Nine-Element Nonpoint Source Implementation Strategic Plan (NPS-IS plan) Olentangy Watershed Headwaters Olentangy River HUC-12 [05060001 08 01]

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The Nine-Element Nonpoint Source Implementation Strategic Plan's (NPS-IS) for Blierdofer Ditch (0410000402 03), Chickasaw Creek (05120101-0201), and Heilman ditch-Swan Creek (04100009 08 04) served as templates for this plan.

Chapter 1

This report is being created by the Crawford Soil and Water Conservation District as an implementation plan for the **Headwaters Olentangy Watershed** HUC-12 (05060001 08 01), with the focus of using best management practices within the watershed to improve water quality and soil health. The impact of this HUC-12 watershed can garner a lot of attention if it is negatively impacting the greater watershed. This is the start of the Olentangy River that flows south to Columbus, OH (Central Ohio), before it outlets to the Scioto River. This NPS-IS was created for the **Headwaters Olentangy HUC-12** watershed to delve into its history of impairment and how best to improve the watershed. The watershed covers three counties – Crawford, Morrow, and Richland. It includes the entire City of Galion, along with woodland and row crop acreage.

This report is being created in advance to help detail the BMP implementation needed in this watershed to achieve defined water quality goals, and to detail objectives and specific projects for such implementation. This NPS-IS for **Headwaters Olentangy Watershed HUC-12** will meet the US EPA's 9-Element watershed plan criteria.

1.1 Report Background

This report was created to sharpen a focus on the **Headwaters Olentangy HUC-12** watershed to show the need for implementation of various BMP's in this watershed that drains south to the Scioto River. "The Olentangy River was the third scenic river designated in Ohio. From just below the Delaware Dam in Delaware downstream to Old Wilson Bridge Road in Worthington (22 Miles)." (ODNR, 2018) We need to maintain the headwaters of the Olentangy to maintain the water quality in the lower portion of the river that includes the Scenic River designation.

Crawford County is split north and south for watershed drainage. The northern 2/3 of the county is part of the of the Western Lake Erie Basin watershed, and the southern 1/3 is part of the Scioto River Watershed. The WLEB has greatly improved its watershed functioning dynamic over several years through various grants and a lot of effort from the agricultural community. This report will focus on the **Headwaters Olentangy HUC-12** and the work that is needed for its impairments.

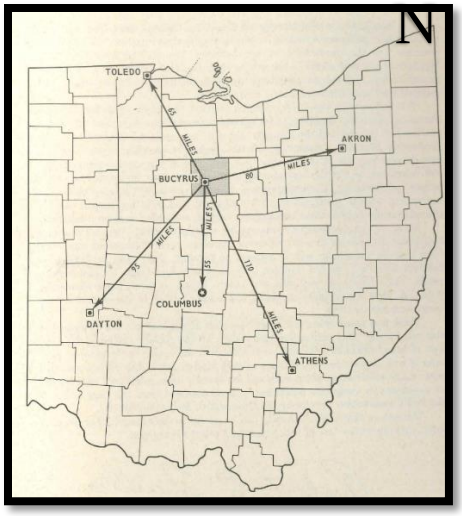

Figure 1: Location of Crawford County within Ohio. (USDA SCS, 1979)

1.2 Watershed Profile and History

The **Headwaters Olentangy** watershed has 31,718 acres within the three counties. "Olentangy was a name given to this river in 1833 by a legislative act that was attempting to restore Native American names to certain rivers in the state. The word Olentangy literally means "River of Red Face paint."." (ODNR, 2018) The headwaters start in Morrow County and flows through Crawford County to outlet to the Town of Caledonia - Olentangy [05060001 08 04] watershed. Directly west is the Mud Run [05060001 08 02], and directly east is the Headwaters Clear Fork Mohican River HUC-12 [05040002 03 01]. Directly north is the Headwaters Middle Sandusky River [04100011 04 03], Loss Creek – Sandusky River [04100011 04 02], and the Headwaters Paramour Creek – Sandusky River [04100011 04 01] HUC-12's. Directly south is the Headwaters Whetstone Creek [05060001 09 02] HUC -12. The **Headwaters Olentangy HUC-12** watershed lies north from the Flat Run [05060001 08 03] watershed which is a separate tributary leading into the Olentangy River. This **Headwaters Olentangy HUC-12** watershed drains south, eventually into the Scioto River, in Columbus, Ohio.

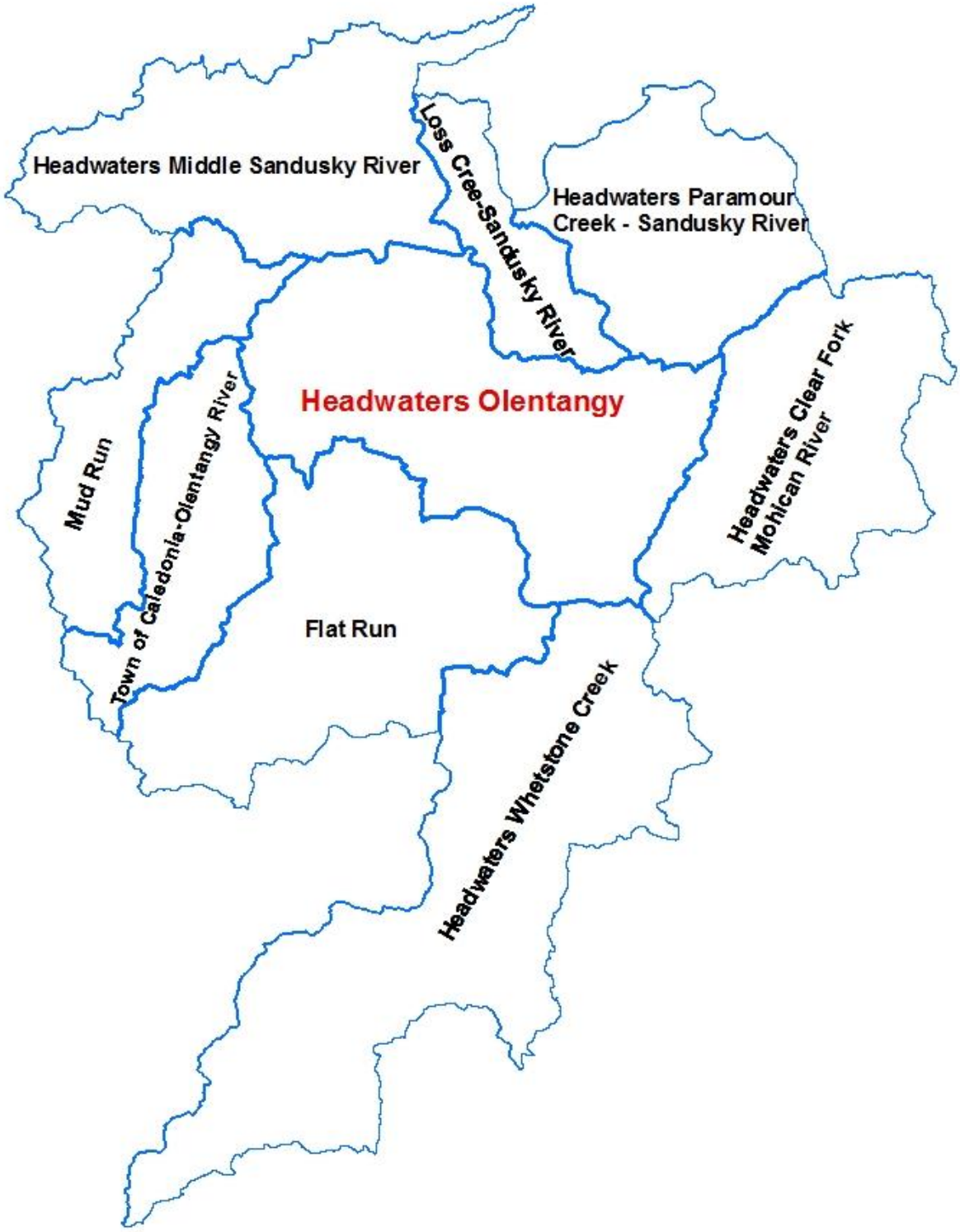

Figure 2: Map shows the Headwaters Olentangy and its surrounding HUC-12 watersheds.

Figure 3: (Not to scale) Map shows the watershed split between Crawford, Morrow, and Richland Counties.

Figure 4: Map shows the flow of the Olentangy River starting on the east end of the watershed and travelling west. The length of the Olentangy main-stem within this HUC-12 is approximately 21.8 miles.

Headwaters Olentangy HUC-12 is a part of the HUC-8 Olentangy Watershed with its northernmost acreage in Crawford county, travelling south through to Franklin County. The Olentangy HUC -8 is split into Upper, Middle and Lower Olentangy HUC -10 and the Whetstone Creek HUC – 10 watersheds.

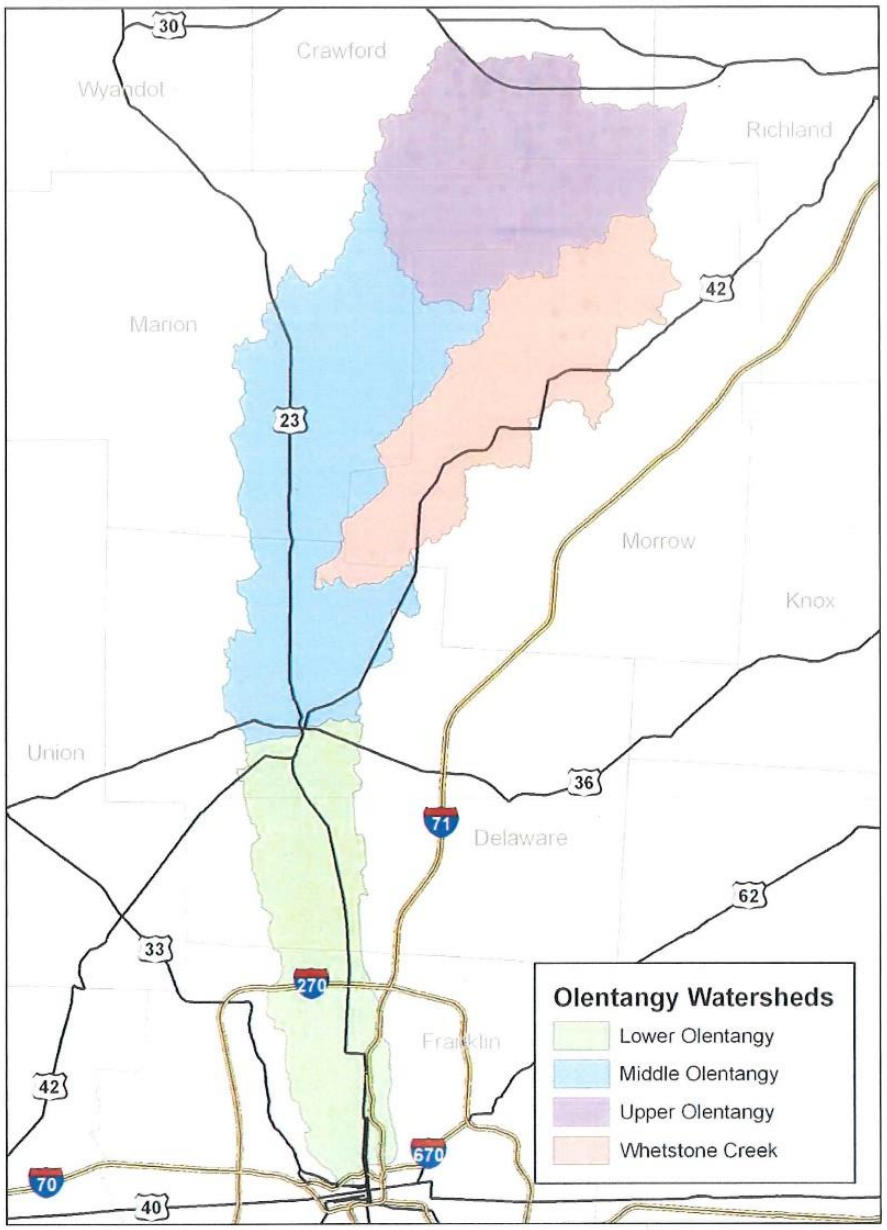

Figure 2.1 Location of the Olentangy watershed

Figure 5: Map depicts the sections of the Olentangy watershed. (OEPA, 2007)

The chart below lists the lengthy schematic of the HUC-12 watersheds that include the Olentangy River mainstem.

Headwaters of Olentangy River 05060001 08 01
Curves North West through Crawford and then travels south through…
Town of Caledonia – Olentangy River 05060001 08 04
Travels South through…
Otter Creek – Olentangy River 05060001 10 01
Travels South West through…
Beaver Run – Olentangy River 05060001 10 03
Travels South and into the Delaware Reservoir in the…
Brandige Run – Olentangy River 05060001 10 05
Delaware Reservoir reverts back to stream travelling South through…
Indian Run – Olentangy River 05060001 10 06
Travels South through…
Delaware Run – Olentangy River 05060001 10 07
Travels South through…
Deep Run – Olentangy River 05060001 11 01
Travels South through…
Rush Run – Olentangy River 05060001 11 02
Outlets to…
The Mouth Olentangy River Watershed 05060001 11 03

Table 1: Maps the HUC-12 Watersheds of the Olentangy River to where the river outlets into the Scioto River. (OEPA, 2016)

The City of Galion uses the Olentangy as a drinking source and the Wastewater Treatment Plant (WWTP) is monitored by the EPA for water quality thresholds.

Before this watershed became populated it was mostly grassland prairie and woodland acreage. Soil organic matter has diminished with the current crop rotations and intense tillage. Nutrients today are applied by either commercial fertilizer and/or manure. The average soil organic matter ranges between 2-3% today, when it used to be 5% or above. According to a recent publication, 50-80% of this watershed has tile drainage. (King et al., 2018) The typical crop rotation for this watershed is a corn-soybean rotation with wheat acreage dropping every year. Crawford County ranks 4th for agricultural products sold in the state. Crawford County is also 3rd in the state with sales of hogs and pigs. (USDA, 2017) There are a handful of dairies left in the county with the majority of livestock after hogs being cattle. In the Headwaters Olentangy HUC-12 there are an estimated 10 livestock operations in the watershed of varying sizes between cattle, hog, and poultry with the majority of production being row-crop agriculture.

1.3 Public Participation and Involvement

Affiliates involved with the work of best management practices include Crawford SWCD, Morrow SWCD, USDA - NRCS, USDA - FSA, OSU Extension, and the Crawford County Engineer's office. The City of Delaware and the Olentangy Watershed Alliance are also involved with the scenic river (Olentangy River) and its water quality. They focus on the lower end of the watershed usually but have done projects within Galion to clean up the river. This report is being written for the intention of receiving future grant funding and having this watershed implementation strategy already created and approved.

The majority of the watershed is agriculture based and will focus on promotion of BMP implementation through education and other means to the agriculture community. And how these practices will improve their watershed. A survey was created in 2018 to ask the Crawford County farming population about what practices they are using and what they feel would help their watershed to improve, not only the watershed, but their farming operations.

The results from the survey show that farmers are interested in implementing best management practices to improve water quality including but not limited to; cover crops and nutrient management practices. They also have interest in re-establishing trees for timber, recreation, and windbreak use. Producers also stated they would be more likely to do BMP's with split or whole cost share to help alleviate the expense. Concerns on their farming operations were water management, filter strip management, and weed management. Concerns within the watershed were focused on drainage, flooding, erosion, sedimentation, and nutrients in surface water; as well as logjams, livestock access to waterways, and channel sedimentation and debris in ditches and the stream. The overall indication from the survey is that they wanted more knowledge on these practices and were willing to go to field days and workshops if they were hosted.

Chapter 2: Headwaters Olentangy HUC-12 Watershed Characterization and Assessment/ Summary

2.1 Summary of HUC-12 Watershed Characterization

2.1.1 Physical and Natural Features

There are 22,546 acres in the Headwaters Olentangy Watershed in Crawford County. 1,707 in Richland, and 7,465 in Morrow County. The average topographical grade is 0-2% slopes. The predominant soils are Bennington-Condit, Wadsworth-Condit, and Rittman-Bennington soils. These soils were formed in mainly glacial till on uplands. They are nearly level or gently sloping, with somewhat poorly to very poorly drained soils. (USDA SCS, 1979 & 1993). "These [steep shale] banks are often dissected by ravines which cut through and expose the underlying rock strata including the Ohio black shale, noted for its presence of large "ironstone" concretions." (ODNR, 2018)

With 73% of the watershed being agriculture, their practices can dictate the healthiness of the ground and surface water within the watershed. It is predominately a corn-soybean rotation with wheat acres dropping every year. The lack of biological cover for 7 months of the year by either wheat, cover crops, or other overwintering crops is a contributor to lacking soil tilth. Through the 4R precision application program we can help educate and assist producers to apply the right amount of nutrients in the right place, at the right rate, and at the right time to reduce or eliminate future run-off. With any disturbance of the soil there is an increasing chance of soil erosion and with a rain event after a fertilizer application there is a chance of runoff to the streams. This is a direct increase of both nutrients and sediments to the stream. Implementing BMP's such as waterways, filter strips, and no-till farming are ways that a producer can improve soil tilth, keep soil from eroding, and nutrients leaving the field via surface water.

2.1.2 Land Use and Protection

The watershed is mainly used for agricultural purposes but does have the whole City of Galion with an estimated population of 11,000 people using the Olentangy River for a drinking supply. There are several factories, parks, schools, and major roadways within this watershed that are point sources of pollution. Agriculture use, and stormwater if not properly managed are the nonpoint sources of pollution in this watershed.

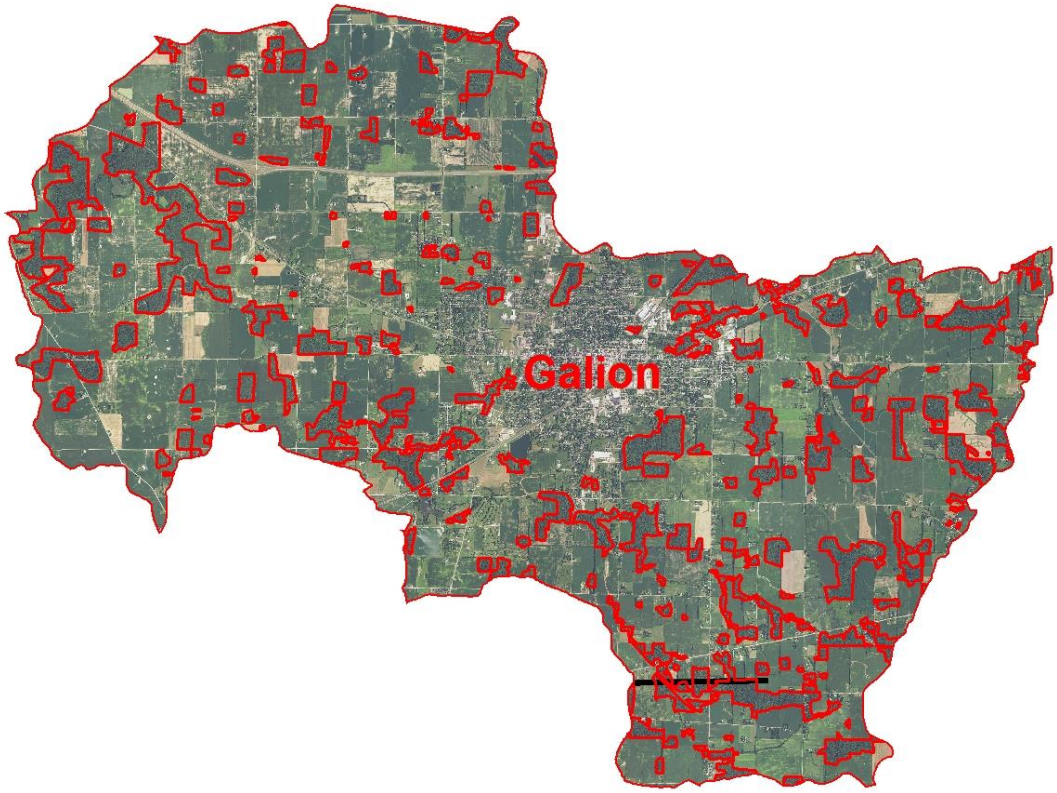

Figure 6: (Not to scale) Map shows the woodland acreages outlined (in red) for the **Headwaters Olentangy River HUC-12**. Table 2 differentiates the land use percentages and acreages.

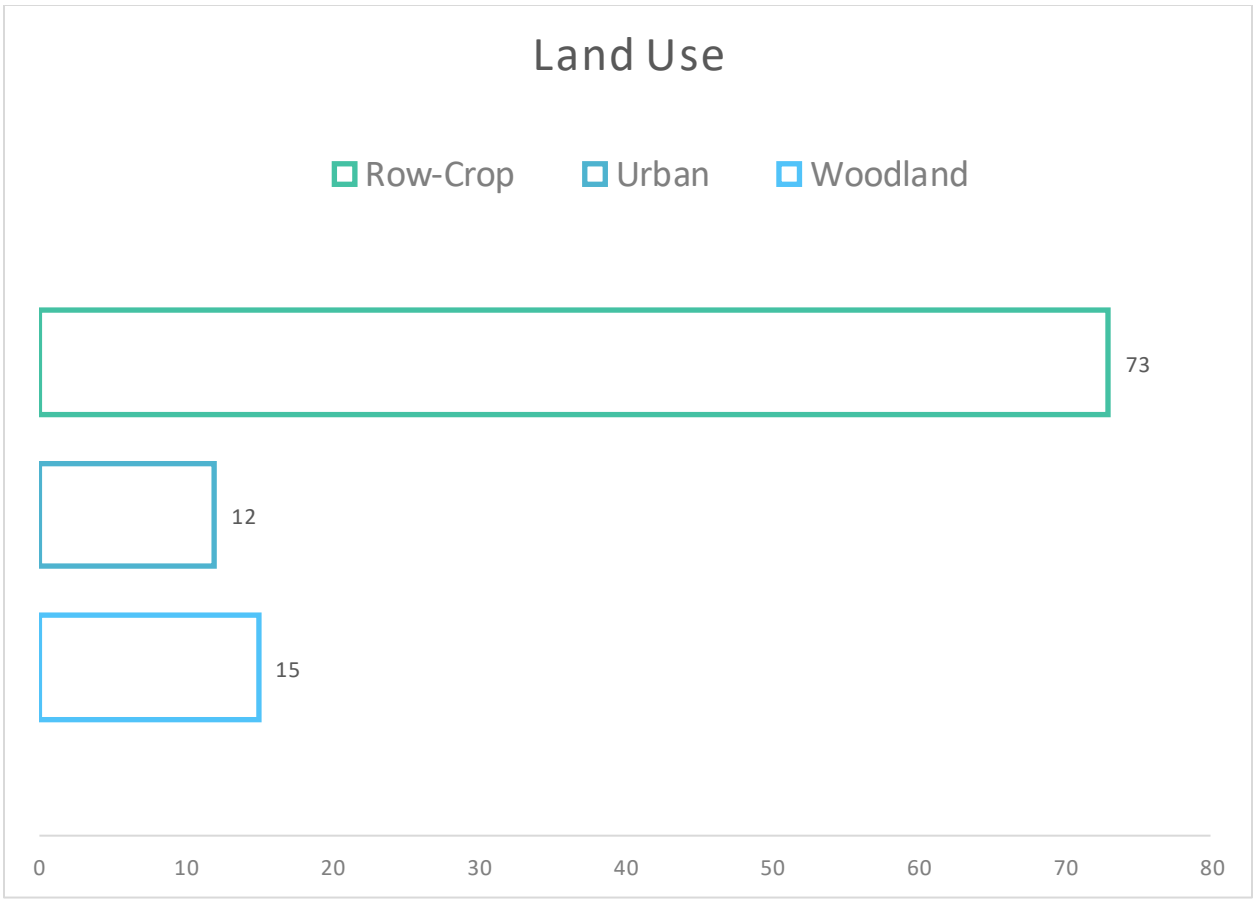

Figure 7: Bar graph shows the land use percentages.

Headwaters Olentangy (05060001 08 01)

Land Use	Acreage
Row Crop	22,814
Woodland	4,856
Urban	3,911
Total	31,718

Table 2: The watershed acreage is broken down into its individual land uses. (Crawford SWCD, 2018)

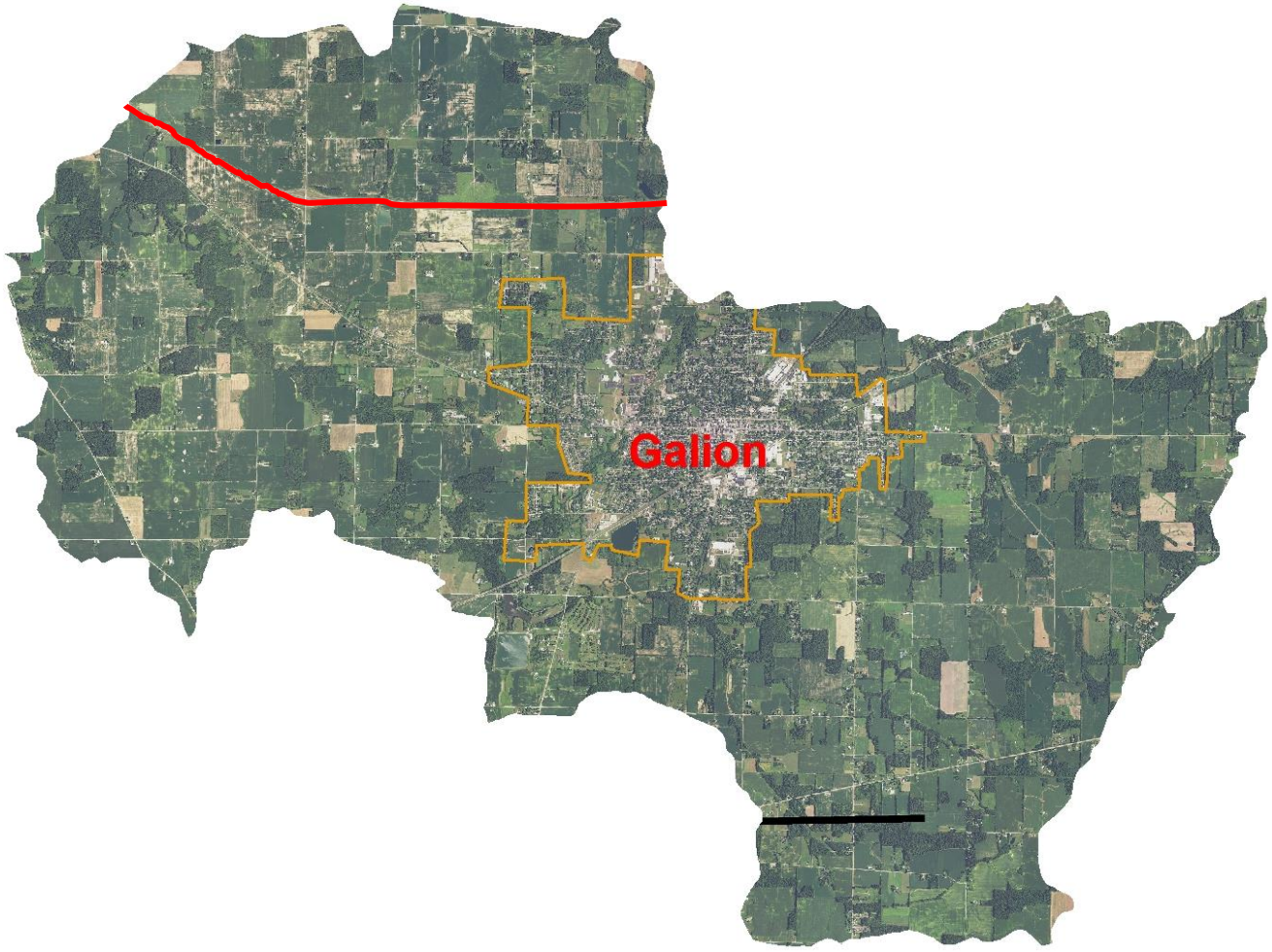

Figure 8: (Not to scale) Maps shows the urban acreage outline (in orange) in the Headwaters Olentangy River HUC-12 for the watershed. Outlined in red is major route 30 which was completed in 2005.

There is one NPDES permit from OEPA for the Galion Wastewater Treatment Plant (WWTP) and its permit code is 2PD00030. It is at river mile 85.9 and is listed as a sanitary/ industrial, extended aeration treatment system with and average daily design flow capacity of 2.7 million gallons per day. One violation listed by the OEPA that they are currently working on is the Westmoor Subdivision being put onto the city sewer system due to failing household sewage treatment systems (HSTS). (OEPA, 2005) The OEPA also has 16 other industrial stormwater NPDES permits within the Olentangy River Watershed that are monitored and regulated through their agency. Refer to table 3.

Facility Name	OEPA Permit Number
Galion, Inc.	2GR00180
Flick Packaging	2GG00212
A & G Manufacturing, Inc.	2GR00090
A & G Manufacturing, Inc.	2GR00091
A & G Manufacturing, Inc.	2GR00089
McClain E-Z Pack, Inc.	2GR00111
K & B Products, Inc.	2GG00103
Carter Machine Co., Plant #1	2GR00219
Carter Machine Co., Plant #2	2GR00237
Ferro Graphics, Inc.	2GR00144
Elliot Machine Works, Inc.	2GR00536
City of Galion	2GR00548
Peco II, Inc.	2GR00195
Komatsu Dresser, Plant #1	2GR00317
Komatsu Dresser, Plant #2	2GR00316
Galion Auto Wrecking, Inc.	2GG00261

Table 3: Listed are the industrial stormwater facilities regulated by a General NPDES permit through OEPA that have the Olentangy River as its receiving stream. Improper management could impact further downstream into the critical area this report is focusing on. (OEPA, 2005)

In 2005 a major ODOT interchange, Route 30, was constructed in the upper portion of the watershed. The Crawford Soil and Water Conservation District worked with landowners and the construction crews to maintain drainage along the new route. Conservation practices were implemented to ensure that good water quality would be met into the tributary ditches and the Olentangy River.

There are 3 major reservoirs in the watershed that are labeled as impoundments. They are the Amick, Amman's and Powers reservoirs. Amman's reservoir feeds into the Olentangy river, where the other two are their own separate reservoirs. These reservoirs are the drinking source for the City of Galion but also provide recreational activities for the community. Refer to figure 9.

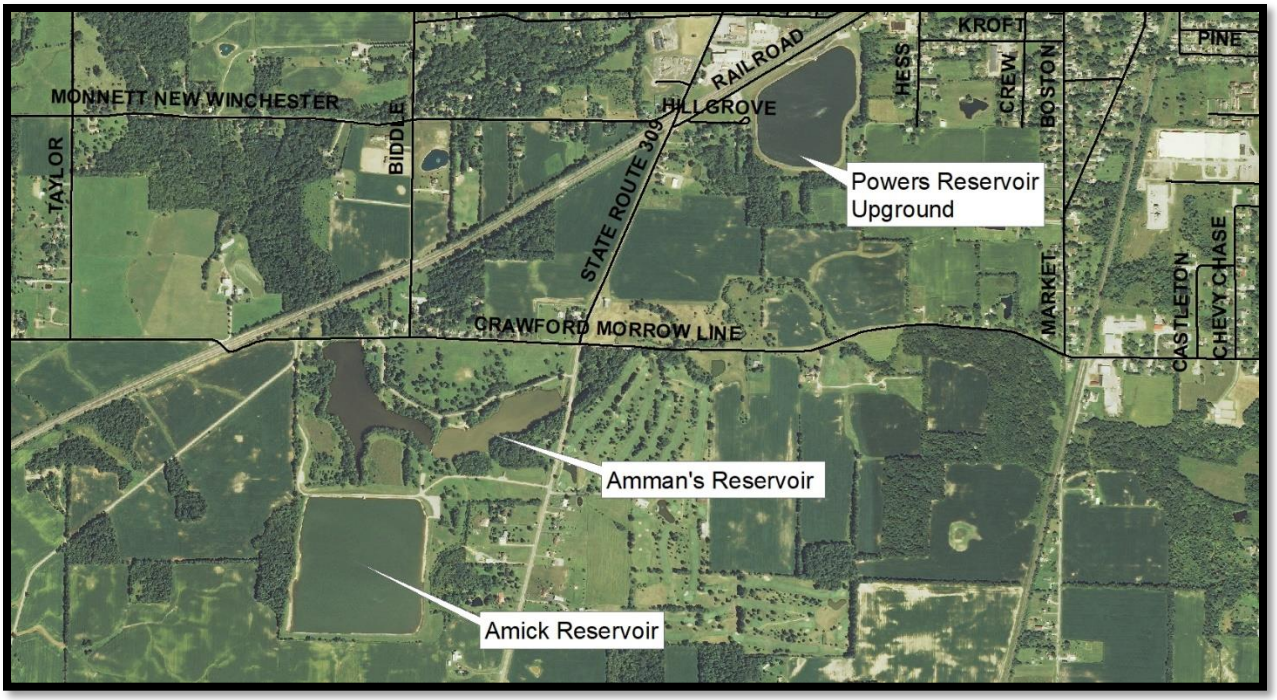

Figure 9: Aerial imagery (not to scale) shows the three reservoirs located on the south side of Galion. The 2 southern reservoirs being in Morrow County.

Crawford County has 5 petition drainage ditches (See table 4) within this watershed that are maintained by the county engineer's office and the maintenance is paid through landowner tax assessments. There are no county maintained ditches in Morrow County. All other ditches in either county are labeled as private ditches and maintained by landowners at their own expense, or not maintained at all.

Ditch Name	Length (Ft.)
Burkhart	2,792
Phillips	13,340
Guinther	11,140
Nigh	21,306
Thatcher	7,200
TOTAL:	57,778

Table 4: Table lists the ditches of the watershed with their corresponding length. These ditches are maintained on a triennial basis with the alternation of mowing, spraying, and dipping the bottom clean.

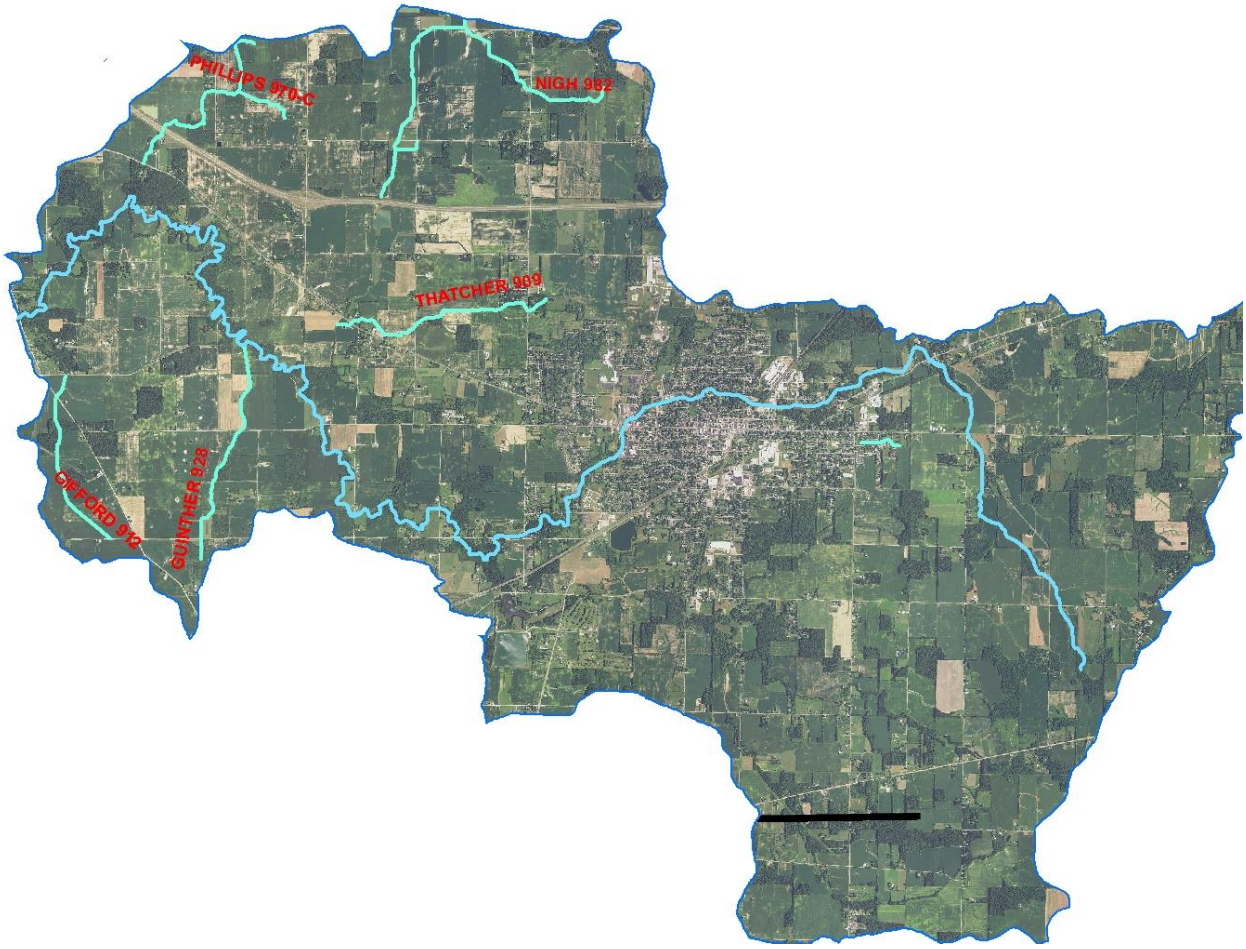

Figure 10: (Not to scale) Map shows the 5 largest ditches (light blue with red labels) in the county that are maintained by the county engineer's office. (Crawford County Engineers, 2018)

2.2 Summary of HUC-12 Biological Trends

The OEPA has five testing stations in this watershed this report will focus on. All in Crawford County. Three stations have full attainment status, while RM 79.7 is partial attainment and RM 85.9 is considered non-attainment. Refer to figures 12-14 for sampling locations. The sampling sites in Headwaters Olentangy HUC-12 are considered WWH* (Warmwater habitats). The sites were tested in 2005 and will not be tested again until 2021.

> *WWH – This designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; this use represents the principal restoration target for the majority of water resource management efforts in Ohio, and is in line with the Clean Water Act goal of fishable waters. (Ohio EPA, 2007)

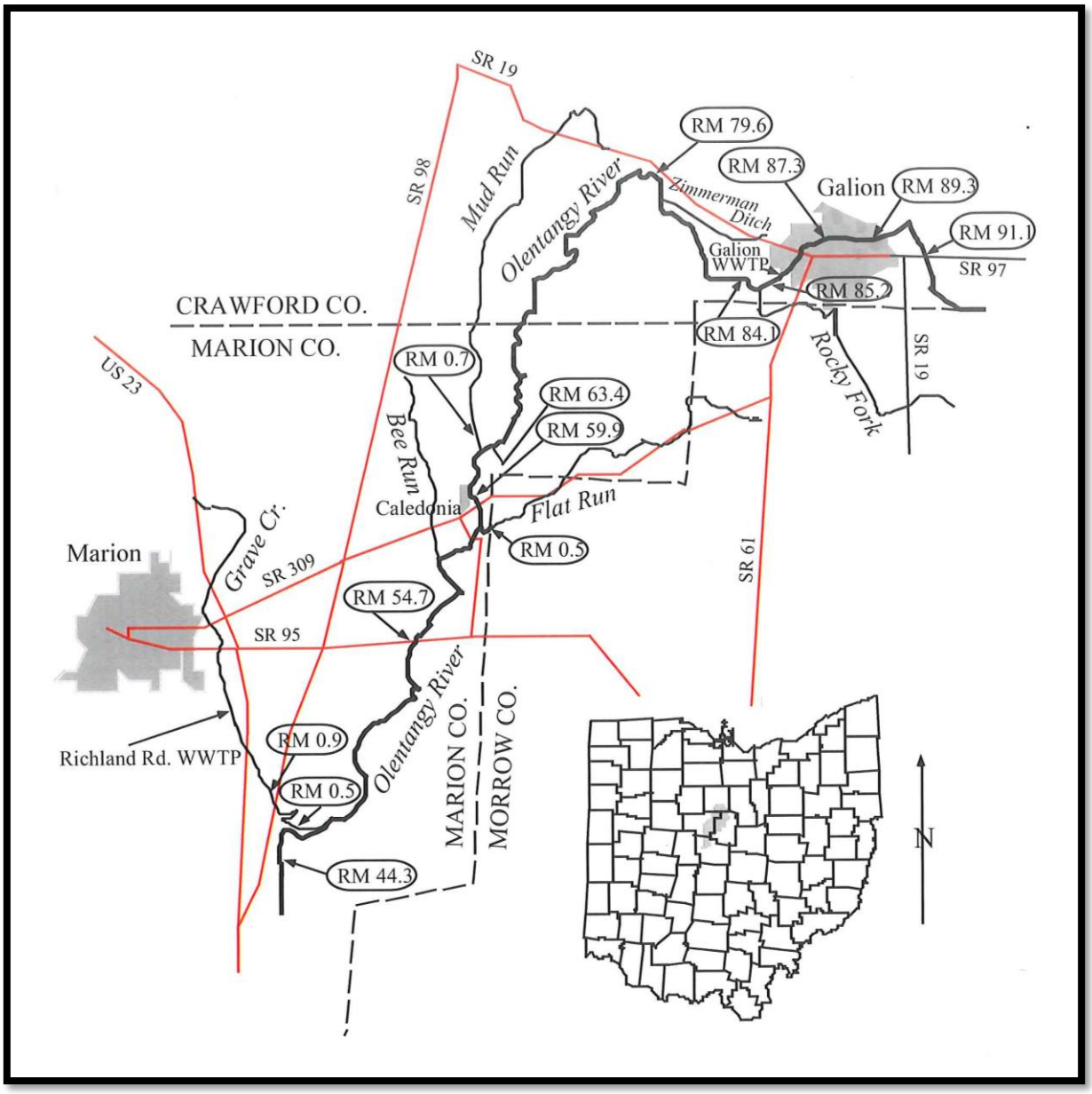

Figure 11: Map shows important river mile markers that were tested along the Olentangy River. The Headwaters Olentangy has testing stations from RM 79.6 - 91.1, along with the WWTP. (OEPA, 1996)

Figure 12: (Not to scale) RM 85.9 at WWTP which is non-attainment status according to the OEPA.

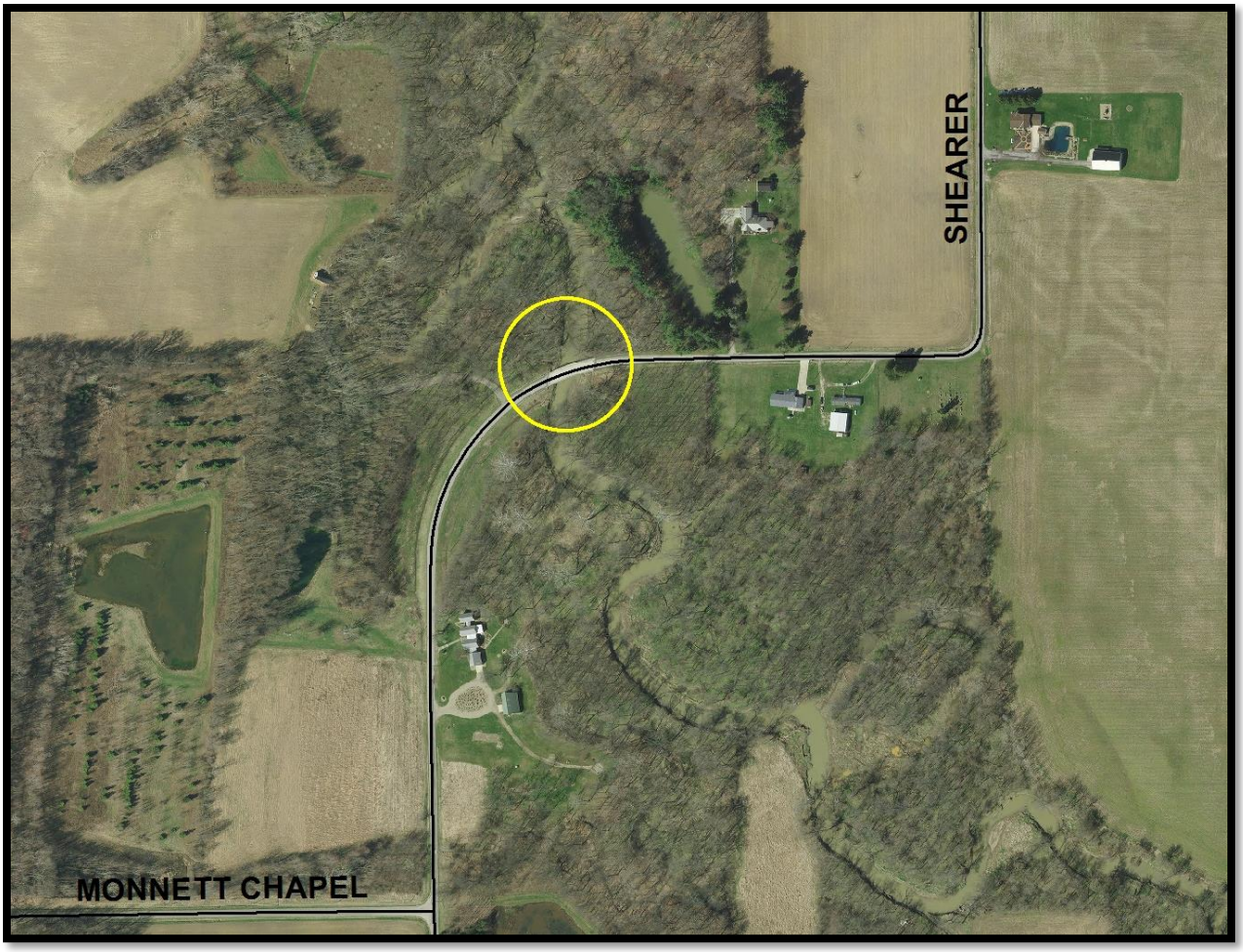

Figure 13: (Not to scale) RM 79.6 Downstream of Shearer Road which is in partial attainment.

There are 59 locations of tile and storm sewer outlets in the City of Galion between RM 86.4-89.24 that were tested by the OEPA for water quality. Most were noted to have no noticeable flow, or clear effluent.

"Livestock with stream access are found along the Olentangy River mainstem at Taylor Road, Iberia Road, Galion-New Winchester Road, and Crawford-Marion Line Road. These locations correspond to river miles 84.1, 82.9, 91.7, and 68.1, respectively." (OEPA, 2007)

Figure 14: (Not to scale) RM 89.3 at Edward Street in Galion is currently listed as full attainment.

Below are Biological and Habitat evaluation indices and thresholds that are used to determine if designated Warm water habitat (WWH) streams are meeting Aquatic Life Use (ALU) designation standards.

Evaluation	Score needed for full attainment
Index of Biotic Integrity (IBI)	40
Invertebrate Community Index (ICI)	36
Modified Index of well-being (Mlwb)	NA for Headwaters sites, 8.3 for wading
Quantitative Habitat Evaluation Index (QHEI)	60

Table 5: The results from the sample sites in the Headwaters Olentangy HUC-12 are listed in Table 6.

River Mile	IBI	Mlwb	ICI	QHEI
89.3	49	NA	Marginally good	84
86.1	38	NA	34	58.5
85.9	38	NA		79
84.5	37	NA	46	82.5
79.7	34	7.8	42	69.5

Table 6: Sample site ALU designations within the **Headwaters Olentangy HUC-12**. (OEPA, 2005)

The IBI is being met only at RM 89.3. Mlwb is only applicable for RM 79.7 and it does not meet the OEPA standard of 8.3, being short by 0.5 units. ICI sample sites are all passing except for RM 86.1 which is short by 2 points. The QHEI is being met at 4 of the 5 stations, with RM 86.1 not meeting the OEPA criterion.

2.3 Summary of NPS Pollution Causes and Associated Sources for Headwaters Olentangy HUC-12 (05060001 08 01)

Three out of the five sites are listed as full attainment sites, one is partial, and the last is non-attainment at RM 85.9. There is also an excess of nitrogen in this watershed that needs to be addressed. There is a need for the nutrient load to be reduced by 20% across urban and agricultural landscape. See Table 7. The causes for the ratings are from nutrients, siltation, direct habitat alterations, and flow alteration. The sources being major municipal point source, non-irrigated crop production, stream modification/ destabilization- agriculture, removal of riparian vegetation – agriculture, and upstream impoundment.

RM	Current Aquatic Life Use	Attainment Status	Cause	Source
79.7	WWH	Partial	Nutrients, cadmium '(94) and siltation	Galion WWTP and agricultural activities
84.5	WWH	Full		
85.9	WWH	Non	Fish avoidance response Toxicity to invertebrates	Galion WWTP
86.1	WWH	Full		
89.3	WWH	Full	Low DO and possible undocumented spills	Upstream package plants and possible undocumented spills

Table 7: Listed are the RM tested by EPA and the pollution threat concerns are listed in the cause and source columns. (OEPA, 2005)

Agricultural		Urban	
Existing Load	Load Reduction Goal	Existing Load	Reduction Goal
#N (@30#/acre)	(20% of existing N load)	#N (@10#/acre)	(20% of existing N load)
570,000	114,000	58,000	12,000

Table 8. Provided by OEPA 2021 calculations. Future modeling may change these listed amounts. (OEPA, 2021)

2.4 Additional Information for Determining Critical Areas and Developing Implementation Strategies for Headwaters Olentangy HUC-12

Working to improve the Headwaters Olentangy HUC-12 will be several agencies including: Crawford SWCD, Marion SWCD, Morrow SWCD, FSA, NRCS, OSU Extension Office, and the Crawford County Engineer. Information, data, and resources were gathered from these agencies as well as from the OEPA. Mainly from the Biological and Water Quality Study of the

Olentangy River, Whetstone Creek and Select Tributaries, 2003-2004. This NPS-IS also looks at the TMDL report written by the Division of Surface Water in 2007.

2.5 BMP's Benefits

Landowner's in the Headwaters Olentangy HUC-12 would be most receptive to the following best management practices based on past surveys and landowner feedback and would be willing to implement these sound practices. Refer to table 9. Cover crops can help improve soil quality for future crops, increase water infiltration, and reduce erosion. "Sediment is agriculture's number one pollutant. - Cover crops protect soil aggregates from the impact of rains drops by reducing soil aggregates break down. By slowing down wind speeds at ground level and decreasing the velocity of water in runoff, cover crops greatly reduce wind and water erosion." (Hoorman, 2009) Benefits from several best management practices can include improving soil quality, water quality, soil stability, increase rain infiltration, reduce erosion, improve nutrients, weed control, and increase field working conditions. "Drainage water management can potentially increase yields by retaining water in the soil profile to be available during the growing season. It can supply what the crops need during subsequent dry periods." (Skaggs, et al., 2012) "A bare soil holds 1.7 inches water while a continuous living cover holds 4.2 inches of water (USDA-NRCS Engineering handbook)." (Hoorman, 2009) USDA's purpose for filter strips (Code 393) is to, "reduce suspended solids and associated contaminants in runoff and excessive sediment in surface waters; reduce dissolved contaminant loadings in runoff; and reduce suspended solids and associated contaminants in irrigation tailwater and excessive sediment in surface waters." (USDA, 2017)

With these being the most common practices, note that there are other practices that will be talked about in this NPS-IS. Refer to the following links for best management practices from various agencies handbooks or brochures. These are also a great quick reference that describes the purpose and benefits of each practice.

- OSU BMP's
- EPA BMP's
- Division of Surface Water NPSIS guide
- H2Ohio practices
- NRCS BMP's brochure

Practice Benefits

Cover Crops	**Increase soil tilth, reduce soil erosion, increase biomatter, increase water holding capacity, etc.**
Nutrient Management	**Reduce excess nutrient losses, improve yields, reduce fertilizer costs, etc.**
Filter Strips	**Reduce soil erosion, filter surface runoff, increase water holding capacity, etc.**
Waterways	**Reduce soil erosion, filter surface runoff, increase water holding capacity, etc.**
Drainage Water Management	**Retain water for crops when they need it and reduce nutrient loads in runoff.**
Blind inlets	**Filter surface runoff, increase drainage, and reduce soil compaction via ponding.**
Streambank stabilization	**Reduce soil erosion, improve floodplain capacity, promote wildlife habitat.**
Bioretention	**Filter surface runoff, increase biodiversity, and increase stormwater management.**
Livestock exclusion fencing	**Reduce nutrient loads, reduce soil erosion, and reduce pathogen contamination.**

Table 9: Table shows the practices that are being utilized in the projects for this watershed. They are not a full representation of practices that can be utilized by producers. For more best management practices follow the links listed in section 2.5. Any combination of these will help to treat and improve water quality and reduce the nutrient load throughout the watershed.

Chapter 3: Critical Area Conditions and Restoration Strategies for Headwaters Olentangy HUC-12

3.1 Overview of Critical Areas

According to the OEPA reports, the Headwaters Olentangy HUC-12 is split into full, partial, and non-attainment status for its designated Aquatic Life Use. This is in part due to municipal and farming practices. A watershed can always be improved, utilizing best management practices will improve water quality and nutrient loads through the whole watershed, with the main focus being upstream and downstream of the City of Galion on the Olentangy River and its tributaries, along with the adjacent row crop acreage. Refer to figure 15.

Figure 15: (Not to scale) Map details the critical areas for the Headwaters Olentangy HUC-12 (Crawford SWCD, 2021) The Orange areas show Critical Area 1 – "Prioritized row-crop agriculture lands" and the green portion is Critical Area 2 – "City of Galion".

Figure 16: (Not to scale) Map details the area for Critical Area 1 "Prioritized row-crop agriculture lands" (shaded area) which is further explained in section 3.2.1. (Crawford SWCD, 2018) The WWTP is denoted with a red circle. The Olentangy River is lined in light blue.

3.2 Critical Area 1 – "Prioritized row-crop agriculture lands": Conditions, goals, and objectives for Headwaters Olentangy HUC-12

3.2.1 Detailed Characterization

The area in Critical Area 1 in the Headwaters Olentangy HUC-12 is focusing on the 73% cropland. Improved conservation practice implementation throughout the watershed are most likely going to be the marker that determines the need to incrementally improve the water quality metrics (i.e., IBI, ICI, QHEI, and Mlwb) in this HUC-12. Whereas, project one will focus on the Olentangy river, and for project two in critical area 1 it identifies all row-crop land and riparian corridor acreage adjacent to waters of the state. Project participation will be prioritized according to the prioritization list below (1 is highest priority, 3 is lowest priority):

1) Fields with documented (photo) evidence of gully or ephemeral erosion
2) Fields with soil test P levels above (100ppm Mehlich – 3) according to up-to-date soil test analyses.
3) Fields scheduled to be fertilized with manure in next 12 months
4) Documented (photo) evidence of natural resource concern to "Waters of the State"

Overall, we want to improve the non-attainment status to a full attainment status by improving QHEI scores at the sample sites. See page 24 for attainment statuses. This being the headwaters watershed, we are not getting the upstream watershed impairments, but we are impacting the downstream, and with each practice implemented the better water quality and nutrient load will flow downstream.

3.2.2 Detailed Biological Conditions

River Mile	**IBI**	**Mlwb**	**ICI**	**QHEI**
89.3	49	NA	Marginally good	84
86.1	38	NA	34	58.5
85.9	38	NA		79
84.5	37	NA	46	82.5
79.7	34	7.8	42	69.5

Table 10: Sample site ALU designations within the **Headwaters Olentangy HUC-12**. (OEPA, 2005)

This data is the most current from OEPA and will not be studied again until 2021.

3.2.3 Detailed Causes and Associated Sources

Causes and Sources for the Headwaters Olentangy HUC-12

Causes
Nutrients
Siltation
Direct habitat alterations
Flow alteration
Sources
Major municipal point source
Non irrigated crop production
Stream modification/ destabilization – agriculture
Removal of riparian vegetation – agriculture
Upstream impoundment

Table 11: Table lists the causes and sources for the **Headwaters Olentangy HUC-12** (OEPA, 2007).

- **Siltation** describes the deposition of fine soil particles on the bottom of stream and river channels. Deposition typically follows high-flow events that erode and entrain soil particles. As the flow subsequently decreases, the entrained soil particles fall from suspension to the stream bottom. This reduces the diversity of stream habitat available to aquatic organisms.

- **Nutrient Enrichment** describes the excess contribution of organic and inorganic materials used by plants during photosynthesis. Excess nutrients are not toxic to aquatic life, but can have an indirect lethal effect through algal-mediated depressed dissolved-oxygen concentrations. Excess nutrients can also result in a trophic shift of the aquatic community, as less-desirable algal species may outperform others in an enriched condition.

- **Habitat Alteration** describes the straightening, widening, or deepening of a stream's natural channel. Habitat alteration can also include the degradation or complete removal of vegetated riparian areas that are essential to a healthy stream. These activities can effectively transform a stream from a functioning ecosystem to a simple drainage conveyance.

- **Flow Alteration** describes any disruption to the natural hydrologic regime of a stream system. Flow alteration includes stream impoundment, increased peak-flow magnitude associated with the urbanization of watersheds, and water-table regulation through sub-surface drainage.

- **Contamination by Pathogens** occurs when human or animal waste reaches the stream. Pathogenic organisms include bacteria, viruses, and protozoan. Contamination by pathogens is a human health issue, as skin contact or accidental ingestion can lead to various conditions such as skin irritation, gastroenteritis, or other more serious illnesses.

Figure 17: Description of primary Causes in the Olentangy River according to OEPA. (OEPA, 2007)

Because this watershed is predominately agriculture, any implementation of conservation and farming practices would benefit this watershed, addressing the causes and sources of impairment for improvement.

Figure 18: Photo shows common gullies found pinched between two slopes. These can lead to direct losses of sediment and nutrients to waters of the state.

Figure 19: Photo shows a log jam in the flooded Olentangy River. Flash flooding is occurring more often and many of the ditches and parts of the Olentangy River do not have a functioning floodplain to help manage for the increase in water and sediments. Increased floods due to reduction in flow by log jams further increase sedimentation and nutrient loads through bank erosion, and flooding of adjacent farm fields.

Figure 20: A recently constructed waterway in a tilled field. Where one resource concern was addressed there is now the concern for sediment to directly go into the waterway due to farming practices. Therefore, stressing the need for BMP's to solve resource concerns.

Figure 21: Runoff waters containing sediment and nutrients are the highest contributor of NPS loads (i.e., volume X concentration) annually. Implementing a variety of BMP's could improve the water quality and reduce the nutrient load before it reaches waters of the state.

Figure 22: A drainage ditch with the crop field being farmed close to the edge of the bank. Adding buffers along the drainage ditch helps reduce nutrients and sediments that would have the potential to runoff directly into the ditch without being filtered.

Figure 23: Severe ditch bank erosion along an intermittent stream in Crawford County. Erosion as severe as this can be a safety hazard and is a source of sedimentation in downstream reaches, and a possible nutrient runoff site from adjacent crop fields.

3.2.4 Outline Goals and Objectives for Critical Area 1 – "Prioritized row-crop agriculture lands"

Figure 24: (Not to scale) Highlighted in orange is Critical Area 1 – "Prioritized row-crop agriculture lands"

There are approximately 25,354 acres in this critical area focusing on the Headwaters Olentangy HUC-12. Strategic placement of riparian buffer and conservation farming practices will help distribute, slow down, and filter runoff from fields. Having a minimum setback of 30' per side from farming practices and converting to filter strip, wildlife corridor, tree planting, or other riparian practice could vastly reduce the sedimentation/siltation impacts and create a wildlife habitat in an established riparian corridor.

Goals

Being that this watershed is mostly in full attainment we are going to focus on practices to improve the land adjacent to the Olentangy River and then branch out to its contributing acres as needed. Priority will follow these parameters:

1) Proximity to stream or ditch
2) Fields with soil test P levels above (100ppm Mehlich – 3) according to up-to-date Nutrient Management Plans
3) Fields with soil organic matter <3%
4) Fields with documented (photo) evidence of gully erosion
5) Fields scheduled to be fertilized with manure in next 12 months

Any additional BMP's will only enhance the stream and watershed to reduce sedimentation and nutrient load. The following goals will focus on the rural sections of the watershed that will have the biggest impact with the use of BMP's.

➔ Goal 1. Achieve IBI score of 40 at RM 85.9.
NOT ACHIEVED: Current score is 38.

- ➔ Goal 2. Achieve IBI score of 40 at RM 84.5.
  NOT ACHIEVED: Current score is 37.

- ➔ Goal 3. Achieve IBI score of 40 at RM 79.7.
  NOT ACHIEVED: Current score is 34.

- ➔ Goal 4. Reduce Nitrogen load by 20%
  NOT ACHIEVED: Current load is 570,000 pounds of N (Assuming 30lbs/ac N) – Refer to Table 8

Objectives

To achieve Full attainment and improved water quality/ soil health to the watershed the following practices will help toward the restoration goal. The objectives for Critical Area 1 have BMP's imposed to show improvement for both critical areas.

- ➔ Objective 1. Implement 18,000 linear feet of grass and/or tree buffers along stream and ditch corridors. This represents ~20% of the stream length in this critical area.

- ➔ Objective 2. Install 10 grade stabilization structures where gullies are eroding stream banks at outlets to waters of the State.

- ➔ Objective 3. Reduce erosion and nutrient loss by installing grassed waterways.
  10 acres of waterway (minimum 20' wide) with proper outlets to waters of the state.
  Establishing, approximately 21,780 linear feet of grass waterways.

- ➔ Objective 4. Improve or restore 2.25 miles of the Olentangy River to promote stream habitat, managing 10% of the stream with 10 projects at 400 feet of average length. Improve river flow alterations and stream bank stabilizations by anchoring banks with logs and earthen material as protection to address scour and sedimentation and in turn increasing instream habitat.

- ➔ Objective 5. Install drainage control structure to reduce nutrient losses.
  Install 20 structures to maintain 400 acres of row crops.

- ➔ Objective 6. Install blind inlets to filter nutrients before reaching the tile and waters of the state.
  Install 20 blind inlets to manage 400 acres of watershed.

- ➔ Objective 7. Plant cover crops to promote soil health, increase infiltration, and reduce runoff in agriculture fields.
  Plant 45% (10,000 acres annually) of the row crops in cover crops.

➔ Objective 8. Improve nutrient management with 4R precision application technology. Fund 20 farming (500 max acres per farm) operations, or up to 10,000 acres to utilize precision application. Monitor before and after using this technology.

➔ Objective 9. Promote increased use of minimum or no-till planting.
Fund 20 farmers (500 acres max per farm) operations, or up to 10,000 acres to utilize no-till or minimum-tillage practices on their farming operations.

➔ Objective 10. Improve education in the watershed about watershed impairment and educate on ways that BMP's can improve the watershed.
Host 2 workshops per year on soil health, water quality, and available programs to improve conservation practices.

➔ Objective 11. Reduce nitrogen load by reducing the access of livestock to the stream. Install 20,000 feet of fencing to limit animal access and to promote a filter strip along the stream to increase streambank stabilization.

Water quality monitoring is an integral part of the project implementation process. Both project – specific and routinely scheduled monitoring should be conducted to determine progress towards meeting the goals (i.e., water quality standards) by OEPA. Through an adaptive management process, the aforementioned objectives will be re-evaluated and modified as necessary. Objectives may be added to make further progress towards attainment goals, or altered, as a systems approach of multiple best management practices (BMP's) can accelerate the improvement of water quality conditions. The Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013) will be utilized as a reevaluation tool for its listing of all eligible NPS management strategies to consider including:

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

3.3 Critical Area 2 – "City of Galion": Conditions, Goals & Objectives for Headwaters Olentangy HUC-12

3.3.1 Detailed Characterization

Critical area two focuses on the 27% urban acreage in the watershed. The denser population has an impact on this watershed and a detrimental trend is noticed as the attainment status drops the further downstream testing took place. There is also a focus on the 4.5 miles or 23,760 linear feet of riparian corridor that runs through this area that could benefit from particular management practices to enhance stream habitat and streambank stabilization. Refer to Table 9.

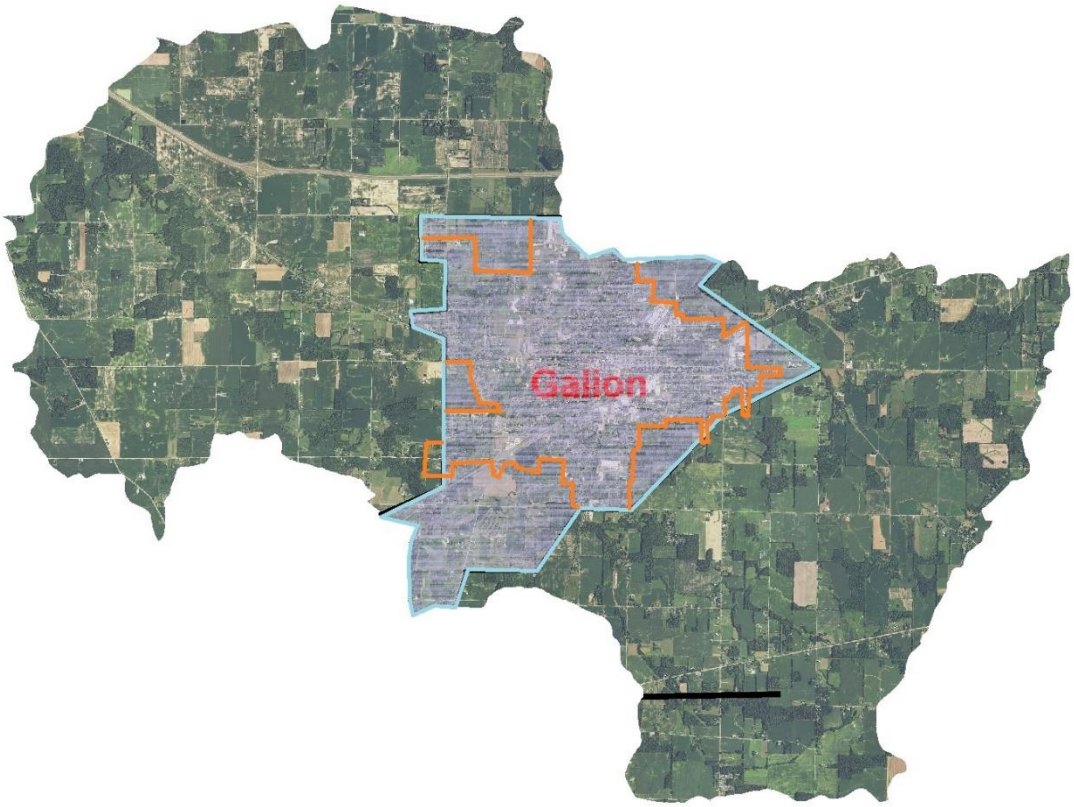

Figure 25: (Not to scale) Critical Area 2 – "City of Galion" is shaded in purple. The orange line outlines the City of Galion.

Figure 26: (Not to scale) Critical Area 2 – Riparian corridor of the City of Galion critical area. The yellow highlighted portion equals 4.5 miles or 23,760 feet of stream riparian corridor that needs improvement in both streambank stabilization, functional floodplain, and biological habitat.

3.3.2 Detailed Biological Conditions

River Mile	IBI	Mlwb	ICI	QHEI
89.3	49	NA	Marginally good	84
86.1	38	NA	34	58.5
85.9	38	NA		79
84.5	37	NA	46	82.5
79.7	34	7.8	42	69.5

Table 12: Sample site ALU designations within the **Headwaters Olentangy HUC-12**. (OEPA, 2005)

This data is the most current from OEPA and will not be studied again until 2021.

3.3.3 Detailed Causes and Associated Sources

Causes and Sources for the Headwaters Olentangy HUC-12

Causes
Nutrients
Siltation
Direct habitat alterations
Flow alteration
Sources
Major municipal point source
Non irrigated crop production
Stream modification/ destabilization – agriculture
Removal of riparian vegetation – agriculture
Upstream impoundment

Table 13: Table lists the causes and sources for the **Headwaters Olentangy HUC-12** (OEPA, 2007).

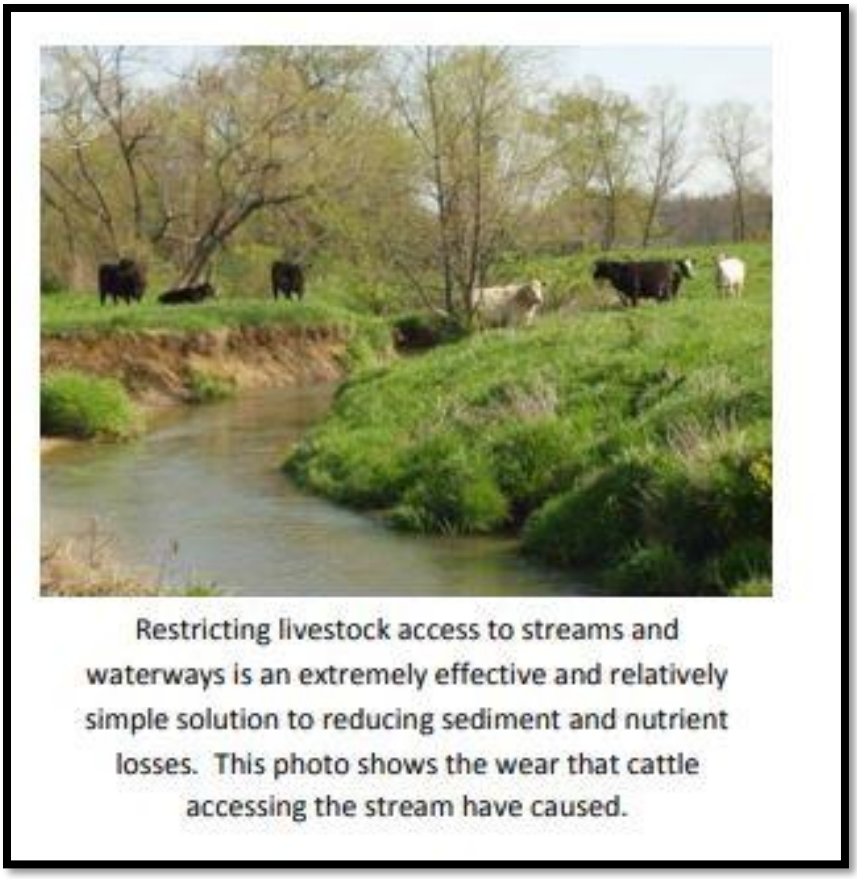

Figure 27: Photo from the Nonpoint source Management Plan Update explaining the benefits of livestock exclusion fencing along the stream. Photo was not taken in this watershed. (OEPA, 2013) "Livestock with stream access are found along the Olentangy River mainstem at Taylor Road, Iberia Road, Galion New Winchester Road, and Crawford Marion Line Road." (OEPA, 2007) These locations are in both of the critical areas.

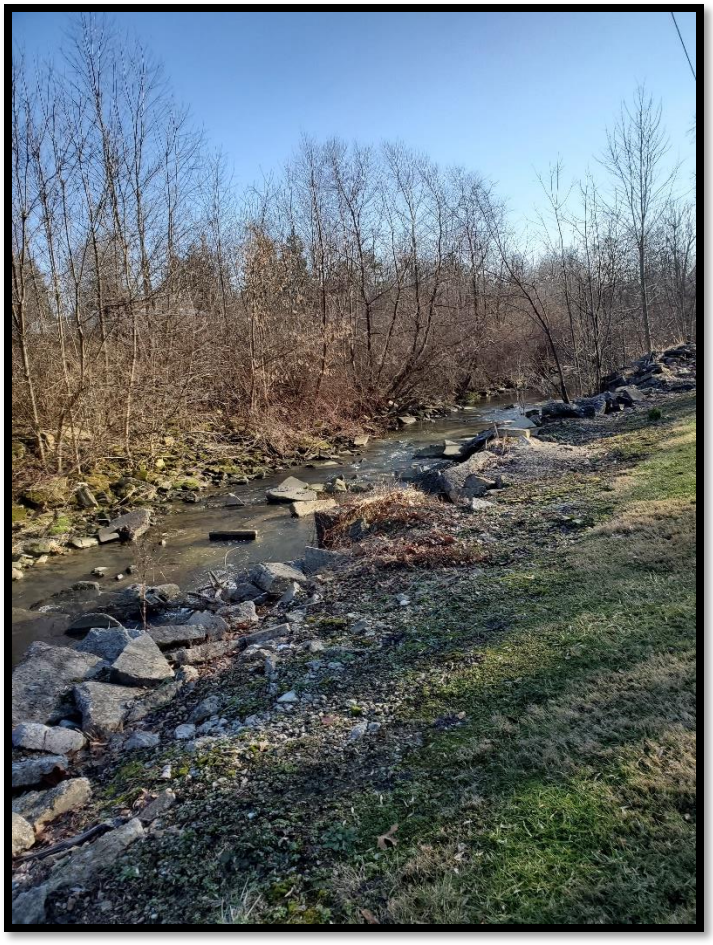

Figure 28: Shows the Olentangy River just south of the WWTP at Hosford Rd.

Figure 29: Common streambank erosion that can be found along the Olentangy River.

Figure 30: Shows the Olentangy Riverbank north of the WWTP.

3.3.4 Outline Goals and Objectives for Critical Area 2

There are approximately 6,364 acres in this critical area focusing on the Headwaters Olentangy HUC-12. The population density in these acres is staggeringly populous compared to Critical Area 1 acres making the urban best management practices critical. Load reduction through this area will have a larger impact on both nutrients and improving habitat to increase the QHEI score. The majority of this critical area is the City of Galion. While the city has a treatment plant that is monitored by the EPA there is also ample opportunity for the residents to have an impact on the river running through the city by utilizing urban stormwater best management practices. Due to the high capacity stream that runs through the area there is also a lot of stream bank erosion concern. Strategic best management practices will help to reduce the sedimentation/ siltation and excess nutrient loads.

Overall, we want to improve the non-attainment status to a full attainment status by improving QHEI and IBI scores at the sample sites. This being the headwaters watershed, we are not getting impairments from another watershed, but we are impacting the downstream with our current lack of urban stormwater management BMP's.

Goals

Being that this watershed is mostly in full attainment we are going to focus on practices to improve the land adjacent to the Olentangy River and then branch out to its contributing acres as needed. There are minimum practices being implemented now, so any BMP's will only enhance the stream and watershed.

- ➔ Goal 1. Achieve IBI score of 40 at RM 86.1.
  NOT ACHIEVED: Current score is 38.

- ➔ Goal 2. Achieve QHEI score of 60 at RM 86.1.
  NOT ACHIEVED: Current score is 58.5.

- ➔ Goal 3. Reduce nitrogen load by 20%
  NOT ACHIEVED: Current load is 58,000 pounds of nitrogen (Assuming 10lbs/acre N) – Refer to Table 8.

Objectives

To achieve Full attainment and improved water quality in the watershed the following practices will help toward the restoration goal. The objectives for Critical Area 2 have BMP's imposed to show improvement for both critical areas.

- ➔ Objective 1. Create rain garden bioretention areas to reduce stormwater fluxes as well as enhance nutrient filtering opportunity.
  Install five (5) bioretention areas to handle a 25-year storm for that lot.

- ➔ Objective 2. Implement green infrastructure for a major impermeable location within the 100-year floodplain to reduce the nutrient load into the stream.
  Install one (1) permeable lot to handle the stormwater runoff before it reaches the Olentangy River. Utilizing grassed swales, permeable pavers, or other retention areas.

- ➔ Objective 3. Reduce nitrogen load by reducing the access of livestock to the stream.
  Install 20,000 feet of fencing to limit animal access and to promote a filter strip along the stream to increase streambank stabilization.

- ➔ Objective 4. Improve wildlife and biodiversity as well as addressing the scours and sedimentation concerns along the Scenic Olentangy River corridor.

Restore 1,000 feet of unstable bank within the Scenic Olentangy River stream corridor using mud sills and other organic material to create habitat within the stream.

Water quality monitoring is an integral part of the project implementation process. Both project – specific and routinely scheduled monitoring will be conducted to determine progress towards meeting the goals (i.e., water quality standards). Through an adaptive management process, the aforementioned objectives will be re-evaluated and modified as necessary. Objectives may be added to make further progress towards attainment goals, or altered, as a systems approach of multiple best management practices (BMP's) can accelerate the improvement of water quality conditions. The Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013) will be utilized as a reevaluation tool for its listing of all eligible NPS management strategies to consider including:

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

Chapter 4: Projects and Implementation Strategy

4.1 Overview Tables and Project Sheets for Critical Areas

The following tables represent the goals and objectives in a tabular form in what we believe will improve the Headwaters Olentangy HUC-12 into full attainment status in the whole watershed. The BMP's to address the impairment concerns will not all have immediate remediation. Therefore, several years of monitoring may be necessary. The project sheets will combine several objectives into one project.

For the Headwaters Olentangy HUC-12, there is one Project and Implementation Strategy Overview Table (subsection 4.2.1). The Critical Area has 4 causes and 5 sources identified for the critical areas. 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 Table has 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 landowner 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 **Headwaters Olentangy HUC-12**.

Priority 3	In an effort to generate interest in projects, an information and education campaign will be developed and delivered. Such outreach will engage citizens to spark interest by stakeholders to participate and implement practices to improve water quality.

Project Summary Sheets (PSS) are in subsection 4.2.2. The PSS provides 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 PSS 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 Headwaters Olentangy HUC-12

The following tables will explain the BMP solutions to help remediate the attainment status for the Headwaters Olentangy HUC-12. 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 Headwaters Olentangy HUC-12 Critical Area 1 is based on a non, partial, and full attainment rating with a focus on nutrients, siltation, direct habitat alterations, and flow alteration. Critical Area 1 is focusing on the area of the Olentangy and its adjacent row crops acreage in the watershed to the east and west of the City of Galion. The overview table will provide a quick summary of what needs to be done, where, and what problems will be addressed. The overview table will act as a guide for the restoration of the impairments within this Critical Area.

Critical Area 1: Project Overview Table for Headwaters Olentangy HUC-12 (05060001 08 01)							
Goal	Objective	Project #	Project Title *(EPA Criteria g)*	Lead Organization *(EPA Criteria d)*	Time Frame *(EPA Criteria f)*	Estimated Cost *(EPA Criteria d)*	Potential/ Actual Funding Source *(EPA Criteria d)*
Urban Sediment and Nutrient Reduction Strategies*							
Altered Stream and Habitat Restoration Strategies*							
1-4	1,2,3	1	Olentangy River Stabilization	Crawford SWCD	5+ years	$275,000.00	Ohio EPA §319, CIG, CRP, CREP, H20hio Programs
Agricultural Nonpoint Source Reduction Strategies*							
1-4	4,5,6,7,8,9,10, 11	2	Olentangy River Adjacent Row Crop Initiative	Crawford SWCD	3-5 years	$962,000.00	Ohio EPA §319, CIG, CRP, CREP, H20hio Programs
High Quality Waters Protection Strategies*							
Other NPS Causes and Associated Sources of Impairment							

*Ohio EPA, 2013

4.3 Critical Area 2 Overview Table and Project Sheet(s) for the Headwaters Olentangy HUC - 12

The following tables will explain the BMP solutions to help remediate the attainment status for the Headwaters Olentangy HUC-12. 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 Headwaters Olentangy HUC-12 – Critical Area 2 is based on a non, partial, and full attainment rating with a focus on nutrients, siltation, direct habitat alterations, and flow alteration. Critical Area 2 is focusing on the stream banks and nutrient loading into the Olentangy. The overview table will provide a quick summary of what needs to be done, where, and what problem will be addressed. The overview table will act as a guide for the restoration of the impairments within this Critical Area.

Critical Area 2: Project Overview Table for Headwaters Olentangy HUC-12 (05060001 08 01)							
Goal	Objective	Project #	Project Title *(EPA Criteria g)*	Lead Organization *(EPA Criteria d)*	Time Frame *(EPA Criteria f)*	Estimated Cost *(EPA Criteria d)*	Potential/ Actual Funding Source *(EPA Criteria d)*
Urban Sediment and Nutrient Reduction Strategies*							
3	1 & 2	1	Nitrogen Reduction via Urban Runoff	Crawford SWCD	1-3 years	$75,000.00	Ohio EPA §319, H20hio
Altered Stream and Habitat Restoration Strategies*							
1-3	3 & 4	1	Olentangy River Enhancement	Crawford SWCD	1-3 years	$200,000.00	Ohio EPA §319, CIG, CRP, CREP, H20hio Programs
Agricultural Nonpoint Source Reduction Strategies*							
High Quality Waters Protection Strategies*							
Other NPS Causes and Associated Sources of Impairment							

*Ohio EPA, 2013

Critical Area 2: Project 1		
Nine Element Criteria	Information needed	Explanation
n/a	Title	Olentangy River Water Quality Enrichment
Criteria d	Project Lead Organization & Partners	Crawford SWCD
Criteria c	HUC-12 & Critical Area	**Headwaters Olentangy HUC-12 (05060001 08 01)** – Critical Area 2
Criteria c	Location of Project	From river mile 89 to river mile 70 including the acreage within an average of 5,000 feet on both sides of the stream.
n/a	Which strategy is being addressed by this project/	Nutrients, siltation, direct habitat alterations, and flow alteration non-point source reductions.
Criteria f	Time Frame	1-3 years With these projects being under development the goal is for a more succinct project summary sheet consistent with future requests for proposals.
Criteria g	Short Description	Reducing the nitrogen load as well as improving the biological habitat along the Olentangy River corridor and floodplain.
Criteria g	Project Narrative	With funding, 5 bioretention areas, 1 green infrastructure, 20,000 feet of livestock exclusion fencing, and 1,000 feet of streambank stabilization will be installed. Funds will be based on $5,000.00 toward each rain garden bioretention area, $50,000.00 per green infrastructure, $5.00/foot of fencing, and $100.00/foot of streambank/ floodplain restoration.
Criteria d	Estimated Total cost	$275,000.00
Criteria d	Possible Funding Source	Ohio EPA §319, CIG, CRP, CREP, H20hio Programs
Criteria a	Identified Causes and Sources	Cause: Nutrients, siltation, direct habitat alteration, flow alteration Sources: streambank modification/ destabilization – agriculture, removal of riparian vegetation – agriculture, and upstream impoundment
Criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment	The goal is to raise the lowest IBI score by 2 points from 38 to 40; raise the lowest QHEI score of 58.5 by 2 points to total 60.5; and reduce the nitrogen load by 20%.

	associated with this Critical Area?	
	Part 2: How much of the needed improvement for the whole Critical area is estimated to be accomplished by this project?	With any goal, extended time should be accounted for in longer term practices. It takes time for monitoring to notice the positive improvement upon the watershed. If the complete goal is met then there will be 25 miles of improved river and its corresponding acreage.
	Part 3: Load reduced?	With the implementation of best management practices, the loads* should be reduced by: ▪ 163 #N/year ▪ 75 #P/year ▪ 64 tons sediment/year *Calculations were derived by OEPA and are subject to change upon development of grant funding and practices installed.
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 (IBI, ICI, Mlwb, and QHEI) from non to full attainment rating. A water sample will be taken during average stream flow and will monitor nutrient levels. OEPA is not expected to test again until 2021, which is still in flux due to Covid-19.
Criteria e	Information and education	This project will be promoted with workshops, field days, and public meetings to inform local producers about the project. Radio, newspaper, and social media will be utilized to advertise to the producers about the programs. Partner with OSU Extension for workshop education and publicity. Reduction results will be publicly posted once known.

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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 natural resources and watersheds; many of which are included in the NPS-IS plan.

A

ALU	Aquatic Life Use

B

BMP	Better Management Practice

C

CIG	Conservation Innovation Grant
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program

D

DSW	Division of Surface Water
DO	Dissolved Oxygen

F

FSA	Farm Service Agency

H

HSTS	Household Sewage Treatment System
HUC	Hydrologic Unit Code

I

IBI	Index of Biotic Integrity

ICI	Invertebrate Community Index

L

LEP	Livestock Environmental Permitting

M

Mlwb	Modified Index of Well-being
Mgd	Million Gallons per Day

N

NPS-IS	Nonpoint Source Implementation Strategic Plan
NRCS	Natural Resource Conservation Service
NPDES	National Pollutant Discharge Elimination System

O

ODA	Ohio Department of Agriculture
ODNR SP&W	Ohio Department of Natural Resources – Division of State Parks & Watercraft
ODOT	Ohio Department of Transportation
OEPA	Ohio Environmental Protection Agency
OSU	Ohio State University
OWA	Olentangy Watershed Alliance

P

Ppm	Parts Per Million
PSS	Project Summary Sheet

Q

QHEI	Qualitative Habitat Evaluation Index

R

RM	River Mile

S

SCS	Soil Conservation Service
SWCD	Soil and Water Conservation District

T

TMDL	Total Maximum Daily Load

U

USDA	United Stated Department of Agriculture
USGS	United States Geological Survey
US EPA	United States Environmental Protection Agency

W

WAP	Watershed Action Plan
WLEB	Western Lake Erie Basin
WWH	Warm Water Habitat
WWTP	Waste Water Treatment Plant

Appendix B: Index of Figures and Tables

Index of Figures/ Photos

Index of Tables