# Nine- Element Nonpoint Source Implementation Strategic Plan (NPS- IS plan)

**Grand Lake St. Marys:**
**Beaver Creek HUC- 12 (05120101-0202)**
**Version 1.0 4-6-17**

Approved June 7, 2017

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## Acknowledgements

Mercer County Soil and Water Conservation District would like to thank the many partners who helped compile the information, maps and projects needed to create this document. This NPS-IS plan will help focus on projects to address the nonpoint source impairments in the Beaver Creek HUC- 12 of the Grand Lake St. Marys Watershed.

# Chapter 1: Introduction

The Beaver Creek HUC-12 (05120101-0202) drains a large portion of the Grand Lake St. Marys drainage basin, south of the lake entirely in Mercer County, Ohio. Grand Lake St. Marys is the source for drinking water in the City of Celina, Ohio. It lies just west of Chickasaw Creek HUC-12 (05120101-0201) and east of Coldwater Creek HUC-12 (05120101-0203). The Beaver Creek watershed is 20.40 square miles in size, and is the second largest of the four 12 digit HUC watersheds within the Grand Lake St. Marys watershed. (WAP 2015) The watershed is made up of primarily intensive row cropping and livestock agriculture, but also includes a golf course, landfill, and several residential areas.

In October of 2016, Mercer County Soil and Water Conservation District was awarded an Ohio EPA FY17 Section 319(h) Watershed Plan Update Project Grant to develop the NPS-IS for Beaver Creek and Chickasaw Creek HUC-12 watersheds. This NPS-IS for Beaver Creek HUC-12 will meet the U.S. EPA's nine minimum elements of a watershed plan for impaired waters.

## 1.1 Report Background

This NPS-IS was created to be one of the first watershed plans in Mercer County to create a document including nine elements and a strategic plan for the Beaver Creek HUC-12. The Beaver Creek watershed, located in the Grand Lake St. Marys (GLSM) watershed, was designated as distressed beginning January 18, 2011 due to severe algal blooms associated with phosphorous and nitrate loading into the lake, which is a public drinking water source. This created a primary interest for focusing on agricultural and residential run-off. Having nonpoint source management projects identified, when implemented, will have measureable impacts on water quality in the Beaver Creek HUC-12.

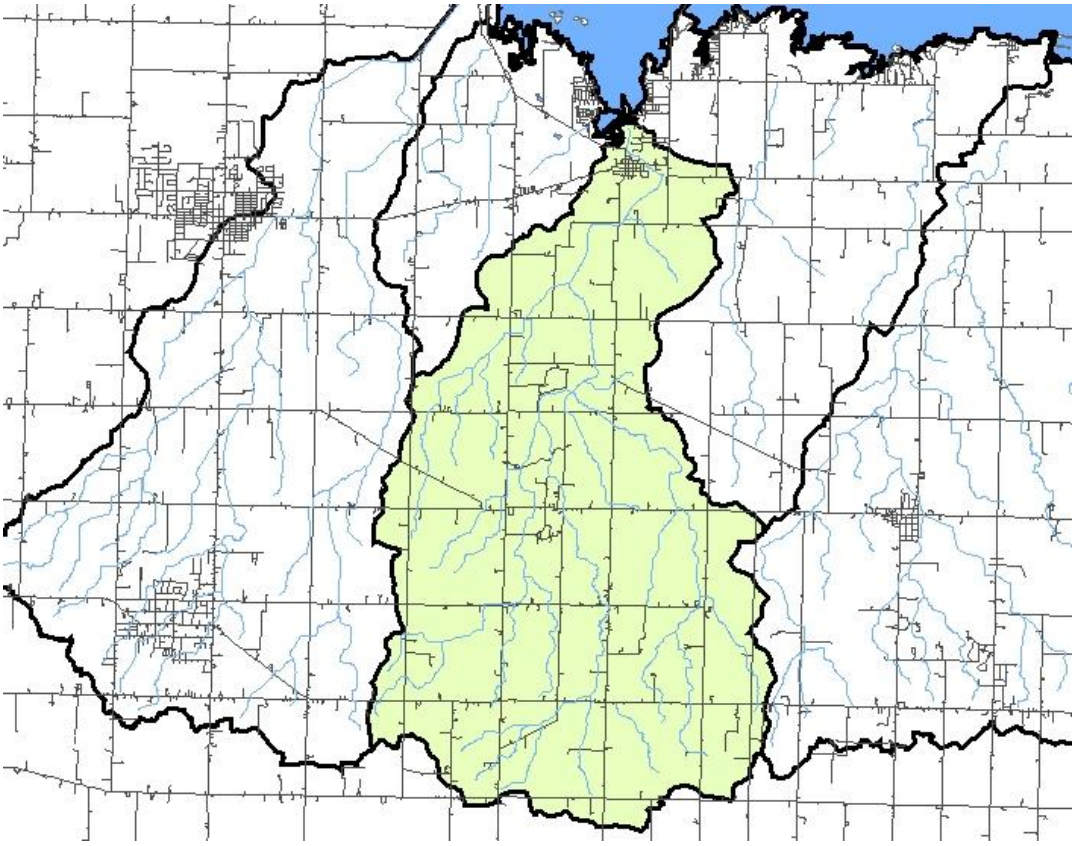

Figure 1: River Mile Map of Beaver Creek HUC-12 South of Grand Lake St. Marys. (WAP 2015)

The Beaver Creek HUC-12 is a part of the Watershed Action Plan for Grand Lake St. Marys and the Wabash River, which was fully endorsed on May 14, 2008 by ODNR and Ohio EPA. This action plan was developed to promote stewardship of the natural resources in the Grand Lake/Wabash River Watersheds as more land and water resources were being used by humans. With the change of program focus, this NPS-IS is created to guide a more specific region in addressing nonpoint source pollution issues for the Grand Lake St. Marys watershed.

## 1.2 Watershed Profile and History

The distressed watershed of GLSM consists of nearly 13,500 acres of lake and 58,880 acres of land. The Beaver Creek HUC-12, which is a portion of the GLSM watershed, is 13,059 acres in size. The watershed includes the Dahlinghaus Ditch, Upper and Lower Beaver Creek and Montezuma Creek. There is a total of nearly 35.61 miles of stream network as mapped in Figure 1. A portion of the east half of the GLSM watershed, which includes Chickasaw Creek and Barnes Creek, is in Auglaize County, Ohio. The remaining portion of the distressed watershed is located in Mercer County, Ohio. (WAP 2015)

Beginning at Grand Lake St. Marys and going upstream, Beaver Creek flows through the Village of Montezuma. After approximately 1.5 miles upstream, the first divide of Beaver Creek is off to the west, which is called Dahlinghaus Ditch. Continuing to the south and slightly east, Beaver Creek will continue greater than a mile until it divides with Montezuma Creek going southeast and Beaver Creek continuing south where it comes close to the Celina Landfill.

The landfill began operation in 1971. The landfill utilizes leachate collection and monitoring wells for both the old and new sections. It is owned today by Laidlaw Systems of Ohio Inc. (Mercer County Auditor)

Beaver Creek watershed has a significant portion of land in cropland. Approximately 80.5 percent is in row crop and pasture land, 12 percent wetlands or open water, four percent forested, and three percent urban/residential. This significant portion of cropland is also utilized for livestock manure applications. (Ohio EPA, 2007)

There has been a long history of livestock farms in the area being composed of dairy, growing steers, swine, chickens, and turkeys. Many small farms have been maintained in their own family for several decades with their kids and grandkids taking over the farm. This has kept a strong community of livestock farmers in the GLSM watershed. Farm expansion has also continued, to allow for the support of these growing families' needs.

Recreational activities in the Beaver Creek HUC-12 include many opportunities of camping, fishing, boating, and hunting on or in the vicinity. Also several religious historical sites are located within the watershed. (Ohio EPA, 2007)

*Monitoring tributary to Grand Lake St. Marys during winter thaw.*

Figure 2: Monitoring a Creek in Grand Lake St. Marys

## 1.3 Public Participation and Involvement

It is important to have diverse involvement in developing restoration plans for a watershed. This should not only include farmers, but businesses, non-profit groups, organizations and the general public. In recent years, there have been many water quality improvement projects completed within the Beaver Creek HUC-12. These projects include an increase in cover crops and managing resource concerns on livestock farms.

The attention on Grand Lake St. Marys has increased greatly since the watershed was declared distressed on January 18, 2011. The lake has long been a point of interest in western Ohio. Tourism and job creation are of great significance to the community. Due to the presence of microcystin toxin, warnings were first posted at the lake in May of 2009. Tourism dropped significantly from 2009 to 2011. However, there has been a steady increase in tourism since, with the 2015 tourism totals surpassing the totals of 2008, the year prior to the public notification system of microcystin toxin. These warnings have put a spotlight on agriculture, with a focus on manure and fertilizer management along with maintaining soil test phosphorus levels within acceptable levels.

Mercer County Soil and Water Conservation District (SWCD) has long been working closely with livestock farmers in developing Comprehensive Nutrient Management Plans (CNMP). With these plans, livestock operations producing 350 tons or 100,000 gallons of manure annually are required to keep an updated plan. The development of a CNMP requires a comprehensive engineering and conservation planning resource assessment of current site conditions. Management options and structural alternatives are developed to address resource concerns identified during the assessment. All CNMPs are approved by a certified conservation planner. Each CNMP must include Environmental Compliance for the planned system and may be comprised of six possible elements:

1. Manure and Wastewater Handling and Storage - a technical element
2. Land Treatment Practices - a technical element
3. Nutrient Management (planned for three future years) a technical element
4. Record Keeping (non-technical element)
5. Feed Management – a technical element (optional, as needed)
6. Other Utilization Options – a technical element for manure not applied to land (optional, as needed)

The Lake Improvement Association (LIA) is an organization that has worked to promote lake tourism and participation from the community in order to improve water quality in the GLSM watershed. The LIA has been in existence since 1947 and has strong membership support. They have partnered with several other agencies on many projects throughout the years and were significantly involved in the development of this plan.

In 2010, a group of farmers within the GLSM watershed came together to look for innovative solutions to improve water quality from an agriculture perspective. This Ag Solutions group met monthly for several years and heard many water quality and manure management technology presentations. They also conducted several trials with different technologies. Participation declined over time; however, the Mercer County Commissioners recognized the importance of keeping agriculture strong in the area and funded a full-time Agriculture Solutions Coordinator position. This position was hired in early 2016, and several projects are currently on-going and many technologies are being researched. The Ag Solutions Coordinator was also significantly involved in the development of this plan.

The Lake Restoration Commission (LRC) was formed in December of 2009 to pioneer the initiative dedicated to fostering the regional cooperation and resources needed for the environmental renewal and sustainability to the lake. The initial efforts primarily focused on identifying the proven scientific strategies and technological solutions able to solve the environmental crisis in GLSM. The LRC has developed treatment trains on two of the tributaries to GLSM, and a treatment train will be constructed and established on Beaver Creek during 2017. The treatment train for the Beaver Creek HUC-12 will be the third constructed on tributaries draining to GLSM. The area involves 40-50 acres of wetland area using natural vegetation to absorb nutrients. Figure 3 below shows an aerial view of the proposed treatment train area for Beaver Creek. The site is less than a half mile from GLSM and will be located right beside the Beaver Creek.


Figure 3: Proposed Area of Beaver Creek Treatment Train in 2017.

Many agricultural BMP's and projects have been installed as a result of the distressed watershed rules. In the Beaver Creek HUC-12, animal operations were a target of concern. All milk house wastewater is now contained, collected, and/or treated. All livestock operations have a minimum of four months of manure storage, with most having six months of storage. This was done in conjunction with complying with the manure application ban starting in January of 2013. The current distressed watershed rules state that no application of manure or fertilizer shall occur between December 15 and March 1st. During all other times of the year, manure applications must be completed following NRCS Practice Standard 590.

Two public interest surveys were conducted to gain input from stakeholders about nonpoint source pollution recovery projects. First, a survey was conducted and distributed by Mercer County Ag Solutions in November 2016 to gauge the interest in potential projects. This survey was distributed to an estimated 100 farmers. There was a 22% response rate. Figure 4 shows the results of the survey. Generally speaking, approximately 70% of those who responded would have an interest in participating in the projects outlined in this plan. On January 30, 2017 a public meeting was held with 15 producers from the area in attendance. Future projects were discussed and the results from the land owners corresponded with figure 4 results.

**Farmer Survey Results**

| | YES | Maybe, with more information | No | N/A |
|---|---|---|---|---|
| Would you install a manure nutrient removal technology if a grant would cover all capital costs, and if operating costs were less than a penny per gallon? | 36.8% | 36.8% | 5.3% | 21.1% |
| Would you participate in a program that would pay you to incorporate all nutrients applied to your fields? | 42.9% | 33.3% | 4.8% | 19.0% |
| Would you participate in a program to reduce soil test phosphorus if your levels are over 200 lb/acre? This would include no additional phosphorus application and an intensive cropping system. | 28.6% | 23.8% | 9.5% | 38.1% |

| | | | | |
|---|---|---|---|---|
| Would you be interested in a stream restoration project if you have a creek running through your land? | 28.6% | 38.1% | 14.3% | 19.0% |
| Would you be willing to learn more about composting penpack manure? | 50.0% | 5.0% | 25.0% | 20.0% |

Figure 4: Survey Results Received from Farmers for Changing Management Practices.

# Chapter 2: Beaver Creek HUC-12 Watershed Characterization and Assessment Summary

## 2.1 Summary Watershed Characterization for Beaver Creek HUC-12

### 2.1.1 Physical and Natural Features

The Grand Lake St. Marys HUC-10 watershed is comprised of four 12-digit HUCs. This document is focused on the Beaver Creek HUC-12 which has direct contact of river flow to Grand Lake St. Marys. It is located between Coldwater Creek HUC-12(05120101-0203) and Chickasaw Creek HUC-12 (05120101-0201), both which also have direct river flows to Grand Lake St. Marys. (WAP 2015)

Agriculture is a significant portion of the Beaver Creek HUC-12 with corn, soybeans, wheat, and alfalfa in rotation. The area has flat topography, fertile soil, and good drainage. The farmers have consistently used these resources to produce crop and livestock yields at or near the top for all Ohio counties. The majority of cropland is subsurface drained with systematically-patterned tiles. The area is relatively flat, however, of the watersheds in the GLSM watershed, Beaver Creek has the highest amount of highly erodible land, according to 2003 NRCS online soil data mart. (WAP 2015)

Specific landmarks and features of this watershed include:

- Celina Landfill
- Elks Golf course
- Airport
- Gas station/ flea market
- Village of Montezuma
- St. Charles Retirement Village

The Celina Landfill is located on Depweg Road and is currently in operation. It uses leachate collection and monitoring wells for both the old and new sections. Beaver Creek flows directly adjacent to the landfill.

Many parts of the small streams have become impaired due to stream channelization, drainage tiles, loss of floodplains, and loss of streamside vegetation. These factors have degraded the creeks and GLSM. When streams are widened and deepened, they contribute excess soil to the stream, which destroys habitat for fish and other aquatic life. This has threatened many aquatic species due to habitat degradation.

| Causes | Sources |
|---|---|
| Direct Habitat Alteration | Non-irrigated crop production |
| Nitrate/Nitrite | Confined animal feeding operations (NPS) |
| Phosphorus | Channelization – agriculture |
| Sedimentation | Removal of riparian vegetation – agriculture |
| | Stream bank destabilization – agriculture |

Figure 5: Causes and Sources of NPS in Beaver Creek HUC-12 (05120101-0202)

According to the latest TMDL report, nutrient loading, nitrogen, and total phosphorous are significant nonpoint pollutants that impact the watershed and Grand Lake St. Marys, both economically and environmentally. Because pastureland and row crops are the dominant land cover in the watershed, many of the probable sources of impairment in this watershed are tied to agricultural practices. As these practices encroach on riparian and in-stream habitats, habitat may be altered through stream channelization, riparian vegetation removal, and subsequent stream bank destabilization. Without the natural filtering capabilities of a healthy, vegetated riparian buffer, runoff from pasturelands/row crops carries pathogens and nutrients from recent manure and fertilizer applications directly into streams. There are numerous small Animal Feeding Operations and larger Concentrated Animal Feeding Operations in this watershed that are also noted sources of nutrients and pathogens. Animals grazing near streams can be a direct source, while runoff from these operations' pastures, holding areas, and manure application fields can also be a significant nonpoint source. This is especially true in the absence of effective

manure management plans and appropriately sized waste storage facilities. (TMDL, GLSM 2007) While this statement was true in 2007, this is no longer the case within the Beaver Creek HUC-12. All livestock operations generating over 350 tons or 100,000 gallons of manure annually maintain a current Comprehensive Nutrient Management Plan and have a minimum of 120 days of manure storage. This is consistent with the distressed watershed rules for GLSM.

Another source of pathogen and nutrient impairment in the Beaver Creek and Grand Lake St. Marys watershed comes from human waste. Unsewered areas with failing septic systems are of serious concern as untreated sanitary wastewater from residential areas is discharged directly into streams. There are two unsewered, clustered residential areas within the Beaver Creek HUC-12. These are the areas of Carthagena and Cassella.

GLSM receives direct flow from the Beaver Creek HUC-12. With nearly 13,000 acres of lake, GLSM is currently in non-attainment status for drinking water. Beaver Creek HUC-12 is one of four 12-digit HUC's that deliver water to GLSM, therefore, is not the only source of nutrient impairment. Because GLSM is a source for drinking water, there is a serious need to improve the water quality in GLSM. This plan will reference many times that the improvements made in the Beaver Creek HUC-12 will improve the overall nutrient and sediment loading of GLSM.

| **Cause** | **Sources** |
|---|---|
| Nitrate/ Nitrite | Agricultural Run-off |
| Phosphorous | Unsewered Residential Areas |
| Fecal Coliform | Industrial Sources |
| Sedimentation | WWTP Discharges |

Figure 6: Causes and Sources of GLSM Drinking Water Attainment Status (HUC 05120101-0204)

### 2.1.2 Land Use and Protection

Figure 7 shows the land use is dominantly cropland. Looking at Figure 8 below, the three predominant land uses for the Grand Lake/Wabash Watershed are 1) cropland; 2) developed areas; and 3) Grand Lake St. Marys itself. This table includes areas outside the Beaver Creek and GLSM watershed; however, the percentages are a very similar comparison to the Beaver Creek HUC-12 watershed's land uses. The table sorts the data in several capacities such as number of acres per land use, square miles per land use, and percent of the total watershed area (including the lake). These numbers are beneficial in

determining potential sources of pollutants in the watershed. They are also valuable at targeting education and implementation of various best management practices. This table is based on information provided by National Land Cover Database updated in 2011. (WAP 2015)

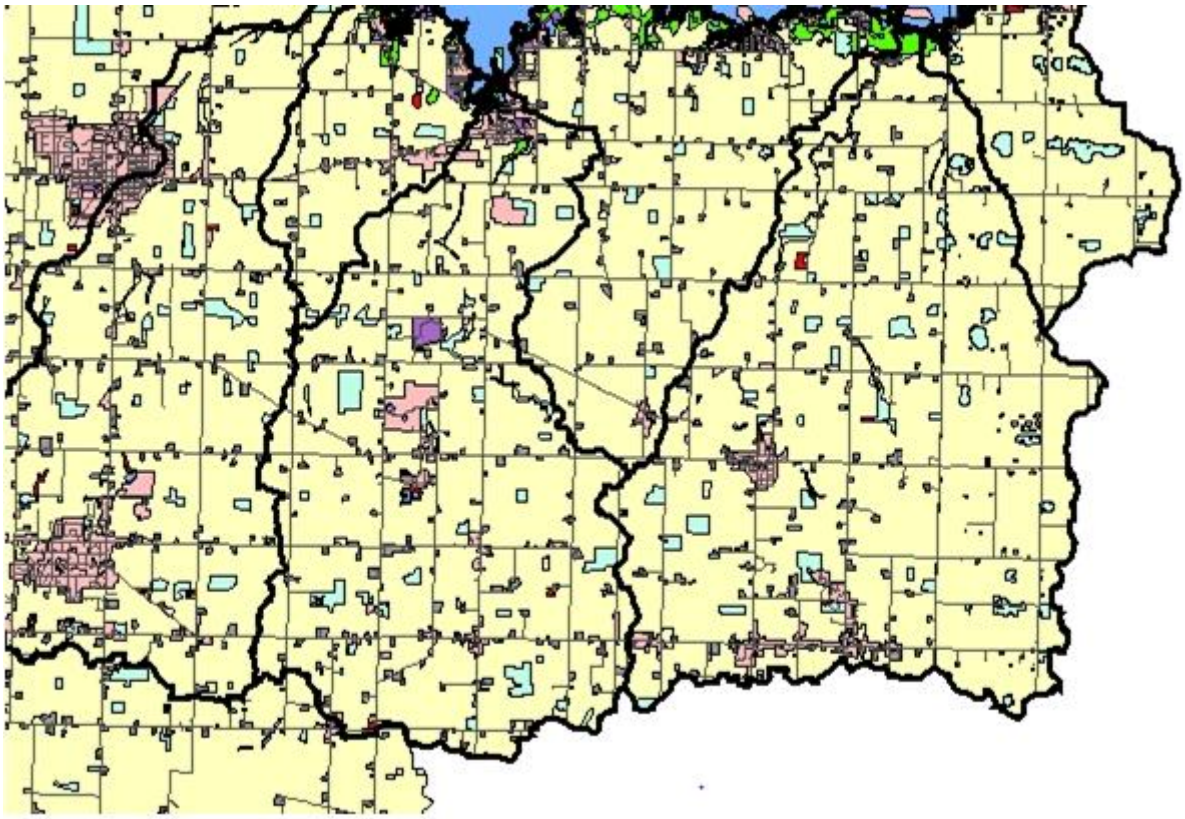


Figure 7: Land Use Map of Grand Lake St. Marys and Surrounding Areas (WAP 2015)

| Land Use/Land Cover | Acres | Square Miles | % of Total Watershed |
|---|---|---|---|
| Cropland (Pasture and Cultivated Crops) | 144,950 | 226.49 | 77.6% |
| Developed Area | 17,929 | 28.01 | 9.6% |
| Forest | 7348 | 11.48 | 3.9% |
| Brush/Shrub (Shrub and Grassland) | 2343 | 3.66 | 1.25% |
| Undeveloped (Barren) | 106 | 0.17 | 0.06% |
| Wetlands (forested & non-forested) | 906 | 1.42 | 0.49% |
| Open Surface Water | 13096 | 20.46 | 7.2% |
| **TOTAL** | **186,678** | **291.68** | **100.0%** |

Figure 8: Land Use/ Cover for GLSM and Wabash Watershed (WAP 2015)

To illustrate the importance of agriculture in Mercer County, the United States Department of Agriculture (USDA) reported the total market value of agricultural products sold in 2012 was $596 million. This statistic ranked Mercer County 1st of the Ohio's 88 counties, and 69th of the 3,079 United States' counties. Approximately 74.3% of the total value of agricultural products sold in 2012 was directly related to sale of livestock, poultry, and their products, also ranking Mercer County 1st in the State and 54th nationally. Net cash farm income of operation was $192.1 million or $159,061 per farm, on average (Mercer Co Comp Plan 2013).

Figure 9 summarizes the riparian status of both the intermittent and perennial streams within the Beaver Creek watershed. It shows the stream miles of both categories along with percentages of the Beaver Creek watershed and the entire GLSM watershed while also showing the approximate distances of canopy on each type of stream. These areas over time have slowly lost tree cover due to row crop agriculture. The information in

Figure 9 is from the original WAP in 2007 that was created for GLSM and Wabash Watersheds.

| BEAVER CREEK | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| RIPARIAN STATUS | TREE CANOPY <10' IN TOTAL WIDTH | | | TREE CANOPY 10 to 40' IN WIDTH | | | TREE CANOPY >40' IN WIDTH | | | TOTAL STREAM MILES |
| | PEREN-NIAL | INTER-MITTENT | SUB-TOTAL | PEREN-NIAL | INTER-MITTENT | SUB-TOTAL | PEREN-NIAL | INTER-MITTENT | SUB-TOTAL | |
| | 3.33 | 9.35 | 12.68 | 6.10 | 1.06 | 7.16 | 3.61 | 12.16 | 15.77 | 35.61 |
| % of Subwatershed Total | 8.1% | 22.8% | 30.9% | 14.8% | 2.6% | 17.4% | 8.8% | 29.6% | 38.4% | 86.7% |
| % of Grand Lake Watershed Total | 2.4% | 6.7% | 9.0% | 4.3% | 0.8% | 5.1% | 2.6% | 8.7% | 11.2% | 25.4% |
| % of Grand Lake/Wabash Watershed Total | 0.5% | 1.3% | 1.8% | 0.9% | 0.2% | 1.0% | 0.5% | 1.7% | 2.2% | 5.0% |

Figure 9: Riparian Corridor Status for the Beaver Creek HUC-12(WAP 2015)

## 2.2 Summary of HUC-12 Biological Trends

In 2007, Ohio EPA sampled the Beaver Creek and GLSM watersheds. The Beaver Creek and GLSM watersheds drain approximately 171 square miles and include two Assessment Units; Grand Lake St. Marys and tributaries, and Beaver Creek downstream of Grand Lake St. Marys to mouth. The assessment unit of Beaver Creek in this EPA study is not a part of the Beaver Creek HUC-12 that is being focused on in this plan. This Beaver Creek is down stream of GLSM to the west. However, for the purpose of this plan, the Beaver Creek HUC-12 is a part of the Ohio EPA TMDL study completed in 2007 as part of the GLSM watershed. (TMDL GLSM 2007)

The Beaver Creek HUC-12 is currently designated as a warm water habitat. A summary of the Beaver Creek HUC-12's biological status are provided in figures 10 and 11.

| RIVER MILE Fish/Invert. | IBI | MIwb | ICI | QHEI | Attainment Status |
|---|---|---|---|---|---|
| ***Beaver Creek*** (22-109) | | | | | |
| | *Eastern Corn Belt Plains* WWH (Existing)/MWH proposed | | | | |
| 4.4/4.5 | 20* | NA | P* | 48.5 | NON/NON |
| 3.5 | 22* | NA | VP* | 40.5 | NON/NON |
| 0.7[A]/1.5 | 28* | 8.4[ns] | VP* | 40.5 | NON/NON |

^ Boat sampling method

* Indicates significant departure from applicable WWH biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

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

flow Performance limited by lack of water

Notes:

- The Modified Index of Well-Being (MIwb) is not applicable (NA) to headwater site types
- A qualitative narrative evaluation used when quantitative data were not available or unreliable due to current velocities less than 0.3 fps flowing over the artificial substrates (P = Poor, F = Fair, MG = Marginally Good, G = Good, VG = Very Good, E = Exceptional)
- Use attainment status based on one organism group is parenthetically expressed

Narrative ranges and WWH biocriteria (bold) for Ohio ecoregions. Exception (EWH biocriteria), very good (EWH nonsignificant departure), poor and very poor evaluations are common statewide. For WWH, the ranges of marginally good and nonsignificant departure are the same (except in HELP).

| **IBI** | | | **MIwb** | | **ICI** | **Narrative Evaluation** |
|---|---|---|---|---|---|---|
| Headwater | Wading | Boat | Wading | Boat | All | |
| 50-60 | 50-60 | 48-60 | ≥9.4 | ≥9.6 | 46-60 | Exceptional |
| 46-49 | 46-49 | 44-47 | 8.9-9.3 | 9.1-9.5 | 42-44 | Very Good |
| ***Eastern Corn Belt Plains*** | | | | | | |
| **40**-45 | **40**-45 | **42**-43 | **8.3**-8.8 | **8.5**-9.0 | **36**-40 | Good |
| 36-39 | 36-39 | 38-41 | 7.8-8.2 | 8.0-8.4 | 32-34 | Marginally Good |
| 28-35 | 28-35 | 26-37 | 5.9-7.7 | 6.4-7.9 | 14-30 | Fair |
| 18-27 | 18-27 | 16-25 | 4.5-5.8 | 5.0-6.3 | 2-12 | Poor |
| 12-17 | 12-17 | 12-15 | 0-4.4 | 0-4.9 | <2 | Very Poor |

**Figure 10:** Attainment of Biological Criteria for Sites Sampled in the Wabash River and GLSM Basin (TMDL GLSM 2007)

In a warm water habitat, the following scores are needed to meet attainment status:

- IBI: 40
- ICI: 36
- MIwb: 8.3
- QHEI: 60

| COC2 (Recreation Season) TMDL | | High Flows | Moist Conditions | Mid-Range Flows | Dry Conditions | Low Flows |
|---|---|---|---|---|---|---|
| **Pollutant** | **TMDL Component** | **56.45 cfs** | **7.31 cfs** | **2.62 cfs** | **0.94 cfs** | **0.36 cfs** |
| **Total Phosphorus (kg/day)** | Current Load | 541.77 | 20.18 | 9.95 | 4.15 | 1.74 |
| | **TMDL= LA+WLA+MOS** | **11.05** | **1.43** | **0.51** | **0.18** | **0.07** |
| | LA | 10.50 | 1.36 | 0.48 | 0.17 | 0.067 |
| | WLA: Montezuma WWTP | 0 | 0 | 0 | 0 | 0 |
| | WLA: MS4 | n/a | n/a | n/a | n/a | n/a |
| | Total WLA | 0 | 0 | 0 | 0 | 0 |
| | MOS (5%) | 0.55 | 0.07 | 0.03 | 0.01 | 0.003 |
| | **TMDL Reduction (%)** | **98%** | **93%** | **95%** | **96%** | **96%** |
| **Nitrate Nitrogen (kg/day)** | Current Load | 8,867 | 420 | No Data | No Data | No Data |
| | **TMDL= LA+WLA+MOS** | **138** | **18** | **6** | **2** | **1** |
| | LA | 131 | 17.11 | 5.68 | 1.89 | 0.96 |
| | WLA: Montezuma WWTP | 0 | 0 | 0 | 0 | 0 |
| | WLA: MS4 | n/a | n/a | n/a | n/a | n/a |
| | Total WLA | 0 | 0 | 0 | 0 | 0 |
| | MOS (5%) | 7 | 0.89 | 0.32 | 0.11 | 0.04 |
| | **TMDL Reduction (%)** | **99%** | **96%** | No Data | No Data | No Data |

**Figure 11:** Loading Statistics for the Beaver Creek HUC-12 during the Recreation Season May 1- October 15 (TMDL GLSM 2007)

The TMDL study shows there is a significant improvement needed to meet the TMDL. Data from 2007 TMDL indicates total phosphorous and nitrate reductions are to be 92% or greater across all flow regimes. The maximum allowable total phosphorous (TP) loads for Montezuma Club Island WWTP are a significant proportion of the allowable TP in Beaver Creek. However, comparing the TMDL reductions needed at Depweg Road and Cassella-Montezuma Road, much higher TP reductions are needed downstream. At Depweg Road, 11 of the 12 nitrate, all TP, and fecal coliform observations exceeded the loading limits for Beaver Creek. During high flows, a TP reduction of 95% is needed.
It has been several years since recent studies have been done. With the large amount of agricultural best management practices that have been implemented over the last several years, it is assumed that levels have improved. There has been some expansion of livestock operations; however these expansions are required to have a current nutrient management plans and manure storage. With these changes, and future nonpoint source pollution restoration projects, a future assessment will be carried out to determine more current water quality before and after a project will take place.

Since the last TMDL was completed in 2007, many BMP's and projects have been installed due to the distressed watershed rules. In the Beaver Creek HUC-12, animal operations are a target of concern. All milk house waste water is now contained, collected, and/or treated on all 15 dairy operations. Two wetlands were constructed to act as a treatment for feedlot water run-off. Silage leachate collection from silage storage facilities was a target project in 2014. Twelve operations in the Beaver Creek HUC-12 have modified their operation to collect and store silage leachate to avoid it to tile exposure. All 38 livestock operations have a minimum of four months of manure storage, with most having six months of storage. These storages were completed in conjunction with complying with the manure application ban starting in January of 2013. The current distressed watershed rules state that no application of manure or fertilizer shall occur between December 15 and March 1st. During all other times of the year, manure applications must be completed following NRCS Practice Standard 590. Several household septic systems were also improved and inspected since the completion of the TMDL in 2007.

## 2.3 Summary of NPS Pollution Causes and Associated Sources for Beaver Creek HUC-12

| Causes | Sources |
|---|---|
| Direct Habitat Alteration | Non-irrigated crop production |
| Nitrate/Nitrite | Confined animal feeding operations (NPS) |
| Phosphorus | Channelization – agriculture |
| Sedimentation | Removal of riparian vegetation – agriculture |
| | Streambank destabilization – agriculture |

Figure 12: Causes and Sources of NPS pollution in Beaver Creek HUC-12

The 2007 TMDL data for the Beaver Creek HUC-12 determines that biological impairments are tied to agricultural practices. Figure nine above illustrates the sources all being related to agriculture. As these agricultural practices encroach on riparian and in-stream habitats, habitat may be altered through stream channelization, riparian vegetation removal, and subsequent stream bank destabilization. Without the natural filtering capabilities of a healthy, vegetated riparian buffer, runoff from pasturelands/row

crops carries pathogens and nutrients from recent manure and fertilizer applications directly into streams.

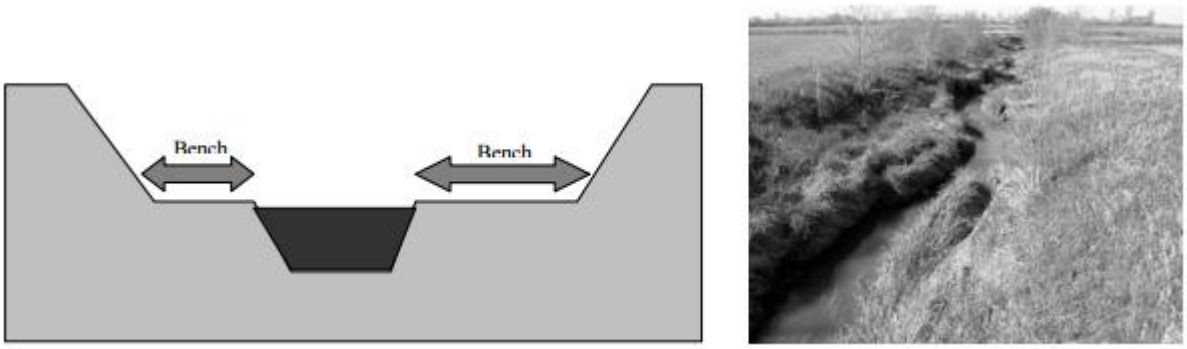


Figure 13: Graphical depiction of a two-stage ditch (left) and photo (right) that was taken in Wood County, Ohio. Notice the slight meander pattern along the ditch bottom in the picture.

There are numerous small Animal Feeding Operations (AFOs) in this watershed that are also noted sources of nutrients and pathogens. Animals grazing near streams can be a direct source, while runoff from these operations' pastures, holding areas, and manure application fields can also be a significant nonpoint source. Over many years of manure production, the soil test phosphorous levels have been built up in some areas to levels over 200 pounds per acre. This is especially true in the absence of effective manure management plans and appropriately sized waste storage facilities. (WAP 2015) However, since the inception of the distressed watershed rules, all livestock operations generating more than 350 tons or 100,000 gallons of manure per year are maintaining a current comprehensive nutrient management plan and have a minimum of 120 days of manure storage. The implementation of these practices has had an impact on water quality within the GLSM watershed.
Pathogen and nutrient loading from failed home sewage treatment systems and nutrient loading from point sources are also contributing to the non-attainment status of the Beaver Creek HUC-12. Within the watershed, Carthagena and Cassella are two clustered residential areas that remain unsewered. Carthagena is the largest unsewered area of concern.

Using the Grand Lake St. Marys and Wabash River Watershed Action Plan-2015, figure 14 below shows the NPS pollution potential. In order to provide a comparison of the pollution potential of the subwatersheds in the Wabash river basin, a ranking system for each of the main potential pollution sources was developed. These potential sources are stream miles with less than 10 feet of vegetation, the number of livestock or poultry operations less than 1,000 feet from a stream, the tons of raw manure produced yearly, the pounds of phosphorus per cropland acre available from the manure, the number of household wastewater disposal systems contained in clusters of ten or more) and the

number of homes built pre-1973. Values of 1(less potential) to 10 (great potential) were given for each category. Indicator scores are then summed to obtain a total pollution potential score for the subwatershed. (WAP 2015)

Subwatershed pollution potential scores can range from a maximum of 60 points to a minimum of six points. This figure allows for a better understanding of the intensity of nonpoint source pollution in the Beaver Creek HUC-12 and on which areas to focus.

# NPS Pollution Potential

| BEAVER CREEK | | | | | | | |
|---|---|---|---|---|---|---|---|
| SUBWATERSHED ATTRIBUTE | Stream Miles with <10' Vegetation SCORE | Operations <1,000' to stream SCORE | Tons Raw Manure per Year SCORE | Lbs. $P_2O_5$ per Crop Acre SCORE | Household Disposal Systems in Groups SCORE | No. Homes Built pre-1973 SCORE | TOTAL SCORE |
| | 2 | 9 | 10 | 6 | 10 | 7 | 44 |

Figure 14: Beaver Creek HUC-12 Score for NPS Pollution using Scoring Matrix Chart (WAP 2015)

## 2.4 Additional Information for Determining Critical Areas and Developing Implementation Strategies for Beaver Creek HUC-12

There are several groups and agencies that work in the Beaver Creek HUC-12 to improve water quality. The Lake Improvement Association has played an active role in promoting activities on and around GLSM. There have been partners on many water quality improvement projects that will promote a cleaner GLSM HUC-12 (05120101-0204) which ultimately generates tourism. The Mercer County Ag Solutions Coordinator has also worked, and is currently working to develop plans for creating ways to restore streams and watercourses by lowering nutrient and sediment loading into Beaver Creek and subsequently to GLSM.

### 2.4.1 Phosphorous Levels Assessment Data

By using information provided by livestock farmers for their Comprehensive Nutrient Management Plans, it is known there are cropland fields with high phosphorous soil tests.

Due to the amount of livestock in the watershed, it is appropriate to assume that there are more nutrients produced than the crops can utilize each year. A portion of the nutrients are moved out of the watershed; however, years of over-application of manure have created a concern of high legacy soil test levels. Prior to the 1990's, animal manure was viewed as a waste, not a fertilizer, and the nutrient value of the manure was not counted when devising a field's nutrient budget. Using these facts and figures, it has helped to aid in creating critical areas for this NPS-IS Plan.

| Beaver Creek | | | | | | |
|---|---|---|---|---|---|---|
| Manure Production | Tons Raw Manure/ Year | Lbs. N per Year | Lbs. K2O Per Year | Lbs. P2O5 Per year | Acres Cropland | Lbs. P2O5 per crop Acre |
| | 176,587 | 2,701,308 | 2,191,800 | 2,246,010 | 11,181 | 201 |
| Less 90% Poultry Manure** | 156,448 | 1,593,629 | 1,325,796 | 1,017,493 | 11,181 | 91 |
| Approximate $ Value Per Year | | $999,484 | $657,540 | $628,882 | | |
| Total Nutrient Value Per Year=$2,285,906 | | | | | | |

** Based on conversations with poultry manure brokers, it is estimated that at least 90% of the poultry manure is brokered out of the watershed.

Figure 15: Manure and Nutrient Production in Beaver Creek HUC-12 (WAP 2015, Mercer SWCD)

The amount of manure produced in Beaver Creek HUC-12, shown in Figure 15, is estimated from the 2007 WAP. The dollar values associated with each nutrient were obtained from local commercial fertilizer costs in 2016. The value for nitrogen is estimated at $0.37 per pound, the value for P2O5 is $0.28 per pound, and the value of K2O is $0.30 per pound.

# Chapter 3: Critical Area Conditions and Restoration Strategies for Beaver Creek HUC-12

## 3.1 Overview of Critical Areas

The entire Beaver Creek HUC-12 is in non-attainment of its warm water habitat aquatic life use designation. The Beaver Creek HUC-12 is also part of the watershed for a public drinking water source for the City of Celina in GLSM HUC-12 (05120101-0204). The Beaver Creek HUC-12 watershed has greater issues related to agricultural use than urban. The stream alterations in this watershed have been modified to remove the majority of riparian vegetation. The stream bank destabilization has also been an impairment related to agriculture as farmers have modified water courses to create row cropping close to the edge of the stream. The highly concentrated area of animal facilities within the critical areas also causes impairments of nitrate/nitrite, phosphorous, and sediment loading. There are two critical areas defined in this watershed to improve these impairments.


***Critical Area 1 includes approximately 11,000 acres of cropland. The initial focus in Critical Area 1 will be on the approximate 1,000 acres have a soil test phosphorus value at or above 200 lb/acre Bray P1. This is recorded in the current nutrient management planning documents at Mercer Soil and Water Conservation District.

Figure 16: Beaver Creek HUC-12 Critical Areas

## 3.2 Critical Area 1: Conditions, goals and objectives for Beaver Creek HUC-12

### 3.2.1 Detailed Characterization

The area defined in Beaver Creek HUC-12 as Critical Area 1 is targeted towards all cropland acres, but as a starting point, those acres with a soil test phosphorous level over 200 pounds per acre in Bray P1 will be targeted. Also, a more prioritized level of importance to this cropland will be proximity to streams. One of the main objectives in this plan is to receive input from producers that will participate in our action plan to reduce these soil test phosphorus values. Farmers have the data to show that there are several fields in the Beaver Creek HUC-12 that have extraordinarily high soil phosphorous tests. By offering a performance reimbursement, farmers will be able to begin a phosphorous reduction strategy on those high soil test phosphorus fields.

With several options under this critical area, NPS pollution that is leaving cropland through artificial drainage and surface water will also be a focus. Available monitoring data has shown that a reduction in soil test phosphorus reduces the potential for nutrient run-off loading. This soil test phosphorus reduction strategy will be completed along with several additional best management practices such as:

- Drainage water management systems
- Increased use of filter strips/ waterways
- Saturated buffers
- Wetlands
- Incorporation of nutrients when needed to apply

Under the distressed watershed rules for GLSM, producers are required to collect soil tests a minimum of every three years, and at a minimum rate of one per 25 acres. The farmers have data to show which farms have a high legacy soil test phosphorous value. However, the requirement to enforce the need for soil testing is if the producer generates 350 tons or 100,000 gallons of manure or more per year. This does allow some facilities to avoid soil testing on their farms. However, agriculture has evolved over the years, and farmers find soil testing beneficial to their operation and are highly likely to engage in soil testing. A current soil test is the starting point for any cropland to meet Critical Area 1 criteria. (Mercer SWCD)

Other areas of the Beaver Creek HUC-12's 13,059 acres that may not have soil testing are the woodlands, pastures, the Elks golf course, and the Celina Sanitary Landfill. These land uses account for several hundred acres. After many years of working with producers in the watershed and getting to know their farms and field activities, Mercer SWCD approximates that seventy five percent of the acres in the Beaver Creek HUC-12 have a recent soil test (less than 2-3 years). Based on information gathered at public meetings

and farmer surveys during the development of this plan, there is approximately 650-1300 acres within Critical Area 1 that have soil test phosphorus levels over 200 lb/acre. The end objective is to reduce the amount of phosphorous leaching into waters and streams. Therefore, the distance to streams and management of tile flow are an important role in the likelihood of leaching phosphorous. It is also important to assist livestock facilities in managing nutrients produced by transporting and applying manure to areas of cropland that need nutrients. (Mercer SWCD)

### 3.2.2 Detailed Biological Conditions

Figure 17 below shows the different habitat quality on a measured level at different river miles on Beaver Creek. The information is the most current that is available and is from the 2007 Ohio EPA TMDL.

| RIVER MILE Fish/Invert. | IBI | MIwb | ICI | QHEI | Attainment Status |
|---|---|---|---|---|---|
| ***Beaver Creek*** (22-109) | | | | | |
| | *Eastern Corn Belt Plains* WWH (Existing)/MWH proposed | | | | |
| 4.4/4.5 | 20* | NA | P* | 48.5 | NON/NON |
| 3.5 | 22* | NA | VP* | 40.5 | NON/NON |
| 0.7[A]/1.5 | 28* | 8.4[ns] | VP* | 40.5 | NON/NON |

[A] Boat sampling method
* Indicates significant departure from applicable WWH biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.
[ns] Nonsignificant departure from biocriteria (≤4 IBI or ICI units or ≤0.5 MIwb units)
[flow] Performance limited by lack of water

Figure 17: Habitat data for Beaver Creek HUC-12 (Ohio EPA)

### 3.2.3 Detailed Causes and Associated Sources

Sources of impairment are outlined from the 2007 Ohio EPA TMDL. Crop production and confined animal feeding operations create nutrient loading into waterways. The animal feeding operations range in size and design. Creating the cause of Critical area 1 mainly comes from the many years of manure application from these sites onto cropland that cannot remove enough nutrients to equal the amount applied. The areas were created from livestock farms that have a history of dating back over one hundred years. This sets up the example that the manure generated at the animal feeding operations was typically applied to fields closest to the structures. The available technology for land application of manure was very limited, and farmers desired to spread manure as quickly and effectively as possible. Manure was considered a waste and its nutrient value was not considered when applied to the land.

In the Beaver Creek HUC-12 and GLSM watershed there are several contributing causes and sources associated with crop production and animal feeding facilities in Critical Area 1:

| Causes | Sources |
|---|---|
| Direct Habitat Alteration | Non-irrigated crop production |
| Nitrate/Nitrite | Confined animal feeding operations (NPS) |
| Phosphorus | Channelization – agriculture |
| Sedimentation | Removal of riparian vegetation – agriculture |
| | Streambank destabilization – agriculture |

Figure 18: Causes and Sources of Beaver Creek HUC-12 with Critical Area 1

Projects that address the above attributes will have a positive effect on the attributes of NPS pollution in the Beaver Creek HUC-12.

| Subwatershed (05120101 02___) | Stream | Location (Monitoring Station) | Total Phosphorus (kg/day) | Flow Regime | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | High Flows | Moist Conditions | Mid-Range Flows | Dry Conditions | Low Flows |
| | | | | 0-10 | 10-40 | 40-60 | 60-90 | 90-100 |
| 020 | Beaver Creek | At Bridge on Cassella-Montezuma Road (COC2) | Current Load | 293.49 | 37.59 | 16.03 | 17.59 | 11.58 |
| | | | % Reduction | -94% | -92% | -91% | -96% | -95% |
| | | | **TMDL= LA+WLA+MOS** | **17.18** | **3.11** | **1.44** | **0.81** | **0.60** |
| | | | LA | 14.92 | 1.55 | 1.37 | 0.77 | 0.57 |
| | | | WLA: Montezuma Club Island WWTP | 1.4 | 1.4 | 0 | 0 | 0 |
| | | | WLA: MS4 | n/a | n/a | n/a | n/a | n/a |
| | | | MOS (5%) | 0.86 | 0.16 | 0.07 | 0.04 | 0.03 |
| 020 | Beaver Creek | At Depweg Road (CAFO8) | Current Load | 270.26 | 4.4 | No Data | 0.52 | No Data |
| | | | % Reduction | -95% | -56% | No Data | -58% | No Data |
| | | | **TMDL= LA+WLA+MOS** | **13.01** | **2.02** | **0.72** | **0.23** | **0.07** |
| | | | LA | 12.36 | 1.92 | 0.68 | 0.22 | 0.07 |
| | | | WLA: Facilities | n/a | n/a | n/a | n/a | n/a |
| | | | WLA: MS4 | n/a | n/a | n/a | n/a | n/a |
| | | | MOS (5%) | 0.65 | 0.1 | 0.04 | 0.01 | 0 |

Figure 19: Phosphorous Loads at Monitoring Locations, 2007 TMDL (Ohio EPA)

| Subwatershed (05120101 02___) | Stream | Location (Monitoring Station) | Nitrate Nitrogen (kg/day) | Flow Regime | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | High Flows | Moist Conditions | Mid-Range Flows | Dry Conditions | Low Flows |
| | | | | 0-10 | 10-40 | 40-60 | 60-90 | 90-100 |
| 020 | Beaver Creek | At Depweg Road (CAFO8) | Current Load | 8,744 | 418 | No Data | 1 | No Data |
| | | | % Reduction | -98% | -94% | No Data | 375% | No Data |
| | | | **TMDL= LA+WLA+MOS** | **163** | **25** | **9** | **3** | **1** |
| | | | LA | 155 | 24 | 8.55 | 2.85 | 0.96 |
| | | | WLA: Facilities | n/a | n/a | n/a | n/a | n/a |
| | | | WLA: MS4 | n/a | n/a | n/a | n/a | n/a |
| | | | MOS (5%) | 8 | 1 | 0.45 | 0.15 | 0.04 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 020 | Beaver Creek | At Bridge on Cassella-Montezuma Road (COC2) | Current Load | 9,042 | 529 | 206 | No Data | No Data |
| | | | % Reduction | -98% | -93% | -92% | No Data | No Data |
| | | | **TMDL= LA+WLA+MOS** | **215** | **39** | **18** | **10** | **8** |
| | | | LA | 190 | 23 | 3 | 9 | 7.62 |
| | | | WLA: Montezuma WWTP | 14 | 14 | 14 | 0 | 0 |
| | | | WLA: MS4 | n/a | n/a | n/a | n/a | n/a |
| | | | MOS (5%) | 11 | 2 | 1 | 1 | 0.38 |

Figure 20: Nitrate Nitrogen Loads and Reductions Needed at Monitoring Locations during 2007 TMDL. (Ohio EPA)

The 2007 TMDL loading data was used as the basis for load reduction calculations in this plan. There were two monitoring locations on Beaver Creek included in the 2007 TMDL report. A weighted average of all flow regimes was used to determine the loading per year to Beaver Creek in 2007. The entire GLSM watershed was declared "distressed" in 2011, and therefore, a number of practices were installed as a result. These practices are outlined in chapter 2.2 of Biological trends. It is assumed that these practices resulted in a 25% drop in total phosphorus loading and a 10% reduction in nitrate-nitrogen loading. This estimated percentage is also conservatively based on research data collected by the USGS monitoring station on Chickasaw Creek. Figure 21 shows the total phosphorus loading and goals, and Figure 22 shows the nitrate-nitrogen loading and goals.

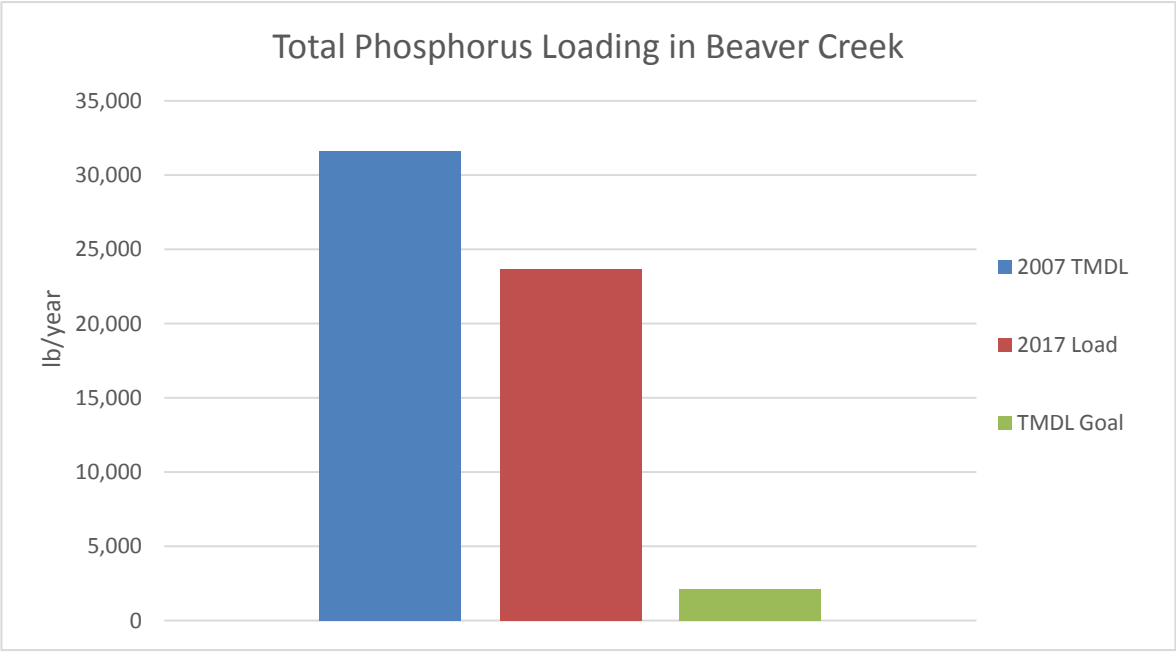


Figure 21: Total Phosphorous Loading of Beaver Creek HUC-12

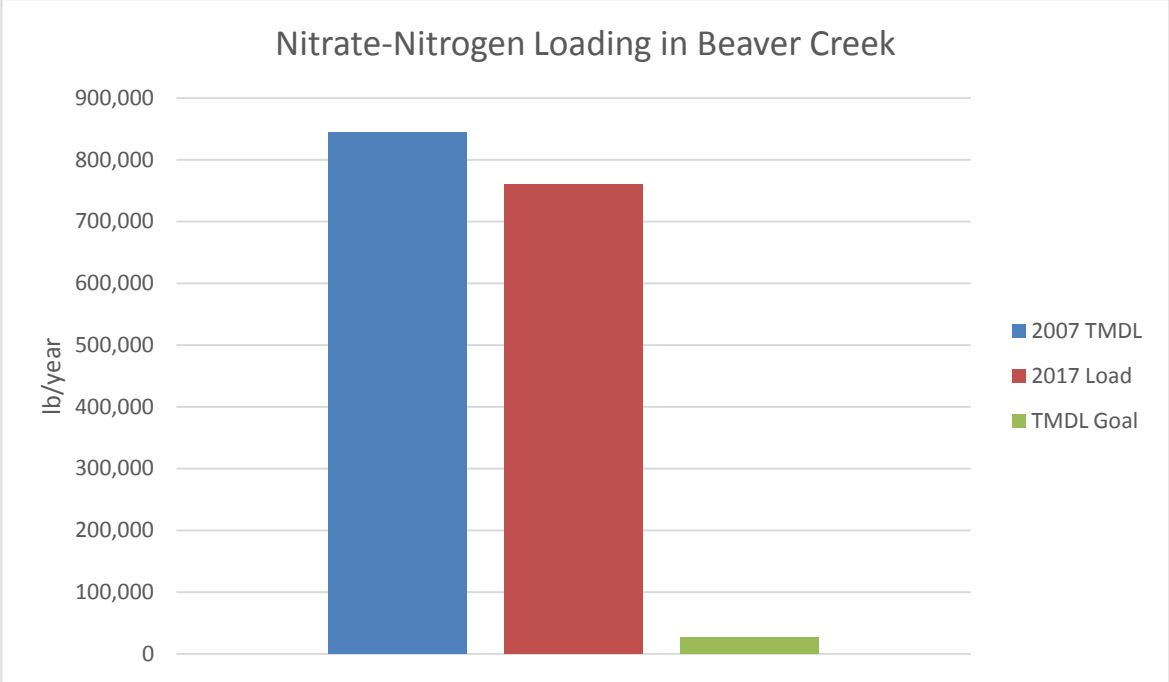


Figure 22: Nitrogen Loading of Beaver Creek HUC-12

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

As explained in detail above, Critical Area 1 is primarily impaired based upon nutrient and sediment loading due to areas of high concentration of animal feeding facilities and the land application of manure. Another significant factor related to the soil nutrient levels is the distance from the field to the creek outlet. Fields located directly adjacent to an open ditch will rank as a higher NPS potential due to surface runoff. A significant majority of the cropland in Critical Area 1 has artificial drainage. In the absence of edge of field conservation practices, this extensively row crop landscape contributes high sediment loading during runoff and drainage events. Soluble phosphorous and nitrates in the sediment are carried into the water flow raising NPS pollution.

With sampling sites in nearby watersheds that have similar landscape and history of livestock production, phosphorous loading is a relevant factor in Grand Lake St. Marys. This in turn has the greater impact on the lake creating future algal blooms and keeping the adjacent GLSM HUC-12 in non-attainment status for drinking water. In order to address the impact of nutrient loading into the streams and eventually into Grand Lake St. Marys, Critical Area 1 will first focus on only the areas of cropland with soil test phosphorus values over 200 pounds per acre. This puts the initial focus on a concentrated amount of land in Critical Area 1 that has the greater NPS pollution.  Over time, however,

additional acres will also be included in projects to continue reductions of nutrient impairment to meet the overall goals and objectives of this plan.

## Goals

The overall nonpoint source restoration goals of any NPS-IS plan is to improve IBI, Mlwb, ICI, and QHEI scores so that the partial or non-attainment status can achieve full attainment of the designated aquatic life use for that water body. An additional focus for this NPS-IS plan is to reduce phosphorus levels in the streams below the TMDL recommended level of 0.17 mg/L. The first step to reaching this result is to lower the field soil test levels and reduce nutrients leaving the soil via surface run-off and tile discharge. (WAP 2015)

> Goal 1: Achieve average IBI score of 40 at monitoring sites. Currently at 23. Achieve average MIwb score of 8.3 at monitoring sites. Has been achieved and is at 8.4. Achieve average ICI score of 36 at monitoring sites. Currently a poor rating. Achieve average QHEI score of 60 at monitoring sites. Currently at 43.
>
> Goal 2: Reduce nitrate- nitrogen levels by 323,000 lbs. in streams and creeks within Critical Area 1.
>
> Goal 3: Reduce phosphorous levels by 12,500 lbs. in streams and creeks within Critical Area 1.
>
> Goal 4: To reduce microcystin toxin levels in Grand Lake Saint Marys so that non-attainment drinking water use designation can be removed. *This goal will be cross-referenced with goals of the GLSM Lake Adaptive Management Plan (currently under development).*

## Objectives

In order to achieve the overall nonpoint source restoration goal of reducing phosphorous and nitrogen levels to help gain full attainment status in Beaver Creek HUC-12, the following objectives that address nutrient loading need to be achieved in Critical Area 1. These objectives are the prioritized management measures and practices in Critical Area 1 and will be the primary objectives as projects are developed to improve the NPS impacts in this Critical Area.

> Objective 1: Enroll 5,000 acres of cropland with a soil test over 100 lb/acre Bray P-1 into a phosphorus reduction program to reduce the soil test value to below 80 lb/acre Bray P-1.

Objective 2: Enroll 5,500 acres of cropland within the watershed in a nutrient placement program that requires all fertilizer amendments to be incorporated.

Objective 3: Install 150 controlled drainage structures as part of a drainage water management system.

Objective 4: Install 40 saturated buffer components onto new or retrofitted drainage water management systems.

Objective 5: Install 70 blind inlets to control surface drainage loading inputs into tile drainage systems.

Objective 6: Implement controlled drainage water management systems to manage water draining from 5,500 acres of cropland.

Objective 7: Utilize swine manure separation/nutrient concentration technologies at three swine farms within the watershed.

Objective 8: Process two million gallons of swine manure using manure separation/nutrient concentration technologies.

Objective 1 will be achieved by intensive cropping systems and no phosphorous application on a total of 5,000 acres. Currently, cropland in Beaver Creek HUC-12 receives manure application containing phosphorous on a regular basis due to location of manure produced. By focusing on soil test levels of phosphorous, a reduction plan can be put in place to lower soil test levels to an agronomic level below 80lb/ acre Bray P1. According to the Ohio Lake Erie Phosphorous Task Force II Report, there will be an approximate 20% phosphorus load reduction by changing land use and bringing soil test phosphorus into the optimum range. The causes of nitrate-nitrogen and phosphorous pollution are a target of concern along with the sources of confined animal feeding operations and crop production.

Objective 2 will focus on different cropland acres than what was used for Objective 1. The acres in Objective 2 will be cropland under 80 lb/ ac Bray P1 soil test and utilizing nutrient application to maintain agronomic soil levels. With incorporation required on this cropland, a reduction of 50% phosphorous run-off and 40 % less nitrogen run-off will occur when incorporated versus leaving it on surface after application. With 5,500 acres involved in this program, 6,000 lbs of phosphorus and 152,000 lbs of nitrogen will be reduced as run-off.

Objectives 3, 4, 5, and 6 will all involve controlling water from surface and tile flow, as well as, filtering the water through structures put in place. Improving base flow conditions and water management will make the objectives together achieve a total

phosphorous load reduction of 3,500 lbs per year and a nitrogen load reduction of 171,000 lbs per year.

Objectives 7 and 8 will focus on liquid manure processing. Using nutrient concentration technologies, liquid manure will be separated into different forms in order to put up to 90% of the phosphorous into a concentrated form with a smaller volume able to be transported out of the watershed economically to an area of cropland requiring phosphorous inputs. The remaining nutrients in the manure left behind can continue to be land applied and utilized as crop uptake.

*As these objectives are implemented, water quality monitoring will be conducted to determine progress toward meeting the identified goals. These objectives and goals will be reevaluated and modified in future versions of this implementation strategy.*

As these objectives are implemented, water quality monitoring (both project related and regularly scheduled monitoring) will be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). These objectives will be reevaluated and modified if determined to be necessary. For instance; many agricultural BMPs can be "stacked" (a systems approach) that will also incrementally improve the quality and quantity of runoff and drainage waters and in-stream water quality.

When reevaluating, the committee will reference the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013), which has a complete 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 and Objectives for the Middle Reach of Beaver Creek HUC-12

### 3.3.1 Detailed Characterization


Figure 23: Critical Area 2 within Beaver Creek HUC-12

The area defined as Critical Area 2 in Beaver Creek HUC-12 is targeted towards a two-square mile area where Beaver Creek flows from south to north from Olding Road to Depweg Road. Two well-known areas of interest are located on and along Beaver Creek. The Elks golf course has an 18-hole course where the east and west branches of Beaver Creek flows though. To the south of that section, the historic St. Charles Seminary owns several hundred acres of land that has Beaver Creek flowing through.

The Beaver Creek is in non-attainment status for its warmwater habitat aquatic life use designation. A significant factor of the causes of non-attainment is the agricultural use maintained as drainage. This creates a very low gradient Rosgen type “F-6” Stream. An F-

6 stream type indicates severe channel incision, poor substrate quality, stagnant glide like low flow characteristics, poor flood plain, and poor buffer diversity and density.
With the central location in the HUC-12, the sources of impairments are most significantly influenced by stream and contributing waterways between Depweg Road and Olding Road. It is also likely the upstream areas listed in Critical Area 1 are also contributing to the non-attainment status of the Beaver Creek HUC-12.

Figure 24: Images of Beaver Creek at Elks Golf Course

### 3.3.2 Detailed Biological Conditions

Little biological data is specified for Critical Area 2, however being within Critical Area 1, the habitat data that is known is provided above in Figure 17. The non-attainment status for the Beaver Creek HUC-12 is also valid for Critical Area 2.

### 3.3.3 Detailed Causes and Associated Sources

The focus on Critical Area 2 is **channelization, removal of riparian vegetation, and stream bank destabilization** (OEPA 2007 TMDL). These are all factors sourced from agriculture. A large portion of the cropland has subsurface drainage. Critical Area 2 is focused on these stream areas to rebuild and regain attainment status. Figures 18 and 19 show the results at Depweg Road, which is where Critical Area 2 begins. The results from Figure 18 and 19 shows the sampling results for phosphorous and nitrates that were detected in the creek. As stated in Critical area 1, all of the livestock manure applications create the concern of nutrient loading to these same streams. With less vegetation on stream banks, and high nonpoint source pollution levels of nutrients going into the water, it creates an environment hard to support fish life. (Ohio EPA, 2007)

### 3.3.4 Outline Goals and Objectives for the Critical Area

As explained in detail above, Critical Area 2 is primarily impaired based upon **sedimentation of channel incision and agricultural drainage**. There are many river miles upstream of this area with similar land uses. However, in Critical Area 2, the stream is moderate in size and would be suited well for potential projects. The locations of interest are the Elks Golf Course and St Charles Seminary that own a significant portion of land where Beaver Creek is located. There are areas of stream that show channelization has occurred and that there are significant impacts from agricultural drainage.
Critical Area 2 was defined to this smaller area in order to focus on these smaller river mile sections were included in a proposed project from a former draft 319 grant proposal. This proposed project provides a good basis to achieve the goals within this critical area.

Goals

Goals in place are to achieve the overall nonpoint source restoration of reducing phosphorous and nitrogen levels with less sedimentation and channelization in streams. The big picture follows downstream to Grand Lake St. Marys to protect over 13,000 acres of lake from harmful algal blooms and sedimentation build up. To help gain full attainment status in Beaver Creek HUC-12, the following objectives that address sedimentation and channelization need to be achieved in Critical Area 2.

Goal 1. Achieve average IBI score of 40 at monitoring sites. Currently at 23. Achieve average MIwb score of 8.3 at monitoring sites. Has been achieved and is at 8.4. Achieve average ICI score of 36 at monitoring sites. Currently a poor rating. Achieve average QHEI score of 60 at monitoring sites. Currently at 43.

Goal 2: Reduce nitrate-nitrogen levels by 95,000 lbs. /year in streams and creeks within Critical Area 2.

Goal 3: Reduce Phosphorous levels by 4,025 lbs. /year in streams and creeks within Critical Area 2.

Objectives

In order to achieve the overall nonpoint source restoration goal of reducing sediment, phosphorous, and nitrogen levels to gain full attainment status in the Beaver Creek HUC-12, the following objectives that address sedimentation and nutrient loading need to be achieved in Critical Area 2. These objectives are the prioritized management measures and practices in Critical Area 2 and will be the primary objectives as projects are sought out and/or developed to improve the NPS impacts in this Critical Area. It should also be noted that achievement of the objectives described for Critical Area 1 (upstream) should also show improvement in Critical Area 2.

Objective 1: Restore 30,000 linear feet of stream channel with flood plain that incorporates wetlands and riparian buffers that allow access of high flow runoff to a functional floodplain bench

Objective 2: Restore 5,300 linear feet of Beaver Creek using natural channel design features and principles.

Objective 3: Install two centralized sewer systems within the watershed.

Objective 4: Eliminate 150 individual home sewage treatment systems.

Objective 1 will allow the restoration of stream and riparian corridor through the use of in-stream wetlands and/or riparian buffers to increase access of high flow runoff water to a functional floodplain bench. It is estimated that 2,600 lbs of phosphorus loading will be reduced and 91,000 lbs. of nitrogen loading will be reduced per year. These numbers are conservatively estimated and are consistent with the 2007 TMDL, which cites an 80% reduction in nitrogen and a 78% reduction in phosphorus with the implementation of riparian buffers.

It is estimated that Objective 2 will reduce phosphorus loading by 375 lbs and nitrogen loading by 750 lbs per year. These estimates are based on the Elks Restoration Project prepared by Oxbow Stream and River Restoration, Inc.

Objectives 3 and 4 will be achieved by installing a centralized sewer system for the areas of Carthagena and Cassella that will be treated by a local wastewater treatment plant. Load reductions are estimated at 1,050 lbs of phosphorous and 3,300 lbs of nitrogen per year. These load reductions are based on an assumption from Swann (2001) of 22 lb/year of nitrogen and 6.9 lb/year of phosphorus discharged per average failing septic system.

Projects that address the above attributes will have a positive effect on the attributes of NPS pollution in the Beaver Creek HUC-12.

As these objectives are implemented, water quality monitoring (both project related and regularly scheduled monitoring) will be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). These objectives will be reevaluated and modified if determined to be necessary. For instance; many agricultural BMPs can be "stacked" (a systems approach) that will also incrementally improve the quality and quantity of runoff and drainage waters and in-stream water quality.

When reevaluating, the committee will reference the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013), which has a complete 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

## 4.1 Overview Tables and Project Sheets for Critical Areas

Below are the projects and evaluation needs believed to be necessary to remove the impairments to the Beaver Creek HUC-12 as a result of the identified cause and associated sources of nonpoint source pollution. Because the attainment status is based on biological conditions, it will be necessary to periodically reevaluate the status of the critical area to determine if the implemented projects are sufficient to achieve restoration. Time is an important factor to consider when measuring project success and

overall status. Biological systems in some cases can show response fairly quickly (i.e. one season); other systems may take longer (i.e., 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.

For the Beaver Creek HUC-12, there are two Project and Implementation Strategy Overview Tables (subsection 4.2.1 and 4.3.1). Each critical area only has one primary cause and associated source of nonpoint source impairment. If another nonpoint source impairment is identified for one of the existing critical areas, it will be explained and added to that critical area's table. If a new impairment is determined that has a different critical area, a new table will be created for that new critical area. The projects described in the Overview Tables have been prioritized using the following three-step prioritized 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 causes and sources of impairment or where there is an expectation that such potential projects will improve water quality in Beaver Creek.

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) are in subsection 4.2.2 and 4.3.2. 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 are developed, these sheets will be updated. Any new PPS created will be submitted to the state of Ohio for funding eligibility verification (i.e., all nine elements are included).

## 4.2 Critical Area 1: Overview Table and Project Sheets for Beaver Creek HUC-12

The information included in the Critical Area 1 Overview Table is a condensed overview of all identified projects needed for nonpoint source restoration of the Beaver Creek HUC-

12 Critical Area 1. Project Summary Sheets are included for short term projects or any project that is considering seeking funding in the near future. Only those projects with complete Project Summary Sheets will be considered for state and federal NPS program funding.

### 4.2.1 Critical Area 1: Project and Implementation Strategy Overview Table

The Beaver Creek HUC-12 Critical Area 1 is based on non-attainment status of aquatic life use designation and nutrient and sedimentation loading from cropland. The Critical area 1 Overview Table provides a quick summary of what needs to be done, where, and what problem (cause/source) will be addressed and includes projects at all levels of development (i.e. concept, need funding, in progress). This overview table is intended to show a prioritized path toward the restoration of the Beaver Creek HUC-12.

| Critical Area 1: Project Overview Table for Beaver Creek HUC-12 (05120101-0202) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Goal** | **Objective** | **Project #** | **Project Title** *(EPA Criteria g)* | **Lead Organization** *(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** | | | | | | | |
| 1,2,3,4 | 1,3,4,5 | 1 | Phosphorous Reduction and Edge of Field Practice Plan | Mercer SWCD | Short | $500,000 | USDA- CIG, EPA 319, EQIP, SWIF, CRP |
| | | | | | | | |
| **Agricultural Nonpoint Source Reduction Strategies** | | | | | | | |
| 1,2,3,4 | 1,3,4,5 | 1 | Phosphorous Reduction and Edge of Field Practice Plan | Mercer SWCD | Short | $500,000 | USDA- CIG, EPA 319, EQIP, SWIF, CRP |
| 2,3,4 | 2,6 | 2 | Nutrient Incorporation Strategy | Mercer SWCD | Short | $300,000 | USDA-CIG, EPA 319 |
| 3,4 | 7,8 | 3 | Nutrient Removal Technology Project | Mercer County Ag Solutions | Short | $500,000 | USDA VAPG, CIG |
| **High Quality Waters Protection Strategies** | | | | | | | |
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| **Other NPS Causes and Associated Sources of Impairment** | | | | | | | |
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## Section 4.2.2 Critical Area 1 Project Summary Sheets

The Project Summary Sheets provided below were developed based on action or activities needed to restore the cropland to minimize nutrient loading from high soil test phosphorous. These projects are considered next step or priority/short term projects. Medium and longer term projects will most likely not have a summary sheet, as these projects are not ready for implementation. The project summary sheets will be mostly the priority or short term project that are ready to implement, or at least those projects have been more thoroughly planned.

Critical Area 1: Project 1

| Nine Element Criteria | Information needed | Explanation |
|---|---|---|
| n/a | Title | Phosphorous Reduction and Edge of Field Practice Plan |
| criteria d | Project Lead Organization & Partners | Mercer County SWCD; Mercer County Ag Solutions |
| criteria c | HUC-12 and Critical Area | Beaver Creek HUC-12 (05120101-0202) Cropland areas |
| criteria c | Location of Project | Beaver Creek HUC-12, south of Grand Lake St Marys, cropland (40*28'17" N, 84*33'36"W) |
| n/a | Which strategy is being addressed by this project? | Agricultural Nonpoint Source Reduction Strategy<br>Altered Stream and Habitat Restoration Strategy |
| criteria f | Time Frame | Short (1-3 Years) |
| criteria g | Short Description | Enroll approximately 1000 acres of current cropland fields with soil test levels greater than 200 lb/acre into a three year commitment of no additional phosphorous applied with an intensive cropping removal system. This will be done in conjunction with drainage water management, saturated buffers, and/or blind inlets. |
| criteria g | Project Narrative | Beaver Creek HUC-12 is a highly populated area with livestock concentration of Dairy, Beef, Poultry, and Hogs. Many years of applying manure has created very high soil test phosphorous levels which create higher chances of leaching of phosphorous through nonpoint source pollution. By reducing these soil test levels, the water quality impact will be less nutrient loading into Beaver Creek and Grand Lake St Marys. Because virtually all the cropland in Beaver Creek HUC-12 is underlain with subsurface tile, there is a great opportunity to install drainage water management systems with saturated buffers and/or blind inlets as an additional level of reduction for discharge water to be filtered. Saturated buffers and legacy phosphorus reduction are currently not NRCS-fundable practices in Ohio.<br>A performance reimbursement will be put towards per acre of risk reduction. Local match will include SWCD time to ensure compliance with the program, local |

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| | | and state funding sources, and producer in-kind match consisting of time and material. A goal of 25 lb/ac on the soil test will be the total reduction over three years. Therefore, each year soil testing will be completed to see if an average of 8-10 lb/ac is reduced. It is assumed that a 20% load reduction of in-stream nutrients will be achieved with this strategy. Utilizing drainage water management, saturated buffers, and/or blind inlets on 600 acres will create an additional 30% phosphorus load reduction and 45% nitrogen load reduction. |
| criteria d | Estimated Total cost | $500,000 |
| criteria d | Possible Funding Source | Ohio EPA 319(h); EQIP; USDA-CIG, SWIF |
| criteria a | Identified Causes and Sources | Cause: Nutrient Loading<br>Sources: Channelization and non irrigated crop production. |
| criteria b & h | Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area? | With the goal being: to raise IBI score above 40. (currently 23), to raise or maintain or increase MIwb score above 8.3 (currently 8.4), to raise ICI score to 36 (currently at a poor rating), and raise QHEI score from 43 to 60. Also, to reduce microcystin toxin levels in GLSM to bring it into drinking water attainment status.<br><br>According to the Agricultural Research Service and Ohio State University data, it is has been determined that high soil test phosphorous levels in soils are likely to leach. Therefore, by completing a measurable study of removing the maximum amount of phosphorus each year through crop removal will define how quickly soil test phosphorus levels can be reduced. In this project the target will be 1,000 acres, which is approximately 10% of total cropland in Beaver Creek HUC-12. This is also the approximate number of acres that are above a 200 lb/ac soil test phosphorus level that have higher likeliness to leach. 600 of these acres will also install drainage water management systems with saturated buffers and/or blind inlets. |
| | Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project? | This project will meet 20% of the objective of reducing soil test phosphorus levels to below the Tri-State optimum level. This project will also meet 11% of the objective of installing drainage water management, saturated buffers and blind inlets. We will be able to measure how quickly soil test phosphorus can be reduced on fields with levels currently over 200 lb/acre, which can then be applied to a future strategy of further reducing soil test phosphorus values to meet the Tri-State Fertility Guide's recommended optimum level. The addition of DWM systems with saturated buffers and blind inlets on 600 acres will also create a nutrient reduction through tile lines. A total of 4% (819 lbs/ P out of 21,563 lbs/ P goal) Phosphorus reduction and 2.5% (18,663 lbs/ N out of 733,371 lbs/ N goal) Nitrogen reduction will be achieved with the project. These percentages are based on 2007 TMDL report. As these nutrient loads are reduced, it is expected QHEI, IBI, ICI, and MIwb scores will increase. |
| | Part 3: Load Reduced? | Estimated: 819 lbs P/year and 18,663 lbs N/year |
| criteria i | How will the effectiveness of this project in addressing the NPS impairment be measured? | A qualified soil test company will perform grid soil analysis of all acres approved and analyze the results each year to measure amount of reduction.<br>Staff from OEPA-DSW Ecological Assessment Unit will perform both pre and post project monitoring to determine progress (through IBI, ICI, and QHEI) from non to full attainment. |
| criteria e | Information and Education | This project will be promoted with public meetings to inform producers, press releases, news articles, social media and personal contacts from Mercer SWCD to eligible producers. Overall reduction results will be shared with the public as |

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| | | well. |

# Critical Area 1: Project 2

| Nine Element Criteria | Information needed | Explanation |
|---|---|---|
| n/a | Title | Nutrient Incorporation |
| criteria d | Project Lead Organization & Partners | Mercer County SWCD; Mercer County Ag Solutions |
| criteria c | HUC-12 and Critical Area | Beaver Creek HUC-12 (05120101-0202) Cropland areas |
| criteria c | Location of Project | Beaver Creek HUC-12, south of Grand Lake St Marys Cropland (40*28'17" N, 84*33'36"W) |
| n/a | Which strategy is being addressed by this project? | Agricultural Nonpoint Source Reduction Strategy |
| criteria f | Time Frame | Short (1-3 years) |
| criteria g | Short Description | Enroll approximately 1000 acres of cropland into a three year commitment of incorporating all nutrients applied to the fields and also requiring a soil test that shows the need for the fertilizer or manure amendment. |
| criteria g | Project Narrative | Beaver Creek HUC-12 is a highly populated area with livestock concentration of Dairy, Beef, Poultry, and Hogs. Encouraging farmers that have historically applied nutrients on the surface to incorporate the applied nutrients immediately so that there is immediate contact with the soil can be achieved through a performance based reimbursement.<br>If enrolled, the field will need a current soil test to show the need for nutrients. A manure test will also be needed demonstrate the amount of nutrients to be applied with an intended rate of application. The method of application and type of incorporation will be documented. Verification of the types of nutrient applied and that it was incorporated by Mercer SWCD. By promoting the incorporation of nutrients, according to Heidelberg University research, up to a 50% reduction in phosphorous runoff can be achieved. It is also assumed that the incorporation of nutrients will achieve a 40% reduction in nitrogen runoff.<br>A performance reimbursement will be put towards per acre of risk reduction. Local match will include SWCD time to ensure compliance with the program, local and state funding sources, and producer in-kind match consisting of time and material. |
| criteria d | Estimated Total cost | $300,000 |
| criteria d | Possible Funding Source | Ohio EPA 319(h) (if eligible); USDA-CIG |
| criteria a | Identified Causes and Sources | Cause: Nutrient Loading<br>Sources: Channelization and non irrigated crop production. |

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| criteria b & h | Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area? | With the goal being: to raise IBI score above 40. (currently 23), to raise or maintain or increase MIwb score above 8.3 (currently 8.4), to raise ICI score to 36 (currently at a poor rating), and raise QHEI score from 43 to 60. Also, to reduce microcystin toxin levels in GLSM to bring it into drinking water attainment status.<br><br>With numerous livestock facilities in the watershed, it is necessary to apply manure to cropland. In this project 1,000 acres will be enrolled which is approximately 10% of the cropland acres in Beaver Creek HUC-12. Those acres will be croplands that are requiring nutrients in a form of manure or commercial fertilizer that will be incorporated and in turn reduce nutrient loading. |
| | Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project? | Goals: There is recognition that there is lag time associated with nonpoint source-related projects and stream response. However, measured stream nitrate and phosphorous levels can be directly impacted after rain events if the nutrients applied are incorporated. The goal of this project is to reach 1,000 acres of cropland, which equates to approximately 10% of the Beaver Creek HUC-12 total cropland. This equates to just over 18% of the overall objective of implementing the practice within the Beaver Creek HUC-12. With participation of these acres targeted towards those making a change in their management practices, it is estimated that there will be a 5% (1078 lbs/ P out of 21,563 lbs/ P goal) Phosphorus reduction and a 3.5% (27,649 lbs/ N out of 733,371 lbs/ N goal) nitrogen reduction. These percentages are based on 2007 TMDL results. As these nutrient loads are reduced, it is expected QHEI, IBI, ICI, and MIwb scores will increase. |
| | Part 3: Load Reduced? | Estimated: 1,078lbs P/year, 27,649 lbs N/year |
| criteria i | How will the effectiveness of this project in addressing the NPS impairment be measured? | Staff from OEPA-DSW Ecological Assessment Unit will perform both pre and post project monitoring to determine progress (through IBI, ICI, and QHEI) from non to full attainment.<br>At closest downstream river mile of these practices, a water sample will be taken during average stream flows to monitor nutrient levels. |
| criteria e | Information and Education | This project will be promoted with public meetings to inform producers, press releases, news articles, social media and personal contacts from Mercer SWCD to eligible producers. Overall reduction results will be shared with the public as well. |

## Critical Area 1: Project 3

| Nine Element Criteria | Information needed | Explanation |
|---|---|---|
| n/a | Title | Nutrient Removal Technology Project |
| criteria d | Project Lead Organization & Partners | Mercer County Economic Development (Ag Solutions) |
| criteria c | HUC-12 and Critical Area | Beaver Creek HUC-12 (05120101-0202) |
| criteria c | Location of Project | Beaver Creek HUC-12, south of Grand Lake St Marys. Interested landowners that produce liquid manure and have a need to export their manure out of the watershed. |
| n/a | Which strategy is being addressed by this project? | Agricultural Nonpoint Source Reduction Strategy |
| criteria f | Time Frame | Short (1-3 years) |
| criteria g | Short Description | Liquid manure, (dairy holding pond and swine manure) will be processed to separate 90% of the phosphorous and solids into a concentrated material that can be transported to cropland outside of watershed needing nutrients. A smaller fraction of both nitrogen and potassium is also recovered during the nutrient concentration process. The economic benefit of not transporting liquid manure that is typically over 90% water will be saved through transportation. |
| criteria g | Project Narrative | Beaver Creek HUC-12 has close to 25 swine operations and 15 dairies. Both of these types of livestock operations produce liquid manure. Liquid manure is difficult to transport due to the amount of water in the manure and cannot be trucked long distances economically. By segregating and concentrating the nutrients, particularly phosphorus, the nutrients can then be economically moved to cropland in need of the nutrients. This can be done through mechanical, chemical and/or biological processes. Mercer County Ag Solutions has researched and trialed several nutrient concentration technologies that would be appropriate for this project. This pilot installation will serve as an education piece for others, to engage other livestock producers and to show them the benefits. Mercer County Ag Solutions has also been researching the possibility of a mobile treatment system that could service multiple farmers. This project could provide the spark needed to invest in this type of system, allowing a significantly higher volume of manure to be processed. It is assumed that by removing these nutrient from the watershed, and overall 20% reduction of in-stream phosphorus loads will occur. |
| criteria d | Estimated Total cost | $500,000 |
| criteria d | Possible Funding Source | USDA VAPG, USDA-CIG |

| | | |
|---|---|---|
| criteria a | Identified Causes and Sources | Causes: Nutrient Loading<br>Sources: Confined animal feeding operations (NPS) |
| criteria b & h | Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area? | Reducing phosphorous applications to cropland that is at or above maintenance level for crop removal is a necessary goal. In order to meet the Beaver Creek HUC-12 balance of nutrients produced through livestock operations, as shown in Figure 15, 200,000 lbs. of P2O5 will need to be exported out of the watershed per year. This is using the Tri-State Fertility Guide's crop removal values and by assuming a typical crop rotation utilized in the Beaver Creek HUC-12. With known values of P205 in each type of animal manure and the amount produced, the surplus of phosphorus is calculated. It is assumed that by transporting this phosphorus out of the watershed, there will be a 20% in-stream phosphorus load reduction, as the nutrient would have typically been applied to cropland above the Tri-State Fertilizer Guide's recommended phosphorus levels. |
| | Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project? | Goals: There is recognition that there is lag time associated with nonpoint source-related projects and stream response. However, by utilizing a Nutrient Removal Technology, approximately 17,250 lbs of P2O5 per year will be transported out of the watershed. This equates to 33% of the overall objective of implementing this practice within the Beaver Creek HUC-12. The end result will be more sustainable phosphorous levels that can be maintained or lowered in order to lessen NPS pollution. This project will also encourage a wider adoption of the practice by other livestock producers, or potentially garner an interest from a local cooperative that could develop a mobile nutrient concentration system. A mobile system would have the ability to treat up to 500,000 gallons of manure per day. A 2% (409 lbs/ P out of 21,563 lbs/ P goal) reduction in phosphorous loading will be achieved. |
| | Part 3: Load Reduced? | Estimated: 409 lbs P/ year |
| criteria i | How will the effectiveness of this project in addressing the NPS impairment be measured? | Mercer SWCD and Mercer County Ag Solutions will monitor the manure production of the operation to achieve the goals of transporting enough phosphorus to areas needing land applied nutrients to meet a balance in Beaver Creek HUC-12. |
| criteria e | Information and Education | This project will be promoted with public meetings to inform producers, press releases, news articles, social media and personal contacts from Mercer SWCD to eligible producers. Overall reduction results will be shared with the public as well. |

## Section 4.3 Critical Area 2: Overview Table and Project Sheets for middle reach of Beaver Creek HUC-12

The information included in the Critical Area 1 Overview Table is a condensed overview of all identified projects needed for nonpoint source restoration of the Beaver Creek HUC-12 Critical Area 1. Project Summary Sheets are included for short term projects or any project that is considering seeking funding in the near future. Only those projects with complete Project Summary Sheets will be considered for state and federal NPS program funding.

### 4.3.1 Critical Area 2: Project and Implementation Strategy Overview Table

The Beaver Creek HUC-12 Critical Area 2 is based on non-attainment status of aquatic life use designation and nutrient and sedimentation loading. The Critical Area 2 Overview Table provides a quick summary of what needs to be done, where, and what problem (cause/ source) will be addressed and includes projects at all levels of development (i.e. concept, need funding, in progress). This over view table is intended to show a prioritized path toward the restoration of the Beaver Creek HUC-12.

| Critical Area 2: Project Overview Table for Beaver Creek HUC-12 (05120101-0202) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Goal** | **Objective** | **Project #** | **Project Title** *(EPA Criteria g)* | **Lead Organization** *(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** | | | | | | | |
| 1,2,3 | 3,4 | 3 | Carthagena Centralized Sewer System | Mercer County | Short | $1,200,000 | WPCLF; RPIG |
| | | | | | | | |
| **Altered Stream and Habitat Restoration Strategies** | | | | | | | |
| 1,2,3 | 1,2 | 1 | Mercer County Elks Golf Course Stream Restoration | Mercer SWCD | Short | $1,250,000 | Ohio EPA 319, Local Lake Facilities |
| 1,2,3 | 1,2 | 2 | In Stream wetlands and Buffers | Mercer SWCD | Short | $600,000 | Ohio EPA 319, SWIF, EQIP, CRP |
| **Agricultural Nonpoint Source Reduction Strategies** | | | | | | | |
| | | | | | | | |
| **High Quality Waters Protection Strategies** | | | | | | | |
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| **Other NPS Causes and Associated Sources of Impairment** | | | | | | | |
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## Section 4.3.2 Critical Area 1 Project Summary Sheets

# Critical Area 2: Project 1

| Nine Element Criteria | Information needed | Explanation |
|---|---|---|
| n/a | Title | Mercer County Elks Golf Course Stream Restoration |
| criteria d | Project Lead Organization & Partners | Mercer County SWCD |
| criteria c | HUC-12 and Critical Area | Beaver Creek HUC-12 (05120101-0202) |
| criteria c | Location of Project | Beaver Creek HUC-12, 3242 U.S. Rt. 127 Celina Ohio<br>40*26'44"N 84*33'40"W |
| n/a | Which strategy is being addressed by this project? | Altered Stream and Habitat Restoration Strategies |
| criteria f | Time Frame | Short (1-3 years) |
| criteria g | Short Description | This project will restore a natural stream channel through the Elks property, and once constructed, the project will enhance the quality of in-stream and riparian habitat and reduce sediment and phosphorous loads in Beaver Creek within Critical Area 2. |
| Criteria g | Project Narrative | This Project will improve in-stream and riparian habitat quality along Beaver Creek within Critical Area 2. This will be achieved by two sections of stream repair projects. First, the East Branch of Beaver Creek will include 1700 linear feet of rebuilt sinuous stream within 3.8 acres of riparian habitat floodplain. The second section will be the west branch of Beaver Creek to create 3600 linear feet of sinuous stream within 8.2 acres of riparian habitat floodplain. A smaller meandering channel will be created to contain more frequent rain events and to provide a constant treatment zone within the stream. |
| Criteria d | Estimated Total cost | $1,250,000 ($600,000 grant with $600,000 matching) |
| criteria d | Possible Funding Source | Ohio EPA 319(h); Local Lake Facilities Authority |
| Criteria a | Identified Causes and Sources | Cause: Nutrient Loading/ sedimentation<br>Source: agricultural drainage, nutrient applications, channelization |
| criteria b & h | Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area? | With the goal being: to raise IBI score above 40. (currently 23), to raise or maintain or increase MIwb score above 8.3 (currently 8.4), to raise ICI score to 36 (currently at a poor rating), and raise QHEI score from 43 to 60. Also, reduce microcystin toxin levels in GLSM to bring it into drinking water attainment status. A reasonable objective would be to restore four miles of stream in Critical Area 2 to increase access of high flow runoff waters to a functional floodplain bench. Project 1 represents approximately 25% of the four mile objective. According to preconstruction habitat evaluations from Oxbow River and Stream Restoration, the QHEI score in 5 years will be up to 60 in the restored river mile of Elks golf |

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|---|---|---|
| | | course. This is a 17 point improvement from the current 43 score. |
| | Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project? | The Elks project will repair 5,300 linear feet of stream and establish approximately 12 acres of riparian area.<br>Goals: There is recognition that there is lag time associated with nonpoint source-related projects and measured stream response. With respect to the goals in critical area 2, the main driver is the QHEI score and nutrient loading into the Beaver Creek HUC-12 and eventually Grand Lake St Marys. |
| | Part 3: Load Reduced? | 374 tons Sediment/year, 744 lbs N/year and 374 lbs P/year |
| criteria i | How will the effectiveness of this project in addressing the NPS impairment be measured? | Staff from OEPA-DSW Ecological Assessment Unit will perform both pre and post project monitoring to determine progress (through IBI, ICI, and QHEI) from non to full attainment. |
| Criteria e | Information and Education | Mercer SWCD will develop outreach materials, and tours of the site to promote how a watershed can be improved and achieve water quality while maintaining drainage. |

# Critical Area 2: Project 2

| Nine Element Criteria | Information needed | Explanation |
|---|---|---|
| n/a | Title | In Stream wetlands and Buffers |
| criteria d | Project Lead Organization & Partners | Mercer County SWCD |
| criteria c | HUC-12 and Critical Area | Beaver Creek HUC-12 (05120101-0202) |
| criteria c | Location of Project | Beaver Creek HUC-12, 3242 U.S. Rt. 127 Celina Ohio<br>40*26'44"N 84*33'40"W |
| n/a | Which strategy is being addressed by this project? | Altered Stream and Habitat Restoration Strategies with Riparian Buffer |
| criteria f | Time Frame | Short (1-3 years) |
| criteria g | Short Description | This project will increase the amount of buffers along streams and also includes the establishment of in-stream wetlands in some areas of the creeks. Once constructed, the project will enhance the quality of in-stream and riparian habitat and reduce sediment and phosphorous loads in Beaver Creek within Critical Area 2. |

| | | |
|---|---|---|
| criteria g | Project Narrative | This project will improve in-stream and riparian habitat quality along Beaver Creek within Critical Area 2. 4,000 linear feet of stream will be restored with in-stream wetlands and/or buffer areas. Stabilization of stream channel and banks will be put in place and increasing quality of habitat for fish and macro invertebrates. The project will enhance the quality of in-stream and riparian habitat and reduce sediment and phosphorous loads in Beaver Creek. It will also restore the stream's connectivity to a functional floodplain. |
| criteria d | Estimated Total cost | $600,000 |
| criteria d | Possible Funding Source | EPA 319, SWIF, EQIP, CRP |
| criteria a | Identified Causes and Sources | Cause: Nutrient Loading/ sedimentation<br>Source: agricultural drainage, nutrient applications, channelization |
| criteria b & h | Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area? | With the goal being: to raise IBI score above 40. (currently 23), to raise or maintain or increase MIwb score above 8.3 (currently 8.4), to raise ICI score to 36 (currently at a poor rating), and raise QHEI score from 43 to 60. Also, reduce microcystin toxin levels in GLSM to bring it into drinking water attainment status.<br><br>Objective 1 of 30,000 linear feet of flood plain bench and buffers installed in Critical Area 2 will be the majority of river miles within Critical Area 2. These areas will buffer and filter nutrient run-off from agricultural land. |
| | Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project? | Plans for project 2 include 4,000 ft of river mile redeveloped, which corresponds to 13% of Objective 1. There is recognition that there is lag time associated with nonpoint source- related projects and measured stream response. With respect to the goals in critical area 2, the main driver is the QHEI score and nutrient loading into the Beaver Creek HUC-12 and eventually Grand Lake St Marys.<br>A total of 1.5% (353 lbs/ P out of 21,563 # P goal) Phosphorus reduction and 1.6% (12,132 #N out of 733,371 #N goal) nitrogen towards meeting the overall TMDL goal will be reduced. As these nutrients are reduced it is expected QHEI, IBI, ICI, and MIwb scores will increase. . According to preconstruction habitat evaluations, the QHEI score in 5 years will be up to 60 in the restored river miles. This is a 17 point improvement from the current 43 score. |
| | Part 3: Load Reduced? | Estimated: 353 lbs P/ year, 12,132 lbs N/ Year |
| criteria i | How will the effectiveness of this project in addressing the NPS impairment be measured? | Staff from OEPA-DSW Ecological Assessment Unit will perform both pre and post project monitoring to determine progress (through IBI, ICI, and QHEI) from non to full attainment. |
| criteria e | Information and Education | Mercer SWCD will develop outreach materials, and tours of the site to promote how a watershed can be improved and achieve water quality while maintaining drainage. |

# Critical Area 2: Project 3

| Nine Element Criteria | Information needed | Explanation |
|---|---|---|
| n/a | Title | Carthagena Centralized Sewer |
| criteria d | Project Lead Organization & Partners | Mercer County Sanitary Department & Mercer County Community & Economic Development |
| criteria c | HUC-12 and Critical Area | Beaver Creek HUC-12 (05120101-0202) |
| criteria c | Location of Project | Beaver Creek HUC-12, 3242 U.S. Rt. 127 Celina Ohio<br>40*26'44"N 84*33'40"W |
| n/a | Which strategy is being addressed by this project? | Urban Sediment and Nutrient Reduction Strategy |
| criteria f | Time Frame | Short (1-3 years) |
| criteria g | Short Description | This project will replace 88 failing home septic systems with centralized sewer, that will be treated by the Montezuma Club Island Wastewater Treatment Plant. Once constructed, the project will reduce phosphorous and nitrate-nitrogen loads in Beaver Creek within Critical Area 2. |
| criteria g | Project Narrative | Carthagena is one of two residentially-dense areas within the Beaver Creek HUC-12 that remains unsewered. Approximately 88 homes are clustered within the Carthagena area, which lies within Critical Area 2. Engineering plans are currently being developed to construct this centralized sewer system. The intention is to apply for grants in and obtain a permit for construction in 2017. Construction will likely begin in late 2017 and finish by the end of 2018. |
| criteria d | Estimated Total cost | $1,460,000 |
| criteria d | Possible Funding Source | Ohio RPIG; Ohio EPA WPCLF |
| criteria a | Identified Causes and Sources | Cause: Nutrient and Pathogen Loading<br>Source: Residential failing/non-functioning septic systems |
| criteria b & h | Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area? | The goals are to raise the IBI score above 40 (currently 23), to maintain or increase MIwb score above 8.3 (currently 8.4), to raise ICI score to 36 (currently at a poor rating), and to raise QHEI score from 43 to 60 at Depweg Road. Reducing nitrate, nitrite, and phosphorous levels will strengthen the quality of streams and the end result will be to obtain a full attainment status for the Beaver Creek HUC-12. |
| | Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project? | This project will result in 2.5% (616 lbs/ P out of 21,563 # P goal) Phosphorus reduction and .25% (1936 #N out of 733,371 #N goal) nitrogen reduction of the current loading outlined in the TMDL report. This project will satisfy nearly 60% of Critical Area 2, Objective 3, which calls for a reduction of nutrients. |

| | | |
|---|---|---|
| | Part 3: Load Reduced? | Estimated: 1,936 lbs N/year and 616 lbs P/year |
| criteria i | How will the effectiveness of this project in addressing the NPS impairment be measured? | A water sample will be taken down stream of the project area before the project begins; then each year after in same location during similar flows for the following five years to be sent off to a certified lab. |
| criteria e | Information and Education | The local media will publicize this project during construction bidding and during construction itself. Social media will also be used to update the public on the status of this project. Focusing on an impairment source other than agriculture is important in the social aspect of watershed improvement. |

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# Appendices

# Appendix A: Acronyms and Abbreviations

The acronyms and abbreviations below are commonly used by organizations working to restore Ohio's watersheds; many of which are included in the NPS-IS plan.

A

| | |
|---|---|
| AOC | Area of Concern |

B

| | |
|---|---|
| BMP | Best Management Practice |

D

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|---|---|
| DNR | Department of Natural Resources |

H

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|---|---|
| HUC | Hydrologic Unit Code |

I

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|---|---|
| ICI | Invertebrate Community Index |

M

| | |
|---|---|
| Mlwb | Modified Index of Well Being |
| MWH | Modified Warmwater Habitat |

O

| | |
|---|---|
| ODA | Ohio Department of Agriculture |
| ODNR | Ohio Department of Natural Resources |
| OEPA | Ohio Environmental Protection Agency |

Q

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|---|---|
| QHEI | Qualitative Habitat Evaluation Index |

S

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|---|---|
| SWCD | Soil and Water Conservation District |

T

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|---|---|
| TMDL | Total Maximum Daily Load |

U

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

W

| | |
|---|---|
| WAP | Watershed Action Plan |
| WWH | Warm Water Habitat |
| WWTP | Waste Water Treatment Plant |

Appendix B: Index of Figures

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