UPPER BLUE CREEK
HUC 12: 04100009 08 01

Nonpoint Source Implementation
Strategic Plan

Approved: November 16, 2018

Funded by: Prepared by:

Ohio Environmental Protection Agency
Mannik Smith Group
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<tr>
<td>ALU</td>
<td>aquatic life use</td>
</tr>
<tr>
<td>BMP</td>
<td>best management practice</td>
</tr>
<tr>
<td>BUI</td>
<td>beneficial use impairment</td>
</tr>
<tr>
<td>DELT</td>
<td>Deformities, Erosions, Lesions, and Tumors</td>
</tr>
<tr>
<td>HUC</td>
<td>hydrologic unit code</td>
</tr>
<tr>
<td>IBI</td>
<td>Index of Biotic Integrity</td>
</tr>
<tr>
<td>ICI</td>
<td>Invertebrate Community Index</td>
</tr>
<tr>
<td>MIwb</td>
<td>Modified Index of Well-Being</td>
</tr>
<tr>
<td>NPS-IS</td>
<td>Nonpoint Source Implementation Strategy</td>
</tr>
<tr>
<td>Ohio EPA</td>
<td>Ohio Environmental Protection Agency</td>
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<tr>
<td>PCS</td>
<td>Partners for Clean Streams</td>
</tr>
<tr>
<td>PSS</td>
<td>project summary sheet</td>
</tr>
<tr>
<td>QHEI</td>
<td>Qualitative Habitat Evaluation Index</td>
</tr>
<tr>
<td>RM</td>
<td>river mile</td>
</tr>
<tr>
<td>SWCD</td>
<td>Soil &amp; Water Conservation District</td>
</tr>
<tr>
<td>TMACOG</td>
<td>Toledo Metropolitan Area Council of Governments</td>
</tr>
<tr>
<td>TMDL</td>
<td>Total Maximum Daily Load</td>
</tr>
<tr>
<td>TN</td>
<td>total nitrogen</td>
</tr>
<tr>
<td>TP</td>
<td>total phosphorous</td>
</tr>
<tr>
<td>TSS</td>
<td>total suspended solids</td>
</tr>
<tr>
<td>U.S. EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>WAU</td>
<td>watershed assessment unit</td>
</tr>
<tr>
<td>WQS</td>
<td>water quality standards</td>
</tr>
<tr>
<td>WWH</td>
<td>warmwater habitat</td>
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ACKNOWLEDGEMENTS

This report was authored by The Mannik & Smith Group, Inc. (MSG) and prepared by MSG and Tetra Tech with funding from the Ohio Environmental Protection Agency (Ohio EPA). The project could not have been accomplished without technical expertise and insight from many individuals and organizations, including:

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INTRODUCTION

Blue Creek feeds into Swan Creek and ultimately drains into the Maumee River and western Lake Erie. The up-stream portion of Blue Creek as well as several named streams make up the Upper Blue Creek watershed assessment unit (WAU) with hydrologic unit code (HUC) 04100009 08 01. The Upper Blue Creek WAU is in the Lower Maumee sub-basin (HUC 04100009) and the Western Basin of Lake Erie. The down-stream portion of Blue Creek is within a separate WAU, Lower Blue Creek (HUC 04100009 08 02). The Upper Blue Creek WAU is 20.28 square miles and is located within Swan Creek Township in Fulton County, Swanton and Providence Townships in Lucas County, and Washington Township in Henry County.

Upper Blue Creek is within the Maumee Area of Concern (Maumee AOC; see Figure 1) that was established as part of the Great Lakes Water Quality Agreement between the United States and Canada (Agreement). The Agreement seeks to restore and protect waters of the Great Lakes and provides a framework for identifying priorities and implementing actions that improve environmental quality in designated AOCs. In 1987, the Agreement designated 43 AOCs across the Great Lakes basin, including the Maumee AOC that drains to Lake Erie in Ohio. Ten beneficial use impairments (BUIs) were identified for the Maumee AOC.

![Figure 1. Maumee Area of Concern and its HUC-12 watersheds](image)

1 The Lower Blue Creek WAU (HUC 04100009 08 02) flows into the Heilman Ditch-Swan Creek WAU (HUC 04100009 08 04) which flows into the Delaware Creek-Maumee River WAU (HUC 04100009 09 04) before draining into Lake Erie at Maumee Bay.
State and federal nonpoint source (NPS) funding is now closely tied to strategic implementation-based planning that meets the U.S. Environmental Protection Agency’s (U.S. EPA) nine minimum elements of a watershed plan for impaired waters. This nonpoint source implementation strategy (NPS-IS) plan was authored by The Mannik & Smith Group, Inc. (MSG). MSG and Tetra Tech collaborated to produce seven NPS-IS plans under contract with the Ohio Environmental Protection Agency (Ohio EPA). The Upper Blue Creek NPS-IS plan is one of 20 NPS-IS plans being developed by Tetra Tech, MSG, and several other organizations for WAUs throughout the Maumee AOC to address the *loss of fish and wildlife habitat* BUI of the Maumee AOC². As of the writing of this plan, six other NPS-IS plans in the Maumee AOC have been previously approved by the U.S. EPA.

1.1 REPORT BACKGROUND

This NPS-IS plan builds upon the Maumee River Remedial Action Plan (RAP) of 1997, which outlined restoration goals for the Ottawa River and Swan Creek watersheds, as well as the Swan Creek Watershed Plan of Action, which prioritized restoration objectives in the Swan Creek watershed (Maumee RAP 1997; 2001). Both of these plans were developed by the Maumee RAP committee created as a result of the Agreement. This committee created the Maumee AOC Stage 2 Watershed Restoration Plan in 2006, which identified best management practices (BMPs) and restoration targets for the entire Maumee AOC (Maumee RAP 2006). Attention is now being focused on addressing nonpoint source pollution within each HUC-12 watershed in the Maumee AOC as opposed to one NPS-IS plan generalized across the whole AOC.

In June 2009, the Toledo Metropolitan Area Council of Governments (TMACOG) and the Lucas Soil & Water Conservation District (SWCD) published a Balanced Growth plan for the Swan Creek watershed (TMACOG 2009). The plan identified *Priority Agricultural Areas*, *Priority Conservation Areas*, and *Priority Development Areas* across the Swan Creek watershed. The Ohio EPA published a Total Maximum Daily Loads (TMDL) report in October 2009 that outlined the causes and sources of impairments, prioritized sources to address, and set TMDL levels across the watershed (Ohio EPA 2009b). Additionally, Partners for Clean Streams (PCS) published a wetland inventory and restoration plan for the Swan Creek and Ottawa River watersheds in 2009 that identified restoration BMPs and project opportunities in the two watersheds (PCS 2009). This NPS-IS plan is built upon and references these previous reports.

Controlling nonpoint source pollution and addressing causes and sources of impairments in the *Upper Blue Creek* watershed is an important step in removing BUIs within the sub-watershed and within the greater Maumee AOC. This NPS-IS plan is specifically focused on recommendations working toward delisting BUI #14: *loss of fish and wildlife habitat* and attainment of state water quality standards (WQS).

![Figure 2. Blue Creek at its intersection with County Road 4 in the Upper Blue Creek WAU.](image)

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² In 2016, the Maumee AOC Advisory Committee proposed a management action to develop nine element watershed plans that will identify projects to restore and protect fish and wildlife habitat. U.S. EPA’s Great Lakes National Program Office awarded funding to Ohio EPA to develop these 20 NPS-IS plans. Ohio EPA is providing funding to several organizations to develop the NPS-IS plans.
1.2 WATERSHED PROFILE AND HISTORY

Blue Creek is 15 miles long and flows through the towns of Neapolis and Whitehouse before flowing into Swan Creek and eventually the Maumee River. Blue Creek is comprised of two sub-watersheds: the Upper Blue Creek watershed (HUC 04100009 08 01) and the Lower Blue Creek watershed (HUC 04100009 08 02). The Upper Blue Creek watershed encompasses several named and unnamed streams including Aumend Ditch, Doran Ditch, Iron Ore Ditch, Laver Ditch, Rakestraw Ditch, Richman Ditch, and Yawberg Ditch. Blue Creek flows into Swan Creek at river-mile (RM) 23, which then flows into the Maumee River at RM 4 before ultimately flowing into the western basin of Lake Erie. Largely non-urbanized, the predominant land use in the Upper Blue Creek watershed is agricultural, and there are several open spaces and protected conservation areas in the watershed, most notably Maumee State Forest.

The Upper Blue Creek watershed lies in the historic Oak Openings region; a 130 square mile complex of rare ecosystems throughout northwest Ohio and southeast Michigan that contains nearly one-third of Ohio's endangered plant species and numerous rare and threatened animals. Because this region houses many sensitive and rare plants and animals, targeted conservation activities should focus on protecting these globally-rare species.

Figure 3. The Upper Blue Creek watershed
When developing watershed planning and restoration plans such as this NPS-IS plan, it is important to have involvement and input from a diverse group of individuals and organizations. This group should include members of the public, private businesses and organizations, academia, governmental agencies, non-profits, and community organizations. Many partners have been working in the Upper Blue Creek watershed and the greater Maumee AOC in order to improve water quality and increase ecological restoration. These partners focus on a diverse set of interests, from access to green space to reducing nutrient loading in Lake Erie.

Some of the key partners working in the Upper Blue Creek watershed include: the Ohio Department of Natural Resources (ODNR), The Nature Conservancy, TMACOG, PCS, and Fulton and Lucas County SWCDs.

Representatives from Tetra Tech and MSG held a public and stakeholder meeting\(^3\) on April 24, 2018 to discuss NPS-IS plans for seven watersheds in the Maumee AOC, including Upper Blue Creek (see Figure 4). The purpose of this meeting was to introduce the NPS-IS project and discuss critical areas and potential projects in the watershed. Then on April 25, 2018, Tetra Tech and MSG presented a brief overview of the NPS-IS project to the TMACOG Watershed Committee\(^4\) at their quarterly meeting. The TMACOG Watershed Committee is made up of a diverse group of stakeholders from municipal and state entities, non-profits, and private firms concerned with improving water quality in the region and Lake Erie. The purpose of the presentation was to solicit feedback on critical areas and project ideas for the NPS-IS plans being authored by Tetra Tech and MSG, including the Upper Blue Creek WAU.

This report was primarily authored by MSG. Chapter 1 was written using information from the Swan Creek Watershed Balanced Growth Plan (TMACOG 2009) and the Maumee Area of Concern Stage 2 Watershed Restoration Plan (Maumee RAP 2006a). Chapters 2 and 3 drew from information from the Total Maximum Daily Loads for the Swan Creek Watershed (Ohio EPA 2009b) and Biological and Water Quality Study of Swan Creek and Selected Tributaries (Ohio 2009a). Critical areas were delineated by MSG with feedback from the Ohio EPA and stakeholder meetings. Project information included in Chapter 4 was compiled with the help of various stakeholders including Fulton SWCD and The Nature Conservancy.

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\(^3\) The public stakeholder meeting was attended by representatives of Black Swamp Conservancy, the City of Toledo, and Wood County Soil and Water Conservation District.

\(^4\) The TMACOG Watershed Committee meeting was attended by representatives of state agencies (ODNR and Ohio EPA), local agencies (Lucas County, TMACOG, City of Toledo, and Metroparks Toledo), non-profit organizations (Partners for Clean Streams), and private firms (Civil & Environmental Consultants, Davey Resources Group, and The Mannik & Smith Group, Inc.).
2 WATERSHED CHARACTERIZATION AND ASSESSMENT SUMMARY

2.1 SUMMARY OF WATERSHED CHARACTERIZATION

Blue Creek is a tributary of Swan Creek in the northeast portion of the Lower Maumee sub-basin (HUC 04100009). The watershed is dominated by agricultural production, resulting in degraded stream habitat and increased siltation throughout the Upper Blue Creek watershed.

2.1.1 Physical and Natural Features

The Upper Blue Creek watershed (HUC 04100009 08 01) is part of Lower Swan Creek (HUC 04100009 08) and encompasses Blue Creek from the headwaters to RM 6. Several named and unnamed streams feed into the upstream portion of Blue Creek contained within the Upper Blue Creek watershed. The entire HUC-12 watershed drainage area is 20.28 square miles, with 54.97 miles of stream, changing in elevation from 691 feet above mean sea level (msl) in the headwaters to 655 feet msl at the point where Blue Creek intersects the HUC-12 boundary in the east.

The Upper Blue Creek WAU is entirely contained in the Huron-Erie Lake Plains level III ecoregion (#57), and is composed predominately of the Oak Openings level IV ecoregion (#57b), with a small northwest portion of the watershed in the Maumee Lake Plain level IV ecoregion (#57a) (U.S. EPA 2012). The bedrock geology in the watershed is comprised of sedimentary rock: mainly shale, limestone, dolomite, and some sandstone, with origins in the Devonian period (Ohio Division of Geological Survey 2006). Due to the recent glacial history of the region, the Oak Openings region consists of historical beaches and lake deposits left behind after the retreat of the glaciers (The Nature Conservancy 2016). As a result, the Upper Blue Creek watershed contains sandier soil compared to the rest of the Maumee AOC. Below the layers of sandy soil (remnants of glacial lake beaches) lie deposits of impervious clay. The variability in the thickness of the sandy layers helps create the diverse microclimates across the region (see Figure 7).

Figure 6. Blue Creek at Jeffers Road. Sandy soil characteristic of the Oak Openings region is illustrated in the undercut stream banks.
The soils in this watershed are generally flat or gently sloping, loamy sand, and somewhat poorly drained (Maumee RAP 2006a). This gives rise to the characteristic oak savanna, wet sedge meadows, and wet prairie ecosystems found in the region that provide habitat for a large number of rare and threatened and endangered species. These ecosystems rely on seasonal saturation or flooding, and as such are commonly found in floodplains. These landscapes are threatened by hydrologic regime alteration including stream channelization, nutrient enrichment, siltation, and the destruction of upland buffers. They are also threatened by a number of invasive plant species able to quickly colonize areas once nutrient enrichment or hydrologic alteration occurs (Kost et al. 2007). These threats are recognized in the Swan Creek Watershed Plan of Action, where wetland restoration and protection, home sewage disposal regulation and education, and agricultural runoff control are the highest priority objectives (Maumee RAP 2001).

Figure 7. Soil and wetland types across the Upper Blue Creek watershed
2.1.2 Land Use and Protection

Land cover in the *Upper Blue Creek* watershed is predominately agriculture (54%) followed by forest (27%) (see Table 1 and Figure 8). Only 9.4% of the watershed is considered impervious cover. The watershed has seen a slight decrease in population from 2010 to 2016 and most residential use is low density and spread across the watershed (U.S. Census Bureau 2016). Over 99% of historic wetland coverage in the *Upper Blue Creek* watershed has been lost (Ohio EPA 2016).

<table>
<thead>
<tr>
<th>Land Cover</th>
<th>Area (acres)</th>
<th>Area (% of watershed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open water</td>
<td>83</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Developed, open space</td>
<td>867</td>
<td>7%</td>
</tr>
<tr>
<td>Developed, low Intensity</td>
<td>325</td>
<td>3%</td>
</tr>
<tr>
<td>Developed, medium intensity</td>
<td>20</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Developed, high intensity</td>
<td>3</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Barren land</td>
<td>1</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Deciduous forest</td>
<td>3,542</td>
<td>27%</td>
</tr>
<tr>
<td>Evergreen forest</td>
<td>572</td>
<td>4%</td>
</tr>
<tr>
<td>Mixed forest</td>
<td>2</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Shrub/scrub</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Grassland/herbaceous</td>
<td>388</td>
<td>3%</td>
</tr>
<tr>
<td>Pasture/hay</td>
<td>1,085</td>
<td>8%</td>
</tr>
<tr>
<td>Cultivated crops</td>
<td>6,012</td>
<td>46%</td>
</tr>
<tr>
<td>Woody wetlands</td>
<td>49</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Emergent herbaceous wetlands</td>
<td>11</td>
<td>&lt;1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12,960</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source: Homer et al. 2015

Notes:
Areas rounded to the nearest acre or percentage point
A double dash indicates that the land cover is not present
a. Totals do not sum exactly due to rounding

Developed areas consist mainly of single-family housing on large lots often associated with agricultural production. The community of Neapolis is a small (2010 population 423) civic center with no centralized wastewater treatment facility. The area around Neapolis is listed as a critical home sewage disposal area in the Maumee AOC Stage 2 Restoration Plan and identified as a critical area for septic system replacement (Maumee RAP 2006a). The watershed also contains the White Pines Golf Course adjacent to Blue Creek and various campground sites.

The Maumee State Forest is a group of parcels in the *Upper Blue Creek* watershed totaling 3,194 acres set aside for perpetual conservation. The state forest contains a sedge meadow, hiking trails, all-purpose vehicle recreational facilities, and tree plantations and arboretaums planted on previous cropland. The Swan Creek Watershed Balanced Growth Plan identified several *Priority Conservation Areas* and *Priority Agriculture Areas* in the *Upper Blue Creek* watershed based on various biological and cultural criteria. The *Priority Conservation Areas* were identified as having critically important habitat and species as well as being important to preserving water quality (TMACOG 2009, see Figure 9). These areas make good targets for conservation and restoration through land acquisition and conservation easement programs.
Figure 8. Land cover in *Upper Blue Creek* watershed

Figure 9. Priority Conservation Areas in the *Upper Blue Creek* watershed
2.2 SUMMARY OF BIOLOGICAL TRENDS

Ohio EPA published the Biological and Water Quality Study of Swan Creek and Selected Tributaries report in 2009, which reported sampled data from 2006 for the Upper Blue Creek and entire Swan Creek watershed (Ohio EPA 2009a). Also in 2009, the Ohio EPA published the Total Maximum Daily Loads for the Swan Creek Watershed report (Ohio EPA 2009b). The Swan Creek watershed was sampled again in the summer of 2017. All stream segments in the Upper Blue Creek watershed have designated aquatic life uses (ALU) of warmwater habitat (WWH).

Attainment of an ALU is determined by using multiple biological indices: the Index of Biotic Integrity (IBI) and Modified Index of well-being (MIwb) which measure the fish community, and the Invertebrate Community Index (ICI) which measures the macroinvertebrate community. When all three indices meet their associated criteria, the ALU is determined to be in full attainment. Attainment is partial when at least one of the indices does not meet its criteria and narrative performance does not fall below the fair category. Attainment is non if all indices fail to meet criteria or if any one index indicates poor or very poor narrative performance. In addition, the Qualitative Health Evaluation Index (QHEI) is used to evaluate physical habitat and a stream’s ability to support a viable and diverse aquatic fauna.

Two points were sampled along Blue Creek in the Upper Blue Creek watershed by the Ohio EPA in 2006 and again in 2017. According to the 2017 data, two sample stations (P11K11 and P11P39) are in full attainment of Ohio’s biological criteria for their designated ALU5. A third point along Blue Creek was sampled by PCS and consultants in 2009 and found to be in non-attainment6. The first sampling station downstream of the Upper Blue Creek watershed was in attainment in 2017 (see Table 2 and Figure 11). As shown in Table 2, fish metric scores increased at all sites sampled in 2017 and macroinvertebrate scores increased or remained the same at two sites (P11K11 and P11P39) and decreased at the sample point downstream of Upper Blue Creek (P11K12).

Figure 10. Blue Creek near White Pines Golf Course.

5 The biological criteria for headwater WWH streams in the HELP (Huron Erie Lake Plain) ecoregion are an IBI of 28 and an ICI of 34. The QHEI target for headwater WWH streams is 55. The biological criteria for wading WWH streams in the HELP ecoregion are an IBI of 32, a MIwb of 7.3, and an ICI of 34. The target QHEI score for wading WWH stream is 60.

6 Data collected was level III credible data as outlined by the Ohio EPA, however no formal attainment decision was made by the Ohio EPA using this data.
### Table 2. Overall biological indices scores in the Upper Blue Creek watershed – Ohio EPA 2006, PCS 2009, Ohio EPA 2017

<table>
<thead>
<tr>
<th>RM (Drainage area mi²)</th>
<th>Site ID</th>
<th>Year</th>
<th>IBI/Mlwb</th>
<th>ICI*</th>
<th>Status</th>
<th>QHEI</th>
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<tbody>
<tr>
<td><strong>Upper Blue Creek (041000090801)</strong>&lt;br&gt;WWH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0H (6.7)</td>
<td>P11K11</td>
<td>2006</td>
<td>--b /H</td>
<td>Fair</td>
<td>--c</td>
<td>29.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2017</td>
<td>32/H</td>
<td>MG</td>
<td>Full</td>
<td>18</td>
</tr>
<tr>
<td>8.9H (10.3)</td>
<td>SC-8</td>
<td>2009</td>
<td>32/H</td>
<td>Poor</td>
<td>Non*</td>
<td>45</td>
</tr>
<tr>
<td>7.8H (12.7)</td>
<td>P11P39</td>
<td>2006</td>
<td>30/H</td>
<td>MG</td>
<td>Full</td>
<td>37.5</td>
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<td></td>
<td></td>
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<td>34/H</td>
<td>MG</td>
<td>Full</td>
<td>35</td>
</tr>
<tr>
<td><strong>Lower Blue Creek (041000090802)</strong>&lt;br&gt;WWH (First site downstream of Upper Blue Creek HUC-12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5W (27.0)</td>
<td>P11K12</td>
<td>2006</td>
<td>22/5.6</td>
<td>46</td>
<td>Non</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2017</td>
<td>40/7.5</td>
<td>MG</td>
<td>Full</td>
<td>29</td>
</tr>
</tbody>
</table>

Source: Ohio EPA 2009a (Data from 2006), PCS 2009 (Data from 2009), Ohio EPA 2018b, Ohio EPA 2018c, Ohio EPA 2018d (Data from 2017).

**Notes**
- **Green** scores meet the IBI or ICI biological criteria or the QHEI target. **Red** scores do not meet the IBI or ICI biological criteria or the QHEI target.
- *Data collected was level III credible data, however no formal attainment decision was made by the Ohio EPA using this data.
  a. Narrative evaluation used in lieu of ICI (E=Exceptional, VG=Very Good, Good, MG=Marginally Good, Fair, LF=Low Fair, Poor, VP=Very Poor)
  b. Fish populations were not sampled at this site due to excessive macrophytes on the stream surface.
  c. Attainment status cannot be determined without IBI scores.
- H. Headwater site (< 20mi²), Mlwb is not applicable.
- W. Wading site.

Figure 11. Sample points located along Blue Creek in the *Upper Blue Creek* watershed
2.2.1 Fish Community Health

Fish data collected by Ohio EPA in 2006 and PCS in 2009 indicate that fish community health (as measured by IBI) in the Upper Blue Creek watershed is meeting Ohio’s biological criteria for WWH streams. Fish data was not collected at RM 10.0 due to excessive macrophytes on the stream surface as a result of nutrient-rich runoff. However, macroinvertebrates were sampled and QHEI was calculated to verify that the habitat was impaired, suggesting that if any fish were present they would likely be pollution tolerant (Ohio EPA 2009a). The sampled fish populations were mainly comprised of pollution tolerant fish, and the most numerous fish collected were all highly tolerant of pollution (see Table 4). None of the fish sampled in 2006 featured any DELTs\(^7\). Many of the fish collected were insectivores or omnivores and low ICI scores at select sampling points (see Table 2) may indicate a risk to future fish community health.

Fish data collected by the Ohio EPA in 2017 indicates an improvement in fish community health across all sample locations. IBI at the headwater site (P11K11) was 32, and IBI at RM 7.8 (P11P39) was 34. The sample site directly downstream of the watershed (P11K12) went from not meeting either IBI or MIwb targets in 2006 with a narrative score of poor to meeting both IBI and MIwb targets and a narrative score of good for IBI and marginally good for MIwb in 2017 (see Table 3).

Table 3. Fish community health metric scores in the Upper Blue Creek watershed from 2017 data

<table>
<thead>
<tr>
<th>RM (Drainage area mi(^2))</th>
<th>Site ID</th>
<th>Year</th>
<th>IBI</th>
<th>MIwb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Blue Creek (041000090801)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WWH 10.0(^H) (6.7)</td>
<td>P11K11</td>
<td>2017</td>
<td>32</td>
<td>H</td>
</tr>
<tr>
<td>7.8(^H) (12.7)</td>
<td>P11P39</td>
<td>2017</td>
<td>34</td>
<td>H</td>
</tr>
<tr>
<td>Lower Blue Creek (041000090802)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WWH (First site downstream of Upper Blue Creek HUC-12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5(^W) (27.0)</td>
<td>P11K12</td>
<td>2017</td>
<td>40</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Source: Ohio EPA 2018b (Data from 2017).

Notes
Green scores meet the IBI or ICI biological criteria or the QHEI target. Red scores do not meet the IBI or ICI biological criteria or the QHEI target.
H. Headwater site (< 20mi\(^2\)), MIwb is not applicable.
W. Wading site.

7 DELT=Deformities, Erosions, Lesions, and Tumors
Table 4. Fish species captured in Blue Creek at sites SC-8 and P11P39

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Feed Guild</th>
<th>Pollution Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Collected at both sites in relatively small numbers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central mudminnow</td>
<td>Umbra limi</td>
<td>I</td>
<td>T</td>
</tr>
<tr>
<td>Green sunfish</td>
<td>Lepomis cyanellus</td>
<td>I</td>
<td>T</td>
</tr>
<tr>
<td>Rock bass</td>
<td>Ambloplites rupestris</td>
<td>C</td>
<td>N/A</td>
</tr>
<tr>
<td>Tadpole madtom</td>
<td>Noturus gyrinus</td>
<td>I</td>
<td>N/A</td>
</tr>
<tr>
<td>Yellow bullhead</td>
<td>Ameiurus natalis</td>
<td>I</td>
<td>T</td>
</tr>
<tr>
<td><strong>Collected at one site in relatively large numbers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluegill sunfish</td>
<td>Lepomis macrochirus</td>
<td>I</td>
<td>P</td>
</tr>
<tr>
<td>Bluntnose minnow</td>
<td>Pimephales notatus</td>
<td>O</td>
<td>T</td>
</tr>
<tr>
<td>Spotfin shiner</td>
<td>Notropis spiopterus</td>
<td>I</td>
<td>N/A</td>
</tr>
<tr>
<td>Stoneroller</td>
<td>Campostoma anomalum</td>
<td>H</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Collected at one site in relatively small numbers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common carp*</td>
<td>Cyprinus carpio</td>
<td>O</td>
<td>T</td>
</tr>
<tr>
<td>Creek chub</td>
<td>Semotilus atromaculatus</td>
<td>I</td>
<td>T</td>
</tr>
<tr>
<td>Golden shiner</td>
<td>Notemigonus crysoleucas</td>
<td>I</td>
<td>T</td>
</tr>
<tr>
<td>Grass pickerel</td>
<td>Esox americanus</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Green x Bluegill</td>
<td>Lepomis cyanellus x gibbosus</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Largemouth bass</td>
<td>Micropterus salmoides</td>
<td>C</td>
<td>M</td>
</tr>
<tr>
<td>Northern pike</td>
<td>Esox lucius</td>
<td>P</td>
<td>N/A</td>
</tr>
<tr>
<td>Redfin pickerel</td>
<td>Esox americanus americanus</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Sand shiner</td>
<td>Notropis stramineus</td>
<td>I</td>
<td>M</td>
</tr>
<tr>
<td>White sucker</td>
<td>Catostomus commersonii</td>
<td>O</td>
<td>T</td>
</tr>
</tbody>
</table>

Source: Ohio EPA 2009a (Data from 2006) and PCS 2009 (Data from 2009).

Notes
* Non-native
a. Feed Guild: P=Piscivore, F=Filter Feeder, V=Invertivore, I=Specialist Insectivore, O=Omnivore, G=Generalist, H=Herbivore, C=Carnivore, N/A=Not Assigned
b. Tolerance Guild: R=Rare Intolerant, S=Special Intolerant, I=Common Intolerant, M=Moderately Intolerant (Headwaters), P=Moderately Tolerant, T=Highly Tolerant, N/A=Not Assigned

2.2.2 Macroinvertebrate Community Health

Macroinvertebrate data collected in the Upper Blue Creek watershed by the Ohio EPA in 2006 and PCS in 2009 indicate that macroinvertebrate community health is impaired at two of the three sampling locations in Blue Creek. Diversity was low in general across the stream (see Table 5 and Ohio EPA 2009a). Good riffle habitat at RM 7.8 resulted in a marginally high EPT diversity at this station; however, the sample point was still predominated by facultative taxa. The Ohio EPA during their surveys in 2006 found that for the station at RM 10.0 “the physical characteristics of this station were impacting the macroinvertebrates and preventing them from reaching their full diversity potential” suggesting that low QHEI scores were the limiting factor in macroinvertebrate community health (Ohio EPA 2009a).
Macroinvertebrate communities sampled in 2017 at RM 10.0 resulted in improved ICI scores in relation to the same populations sampled in 2006 (see Table 2). The macroinvertebrate score at RM 7.8 did not change between 2006 and 2017, and the score at RM 5.5 downstream of Upper Blue Creek decreased, but is still within attainment.

Table 5. Macroinvertebrates sampled in Blue Creek at SC-8 in 2009

<table>
<thead>
<tr>
<th>Elevated Taxa</th>
<th>Lowest Taxa</th>
<th>Common Name</th>
<th>Tolerancea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Celeoptera</td>
<td><em>Psephenus sp.</em></td>
<td>Aquatic beetle</td>
<td>4</td>
</tr>
<tr>
<td>Ephemeroptera</td>
<td><em>Caenis sp.</em></td>
<td>Mayfly</td>
<td>7</td>
</tr>
<tr>
<td>Gastropoda</td>
<td><em>Physa sp.</em></td>
<td>Snail</td>
<td>8</td>
</tr>
<tr>
<td>Gastropoda</td>
<td><em>Helisoma sp.</em></td>
<td>Snail</td>
<td>6</td>
</tr>
<tr>
<td>Gastropoda</td>
<td><em>Lymnaea sp.</em></td>
<td>Snail</td>
<td>6</td>
</tr>
<tr>
<td>Megaloptera</td>
<td><em>Sialis sp.</em></td>
<td>Alderfly</td>
<td>4</td>
</tr>
<tr>
<td>Pelecypoda</td>
<td><em>Pelecypoda</em></td>
<td>Clam</td>
<td>6-8</td>
</tr>
<tr>
<td>Odonota</td>
<td><em>Enallagma sp.</em></td>
<td>Damselfly</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: PCS 2009.

Notes

a. Tolerance values range from 0 (highly intolerant of pollution) to 10 (highly tolerant of pollution)

2.2.3 Fish Habitat

Fish habitat, as measured by QHEI in 2006 and 2009, ranges from fair at RM 8.9 to very poor at RM 10.0. The stretch of Blue Creek in the Upper Blue Creek watershed is characterized by channelization, little to no riparian buffer, leveed banks, and high levels of siltation. Row crops abutting the edges of the stream and tile drainage directly into the creek from nearby agricultural fields increase the nutrient loading of the creek as well as the amount of siltation (see Figure 15 and Figure 15). Some sections of the stream contain good quality substrate, but the amount of siltation has rendered their instream cover to negligible amounts.

QHEI scores were low across all scoring criteria, with the exception of the Pool/Current category, indicating that Blue Creek is deep enough and has sufficient water velocity to support fish populations (see Table 6). However, the heavy siltation across the stream suggests that stream power and gradient is insufficient to move the silt substrates entering the stream (PCS 2009). Extensive stream modifications have left these habitats with little possibility of recovery without the help of human intervention. Furthermore, several stretches of Blue Creek have been re-routed from their natural courses to accommodate infrastructure and agriculture. The stream is also culverted at several road junctions across the watershed.

QHEI scores decreased between the 2006 and 2017 sampling events in the Upper Blue Creek watershed, indicating that the heavy siltation and extensive embeddedness of the streams has not improved in the past ten years (see Table 6). The upstream sample station QHEI score dropped by more than ten points, mostly due to a decrease in stream cover.
Table 6. *Upper Blue Creek* QHEI data with the score broken down by category

<table>
<thead>
<tr>
<th>RM (Drainage Area mi²)</th>
<th>Site ID</th>
<th>Year</th>
<th>Narrative Score</th>
<th>QHEI Total</th>
<th>QHEI Metrics (Maximum Score)</th>
<th>Substrate (20)</th>
<th>Cover (20)</th>
<th>Channel (20)</th>
<th>Riparian (10)</th>
<th>Pool/Current (12)</th>
<th>Riffle/Run (8)</th>
<th>Gradient (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0⁽H⁾ (6.7)</td>
<td>P11K11</td>
<td>2006</td>
<td>Very Poor</td>
<td>29.5</td>
<td>1.0</td>
<td>8.0</td>
<td>5.0</td>
<td>3.5</td>
<td>8.0</td>
<td>0.0</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2017</td>
<td>Very Poor</td>
<td>18</td>
<td>0.5</td>
<td>2.0</td>
<td>4.0</td>
<td>3.0</td>
<td>4.0</td>
<td>0.0</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>8.9⁽H⁾ (10.3)</td>
<td>SC-8</td>
<td>2009</td>
<td>Fair</td>
<td>45</td>
<td>10.0</td>
<td>11.0</td>
<td>6.0</td>
<td>5.0</td>
<td>6.0</td>
<td>3.0</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>7.8⁽H⁾ (12.7)</td>
<td>P11P39</td>
<td>2006</td>
<td>Poor</td>
<td>37.5</td>
<td>1.0</td>
<td>11.0</td>
<td>7.5</td>
<td>4.0</td>
<td>10.0</td>
<td>0.0</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2017</td>
<td>Poor</td>
<td>35</td>
<td>8.0</td>
<td>7.0</td>
<td>6.0</td>
<td>5.5</td>
<td>3.0</td>
<td>1.0</td>
<td>4.0</td>
<td></td>
</tr>
</tbody>
</table>

Source: Ohio EPA 2009a (Data from 2006), Keith Carr personal communication, Ohio EPA 2018c (Data from 2017).

**Notes**
- Green scores meet the QHEI target. Red scores do not meet the QHEI target. The QHEI target for headwater WWH streams in the HELP ecoregion is 55
- Narrative scores as pertaining to headwater sites (drainage area ≤20mi²)

**Figure 14.** Blue Creek at RM 10.0. Eutrophication, channelization, and lack of cover characterize this stretch of the stream.  
Source: Ohio EPA 2009a

**Figure 15.** Blue Creek at RM 7.8. Channelization and limited riparian buffer are characteristic of this sample station.  
Source: Ohio EPA 2009a
2.3 SUMMARY OF POLLUTION CAUSES AND ASSOCIATED SOURCES

Ohio EPA determined causes and sources of aquatic life use impairments at one sampling location in the Upper Blue Creek watershed and one sampling location directly downstream of the Upper Blue Creek watershed using data collected from 2006 (see Table 7). They recognized three nonpoint sources: stream channelization, tile drainage, and failing home sewage disposal (septic) systems. This plan does not address point source pollution or illicit discharges. See the TMDL report for a list of NPDES (National Pollutant Discharge Elimination System) permitted facilities in the Upper Blue Creek WAU (Ohio EPA 2009b). For information about phosphorous loading in the Lake Erie basin and efforts to address harmful algal blooms see the State of Ohio’s Domestic Action Plan, U.S. Action Plan for Lake Erie, and the Ohio Lake Erie Phosphorous Task Force II Final Report (Ohio Lake Erie Commission 2018, U.S. EPA 2018, Ohio EPA 2013).

The northeastern section of the watershed was once considered a critical area for septic system replacement (Maumee RAP 2006a). According to the 2017 Section 208 report for the Toledo metropolitan area, Neapolis is still considered a critical sewage area (TMACOG 2017). These areas are identified as areas with high concentrations of failing onsite sewage systems where replacements and upgrades to the existing system will not be sufficient. Part of the reason upgrades would be insufficient is that septic system leach fields do not tend to function as intended in this area due to the seasonally high water table (TMACOG 2017). Most of the residential developments in Upper Blue Creek are dependent on home sewage disposal (septic) systems. As indicated by the Ohio EPA in the Biological and Water Quality Study of Swan Creek and Selected Tributaries report, sewage discharges in un-sewered areas are a main source of impairment at site P11K12 (RM 5.5, Ohio EPA 2009a). Leaking and poorly maintained septic systems release pathogens and organics into groundwater and nearby streams, increasing nutrient enrichment and pollution. However, it should be noted that as of 2017, the two downstream sample points (PP11P39 and P11K12) are within attainment of their ALU, although it is unknown if the sewage discharge sources have been alleviated.

Table 7. Causes and sources of aquatic life use impairments in the Upper Blue Creek watershed

<table>
<thead>
<tr>
<th>RM (Drainage Area mi²)</th>
<th>Site ID</th>
<th>Causes</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0H (6.7)</td>
<td>P11K11</td>
<td>• Direct habitat alterations</td>
<td>• Channelization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sedimentation/siltation</td>
<td>• Crop production with subsurface drainage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Bacteria – E. coli*</td>
<td>• On-site sewage discharge*</td>
</tr>
</tbody>
</table>

Lower Blue Creek (041000090802)
WWH (First site downstream of Upper Blue Creek HUC-12)

<table>
<thead>
<tr>
<th>RM (Drainage Area mi²)</th>
<th>Site ID</th>
<th>Causes</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5W (27.0)</td>
<td>P11K12</td>
<td>• Direct habitat alterations</td>
<td>• Channelization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sedimentation/siltation</td>
<td>• Crop production with subsurface drainage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Nitrate/nitrite</td>
<td>• Sewage discharges in unsewered areas*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Bacteria – E. coli*</td>
<td></td>
</tr>
</tbody>
</table>

Source: Ohio EPA 2009a
Notes
* also considered a recreational use impairment. Addressing recreational use impairments is beyond the scope of this NPS-IS plan, which is limited to ALU impairments

This data suggests that the major causes of impairment in the Upper Blue Creek WAU and the explanation for why certain reaches of the stream are in non-attainment are: hydrologic modification as a result of agricultural land use and channelization; nutrient-rich runoff from agricultural fields; and the influx of E. coli and organics from leaking septic systems.

2.4 ADDITIONAL INFORMATION

Additional documents and reports used to prepare this NPS-IS plan are cited in the Reference section (Section 5).
3 CONDITIONS & RESTORATION STRATEGIES FOR THE UPPER BLUE CREEK CRITICAL AREAS

3.1 OVERVIEW OF CRITICAL AREAS

Of the three sampling sites located within the Upper Blue Creek watershed, two are in full attainment as of 2017 (P11K11 and P11P39). The other station (SC-8) is in non-attainment. One Ohio EPA sample station located downstream of the Upper Blue Creek watershed (P11K12) is also in attainment according to 2017 data. However, habitat scores at all three sample points in 2017 were below their targets and fish and macroinvertebrate scores were just above target levels. As such, these sample points have been deemed “threatened” to indicate that they are close to falling back out of attainment. One critical area has been delineated to address the nonpoint source pollution issues that are believed to be causing the impairments and “threatened” statuses (see Table 8 and Figure 17). Critical area boundaries were determined based on land use, potential for successful project implementation, and suitability for the types of projects needed to address impairments.

Table 8. Upper Blue Creek WAU (HUC 04100009 08 01) Critical Areas

<table>
<thead>
<tr>
<th>Critical Area #</th>
<th>Sample Sites</th>
<th>Critical Area Description</th>
<th>Attainment Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P11K11, SC-8</td>
<td>Blue Creek and unnamed tributaries at and upstream of sample site SC-8 (RM 8.9)</td>
<td>Full (Threatened), Non†</td>
</tr>
</tbody>
</table>

Notes
† Data collected was level III credible data (PCS 2009), however no formal attainment decision was made by the Ohio EPA using this data.

Figure 16. Blue Creek at County Road 2 and White Pines Golf Course. Tree cover upstream of this point is sparse.
Figure 17. Critical Areas in the Upper Blue Creek WAU

Figure 18. Blue Creek in the western part of the watershed. Buffers between crop fields and streams in this area generally do not contain woody plants.
3.2 CRITICAL AREA #1: CONDITIONS, GOALS, & OBJECTIVES

3.2.1 Detailed Characterization

This critical area contains the headwaters of Blue Creek and various unnamed tributaries that flow through roadside and agricultural ditches before joining Blue Creek. Of the 1,132 total acres, the predominant land cover in this critical area is agriculture (68%) and forest (17%) (see Table 9). Surrounding land use is largely agricultural. White Pines Golf Course (130 acres) is adjacent to 0.6 mile out of the total 6.2 miles of Blue Creek included in Critical Area 1. This critical area also contains portions of the Maumee State Forest. Many of the streams are channelized and separated from their historical floodplains by agricultural production. Buffer width is highly variable due to wide buffers in state-protected lands and very narrow buffers along agricultural land.

Priority agricultural lands have also been identified surrounding Critical Area 1 (see Figure 17). Priority agricultural lands are areas currently in agricultural production that should be targeted for future BMP implementation projects and land conversion projects. Interventions on these parcels would not necessarily directly impact in-stream habitat, but would have indirect benefits to water quality though nutrient and sediment reduction. While these areas are not within Critical Area 1, they have been identified to showcase preferred sites for upstream water quality improvement and land use change projects.

Table 9. Land Cover in Critical Area 1 of Upper Blue Creek

<table>
<thead>
<tr>
<th>Land Cover</th>
<th>Area (acres)</th>
<th>Area (% of critical area)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open water</td>
<td>2</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Developed, open space</td>
<td>91</td>
<td>8%</td>
</tr>
<tr>
<td>Developed, low intensity</td>
<td>22</td>
<td>2%</td>
</tr>
<tr>
<td>Developed, medium intensity</td>
<td>1</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Developed, high intensity</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Barren land</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Deciduous forest</td>
<td>148</td>
<td>13%</td>
</tr>
<tr>
<td>Evergreen forest</td>
<td>40</td>
<td>4%</td>
</tr>
<tr>
<td>Mixed forest</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Shrub/scrub</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Grassland/herbaceous</td>
<td>26</td>
<td>2%</td>
</tr>
<tr>
<td>Pasture/hay</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Cultivated crops</td>
<td>764</td>
<td>68%</td>
</tr>
<tr>
<td>Woody wetlands</td>
<td>1</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Emergent herbaceous wetlands</td>
<td>3</td>
<td>&lt;1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,132</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source: Homer et al. 2015

Notes
Areas rounded to the nearest acre or percentage point
A double dash indicates that the land cover is not present
a. Totals do not sum exactly due to rounding
Figure 19. Critical Area 1 in the Upper Blue Creek watershed.

Figure 20. Blue Creek in part of the Maumee State Forest. Riparian cover and in-stream habitat structures are high here compared to other areas of the watershed.
3.2.2 Detailed Biological Condition

The Ohio EPA sample site (P11K11) located in Critical Area 1 was not sampled for fish populations during the 2006 sampling event due to excessive macrophytes on the stream surface. However, macroinvertebrate data in conjunction with calculated QHEI scores suggest that any fish populations present would be pollution tolerant and low diversity (Ohio EPA 2009a). In 2017, the fish population at sample site P11K11 was meeting its associated biological criteria with a narrative score of *fair* (see Table 10). No DELT anomalies were observed.

Fish community samples at RM 8.9 from 2009 indicate that the SC-8 sample point is in attainment of the IBI; MIwb is not applicable because the station is considered a headwater site. Narrative evaluation of fish communities is considered *fair* and sampled fish ranged from moderately intolerant to highly tolerant of pollution. QHEI scores were below the target.

<table>
<thead>
<tr>
<th>RM (Drainage Area mi²)</th>
<th>Site ID</th>
<th>Year</th>
<th>QHEI</th>
<th>Total Species</th>
<th>IBI</th>
<th>Mlw</th>
<th>Predominant Species (percent of catch)</th>
<th>Narrative Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0ʰ (6.7)</td>
<td>P11K11</td>
<td>2006</td>
<td>29.5</td>
<td>--*</td>
<td>--*</td>
<td>H</td>
<td>Johnny darter (36%), Central mudminnow (19%), Tadpole madtom (18%), Redfin pickerel (18%)</td>
<td><em>Fair</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2017</td>
<td>18</td>
<td>7</td>
<td>32</td>
<td>H</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.9ʰ (10.3)</td>
<td>SC-8</td>
<td>2009</td>
<td>45</td>
<td>17</td>
<td>32</td>
<td>H</td>
<td>Stoneroller (29.4%), Bluntnose minnow (23.2%), Bluegill sunfish (21.4%)</td>
<td><em>Fair</em></td>
</tr>
</tbody>
</table>

Source: Ohio EPA 2009a (Data from 2006), Ohio EPA 2018a (Data from 2017), PCS 2009.

Notes
- Green scores meet the IBI or ICI biological criteria or the QHEI target. Red scores do not meet the IBI or ICI biological criteria or the QHEI target.
- * Fish populations were not sampled at this location in 2006
- H. Headwater site (< 20mi²), MIwb is not applicable.

Figure 21. Blue Creek near White Pines Golf Course in Critical Area 1.
Macroinvertebrate community health at sampling site P11K11 in 2006 was narratively scored as fair (see Table 11). Predominant species were both facultative and there were few EPT taxa and no sensitive taxa collected. Diversity in general was low. The Ohio EPA states that the lack of macroinvertebrate diversity was caused by poor physical habitat, most notably the absence of riffles and runs (Ohio EPA 2009a). According to the 2006 data, the P11K11 sampling site is not meeting the WWH standard for ICI score (goal is 34). In 2017, the ICI score was in attainment of the biological criteria target with a narrative score of marginally good.

Macroinvertebrate diversity at sample point SC-8 was low (eight total taxa were collected) and only one EPT taxa was collected, a pollution-tolerant mayfly species. Total numbers of individuals collected were also low (17 total individuals), and most collected were pollution-tolerant snails and clam species.

<table>
<thead>
<tr>
<th>RM (Drainage Area m$^2$)</th>
<th>Site ID</th>
<th>Year</th>
<th># of Taxa</th>
<th>Predominant Species (Tolerance Category)$^c$</th>
<th>Narrative Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0$^h$ (6.7)</td>
<td>P11K11</td>
<td>2006</td>
<td>24</td>
<td>Flatworms (F), scuds (F)</td>
<td>Fair</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Sensitive$^b$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2017</td>
<td>44</td>
<td>n/a</td>
<td>Marginally Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td>Flatworms (F), scuds (F)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>n/a</td>
<td>Sensitive$^b$</td>
<td></td>
</tr>
<tr>
<td>8.9$^h$ (10.3)</td>
<td>SC-8</td>
<td>2009</td>
<td>8</td>
<td>Snails, clams</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Sensitive$^b$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Sensitive$^b$</td>
<td></td>
</tr>
</tbody>
</table>

Source: Ohio EPA 2009a (Data from 2006), Ohio EPA 2018d (Data from 2017), PCS 2009.

Notes
Green scores meet the IBI or ICI biological criteria or the QHEI target. Red scores do not meet the IBI or ICI biological criteria or the QHEI target.

- EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies)
- Sensitive Taxa: Taxa listed on the Ohio EPA Macroinvertebrate Taxa List as MI (Moderately Intolerant) or I (Intolerant)
- Tolerance Category: VT=Very Tolerant, T=Tolerant, MT=Moderately Tolerant, F=Facultative, MI=Moderately Intolerant, I=Intolerant
- H. Headwater site (< 20mi$^2$)

Figure 22 and Figure 23. Stretches of Blue Creek through the Maumee State Forest. Riparian cover is high; however, stream substrates show high levels of sedimentation.
3.2.3 Detailed Causes and Associated Sources

The Ohio EPA sampled site P11K11 in 2006 and identified causes and sources of aquatic life use impairments specific to Critical Area 1 (see Table 12). These sources indicate negative impacts of habitat modification, land use change, and human development in the areas surrounding Blue Creek. Critical Area 1 is characterized by channelized streams and agricultural ditches with narrow to non-existent riparian buffers and low instream cover. Many of these channels were not formerly natural stream channels, but rather man-made in order to drain agricultural areas of historical wetlands (PCS 2009). Siltation and sedimentation caused by fine-particle agricultural runoff are a major cause of low habitat scores. Erosion along steep banks composed of predominantly sandy soils is also contributing to sedimentation. The predominance of subsurface tile drainage in this area increases nutrient loading into streams, causing eutrophication along segments of Blue Creek (see Figure 24).

Figure 24. Blue Creek at County Road 3. Note tile drainage pipe on the right side of the stream.

The riparian buffer along Blue Creek in Critical Area 1 averages 15 feet and is comprised mainly of herbaceous plants and small shrubs, and sometimes exclusively turf grass. Shaded cover along the stream is low except where streams traverse state-protected land as part of the Maumee State Forest. Most of the stretch of Blue Creek north of County Road D contains no riparian buffer and row crops directly border the stream. Most segments of Blue Creek and its unnamed tributaries are channelized and ditched, especially along roads and row crop fields. As evident in aerial photographs, some tributary segments have been filled to create agriculture fields, although their historical hydrology is still apparent in patterns of wet soil. While most of the streams in this area are still open to the air, there are many instances of culverted sections to accommodate roadways.

The portion of Blue Creek along White Pines Golf Course has a variable riparian buffer width. Some areas along the golf course streambank are shaded with trees and have a 50 foot wide buffer, while others have a narrow 10 foot buffer comprised of herbaceous plants. The man-made, unnamed tributary of Blue Creek that flows through the golf course is heavily channelized and routed to fill ponds that act as water hazards on the course. Other parts of the tributary are culverted underground to accommodate fairways. Sections of this tributary have almost no buffer between the stream and turf areas of the golf course. The golf course being directly adjacent to Blue Creek poses a risk of nutrient-rich runoff as a result of regular golf course maintenance. The lack of riparian buffer along some of the stream increases the potential nutrient loading from the course.

The upstream portions of the unnamed tributary flow through part of the Maumee State Forest, which acts as a high-quality wooded buffer. Buffer width is variable, but generally very wide. Portions of the tributary flow alongside the Maumee State Forest all-purpose vehicle track, where the buffer narrows and contains fewer shade trees.
Agricultural BMP installation is variable throughout the Upper Blue Creek headwaters. Cover crops tend to be the most widespread practice in land surrounding Critical Area 1. Buffer strips are also used in certain areas, especially near the intersection of County Road 3 and County Road C. Crop rotation best management practices, where corn is rotated with other crops after a number of seasons, are not generally employed in the watershed\(^8\). In some places, corn is planted every year for more than five years. Based on areas of current BMP implementation, farmland in the northwestern part of the watershed should be targeted for farmer outreach programs. As such, these areas have been prioritized and mapped in Figure 17). Fulton SWCD is prioritizing the following conservation practices to improve aquatic habitat: filter strips (FOTG #393), grade stabilization structures (FOTG #410), oak savanna restoration (FOTG #643), grassed waterways (FOTG #412), and riparian forested buffers (FOTG #391)\(^9\).

Human development in Critical Area 1 is low density and widely spaced. As such, residents in this area rely on home sewage disposal (septic) systems. Failing systems are identified as one of the major sources of impairment at site P11K11 (see Table 12). Pathogenic and human health related impairments are not the focus of this plan; however, leaking septic systems can also increase eutrophication, contaminate groundwater and soil, and increase nutrient loading into streams, all of which contribute to degraded habitat and fish populations.

### Table 12. Causes and sources of ALU impairment in Critical Area 1

<table>
<thead>
<tr>
<th>RM (Drainage Area mi(^2))</th>
<th>Site ID</th>
<th>Causes</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0(^4) (6.7)</td>
<td>P11K11</td>
<td>• Direct habitat alterations</td>
<td>• Channelization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sedimentation/siltation</td>
<td>• Crop production with subsurface drainage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Bacteria – E. coli</td>
<td>• On-site sewage discharge</td>
</tr>
</tbody>
</table>

Priority Projects:

- Riparian buffer installation
- Wetland restoration
- Conversion of agricultural land to oak savanna
- Streambank stabilization
- Agricultural BMP installation
  - Filter strips, cover crops, etc.
  - Failing septic system solutions

### 3.2.4 Goals and Objectives for Critical Area #1

As explained above, Critical Area 1 is primarily impaired by direct habitat alterations through channelization and riparian buffer removal, and sedimentation and siltation. Habitat restoration, streambank stabilization, and agricultural BMP implementation will be needed to improve aquatic community health. Although not listed as a cause of impairment in the watershed, a reduction in nutrient (phosphorus and nitrogen) loading is an important step in improving water quality in Lake Erie. Best management practices that capture sediment or bind nutrients, such as bioretention practices, should be implemented in the watershed to help capture nutrients before they reach the lake. For information about phosphorous loading in the Lake Erie basin and efforts to address harmful algal blooms see the *State of Ohio’s Domestic Action Plan*, *U.S. Action Plan for Lake Erie*, and the *Ohio Lake Erie Phosphorous Task Force II Final Report* (Ohio Lake Erie Commission 2018, U.S. EPA 2018, Ohio EPA 2013).

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\(^8\) Kimberly Panozzo, University of Toledo Department of Geography and Planning. Personal communication.

\(^9\) Pete Carr, Fulton SWCD. Personal communication.
3.2.4.1  Goals

The overall nonpoint source restoration goals of any NPS-IS plan is to improve IBI, MIwb, ICI, and QHEI scores such that a waterbody is brought into full attainment of the designated ALU. Non-attainment\(^{10}\) in this critical area is due to poor ICI scores. Additionally, QHEI scores are below the target. Although sample point P11K11 is currently in attainment according to 2017 sampling data, IBI and ICI scores are still low enough to cause concern about future attainment. Hence, this sample point is considered in attainment, but “threatened.” Therefore, the goal for Critical Area 1 of the Upper Blue Creek watershed is to improve ICI scores at site SC-8 (RM 8.9) so that the site will improve from non-attainment to full attainment of the designated ALU and to improve IBI, ICI, and QHEI scores at site P11K11 (RM 10.0). Phosphorous reduction goals based on the Recommended Phosphorous Loading Targets for Lake Erie report published by the Great Lakes Water Quality Agreement’s Nutrient Annex subcommittee (40% reduction in Total Phosphorous and Dissolved Reactive Phosphorous) should be considered for Critical Area 1 due to the presence of the golf course along Blue Creek as well as the high percentage of agricultural land use (GLWQA 2015). Further baseline phosphorous data is needed before quantitative phosphorous reduction goals can be established for the Upper Blue Creek watershed. Critical Area 1 goals are specifically to:

- **Goal 1.** Maintain/achieve an IBI score at or above 28 at sampling site P11K11 (RM 10.0) on Blue Creek
  - ACHIEVED: Site currently has a score of 32

- **Goal 2.** Maintain/achieve an IBI score at or above 28 at sampling site SC-8 (RM 8.9) on Blue Creek
  - ACHIEVED: Site currently has a score of 32

- **Goal 3.** Maintain/achieve an ICI score of 34 at sampling site P11K11 (RM 10.0) on Blue Creek
  - ACHIEVED: Site currently has a score of *marginally good*

- **Goal 4.** Maintain/achieve an ICI score of 34 at sampling site SC-8 (RM 8.9) on Blue Creek
  - NOT ACHIEVED: Site currently has a score of *poor*

- **Goal 5.** Maintain/achieve a QHEI score of 55 at sampling site P11K11 (RM 10.0) on Blue Creek
  - NOT ACHIEVED: Site currently has a score of 18

- **Goal 6.** Maintain/achieve a QHEI score of 55 at sampling site SC-8 (RM 8.9) on Blue Creek
  - NOT ACHIEVED: Site currently has a score of 45

3.2.4.2  Objectives

To achieve the overall nonpoint source restoration goal of full attainment, the following objectives need to be achieved within Critical Area 1:

- **Objective 1.** Re-grade and stabilize 10,000 linear feet of streambank (about 10% of total streambank length in Critical Area 1)
  - Blue Creek and its channelized tributaries currently have steep banks. Because of the sandy soil, banks should be 6:1 or 7:1 slope with native vegetation to stabilize and prevent erosion (PCS 2009)
  - *Restore Impaired Streams Altered Habitats* (Ohio EPA 2014; Goal 2.01.01)
  - *Stabilize Severely Eroding Stream Banks* (Ohio EPA 2014, Goal 2.03.02)

- **Objective 2.** Create or restore 50 acres of wetland habitat (about 5% of total acreage of Critical Area 1. The Upper Blue Creek watershed was historically 66% wetland (Ohio EPA 2016))

\(^{10}\) Data collected was level III credible data, however no formal attainment decision was made by the Ohio EPA using this data.
Objective 3. Create or restore 50 acres of riparian forested buffer (FOTG #391) to increase stream cover and reduce erosion and nutrient loss

- Restore and Protect Riparian Habitat (Ohio EPA 2014, Goal 2.03.01)
- Increase Native Shrub and Tree Plantings in Riparian Areas (Ohio EPA 2014, Goal 2.03.04)
- Reduce Erosion and Nutrient and Sediment Loss to Surface Waters (Ohio EPA 2014, Goal 3.01.02)

As these objectives are implemented, water quality monitoring (both project-related and regularly scheduled monitoring) will be completed to determine progress toward meeting the identified goals (i.e., water quality standards). These objectives will be reevaluated and modified, as necessary. When reevaluating, see Ohio's Nonpoint Source Management Plan Update (Ohio EPA 2014), which has a complete listing of all eligible NPS management strategies.
Projects and evaluations believed to be necessary to address the causes and sources of impairments to the Upper Blue Creek watershed are presented by critical area in this section. As Ohio assesses attainment using numeric biological criteria, periodic re-evaluation of biological conditions will be necessary to determine if the implemented projects restore the critical areas to the predicted levels.

Time is an important factor to consider when measuring project success and overall status. Biological systems in some cases can show response fairly quickly (e.g., one season); other systems may take longer (e.g., several seasons, years) to show recovery. There may also be reasons other than nonpoint source pollution for the impairment. Those issues will need to be addressed under different initiatives, authorities, or programs which may or may not be accomplished by the same implementers addressing the nonpoint source pollution issues.

The Upper Blue Creek was delineated with one critical area to address causes and sources of ALU impairment. The critical area is assigned a project overview table in the following subsection (4.1.1). Projects identified in the overview table were prioritized based on the following method:

- **Highest Priority**: Projects that directly address one or more of the critical area’s listed objectives
  - Landowner support
  - Provides additional benefits to the community (e.g., reduces residential flooding, provides recreational benefit)
- **Medium Priority**: Projects that directly address one or more of the critical area’s listed objectives
- **Lowest Priority**: Projects that indirectly address one or more of the critical area’s listed objectives

If additional NPS impairments are identified for an existing critical area, the critical area’s overview table will be updated. If a new impairment is identified that is not within an existing critical area, then a new critical area will be delineated and a new summary table will be created. Future versions of this NPS-IS plan will update the project overview sheets with additional projects as they are developed to meet the stated objectives in each critical area.

Project Summary Sheets (PSS) are in Section 4.1.2. These PSS 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).

MSG calculated load reductions for critical area projects. Total suspended solids (TSS), total phosphorous (TP), and total nitrogen (TN) load reductions were estimated based on existing loads for the Maumee River and nutrient reduction rates from published literature sources (Blanco-Canqui et al. 2014; Gleason, Laubhan & Euliss, 2008; Lowrance et al. 1997; Mander et al. 1997).
4.1 CRITICAL AREA #1: OVERVIEW TABLE AND PROJECT SHEETS

The information included in Table 13 is a condensed overview of all identified projects needed for nonpoint source restoration of Critical Area 1. PSS are included for short term projects or any project that is considering seeking funding in the near future. Only those projects with complete PSS will be considered for state and federal nonpoint source program funding.

4.1.1 Critical Area #1: Project Implementation Strategy Overview Table

Critical Area 1 is based upon non-attainment at sampling site SC-8 (RM 8.9). The overview table (see Table 13) provides a quick summary of what needs to be completed and where and what problems (cause/source) will be addressed. The table includes projects at all levels of development (e.g., concept, in progress), and the table is intended to show a prioritized path toward restoration of Critical Area 1 in the Upper Blue Creek watershed.

Figure 25. Site of proposed Riparian Buffer Installation (Project 3).
Table 13. Overview table for Critical Area 1

<table>
<thead>
<tr>
<th>Goal</th>
<th>Objective</th>
<th>Project</th>
<th>Project title</th>
<th>Lead organization (criteria d)</th>
<th>Timeframe (criteria f)</th>
<th>Estimated cost (criteria d)</th>
<th>Potential/actual funding sources (criteria d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td>Urban sediment and nutrient reduction strategies</td>
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<tr>
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</tr>
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<td><strong>Altered stream and habitat restoration strategies</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4,5,6</td>
<td>1,3</td>
<td>1</td>
<td>Maumee State Forest Expansion – Rusin Property</td>
<td>ODNR</td>
<td>Short</td>
<td>$187,000</td>
<td>ODNR, Ohio EPA §319, GLRI</td>
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<tr>
<td>4,6</td>
<td>2</td>
<td>2</td>
<td>Maumee State Forest Expansion – Bostleman Property</td>
<td>ODNR</td>
<td>Short</td>
<td>$135,000</td>
<td>ODNR, Ohio EPA §319, GLRI</td>
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<td>4,5,6</td>
<td>3</td>
<td>3</td>
<td>Riparian Buffer Installation</td>
<td>Fulton SWCD</td>
<td>Short</td>
<td>$1,000</td>
<td>Fulton SWCD, USDA</td>
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<td>4,6</td>
<td>1,2,3</td>
<td>4</td>
<td>Blue Creek Non-Isolated Wetland Restoration (DMDS project)</td>
<td>TBD</td>
<td>Long</td>
<td>$1,500,000</td>
<td>Ohio EPA §319, GLRI, SOGL</td>
</tr>
<tr>
<td>4,5,6</td>
<td>1,2,3</td>
<td>5</td>
<td>Isolated Wetland and Stream Restoration</td>
<td>TBD</td>
<td>Long</td>
<td>$297,810</td>
<td>Ohio EPA §319, GLRI</td>
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<td>Agricultural nonpoint source reduction strategies</td>
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</tr>
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<td>3</td>
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<td>Fulton SWCD</td>
<td>Short</td>
<td>$1,000</td>
<td>Fulton SWCD, USDA</td>
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<td>High quality waters protection strategies</td>
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<td>Other NPS causes and associated sources of impairment</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
4.1.2 Critical Area #1: Project Summary Sheets

The PSS provided below were developed based on the actions or activities needed to achieve attainment of the ALU designation at sampling site SC-8 (RM 8.9) and to maintain attainment of the ALU designation at sampling site P11K11 (RM 10.0). These projects are considered next step or priority/short term projects. Medium and long-term projects are not presented in PSS since they are not yet ready for implementation.

<table>
<thead>
<tr>
<th>Nine Element Criteria</th>
<th>Information Needed</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>Title</td>
<td>Maumee State Forest Expansion – Rusin Property</td>
</tr>
<tr>
<td>Criterion d</td>
<td>Project Lead Organization and Partners</td>
<td>Ohio Department of Natural Resources</td>
</tr>
<tr>
<td>Criterion c</td>
<td>HUC-12 &amp; Critical Area</td>
<td>Upper Blue Creek (HUC 04100009 08 01) &amp; Critical Area 1</td>
</tr>
<tr>
<td>Criterion c</td>
<td>Project Location</td>
<td>Parcel along County Road C between Woodside Drive and County Road 3</td>
</tr>
<tr>
<td>n/a</td>
<td>Which strategy is being addressed by this project?</td>
<td>Altered stream and habitat restoration strategies</td>
</tr>
<tr>
<td>Criterion f</td>
<td>Time Frame</td>
<td>Short</td>
</tr>
<tr>
<td>Criterion g</td>
<td>Short Description</td>
<td>22-acre land acquisition and conversion of farmland to forest and wetland</td>
</tr>
<tr>
<td></td>
<td>Project Narrative</td>
<td>This project includes the acquisition of 22 acres of agricultural land adjacent to the Maumee State Forest. The cropland on the site will be converted to woodland through tree plantings and wildlife enhancement. Existing woodlands on site will be enhanced with invasive species control and forestry management to encourage oak species. There is also potential to establish wetlands in low-lying areas with wet soils. 600 ft of stream and the associated riparian buffer will also be restored through bank stabilization and native plantings</td>
</tr>
<tr>
<td>Criterion d</td>
<td>Estimated Total Cost</td>
<td>$187,000</td>
</tr>
<tr>
<td>Criterion d</td>
<td>Possible Funding Source</td>
<td>ODNR, Ohio EPA §319, GLRI</td>
</tr>
<tr>
<td>Criterion a</td>
<td>Identified Causes and Sources</td>
<td>Cause: Sedimentation/siltation Source: Crop production with subsurface drainage</td>
</tr>
<tr>
<td></td>
<td>Part 1: How much improvement is needed to remove the NPS impairment associated with this Critical Area?</td>
<td>IBI scores are currently meeting expected biological criteria. A significant improvement is necessary to raise the ICI score at SC-8 from its current score of poor to 34 to meet water quality standards. QHEI scores need to increase from 45 to 55 at SC-8 and from 18 to 55 at P11K11 to meet water quality standards</td>
</tr>
<tr>
<td></td>
<td>Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?</td>
<td>Objective 1: Re-grade and stabilize 600 of 10,000 linear feet of streambank Objective 3: Create or restore 3 of 50 acres of riparian forested buffer (FOTG #391) to increase stream cover and reduce erosion and nutrient loss</td>
</tr>
<tr>
<td></td>
<td>Part 3: Load reduced?</td>
<td>Project is expected to increase the IBI and ICI scores by 1 or 2 points each and the QHEI score by 3 or 4 points (10% of critical area goals).</td>
</tr>
<tr>
<td>Criterion i</td>
<td>How will the effectiveness of this project in addressing the NPS impairment be measured?</td>
<td>IBI, ICI, and QHEI will be assessed before and after project implementation. If this project is funded through §319, Ohio EPA DSW EAU will perform the monitoring.</td>
</tr>
<tr>
<td>Criterion e</td>
<td>Information and Education</td>
<td>This property will become part of the larger Maumee State Forest</td>
</tr>
</tbody>
</table>
Forest. The Maumee State Forest hosts multiple outreach and educational events throughout the year. They are also involved in demonstration and research plantings. This project will increase the land available for outreach events and educational programs. Signage will be provided at the project site to describe the water quality benefits of the project and to acknowledge and identify all appropriate partners and funding agencies.

Figure 26. The stream along the north side of County Road C is the proposed site of the Riparian Buffer Installation project (Project 3).

Source: Google Earth 2018
<table>
<thead>
<tr>
<th>Nine Element Criteria</th>
<th>Information Needed</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>Title</td>
<td>Maumee State Forest Expansion – Bostleman Property</td>
</tr>
<tr>
<td>Criterion d</td>
<td>Project Lead Organization and Partners</td>
<td>Ohio Department of Natural Resources</td>
</tr>
<tr>
<td>Criterion c</td>
<td>HUC-12 &amp; Critical Area</td>
<td>Upper Blue Creek (HUC 04100009 08 01) &amp; Critical Area 1</td>
</tr>
<tr>
<td>Criterion c</td>
<td>Project Location</td>
<td>Parcel along County Road A between South Fulton-Lucas County Road and County Road 2, south of Blue Creek</td>
</tr>
<tr>
<td>n/a</td>
<td>Which strategy is being addressed by this project?</td>
<td>Altered stream and habitat restoration</td>
</tr>
<tr>
<td>Criterion f</td>
<td>Time Frame</td>
<td>Short</td>
</tr>
<tr>
<td>Criterion g</td>
<td>Short Description</td>
<td>15-acre acquisition and conversion of current farmland to forested land and wetlands</td>
</tr>
<tr>
<td>Criterion g</td>
<td>Project Narrative</td>
<td>This project involves the acquisition of a 15 acre parcel that is partially agricultural land and partial woodland. The existing woodland will be enhanced through invasive species control and forestry management to encourage oak species. Farmland will be converted to forest with the potential for wetland restoration in the wet areas</td>
</tr>
<tr>
<td>Criterion d</td>
<td>Estimated Total Cost</td>
<td>$135,000</td>
</tr>
<tr>
<td>Criterion d</td>
<td>Possible Funding Source</td>
<td>ODNR, Ohio EPA §319, GLRI</td>
</tr>
<tr>
<td>Criterion a</td>
<td>Identified Causes and Sources</td>
<td>Cause: Sedimentation/siltation. Source: Crop production with subsurface drainage</td>
</tr>
<tr>
<td>Criteria b &amp; h</td>
<td>Part 1: How much improvement is needed to remove the NPS impairment associated with this Critical Area?</td>
<td>IBI scores are currently meeting expected biological criteria. A significant improvement is necessary to raise the ICI score at SC-8 from its current score of poor to 34 to meet water quality standards. QHEI scores need to increase from 45 to 55 at SC-8 and from 18 to 55 at P11K11 to meet water quality standards</td>
</tr>
<tr>
<td></td>
<td>Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?</td>
<td>Objective 2: Create or restore 7 of 50 acres of wetland habitat. Project is expected to increase the QHEI score by 1 or 2 points (5% of critical area goals).</td>
</tr>
<tr>
<td></td>
<td>Part 3: Load reduced?</td>
<td>Project is expected to create a reduction of 3,028 kg of TSS/year, 8.2 kg TP/year, and 129 kg TN/year.</td>
</tr>
<tr>
<td>Criterion i</td>
<td>How will the effectiveness of this project in addressing the NPS impairment be measured?</td>
<td>IBI, ICI, and QHEI will be assessed before and after project implementation. If this project is funded through §319, Ohio EPA DSW EAU will perform the monitoring.</td>
</tr>
<tr>
<td>Criterion e</td>
<td>Information and Education</td>
<td>This property will become part of the larger Maumee State Forest. The Maumee State Forest hosts multiple outreach and educational events throughout the year. They are also involved in demonstration and research plantings. This project will increase the land available for outreach events and educational programs. Signage will be provided at the project site to describe the water quality benefits of the project and to acknowledge and identify all appropriate partners and funding agencies.</td>
</tr>
</tbody>
</table>
## Critical Area 1: Project 3

<table>
<thead>
<tr>
<th>Nine Element Criteria</th>
<th>Information Needed</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>Title</td>
<td>Riparian Buffer Installation</td>
</tr>
<tr>
<td><strong>Criterion d</strong></td>
<td>Project Organization and Partners</td>
<td>Fulton County Soil and Water Conservation District</td>
</tr>
<tr>
<td><strong>Criterion c</strong></td>
<td>HUC-12 &amp; Critical Area</td>
<td>Upper Blue Creek (HUC 04100009 08 01) &amp; Critical Area 1</td>
</tr>
<tr>
<td><strong>Criterion c</strong></td>
<td>Project Location</td>
<td>Unnamed ditch along County Road C between Woodside Drive and County Road 5</td>
</tr>
<tr>
<td>n/a</td>
<td>Which strategy is being addressed by this project?</td>
<td>Altered stream and habitat restoration strategies Agricultural nonpoint source reduction strategies</td>
</tr>
<tr>
<td><strong>Criterion f</strong></td>
<td>Time Frame</td>
<td>Short</td>
</tr>
<tr>
<td><strong>Criterion g</strong></td>
<td>Short Description</td>
<td>Installation of forested riparian buffer along an unnamed roadside ditch</td>
</tr>
<tr>
<td><strong>Criterion g</strong></td>
<td>Project Narrative</td>
<td>The unnamed ditch in the project area lies between agricultural fields and County Road C. It currently has a small herbaceous buffer. Through this project, a 50 ft forested riparian buffer in accordance with NRCS FOTG #391 will be installed between the ditch and the cropland. The buffer will consist of four or more rows of native trees and shrubs.</td>
</tr>
<tr>
<td><strong>Criterion d</strong></td>
<td>Estimated Total Cost</td>
<td>$1,000</td>
</tr>
<tr>
<td><strong>Criterion d</strong></td>
<td>Possible Funding Source</td>
<td>Fulton SWCD, USDA</td>
</tr>
<tr>
<td><strong>Criterion a</strong></td>
<td>Identified Causes and Sources</td>
<td>Cause: Sedimentation/siltation Source: Crop production with subsurface drainage</td>
</tr>
<tr>
<td><strong>Criteria b &amp; h</strong></td>
<td>Part 1: How much improvement is needed to remove the NPS impairment associated with this Critical Area?</td>
<td>IBI scores are currently meeting expected biological criteria. A significant improvement is necessary to raise the ICI score at SC-8 from its current score of poor to 34 to meet water quality standards. QHEI scores need to increase from 45 to 55 at SC-8 and from 18 to 55 at P11K11 to meet water quality standards</td>
</tr>
<tr>
<td><strong>Criteria b &amp; h</strong></td>
<td>Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?</td>
<td>Objective 3: Create or restore 3 of 50 acres of riparian forested buffer (FOTG #391) to increase stream cover and reduce erosion and nutrient loss</td>
</tr>
<tr>
<td><strong>Criteria i</strong></td>
<td>How will the effectiveness of this project in addressing the NPS impairment be measured?</td>
<td>The downstream sample point (P11K11) will continue to be monitored through the State of Ohio’s surface water monitoring program. IBI, ICI, and QHEI metrics are used in those assessments to determine progress towards delisting impairments</td>
</tr>
<tr>
<td><strong>Criterion e</strong></td>
<td>Information and Education</td>
<td>The NRCS offers educational and information resources about each conservation practice standard (including FOTG #391) on their website. The BMP project will also be highly visible from County Road C.</td>
</tr>
</tbody>
</table>
5 REFERENCES


