operations regarding their challenges and successes with various conservation practices, as well as problem areas on their properties. The team also met with Preble County Park district that manages a nature preserve within this watershed. (See Section 2.1.3. for Public Land discussion). TVCT is committed to continue its mission 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. Preble and Darke SWCDs are dedicated to continuing to promote conservation practices with public involvement through education and outreach activities. The SWCDs engage with the public in several ways, including publishing newsletters, in-person farm visits and regularly updating social media outlets such as Facebook as well as their websites.

Two regional watershed partners, The Nature Conservancy District and Miami Conservancy District have engaged in the review and discussion of the draft Millers Fork HUC-12 NPS-IS and also provided funds (in kind and cash) to complete the modeling of the Agricultural Conservation Planning Framework (ACPF) for Millers Fork HUC-12 (see Section 2.5).

A second press release was issued on November 3, 2023, informing the public that the Draft Nine-Element NPS-IS is complete. The public is encouraged to request a copy of the plan, review it and provide comments. Once comments are received and reviewed, the next version of the Millers Fork HUC-12 Nine-Element NPS-IS will be updated to incorporate the comments.

Chapter 2: Watershed Characterization and Assessment Summary

The Millers Fork HUC-12 watershed includes numerous unnamed tributaries (Figure 1-1). In 2005, Ohio EPA conducted the Biological and Water Quality Study of Twin Creek and Selected Tributaries which included Millers Fork (OEPA, 2007). The report stated that the three sampling locations from Millers Fork partially met the EWH aquatic life use, though the northern most sampling site in Twin Township, Darke County received the recommendation to be downgraded from EWH to WWH.



The Millers Fork HUC-12 is located within the Eastern Corn Belt Plains (ECBP) ecoregion (Figure 2-1). The ECBP ecoregion is a rich agricultural producing area and primarily a rolling till plain with local end moraines that were associated with glacial deposits of Wisconsinian age (7,500 to 11,000 years ago). This region's nutrient-rich soils significantly influence water quality including elevated concentrations of nitrate and phosphorus in many watersheds (USEPA, 2000).

2.1. Summary of Watershed Characterization for Millers Fork HUC-12

2.1.1. Physical and Natural Features

FIGURE 2-2 MILLERS FORK NEAR COUNTY LINE ROAD

In the Millers Fork HUC-12 watershed, deposits of glacial till composed of cobbles, gravel, sand, silts, and clays overlay sedimentary bedrock of limestone and shale formations or interbedded limestones and shales (Ohio Geological Survey, 2005). Glacial till, visible as moraines or depositional ridges of glacial outwash, formed lobate ridges according to glacial advance and retreat. Wisconsinian Era end moraine and ground moraine compose most of the unconsolidated sediments in the watershed (Ohio Geological Survey, 2005). Drift thickness, the amount of glacial deposition that occurs above bedrock, varies from as thin as 20 feet in the watershed's uplands to as thick as 200 feet in the outwash areas and bedrock cut valleys that cover ancient river valleys (Ohio Geological Survey, 2005). Bedrock is commonly visible in the Millers Fork streambed in the lower portion of the watershed.

Upland soils in the watershed are primarily loamy glacial till that are generally high in fertility and have poor to moderate drainage. Over 33% of the watershed is poorly drained or very poorly drained (NRCS, 2020). The dominant upland soil association consists of Brookston and Crosby silt loams (Appendix B) which represent soils that have slow and very slow infiltration when thoroughly wet. These soils have a very slow rate of water transmission (Figure 2-3).

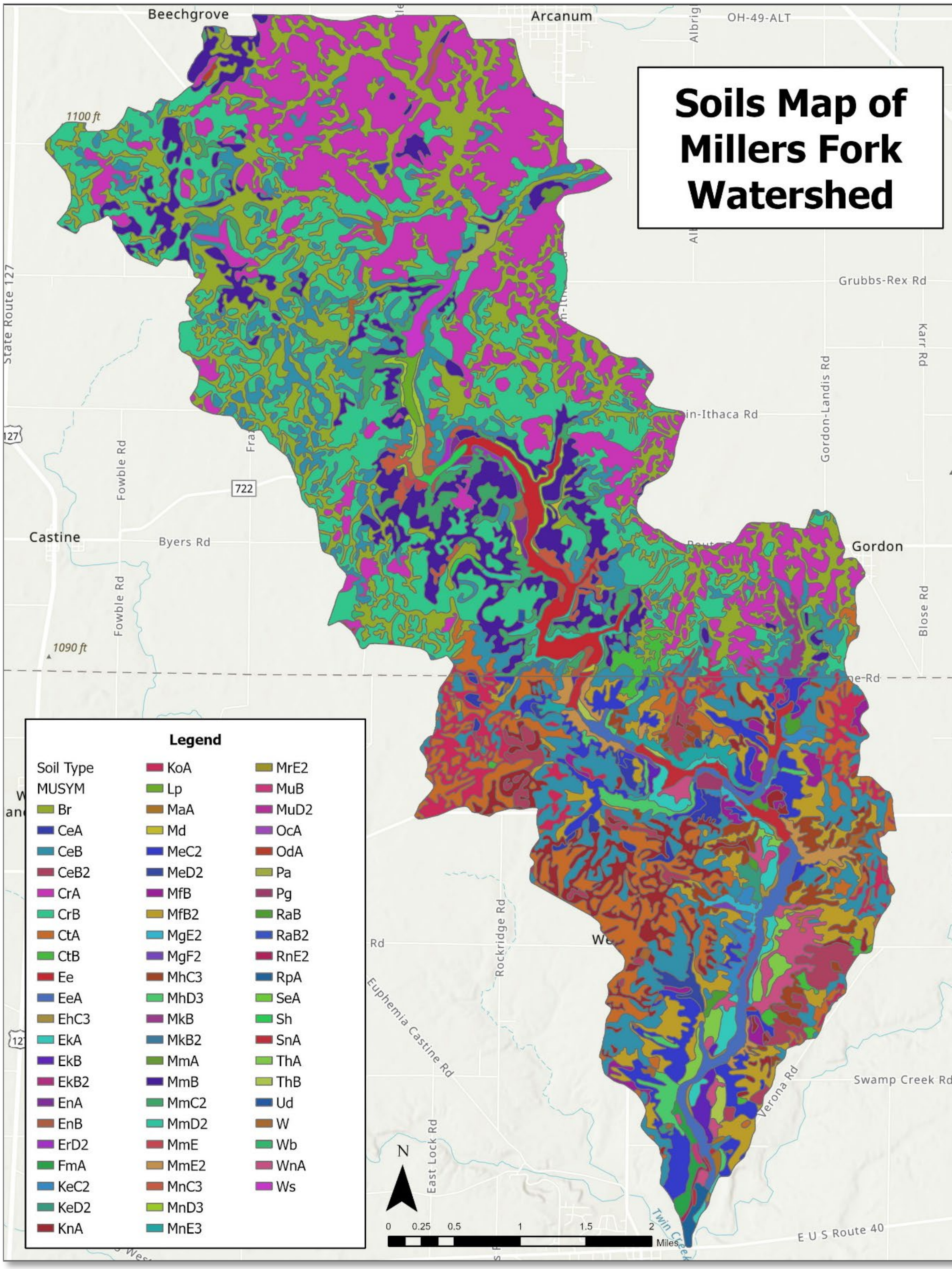


FIGURE 2-3 SOILS MAP OF MILLERS FORK HUC-12 (USDA-NRCS)

The watershed soils are cultivated in large acreages and are important to farming in this watershed. The control of runoff and soil erosion are the main concern in managing these soils for farming while moderately slow permeability and slope are the dominant limitations to many nonfarm uses (NRCS, 2023). Soils along Millers Fork primarily are derived from fine to coarse-grained floodplain deposits that overlie older alluvial or outwash sediments. Such floodplain soils tend to be fertile and well-drained (Figure 2-4).

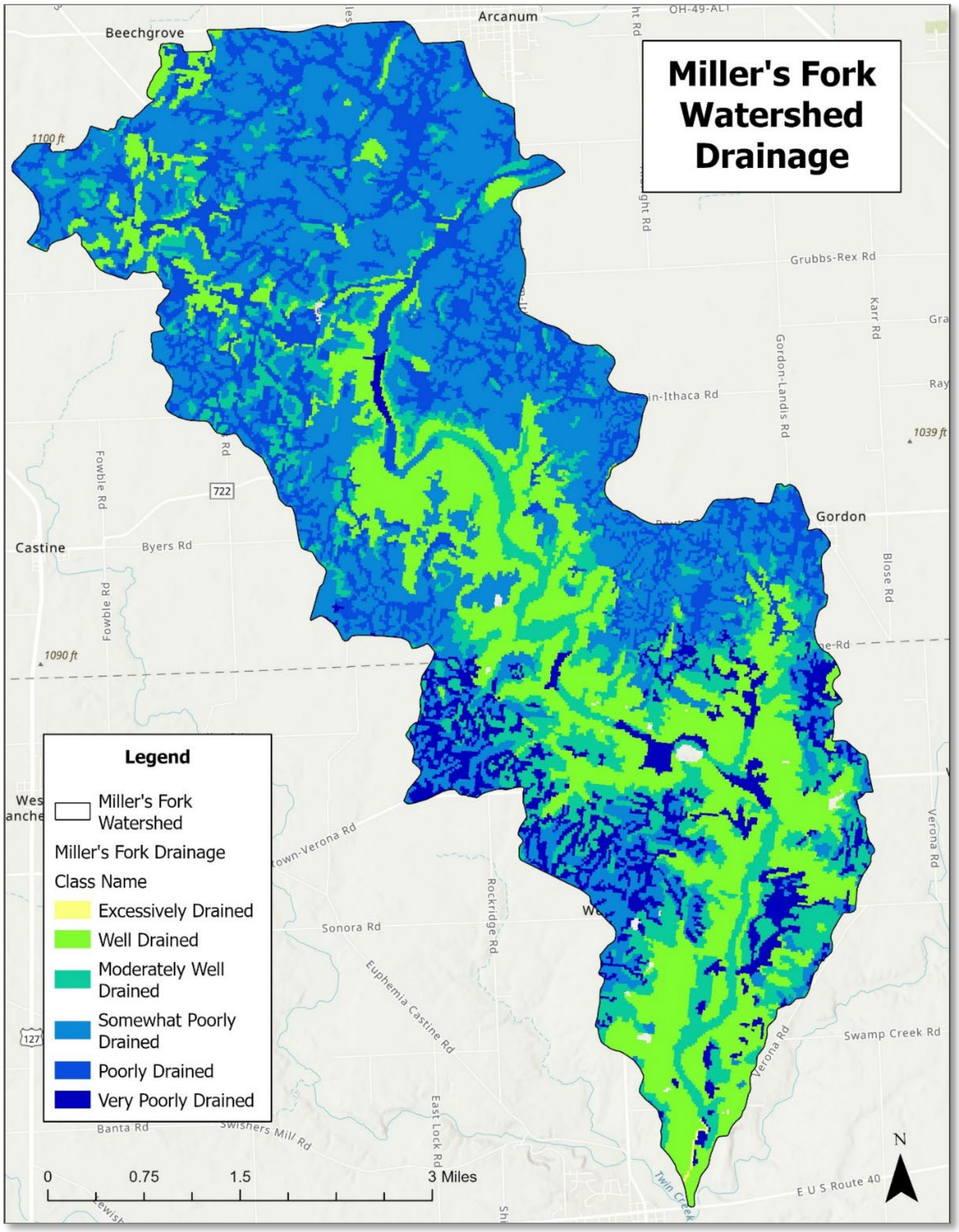


FIGURE 2-4 DRAINAGE CLASS WITHIN MILLERS FORK HUC-12 (USDA-NRCS, ESRI)

It appears that there is not an abundance of wetlands in the Millers Fork HUC-12 (Figure 2-5). Most natural wetlands in the Millers Fork HUC-12 watershed were likely lost with the installation of field drainage systems that began as long ago as the early to mid-19th century.

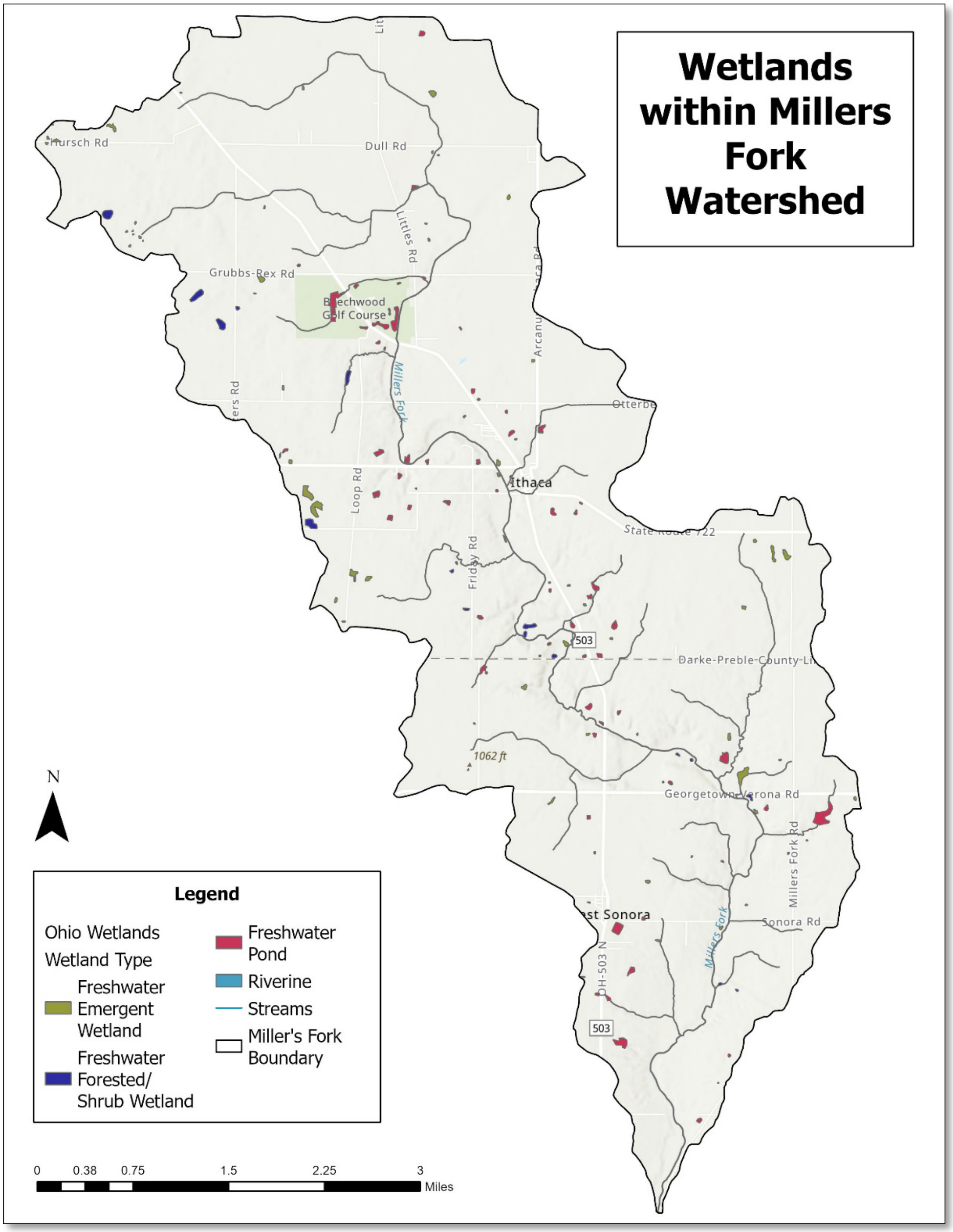


FIGURE 2-5 WETLANDS WITHIN MILLERS FORK HUC-12 (USFWS)

The slope appears to be gentle in the northern portion of the Millers Fork HUC-12 but there is higher relief beginning at Otterbein-Ithaca Road and south to the Preble County line before flattening out again in Preble County. Channelization, low flows, and limited riparian vegetation are common in the uppermost portion of Millers Fork, but the stream gains a more natural meander pattern and associated higher QHEI scores further downstream. The riparian corridor appears to have moderate to high relief and some of the streambanks have as high as 8-degree slopes which may be the cause of some of the severe streambank erosion observed in the watershed (Figure 2-6).

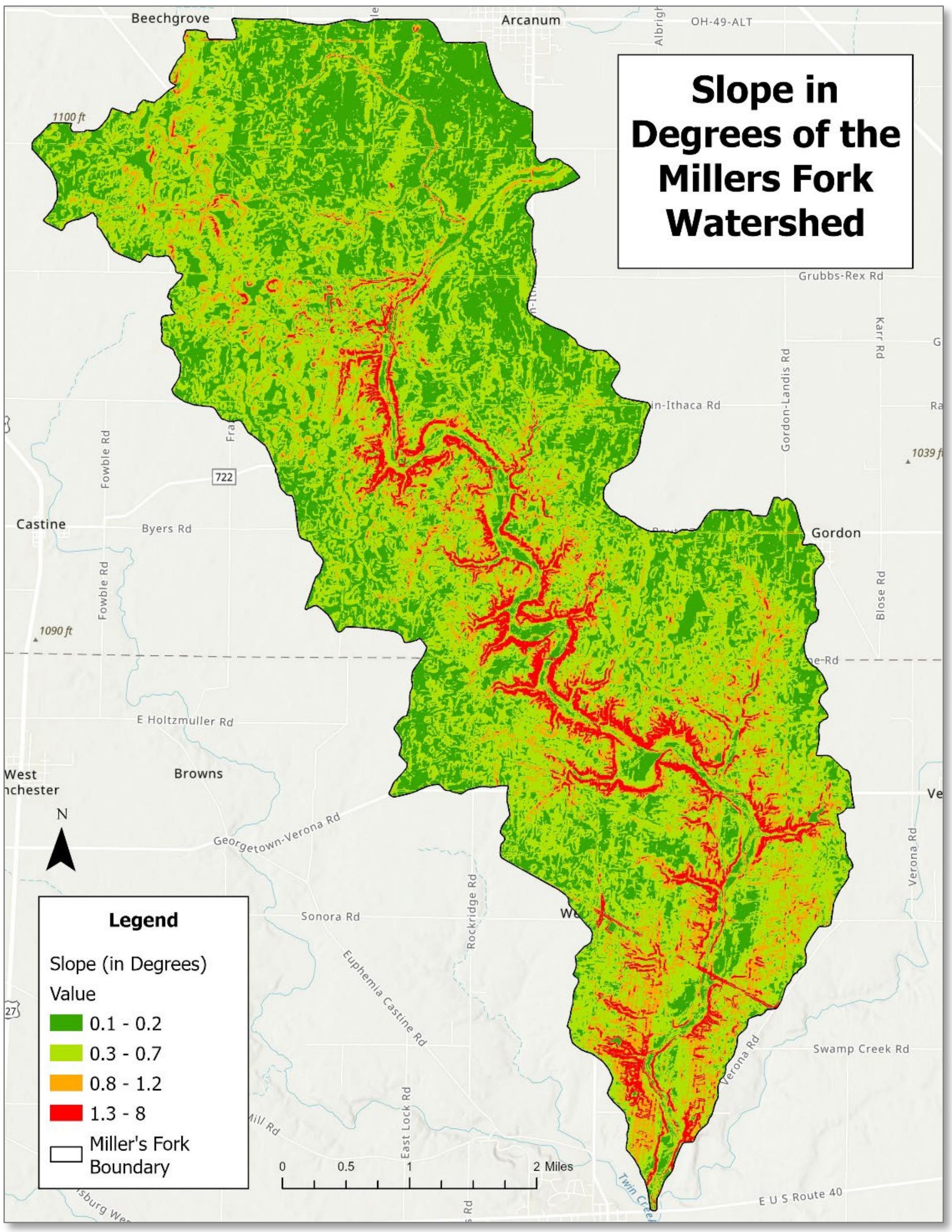


FIGURE 2-6 SLOPES IN DEGREES OF THE MILLERS FORK HUC-12 (USDA, 2023)

2.1.2. Agricultural Land Use and Conservation Practices

Agriculture is the predominant land use in the Millers Fork HUC-12 watershed and will continue to be for the foreseeable future (Figure 2-7).

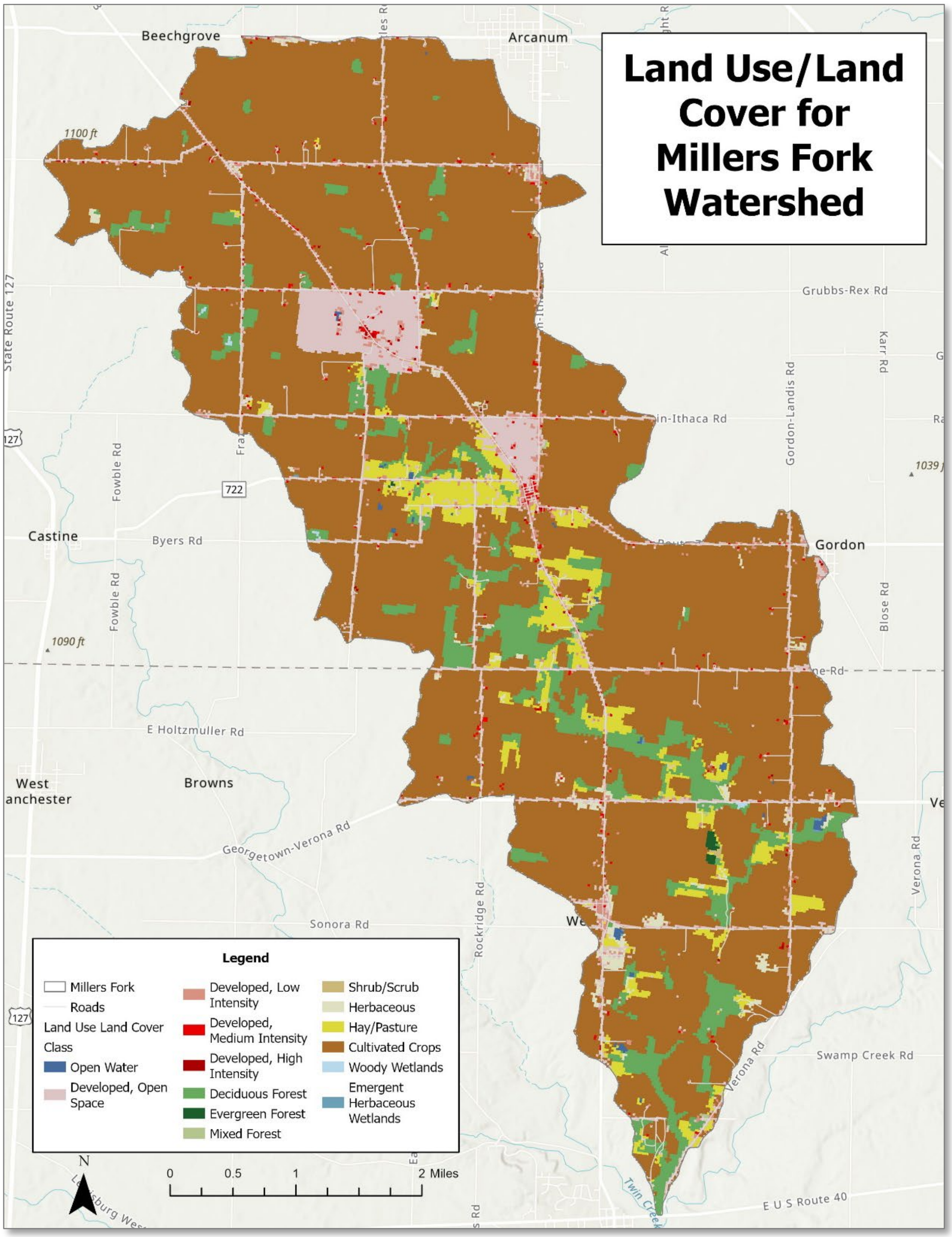


FIGURE 2-7 LAND USE MAP OF MILLERS FORK HUC-12 (USGS, 2021)

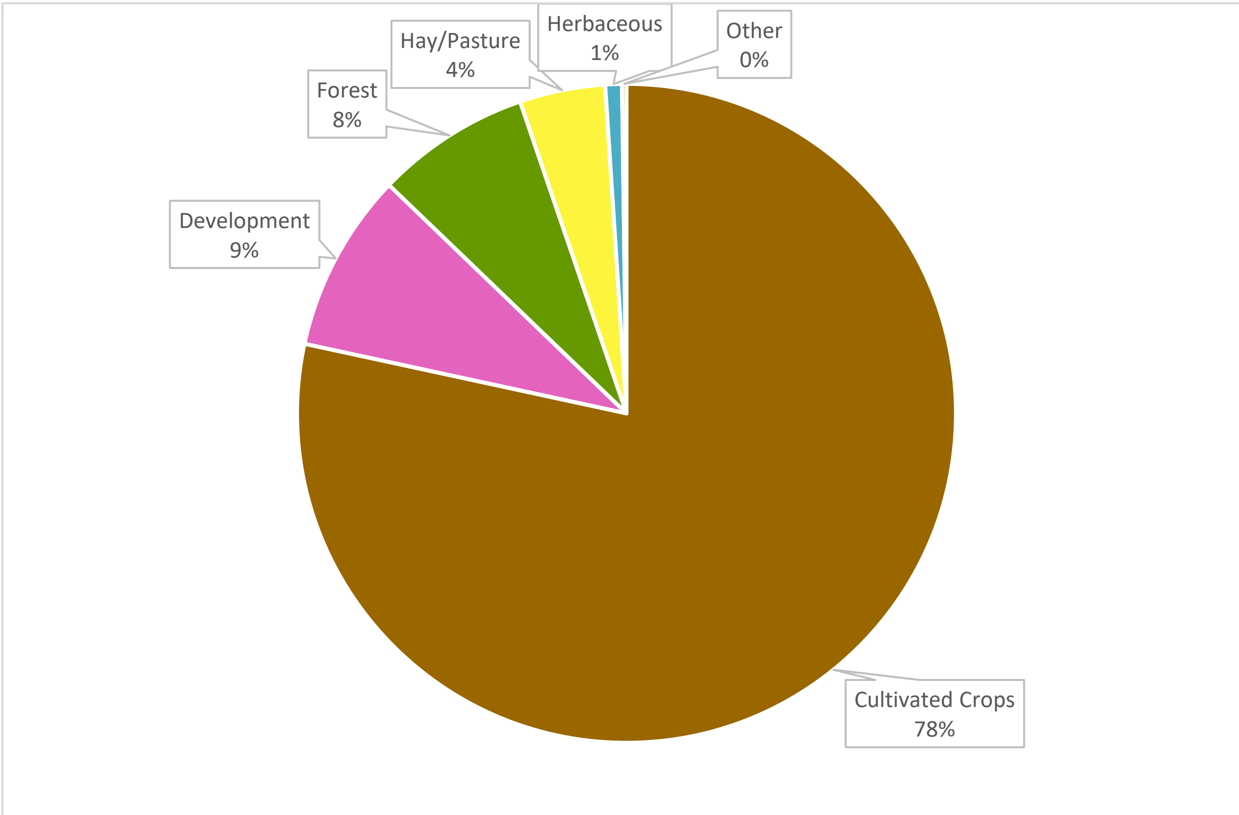


FIGURE 2-8 LAND USE IN MILLERS FORK HUC-12

Figure 2-8 indicates 78% of the watershed land use is in row-crop production, 4% in hay and pasture, 8% is forested and approximately 9% is developed (NLCD, 2019). The deciduous forests in the Millers Fork HUC-12 only occupy about 8% of the watershed and are primarily located in the riparian zone of Millers Fork and its tributaries. The riparian area is also where the steeper slopes are within the central three-fourths of this watershed (Figure 2-6). The quality of the riparian zone is moderate with a mixture of high-quality native trees and grasses as well as the dominant invasive such as bush honeysuckle.

Ithaca a small village with a population of 81 (2020 U.S. Census) is the only incorporated community fully in the HUC-12. The Village of Gordon (population 245) is located partially in the Millers Fork HUC-12. A low-density agricultural portion of land within the Village of Verona's municipal boundary is also in Millers Fork watershed. Verona's wastewater treatment plant (WWTP) discharges to the adjacent watershed, Swamp Creek. Ithaca (Darke County), Gordon (Darke County), and West Sonora (Preble County) are not served by any municipal wastewater treatments, so, all of the churches, homes and businesses in these populated areas are served by HSTS.

Row-Crop Agriculture

Corn and soybeans are the major crops produced in the Millers Fork HUC-12. In between 2016 and 2022 there was a combined average of approximately 11,353 acres of corn and soybeans produced in this watershed each year.

TABLE 2-1 CROPLAND AREA ACREAGE IN THE MILLERS FORK HUC-12

Crop	2022	2020	2018	2016
Corn	3,637	4,277	3,871	4,407
Soybean	7,436	7,233	7,546	7,005
Winter wheat	247	135	121	113
Alfalfa	208	275	147	--
Hay	63	98	46	22
Double Crop Winter Wheat/Sovbeans	94	50	7	3

Source: USDA NASS CropLand CROS 2023

Livestock Operations

No concentrated animal feeding facility (CAFF) and no permitted concentrated animal feeding operations (CAFOs) are in the Millers Fork HUC-12. Approximately 10 small-sized livestock operations were identified (Table 2-3), and two medium-sized operations were identified.

TABLE 2-2 LIVESTOCK OPERATIONS IN THE MILLERS FORK HUC-12

Livestock Species	Operations	Average no. of animals per operation
Horses	5	3
Dairy cattle	0	0
Beef Cattle	2 to 5	15 to 100
Poultry	0	0
Hogs	2	275

Most land within the Millers Fork HUC-12 is privately owned; therefore, agency knowledge of the individual conservation practices may not be up to date. Some conservation practices can be estimated through program enrollment initiated through the SWCD/NRCS and Farm Service Agency, as well as the annual crop tillage survey performed by Miami University, Oxford OH. Current and recent past (1-5 years) estimates of several practices provided by Preble and Darke SWCDs within the Millers Fork HUC-12 are provided in Table 2-3. As documented by Miami University tillage survey, with 25% (corn fields) and 75% (soybean field) of the Upper Twin watershed currently implementing conservation tillage, this watershed has already made good progress in nutrient management. The total estimate of nitrogen and phosphorus load reductions when combining all of the current and recent past (1-5 years) conservation practices are 14,106 lb/yr and 5,652 lb/yr, respectively using STEPL tool (Table 2-3).

TABLE 2-3 CURRENT AND RECENT PAST CONSERVATION PRACTICE ESTIMATES USING STEPL*

Practice Type	Estimated Acreage Treated/ Number of Structures Installed	Estimated Nitrogen Load (lb/yr)	Estimated Phosphorous Load (lb/yr)
Conservation Tillage (no till, reduced till)	9,055	12,970	5,322
Cover Crops	465	315	32
Buffer - Whole-Field Warm Season Grass, Cool Season Grass Filter Strip, Warm Season Grass Field Border, Grassed Waterways	31	46	12
Gypsum Application	750 acres	NA	NA
Nutrient Management (Variable Rate Fertilization)	1,067 acres	500	231
Land Retirement (WRP easement)	77 acres (see Protection Land section below)	275	55

**Estimates calculated using Spreadsheet Tool for Estimating Pollutant Loads (STEPL), Version 4.4 (USEPA, 2020).*

2.1.3. Protected Land and Endangered Species

Conservation Easement

Three Valley Conservation Trust holds no easements in the Millers Fork HUC-12. Darke SWCD holds a 77-acre agricultural easement in the northern section of the watershed.

Many of the conservation easements held by nonprofit or governmental entities such as Three Valley Conservation Trust requires that best management practices be used by the landowner as part of a Whole Farm Conservation Plan, an active management plan through US Fish and Wildlife Service, and/or habitat enhancement through the soil and water conservation districts and habitat groups such as Pheasants Forever and Quail Unlimited.

Park Land

Preble County Park District owns a six-acre parcel in Millers Fork HUC-12, just south of the of unincorporated West Sonora on State Route 503. The park district's larger parcel, the Garber Nature Center, further south on State Route 503, lies on the ridge between Millers Fork and Headwaters Twin watershed. Approximately 20-percent of the 100-acre property, along the frontage, drains to Millers Fork. Most of this land along the frontage is leased to a local farmer and used for row-crop production. A shelter house and maintenance building also exist along the frontage.

Endangered Animal Species

Several rare, threatened, and endangered plant and animal species are known to live in the Millers Fork HUC-12 and have some level of state or federal protection or concern (Table 2-4).

Loss of riparian and poor water quality conditions can contribute to the degradation of their natural habitats.

TABLE 2-4 FEDERALLY RARE, THREATENED, AND ENDANGERED ANIMAL SPECIES, BY COUNTY

Species	Status	County	Habitat Characteristics
Indiana bat (*Myotis sodalis*)	Endangered	Preble	Hibernates in caves and mines and forages in small stream corridors with well-developed riparian woods, aswell as upland forests
Northern long-eared bat (*Myotis septentrionalis*)	Threatened	Preble	Hibernates in caves and mines and swarms in surroundingwooded areas in autumn; roosts and forages in upland forests during late spring and summer
Snuffbox mollusk *(Epioblasma triquetra)*	Endangered	Darke	Found in small-to medium-sized creeks, burrowed deep in sand, gravel or cobble substrates; affected by sedimentation, agricultural run-off, and failing septic systems.
Clubshell mollusk *(Pleurobema clava)*	Endangered	Darke	Prefers clean, loose sand and gravel in medium to small rivers and streams; burrowed in the bottom substrate up to four inches; affected by agricultural run-off and industrial waste.
Eastern massasauga *(Sistrurus catenatus)*	Threatened	All	Live in wet areas including wet prairies, marshes and low areas along rivers and lakes. In many areas massasaugas also use adjacent uplands during part of the year. They often hibernate in crayfish burrows but may also be found under logs and tree roots or in small mammal burrows.

Source: ODNR Division of Wildlife, 2020; US Fish and Wildlife Service, 2017

Numerous invasive plant species occur throughout the Millers Fork HUC-12. Common invasive species include bush honeysuckle (*Lonicera species*), Japanese honeysuckle (*Lonicera japonica*), multi- flora rose (*Rosa multiflora*), and garlic mustard (*Alliaria petiolata*), These Invasive plants have negative impacts on native vegetation and animals within the watershed. Bush and Japanese honeysuckle out-compete and displace native plants and alter natural habitats by decreasing light availability and depleting soil moisture and nutrient content. Exotic bush honeysuckle competes with native plants for pollinators, resulting in a reduced seed set for native species. Multiflora rose forms dense thickets, excluding most native shrubs and herbs from establishing, and may be detrimental to nesting of native birds. Garlic mustard invades areas disturbed by human activities and displaces many native wildflowers.

2.1.4. Home Sewage Treatment Systems

HSTS are small wastewater treatment units that serve individual homes or businesses. The effectiveness of each HSTS depends on its age, maintenance records, and characteristics of the site including soil drainage, depth to water table, bedrock depth, land slope, and household size. Five-percent of total phosphorus and 3-percent of total nitrogen loading to the Great Miami River were from HSTS between 2017 and 2021 (ODA, 2023). While non-functioning HSTS contribute a small percentage of nutrient pollution, the high bacteria levels they discharge negatively impact stream recreational uses due to potential human health impacts (ODA, 2023). HSTS are considered a major bacteria contributor affecting the water quality of Millers Fork as indicated in the 2007 OEPA report. The Natural Resources Conservation Service (NRCS) Soil Web Survey for Septic Tank Absorption Fields for Millers Fork HUC-12 indicated that 99.7% of the watershed is very limited. The evaluation is based on soil properties that affect adsorption of the effluent, construction and maintenance of the system and public health.

During development of the 2010 TMDL, a consulting firm was reportedly developing a plan to connect Gordon and Ithaca to the Village of Verona's WWTP, but no action was apparently taken to do so.

The 2020 OKI report on management of onsite systems concluded that better septic system management was recommended for the entire Twin Creek Watershed (OKI, 2020).

HSTS in the watershed are regulated by the Darke County General Health District (DCGHD) and Preble County Public Health (PCPH) in compliance with the Ohio Administrative Code (OAC) 3701-29-19. Since 2003, DCGHD has made great strides in collecting data about the location and type of HSTS in their jurisdiction, thanks to 319 funding for the project. According to the DCGHD, there are approximately 57 homes in the villages of Ithaca and Gordon and nearly 27 percent of those households either have no secondary treatment (e.g., leach field) or the leach field is more than fifty years old. Those systems are likely discharging waste to a storm sewer or field tiles that discharge to nearby Millers Fork. Small lot size limits the ability of many homeowners to install new or replacement leach fields.

PCPH has applied for and been awarded approximately $300,000 to assist residential sewage system owners in handling the cost of fixing their sewage treatment systems. The populated area of West Sonora in Harrison Township of Preble County was identified as an area of concern by PCPH, Preble SWCD, Ohio EPA (MVRPC, 2011) and by participants in the April 2023 public input meeting for this plan.

In 2015, MVRPC contacted Ithaca and Gordon village officials to offer no-cost wastewater facility planning assistance. The offer was not accepted at that time, but MVRPC may have funds in the near future to make this offer again (April 14, 2023, personal communication with Matt Lindsay).

Education is key to reducing the effects of failing HSTS on the stream. Darke SWCD and DCGHD recently have trained 60 contractors in proper HSTS installation procedures. To educate the public about failed HSTS and water quality, a septic system workshop was hosted by Preble SWCD in partnership with the Ohio Farm Bureau in 2021. The workshop was attended by 25 participants and featured talks from a soil scientist who does investigations for septic systems at Ohio State University and Preble SWCD staff.

Because of the poor soil drainage and shallow depth to bedrock, it is likely that failed HSTS are prevalent and widespread in this watershed. Better resources and coordination from local partners are needed to address the failed HSTS in this rural community and in the region. The geometric mean of five samples tested for *E. coli* in September 2005 exceeded Primary Contact Recreation standards

2.1.5. Groundwater Vulnerability and Source Water Protection

There are two basic types of aquifers in the Great Miami River Watershed: the buried valley aquifers – a glacial deposit largely consisting of sand and gravel and bedrock aquifers where significant amounts of water are stored in the fractures of the rock formation. Some groundwater exists at shallow depths and is unprotected by a confining clay layer. Protecting this shallow groundwater from nutrients and pesticides is a major concern. (ODA, 2023)

The Great Miami River and some of its tributaries including Twin Creek are located along the path of the buried valley aquifers. The Great Miami Buried Valley Aquifer was designated a Sole Source Aquifer in 1988. Ohio Department of Natural Resources (ODNR) published the groundwater pollution potential maps for the State using the DRASTIC system in early 2000. Recently, a GIS based modified DRASTIC model was published by ODNR in 2022. DRASTIC parameters include Depth to Water, Net Recharge, Aquifer Media, Soil Media, Topography, Impact of Vadose Zone Media and Hydraulic Conductivity and provide an important tool to evaluate the groundwater vulnerability of an area including communities served by HSTS. Figure 2-9 shows the Groundwater Vulnerability Index (GVI) of the Millers Fork HUC-12. The majority of the watershed is at the medium to high GVI.

Rural communities, including villages and unincorporated populated areas, without a public water system -- and the surrounding rural homes -- rely on both HSTS and private wells in close proximity to one another and are thus at risk of contaminating their drinking water resources with nitrate and bacteria (Swann, 2001). The villages of Ithaca and Gordon, plus the unincorporated community of West Sonora are such areas relying on HSTS and private drinking water wells.

In the Millers Fork HUC-12, the public drinking water supply is entirely from groundwater sources. Many of these sources lie within the floodplain areas of local streams. The villages of Arcanum and Lewisburg, plus Son Rise Church in Ithaca and Beechwood Golf Course Clubhouse are the public water wellfields in the Millers Fork HUC-12 watershed or with supposed source water protection areas in the watershed.

Arcanum and Lewisburg have drinking water source assessments, developed by the OEPA in and around 2003. Arcanum's wellfield's five- and ten-year time-of-travel zones include nearly a square mile of agricultural area in the upstream portion of the watershed, including both banks of Millers Fork in the area where low biological indices prompted a recommendation to downgrade ALU to WWH. The Arcanum system was identified as having a moderate susceptibility to contamination due to presence of a protective layer of clay overlying

the aquifer, the unknown nature of the limestone aquifer, no evidence to suggest that ground water has been impacted by any significant levels of chemical contaminants from human activities, and presence of significant contamination sources existing within the protection area, including agricultural activities (OEPA 2003).

In addition to the OEPA assessment, the Village of Lewisburg had also completed a Wellhead Protection Plan in the mid- to late-1990s which mentions the potential negative impact of HSTS. The Village of Lewisburg's wellfields are down-gradient from this watershed, but the wellfield's five- and ten-year time-of-travel zones include agricultural areas in the downstream portion of the watershed. The Lewisburg system was identified as having a high susceptibility to contamination due to less than 20 feet depth to groundwater, less than 20 feet thickness of confining layer, and potential significant contamination sources existing within the protection area, including agricultural activities (OEPA 2003). These contamination sources included NPS agricultural activities (chemical applications and field runoff) and failing HSTS (OEPA 2002).

None of the drinking water source areas has an OEPA-endorsed Source Water Protection Plan, though Lewisburg has a Wellhead Protection Plan in addition to the 2003 OEPA assessment. Source Water Protection Plans and similar studies would help determine the degree of exchange – if any -- between groundwater and surface water in the local geology. These plans would also determine other risk factors and practices to reduce those risks.

In summary, to address the non-point source pollution that is associated with failed septic systems and to protect the water resources in this sparsely populated and rural Millers Fork watershed is an important and yet challenging task that requires local cooperation, and investment in time and effort. As noted previously, education and outreach are critical and there are resources that can assist the county health departments if the communities are supportive. In this NPS-IS, it is recommended that all public water systems in the Millers Fork HUC-12 obtain an OEPA-endorsed Source Water Protection Plan. When these plans are complete, protecting drinking source water may become a new critical area of a future version of this NPS-IS Plan.

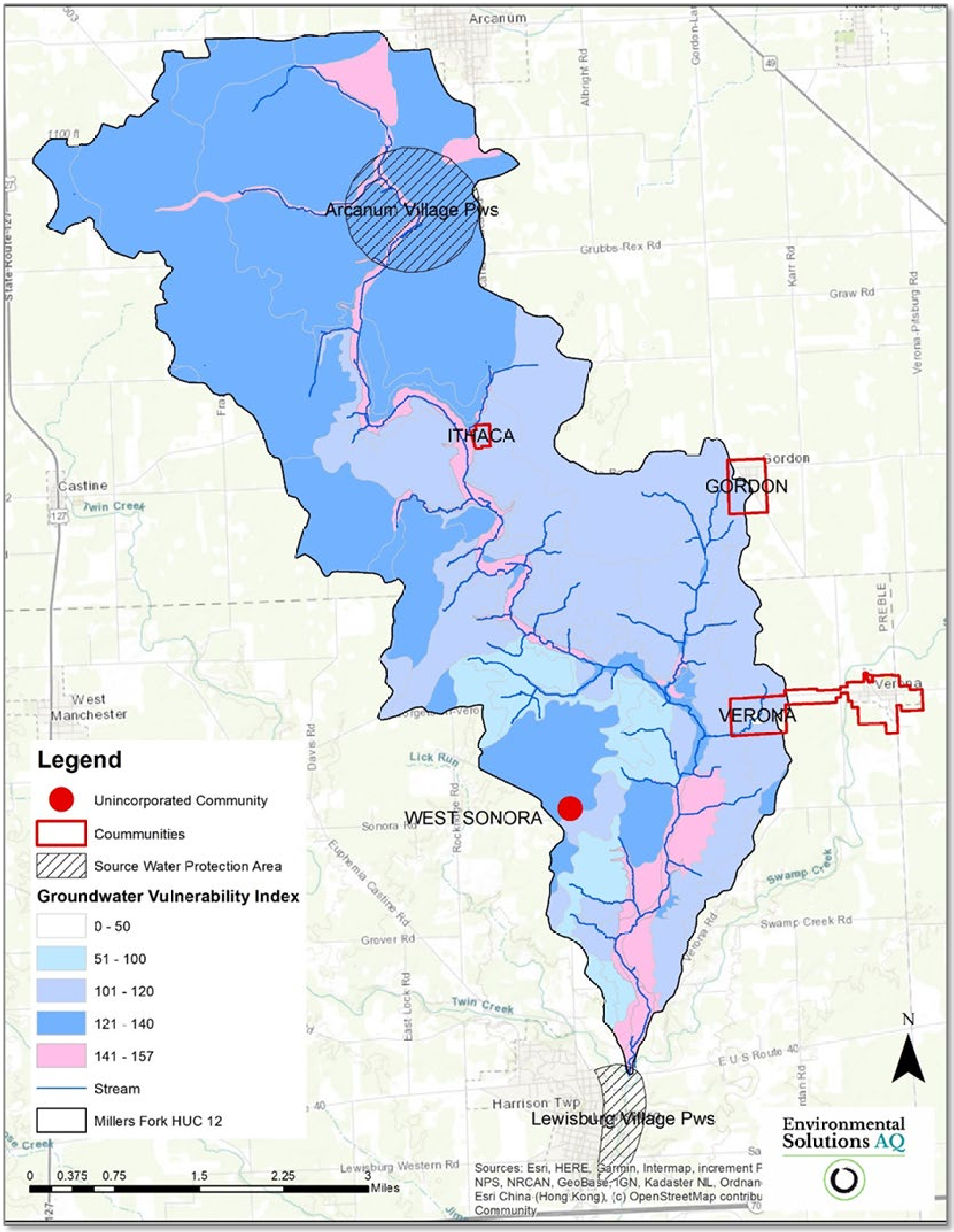


FIGURE 2-9 MILLERS FORK GROUNDWATER VULNERABILITY AND SOURCE WATER PROTECTION

2.2. Summary of Biological Trends for Millers Fork HUC-12

Ohio EPA Biological and Water Quality Study of the Twin Creek and Selected Tributaries 2007 is the only comprehensive sampling data analysis of Twin Creek and Millers Fork HUC-12 watershed. Using the data from this report, OEPA prepared the TMDL for the Twin Creek Watershed. This section summarizes the findings of the 2005 OEPA sampling report (OEPA, 2007) and the OEPA TMDL Report (OEPA, 2010).

Three sampling locations were selected in the Millers Fork HUC-12 during the 2005 OEPA sampling event (Figure 2-10, Table 2-5). All of the sampling locations are located along Millers Fork. Table 2-6 shows the biological indices scores for the three sampling sites in Millers Fork HUC-12.

TABLE 2-5 2007 OEPA SAMPLING LOCATION WITHIN MILLERS FORK HUC-12

Stream Mile	Drainage Area (mi^2)	Cross Road	Longitude	Latitude
10.8	5.7	Grubbs-Rex Rd.	-84.5682	39.9607
8.0	10.1	Clark Rd.	-84.5559	39.9362
3.9	19.7	Georgetown-Verona Rd.	-84.5232	39.9029

**Conventional water chemistry sampling only*
Source: OEPA, 2007

TABLE 2-6 BIOLOGICAL INDICES SCORES FOR THREE SAMPLING SITES IN MILLERS FORK HUC-12

Millers Fork Stream Mile	IBI	MIwb	ICI	QHEI	Aquatic Life Use Designation	Attainment Status
10.8	40	N/A	LF	33.0	EWH, recommended WWH	Partial
8.0	48	N/A	G	66.5	EWH	Partial
3.9	48	N/A	MG	58.0	EWH	Partial

Source: OEPA, 2007
IBI Index of Biotic Integrity
The Modified Index of Well Being (MIwb) is not applicable to headwater sites (drainage ≤20 mi2).
ICI - Invertebrate Community Index (G=Good; MG=Marginally Good; H Fair =High Fair; F=Fair; L Fair=Low Fair; P=Poor; VP=Very Poor).
QHEI - Qualitative Habitat Evaluation Index
WWH Warmwater Habitat – ECBP Ecoregion

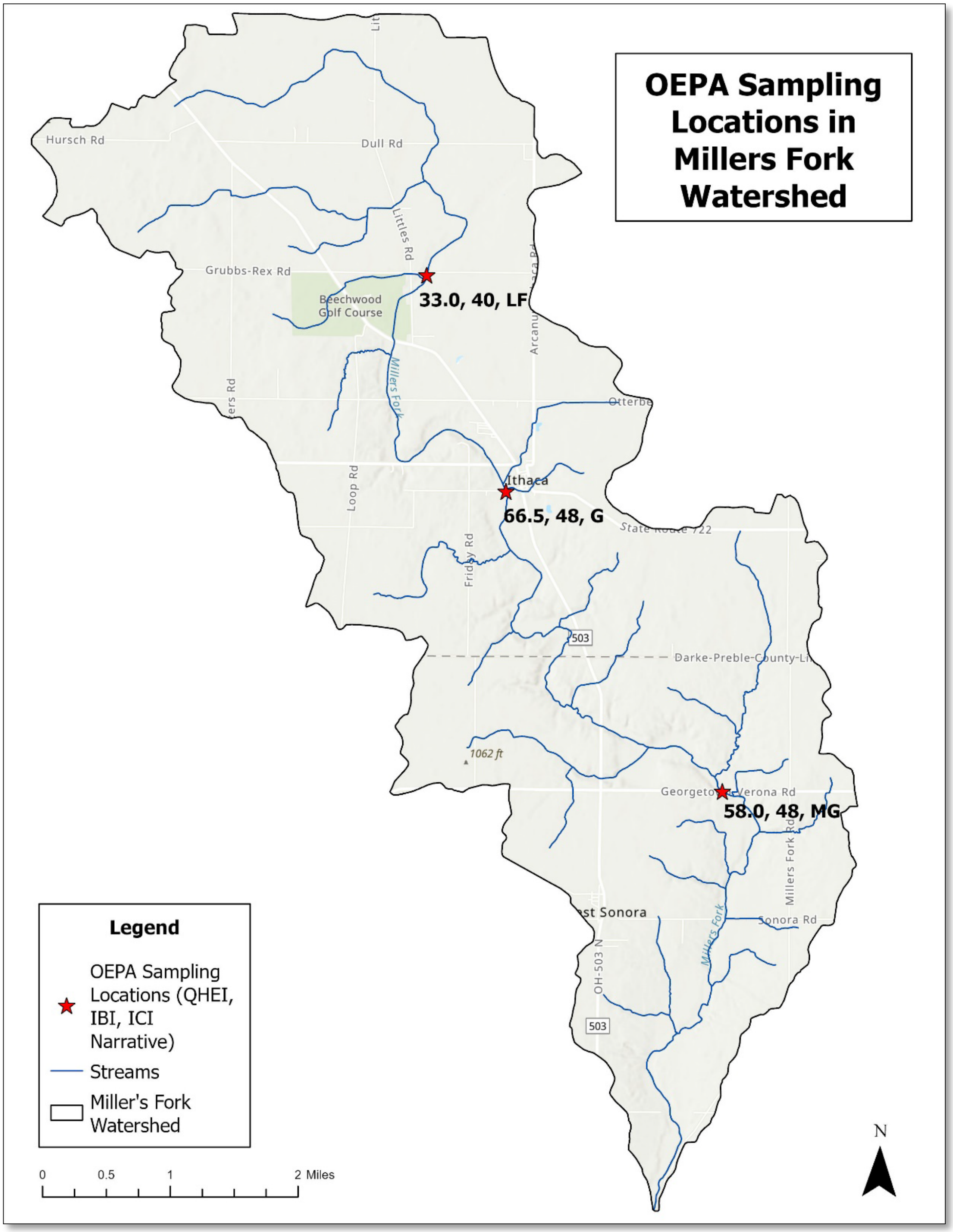


FIGURE 2-10 2005 OEPA SAMPLING LOCATIONS IN MILLERS FORK HUC-12 (OEPA, 2007)

2.2.1. Biological Assessment: Fish Assemblages

The fish assemblages of Twin Creek and its tributaries which included Millers Fork were surveyed and assessed by OEPA in 2005. A total of 35,596 fish comprising 42 species and six hybrids was collected from all Twin Creek tributaries, between July and September 2005. Based on aggregated catch statistics from all tributaries, numerically predominant species included Central stoneroller (30.0%), Northern creek chub (16.1%), white sucker (7.2%), rainbow darter (6.1%), mottled sculpin (5.1%), and striped shiner (3.6%). In terms of relative biomass (kg/0.3km), dominant species were, Central stoneroller (30.2%), Northern creek chub (23.6%), white sucker (14.1%), striped shiner (6.4%), rockbass (3.6%), and mottled sculpin (3.2%). In terms of ranked abundance and biomass measures, these dominant species are typical associates of headwater or brook environments. Community indices and accompanying narrative evaluations from these waters ranged between exceptional (IBI=56/MIwb=9.8) and marginally good (IBI=36/MIwb=8.0) (Table 2-7). Taken together with the entire Twin Creek tributaries, the fish assemblages were collectively characterized in the narrative as very good. The Twin Creek tributaries including Millers Fork were found to support fish assemblages fully consistent with the biocriteria applicable to existing and recommended ALUs.

TABLE 2-7 FISH COMMUNITY AND DESCRIPTIVE STATISTICS FOR MILLERS FORK HUC-12

Stream River Mile	Mean Number Species	Cumu-lative Species	Mean Rel. No. (No./km)	Mean Rel. Wt. (Wt./km)	MeanIBI	MeanMIwb	QHEI	Narrative Evaluation
10.8	21.0	21	1672.00	6.76	40	N/A	33.0	Good
8.0	22.0	22	1324.50	6.19	48	N/A	66.5	Very Good
3.9	19.0	19	405.0	11.11	48	N/A	58.0	Very Good

Source: OEPA 2007

2.2.2. Biological Assessment: Macroinvertebrate Community

The macroinvertebrate community in Millers Fork was evaluated at three sampling locations. Samples collected at RM 10.8, RM 8.0, and RM 3.9 partially met the current EWH aquatic life use and received low fair, good, and marginally good qualitative evaluation.

The most upstream site at RM 10.8 received a qualitative evaluation of low fair. Channelization, poor riparian buffer, and siltation caused facultative and tolerant taxa, such as leeches and planorbid snails to make up the majority of the organisms. Only 5 of the 38 taxa collected were sensitive and 12 were tolerant. This site is recommended to be redesignated as WWH. Raw sewage was observed dumping into the stream upstream of the Grubbs-Rex Road Bridge, which likely had a negative impact on this sampling location.

The two downstream sampling locations fared better, though still did not attain their EWH designation. Though the habitat has a denser canopy and greater sinuosity, bedrock at RM 8.0 and siltation at RM 3.9 limited the habitat and resulting existence of tolerant species. At the most downstream site, moderate bank erosion on the left bank was observed. The silt from this erosion, plus the predominance of agriculture including a few hog farms may be a possible source of impairment.

TABLE 2-8 MACROINVERTEBRATE SAMPLING RESULTS FOR MILLERS FORK HUC-12

Stream RM	Dr. Area (Sq. mi.)	Data Codes	Qual. Taxa	EPT Ql/Total	Sensitive Taxa Ql./Total	Density Ql. Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies) in Parentheses	ICI	Narrative Evaluation
10.8	5.7	-	38	5	5	L	0	Sow bugs (F), snails (MT, F, MI), fingernail clams (F)	-	Low Fair
8.0	10.1	-	46	13	16	M	0	Net-spinning caddisflies (F,MI), case-building caddisflies (MI), riffle beetles (F,MI), Elimia snails (MI)	-	Good
3.9	19.7	-	47	10	14	M	0	Riffle beetles (F,MI), Elimia snails (MI), Caenis mayflies (F), waterpenny beetles (MI)	-	Marginally Good

Source: OEPA. 2007
RM: River Mile.
Dr. Ar.: Drainage Area
Data Codes: 8=Non-Detectable Current, 9=Intermittent or Near-Intermittent Conditions, 12=Suspected High Water Influence/Disturbance, 13=Suspected Disturbance by Vandalism, 15=Current >0.0 fps but <0.3 fps, 29=Primary Headwater Habitat Stream.
Ql.: Qualitative sample collected from the natural substrates.
Sensitive Taxa: Taxa listed on the Ohio EPA Macroinvertebrate Taxa List as MI (moderately intolerant) or I (intolerant).
Qt.: Quantitative sample collected on Hester-Dendy artificial substrates, density is expressed in organisms per square foot.
Qualitative sample relative density: L=Low, M=Moderate, H=High.

2.2.3. Physical Habitat - Qualitative Habitat Evaluation Index QHEI

In 2005, OEPA 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, OEPA 2006). During this evaluation, several habitat characteristics are 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.

From the 2005 OEPA sampling results on Millers Fork, the QHEI scores at the middle and downstream sites (66.5 and 58, respectively) were determined to partially support the EWH ALU designation. However, the most upstream site scored a 33 QHEI, which is higher than the 1995 QHEI score in this reach. The 2007 report summarizes that the EWH designation at the upstream site was in error. If the ALU was corrected to WWH, that site would only partially attain WWH.

Biological performance for Millers Fork HUC-12 was determined to have low fair to very good communities. ALU designations were based on the Biological and Water Quality Study of Twin Creek and Selected Tributaries conducted by OEPA in 2005 (OEPA, 2007). According to the 2010 Twin Creek WAP, the Millers Fork HUC-12 was designated EWH from stream mile 8.0 to the mouth. Millers Fork at Grubbs-Rex Road, the most upstream Ohio EPA sampling site at stream mile 10.8, was recommended to be downgraded to WWH due to low-fair biological index scores.

TABLE 2-9 QHEI MATRIX AND SCORES FOR MILLERS FORK HUC-12 (SOURCE OEPA 2007)

			Millers Fork		
Key QHEI Elements		River Mile	10.8	8.0	3.9
		QHEI Score	33.0	66.5	58.0
		Gradient (ft/mi)	3.78	6.76	7.14
WWH Attributes		Not Channelized or Recovered		•	•
		Boulder/Cobble/Gravel Substrates		•	•
		Silt Free Substrates			
		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	0	7	5
MWH Attributes	Hi Influence	Channelized/No Recovery	•		
		Silt/Muck Substrates	•		•
		No Sinuosity	•		
		Sparse/No Cover	•	•	•
		Max Depth <40 cm	•		
		Hi-Influence Modified Attributes	5	1	2
	Moderate Influence	Recovering Channel	•		•
		Heavy/Moderate Silt Cover	•		•
		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 Overall Embeddedness	•		•
		High/Moderate Riffle Embeddedness			
		No Riffle	•	•	•
M.I. MWM Attributes			7	3	7
MWH H.I.+1/WWH+1 Ratio			6.0	0.25	0.50
MWH M.I.+1/WWH+1 Ratio			*.*	0.63	1.67

2.2.4. Water Quality

In addition to the biological and physical monitoring discussed above, OEPA collected water samples from Twin Creek and selected tributaries and analyzed the water quality to understand existing conditions in 2005. Results from the study indicated conventional water chemistry was good and all water column samples taken for cadmium, chromium, copper, mercury, nickel, and selenium were below the detection limit (BDL) in Millers Fork. Water column calcium, iron, manganese, magnesium, zinc, hardness, BOD5, chloride, and sulfate were within acceptable ranges. However, ammonia was over the 90^{th} percentile on 11 of 14 sampling events (OEPA 2007).

Evidence of failing septic systems were present at RM 10.8 and 8.0 Millers Fork sampling sites in 2005 and evidence was confirmed in laboratory testing. *E. coli* at all three sampling sites exceeded Primary Contact Recreational Water Quality Standards (PCR WQS) in 40% of test results. The 90^{th} percentile headwater value for ammonia was exceeded during 75-80% of sampling events at all three Millers Fork sampling sites. The tributary that drains to Millers Fork at RM 8.0 drains the unsewered community of Ithaca.

A major log jam downstream of the RM 3.9 sampling site stagnated the flow in 2005, contributing to dissolved oxygen samples below the EWH minimum 4/5 times, and continuous Datasonde samples below EWH continuously in July and August. Embeddedness and TSS levels at the downstream sampling site exceeded the 75^{th} percentile headwater values in 80% of sampling events.

Sediment samples at RM 3.9 detected legacy breakdown products of the pesticide DDT (Dichlorodiphenyltrichloroethane), which was banned in 1972.

Most water column samples were below the 90^{th} percentile background level for total phosphorus, NH_3-N and NO_3-N in the Millers Fork samples, with the exception of the most upstream sampling site.

TABLE 2-10 NUTRIENT SAMPLING RESULTS FOR MILLERS FORK HUC-12

Stream (RM)	area mi²	Frequency of Phosphorus >90th Percentile	Phosphorus Median (mg/l)	Frequency of NH_3>90th Percentile	NH_3 Median (mg/l)	Frequency of NO_3 >90th Percentile	NO_3 Median (mg/l)
Millers Fork (10.8)	5.7	3/4	0.131	¾	0.35	0/4	.010
Millers Fork (8.00)	10.1	0/5	0.142	4/5	0.146	0/5	0.47
Millers Fork (3.95)	19.7	0/5	0.12	4/5	0.160	0/5	0.10

Source: OEPA 2007

2.3. Summary of TMDL

The Twin Creek watershed TMDL was required because portions of the Twin Creek and its tributaries did not attain their water quality goals for aquatic life and recreation (OEPA, 2010). The TMDL stated that low DO, ammonia, phosphorus, bacteria (recreation use) and low flow are the causes of impairment. The sources of the impairment included natural and agriculture fat the upper reach of the watershed. Failing HSTS was also considered a source of high bacteria in the Millers Fork HUC-12. Low flow impairment in the lower portion of Millers Fork HUC-12 also contributed to the impairment causing distress in the macroinvertebrate community.

In addition to increasing conservation easements and education and outreach, the TMDL recommended the following restoration strategies for Millers Fork HUC-12 (Table 2-11):

Table 2-11 Restoration Strategies for Millers Fork HUC-12 from 2010 TMDL

Impairment	Agricultural BMPs	Bank and Riparian Restoration	Stream Restoration	Wetland Restoration	Home Sewage Planning and Improvement
Loss of riparian (sedimentation/siltation, low DO, ammonia) Channelization (sedimentation/siltation, low DO, ammonia) Crops with subsurface drainage (sedimentation/siltation, low DO, ammonia) Animal feeding operations (sedimentation/siltation, low DO, ammonia) Unsewered area (low DO, ammonia)	Plant cover crops Implement conservation practices Implement grass/legume rotations Install grassed waterways Install vegetated buffer areas/strips Install location-specific conservation buffers Install/restore wetlands Conduct soil testing Develop nutrient/manure management plans install livestock exclusion fencing	Plant native grasses and trees/shrubs in riparian areas	Restore floodplain and install in-stream habitat structures	Reconnect wetland to stream, reconstruct and restore wetlands, plant wetland plants	Develop HSS plan, Inspect HSTS, Repair or replace traditional HSTS, Repair or replace alternative HSTS

2.3.1. Baseline Load Estimates

Estimated baseline nutrient loads and estimated target load reduction for the Millers Fork HUC-12 were calculated using a mass balance equation provided by Rick Wilson, OEPA (Table 2-12). The goal loads presented are 20-percent of the total estimated baseline loads for annual contributions in the Millers Fork watershed.

TABLE 2-12 ESTIMATED NITROGEN AND PHOSPHORUS LOADINGS FROM CONTRIBUTING NPS-IS SOURCES IN MILLERS FORK HUC-12

	Agricultural Load (lbs Nitrogen/acre)	Agricultural Load (lbs Phosphorus/acre)	Development Load (lbs Nitrogen/acre)	Development Load (lbs Phosphorus/acre)
Current Estimates*	249,518	15,800	13,385	848
Target Reduction Goals (20%)*	49,904	3,160	2,677	170

*Estimates provided by Rick Wilson, OEPA in July 2023

The source of nutrient impairment in this watershed is assumed to be primarily agriculture with 78% of the land use is row crops. HSTS was estimated to contribute to only 5% of total phosphorus and 3% of total nitrogen and NPDES contributed to 29% of total phosphorus and 14% of total nitrogen in the Great Miami River watershed (OEPA, 2020). The number of failing HSTS is unknown, though in the 2010 TMDL, the percentage is assumed to be 50% due to soil limitations, the age of many systems, and the lack of enforcement resources at the two local health departments. Water quality modeling of the Lower Great Miami River Basin was performed by Miami Conservancy District in 2017 and provided insights into the significant nutrient loadings and reduction scenarios and single point sampling limitation in this watershed (MCD, 2017).

2.4. Summary of Pollution Causes and Sources

Millers Fork HUC-12 and Twin Creek were surveyed in 2005 and the results showed that Millers Fork had good and marginally good water quality and were able to partially support WWH in the headwaters and partially support EWH beginning at Clark Road near Ithaca (Figure 2-11). The biological indicators suggested that water quality improvement through BMPs in the upland and nutrient management are important and required to support high-quality habitats in Millers Fork and its tributaries. In the Millers Fork HUC-12, channelization, subsurface drainage and failing septic systems are the main sources of impairment locally. Nutrients in the form of nitrogen and phosphorus support the growth of algae and aquatic plants, which provide food and habitat for fish, shellfish and smaller organisms that live in water but too much nutrients in the water causes algae to grow faster than ecosystems can handle (USEPA, 2022). Nitrogen loss from row-crop agriculture in rural watersheds which drain to the Gulf of Mexico is also the primary source of Gulf Hypoxia -- caused by excess nutrient (Nitrogen) loading, siltation/sedimentation from cropland, and intense runoff delivery via drainage tiles to the waterbodies.

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

2.5.1. Logjams

Within the Millers Fork HUC-12, mainly small forested areas exist along stream corridors, along with scattered upland farm woodlots. Forested riparian areas generally have a positive impact on water quality, and the OEPA habitat and biological indicator data demonstrates that ALU attainment is higher in the areas of Millers Fork HUC-12 with riparian tree cover. Trees in the riparian area absorb pollutants and hold nutrients in the soil, prevent soil erosion, and shade streams to keep water temperatures stable (ODA, 2023).

Unfortunately, trees in the riparian area may fall due to disease, pests, beaver activity, extreme weather, and erosion. When trees fall into the floodplain, they can be carried into the stream during high water. Woody debris in the stream provides cover for fish, improving habitat. Too much woody debris that blocks flow or dams up the stream is called a logjam. Logjams contribute to localized flooding during low to moderate intensity storms. They also impact the path of the stream as flowing water seeks the path of least resistance around fallen trees. When the stream path threatens roadways, bridges, power lines, or other infrastructure, the community may face a costly stream restoration project.

Since much of the Millers Fork HUC-12 is flat and has poorly drained soils, many local landowners and agricultural producers place a high value on efficient drainage. Efficient drainage benefits agricultural production, especially where the soils have been classified as prime farmland when drained.

The need for efficient drainage has resulted in a decades-old ditch maintenance program within the Darke County government structure. The ditch maintenance program is funded through a petition process that causes benefitting landowners to equitably share the cost of clearing riparian forest and maintaining the improved waterway (Surber). County ditch maintenance typically includes clearing trees and brush, straightening the channel, mowing, and spraying pesticides to prevent the return of woody vegetation. Some private landowners in the watershed choose to clear riparian forests and maintain the streams through their property in similar fashion as a county ditch. If clearing activity is performed without appropriate Best Management Practices, equipment can disturb the soil, increasing erosion, sedimentation, and watershed impairment (ODA, 2023).

Landowners can prevent the need for large stream restoration projects by regularly maintaining the natural stream channels on their properties (ODNR, 2005). Alternate means of providing adequate drainage without impairing streams might include:

- Conducting a snag-and-drag remedy when logjams block local streams.
- Clearing only dead trees from the riparian zone.
- Utilizing BMPs in conjunction with the ODNR Division of Forestry.
- Cutting riparian trees on only one side of the stream so shade benefits continue.

2.5.2. Climate Resilience

Rising average global temperatures are likely caused by rising greenhouse gases in the atmosphere. The effects of rising average temperatures can include extreme weather events, especially more frequent heavy rain and more severe drought (https://climate.nasa.gov/effects/).

Modifying land management practices has the potential to reduce nutrient runoff into waterways, which is the goal of this planning process. These same practices also mitigate greenhouse gases by sequestering carbon (ODA, 2023), making society more climate resilient (COMET-Planner, https://pln-50-ui-010109-dot-comet-201514.appspot.com/).

The degree of climate benefits of various conservation practices can be quantified. USDA's COMET-Planner estimates greenhouse gas emission reductions. For example, replacing 10 acres of cropland with woody plants -- near a stream in the Millers Fork HUC-12 -- would remove 74 tons of carbon dioxide per year from the atmosphere. These additional benefits and potential climate resilience funding sources are important considerations for future projects and incentives.

Cropland management projects that might be considered as promoting climate resilience while also reducing nutrient runoff pollution – listed with their NRCS Conservation Practices code -- include grassed waterway (CPS 412), riparian buffer (CPS 391), contour buffer strips (CPS 332) cover crops (CPS 340), nutrient management (CPS 590), no-till (CPS 329), reduced till (CPS 345), riparian herbaceous cover (CPS 390), and filter strips (CPS 393) (http://comet-planner.com/).

2.5.3. Biosolids Applications

In the Millers Fork HUC-12, there are more than 12 permits for biosolid application on agricultural fields, issued and regulated by the Ohio EPA's Biosolids Program. Biosolid application can be a sustainable way to manage the product of the treatment process at public wastewater treatment plants. When proper management techniques – including proper rates of application and proper environmental conditions following the NRCS Conservation Practice Standard 590 – are utilized, the potential for the organic nutrients of biosolids to leach into groundwater or runoff into surface water are reduced. Proper application rates and timing are key to reducing water quality problems that result from biosolid application. "Maintenance of buffer zones between application areas and surface water bodies and soil conservation practices will minimize impacts to surface water." (USEPA, 2000). The Village of Arcanum's drinking water source protection area is in close proximity to one of the biosolid application areas. A Source Water Protection Plan, if developed for the Arcanum public water system, would consider the proximity and potential risks associated with biosolid application. Though biosolid application is a regulated point source, conservation practices that capture and treat runoff from these fields are eligible for nonpoint source funding. Such projects should be prioritized.

2.5.4. 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 in-field, below-field and in the riparian zone (Tomer et al., 2013). The following ACPF conservation practices -- both for in-field and below-field -- and riparian buffers are found applicable in our region:

Grassed Waterway – NRCS Practice code 412
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
Buffer Contour Strip – NRCS Practice code 332

Filter Strip – NRCS Practice code 393 - Filter Strips are not specifically identified in the ACPF but it is 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. Suspended and dissolved solids in overland flow are intercepted and treated by a combination of proper slope placement, minimum 30-foot width, and maintenance -- to include annual plant material removal – are defined by the NRCS Field Office Technical Guide (NRCS, 2017). This has been a very effective nutrient removal and treatment practice in Darke and Preble Counties and will replace the Contour Buffer Strips identified in the ACPF.

As conservation practices are combined or “stacked” in a field, the total nutrient quantity removed increases (Lee, 2022). Therefore, incorporating multiple conservation practices draining to the same ditch or tributary are advantageous to meet the goals of the plan.

One of the important outputs generated by the ACPF is the riparian assessment. The ACPF riparian assessment (riparian buffer and streambank stabilization) utilizes a matrix of two variables: the width of the riparian zone and runoff delivery. This analysis provides better options to improve the effectiveness of riparian conservation planting where field runoff occurs. The output further provides specific riparian design types based on the cross-classification matrix which include critical zone 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 emphasize streambank stability because the buffer width is currently narrow. 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 type of treatment is especially applicable in this watershed since the riparian zone is steep (Figure 2-6) and many bare and exposed banks are the source of stream erosion and siltation/sedimentation.

2.5.5. ACPF modeling for Millers Fork HUC-12

Miami Conservancy District, a major partner of this project, financially supported the ACPF effort of this HUC-12. The Nature Conservancy also contributed time and effort in preparing and preprocessing of the datasets for running ACPF. The ACPF model was performed for the Millers Fork 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 ACPF model identified a number of possible in-field conservations practices, below-field practices and also riparian zone designs in the Millers Fork HUC-12. In this HUC-12, 17% of the fields are considered high and very high runoff risks and 90% of the agricultural fields in this watershed are tile-drained as estimated by the ACPF (Table 2-14). Figures 2-12 to 2-15 depict the ACPF model results.

Outputs from the ACPF model were discussed at stakeholder meeting on June 5, 2023, and at follow up field visits and ground verification at selected locations on June 20, 27, and 30. The ACPF maps provide a visual tool, making field visits and discussions more effective and efficient. It is noted that although the ACPF recommended contoured buffer strips, it is not a practice that is common in the region. Therefore, instead of contoured buffer strips, the in-field practice of riparian filter strips is more appropriate.

The ACPF output shows an abundant of grassed waterways as a significant way to improve water quality in this watershed. The recommendation was based on the topography and drainage of the watershed. These locations were field verified on June 20, 27 and 30, 2023.

Table 2-13 Conservation Practices at Millers Fork HUC-12, Suggested by the ACPF (ACPF maps and estimates are only for planning purposes)

Practice	Unit	Length (miles)	Total Area (Acres)
In-Field Practices			
Grassed Waterways	2,029 sites	222	NA
Contoured Buffer Strips	56 sites	11.6	NA
Tile Drainage Management	45 sites	NA	1,230
Depressions (potential wetland restoration sites)	77 depressions	NA	387
Below-Field Practices			
Nutrient Removal Wetlands	12 wetlands	NA	CA***:1,340; Pool: 17.2; Buffer: 38
WASCOBs	28 sites	NA	CA***: 269
Denitrifying Bioreactors	104 sites	NA	25****
Farm Ponds	3	NA	CA***: 98 Pools: 3.7
Riparian Zone Practices			
High Nutrient Sensitive Buffers	NA	2.9	NA
Riparian Buffers Filters (various plants)	NA	64	NA
Stream Bank Stabilization	NA	19.5	NA
Saturated Buffer	NA	7.5	NA
Saturated Buffer Requiring Carbon Enhancement	NA	3.8	NA

**Assuming 30 feet wide*
*** Total potentially treated area*
**** Contributing area*
***** Average surface area of potential bioreactor*
NA – Not applicable

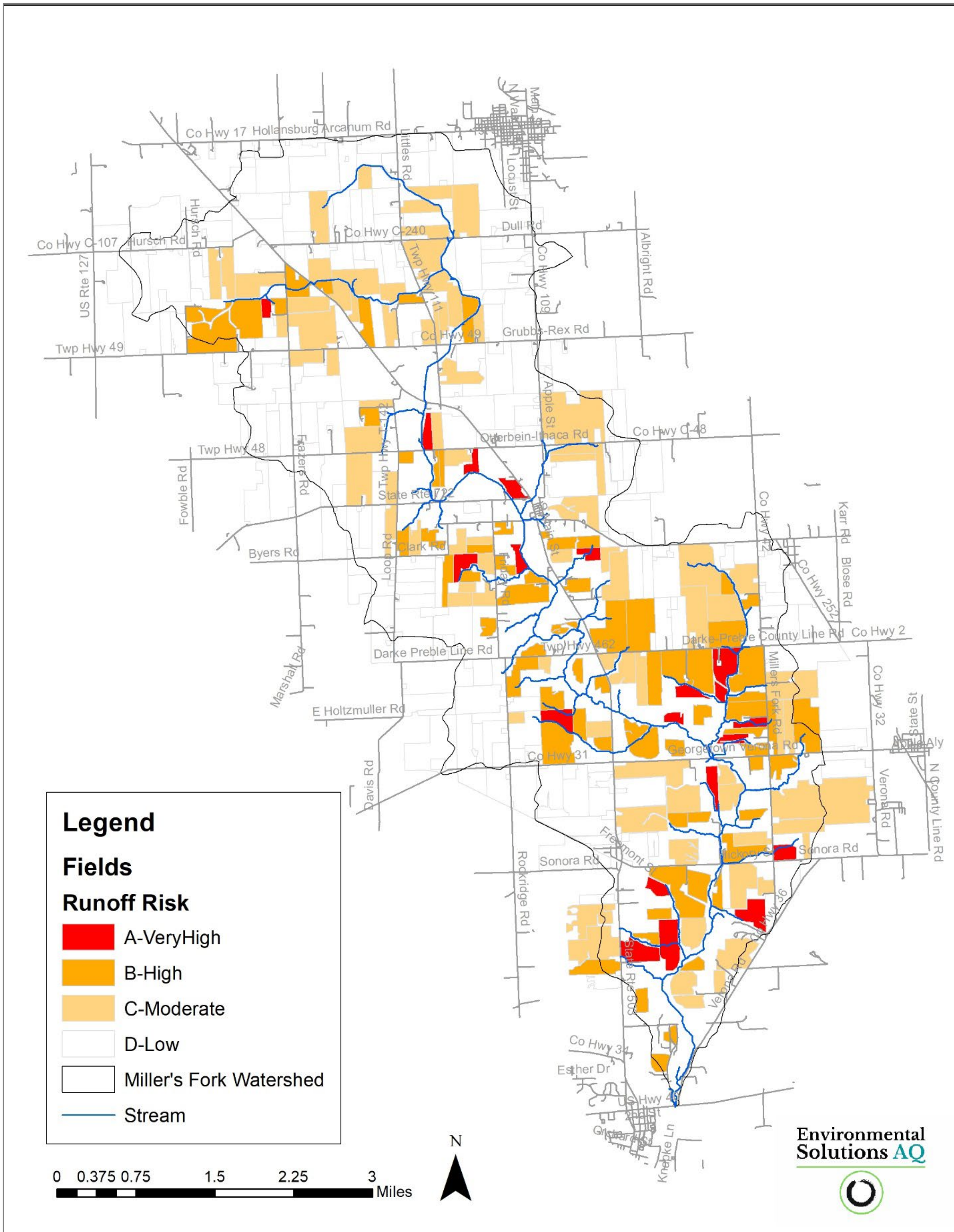


FIGURE 2-12 ACPF RUN-OFF RISK IN MILLERS FORK HUC-12 WATERSHED

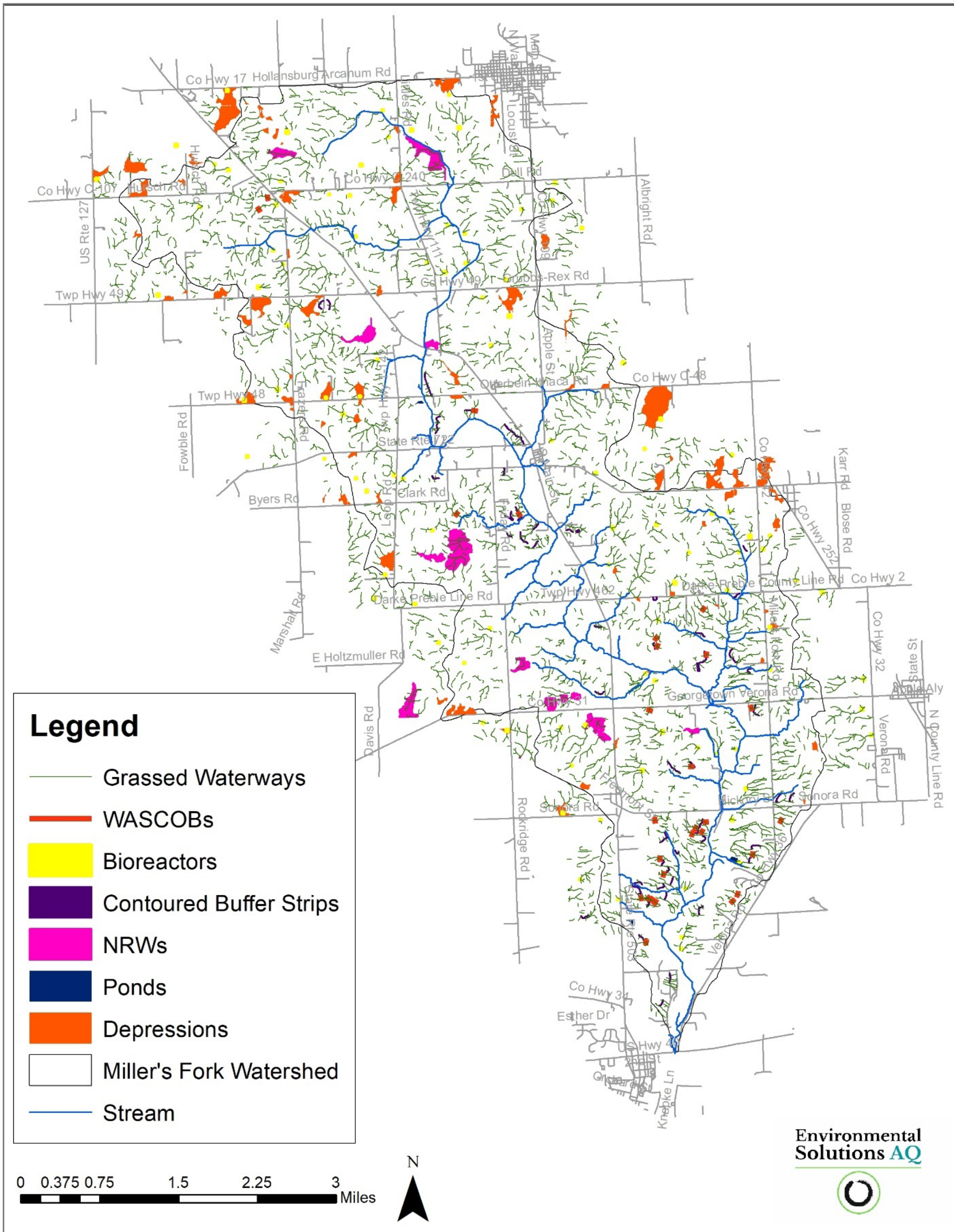


FIGURE 2-13 IN-FIELD AND BELOW-FIELD PRACTICES SUGGESTED BY ACPF FOR MILLERS FORK HUC-12 WATERSHED

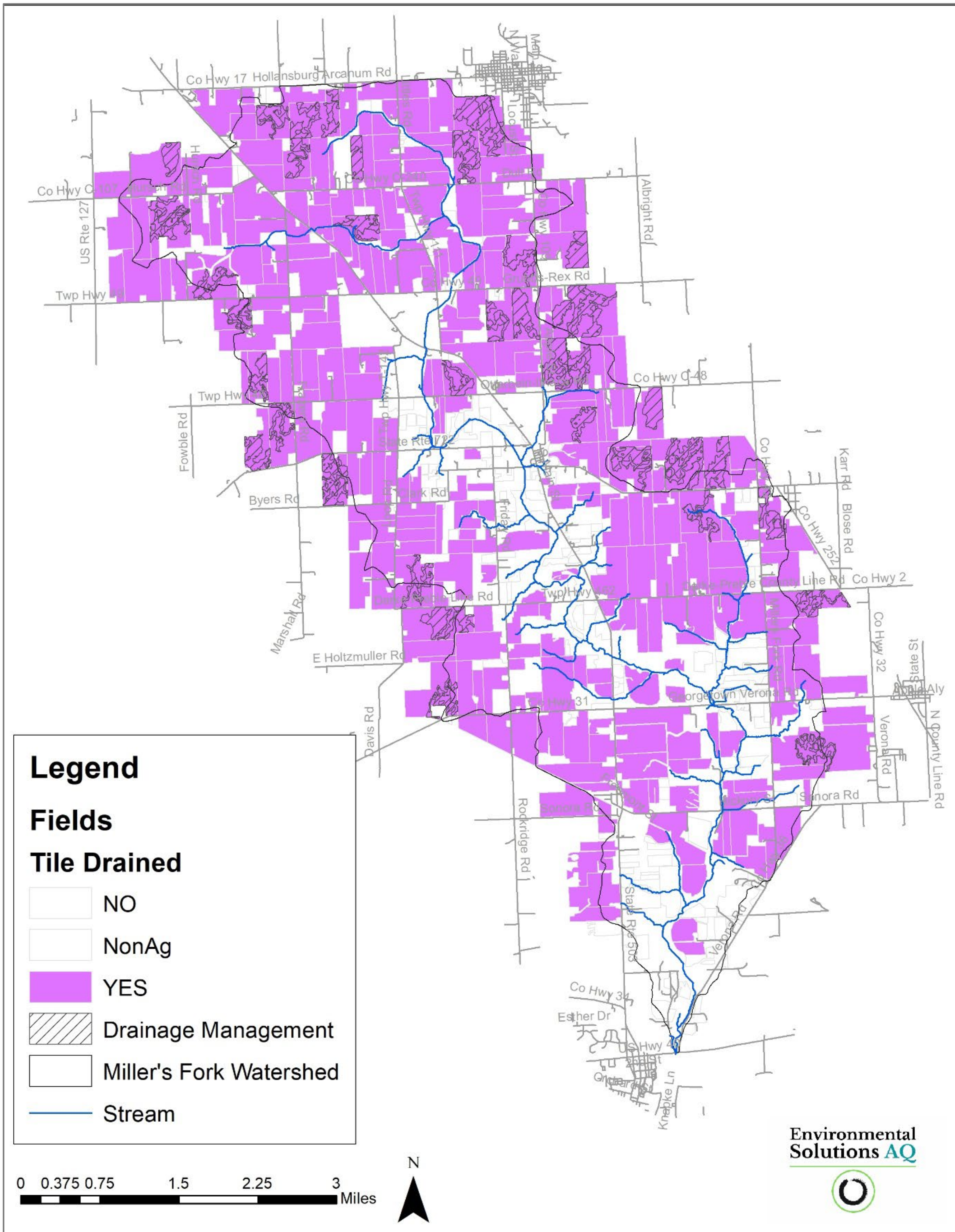


FIGURE 2-14 TILE DRAINAGE CONTROL AND IN-FIELD PRACTICES SUGGESTED BY ACPF FOR MILLERS FORK HUC-12 WATERSHED

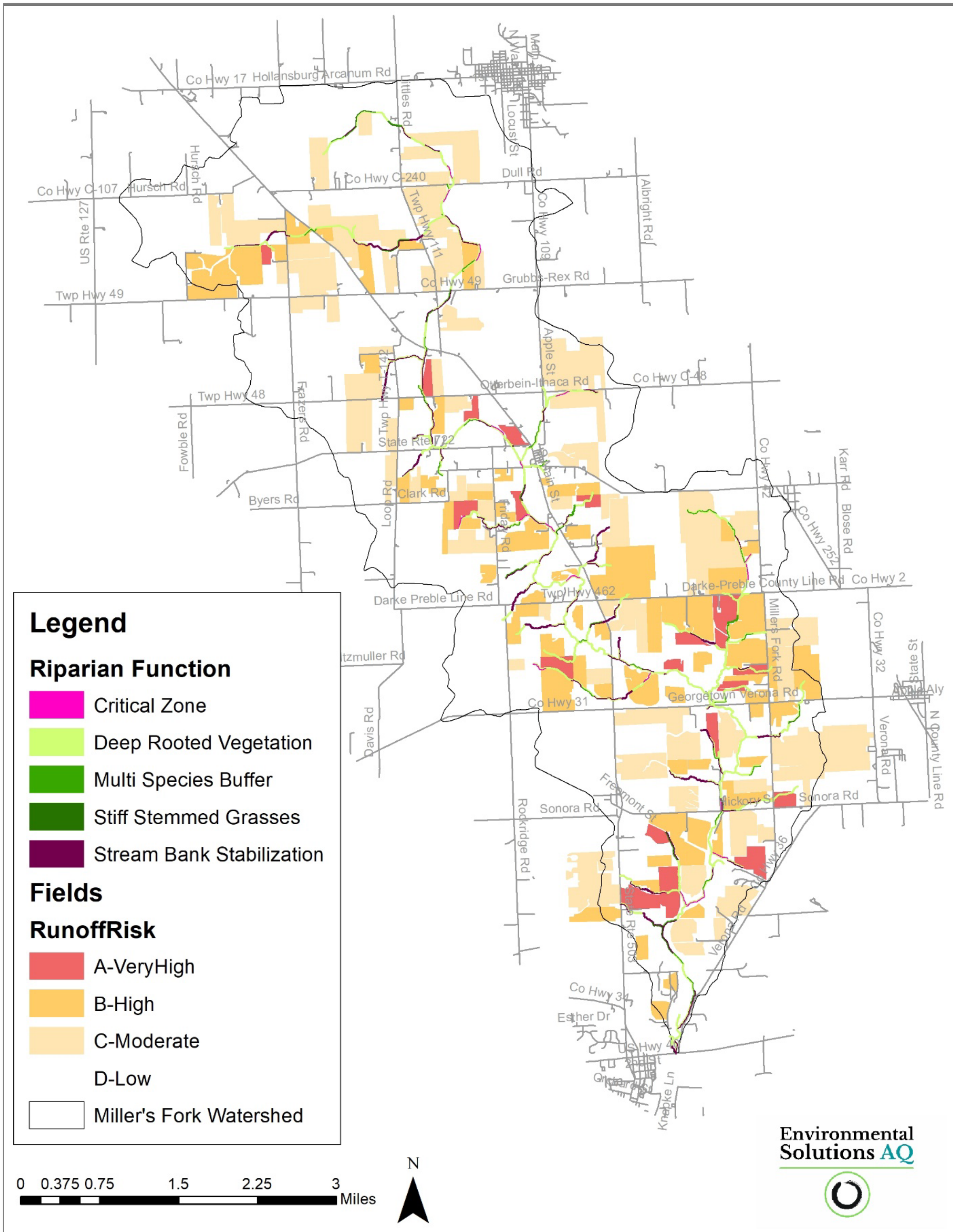


FIGURE 2-15 RIPARIAN FUNCTIONS SUGGESTED BY ACPF FOR MILLERS FORK HUC-12 WATERSHED

Chapter 3: Conditions & Restoration Strategies for Millers Fork HUC-12 Critical Areas

3.1. Overview of Critical Areas

Millers Fork was assessed during Ohio EPA's 2005 Twin Creek and selected tributaries survey (OEPA, 2007). Of the three samples taken in the Millers Fork HUC-12, none of them were in full attainment of EWH or recommended WWH ALU.

The 2010 TMDL provided impairment causes and restoration strategies. Meeting the goal of nutrient reductions requires targeted programs that expand existing partnerships and build new partnerships while supporting education and outreach to promote on-the-ground implementation (USEPA, 2014). Implementation of effective actions and progress must be verified with improved tracking mechanisms and watershed monitoring, and modeling tools (USEPA, 2014).

Millers Fork HUC-12 is dominated by tile-drained agricultural fields and landowners have voiced their concerns about failing septic systems, flooding, and agricultural runoff during the public meeting and through other forms of communication. This HUC-12's land use is largely agricultural with 78% cultivated crops and with 12,949 acres of tile-drained fields (determined by ACPF).

Three critical areas have been identified within the Millers Fork HUC-12 in this NPS-IS. The critical areas were identified to address the in-field and below-field nutrient management (Table 3-1).

Critical Area 1 is tile-drained row-crop agricultural fields. Conservation practices reduce nutrient loading that impacts the far-field (Gulf of Mexico) and near-field (local waterways).

Critical Area 2 is the riparian zone. This critical area targets improving the riparian zone and restoring stream functions, as well as improving and protecting sensitive riparian habitats.

Critical Area 3 is failing HSTS, especially in the unsewered community of Ithaca. This critical area addresses bacteria and nutrient reduction from the systems that directly discharge human waste to Millers Fork.

Table 3-1 Critical areas of Millers Fork HUC-12

Critical Area	Area Description	Impairment Being Addressed	Size
1	**Tile-drained row crop agricultural fields** as determined by ACPF	Near-Field and Far-Field impairment – Gulf of Mexico hypoxia with N and P reduction) - Nutrient management in prioritized agricultural lands using BMPs	12,949 Acres
2	Upper reach of Millers Fork and tributaries' **riparian corridor** with insufficient riparian zones and loss of functioning floodplain	Near-Field and Far-Field impairment – Gulf of Mexico hypoxia - Improve habitat scores of QHEI and stream health by reducing nutrients and associated sedimentation.	87 miles (both sides of main stem and tributaries) determined by ACPF.
3	**Failing HSTS,** especially in the unsewered community of Ithaca in close proximity to Millers Fork	Near-Field - Reduce ammonia, bacteria, N and P discharging directly to local streams or to tiles that lead to steams from an unsewered community.	34 failing HSTS: The unsewered community (Ithaca) – 14 known failing HSTS plus 20 failing HSTS outside of the village and near Millers Fork

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

3.2.1. Detailed Characterization

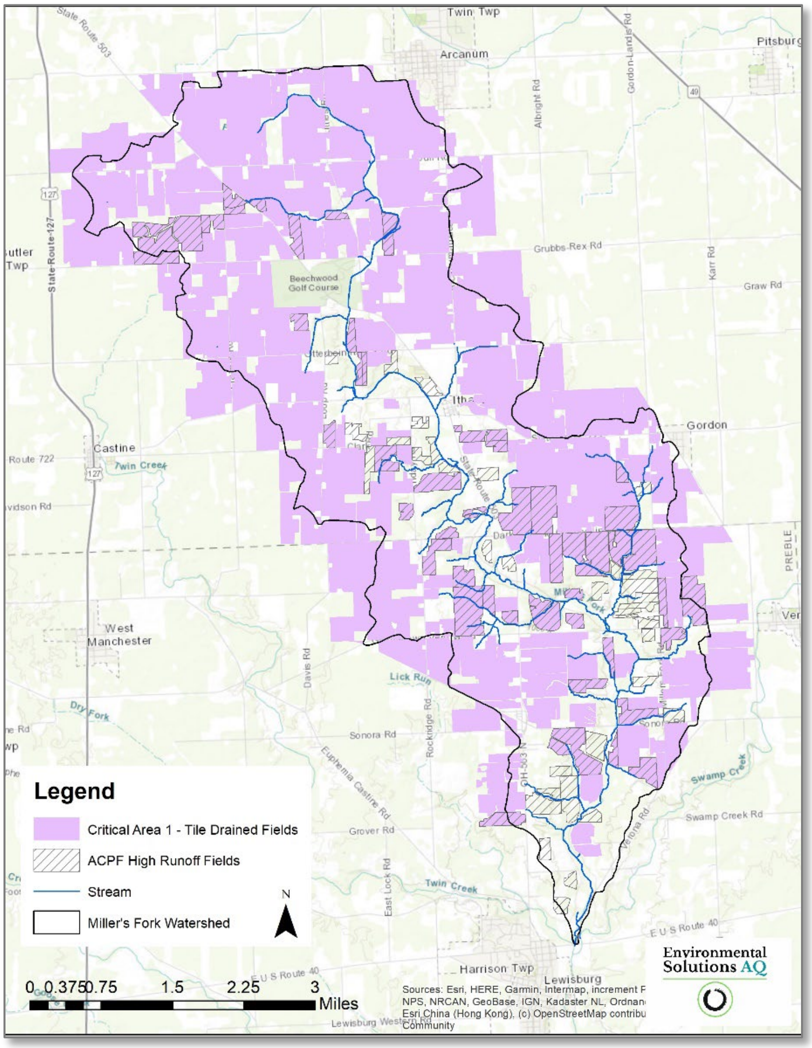


FIGURE 3-1 CRITICAL AREA 1: TILE-DRAINED FIELDS OF MILLERS FORK HUC-12

Given the dominance of agricultural land use in the Millers Fork HUC-12, agricultural nutrient management BMPs implemented in high runoff, tile-drained fields is the best way to reduce nutrient loss to nearby waterways. 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 tile-drained agricultural fields as determined by the ACPF model (Figure 3-1). ACPF also determined the specific high runoff fields based on slope steepness and the fields' close proximity to the stream. The ACPF model was used to identify very high and high runoff fields covering 2,535 acres of the agricultural land (17%) within the Millers Fork watershed.

Based on stakeholders' input and the watershed characteristics, the prioritized areas and potential projects should meet at least one of the following criteria:

- Lands identified as high and very high runoff fields by ACPF;
- Lands directly adjacent to Millers Fork or its tributaries;
- Lands currently under conventional tillage regimes and/or underutilizing cover crops;
- Lands without current nutrient management plan

3.2.2. Detailed Biological Conditions

The 2005 sampling conducted by OEPA at three sampling points in this HUC-12 indicates that conditions were suitable for partially supporting EWH or WWH at the most upstream location. Table 3-2 illustrates the attributes of the fish sampled in 2005 at each monitoring location, resulting in IBI scores of 40 at the upstream site and 48 at the two downstream sites. Table 3-2 also includes the habitat assessment scores, represented by QHEI values.

TABLE 3-2 FISH COMMUNITY AND HABITAT DATA FOR MILLERS FORK HUC-12 CRITICAL AREA 1

RM	QHEI	Drainage Area (mi^2)	Mean # of Species	Predominant species (% of catch) *	IBI	Narratives
10.8	33	5.7	21	Central Stoneroller (30%), Northern Creek chub (16.1%), white sucker (7.2%), rainbow darter (6.1%), mottled sculpin (5.1%) and Striped shiner (3.6%).	40	Good
8.0	66.5	10.1	22		48	Very Good
3.9	58.0	19.7	19		48	Very Good

*only aggregate sampling results from the tributaries were reported (OEPA, 2007)

From the 2005 OEPA sampling results, the QHEI scores in Miller's Fork were determined to partially support the EWH ALU or recommended WWH AIU designation. The habitat assessment at the upstream site scored 33 and downstream sites scored 66.5 and 58.0. Biological performance for Millers Fork was low fair to very good. The OEPA report concluded that tolerant taxa like sow bugs, fingernail clams, and snails comprising the majority of the macroinvertebrate species at RM 10.8 was an indication of poorer water quality. The RM 10.8 sampling location received the lowest QHEI, ICI and IBI scores of all three sampling locations.

TABLE 3-3 MACROINVERTEBRATE DATA

Stream RM	Dr. Area (Sq. mi.)	Density Ql. Qt.	Predominant Organisms on the Natural Substrates; With Tolerance Category(ies) in Parentheses	ICI	Narrative Evaluation
10.8	5.7	L	Sow bugs (F), snails (MT, F, MI), fingernail clams (F)	-	Low Fair
8.0	10.1	M	Net-spinning caddisflies (F,MI), case-building caddisflies (MI), riffle beetles (F,MI), Elimia snails (MI)	-	Good
3.9	19.7	M	Riffle beetles (F,MI), Elimia snails (MI), Caenis mayflies (F), waterpenny beetles (MI)	-	Marginally Good

Source: OEPA, 2007

Tolerance Categories: VT=Very Tolerant, T=Tolerant, MT=Moderately Tolerant, F=Facultative, MI=Moderately Intolerant, I=Intolerant.

3.2.3. Detailed Causes and Associated Sources

The 2005 OEPA survey demonstrated that the streams in this HUC-12 were of good to very good conditions, aside from one location that was low fair. None of the sampling locations fully attained its designated ALU. Sedimentation and siltation, especially at the most downstream sampling site. The 2010 TMDL pointed to crops with subsurface drainage as a source of the sedimentation/siltation, low dissolved oxygen, and ammonia impairments in Millers Fork.

Cropland activities in the Great Miami River basin can contribute to excessive nutrient loadings to local streams and small tributaries and ultimately contributing to in Gulf Hypoxia (OEPA, 2020). 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. The implementation of BMPs on tiled agricultural lands can address the causes of sediment/topsoil and nutrient loss in the fields and reduce the sources of this excess nutrient and sediment into the waterways.

3.2.4. Outline Goals and Objectives for the Critical Area

The goal of the NPS-IS is to improve water quality, meet nutrient reduction goals, and improve impairment status. In Critical Area 1, the samples collected in 2005 showed that Miller's Fork to be in partial attainment at each location, with the most upstream site also receiving a recommendation to downgrade its designation. Over 90% of the Critical Area 1 is tile-drained agricultural fields. Drain tiles can act as conduits and directly transport nutrients to waterways. They must be well-managed to reduce risk of nutrient loss and to maximize fertilizer use efficiency. To address the 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 Millers Fork HUC-12. To achieve the nutrient loading goals, the following goal and objectives have been established:

Goal 1 – Reduce nitrogen loading contributions in Critical Area 1 by 20% from 249,518 lb to 199,614 lb, a reduction of 49,904 lb.

NOT ACHIEVED: Current total nitrogen load is estimated to be 249,518 lb.

Goal 2 – Reduce phosphorus loading contributions in Critical Area 1 by 20% from 15,800 lb to 12,640, a reduction of 3,160 lb.

NOT ACHIEVED: Current total phosphorus load is estimated to be 15,800 lb.

Goal 3 – Achieve a QHEI score at or above 60 throughout the watershed.

NOT ACHIEVED: The 2005 QHEI score at the most upstream sampling site was 33, 66.5 at the site near Ithaca, and 58 at the most downstream site.

Objectives

In order to reach the nitrogen load reduction goal of 20% within the Millers Fork HUC-12 and improve ALU attainment, an 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 3-4).

Objective 1: Implement an additional 426 acres of conservation tillage to add to the current 9,055 acres.

Objective 2: Plant additional 626 acres of cover crops to augment the 465 acres that have already been planted per year.

Darke and Preble SWCDs believe cover crops is a practice that has the potential to increase in the watershed with appropriate resources and incentives. They each have a list of interested agricultural producers who would implement the practice with some support. Ducks Unlimited and Farmers for Soil Health are among the funding sources for the practice, in addition to the traditional federal programs.

An outreach initiative could promote cover crops to producers. Such an initiative might include a field day at the farm of a local producer utilizing cover crops, researchers explaining how cover crop implementation improves yields, and an overview of various incentive opportunities.

Objective 3: Reduce nutrient loss through the installation of in-field BMPs such as grassed waterways and filter strips (NRCS code 393, see Section 2.5.4. for description) on at least 25 acres per year at locations suggested by the ACPF model. These practices are deemed most effective in removing and treating nutrient runoff in this region.

- They reduce soil movement and thus the phosphorus chemically bound to the soil.
- Producers easily adopt the practice as a means to manage in-field gully erosion

Objective 4: Reduce nutrient loss from subsurface tile drainage or below-field practices through the installation of drainage water management structures at locations suggested by the ACPF model.

Table 3-4 Estimated Nutrient Loading Reductions from Each Objective

Objective Number	Best Management Practice	Acreage Treated per year	Estimated Nitrogen (N)/Phosphorus (P) Load Reduction (lbs/yr)*
1	**Conservation Tillage**	426	604 lb/yr (N)/248 lb/yr (P)
1	**Cover Crops**	626	420 lb/yr (N)/42 lb/yr (P)
2	**In-field BMPs: Grassed Waterway**	294	439 lb/yr (N)/115 lb/yr (P)
2	**In-field BMP: Filter Strips**	464	680 lb/yr (N)/178 lb/yr (P)
3	**Below-field BMPs: Controlled drainage BMP such as nutrient removal wetlands or WASCOBs**	116	133 lb/yr (N)/19 lb/yr (P)
	TOTAL	1926	2,276 lb/yr (N)/602 lb/yr (P)

**Estimates calculated using Spreadsheet Tool for Estimating Pollutant Loads (STEPL), Version 4.4 (USEPA, 2019)*

These objectives will be directed towards implementation on prioritized tile-drained agricultural lands using the stakeholders/landowners 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 Millers Fork HUC-12.

There are significant demands for grass waterway installation in this HUC-12 especially in the northern portion of the watershed. Erosion and gully formations are common and visible in many fields. The SWCD staff has limited resources to keep up with the grass waterway installation requests. There is an opportunity to promote additional practices associated with grassed waterways, such as cascading waterways and edge of field retention features that will filter additional nutrients from field runoff.

The practices of nutrient removal wetlands and WASCOBs are uncommon in this region due to the soils and drainage conditions and the lack of examples in the area. Extra outreach effort will be required in the coming years to promote these water management practices.

Currently there is no routine monitoring or sampling in the Millers Fork HUC-12. But the future project-specific monitoring efforts 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 Millers Fork 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 OEPA 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 Millers Fork and Tributaries.

3.3.1. Detailed Characterization

In 2005, three samples were collected from the stream and sampled for biological indices and water quality. All three samples were partially attaining their ALU designations – the most upstream was partially attaining a recommended WWH ALU and the lower two were partially attaining EWH ALU. The biological indicators showed the stream ranged from low fair to good conditions.

Because of the tile-drained agricultural fields, nutrients from upland are transported directly into the streams and in high speed and volume during and after storms which appear to be more intense in recent years. In the upper portion of the watershed, Millers Fork is typically channelized and with very narrow riparian buffer. The lack of riparian buffer affects the water quality and habitat.

The high-quality riparian habitats including riparian buffers, wetlands and floodplains connected to the streams are critical for mitigating the negative impacts of nutrients, siltation/sedimentation, and excessive runoff volume from the surrounding agricultural lands. 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 and agriculture activities.

In this Critical Area 2, the ACPF offers riparian design using the two variables of runoff delivery and width of the shallow water table zone. By applying these strategies, the riparian zone will have better function in nutrient removal, water quality improvement, and restore natural stream functions.

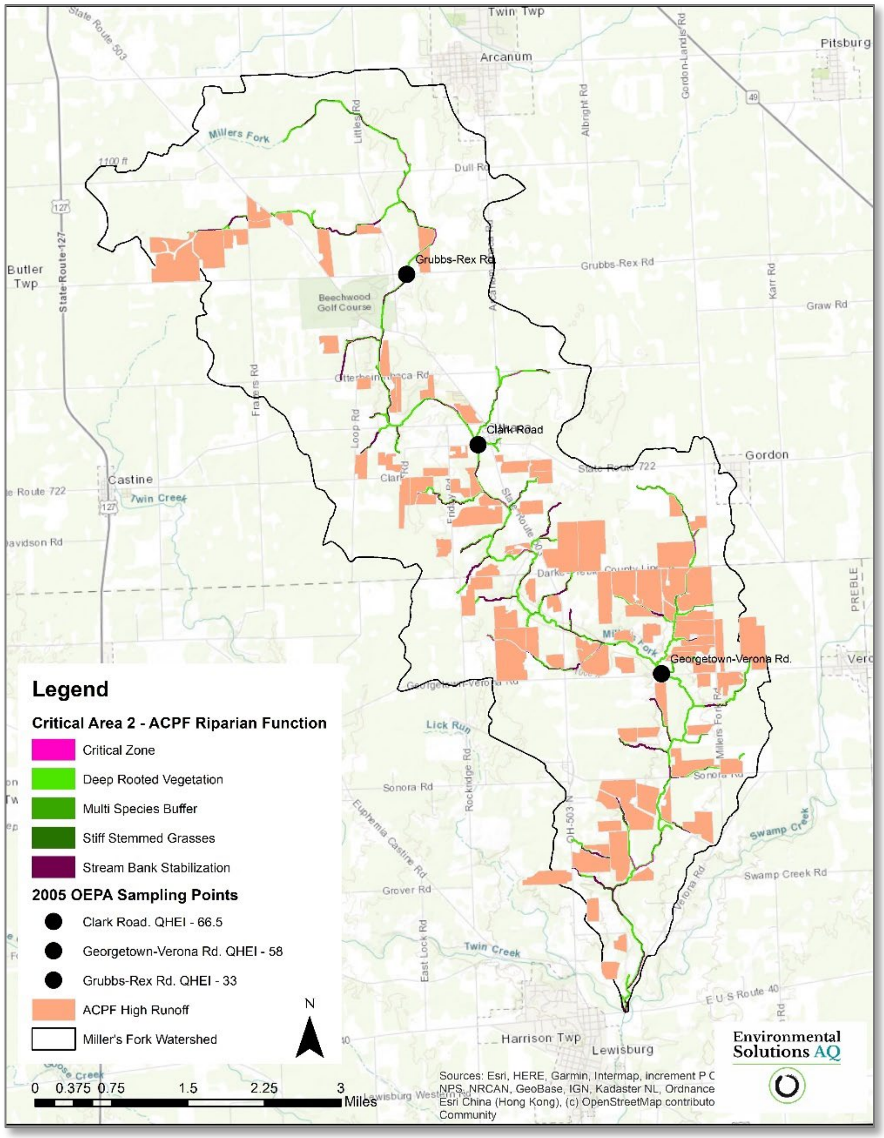


FIGURE 3-3 CRITICAL AREA 2 - MILLERS FORK HUC-12 RIPARIAN ZONE

Based on inputs from landowners and stakeholders, the prioritized areas and potential projects in Critical Area 2 may meet the following criteria:

- Riparian area of Millers Fork and tributaries, none of which received full attainment (Table 2-8)
- Riparian areas of Millers Fork and tributaries near the high runoff fields
- Riparian areas with narrow, lack of vegetation or with little or no riparian buffer
- Riparian areas suitable for floodplain/wetland enhancement and/or restoration

3.3.2. Detailed Biological Conditions

As previously shown in Section 2, the 2005 sampling conducted by OEPA at three sampling points in this HUC-12 indicated the QHEI scores of 33 at the upstream site, partially attaining a recommended WWH ALU designation. QHEI scores of 66.5 and 58 at the two successive downstream sampling sites were high enough to partially attain EWH ALU designations.

3.3.3. Detailed Causes and Associated Sources

The biological indices, habitat and water quality data collected in 2005 showed Millers Fork had low fair to very good conditions, depending on which segment and which indicator was being studied. The majority of Millers Fork and tributaries in the upper section of the watershed has been channelized and with narrow or no riparian buffer. A downgrading of the ALU for the upper Millers Fork was recommended from EWH ALU to WWH ALU – with partial attainment for WWH. This most upstream site's impairment was caused by sedimentation/siltation, low dissolved oxygen, and ammonia, the sources of which were channelization, loss of riparian habitat, crop production with subsurface drainage, and sewage discharge from unsewered area (OEPA, 2007). Crops are planted very close to the stream and excess nutrients are directly flows into the creek. The implementation of planting of riparian buffers and stream restoration can slow the runoff from the fields and reduce the amount of nutrients washing directly into the streams. The most downstream OEPA sampling site was also impaired by channelization, loss of riparian habitat, and crop production with subsurface drainage.

Where higher quality riparian corridors exist, 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 eroding 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

The goal of the NPS-IS is to improve water quality and meet nutrient reduction goals and improve impairment status. Narrow stream buffers and severe stream erosion and siltation/sedimentation, which are common in the Millers Fork 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 and improving water quality and aquatic life in both near-field and far-field waterways.

Currently riparian BMPs are underutilized in this watershed. The floodplain and wetland restoration, stabilization of severely eroding banks and riparian buffer planting will provide great benefits to maintain and improve stream health and aquatic life attainment. No stream restoration projects have been implemented in this HUC-12.

Goal 1 – Achieve an IBI score at or above 40.

ACHIEVED: In 2005, IBI was 40 at the most upstream sampling location and 48 further downstream, achieving a narrative evaluation of good or very good with the mean number of fish species collected per site ranging from 19 to 22.

Goal 2 – Achieve an ICI narrative evaluation of "good" or better.

NOT ACHIEVED: In 2005, ICI was described as “low fair” at the most upstream Millers Fork sampling site, but good and marginally good at the downstream sampling sites.

Goal 3 – Achieve a QHEI score at or above 60 throughout the watershed.

NOT ACHIEVED: Only one of the three sampling sites exceeded a QHEI of 60 in 2005, and that was at stream mile 8.0 at Clark Road. The upstream site at stream mile 10.8 achieved only a 33 QHEI and the downstream site at stream mile 3.9 achieved a 58 QHEI.

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: Improve the biological habitats in Millers Fork HUC-12 by restoring the natural stream channel along at least 3 miles, or implementing a conservation or two-stage ditch reconnecting the stream with the floodplain and reducing sedimentation at *Critical Area #2*.

Objective 2: Improve the natural habitats in Millers Fork HUC-12 by restoring the riparian buffer along 3 miles at *Critical Area #2.*

Objective 3: Protect with conservation easements or via land acquisitions 20 acres or at least 2 miles of Millers Fork and its main tributaries.

Table 3-5 Estimated Nutrient Reductions from Each Objective

Objective Number	Best Management Practice	Total Length/Acreage Treated	Estimated Load Reduction using STEPL*
1	Stream and floodplain restoration using ACPF modeling	3 miles/121 Acres (avg 50 feet wide)	45 lbs/yr (N)/10 lbs/yr (P)
2	Riparian Buffer as designed using ACPF modeling based on the width of the riparian zone and runoff delivery (see Section 2.5.1).	3 miles/406 Acres (avg 50 feet wide)	23 lbs/yr (N)/6 lbs/yr (P)
3	Protecting riparian areas and wetland with conservation easements and retire 20 acres.	20 Acres**	55 lb/yr (N)/11 lb/yr (P)
TOTAL		**56 acres**	**123 lb/yr (N) and 27 lb/yr (P)**

*Estimated using Spreadsheet Tool for Estimating Pollutant Loads (STEPL), Version 4.4 (USEPA, 2019)
N-Nitrogen; P-Phosphate
**20 acres of land retirement is used for this estimate

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 and SWCDs will continue to promote conservation easements to help farmers permanently protect their land and improve overall health of Millers Fork watershed.

Currently there is no routine monitoring or sampling in the Millers Fork HUC-12. But the future project-specific monitoring efforts 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 become 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 OEPA 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

3.4. Critical Area 3: Conditions, Goals, & Objectives for Nutrient Reduction and Management from the Unsewered Community of Ithaca along Millers Fork

3.4.1. Detailed Characterization

According to the 2020 U.S. Census, Ithaca, a small Darke County village with a population of 81 is the only village fully within the HUC-12. Lewisburg is partially within this HUC-12 and holds an NPDES permit to operate a wastewater treatment plant.

FIGURE 3-4 MILLERS FORK AT ITHACA

Ithaca, a village that has a total area of 19 acres and is located adjacent to Millers Fork, is not served by any wastewater treatment plant. Hence, all of the businesses, churches, and homes in Ithaca -- as well as homes, typically on larger lots outside villages -- rely on HSTS to treat sewage. The Clean Watershed Needs Survey conducted the Household Sewage Treatment System Failures in Ohio by the Ohio Department of Health in 2012 indicated the failure rate of HSTS in southwest Ohio was 18% (ODH, 2013). However, the Darke County General Health Department (DCGHD) stated the failure rate for the Village of Ithaca is estimated to be significantly higher. Many citizen complaints about raw sewage entering surface waters near Ithaca have been reported by DCGHD. Rural homes throughout the watershed are also served by HSTS.

Ohio's Nutrient Mass Balance Study for Ohio's Major Rivers 2020 (OEPA, 2020) estimated the HSTS community in the Great Miami River Basin contributed 5% of the total P load and 3% of the total N load. HSTS are considered a major bacteria contributor affecting the water quality of Millers Fork as indicated in the 2007 OEPA report. The NRCS Soil Web Survey for Septic Tank Absorption Fields for Millers Fork HUC-12 indicated that 99.7% of the watershed is very limited.

Because of the poor soil drainage and shallow depth to bedrock, it is likely that failed HSTS are prevalent and widespread in this watershed.

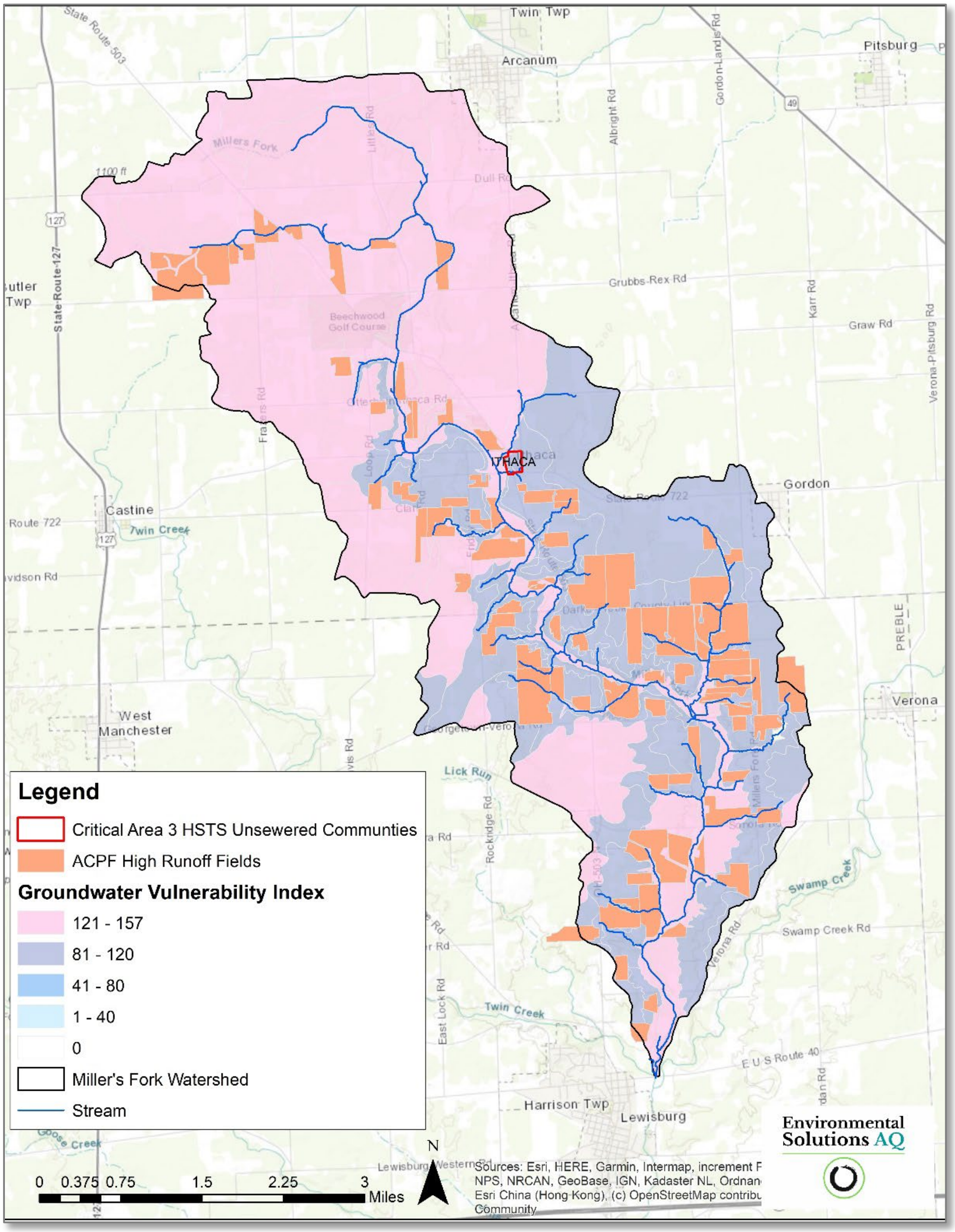


FIGURE 3-5 CRITICAL AREA 3 - UNSEWERED COMMUNITY OF ITHACA

3.4.2. Detailed Biological Conditions

Millers Fork flows adjacent to the Village of Ithaca. As previously shown in Section 2, the 2005 sampling conducted by OEPA found Millers Fork at Clark Road to be partially attaining EWH ALU designation.

The stream segment near Ithaca scored an IBI of 48 and an ICI narrative evaluation of “good;” with 13 EPT taxa and 16 sensitive taxa collected. OEPA determined that bedrock substrates limited macroinvertebrate community performance near Ithaca.

3.4.3. Detailed Causes and Associated Sources

Upper Twin Creek, including Millers Fork, is not attaining primary contact for recreational use (PCR) due to elevated bacteria levels. Ammonia and low dissolved oxygen were listed as causes of impairment for Millers Fork, with the likely source of unsewered areas, aka failing septic systems. In 2005, Millers Fork at Ithaca had NH_3 values over the 90^{th} percentile in four out of five samples collected. *E. coli* at all three sampling sites exceeded PCR WQS in 40% of test results.

Failing systems are likely discharging waste to a storm sewer pipes or field tiles that discharge directly to Millers Fork. OEPA’s 2007 report also demonstrated the agency’s concern about failing septic systems in Ithaca:

“A tributary to Millers Fork (RM 8.0) draining the unsewered community of Ithaca, was sampled on September 7, 2005. The tributary had indications of sewage discharge. Analytical results documented ammonia at 7.43 mg/l, Fecal coliform at 6100 colonies/100ml and E. coli at 3200 colonies/100ml. Both bacteria samples were submitted past holding time, but are a good screening tool to document failing septic systems in the community of Ithaca” (OEPA, 2007).

According to DCGHD staff, the Village of Ithaca has 52 HSTS serving homes, businesses, churches, etc. and approximately 27% of those systems are failing, or 14 HSTS. The systems either have no secondary treatment (e.g. leach field) or the leach field is more than fifty years old. Not included in this failure rate are 11 sandfilters and 20 aeration systems.

Lot sizes smaller than one-half acre severely limit the ability of homeowners to install new or replacement leach fields. Groundwater is also likely being impacted – a particular risk of nitrate contamination, especially in shallower wells (Swann, 2001).

To determine the annual nutrient load from HSTS to Millers Fork in Ithaca, an estimate of the concentration of Total N and Total P in septic tank effluent is needed. Since there are no nutrient concentrations determined in Ithaca, four studies with similar septic tank effluent concentrations were located from literature search (Swann, 2001). Table 3-6 provides an average of those studies’ findings, plus the conversion to pounds per million gallons of water.

TABLE 3-6 ESTIMATED CONCENTRATIONS OF NUTRIENTS IN SEPTIC TANK EFFLUENT

	Average mg/L in septic tank effluent from four similar studies	**Ave. lbs./million gallons in septic tank effluent**
Total N	42.4	353.8
Total P	16	134

Source: Swann 2001

DCGHD estimated the number of septic systems they believe to be failing. Because Ithaca is adjacent to Millers Fork and has a municipal storm sewer system, DCGHD staff hypothesizes many if not all failing systems are connected by storm sewer or discharging directly by private pipe to Millers Fork. 2020 Census data and USGS estimates of average water use per day are also included in Table 3-7.

TABLE 3-7 ITHACA POPULATION, HSTS AND ESTIMATED WATER USE

Ithaca, Ohio					
Population (2020 US Census)	**Number of HSTS (DCGHD)**	**People per HSTS, based on US Census**	**Number of failing HSTS (DCGHD)**	**Total number of humans whose waste is discharging failed system**	**Gallons of water used per day at 82 gal/person (USGS)/M Gallion per year**
81	**52**	**1.5**	**14**	**21**	**1,722/0.62**

Source: US Census, DCGHD

This data provides the opportunity to estimate pounds per year of both total nitrogen and total phosphorus (Table 3-8).

TABLE 3-8 ESTIMATED ANNUAL NUTRIENT LOADS TO TWIN CREEK FROM FAILING SEPTIC SYSTEMS IN ITHACA, OHIO

	Million gallons effluent per year flowing from failing HSTS in Ithaca, Ohio	**Average concentrations of nutrients in mg/L (Swann)**	**Average concentrations of nutrients in lbs./million gallons***	**Estimated pounds per year of nutrients discharging HSTS from Ithaca to Millers Fork****
Total N	0.62	42.4	353.8	219.4
Total P		16	134	83.1

**https://www.unitconverters.net/concentration-solution/milligram-liter-to-pound-million-gallon-us.htm*

***Pounds per year = AVE mg/L N or P -> Ave lbs./ M gal N or P * (number of humans on failing septic systems * 82 gallons per day use * 365 days in a year)*

Better resources and coordination from local partners are needed to address the failed HSTS in this rural community and in the region.

3.4.4. Outline Goals and Objectives for the Critical Area

The goal of NPS-IS is to improve water quality and meet nutrient reduction goals. Reduction of HSTS nutrient contributions will lead to the reduction of bacteria and nutrients releasing to the environment and local waterways. The Millers Fork HUC-12 is a rural watershed (15,718 acres) and most of the watershed is unsewered.

Based on the watershed characteristics, the prioritized areas in Critical Area 3 and potential projects should meet at least one of the following criteria:

- Lands where the villages or other densely populated areas are unsewered (Ithaca);
- Lands directly adjacent to Millers Fork or its tributaries;
- Lands within the high Groundwater Vulnerability Index;
- Lands within the source water protection areas

Baseline development loads for nitrogen is 13,385 lb and phosphorous is 847.6 lb (Table 2-12). In order to meet the 20% overall nutrient reduction goals, reductions in nutrient contributions from failing HSTS at Ithaca should be considered.

Goal 1 Reduce phosphorus loading contributions in Critical Area #3 to a level at or below 678lbs/year (20% reduction).

NOT ACHIEVED: Currently 14 of 52 HSTS are failing in the Village of Ithaca. Phosphorus load contribution is estimated to be 83 lbs. annually.

Goal 2 Reduce nitrogen loading contributions in Critical Area #3 to a level at or below 10,708 lb (20% reduction).

NOT ACHIEVED: Currently 14 of 52 HSTS are failing in the Village of Ithaca. Nitrogen load contribution is estimated to be 219 lb.

Goal 3 Attain and maintain PCR use in Millers Fork.

NOT ACHIEVED: At RM 3.95, the geometric mean of five September 2005 samples for *E. coli* was calculated at 150 colonies/100 ml, an exceedance of the PCR WQS of 126 colonies/100 ml. Samples collected at RM 8.0 and 10.78 were submitted past holding time, but were considered a good screening tool for failing septic systems in the area. Their E. coli counts wre 3,200 colonies/100 ml and 80,000 colonies/100 ml respectively (OEPA 2007).

If all failing/discharging HSTS were replaced in Ithaca, it is estimated that 219.4 pounds of nitrogen and 83.1 pounds of phosphorus would be prevented from entering Millers Fork annually. Significant *E. coli* and fecal coliform bacteria and other pathogens would no longer discharge to Millers Fork, protecting the health of families in the Millers Fork HUC-12 (OEPA 2010).

Objectives

In order to make substantive progress toward the achievement of the phosphorous load reduction goal of 169.5 lbs. for the HSTS contribution, effort must commence on more widespread implementation, according to the following objectives as first steps to address the failing HSTS within *Critical Area #3.*

Objective 1: Replace 14 HSTS in the Village of Ithaca or connect them to sanitary sewer infrastructure.

Objective 2: Enroll all HSTS in the HUC-12 in county health department permitting programs, including operation and maintenance systems.

Objective 3: Replace 20 failing HSTS outside of the Village of Ithaca, and within 500 feet of Millers Fork and/or known to have no secondary treatment and to be discharging directly to surface water.

To achieve these objectives, Darke and Preble county health departments could pursue funding assistance from Ohio EPA Division of Financial Assistance (DEFA) to provide cost-share for income-eligible homeowners. Additional staff resources are needed to achieve universal compliance.

It is recommended that the Village of Ithaca commission an engineering study to explore the feasibility of connecting to an existing wastewater treatment plant or of building the village's own wastewater treatment plant.

Currently there is no routine stream monitoring or sampling in the Millers Fork HUC-12. But the future project-specific monitoring efforts 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 become 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 OEPA 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 Great Miami River Basin is one of the major nutrient contributors to Ohio River and Gulf Hypoxia (OEPA, 2020). It is important and beneficial for the NPS-IS initiatives to be implemented in this region as soon as possible. Millers Fork HUC-12 is an agricultural watershed and implementation of proposed conservation practices is targeted to reduce nutrient load reduction by 20%. Based on the 2005 OEPA sampling, the Millers Fork HUC-12 was a low-fair to good quality stream and therefore, the goal is to improve and protect its stream and habitat health.

The Project and Implementation Strategy of the Millers Fork 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 three 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

Three Project and Implementation Strategy Overview tables and an associated project summary sheet for each of the critical areas (Tile-drained agricultural fields, riparian areas of Millers Fork and tributaries, and the unsewered community of Ithaca) 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 within the Millers Fork HUC-12, supplemental information will be provided as funding allows.

4.2. Project Tables

The Project Overview Table for each Critical Area presents 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 4-1 Millers Fork Critical Area 1 Table

For Millers Fork HUC-12 (050800020201) 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							
1,2	2	1	Agricultural BMP – 626 Acres Cover Crops	Darke & Preble SWCD	Short to Medium (1-7 years)	$25,000	EQIP-CIC, CSP, Ducks Unlimited, Farmers for Soil Health
High Quality Waters Protection Strategies							
Other NPS Causes and Associated Sources of Impairment							

TABLE 4-2 CRITICAL AREA 1 - PROJECT 1 TABLE

Project #1– Millers Fork HUC-12 Critical Area 1		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	Title	Agricultural BMPs – Cover Crops
criteria d	Project Lead Organization & Partners	Darke Soil and Water Conservation District Preble Soil and Water Conservation District
criteria c	HUC-12 and Critical Area	Millers Fork HUC-12 (0508000200201) – Critical Area 1
criteria c	Location of Project	Private landowners – 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 cover crop installation
criteria g	Project Narrative	Darke, Montgomery, and Preble SWCDs will administer a cost-share program to local landowners in prioritized agricultural lands to install about 626 acres of cover crops.
criteria d	Estimated Total cost	$25,000
criteria d	Possible Funding Source	EQIP-CIC, CSP, Ducks Unlimited, Farmers for Soil Health
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 2:** Plant an additional 626 acres of cover crops annually in addition to the 465 acres that are already planted per year. The overall goal in Critical Area #1 is to reduce estimated total nitrogen load for agricultural lands by 20% (49,904 lb). In order to meet the Gulf of Mexico hypoxia reduction goals, the total nitrogen loadings must be reduced by additional 49,904 lb/year and the phosphorous load reduction needed is 3,160lb./year.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	Goal: This project is expected to achieve 1% of the total nitrogen reduction goal and 1.3% of the total phosphorous reduction goal.
	Part 3: Load Reduced?	Estimate of 420 lbs/yr (N)/42 lbs/yr (P) load reduction based on STEPL 4.4b Spreadsheet Model for 10 Watersheds.

Table 4-3 Millers Fork Critical Area 2 Table

For Millers Fork HUC-12 (050800020201) 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							

Table 4-4 Millers Fork Critical Area 3 Table

For Millers Fork HUC-12 (050800020201) Critical Area 3							
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							

APPENDIX

APPENDIX A – References

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APPENDIX B – Soils of Millers Fork HUC-12 Watershed

Soil Name	Soil Description	Drainage Classification	Acres	Percent of HUC-12
Br	Brookston silty clay loam, fine texture, 0 to 2 percent slopes	Poorly drained	2854.60	18.40%
Bs	Brookston silty clay loam, fine texture, 0 to 2 percent slopes	Poorly drained	2.60	0.02%
CeA	Celina silt loam, 0 to 2 percent slopes	Moderately well drained	3.71	0.02%
CeA	Celina silt loam, 0 to 2 percent slopes	Moderately well drained	1.15	0.01%
CeA	Celina silt loam, 0 to 2 percent slopes	Moderately well drained	88.04	0.57%
CeB	Celina silt loam, 2 to 6 percent slopes	Moderately well drained	627.81	4.05%
CeB	Celina silt loam, 2 to 6 percent slopes	Moderately well drained	11.65	0.08%
CeB	Celina silt loam, 2 to 6 percent slopes	Moderately well drained	894.21	5.76%
CeB2	Celina silt loam, 2 to 6 percent slopes, eroded	Moderately well drained	236.71	1.53%
CrA	Crosby silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Somewhat poorly drained	2768.54	17.85%
CsA	Crosby silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Somewhat poorly drained	2.06	0.01%
CrB	Crosby silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	Somewhat poorly drained	2102.99	13.56%
CtA	Crosby-Celina silt loams, 0 to 2 percent slopes	Somewhat poorly drained	866.27	5.58%
CtA	Crosby-Celina silt loams, 0 to 2 percent slopes	Somewhat poorly drained	58.93	0.38%
CtA	Crosby-Celina silt loams, 0 to 2 percent slopes	Somewhat poorly drained	6.88	0.04%
CtB	Crosby-Celina silt loams, 2 to 4 percent slopes, eroded	Somewhat poorly drained	54.54	0.35%
CtB	Crosby-Celina silt loams, 2 to 4 percent slopes, eroded	Somewhat poorly drained	24.76	0.16%
EeA	Eel silt loam, gravelly substratum, 0 to 1 percent slopes, occasionally flooded	Moderately well drained	136.04	0.88%
Ee	Eel silt loam, occasionally flooded	Moderately well drained	94.59	0.61%
EhD3	Eldean gravelly clay loam, 12 to 18 percent slopes, severely eroded	Well drained	4.10	0.03%
EhC3	Eldean gravelly clay loam, 6 to 12 percent slopes, severely eroded	Well drained	41.45	0.27%
EgB2	Eldean gravelly loam, 2 to 6 percent slopes, eroded	Well drained	0.77	0.00%

EnA	Eldean loam, 0 to 2 percent slopes	Well drained	9.91	0.06%
EkA	Eldean loam, 0 to 2 percent slopes	Well drained	115.93	0.75%
EnB	Eldean loam, 2 to 6 percent slopes	Well drained	24.89	0.16%
EkB	Eldean loam, 2 to 6 percent slopes	Well drained	62.81	0.40%
EkB2	Eldean loam, 2 to 6 percent slopes, eroded	Well drained	15.94	0.10%
ErD2	Eldean-Miamian complex, 12 to 18 percent slopes, eroded	Well drained	7.63	0.05%
FmA	Fox silt loam, till substratum, 0 to 2 percent slopes	Well drained	18.08	0.12%
FmB	Fox silt loam, till substratum, 2 to 6 percent slopes	Well drained	0.76	0.00%
HeF2	Hennepin-Miamian silt loams, 25 to 50 percent slopes, eroded	Well drained	0.02	0.00%
KeD2	Kendallville-Eldean silt loams, 12 to 18 percent slopes, eroded	Well drained	23.51	0.15%
KeD2	Kendallville-Eldean silt loams, 12 to 18 percent slopes, eroded	Well drained	2.51	0.02%
KeC2	Kendallville-Eldean silt loams, 6 to 12 percent slopes, eroded	Well drained	46.99	0.30%
KnA	Kokomo silt loam, 0 to 1 percent slopes	Very poorly drained	327.56	2.11%
KoA	Kokomo silty clay loam, 0 to 1 percent slopes	Very poorly drained	728.22	4.69%
KoA	Kokomo silty clay loam, 0 to 1 percent slopes	Very poorly drained	74.65	0.48%
KoA	Kokomo silty clay loam, 0 to 1 percent slopes	Very poorly drained	14.38	0.09%
Ln	Linwood muck	Very poorly drained	3.33	0.02%
Lp	Lippincott silty clay loam, 0 to 2 percent slopes	Very poorly drained	12.26	0.08%
MaA	Medway silt loam, 0 to 1 percent slopes, occasionally flooded	Moderately well drained	3.71	0.02%
Md	Medway silt loam, occasionally flooded	Moderately well drained	2.48	0.02%
MnD3	Miamian clay loam, shallow to dense till substratum, 12 to 18 percent slopes, severely eroded	Well drained	27.49	0.18%
MnC3	Miamian clay loam, shallow to dense till substratum, 6 to 12 percent slopes, severely eroded	Well drained	46.27	0.30%
MmA	Miamian silt loam, 0 to 2 percent slopes	Well drained	4.40	0.03%
MmD2	Miamian silt loam, 12 to 18 percent slopes, eroded	Well drained	27.89	0.18%

MeD2	Miamian silt loam, 12 to 18 percent slopes, eroded	Well drained	38.31	0.25%
MmE	Miamian silt loam, 18 to 25 percent slopes	Well drained	4.69	0.03%
MmB	Miamian silt loam, 2 to 6 percent slopes	Well drained	623.97	4.02%
MlB2	Miamian silt loam, 2 to 6 percent slopes, eroded	Well drained	0.58	0.00%
MmC2	Miamian silt loam, 6 to 12 percent slopes, eroded	Well drained	200.27	1.29%
MeC2	Miamian silt loam, 6 to 12 percent slopes, eroded	Well drained	372.63	2.40%
MfB	Miamian-Celina silt loams, 2 to 6 percent slopes	Well drained	104.15	0.67%
MkB	Miamian-Celina silt loams, 2 to 6 percent slopes	Well drained	20.69	0.13%
MfB2	Miamian-Celina silt loams, 2 to 6 percent slopes, eroded	Well drained	512.08	3.30%
MkB2	Miamian-Celina silt loams, 2 to 6 percent slopes, eroded	Well drained	8.17	0.05%
MnE3	Miamian-Hennepin clay loams, 18 to 25 percent slopes, severely eroded	Well drained	34.67	0.22%
MmE2	Miamian-Hennepin silt loams, 18 to 25 percent slopes, eroded	Well drained	59.01	0.38%
MrE2	Miamian-Hennepin silt loams, 18 to 25 percent slopes, eroded	Well drained	1.78	0.01%
MgE2	Miamian-Kendallville silt loams, 18 to 25 percent slopes, eroded	Well drained	30.53	0.20%
MgF2	Miamian-Kendallville silt loams, 25 to 50 percent slopes, eroded	Well drained	4.31	0.03%
MhD3	Miamian-Losantville clay loams, 12 to 18 percent slopes, severely eroded	Well drained	79.61	0.51%
MhC3	Miamian-Losantville clay loams, 6 to 12 percent slopes, severely eroded	Well drained	210.38	1.36%
MuA	Milton silt loam, 0 to 2 percent slopes	Well drained	1.06	0.01%
MuD2	Milton silt loam, 12 to 18 percent slopes, eroded	Well drained	10.38	0.07%
MuB	Milton silt loam, 2 to 6 percent slopes	Well drained	1.79	0.01%
MuB2	Milton silt loam, 2 to 6 percent slopes, eroded	Well drained	2.39	0.02%
MuC2	Milton silt loam, 6 to 12 percent slopes, eroded	Well drained	6.88	0.04%
Mnl3A	Minster silty clay loam, till substratum, 0 to 1 percent slopes	Very poorly drained	2.05	0.01%
OcA	Ockley silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Well drained	10.48	0.07%

OcB	Ockley silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	Well drained	3.97	0.03%
OdA	Odell silt loam, 0 to 3 percent slopes	Somewhat poorly drained	1.96	0.01%
Pa	Patton silty clay loam, 0 to 2 percent slopes	Poorly drained	82.68	0.53%
Pg	Pits, gravel		6.50	0.04%
RaA	Rainsville silt loam, 0 to 2 percent slopes	Moderately well drained	0.88	0.01%
RaB	Rainsville silt loam, 2 to 6 percent slopes	Moderately well drained	36.79	0.24%
RaB2	Rainsville silt loam, 2 to 6 percent slopes, eroded	Moderately well drained	12.50	0.08%
RnE2	Rodman gravelly loam, 18 to 25 percent slopes, eroded	Excessively drained	4.19	0.03%
RnF2	Rodman gravelly loam, 25 to 50 percent slopes, eroded	Excessively drained	1.03	0.01%
RoE2	Rodman-Kendallville complex, 18 to 25 percent slopes, eroded	Excessively drained	2.48	0.02%
RoF2	Rodman-Kendallville complex, 25 to 50 percent slopes, eroded	Excessively drained	4.94	0.03%
RpA	Rossburg silt loam, moderately wet, sandy substratum, 0 to 1 percent slopes, occasionally flooded	Well drained	98.86	0.64%
SeA	Savona silt loam, 0 to 2 percent slopes	Somewhat poorly drained	1.91	0.01%
Sh	Shoals silt loam, occasionally flooded	Somewhat poorly drained	16.43	0.11%
SnA	Sloan silt loam, sandy substratum, 0 to 1 percent slopes, frequently flooded	Very poorly drained	1.00	0.01%
SnA	Sloan silt loam, sandy substratum, 0 to 2 percent slopes, frequently flooded	Very poorly drained	117.99	0.76%
StA	Stonelick loam, gravelly substratum, 0 to 1 percent slopes, frequently flooded	Well drained	46.86	0.30%
ThA	Thackery silt loam, 0 to 2 percent slopes	Moderately well drained	57.81	0.37%
ThB	Thackery silt loam, 2 to 6 percent slopes	Moderately well drained	21.61	0.14%
Ud	Udorthents		0.73	0.00%
Ud	Udorthents, loamy		3.27	0.02%
Wb	Wallkill silt loam	Very poorly drained	2.77	0.02%
W	Water		6.62	0.04%
W	Water		15.54	0.10%

WnA	Westland silt loam, 0 to 2 percent slopes	Very poorly drained	116.43	0.75%
Ws	Westland silty clay loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Poorly drained	22.37	0.14%
			15513	100.00%

Source: USDA, 2020