Nine-Element Nonpoint Source Implementation Strategy (NPS-IS) for Tenmile Creek HUC-12 (04100001 03 06)

Version 1.0 created by The Olander Parks System, Partners for Clean Streams, Metroparks Toledo and The Nature Conservancy; Approved: August 24, 2017

Version 2.0 Prepared for:
Partners for Clean Streams

Prepared by:
Civil & Environmental Consultants, Inc.
Toledo, Ohio

Version 2.0 Approved:

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Acknowledgements

Version 2.0 prepared and written by:

Deanna Bobak
Civil & Environmental Consultants, Inc.
4841 Monroe Street, Suite 103
Toledo, OH 43623

Kris Patterson
Partners for Clean Streams
132 W. 2nd Street #C
Perrysburg, OH 43551

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Cover photo: Tenmile Creek at Richards Park, courtesy of Civil & Environmental Consultants, Inc.

Acronyms and Abbreviations

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

Numbers	
§319	Section 319 of the Clean Water Act
A	
ALU	Aquatic Life Use
AOC	Area of Concern
B	
BUI	Beneficial Use Impairment
C	
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
D	
DAP	Domestic Action Plan
DMDS	Data Management and Delisting System
DO	Dissolved Oxygen
E	
ECHO	Environmental Compliance History Online (database)
EWH	Exceptional Warmwater Habitat
EQIP	Environmental Quality Incentives Program
F	
FOTG	Field Office Technical Guide
FSA	Farm Service Agency
G	
GLC	Great Lakes Commission
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement
H	
H2Ohio	H2Ohio Initiative (Ohio state funding mechanism for water quality improvement)
HAB	Harmful Algal Bloom
HELP	Huron-Erie Lake Plains Ecoregion
HSTS	Home Sewage Treatment System
HUC	Hydrologic Unit Code
I	
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
IJC	International Joint Commission

M

MAAC	Maumee Area of Concern Advisory Committee
MIwb	Modified Index of Well Being
MWH	Modified Warmwater Habitat

N

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

O

ODA	Ohio Department of Agriculture
ODNR	Ohio Department of Natural Resources
Ohio EPA	Ohio Environmental Protection Agency
OLEC	Ohio Lake Erie Commission

P

PCS	Partners for Clean Streams

Q

QHEI	Qualitative Habitat Evaluation Index

R

RAP	Remedial Action Plan
RM	River Mile

S

SWCD	Soil and Water Conservation District

T

TMACOG	Toledo Metropolitan Area Council of Governments
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TOPS	The Olander Parks System
TSD	Technical Support Document

U

USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency

V

VRT	Variable Rate Technology

W

WAP	Watershed Action Plan
WLEB	Western Lake Erie Basin
WQS	Water Quality Standards (Ohio Administrative Code 3745-1)
WRP	Wetlands Reserve Program
WWH	Warmwater Habitat

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CHAPTER 1: INTRODUCTION

The **Tenmile Creek HUC-12** (04100001 03 06) is located at the northern edge of Lucas County, Ohio (Figure 1). This watershed contains the drainage area immediately downstream from the *Headwaters Tenmile Creek HUC-12* (041000010 03 04) and the *Prairie Ditch HUC-12* (041000010 03 03), with a downstream terminus at the confluence of Tenmile Creek and North Tenmile Creek, where Tenmile Creek becomes the Ottawa River. At 14.97 square miles[1] (9,580.79 acres) in size, the Tenmile Creek HUC-12 is relatively small; however, the landscape of the watershed is quite diverse. It includes high-density residential neighborhoods, multiple industrial sites, row crop agriculture, pastures, parks, and wooded riparian areas.

Figure 1: Tenmile Creek HUC-12 Overview

1.1 Report Background

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

[1] 11.21 square miles are located in Ohio, with the remaining area in Michigan.

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

Table 1: Nine Elements for Watershed Plans and Implementation Projects

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

(Source: USEPA, 2008)

Maumee Area of Concern

In 1987, the Maumee Area of Concern (AOC) was created under the Great Lakes Water Quality Agreement (GLWQA). With this, a committee formed to develop the Maumee Remedial Action Plan (RAP). In 2006, the Maumee RAP committee created the *Maumee AOC Stage 2 Watershed Restoration Plan*. This document served to be a comprehensive clearinghouse for restoration of the watersheds within the Maumee AOC to meet requirements for many programs under the International Joint Commission, USEPA and Ohio governmental agencies at the time (Partners for Clean Streams, 2016). As part of the Ottawa River watershed, the **Tenmile Creek HUC-12** was included in this report.

The *Stage 2 Watershed Restoration Plan* was submitted to the Ohio Department of Natural Resources (ODNR) and Ohio EPA; however, full endorsement was pending inclusion of a Coastal Nonpoint Source Pollution Management Measures section (Ohio EPA, 2009). Since programs have more recently aligned with the USEPA's nine-element plans, the inclusion of this section was abandoned, and NPS-IS for the individual HUC-12 watersheds within the greater Maumee AOC were developed. The *Tenmile Creek HUC-12 NPS-IS, Version 1.0*, was written in 2017 to address nonpoint source pollution issues specifically within its drainage area, as opposed to a comprehensive watershed plan for all issues found within the region.

State of Ohio Domestic Action Plan

The state of Ohio has had a long history of identifying problems and combating Harmful Algal Blooms (HABs) within Lake Erie (OLEC, 2020). After successfully abating nutrient enrichment in the 1980s, the occurrence and severity of HABs within Lake Erie began to increase in the mid-1990s. Building on efforts initiated by the Ohio Phosphorus Task Force, Ohio participated at the federal level in the GLWQA of 2010. Along with Michigan and Ontario, Ohio committed to a goal of reducing phosphorus loadings to Lake Erie by 40% in both 2015 and in 2019 through signing the Lake Erie Collaborative Agreement, leading to the precursor of Ohio's Domestic Action Plan (DAP).

In 2018, all sub-watersheds (HUC-12s) within the Ohio portions of the Auglaize HUC-8 (including the Ottawa River (Lima), Little Auglaize River and Little Flatrock Creek), the Blanchard HUC-8 (including Eagle Creek), the St. Marys HUC-8 and the Platter Creek HUC-12 were recommended for designation as a "Watershed in Distress". This recommendation was due to relatively higher concentrations of phosphorus in surface waters contributing to HAB occurrence in Lake Erie. These waterways were found to have flow-weighted mean concentrations of phosphorus two or more times the phosphorus loading goals set forth by the GLWQA and the subsequent DAP developed by the State of Ohio (ODA, 2018). As a result, nutrient loadings were modeled and reduction targets were set for these priority areas, as well as all sub-watersheds within the Western Lake Ere Basin (WLEB). Though not included in the 2020 DAP, preliminary loadings were estimated for the Ohio portions of the Ottawa-Stony HUC-8, of which the **Tenmile Creek HUC-12** is a part.

Tenmile Creek HUC-12 NPS-IS

The *Tenmile Creek HUC-12 NPS-IS, Version 1.0*, was sponsored by The Olander Parks System (TOPS), Metroparks Toledo, Partners for Clean Streams (PCS) and The Nature Conservancy (TNC) as part of a larger, organized effort by members of Maumee AOC Advisory Committee (MAAC) to make projects eligible for funding that would help make progress towards the removal of beneficial use impairments (BUIs) to waters located within the Maumee AOC. Fourteen BUIs are defined for the state of Ohio and identify a reduction in the chemical, physical or biological integrity of the Waters of the Great Lakes (Ohio EPA, 2017). This update to the *Tenmile Creek HUC-12 NPS-IS, Version 1.0* serves to include updated information regarding BUI status, AOC-specific considerations and nutrient reduction targets associated with the WLEB.

Removal of NPS impairments, reduction in overall sediment and nutrient loss and restoration of streambanks, floodplains and wetlands within the **Tenmile Creek HUC-12** is crucial to the attainment of aquatic life use (ALU) standards and removal of BUIs within this sub-watershed and the greater Maumee AOC. Furthermore, removal of NPS impairments and reduction in overall nutrient loss will reduce the severity, extent and occurrence of HABs within the WLEB. One site within Tenmile Creek is in *Full Attainment* of the Warmwater Habitat (WWH) designation in the **Tenmile Creek HUC-12**, while two sites are in *Partial Attainment* of the WWH designation due to excessive sedimentation/siltation caused by channelization and associated hydromodification. Related to ALU standards within the AOC program, the **Tenmile Creek HUC-12** is impaired for BUI #3: Fish Populations and BUI #6: Macroinvertebrate Populations (Table 2). This NPS-IS will be used to strategically identify and outline key projects that should be implemented within the **Tenmile Creek HUC-12** to address management of NPS issues that have both near-field and far-field impacts on maintenance/attainment of State of Ohio water quality standards (WQS), as well as attainment of AOC targets for BUI removal.

Table 2: BUI Status in the Tenmile Creek HUC-12

BUI Description	BUI Status	Metric	Target Score	HUC-12 Score (Average)	Percent Target Met
#3a: Degradation of Fish Populations	Impaired	WWH - IBI	28	36.67	130.95%
		WWH - MIwb	6.8	6.73	98.93%
#6: Degradation of Benthos	Impaired	WWH - ICI	30	27.33	91.1%
#14a: Loss of Fish Habitat	Not Impaired	WWH - QHEI	60	60.17	100.28%

(Source: PCS DMDS, 2022)

NOTES
BUI Beneficial Use Impairment
WWH Warmwater Habitat
IBI Index of Biotic Integrity
MIwb Modified Index of Well Being
ICI Invertebrate Community Index
QHEI Qualitative Habitat Evaluation Index

1.2 Watershed Profile & History

The Ottawa River is 45 miles long with a drainage basin of 220.9 square miles; 146.7 of these are located in Ohio (Maumee RAP, 2006). The Ottawa River begins in Fulton County with the 27.4-mile-long Tenmile Creek, which originates west of Ohio State Route 109 and south of US Route 20. The stream falls an average of 4.9 feet/mile from its origin elevation of 755 feet to an elevation of 620 feet in the city of Sylvania, Lucas County. Tenmile Creek drains an area of ~81 square miles and joins North Tenmile Creek (drainage area= 42 square miles) in Sylvania at Harroun Park. This confluence forms the Ottawa River. Ohio EPA identifies this juncture to be 19.75 miles upstream from the Ottawa River's Lake Erie mouth (Figure 2)[2]. From this point, the 19.75-mile-long Ottawa River maintains a similar grade (4.7 feet/mile) as

[2] River mile maps used in this document were created using data digitized by TMACOG (made available from the PCS DMDS online system) utilizing 2004 aerial photography and may not represent current stream lengths or correlate to other river mile data sets, notably they do not precisely align with Ohio EPA river mile delineations (Ohio EPA, 2022).

it flows through the village of Ottawa Hills, the main campus of the University of Toledo, and the City of Toledo to empty into Maumee Bay and Lake Erie in Monroe County (Ohio EPA, 2015).

The Ottawa River watershed can be divided into three major reaches (USACE, 2009). The headwaters of Tenmile Creek to the City of Sylvania (River Mile (RM) 20.0) has low banks (15 to 25 feet), is relatively stable and comprises the upper reach of the watershed. The middle reach lies between RM 20.0 and 5.0 and is characterized by high banks (35 to 45+ feet) that are intermixed with distinct floodplains. Bedrock can be found in the channel within Wildwood Preserve Metropark in this reach. The lower reach is from RM 5.0 to the mouth and is under backwater influence from Maumee Bay. The entire Ottawa River watershed is located within the Huron-Erie Lake Plains (HELP) ecoregion, specifically the Lake Plain, which is a broad, fertile, nearly flat plain formed from retreating glacial lakes, characterized by slowly-draining silt and clay soils. Large portions of the **Tenmile Creek HUC-12** include or are buffered by small, remnant sections of the ecologically important Oak Openings ecosystem (Figure 3).

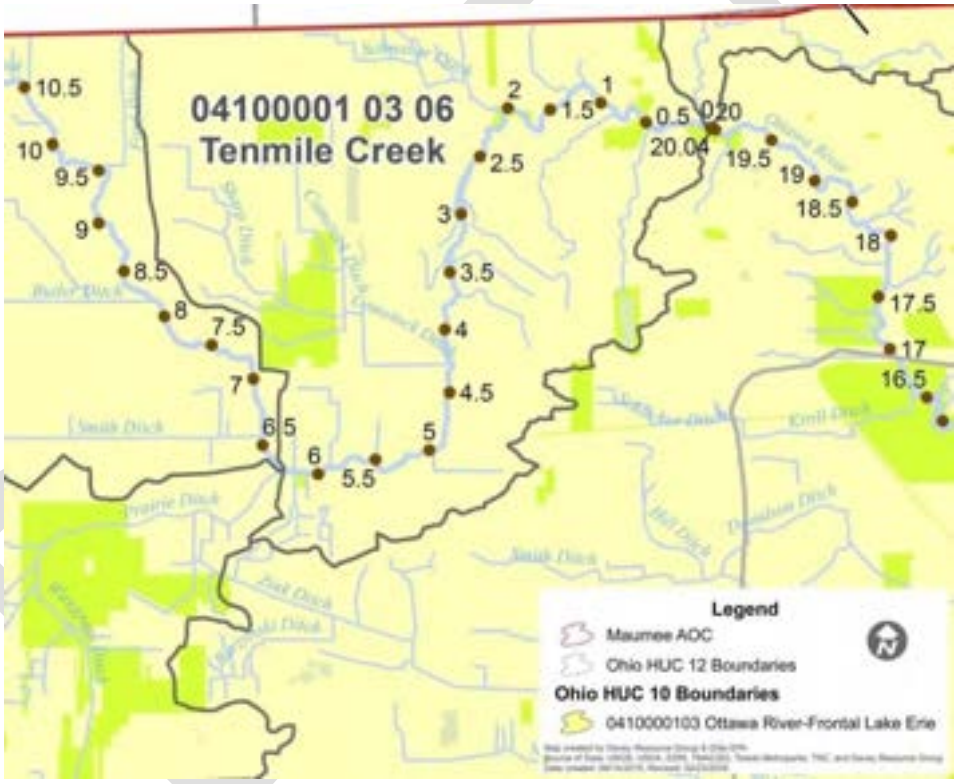

Figure 2: River Mile Map of the Tenmile Creek/Ottawa River Confluence

Oak Openings Region

As much as 60% of the **Tenmile Creek HUC-12** is part of the globally significant Oak Openings Region (Figure 3). The Oak Openings is a uniquely diverse region that spans six counties in northwest Ohio and southeast Michigan to cover 130 square miles. Sandy dunes and swales, formerly the shoreline of historic Lake Warren, sit atop a layer of clay, which retains water throughout the year. Where sands are deep, oak savannas and sand barrens persist. Wet prairies and forested wetland communities dominate areas of shallow sand and high water tables. This combination of geology and hydrology results in the presence of globally rare wetland and upland habitats.

Prairie restoration at The Olander Park System's Sylvan Prairie Park. Photo courtesy of TOPS.

This area, representative of a former beach, reflects historically higher lake levels in ancestral Lake Erie near the end of the last ice age. As water levels dropped, the sand was reworked to form sand dunes over broad areas. Also at about this time, rivers began to dig themselves into the landscape as glacial waters drained away (The Nature Conservancy, 2016).

Early pioneers approached the Oak Openings region after days of trekking through the sticky mud and dense woods of the Great Black Swamp. The high sandy dunes and dry open woodland appealed to them as a land for farming; however, the sandy soils did not provide easy yields. Today, over 70% of the Oak Openings land has been developed or is in agricultural production, leaving less than 30% in natural cover. Natural floodplain corridors occur between the Oak Openings region and Lake Erie along the Ottawa River.

The Oak Openings region is known for its rare and unique flora; five of its six natural plant communities are considered globally rare. Since the first rare plant list, Lucas County has led the state with more rare plant species than any other Ohio county, mainly due to the Oak Openings region. Due to the sensitivity of its globally rare species, conservation actions should be targeted to efficiently protect the unique plants and animals (The Nature Conservancy, 2016).

Great Black Swamp

Over 40% of the **Tenmile Creek HUC-12** was historically Ash-Elm Swamp Forest, basically a northern lobe of the Great Black Swamp (Figure 4, Gordon, 1980; digitized by Karen V. Root from Bowling Green State University). Starting in the late 1800s, the dense deciduous forests were cleared, and the heavy clay soils were drained extensively. This land is now dominated by row crop agriculture. Virtually all of the agricultural fields in this part of the watershed utilize subsurface drainage tiles since the silt/clay soils are so poorly drained. Drainage waters from the agricultural fields in this sub-watershed flow into 15.5 miles of ditches, which then empty into Tenmile Creek, contributing to sediment and nutrient loading in the waterway.

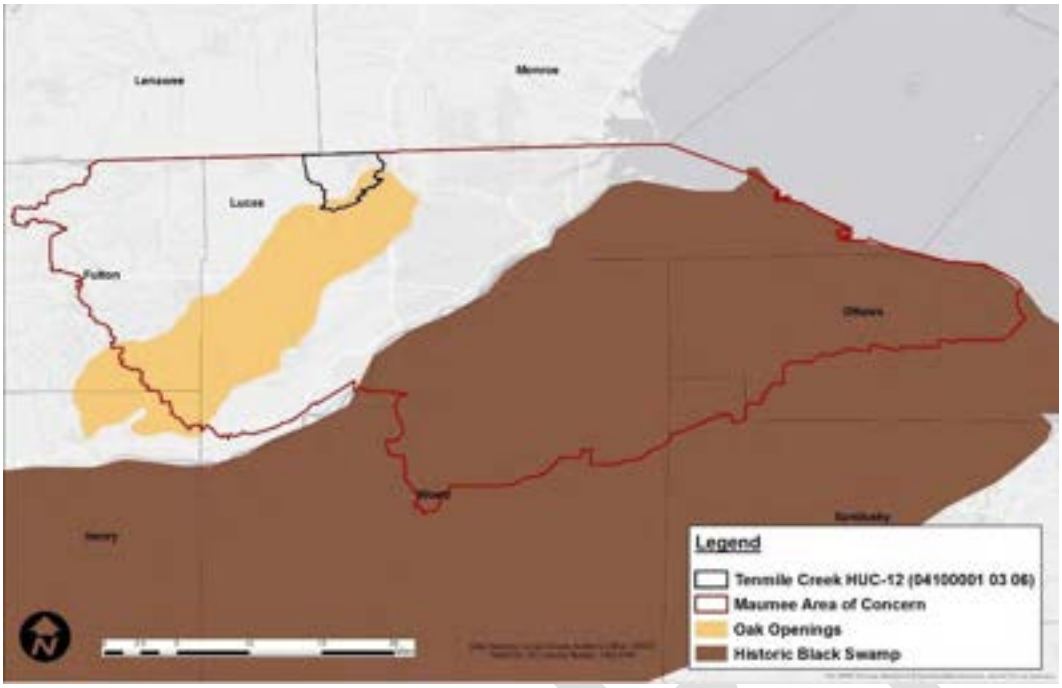

Figure 3: The Oak Openings Region and the Great Black Swamp

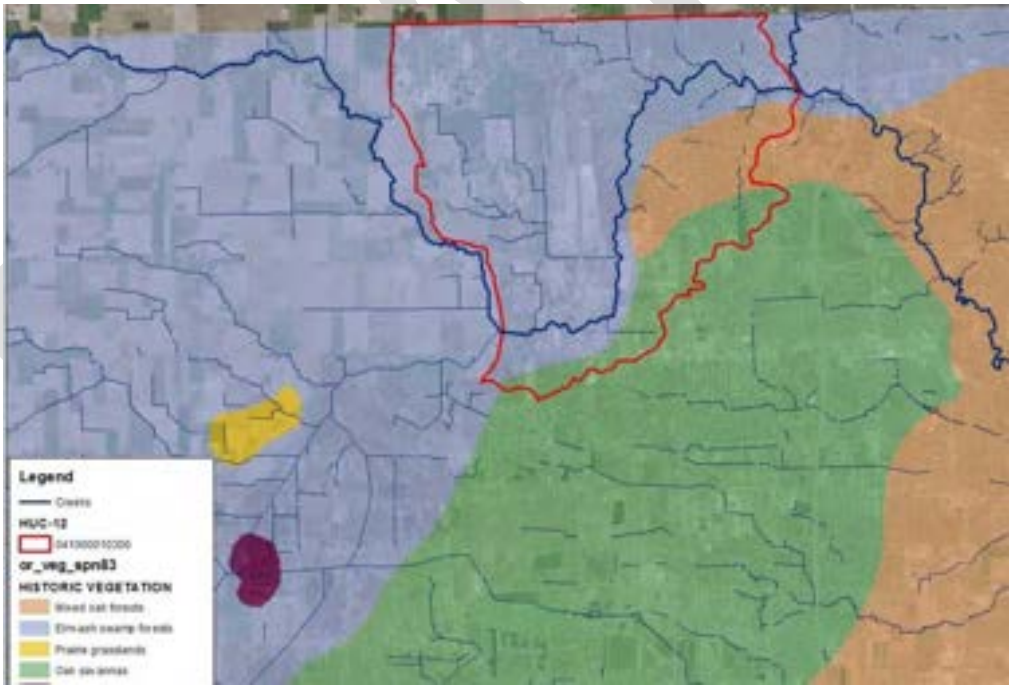

Figure 4: Historic Vegetation of Tenmile Creek

1.3 Public Participation and Involvement

Watershed planning and restoration plans should include involvement from a diverse group of entities, including governmental agencies, private businesses, academia, non-profit groups, neighborhood organizations and the public at large. Many partners have been working in the Ottawa River watershed

towards ecological restoration and water quality goals. Several watershed groups have been involved with the Ottawa River watershed, including ClearWater and the Maumee RAP. In 2007, after working under the umbrella of Toledo Metropolitan Area Council of Governments (TMACOG) for almost twenty years, the Maumee RAP merged with PCS and ClearWater was dissolved. Most restoration efforts in the Ottawa River watershed are now led by or closely partnered with PCS. Nonprofit groups, such as Metroparks Toledo, TNC, the TMACOG, governmental agencies, academia, citizen action groups and watershed organizations have been interested and involved in the improvement and protection of the Ottawa River watershed. Previous projects have focused on remediation of brownfields and contaminated sediments in the lower reaches of the river, as well as the protection, restoration, and enhancement of habitat and stream health throughout the entire watershed.

Four partner agencies from the Green Ribbon Initiative pooled resources to leverage 319(h) Nonpoint Source Program monies to fund a planner to write NPS-IS plans for three contiguous watersheds located in the Oak Openings Region. Employed by TOPS, the planner worked closely with staff from TNC, PCS and Metroparks Toledo to create the *Tenmile Creek HUC-12 NPS-IS, Version 1.0*. The Green Ribbon Initiative is a shared vision of public and private organizations, landowners and individuals working to "preserve, enhance and restore critical natural areas in the Oak Openings Region of Northwest Ohio and Southeast Michigan".

In 2021, PCS received funding from multiple sources, including the Great Lakes Restoration Initiative and the Lake Erie Protection Fund, to update pre-existing NPS-IS throughout the Maumee AOC. PCS works directly with citizens, businesses, governmental agencies, and other non-profit organizations who take local ownership in their rivers, streams, and lakes. PCS strives for clean, clear and safe waters by connecting organizational and individual partners through educational opportunities, conservation programs, stream clean-ups and outreach programs for the benefit of local and regional water in Northwest Ohio. PCS also works as the facilitating organization for the MAAC. Through the MAAC, a diverse assortment of interested citizens, government agencies, businesses, and other non- profit organizations collaborate and plan together to meet the broader goals set for AOCs under the GLWQA. The AOC Program in Ohio is under direction of Ohio EPA with guidance from USEPA.

Additional key partners within this HUC-12 and the greater Ottawa River watershed include: the University of Toledo, Lucas County Engineers Office, Lucas Soil and Water Conservation District (SWCD), the Toledo-Lucas County Sustainability Commission, and the cities of Sylvania and Toledo.

Chapters 1, 2 and 3 were primarily authored using the *2020 Integrated Report* (Ohio EPA, 2020a), *Biological and Water Quality Study of Tenmile Creek and the Ottawa River, 2011, Ohio EPA Technical Report EAS/2014-06-06* (Ohio EPA, 2015). Updates to the *Tenmile Creek HUC-12 NPS-IS, Version 1.0* were led by PCS and included additional AOC information, as well as nutrient reduction targets set forth by Ohio's DAP (OLEC, 2018; OLEC, 2020). Project information for Chapter 4 was compiled from the on-line Maumee AOC Data Management and Delisting System (DMDS) (PCS, 2022) and by collaborative meetings with stakeholders and community partners.

CHAPTER 2: HUC-12 WATERSHED CHARACTERIZATION AND ASSESSMENT SUMMARY

2.1 Summary of HUC-12 Watershed Characterization

2.1.1 Physical and Natural Features

The *Ottawa River-Frontal Lake Erie HUC-10* (04100001 03) is comprised of nine HUC-12 watersheds, draining an area of 146.52 square miles in Ohio (Figure 5). This document focuses on the #06 unit of the *Ottawa River-Frontal Lake Erie HUC-10*—the **Tenmile Creek HUC-12** (04100001 03 06). Located midway through the *Ottawa River-Frontal Lake Erie HUC-10*, this sub-watershed marks the transition from its principal waterway, Tenmile Creek, to the Ottawa River. Tenmile Creek is approximately 28.0 miles long and begins in the *Headwaters Tenmile Creek HUC-12* (04100001 03 04). It is joined by Prairie Ditch (encompassed in the *Prairie Ditch HUC-12* (04100001 03 03)) to establish the upstream node of the **Tenmile Creek HUC-12**. The confluence of Tenmile Creek with North Tenmile Creek (flowing from the *North Tenmile Creek HUC-12* (04100001 03 05)) serves as the downstream terminal node for the Tenmile Creek watershed and the upstream initial node for the *Heldman Ditch-Ottawa River HUC-12* (04100001 03 07). The reach of Tenmile Creek contained within the HUC-12 boundaries lies between approximately RM 6.25 to RM 0, where the confluence of Tenmile Creek with North Tenmile Creek marks the beginning of the Ottawa River (Ohio EPA, 2015). It drains an area of 14.97 square miles (9,580.79 acres), of which 11.23 square miles (7,188 acres) are contained within Ohio.

Figure 5: Ottawa River-Frontal Lake Erie HUC-10

The Ottawa River watershed is wholly contained within the HELP ecoregion. The HELP ecoregion is described as "Fine, poorly-drained, water-worked glacial till and lacustrine sediment; also coarser end moraine and beach ridge deposits" (Maumee RAP, 2006). In the upstream portion of the Ottawa River watershed (*Headwaters Tenmile Creek HUC-12*, *Prairie Ditch HUC-12*, and **Tenmile Creek HUC-12**), agricultural fields lie on Lake Plain till deposits overlying Devonian bedrock. Rural and suburban developments in the **Tenmile Creek HUC-12** are situated in the Sand Plains of the Oak Openings region atop a Devonian/Silurian base. Urban areas in the **Tenmile Creek HUC-12** and downstream throughout the remainder of the watershed lie on Lake Plain lacustrine fine sand, silt and clay deposits over Silurian bedrock. Bedrock in this area is dense; soils are level to gently sloping and are very poorly to somewhat poorly drained throughout the basin. Much of the **Tenmile Creek HUC-12** has severely wet soils

unsuitable for basement building foundations, septic leach fields or manure application without artificial drainage (Ohio EPA, 2015).

Along the Tenmile Creek mainstem in Lucas County, especially in the downstream portion of the **Tenmile Creek HUC-12**, a wider riparian corridor exists. This mature corridor maintains important populations of wildlife, particularly for threatened and endangered raptors. In 2014, bald eagles constructed a nest in the riparian trees east of Centennial Road, near Tenmile Creek, and the nest was successful in years after. A state endangered Northern Harrier overwinters at Sylvan Prairie Park every year.

Specific landmarks and features in this watershed include:

- Hanson Aggregates Midwest, LLC: active limestone quarry (NPDES Permit #2IJ00039*LD and #2IJ00096*DD)
- Centennial Quarry and Terrace: reclaimed quarry now used for recreation/entertainment
- Olander Park System lands: Sylvan Prairie, Fossil Park, Olander Park
- Highland Meadows Golf Course
- Sylvania Pacesetter Park: a large, outdoor recreational area
- Harroun Park and Richards Park, managed by the City of Sylvania
- Lourdes University
- Pre-cast concrete yard, landscape/mulch yard, auto yard
- Former landfill (King Road Landfill)
- Row crop agricultural lands in the upstream portion of the watershed
- Commercial/residential developments in the downstream portion of the watershed

Olander Park. Photo courtesy of TOPS.

Only two National Pollutant Discharge Elimination System (NPDES)-permitted facilities are active in the **Tenmile Creek HUC-12** and are both held by Hanson Aggregates, LLC. Both sites have identified violations during the last three years related to failure to report effluent discharge results, though no exceedances are listed within the Environmental Compliance History Online (ECHO) database (USEPA, 2021).

The U.S. Army Corps of Engineers (USACE) has noted significant nonpoint pollution issues associated with erosion and sedimentation, particularly in the Ottawa River watershed. Actively eroding streambanks contribute to sediment problems, especially in the lower reaches of the Ottawa River where fine-grained sediments more readily adsorb contaminants and diminish flow capacities (USACE, 2009). Sediments deposited in drainage and stream channels must be removed for stream functionality and water quality improvements, and wetlands that filter runoff and trap sediment and associated

nutrients/contaminants need to be conserved and restored where possible. Multiple agencies have recognized the importance of 1) restored hydrology and flow regimes, 2) conservation of wetlands, floodplains, and vegetative buffers, and 3) the importance of sediment reduction programs to decrease flood peaks and sediment transport to Lake Erie.

Vegetation in Sylvan Prairie Park. Photo courtesy of TOPS.

Habitat has been degraded not only by wetland destruction and removal of riparian corridors and vegetative buffers, but invasive species have also gained a foothold within the watershed. Phragmites, common and cutleaf teasel, reed canarygrass and glossy buckthorn are common species that cause the largest issues in riparian zones and floodplains. In upland natural areas, Bradford pear, Canada thistle, and Amur & Japanese honeysuckle pose significant challenges for restoration.

2.1.2 Land Use and Protection

In the **Tenmile Creek HUC-12**, land use characteristics have an impact on stream quality. Table 3 details the land use types found within the **Tenmile Creek HUC-12** and the adjacent upstream watersheds[3]. Row crops comprise approximately 27% of the watershed, mainly in the upstream segments of the watershed, and in the area contained within Michigan. This is consistent with the heavy agricultural land use in the adjacent sub-watersheds immediately upstream (Figure 6). The majority of the Tenmile Creek HUC-12 is developed (53%), mainly in residential housing throughout the city of Sylvania, with some commercial use interspersed. The quarry operation covers a considerable five percent of land within the watershed (Ohio EPA, 2015). Upstream of the **Tenmile Creek HUC-12**, most of the watershed is maintained as a treeless ditch, having some effect on aquatic life and dissolved oxygen (DO) levels within Tenmile Creek (Ohio EPA, 2015).

Table 3: Land Use Classification in the Tenmile Creek HUC-12

Land Use	Tenmile Creek HUC-12 (041000010 03 06)		
	Area (mi^2)	Area (acres)	% Watershed Area
Barren Land	446.53	0.70	4.66%
Cultivated Cropland	2,564.22	4.01	26.76%
Deciduous Forest	705.75	1.10	7.37%
Developed, High Intensity	447.53	0.70	4.67%
Developed, Medium Intensity	2,061.89	3.22	21.52%
Developed, Low Intensity	1,234.36	1.93	12.88%
Developed, Open Space	1,335.30	2.09	13.94%
Emergent Herbaceous Wetlands	11.27	0.02	0.12%
Evergreen Forest	1.78	<0.01	0.02%

[3] Land use data presented here is for the entire watershed, contained in both Ohio and Michigan.

Land Use	Tenmile Creek HUC-12 (041000010 03 06)		
	Area (mi^2)	Area (acres)	% Watershed Area
Hay/Pasture	373.00	0.57	3.89%
Herbaceous	158.80	0.25	1.66%
Mixed Forest	23.62	0.04	0.25%
Open Water	70.17	0.11	0.73%
Shrub/Scrub	10.67	0.02	0.11%
Woody Wetlands	135.90	0.21	1.42%
Total	**9,580.79**	**14.97**	**100.00%**

(Source: Homer et al., 2020)

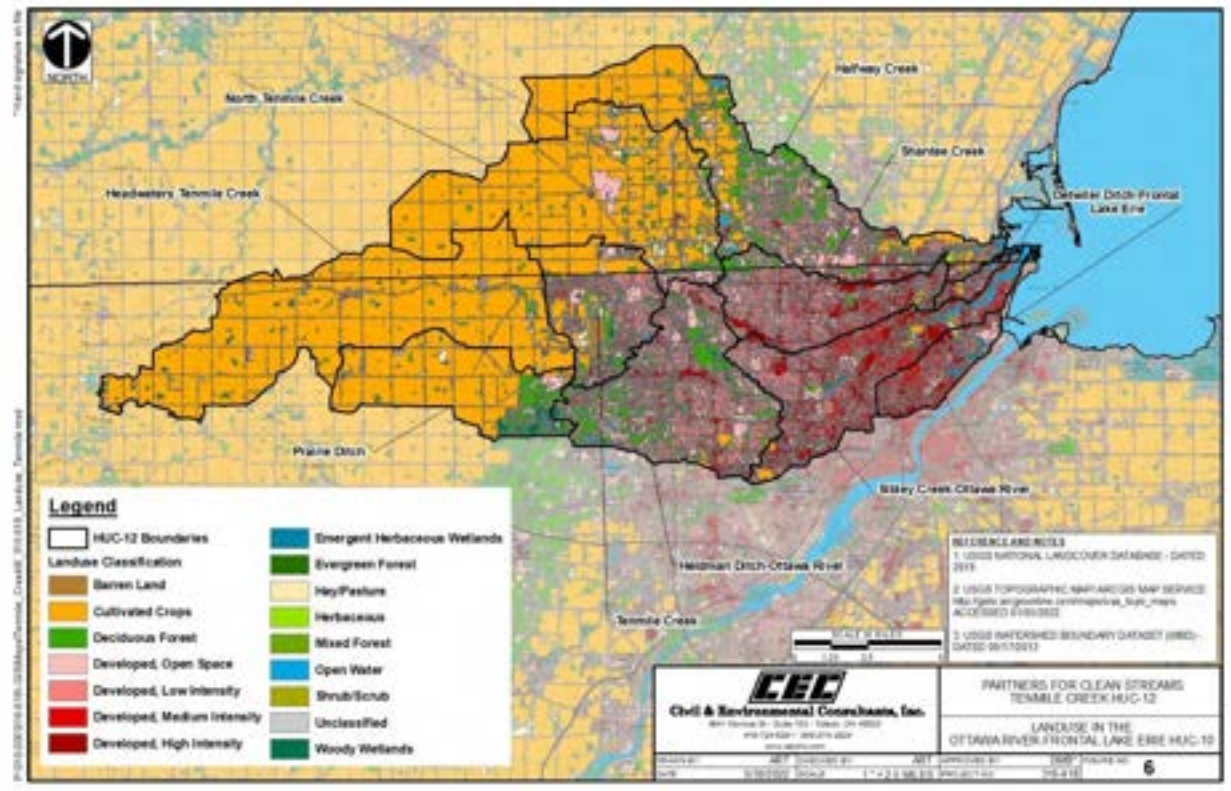

Figure 6: Land Use in the Ottawa River-Frontal Lake Erie HUC-10

Approximately 70% of the Tenmile Creek HUC-12 is located within the NPDES regulated Municipal Separate Storm Sewer System (Figure 7). One Phase I Municipal Separate Storm Sewer System (MS4) permit (City of Toledo) exists throughout this watershed, along with several Phase II municipalities and agencies, including Lucas County, the City of Sylvania, and Sylvania Township. These storm water systems do not connect with water treatment systems; therefore, oil, grease, pesticides, herbicides, dirt and grit are carried directly to waterways and have a high potential to negatively impact water quality (Ohio EPA, 2009). Related to contaminants that are directly discharged to receiving stream systems, the runoff of chlorides from road deicing activities is a growing concern within the Maumee AOC and throughout numerous urban watersheds. Studies have shown the use of deicing salts and brines have

tripled over the last 45 years, and that the salinity of freshwater systems is increasing worldwide (Hintz *et al.*, 2022a; Hintz *et al.,* 2022b). Preliminary studies have shown elevated chlorides in waters across the Maumee AOC, and Ohio EPA and researchers from the University of Toledo are currently looking at the degree of impact to aquatic communities form these activities. At this time, levels found within the **Tenmile Creek HUC-12** are not as alarming as in other sub-watersheds.

Recently, the City of Toledo implemented the Toledo Waterways Initiative, a long-term, 18-year project to reduce combined sewer overflows (CSOs), improve storm sewer systems and reduce water pollution in the Maumee River, Ottawa River and Swan Creek waterways (Toledo Waterways Initiative, 2017). Most of these efforts are concentrated downstream from the **Tenmile Creek HUC-12**.

Figure 7: Toledo Urbanized Area

Two parks and a university protect approximately 386 acres of the **Tenmile Creek HUC-12** (Figure 8). Detailed listings of land holdings for TOPs, the City of Sylvania Parks & Forestry, and Lourdes University can be found in Table 4.

Table 4: Parks and Protected Lands

Name	Acreage	Description
The Olander Park System		
Sylvan Prairie Park	220	Prairie, wetlands, naturalized ditches and riparian areas
Olander Park	60	Oak Openings oak savanna surrounding 30-acre lake
Fossil Park	15	Quarry for public fossil hunting, surrounded by woods
Herr Road Property	5	Wooded floodplain and vernal pool along Tenmile Creek
Southview Oak Savanna	7	Oak Openings oak savanna along University-Parks Trail
City of Sylvania Parks & Forestry		
Harroun Community Park	27	Nature preserve with trails bordering Tenmile Creek
David E. Richards Park	14.5	Passive, naturalistic woodlands along Tenmile Creek
Lourdes University		
Lourdes University	38	Parts of campus are maintained as natural areas including native prairie and oak savanna; borders Tenmile Creek

(Source: TOPS, 2017)

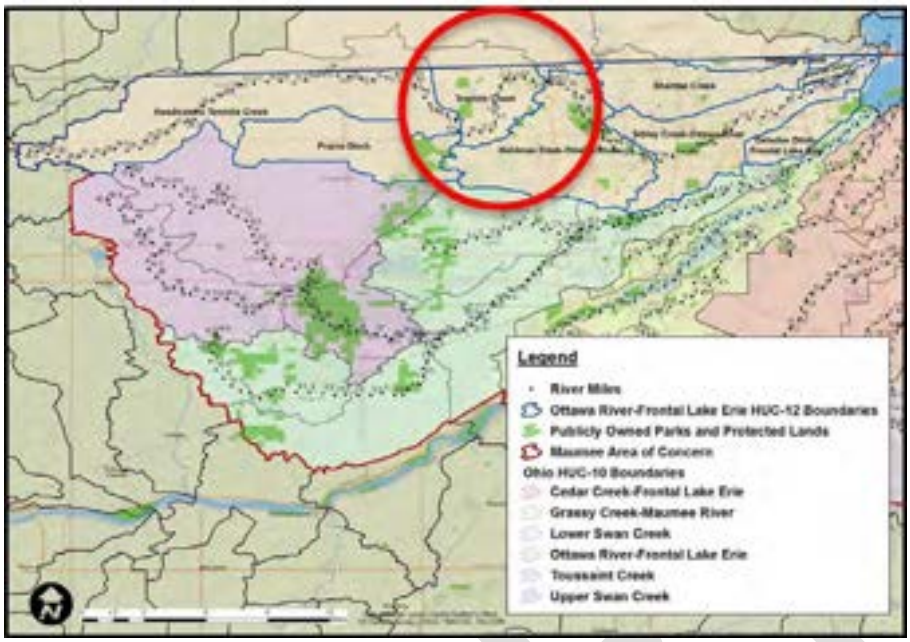

Figure 8: Parks and Protected Lands

2.2 Summary of HUC-12 Biological Trends

Ohio EPA sampled the entire Ottawa River watershed in 2011, with the exception of the lower nine miles of the mainstem Ottawa River, as documented in the *Biological and Water Quality Study of Tenmile Creek and the Ottawa River, 2011, Technical Report EAS/2014-06-06*. This report serves as the Technical Support Document (TSD) for the Ottawa River Total Maximum Daily Loads (TMDL) study, once complete. This document was used extensively in the preparation of the *Tenmile Creek HUC-12 NPS-IS, Version 1.0*, which is the basis for this Version 2.0 update. Habitat and biological communities in the **Tenmile Creek HUC-12** will be sampled again as part of routine state monitoring in the summer of 2026. All segments of this assessment unit were designated and/or confirmed as WWH (Ohio EPA, 2015).

Tenmile Creek in Harroun Park. Photo courtesy of Civil & Environmental Consultants, Inc.

A summary of the sample locations and their biological status in the **Tenmile Creek HUC-12** is provided in Table 5. Throughout the **Tenmile Creek HUC-12**, aquatic communities were dominated by pollution tolerant species adapted to extremes in DO availability, nutrient pulses, water temperature and flow (Ohio EPA, 2015). Sites immediately upstream and downstream of the **Tenmile Creek HUC-12** are included for reference the table. In addition, WQS for the HELP ecoregion are presented in Table 6. Standards for the Maumee AOC are based upon these WQS; although thresholds are set slightly lower, at the nonsignificant departure range for each WQS. The focus of this NPS-IS, and all of those

throughout the Maumee AOC, is the attainment of state WQS, with the benefit of removing BUIs. Figure 9 details sampling points and attainment status within the **Tenmile Creek HUC-12**.

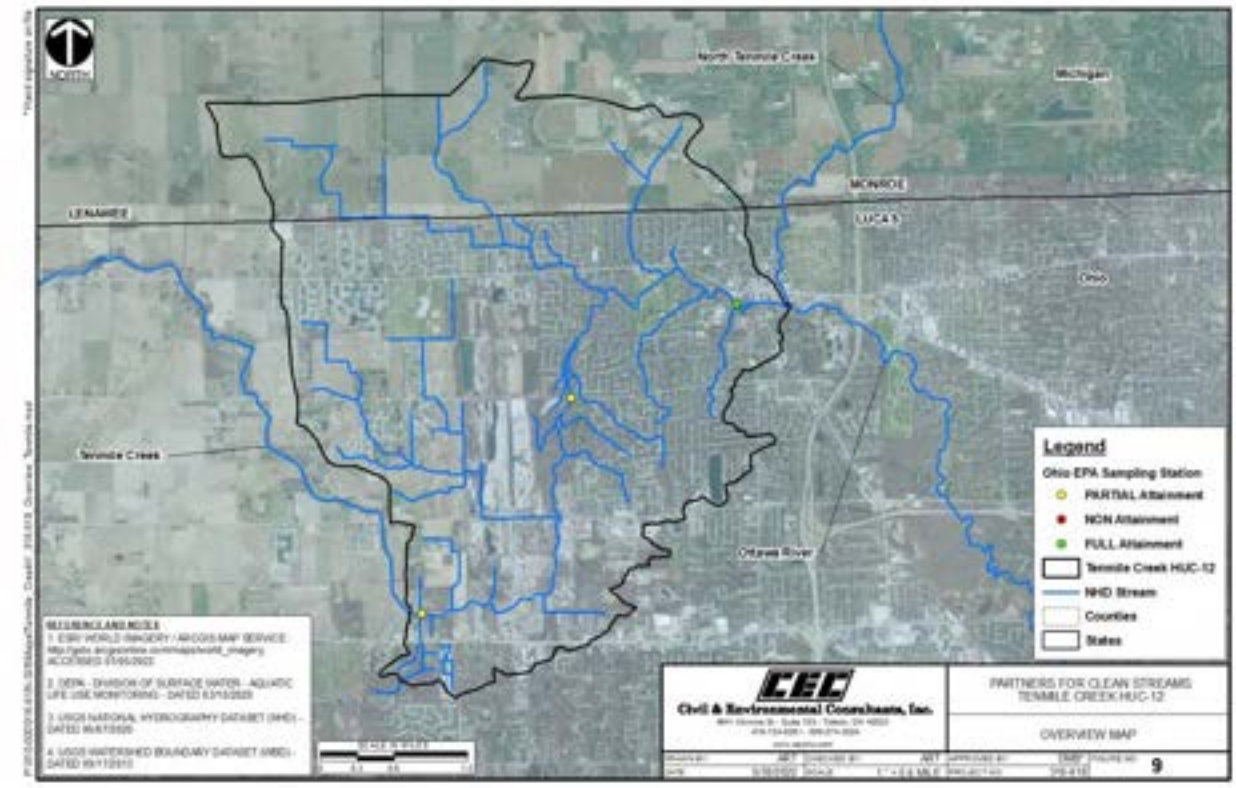

Figure 9: Tenmile Creek HUC-12 Overview

Table 5: Biological Indices Scores for Selected Sites in the Tenmile Creek HUC-12 and Adjacent Sub-watersheds

Tenmile Creek HUC-12 (04100001 03 06)							
River Mile	**Drainage Area (mi^2)**	**IBI**	**MIwb[a]**	**ICI[b]**	**QHEI**	**Attainment Status**	**Location**
Tenmile Creek (WWH)							
5.9^{W}	64.5	34	7.0^{ns}	18*	52.5	Partial	Herr Road
2.9^{W}	70.0	37	6.1*	26*	51.0	Partial	Brint Road[4]
0.5^{W}	81.0	39	7.5	38	77.0	Full	Silica Drive
Tenmile Creek (WWH) in Headwaters Tenmile Creek HUC-12							
9.2^{W}	43.0	31^{ns}	6.7*	G	49.0	Partial	Kilburn Road
Prairie Ditch (MWH) in Prairie Ditch HUC-12							
0.3^{W}	17.3	28	N/A	F	19.0	Full	Central Avenue

4 The *Biological and Water Quality Study of Tenmile Creek and the Ottawa River* lists the Brint Road site as in Non-Attainment of the WWH designation; however, the 2020 Integrated Report lists the site as in Partial Attainment. For the purposes of this NPS-IS, this site is considered in Partial Attainment.

Ottawa River (WWH) in Heldman Ditch-Ottawa River HUC-12							
19.5[W]	124.6	37	6.3*	34	78.0	Partial	Harroun Road

(Source: Ohio EPA, 2015; Ohio EPA, 2020a)

NOTES

IBI *Index of Biotic Integrity*

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

ICI *Invertebrate Community Index*

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

QHEI *Qualitative Habitat Evaluation Index*

W *Wading site*

* *Significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the poor to very poor range.*

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

WWH *Warmwater Habitat*

N/A *Not applicable*

Table 6: Water Quality Standards for the Huron-Erie Lake Plains Ecoregion

HELP Ecoregion	WWH WQS			MWH WQS		
	Headwater	Wading	Boat	Headwater	Wading	Boat
IBI	28	32	34	20	22	20
MIwb	N/A	7.9	8.6	N/A	5.6	5.7
ICI	34	34	34	22	22	22
QHEI[a]	55	60	60	43.5	43.5	43.5

(Source: Ohio EPA, 2015)

NOTES

WWH *Warmwater Habitat*

MWH *Modified Warmwater Habitat*

WQS *Water Quality Standards*

a *QHEI is not criteria included in Ohio WQS; however, it has been shown to be highly correlated with the health of aquatic communities. In general, sites scoring 60 or above (or above 55 for headwater sites) support healthy aquatic assemblages indicative of WWH (Ohio EPA, 2013). Sites scoring 75 or above support Exceptional Warmwater Habitat assemblages (Ohio EPA, 1999).*

N/A *MIwb not applicable to headwaters sampling locations with drainage areas ≤ 20 mi^2.*

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

While IBI scores at all locations reached attainment values, MIwb scores were most affected by lack of diversity of species with narrow niches, as well as low species abundance and biomass. Fish communities in the entire Tenmile Creek watershed were wholly pollution tolerant species, with no intolerant species collected in 2011. Higher quality substrates, such as those found in the downstream Tenmile Creek location at Silica Drive (RM 0.5) were associated with higher abundances of darter species (Ohio EPA, 2015). Despite the presence of boulders and cobble throughout the **Tenmile Creek HUC-12**, generally, the lack of interstitial voids and massive silt covering at sampling locations resulted in degraded substrate quality. Additionally, the absence of other WWH qualities, such as instream cover and a fast current also contributed to degraded habitat. Poor habitats throughout **Tenmile Creek HUC-**

12 and its upstream, adjacent watersheds (*Prairie Ditch HUC-12* and *Headwaters Tenmile Creek HUC-12*), coupled with drainage maintenance issues have further limited fish communities within the watershed (Ohio EPA, 2015).

Macroinvertebrates (Invertebrate Community Index [ICI])

The performance of macroinvertebrate communities declined in Tenmile Creek after the confluence with Prairie Ditch, consistent with limited riffle availability. Half as many *Ephemeroptera, Plecoptera* and *Trichoptera (*EPT) taxa were collected and only two to five sensitive species were present at the downstream sites (Ohio EPA, 2015). Species in this reach were predominantly moderately pollution tolerant midges, and organism density was low. With improved habitat at the most downstream site at Silica Drive (RM 0.5), organism density increased, as well as the abundance of hydropsychid caddisflies and baetid mayflies and sensitive taxa. Despite achievement of a good ICI score (ICI= 38) at the Silica Drive sampling location, the resulting low numbers of EPT taxa suggests limiting effects on the macroinvertebrate communities are still present (Ohio EPA, 2015).

Mussel reconnaissance in Tenmile Creek. Photo courtesy of Civil & Environmental Consultants, Inc.

Habitat (via Qualitative Habitat Evaluation Index [QHEI])

The upper reaches of Tenmile Creek have been maintained as a treeless, headwater ditch. Poor habitat upstream has generally improved with increased drainage area moving downstream (Ohio EPA, 2015). The presence of riparian trees in Lucas County has helped to raise habitat quality to the fair range in the upstream sampling locations of the **Tenmile Creek HUC-12**. In the lower reach of Tenmile Creek, moving into the downstream adjacent *Heldman Ditch-Ottawa River HUC-12*, dolomite bedrock substrate and functional cover was present. The highest habitat score (QHEI= 77) in the entire Tenmile Creek watershed was found at Silica Drive (RM 0.5), which also corresponds to the highest IBI score (IBI= 39) in the mainstem Tenmile Creek (Ohio EPA, 2015).

Ohio EPA sampling crews documented various water quality and habitat attributes during the QHEI assessment in the summer of 2011 (Table 7). Attributes in the adjacent upstream watersheds (e.g., channelized waters, silt/muck substrates, etc.) to the **Tenmile Creek HUC-12** are likely also contributing to the *Partial Attainment* status of sites within the sub-watershed. Generally, streams that have QHEI scores of at least 60 are capable of supporting WWH assemblages. Strong correlations exist between habitat attributes and a stream's ability to support healthy aquatic assemblages (Ohio EPA, 1999). The presence of certain attributes are shown to have a larger negative impact on fish and macroinvertebrate communities. Streams designated as WWH should exhibit no more than four total Modified Warmwater Habitat (MWH) attributes; additionally, no more than one of those four should be of high-influence (Ohio EPA, 2013). Only the most downstream location in Tenmile Creek (RM 0.5) met these criteria.

Table 7: QHEI Matrix with WWH and MWH Attribute Totals for Selected Sites in the Tenmile Creek HUC-12 and Adjacent Sub-watersheds

Tenmile Creek HUC-12 (04100001 03 06)																																		
Key QHEI Components			WWH Attributes											MWH Attributes																					
														High Influence						Moderate Influence															
River Mile	QHEI Score	Gradient (ft/mi)	Not Channelized or Recovered	Boulder/Cobble/Gravel Substrate	Silt Free Substrates	Good/Excellent Development	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Embeddedness	Max Depth >40 cm	Low/No Riffle/Run Embeddedness	WWH Attributes	Channelized/No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth <40 cm	High-Influence MWH Attributes	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrate (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1 or 2 Cover Types	Intermediate/Poor Pools	No Fast Current	High/Moderate Embeddedness	High/Moderate Riffle Embeddedness	No Riffle	Moderate-Influence MWH Attributes
Tenmile Creek (WWH)																																		
5.9[W]	52.5	5.26	•	•			•				•		4				•		1	•	•		•	•				•	•	•		7
2.9[W]	51.0	3.79	•	•							•		3				•		1		•			•	•			•	•		•	6
0.5[W]	77.0	14.3	•	•		•	•	•		•	•	•	8						0									•	•			2
Headwaters Tenmile Creek HUC-12																																		
Tenmile Creek																																		
9.2[W]	49.0	3.62		•							•		2		•	•	•		3		•			•		•		•	•		•	6
Prairie Ditch HUC-12																																		
Prairie Ditch (MWH)																																		
0.3[W]	19.0	2.44									•		1	•	•	•	•		4		•		•	•		•	•	•	•		•	8
Heldman Ditch-Ottawa River HUC-12																																		
Ottawa River (WWH)																																		
19.5[W]	78.0	9.26	•	•		•	•	•			•		6						0						•			•	•	•		4

(Source: Ohio EPA, 2015)

NOTES
W Wading site

2.3 Summary of HUC-12 Pollution Causes and Associated Sources

As listed in the *2020 Integrated Report*, Ohio EPA has determined that the biological impairments in the Tenmile Creek HUC-12 are caused by heavy sedimentation/siltation from channelization and its surrogate source, hydromodification (Table 8). The most upstream Tenmile Creek reach is in *Partial Attainment* and is heavily influenced by the agricultural land use practices prevalent throughout the upstream watersheds. The middle reach in Tenmile Creek is also in *Partial Attainment* and is impacted by not only the upstream attainment stressors, but also disturbance from quarrying operations and other industrial/residential development encroaching upon the segment. The lower reach of Tenmile

Creek in this watershed is mainly residential, protected in various parcels of parkland and is currently reaching *Full Attainment*.

Table 8: Causes and Sources of Impairments for Sampling Locations in the Tenmile Creek HUC-12 and Adjacent Sub-watersheds

Tenmile Creek HUC-12 (04100001 03 06)				
River Mile	**Primary Cause(s)**	**Primary Source(s)**	**Attainment Status**	**Location**
Tenmile Creek (WWH)				
5.9[W]	Sedimentation/siltation	Channelization*	Partial	Herr Road
2.9[W]	Sedimentation/siltation	Channelization*	Partial	Brint Road
0.5[W]	--	--	Full	Silica Drive
Tenmile Creek (WWH) in Headwaters Tenmile Creek HUC-12				
9.2[W]	Sedimentation/siltation	Channelization*	Partial	Kilburn Road
Prairie Ditch in Prairie Ditch HUC-12				
0.3[W]	--	--	Full	Central Avenue
Tenmile Creek in Heldman Ditch-Ottawa River HUC-12				
19.5[W]	Sedimentation/siltation	Urban runoff/storm sewers	Partial	Harroun Road

(Source: Ohio EPA, 2015)

NOTES
W Wading site
** Addressing hydro-modification (a surrogate source w/ channelization) in both non-irrigated cropland and urban landscapes can also improve water quality.*

Loss of sediments from the surrounding landscape may also imply loss of nutrients, as a fraction of these nutrients introduced to the landscape through fertilization techniques and other sources bind to soil particles. As soil particles are lost to local waterways, additional nutrients can become available for microorganism uptake, and in situations where nutrients concentrate and are overabundant, eutrophication occurs and drives HAB formation. This can occur both in-stream as well as in far-field, receiving waterbodies, such as Lake Erie. Ohio EPA has estimated spring phosphorus loadings from individual sub-watersheds throughout the greater WLEB watershed. These estimates also include a breakdown of estimated loads from contributing sources of NPS pollutants, such as agricultural lands/activities, developed/urban lands, failing hoe sewage treatment systems (HSTS) and natural sources (Table 9). Efforts to reduce nutrients from each of these contributing sources will focus on reaching the 40% reduction goal outlined by Annex 4 of the GLWQA and the Ohio DAP.

Table 9: Estimated Spring Total Phosphorus Loadings from Contributing NPS Sources in the Tenmile Creek HUC-12*

	Agricultural Load (lbs)	Developed/Urban Load (lbs)	Natural Load (lbs)	HSTS Load (lbs)	NPS Total (lbs)
Current Estimates**	1,000	1,500	<100	100	2,700
Target Loadings	600	900	<60	60	1,600

(Source: OLEC, 2020)

NOTES

** Amounts include loadings from the Ohio portion only*

*** Estimated using two significant figures*

2.4 Additional Information for Determining Critical Areas and Developing Implementation Strategies

Several organizations and agencies focus on improving habitat and water quality within the **Tenmile Creek HUC-12.** Documents and/or plans created by these organizations were used as supplemental information to prepare this NPS-IS plan and are referenced in the Works Cited section, as appropriate. Assessment data from the 2011 TMDL sampling event and data referenced in the *2020 Integrated Water Report* were used in the creation of this NPS-IS (Ohio EPA, 2015; Ohio EPA, 2020a).

CHAPTER 3: CRITICAL AREA CONDITIONS & RESTORATION STRATEGIES

3.1 Overview of Critical Areas

In total, three sampling sites are located in the **Tenmile Creek HUC-12**. One sampling location within Tenmile Creek is in *Full Attainment* of the WWH designation, while two sampling sites are in *Partial Attainment* of the WWH designation due to excessive sedimentation/siltation from channelization and hydromodification. The *Tenmile Creek HUC-12 NPS-IS, Version 1.0* delineated two critical areas for the **Tenmile Creek HUC-12**, both related to a geographical critical area for addressing impairment at the near-field level. With this update, the critical areas have been updated to consider critical resource needs to address both near-field and far-field impairment within the **Tenmile Creek HUC-12**.

Three critical areas have been identified within the **Tenmile Creek HUC-12** (Figure 10[5]). Two critical areas will address far-field impacts of nutrients and sediments flowing to Lake Erie from the Tenmile Creek/Ottawa River complex from land use practices, while a third critical area will address habitat alterations and channelization effects that may exacerbate in-stream conditions that impact near-field impairment (yet still benefit far-field communities) (Table 10).

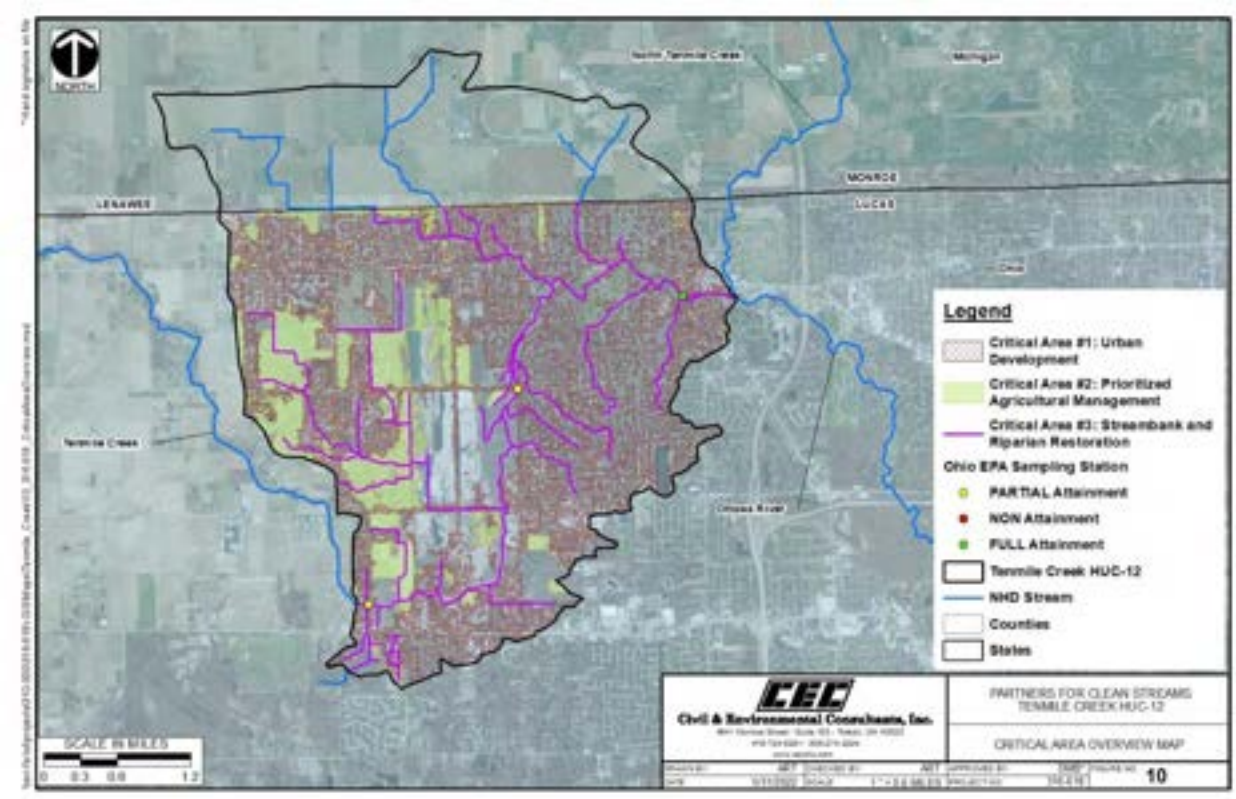

Figure 10: Tenmile Creek HUC-12 Critical Area Overview

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

Table 10: Tenmile Creek HUC-12 Critical Area Descriptions

Critical Area Number	Critical Area Description	NPS Pollutant Addressed
1	Urban Nutrient Reduction	Far-field (with near-field effects)
2	Prioritized Agricultural Management	Far-field (with near-field effects)
3	Streambank Stabilization and Riparian Restoration	Near-field (with far-field effects)

3.2 Critical Area #1: Conditions, Goals & Objectives for Nutrient Reduction from Urban Lands

3.2.1 Detailed Characterization

In urban environments, NPS contributions to stormwater runoff can come from a variety of sources, including fertilizers, detergents, leaves and detritus, wild and domesticated animal excrement, lubricants, sediment erosion, and organic and inorganic decomposition processes (Carpenter *et. al*, 1998; Burton and Pitt, 2001). Urbanization and development often leads to increased pollutant availability, runoff, peak flows, stream "flashiness" and stream instability, along with decreased stream function, storage and retention capabilities and pollutant assimilation in soils (ODNR, 2006). Many of these effects have a direct impact on aquatic life. Degradation to stream ecosystems has been shown even in areas of low amounts of urbanization (5-10% imperviousness) (Schueler, 1994).

Critical Area #2 contains the concentration of developed land in the city of Sylvania and the surrounding Sylvania township (Figure 11). This urbanized area contains 4,563 acres of residential, commercial and light industrial land use. Approximately 2,320 acres lie within the City of Sylvania proper within the **Tenmile Creek HUC-12**, while the remainder lies within Sylvania Township. The City of Sylvania operates under a Phase II MS4 permit, while Sylvania Township operates under a combined Phase II MS4 permit with Lucas County and several other townships. Population growth in Sylvania has remained steady over the last decade, with a 1.2% increase seen between the 2010 and 2020 censuses. Sylvania Township is the eighth most populous township in the state of Ohio (US Census Bureau, 2010).

Parking lot runoff discharging to Tenmile Creek. Photo courtesy of Civil & Environmental Consultants, Inc.

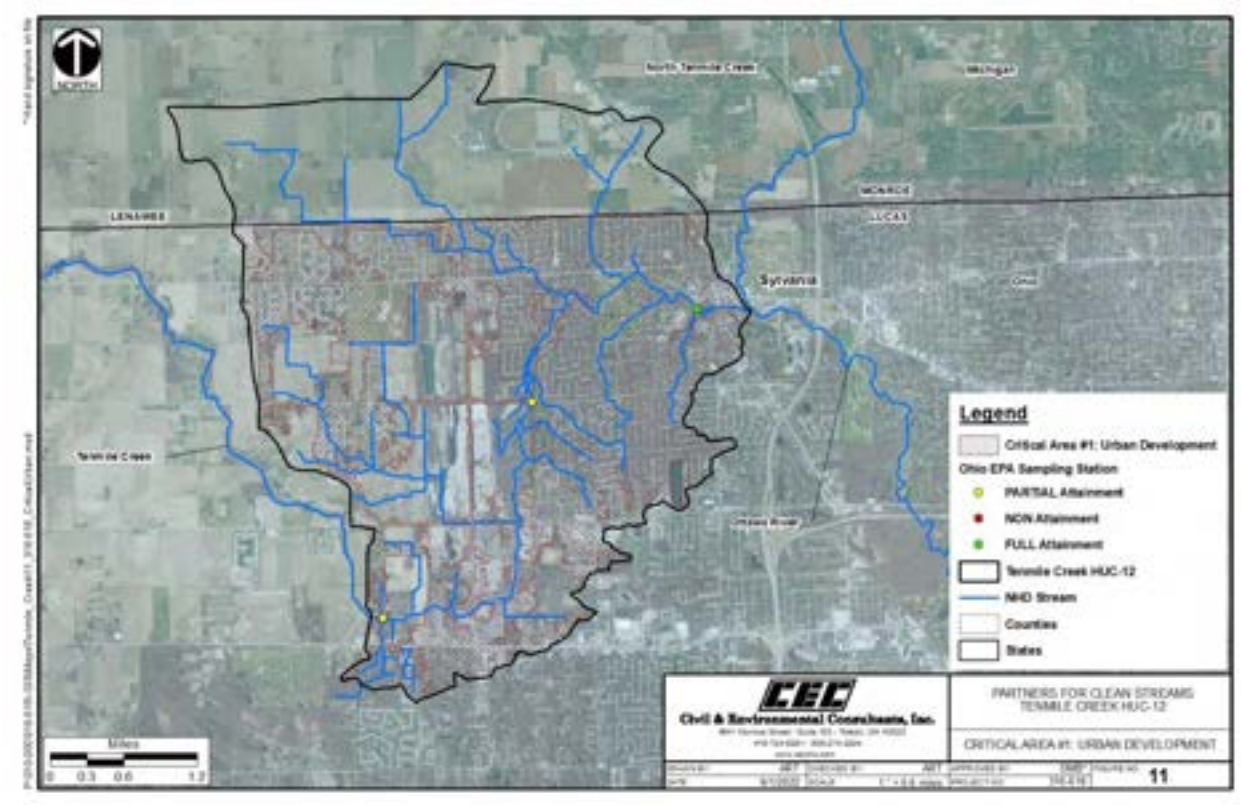

Figure 11: Tenmile Creek HUC-12 Critical Area #1

3.2.2 Detailed Biological Conditions

Fish community data for this sampling location within the **Tenmile Creek HUC-12** is summarized below (Table 11). Analysis of the abundance, diversity and pollution tolerance of existing fish species found by Ohio EPA at each sampling location, in relation to the corresponding QHEI score, aids in the identification of causes and sources of impairment. The sampling locations at RM 5.9 and RM 2.9 are mainly found in the agricultural portion of the sub-watershed and are included in *Critical Area #2*; however, urban development is encroaching upon almost the entirety of the sub-watershed within the Ohio borders. Habitat at RM 0.5 is the highest within the most urbanized stretch of Tenmile Creek at RM 0.5; however, much of the stream through this section has a wider riparian footprint, despite channelization through some sections. Fish communities still exhibit a high percentage of pollution tolerant species.

Table 11: Critical Area #1 - Fish Community and Habitat Data

Tenmile Creek HUC-12 (04100001 03 06)							
River Mile	**Drainage Area (mi^2)**	**Total Species**	**QHEI**	**IBI**	**MIwb[a]**	**Predominant Species (Percent of Catch)**	**Narrative Evaluation**
Tenmile Creek (WWH)							
0.5^{W}	81.0	16	77.0	39	7.5	Creek chub (21%), orangethroat darter (19%), central stoneroller (15%)	Good – Marginally Good

(Source: Ohio EPA, 2015)

NOTES
IBI Index of Biotic Integrity
a The Modified Index of Well Being (MIwb) is not applicable to headwater sites (drainage ≤20 mi^2).
QHEI Qualitative Habitat Evaluation Index
W Wading site
WWH Warmwater Habitat

Characteristics of the aquatic macroinvertebrate community for the **Tenmile Creek HUC-12** are summarized below (Table 12). Analysis of the abundance, diversity, and pollution tolerance of existing aquatic macroinvertebrates found by Ohio EPA at this sampling location, related to QHEI score, can aid in the identification of causes and sources of impairment. Macroinvertebrate communities performed well in the lower reach of Tenmile Creek; however, substrate embeddedness is still a notable issue. A low number of sensitive and EPT taxa were present at RM 0.5, and communities were dominated by facultative species.

Table 12: Critical Area #1 – Macroinvertebrate Community Data

Tenmile Creek HUC-12 (04100001 03 06)			
River Mile	**ICI Score-Narrative[a]**	**Notes (Density of Ql./Qt.)**	**Predominant Species**
Tenmile Creek (WWH)			
0.5[W]	38 – Good 6 sensitive taxa	Low-moderate qualitative density	Hydropsychid caddisflies (F), baetid mayflies (F), flatworms (F)

(Source: Ohio EPA, 2015)

NOTES
a Narrative evaluation used in lieu of ICI
W Wading site
WWH Warmwater Habitat

3.2.3 Detailed Causes and Associated Sources

Tenmile Creek is in *Full Attainment* of the WWH designation at RM 0.5. The data summarized previously in Table 7 (p.18) may reveal a direct link between the presence of attributes in the watershed that have influence on the aquatic communities throughout the **Tenmile Creek HUC-12** in *Critical Area #1*. These contributing attributes in *Critical Area #1* include:

- High Embeddedness; and
- Lack of Fast Current.

Many of the negative habitat attributes found during the QHEI sampling event result from land use activities, including impacts from urban development within the watershed. From a far-field perspective, urban land use activities contribute to excessive nutrient loadings to the Ohio River, eventually reaching the Mississippi and then the Gulf of Mexico, contributing to its extensive hypoxic zone. Reductions in nutrients in urban areas and management of stormwater inputs can help decrease overall NPS pollution and improve aquatic communities. Reductions in nutrients in urban areas through the use of green

infrastructure for the retention, detention and filtration of urban pollutants can also help decrease overall NPS pollution and improve aquatic communities. Compared with natural land cover, shallow and deep infiltration and evapotranspiration decreases while surface runoff increases in urban lands (USEPA, 2003). When watersheds have as little as 10% impervious surface, studies have shown that not only does runoff increase substantially, but pollutant loads also increase (CWP, 1998).

3.2.4 Outline Goals and Objectives for the Critical Area

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

Goal 1. Reduce phosphorus loading contributions in the **Tenmile Creek HUC-12** to a level at or below 900 lbs/year (40% reduction).
NOT ACHIEVED: Current estimated load contribution is 1,500 lbs/year.

Simultaneous goals relate to the attainment or maintenance of WQS for aquatic communities within Tenmile Creek. Implementation of best management practice (BMP) objectives geared towards nutrient reduction efforts will generally also help make incremental progress towards the following goals:

Goal 2. Maintain IBI score at or above 32 at Silica Drive in Tenmile Creek (RM 0.5).
✓ ACHIEVED: Site currently has a score of 37.

Goal 3. Maintain MIwb score at or above 7.3 at Silica Drive in Tenmile Creek (RM 0.5).
✓ ACHIEVED: Site currently has a score of 7.5.

Goal 4. Maintain ICI score at or above 34 at Silica Drive in Tenmile Creek (RM 0.5).
✓ ACHIEVED: Site currently has a score of 38.

Goal 5. Maintain QHEI score at or above 60 at Silica Drive in Tenmile Creek (RM 0.5).
✓ ACHIEVED: Site currently has a score of 77.

Objectives

In order to make substantive progress toward the achievement of the urban phosphorus load reduction goal of 600 lbs for the **Tenmile Creek HUC-12**, efforts must commence on more widespread implementation, according to the following objectives within *Critical Area #1.* Additionally, actions taken to address nutrient reduction will also help reduce stressors on aquatic communities within Tenmile Creek to maintain WQS.

Objective 1: Reduce stormwater inputs and impacts in the sub-watershed by implementing green infrastructure projects within *Critical Area #1* to retain, detain, and/or treat runoff from at least 1,000 acres of urbanized impermeable surfaces (i.e., parking lots, roads, etc.).

Objective 2: Reduce stormwater inputs and impacts in the sub-watershed by restoring and/or creating floodplain/riparian areas and wetland detention/storage basins to retain, detain and/or treat urban drainage from at least 500 acres.

Depending on the specific green infrastructure approach chosen, reduction efficiencies for these objectives may not reach the intended nutrient reduction goals for urban lands in this sub-watershed. Stakeholders in this watershed acknowledge that additional and/or altered objectives may be needed in future versions of this NPS-IS but underscore the exigence in beginning to implement projects that incrementally make progress towards achieving the aforementioned objectives as soon as possible. The objectives, as written, are reflective of what stakeholders gage as reasonable and implementable in the **Tenmile Creek HUC-12** incrementally, over time.

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

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

3.3 Critical Area #2: Conditions, Goals & Objectives for Prioritized Agricultural Management

3.3.1 Detailed Characterization

Agricultural lands in the Tenmile Creek HUC-12. Photo courtesy of TOPS.

Ohio's *Nutrient Mass Balance Study* (Ohio EPA, 2020c) estimated 90% of the nutrient loadings to Lake Erie via the Maumee River were primarily from nonpoint sources, related to land use activities, with only small contributions from failing HSTS and NPDES-permitted facilities. This estimate is consistent with several other studies. While the Tenmile Creek/Ottawa River complex is not within the Maumee basin, its proximity to and similarities in land use likely yield similar results. The use of BMPs are recommended for agricultural operations to minimize nutrient and associated sediment loss to local waterways and drainage ditches through surface and tile flow. While BMPs are encouraged on all agricultural lands, certain lands are more prone to nutrient loss than others and are prioritized for BMP implementation. Lands maintained under conventional agricultural production or managed as pasture are prone to contribute excessive sediment and nutrient loadings to adjacent waterways that eventually flow to Lake Erie. Lands that are proximal to streams and ditches or do not currently implement specific BMPs are most vulnerable to excessive nutrient and sediment loss, and these lands are also prioritized as critical within this watershed. *Critical Area #2* contains prioritized agricultural lands throughout the **Tenmile Creek HUC-12** (Figure 12). It is important to note that nutrient reduction activities enacted in upstream, adjacent sub-watersheds (*Headwaters Tenmile Creek HUC-12* and *Prairie Ditch HUC-12*) will also positively impact the aquatic communities at RM 5.9, as its drainage area is mainly contained upstream of the **Tenmile Creek HUC-12**.

Of the 1,135 agricultural acres in the **Tenmile Creek HUC-12** (contained within the Ohio portion), prioritized lands are operations that meet one or more of the following criteria:

- Lands directly adjacent to streams or drainage waterways;
- Lands in need of surface water management structures;
- Lands with uncontrolled or unfiltered subsurface drainage water;
- Lands without a current (<3 years) nutrient management plan or soil test; or,
- Lands with high soil phosphorus levels (>40 ppm Mehlich).

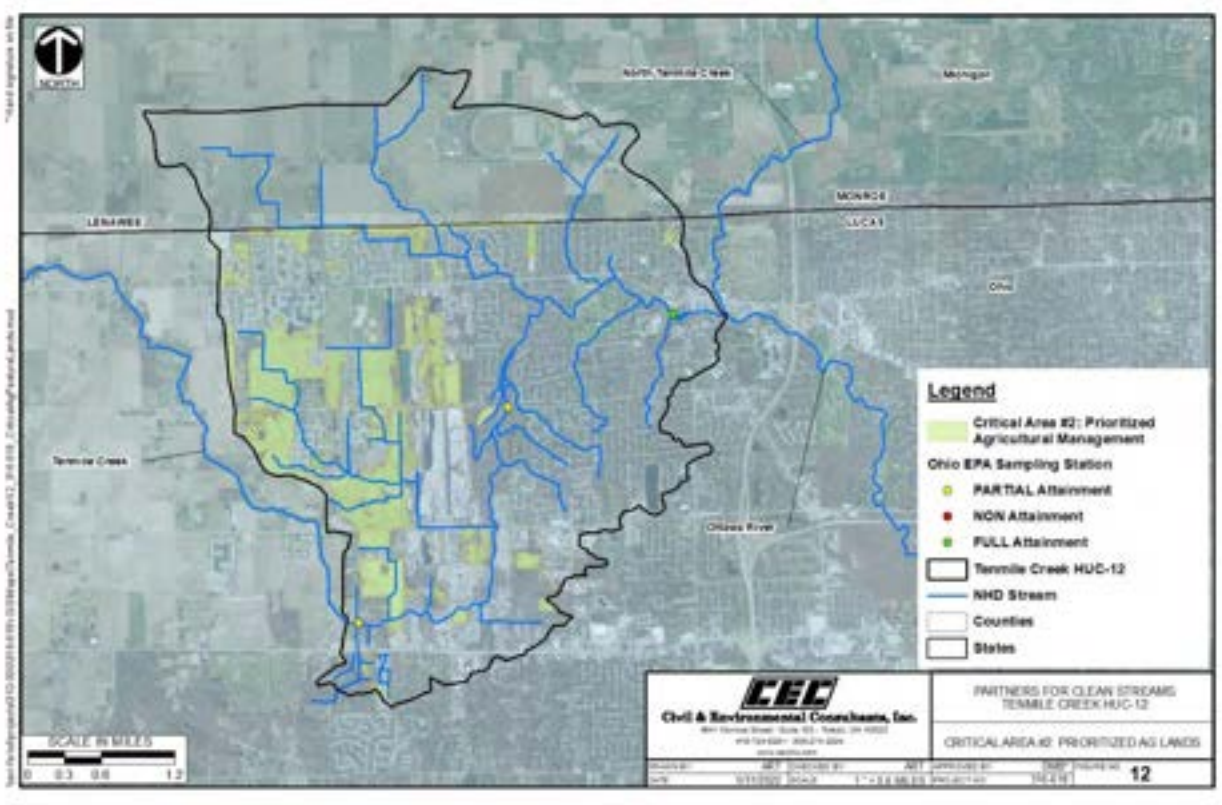

Figure 12: Tenmile Creek HUC-12 Critical Area #2

3.3.2 Detailed Biological Conditions

Fish community data for sampling locations within the **Tenmile Creek HUC-12** is summarized below (Table 13). Analysis of the abundance, diversity and pollution tolerance of existing fish species found by Ohio EPA at each sampling location, in relation to the corresponding QHEI score, aids in the identification of causes and sources of impairment. Habitat at these two sampling locations is impacted by heavy silt cover as well as little to no riparian corridor, contributing to higher stream temperatures and fluctuations in the DO regime (Ohio EPA, 2015). Fish communities are dominated by mainly pollution-tolerant species.

Table 13: Critical Area #2 - Fish Community and Habitat Data

Tenmile Creek HUC-12 (04100001 03 06)							
River Mile	**Drainage Area (mi^2)**	**Total Species**	**QHEI**	**IBI**	**MIwb[a]**	**Predominant Species (Percent of Catch)**	**Narrative Evaluation**
Tenmile Creek (WWH)							
5.9^{W}	64.5	21	52.5	34	7.0^{ns}	Green sunfish (22%), bluntnose minnow (18%), bluegill sunfish (14%)	Marginally Good
2.9^{W}	70.0	15	51.0	37	6.1*	Green sunfish (38%), striped shiner (20%), redfin pickerel (10%)	Marginally Good - Fair

(Source: Ohio EPA, 2015)

NOTES

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

Characteristics of the aquatic macroinvertebrate communities for the **Tenmile Creek HUC-12** are summarized below (Table 14). Analysis of the abundance, diversity, and pollution tolerance of existing aquatic macroinvertebrates found by Ohio EPA at these sampling locations, related to QHEI scores, can aid in the identification of causes and sources of impairment. Macroinvertebrate communities performed in the fair to good range over the course of Tenmile Creek. Few sensitive taxa were present within the **Tenmile Creek HUC-12**. Counts of EPT taxa were also low, with 8-9 taxa found at each site. Facultative species dominated communities at all Tenmile Creek locations sampled in the sub-watershed in 2011.

Table 14: Critical Area #2 – Macroinvertebrate Community Data

Tenmile Creek HUC-12 (04100001 03 06)			
River Mile	**ICI Score-Narrative[a]**	**Notes (Density of Ql./Qt.)**	**Predominant Species**
Tenmile Creek (WWH)			
5.9[W]	18* — Fair 2 sensitive taxa	Low qualitative density	Midges (F, MT), hydropsychid caddisflies (F)
2.9[W]	26*— Fair 5 sensitive taxa	Low qualitative density	Midges (F), water mites (F), crayfish (F)

(Source: Ohio EPA, 2015)

NOTES
a *Narrative evaluation used in lieu of ICI*
W *Wading site*
WWH *Warmwater Habitat*
* *Significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units).*

3.3.3 Detailed Causes and Associated Sources

Tenmile Creek is in *Partial Attainment* of the WWH designation at RM 5.9 and RM 2.9. The data summarized previously in Table 7 (p.18) may reveal a direct link between the presence of attributes in the watershed that have influence on the aquatic communities throughout the **Tenmile Creek HUC-12** in *Critical Area #2*. These contributing attributes in *Critical Area #2* include:

- Heavy/Moderate Silt Cover;
- Sparse/No Cover;
- Fair/Poor Development;
- High Embeddedness; and
- Lack of Fast Current.

Many of these habitat attributes are also present in adjacent, upstream sub-watersheds. Efforts to reduce nutrient and sediment loss in these areas will also directly benefit the aquatic communities at RM 5.9, due to its proximity to the *Headwaters Tenmile Creek HUC-12* and the *Prairie Ditch HUC-12*. Goals and objectives for these sub-watersheds are addressed in each sub-watershed's respective NPS-IS.

From a far-field perspective, agricultural land use activities contribute to excessive nutrient loadings to Lake Erie that result in eutrophication and the formation of HABs. The use of a variety of BMPs on private agricultural lands, at both in-field and edge-of-field locations can help reduce the amount and concentration of nutrient-laden surface runoff and tile drainage. Many BMPs can not only address reduction of nutrients in surface and drainage water, but they can also simultaneously address the loss of sediment from agricultural lands, which contributes to sediment-covered substrates in local waterways. In addition, a reduction of sediment loss to local waterways can also reduce nutrient loss to near-field and far-field waterbodies, as nutrients will also adsorb to sediment particles, potentially becoming dissolved at a later time. The implementation of BMPs on agricultural lands that are prone to sediment and nutrient loss serves as a benefit for both near-field and far-field waterbodies.

3.3.4 Outline Goals and Objectives for the Critical Area

The overarching goal of any NPS-IS is to improve water quality scores or meet nutrient reduction goals in order to remove a waterbody's impairment status. Agricultural land use activities in *Critical Area #2* contribute to near-field impairment and stressed aquatic communities in Tenmile Creek, and these activities contribute to far-field impairment through excessive nutrient loss (phosphorus) to local waterways that flow to Lake Erie. Through the GLWQA Annex 4 and the subsequent DAP for the State of Ohio, nutrient target loads have been set for the Maumee River, and other associated waterways. These phosphorus target loads have been set at levels that are 40% lower than the current estimated loadings. Ohio's *Nutrient Mass Balance Study* has also shown that a large portion of the nutrient load to Lake Erie occurs during springtime rains (Ohio EPA, 2020a; Ohio EPA, 2020c).

Many objectives within the **Tenmile Creek HUC-12** align with the priorities of the H2Ohio Initiative, a water quality initiative with a focus on phosphorus reduction. This program provides economic incentives to producers who develop nutrient management plans for their fields and implement effective and cost-efficient BMPs that include: soil testing, variable rate fertilization, subsurface nutrient application, manure incorporation, conservation crop rotation, cover crops, drainage water management structures, two-stage ditch construction, edge of field buffers and headwaters and coastal wetlands that reduce agricultural runoff (H2Ohio, 2019). The Lucas SWCD has enrolled over 14,850 acres throughout the county in the H2Ohio program[6] (*personal communication with Joey Warner, Lucas SWCD District Administrator; June 3, 2022)*. Additional practices throughout the western part of the county include those enrolled in the Lake Erie Conservation Reserve Enhancement Program (CREP) and Conservation Reserve Program (CRP), administered by the Farm Service Agency (FSA), and the

[6] Tracked/reported at the county level.

Environmental Quality Incentives Program (EQIP), administered by the United States Department of Agriculture (USDA)-Natural Resources Conservation Service (NRCS) (Table 15).

Table 15: Federal Program Practices in Lucas County

Program Name	Practice	Total Acres*
Lake Erie CREP	Filter Strips	138.80
	Field Windbreak	
	Rare and Declining Habitat	
CRP	Permanent Native Grasses	92.48
	Hardwood Trees	
	Wildlife Habitat	
	Field Windbreak	
	Filter Strips	
	Wetland Restoration	
	Trees	
	Grasses	
	Pollinator Habitat	
EQIP	Cover crops, pasture systems and forest management plan	N/A

(Source: personal communication with Joey Warner; Lucas SWCD District Administrator; June 8 and 9, 2022)

NOTES
**Acres reported at the county level and may not necessarily fall within the Tenmile Creek HUC-12 boundaries.*
N/A Data not available.

Goals

Ohio EPA has modeled nutrient loadings associated with various land uses and sources within each HUC-12 in the Maumee River Basin, and has set phosphorus reduction goals for each associated source, based upon springtime load estimates. To achieve the desired phosphorus reduction from agricultural land use in the **Tenmile Creek HUC-12**, the following goal has been established:

Goal 1. Reduce phosphorus loading contributions in the **Tenmile Creek HUC-12** to a level at or below 600 lbs/year (40% reduction).
NOT ACHIEVED: Current estimated load contribution is 1,000 lbs/year.

Simultaneous goals relate to the attainment of WQS for aquatic communities within Tenmile Creek. Implementation of BMP objectives geared towards nutrient reduction efforts will generally also help make incremental progress towards the following goals:

Goal 2. Maintain IBI score at or above 32 at Herr Road in Tenmile Creek (RM 5.9).
✓ ACHIEVED: Site currently has a score of 34.

Goal 3. Achieve MIwb score at or above 7.3 at Herr Road in Tenmile Creek (RM 5.9).
NOT ACHIEVED: Site currently has a score of 7.0.

Goal 4. Achieve ICI score at or above 34 at Herr Road in Tenmile Creek (RM 5.9).
NOT ACHIEVED: Site currently has a score of 18.

Goal 5. Achieve QHEI score at or above 60 at Herr Road in Tenmile Creek (RM 5.9).
NOT ACHIEVED: Site currently has a score of 52.5.

Goal 6. Maintain IBI score at or above 32 at Brint Road in Tenmile Creek (RM 2.9).
✓ ACHIEVED: Site currently has a score of 39.

Goal 7. Achieve MIwb score at or above 7.3 at Brint Road in Tenmile Creek (RM 2.9).
NOT ACHIEVED: Site currently has a score of 6.1.

Goal 8. Achieve ICI score at or above 34 at Brint Road in Tenmile Creek (RM 2.9).
NOT ACHIEVED: Site currently has a score of 26.

Goal 9. Achieve QHEI score at or above 60 at Brint Road in Tenmile Creek (RM 2.9).
NOT ACHIEVED: Site currently has a score of 51.

Objectives

In order to make substantive progress toward the achievement of the annual nutrient load reduction goal of 400 lbs of total phosphorus for the **Tenmile Creek HUC-12**, efforts must commence on more widespread implementation, according to the following objectives within *Critical Area #2.* Additionally, actions taken to address nutrient reduction will also help reduce stressors on aquatic communities within Tenmile Creek and its tributaries.

Objective 1: Implement nutrient management (planning and implementation through soil testing and Variable Rate Technology (VRT)) on at least at least 400 acres.

Objective 2: Plant cover crops on at least 200 acres annually[7].

Objective 3: Implement conservation tillage (of at least 30% residue) on at least 200 additional acres.

Objective 4: Reduce erosion and nutrient loss through the installation of filter strips/buffers (of at least a 35 ft setback) that receive/treat surface water from at least 300 acres.

Objective 5: Reduce nutrient loss from subsurface tile drainage through the installation of drainage water management structures that drain at least 100 acres.

Objective 6: Create, enhance and/or restore at least 10 acres of wetlands and/or water retention basins for treatment of agricultural runoff and/or nutrient reduction purposes from 250 total agricultural acres.

Objective 7: Increase the retirement of marginal and highly vulnerable lands by enrolling at least 10 acres into programs such as the CRP, Lake Erie CREP or the Wetlands Reserve Program (WRP).

[7] Cover crops may be planted in the absence of grant funding.

Objective 8: Stabilize at least 4,200 linear feet (0.8 miles) of agricultural drainage waterways from further bank erosion through a two-stage ditch, natural channel design approach and/or bio-engineering techniques.

These objectives will be directed towards implementation on prioritized agricultural lands and are estimated to make progress towards the HTF's interim and final nutrient reduction goals (Table 16). Additional conservation activities within the **Tenmile Creek HUC-12**, both on priority and secondary lands, may also make incremental progress towards nutrient reduction goals. The implementation of BMPs included in these objectives, as well as BMPs implemented through federal and state programs and other voluntary efforts may be tracked to monitor progress towards nutrient reduction goals within the watershed.

Table 16: Estimated Annual Nutrient Load Reductions from Each Objective

Objective Number	Best Management Practice	Total Acreage Treated*	Estimated Annual Phosphorus Load Reduction (lbs)	Estimated Spring Phosphorus Load Reduction (lbs)
1	Nutrient Management (Planning and Implementation through Soil Testing and VRT)[a]	400	80	50
2	Cover Crops	200	20	10
3	Conservation Tillage (30-59% residue)	200	60	40
4	Filter Strips/Buffers (of at least 35 ft)[b]	300	110	70
5	Drainage Water Management Structures	100	20	10
6	Wetlands[c] and/or Water Retention Basins	250[d]	130	90
7	Land Retirement	10	120	80
8	Streambank Stabilization	250[e]	120	80
TOTAL		**1,710**	**660**	**430**

(Source Model: Spreadsheet Tool for Estimating Pollutant Loads (STEPL), Version 4.4b, (USEPA, 2020))

NOTES

a Nutrient Management consists of "managing the amount (rate), source, placement (method of application) and timing of plant nutrients and soil amendments to budget, supply and conserve nutrients for plant production; to minimize agricultural nonpoint source pollution of surface and groundwater resources; to properly utilize manure or organic byproducts as a plant nutrient source; to protect air quality by reducing odors, nitrogen emissions (ammonia, oxides of nitrogen) and the formation of atmospheric particulates; and/or to maintain or improve the physical, chemical and biological condition of soil," as defined by the STEPL guidance documents (Tetra Tech, 2018).

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

c Phosphorus load reduction for wetlands was calculated using estimates of 1.05 lbs/acres phosphorus for the Maumee watershed (Heidelberg, 2017).

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

e *One linear foot of stream is estimated to treat 0.04 acres.*

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

The stakeholders of the **Tenmile Creek HUC-12** recognize a gap between the total estimated phosphorus reduction realized from these objectives and the stated phosphorus reduction goals. Stakeholders in this watershed acknowledge that additional and/or altered objectives may be needed in future versions of this NPS-IS, but underscore the exigence in beginning to implement projects that incrementally make progress towards achieving the aforementioned objectives as soon as possible. The objectives, as written, are reflective of what stakeholders gage as reasonable and implementable in the **Tenmile Creek HUC-12** incrementally, over time.

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

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

3.4 Critical Area #3: Conditions, Goals & Objectives for Streambank and Riparian Restoration

3.4.1 Detailed Characterization

Riparian restoration and streambank stabilization is needed throughout the **Tenmile Creek HUC-12**. The 2015 *Biological and Water Quality Study of Tenmile Creek and the Ottawa River* noted very little riparian shading along Tenmile Creek, especially in the reaches upstream of the City of Sylvania (Ohio EPA, 2015). Even in areas with a wider riparian corridor, erosive forces from flashy waters and channelized segments have caused substantial undercutting of streambanks throughout the sub-watershed. *Critical Area #3* contains priority streambanks within the 31 miles of stream length and associated riparian corridors throughout the **Tenmile Creek HUC-12** (Figure 13). It is estimated that at least 20% (~6.0 miles) of streambanks within Tenmile Creek are undercut/vertical and 9.5 miles have denuded riparian corridors.

Vertical banks in Tenmile Creek. Photo courtesy of Civil & Environmental Consultants, Inc.

Using the rationale described in the *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (USEPA, 2008) (Section 10.3.4): "In general, management practices are implemented immediately adjacent to the waterbody or upland to address the sources of pollutant loads", *Critical Area #3* includes approximately 81,840 linear feet (15.5 miles) of stream length and a 75-foot buffer width on each side. The potential for restoration of approximately 280 acres of riparian corridor and floodplain exists in *Critical Area #3*.

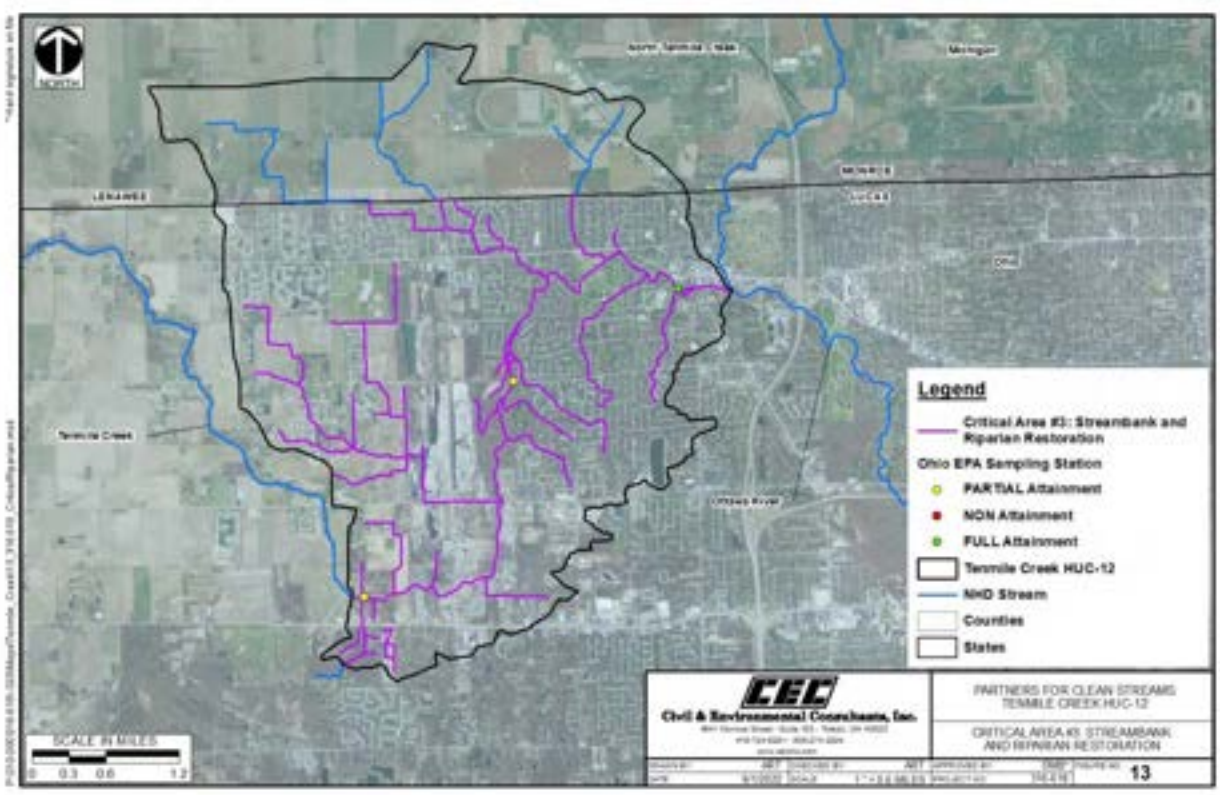

Figure 13: Tenmile Creek HUC-12 Critical Area #3

3.4.2 Detailed Biological Conditions

Fish community data for this sampling location within the **Tenmile Creek HUC-12** is summarized below (Table 17). Analysis of the abundance, diversity and pollution tolerance of existing fish species found by Ohio EPA at each sampling location, in relation to the corresponding QHEI score, aids in the identification of causes and sources of impairment. The sampling locations at RM 5.9 and RM 2.9 are mainly found in the agricultural portion of the sub-watershed and exhibit attributes indicative of surrounding land use. Habitat at RM 0.5 is the highest within the most urbanized stretch of Tenmile Creek; however, much of the stream through this section has a wider riparian footprint, despite channelization through some sections. Fish communities still exhibit a high percentage of pollution tolerant species.

Table 17: Critical Area #3 - Fish Community and Habitat Data

Tenmile Creek HUC-12 (04100001 03 06)							
River Mile	**Drainage Area (mi^2)**	**Total Species**	**QHEI**	**IBI**	**MIwb[a]**	**Predominant Species (Percent of Catch)**	**Narrative Evaluation**
Tenmile Creek (WWH)							
5.9^{W}	64.5	21	52.5	34	7.0^{ns}	Green sunfish (22%), bluntnose minnow (18%), bluegill sunfish (14%)	Marginally Good
2.9^{W}	70.0	15	51.0	37	6.1*	Green sunfish (38%), striped shiner (20%), redfin pickerel (10%)	Marginally Good - Fair
0.5^{W}	81.0	16	77.0	39	7.5	Creek chub (21%), orangethroat darter (19%), central stoneroller (15%)	Good – Marginally Good

(Source: Ohio EPA, 2015)

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

Characteristics of the aquatic macroinvertebrate community for the **Tenmile Creek HUC-12** are summarized below (Table 18). Analysis of the abundance, diversity, and pollution tolerance of existing aquatic macroinvertebrates found by Ohio EPA at these sampling locations, related to QHEI score, can aid in the identification of causes and sources of impairment. Macroinvertebrate communities performed well in the lower reach of Tenmile Creek; however, substrate embeddedness is still a notable issue. A low number of sensitive and EPT taxa were present at RM 0.5, and communities were dominated by facultative species.

Table 18: Critical Area #3 – Macroinvertebrate Community Data

Tenmile Creek HUC-12 (04100001 03 06)			
River Mile	**ICI Score-Narrative[a]**	**Notes (Density of Ql./Qt.)**	**Predominant Species**
Tenmile Creek (WWH)			
5.9^{W}	18* — Fair 2 sensitive taxa	Low qualitative density	Midges (F, MT), hydropsychid caddisflies (F)
2.9^{W}	26*— Fair 5 sensitive taxa	Low qualitative density	Midges (F), water mites (F), crayfish (F)
0.5^{W}	38 – Good 6 sensitive taxa	Low-moderate qualitative density	Hydropsychid caddisflies (F), baetid mayflies (F), flatworms (F)

(Source: Ohio EPA, 2015)

NOTES
a Narrative evaluation used in lieu of ICI
W Wading site

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

3.4.3 Detailed Causes and Associated Sources

Within the **Tenmile Creek HUC-12**, the two upstream (agricultural) Tenmile Creek locations are in *Partial Attainment* of the WWH designation, while the most downstream, urban sampling site is in *Full Attainment* of the WWH designation. The data summarized previously in Table 7 (p.18) may reveal a direct link between the presence of attributes in the watershed that have influence on the aquatic communities throughout the **Tenmile Creek HUC-12** in *Critical Area #3*. These contributing attributes in *Critical Area #3* include:

- Heavy/Moderate Silt Cover;
- Sparse/No Cover;
- Fair/Poor Development;
- High Embeddedness; and
- Lack of Fast Current.

Habitat, as scored by the QHEI, is not a WQS; however, habitat is highly correlated with the performance of aquatic communities. In general, sites that score at least 60 (or 55 for headwater streams) are successful at supporting WWH aquatic assemblages; sites scoring at least 75 are generally supporting Exceptional Warmwater Habitat (EWH) aquatic assemblages. Projects that address the above described habitat-related attributes (e.g., stream cover, channelization, etc.) through in-stream, streambank and riparian restoration in areas upstream and contributing to habitat impacts will have a positive effect in the QHEI scoring index. As the habitat score (QHEI) becomes better, IBI, MIwb and ICI index scores are also expected to improve.

3.4.4 Outline Goals and Objectives for the Critical Area

The overarching goal of any NPS-IS is to improve water quality scores or meet nutrient reduction goals in order to remove a waterbody's impairment status. Projects that address the above described habitat-related attributes (e.g., channelization, vegetative cover, etc.) through in-stream and riparian restoration will have a positive effect in the QHEI scoring index. As the habitat score (QHEI) becomes better, IBI and ICI index scores are also expected to improve.

The remaining goals for *Critical Area #3* of the **Tenmile Creek HUC-12** are to reduce sedimentation (and associated nutrient) effects to improve the aquatic scores through stabilizing streambanks and restoring floodplains and riparian corridors. These goals are to specifically:

Goal 1. Maintain IBI score at or above 32 at Herr Road in Tenmile Creek (RM 5.9).

✓ ACHIEVED: Site currently has a score of 34.

Goal 2. Achieve MIwb score at or above 7.3 at Herr Road in Tenmile Creek (RM 5.9).
NOT ACHIEVED: Site currently has a score of 7.0.

Goal 3. Achieve ICI score at or above 34 at Herr Road in Tenmile Creek (RM 5.9).
NOT ACHIEVED: Site currently has a score of 18.

Goal 4. Achieve QHEI score at or above 60 at Herr Road in Tenmile Creek (RM 5.9).
NOT ACHIEVED: Site currently has a score of 52.5.

Goal 5. Maintain IBI score at or above 32 at Brint Road in Tenmile Creek (RM 2.9).
✓ ACHIEVED: Site currently has a score of 37.

Goal 6. Achieve MIwb score at or above 7.3 at Brint Road in Tenmile Creek (RM 2.9).
NOT ACHIEVED: Site currently has a score of 6.1.

Goal 7. Achieve ICI score at or above 34 at Brint Road in Tenmile Creek (RM 2.9).
NOT ACHIEVED: Site currently has a score of 26.

Goal 8. Achieve QHEI score at or above 60 at Brint Road in Tenmile Creek (RM 2.9).
NOT ACHIEVED: Site currently has a score of 51.

Goal 9. Maintain IBI score at or above 32 at Silica Drive in Tenmile Creek (RM 0.5).
✓ ACHIEVED: Site currently has a score of 39.

Goal 10. Maintain MIwb score at or above 7.3 at Silica Drive in Tenmile Creek (RM 0.5).
✓ ACHIEVED: Site currently has a score of 7.5.

Goal 11. Maintain ICI score at or above 34 at Silica Drive in Tenmile Creek (RM 0.5).
✓ ACHIEVED: Site currently has a score of 38.

Goal 12. Maintain QHEI score at or above 60 at Silica Drive in Tenmile Creek (RM 0.5).
✓ ACHIEVED: Site currently has a score of 77.

Objectives

The implementation of these objectives, partnered with implementation throughout other identified critical areas will help ameliorate negative impacts from sedimentation within the **Tenmile Creek HUC-12**, and positive gains will be made towards removing both near-field and far-field impairments. In order to achieve the overall NPS restoration goals of reaching *Full Attainment* at all sites within **Tenmile Creek HUC-12**, the following objectives need to be achieved within *Critical Area #3.*

Objective 1: Stabilize at least three miles (15,840 linear feet) of degraded or downcut streambanks through a two-stage ditch or natural channel design approach and/or bio-engineering techniques.

Objective 2: Restore at least two miles (10,560 linear feet) of in-stream channel habitat through natural channel design methods and bioengineering, including, but not limited to, constructed riffles, habitat rocks/boulders, root wads, mud sills and tree revetments.

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

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

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

CHAPTER 4: PROJECTS AND IMPLEMENTATION STRATEGY

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

Implementation of practices described in this NPS-IS will also contribute to nutrient load reduction (specifically the 40% reduction in phosphorus load) to protect and restore use attainment in Lake Erie. Nutrient load reduction efforts are consistent with the Lake Erie Collaborative Agreement through the International Joint Commission (IJC) and Ohio's DAP (IJC, 2012; OLEC, 2018).

For the **Tenmile Creek HUC-12** there are three *Project and Implementation Strategy Overview Tables* (subsection 4.1, 4.2, and 4.3). Future versions of this NPS-IS may include subsequent sections as more critical areas are refined and more projects become developed to meet the requisite objectives within a critical area. The projects described in the *Overview Table* have been prioritized using the following three-step prioritization method:

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

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

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

Project Summary Sheets (PSS) follow the *Overview Tables*, if projects were identified; these provide the essential nine elements for short-term and/or next step projects that are in development and/or in need of funding. As projects are implemented and new projects developed, these sheets will be updated. Any new PSS created will be submitted to the state of Ohio for funding eligibility verification (i.e., all nine elements are included).

4.1 Critical Area #1 Project and Implementation Strategy Overview Table

Table 19: Tenmile Creek HUC-12 (04100001 03 06) — Critical Area #1							
Goal	**Objective**	**Project #**	**Project Title (EPA Criteria g)**	**Lead Organization (EPA criteria d)**	**Time Frame (EPA Criteria f)**	**Estimated Cost (EPA Criteria d)**	**Potential/Actual Funding Source (EPA Criteria d)**
Urban Sediment and Nutrient Reduction Strategies							
1	1	1	City of Sylvania River Trail Bioretention Project	City of Sylvania	Short (1-3 years)	$105,000	Ohio EPA §319, GLRI, GLC, SOGL, City of Sylvania
1-5	1,2	2	Northview High School Green Infrastructure and Stream Restoration Project	City of Sylvania/ Sylvania Schools	Short (1-3 years)	$355,000	Ohio EPA §319, GLRI, GLC, SOGL, City of Sylvania
Altered Stream and Habitat Restoration Strategies							
1-5	1,2	2	Northview High School Green Infrastructure and Stream Restoration Project	City of Sylvania/ Sylvania Schools	Short (1-3 years)	$355,000	Ohio EPA §319, GLRI, GLC, SOGL, City of Sylvania
1-5	2	3	Richards Park Stream and Floodplain Restoration	City of Sylvania	Short (1-3 years)	$1,500,000	Ohio EPA §319, GLRI, GLC, SOGL, H2Ohio
Agricultural Nonpoint Source Reduction Strategies							
High Quality Waters Protection Strategies							
Other NPS Causes and Associated Sources of Impairment							

4.1.1 Project Summary Sheet(s)

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

Table 20: Critical Area #1 – Project #1		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	**Title**	City of Sylvania River Trail Bioretention Project
criteria d	**Project Lead Organization & Partners**	City of Sylvania
criteria c	**HUC-12 and Critical Area**	Tenmile Creek HUC-12 (04100001 03 06): *Critical Area #1* *(cross-referenced in the Heldman Ditch-Ottawa River HUC-12; Version 1.3 NPS-IS plan approved 01/05/2021)*
criteria c	**Location of Project**	Harroun Park @ Main Street (41.713817, -83.701828)
n/a	**Which strategy is being addressed by this project?**	Urban Nonpoint Source Reduction Strategy
criteria f	**Time Frame**	Short (1-3 Years)
criteria g	**Short Description**	Install a bioretention pond to filter and retain stormwater in Harroun Park;
criteria g	**Project Narrative**	Harroun Park serves as a 54-acre urban park located in the central portion of Sylvania's business district. The parking lot of Harroun Park and the adjacent business area covers approximately two acres of impervious surface, which drains to a 0.4 acre mowed depression in the lot's center. Stormwater from this area is directed to Tenmile Creek through an outlet that opens into a rip-rapped/gravel section of the streambank, approximately 350 feet from Main Street and the beginning of the Sylvania River Trail. The proposed project aims to convert the mowed depression to a bioretention rain garden, allowing for the slow percolation and filtering of stormwater. The stormwater inlet will be elevated with a riser and the depression will be filled with a soil medium and native plants that will promote filtering in the subsurface and transpiration by plants.
criteria d	**Estimated Total cost**	$105,000 (updated 2022)
criteria d	**Possible Funding Source**	Ohio EPA §319, GLRI, GLC, SOGL, City of Sylvania
criteria a	**Identified Causes and Sources**	Cause: Sedimentation/Siltation Source: Urban runoff/storm sewers

Table 20: Critical Area #1 – Project #1		
Nine Element Criteria	**Information needed**	**Explanation**
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	The overall goal in *Critical Area #1* is to reduce estimated total spring phosphorus loads. Current estimates indicate 1,500 lbs. of phosphorus in the spring load is attributed to urban land use activities. In order to meet the GLWQA nutrient reduction goals, spring loadings must be reduced by 40%, or 600 lbs.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	It is expected that this project will cause a decrease in spring phosphorus loadings by 0.4 lbs (0.7%).
	Part 3: Load Reduced?	Estimated: 6 #N/year, 1 #P/year, 0.4 tons sediment/year (updated 2022)
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Staff from the OEPA-DSW Ecological Assessment Unit will perform both pre- and post-project monitoring. The Harroun Rd. sampling site (RM 19.50) will be monitored as part of the State of Ohio's ongoing surface water monitoring program cycle to determine progress from *Partial Attainment to Full Attainment*.
criteria e	**Information and Education**	The City of Sylvania promotes on-going development of its downtown district and public stewardship and interest in the Tenmile Creek watershed. The Sylvania River Trail is a phased 1.5 mile trail extending along Tenmile Creek/Ottawa River. Harroun Park serves as an anchor for this trail and offers an access point for parking. Projects within this area would receive high visibility through signage and informational kiosks. The location would also offer opportunities for The Olander Parks System to incorporate educational programming.

Table 21: Critical Area #1 – Project #2		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	**Title**	Northview High School Green Infrastructure and Stream Restoration Project
criteria d	**Project Lead Organization & Partners**	City of Sylvania and Sylvania City Schools
criteria c	**HUC-12 and Critical Area**	Tenmile Creek HUC-12 (04100001 03 06): *Critical Area #1* *(cross-referenced in the Heldman Ditch-Ottawa River HUC-12; Version 1.3 NPS-IS plan approved 01/05/2021)*
criteria c	**Location of Project**	Northview High School (41.650020, -83.766274)
n/a	**Which strategy is being addressed by this project?**	Altered Stream and Habitat Restoration Strategy Urban Nonpoint Source Reduction Strategy
criteria f	**Time Frame**	Short (1-3 Years)
criteria g	**Short Description**	Redirect stormwater outfall into a constructed stormwater wetland for filtration and retention and reduce streambank erosion through natural channel design features.
criteria g	**Project Narrative**	The campus of Northview High School, Sylvania, OH covers approximately 35 acres and contains 300 linear feet of Tenmile Creek on the northeastern portion of the property. Approximately half of the property is impervious surface consisting of parking lots, sidewalks, and buildings that drain directly to a storm sewer outfall in Tenmile Creek, just upstream of a pedestrian bridge on Silica Drive. The proposed project aims to divert the stormwater from this outfall into a ~1 acre stormwater wetland, located along the eastern edge of the property for filtering and reducing urban runoff received by Tenmile Creek. Sampling sites downstream from Silica Road cite sedimentation/siltation as a cause of impairment, and current streambank conditions indicate erosional issues along this stretch. Cross vanes, where appropriate, will be installed to redirect water flow to the center of the channel, thereby reducing sediment erosion and stabilizing the banks. Riparian plantings along each side of Tenmile Creek will also promote the natural attenuation of sediment and urban contaminants from the residential neighborhood directly upstream and from nutrient runoff directly associated with the high school's practice fields.
criteria d	**Estimated Total cost**	$355,000 (updated 2022)
criteria d	**Possible Funding Source**	Ohio EPA §319, GLRI, GLC, SOGL, City of Sylvania
criteria a	**Identified Causes and Sources**	Cause: Sedimentation/Siltation Source: Urban runoff/storm sewers

Table 21: Critical Area #1 – Project #2		
Nine Element Criteria	**Information needed**	**Explanation**
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	The overall goal in *Critical Area #1* is to reduce estimated total spring phosphorus loads. Current estimates indicate 1,500 lbs. of phosphorus in the spring load is attributed to urban land use activities. In order to meet the GLWQA nutrient reduction goals, spring loadings must be reduced by 40%, or 600 lbs.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	It is expected that this project will cause a decrease in spring phosphorus loadings by 12 lbs (2.1%).
	Part 3: Load Reduced?	Estimated: 67 #N/year, 19 #P/year, 20.7 tons sediment/year (updated 2022)
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Staff from the OEPA-DSW Ecological Assessment Unit will perform both pre- and post-project monitoring. The Harroun Rd. (RM 19.50) and Silica Rd.(RM 0.5) sampling sites will be monitored as part of the State of Ohio's ongoing surface water monitoring program cycle to determine progress from partial attainment to full attainment.
criteria e	**Information and Education**	Northview High School enrolls ~1,250 students and has an active environmental sciences program. Students at the school have participated in water quality data collection from Tenmile Creek for almost 20 years as part of the Toledo Metropolitan Area Council of Government's Student Watershed Watch. The high school houses a small wind turbine on campus, and the stormwater wetland and riparian corridor would be a valuable addition to an outdoor classroom focused upon sustainability. High school students would utilize the wetland and stream for water quality monitoring, plant identification and as an active demonstration site of the benefits of green infrastructure. Additional education and outreach opportunities exist for the general public. The City of Sylvania has constructed Phase I and Phase II of the River Trail, a trail that winds along Tenmile Creek throughout the downtown and business areas of the city. Phase III is slated for implementation in five years and connects the trail from its downtown trailhead to a stopping point on Silica Drive. Interactive kiosks at the wetland are planned to engage both students and the general public.

Table 22: Critical Area #1 – Project #3		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	**Title**	Richards Park Stream and Floodplain Restoration
criteria d	**Project Lead Organization & Partners**	City of Sylvania
criteria c	**HUC-12 and Critical Area**	Tenmile Creek HUC-12 (04100001 03 06)- *Critical Area #3*
criteria c	**Location of Project**	41.715287, -83.727542
n/a	**Which strategy is being addressed by this project?**	Altered Stream and Habitat Restoration
criteria f	**Time Frame**	Short (1-3 Years)
criteria g	**Short Description**	Restore and realign ~1700 linear feet of Tenmile Creek
criteria g	**Project Narrative**	Along a ~1,800 linear foot section within Richards Park, Tenmile Creek flows northeast and is redirected approximately 90-degrees towards the southeast in the direction of a two-lane bridge supporting Bonniebrook Road at the entrance of the subdivision. Just upstream of the bend within this section, Schreiber Ditch converges with Tenmile Creek. Schreiber Ditch, a ~2.7 mile long stream, drains an approximate 3.5 square mile area that is predominantly urban and high density residential lots. Significant erosion and bank destabilization has been implemented along Tenmile Creek at the bend and aerial analysis estimates lateral recession at the point to be an average of approximately 0.7 feet per year towards residential infrastructure. Realignment of the stream channel and placement of natural materials, including in-stream grade control structures, toewood, natural brush layering and soil lifts will not only reduce excessive erosion on the northern bank of Tenmile Creek and protect infrastructure, but it will help reestablish floodplain connection and restore approximately 6.1 acres of wetland area in former channel and adjacent lands. Approximately 1,520 linear feet of channel will be realigned to stabilize the stream channel within this region and portions of the abandoned channel will be restored into floodplain wetland depressions. The proposed alignment will reduce the shear stress resulting from a tight radius of curvature along the western boundary line of several residences in the Bonniebrook Subdivision and along the northern stream bank, directly upstream of the Bonniebrook Road bridge. The former channel will be plugged and regraded to provide flood capacity and filtration through wetland restoration. Approximately four in-stream grade control structures (boulder cross vane, double boulder cross vane at the bridge, rock J-hooks) will be installed to help direct and manage stream flow to the center of the channel and away from the streambanks. Approximately seven riffles will be rebuilt within this portion of the channel. Streambanks will be stabilized using coir

Table 22: Critical Area #1 – Project #3		
Nine Element Criteria	**Information needed**	**Explanation**
		matting, live stakes, toewood, and geo-lifts with live brush layering. The new stream channel will be graded for floodplain reconnection, planted with native woody vegetation and live stakes. The restored floodplain connection will help in the retention, detention and filtration of both agricultural and urban run-off.
criteria d	**Estimated Total cost**	$1,500,000
criteria d	**Possible Funding Source**	Ohio EPA §319, GLRI, GLC, SOGL, H2Ohio
criteria a	**Identified Causes and Sources**	Cause: Sedimentation/Siltation Source: Channelization
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	The overall goal in *Critical Area #1* is to reduce estimated total spring phosphorus loads. Current estimates indicate 1,500 lbs. of phosphorus in the spring load is attributed to urban land use activities. In order to meet the GLWQA nutrient reduction goals, spring loadings must be reduced by 40%, or 600 lbs.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	It is expected that this project will cause a decrease in spring phosphorus loadings by 120 lbs (20%).
	Part 3: Load Reduced?	Estimated: 477 #N/year, 184 #P/year, 297.9 tons sediment/year
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Staff from the OEPA-DSW Ecological Assessment Unit will perform both pre- and post- project monitoring. In addition, the Brint Rd. sampling site at RM 2.9 will also be monitored (as part of the State's ongoing surface water monitoring program cycle) to determine progress (through IBI, ICI, and QHEI) from *Partial Attainment* to *Full Attainment.*
criteria e	**Information and Education**	The City will hold public meetings and a tour. Appropriate signage will be installed.

4.2 Critical Area #2 Project and Implementation Strategy Overview Table

Table 23: Tenmile Creek HUC-12 (04100001 03 06) — Critical Area #2							
Goal	**Objective**	**Project #**	**Project Title (EPA Criteria g)**	**Lead Organization (EPA criteria d)**	**Time Frame (EPA Criteria f)**	**Estimated Cost (EPA Criteria d)**	**Potential/Actual Funding Source (EPA Criteria d)**
Urban Sediment and Nutrient Reduction Strategies							
Altered Stream and Habitat Restoration Strategies							
Agricultural Nonpoint Source Reduction Strategies							
High Quality Waters Protection Strategies							
Other NPS Causes and Associated Sources of Impairment							

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

4.3 Critical Area #3 Project and Implementation Strategy Overview Table

Table 24: Tenmile Creek HUC-12 (04100001 03 06) — Critical Area #3							
Goal	**Objective**	**Project #**	**Project Title (EPA Criteria g)**	**Lead Organization (EPA criteria d)**	**Time Frame (EPA Criteria f)**	**Estimated Cost (EPA Criteria d)**	**Potential/Actual Funding Source (EPA Criteria d)**
Urban Sediment and Nutrient Reduction Strategies							
Altered Stream and Habitat Restoration Strategies							
5-8	1	1	Tenmile Creek Instream Restoration Project	The Olander Parks System	Short (1-3 years)	$270,000	Ohio EPA §319, GLRI, GLC, SOGL
Agricultural Nonpoint Source Reduction Strategies							
High Quality Waters Protection Strategies							
Other NPS Causes and Associated Sources of Impairment							

4.3.1 Project Summary Sheet(s)

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

Table 25: Critical Area #3 – Project #1		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	**Title**	Tenmile Creek Instream Restoration Project
criteria d	**Project Lead Organization & Partners**	Lead: The Olander Park System Partner: Lehigh Hanson
criteria c	**HUC-12 and Critical Area**	Tenmile Creek HUC-12 (04100001 03 06) - *Critical Area #3*
criteria c	**Location of Project**	Tenmile Creek, between RM 4.0 and RM 2.9 (South of Sylvania Avenue, Sylvania Township, Lucas County, Ohio)
n/a	**Which strategy is being addressed by this project?**	Altered Stream and Habitat Restoration
criteria f	**Time Frame**	Short (1-3 Years)
criteria g	**Short Description**	Install ~900 linear feet of instream features for the creation of high quality habitat to in improve water quality attainment metrics for fish diversity and well- being (IBI, MIwb), and aquatic insects (ICI) — the measures of aquatic life use attainment; and improve habitat index scores (as QHEI is directly related to metrics used to determine attainment of water quality standards).
criteria g	**Project Narrative**	This project will install instream features (e.g., j-hooks, riffles) in ~900 linear feet of Tenmile Creek between RM 4.0 and RM 2.9 to create instream habitat features, stabilize eroding banks in priority areas and promote the efficient transport of bedload downstream, particularly in an area that receives discharge from a NPDES-permitted facility.
criteria d	**Estimated Total cost**	$270,000 (updated 2022)
criteria d	**Possible Funding Source**	Ohio EPA §319, GLRI, GLC, SOGL
criteria a	**Identified Causes and Sources**	Cause: Sedimentation/Siltation Source: Channelization
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	With respect to the goals in *Critical Area #3* the main driver is QHEI. Current data shows that the stream at RM 2.9 (Brint Road) in *Critical Area #3* is at 51—which is 9 points below the threshold index score of 60.

Table 25: Critical Area #3 – Project #1		
Nine Element Criteria	**Information needed**	**Explanation**
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	It is expected that this project will cause an incremental increase in the QHEI scoring by at least 3 points (or 33% progress toward the goal), with comparable increases in IBI, MIwb and ICI scores.
	Part 3: Load Reduced?	Estimated: 436 #N/year, 44 #P/year, 26 tons sediment/year
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Staff from the OEPA-DSW Ecological Assessment Unit will perform both pre- and post- project monitoring. In addition, the Brint Rd. sampling site at RM 2.9 will also be monitored (as part of the State's ongoing surface water monitoring program cycle) to determine progress (through IBI, ICI, and QHEI) from *Partial Attainment* to *Full Attainment.*
criteria e	**Information and Education**	This project will be promoted with press releases and newspaper articles. In addition, The Olander Park System has a robust outreach and education program developed and will create brochures, web and social media postings, as well as create programs and educational walks/tours that provide access to students and community members. Appropriate signage will be installed.

4.4 Implemented Project Record

Table 26: Tenmile Creek HUC-12 (04100001 03 06) — Implemented Projects					
Project Title	**Lead Organization**	**Year Completed**	**Funding Source**	**Short Description**	**Reference Document**
Harroun Park – Tenmile Creek River Trail Restoration	City of Sylvania	2021	OLEC – GLRI sub-award	Improve stream morphology, reduce streambank erosion and restore riparian habitat in Tenmile Creek/Ottawa River.	Heldman Ditch-Ottawa River HUC-12 NPS-IS, Version 1.4
Tenmile Creek Stream and Riparian Corridor Restoration (as part of the larger Tenmile Creek Flood Mitigation Project)	Lucas County Engineers Office	2020	Ohio EPA – GLRI subaward	Create ~6,860 feet of terraced floodplain and enhance instream and riparian habitat along this segment of Tenmile Creek.	Tenmile Creek HUC-12 NPS-IS, Version 1.0
Riparian Restoration in Three Tributaries to Tenmile Creek	The Olander Park System	2017	Multiple	Restore 1,400 linear feet in Kimball, Palmer and Comstock Ditches and enhance riparian corridor on 33 acres of land at Sylvan Prairie Park in order to improve water quality.	Tenmile Creek HUC-12 NPS-IS, Version 1.0
Tallgrass Prairie and Wet Meadow Installation	The Olander Park System	2017 and on-going	Multiple	Convert and manage up to 150 acres of former agricultural land to tallgrass prairie and wet meadow so that in incremental progress in water quality attainment metrics are achieved.	Tenmile Creek HUC-12 NPS-IS, Version 1.0

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