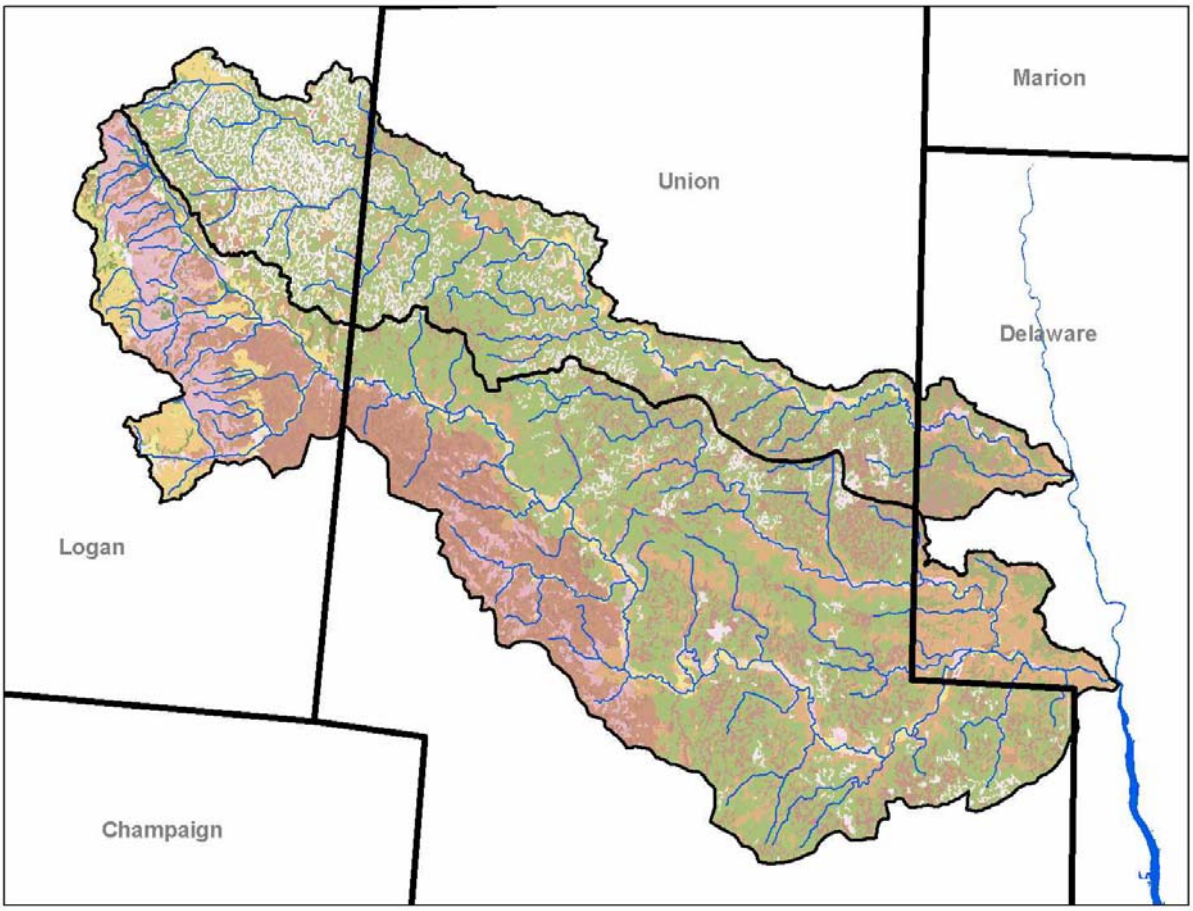
# Bokes Creek & Mill Creek Watersheds Inventory and Watershed Action Plan

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# Hydrologic Unit Code (HUC)

11 digit HUC

Bokes Creek: 05060001-060

Mill Creek: 05060001-070

14 digit HUC

Bokes Creek: 05060001-060-010

Mill Creek: Mill Creek to below Otter Creek: 05060001-070-010
Mill Creek below Otter Creek to New Dover: 05060001-070-020
Mill Creek below New Dover to Scioto River (except Blues Creek): 05060001-070-030
Blues Creek: 05060001-070-040

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# Acknowledgements

Public participation has been the focus in the development of this watersheds action plan. The public has been invited and encouraged to provide solutions from the beginning. The initial organization of the watershed action plan included two public meetings in Marysville for residents of the Bokes Creek and Mill Creek watersheds. At this meeting, residents were asked 1) to list their watershed concerns, and 2) their interest in participating in the process.

The Steering Committee of the Bokes/Mill Creek Watershed Partnership has been instrumental in providing suggestions and reviewing the watersheds inventory and action plan. They are acknowledged for their contributions to this project:

Dan Binder
Gary Cunningham
Keith Dimoff
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Partnership subcommittee members are also acknowledged for the many hours voluntarily spent at meetings and events to make this plan feasible.

Also, special thanks to the Union Soil and Water Conservation District and Natural Resources Conservation Service for their support in the development of the watersheds inventory and action plan. Thanks are especially dedicated to Keri Hudec for the conditional approval of the plan as well as the restoration of Powderlick Run in 2003 and to Christina Burri for her time and efforts spent towards the approval of the final watershed action plan in 2008.

To obtain a copy of the watersheds inventory and action plan, please contact:

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# Executive Summary

In 2001, the Bokes/Mill Creek Watershed Partnership was formed in an effort to protect and improve the water quality of the Bokes Creek and Mill Creek watersheds spanning Logan, Union and Delaware Counties, Ohio. Since that time, the Bokes/Mill Creek Watershed Partnership, Union Soil and Water Conservation District and numerous other agencies, groups and individuals have worked together toward the development of a Watershed Action Plan for the Bokes Creek and Mill Creek watersheds, subwatersheds of the Scioto River. The watershed action plan documents the problems that need to be addressed within the watersheds, as well as the goals, activities and commitments of the Partnership to correct impairments and preserve critical areas.

The watershed inventory was established as a baseline of information for the water resources of the Bokes Creek and Mill Creek watersheds. The inventory contains a compilation of the water-resource and other information that is currently available for the watersheds and has aided in setting priorities and making decisions.

The project area consists of the Bokes Creek watershed (Ohio Hydrologic Unit #05060001-060), which encompasses 84.2 square miles, and the Mill Creek watershed (Ohio Hydrologic Unit #05060001-070), which encompasses 178 square miles. Both watersheds are predominantly agricultural, although the Mill Creek watershed is also represented by several industries, urban areas and housing developments. To better outline the impairments existing in the watershed, the Bokes Creek watershed has been divided into three critical areas: A) Headwaters of Bokes Creek to the Powderlick Run confluence, B) Powderlick Run: Bokes Creek tributary and C) Bokes Creek from the Powderlick Run confluence to the Scioto River confluence. The Mill Creek watershed has been divided into four critical areas: A) Headwaters of Mill Creek to SR 31 (in Union County), B) Mill Creek (east of SR 31) to the Scioto River confluence, C) Crosses Run: Mill Creek tributary, and D) Blues Creek: Mill Creek tributary.

The watersheds inventory indicates that both the Bokes Creek and Mill Creek watersheds have impaired water quality. Nutrient enrichment and low dissolved oxygen within Bokes Creek result from agricultural runoff, failing septic systems and habitat alteration throughout the watershed. Municipal and industrial point source dischargers predominantly affect Mill Creek; however, urban and agricultural runoff and habitat alteration also contribute to organic enrichment and low dissolved oxygen levels. A boom in new housing developments within the Mill Creek watershed, branching out from State Route 31 north of the City of Marysville, also contributes to storm water runoff. The streams need to be protected from further impact if the water quality is to be improved through comprehensive watershed planning efforts.

Working collaboratively, stakeholders developed strategies to correct impairments. In addition, stakeholders designed a watershed action plan that outlines the approaches that will be used to guide protection activities. For example, in order to address phosphorous levels in Powderlick Run, a tributary to Bokes Creek, a natural stream

channel design project was initiated in the spring of 2003. The natural stream channel approach was determined to assist in meeting water quality standards.

# Section One
## Introduction

### Need for a Watershed Action Plan

Since 1998, Bokes Creek and Mill Creek (excluding the section of Mill Creek from its headwaters to its confluence with Otter Run) have been documented as impaired streams on the Ohio Environmental Protection Agency's Total Maximum Daily Load (TMDL) list. With no existing plan, this watershed action plan was prepared by the Bokes/Mill Creek Watershed Coordinator, the Bokes/Mill Creek Watershed Partnership steering committee and subcommittees and the Union Soil and Water Conservation District to address the nonpoint and point sources of pollution in the Bokes Creek and Mill Creek watersheds. The primary objective of the action plan is to protect and improve the water quality of Bokes Creek and Mill Creek while maintaining a balance between the livelihood of farmers and industries. As land use throughout the watersheds continues to change, updates to the action plan may incorporate other entities (i.e. developers, land planners). The action plan modifications will provide coordination between stakeholders to control future development while maintaining the rural character of the watersheds.

### Watershed Action Plan Process Overview

The design of the watershed action plan has several purposes: 1) to maintain local control of the watershed planning process, 2) to facilitate funding for implementation projects, 3) to improve the in-stream water quality to within water quality standards; and therefore, 4) to remove the Bokes Creek and Mill Creek watersheds from the Ohio EPA's TMDL list.

In August of 2000, the Union SWCD received a 319 grant, funded in part by the Ohio EPA and the Ohio Department of Natural Resources (ODNR), and additional funding from the Union County commissioners, to finance a Bokes/Mill Creek Watershed Coordinator position. Hired to develop a comprehensive, community-based watershed action plan, the Watershed Coordinator serves as a local link between the Ohio EPA and local government and citizens throughout the TMDL process. The position was filled, and the Watershed Coordinator started in October 2000. In 2009, the move from Watershed Coordinator to Watershed Technician took place. Currently, the Watershed Technician position is funded by three matching sources: The City of Marysville, The Scotts Company, and the Union County Commissioners. While the name has changed, the purpose of the Watershed Technician position remains the same.

## Bokes/Mill Creek Watershed Partnership

The initial planning process involved the identification of and contacting of key stakeholders throughout the watersheds. Local leaders, municipality officials, industries and landowners that have historically participated in or supported Union SWCD programs were contacted by direct mail and telephone. General newspaper articles and radio broadcasts also invited public participation. After stakeholders were initially contacted, a series of public meetings were held to solicit public involvement and to gage the stream-related concerns of the community. The stakeholders at those public meetings include Union SWCD, Logan SWCD, Delaware SWCD, members of the agricultural community, Union County Commissioners, City of Marysville, Scotts Co., Ohio EPA, OSU Extension, Farm Service Agency, Natural Resources Conservation Service, Division of Wildlife, Department of Natural Resources, Union County Health Department, Logan County Health Department, and Delaware County Health Department. The public concerns, in order of priority, include: 1) residential development, 2) poor stream corridor management, 3) older and failing home septic systems, 4) stream habitat vs. drainage issues, 5) loss of floodplain, 6) poor urban runoff management and loss of aquatic life, 7) sediment and nutrient loading, 8) need for more buffer strips, 9) poor drainage outlets, 10) increasing stress on old drainage systems, 11) poor community planning, and 12) planning vs. change (solid planning to find a balance between the continuing changes and existing uses in the watershed).

These public meetings paved the way for the formation of the Bokes/Mill Creek Watershed Partnership and its steering committee one year later. Composed of private citizens/landowners, agricultural community (farmers), municipal officials, government entities, environmental interest/advocacy groups and the industrial community, the Bokes/Mill Creek Watershed Partnership is an informal subdivision of the Union SWCD.

The Partnership operates by consensus. If consensus is not achieved, the Chairman will make the final decision. To add structure and a sense of purpose, the Bokes/Mill Creek Watershed Partnership developed bylaws and a mission statement that incorporated the relevant priorities the community members wanted to address. It was important to develop a mission statement with significant input from the farming community because they represent the largest land use throughout the watersheds, while simultaneously supporting the Ohio EPA's TMDL process. The mission statement reads:

***To promote community involvement in the enhancement, improvement, and protection of the resources that Bokes Creek and Mill Creek offer, while helping to ensure that the needs of future generations are fully met.***

**Steering Committee**
Originally consisting of 15 members, the steering committee has expanded to include 18 members.

Heavy emphasis was placed on maintaining a locally led steering committee, requiring that steering committee members live or work in the watersheds to be permitted a vote on local issues. It was imperative for the watershed action plan to be composed by community members, those whom would be impacted by what the plan outlines. After the development of the watershed action plan is complete, the Watershed Technician and the Bokes/Mill Creek Watershed Partnership will initiate the implementation process. Guest speakers discuss ways to improve water quality, and Ohio EPA representatives regularly discuss the TMDL and the next steps necessary to meet clean water goals.

The Bokes/Mill Creek Watershed Partnership was formed in October 2001, and the four subcommittees began meeting in December 2001. The priority problems in the watershed were identified and subcommittees were formed to address these issues. These meetings were held to discuss viable alternatives or ways to prevent pollution and improve the water quality of Bokes Creek and Mill Creek. Because landowners were asked for their opinions from the beginning, they felt they had a voice and maintained local control of the process. All subcommittees operated by consensus.

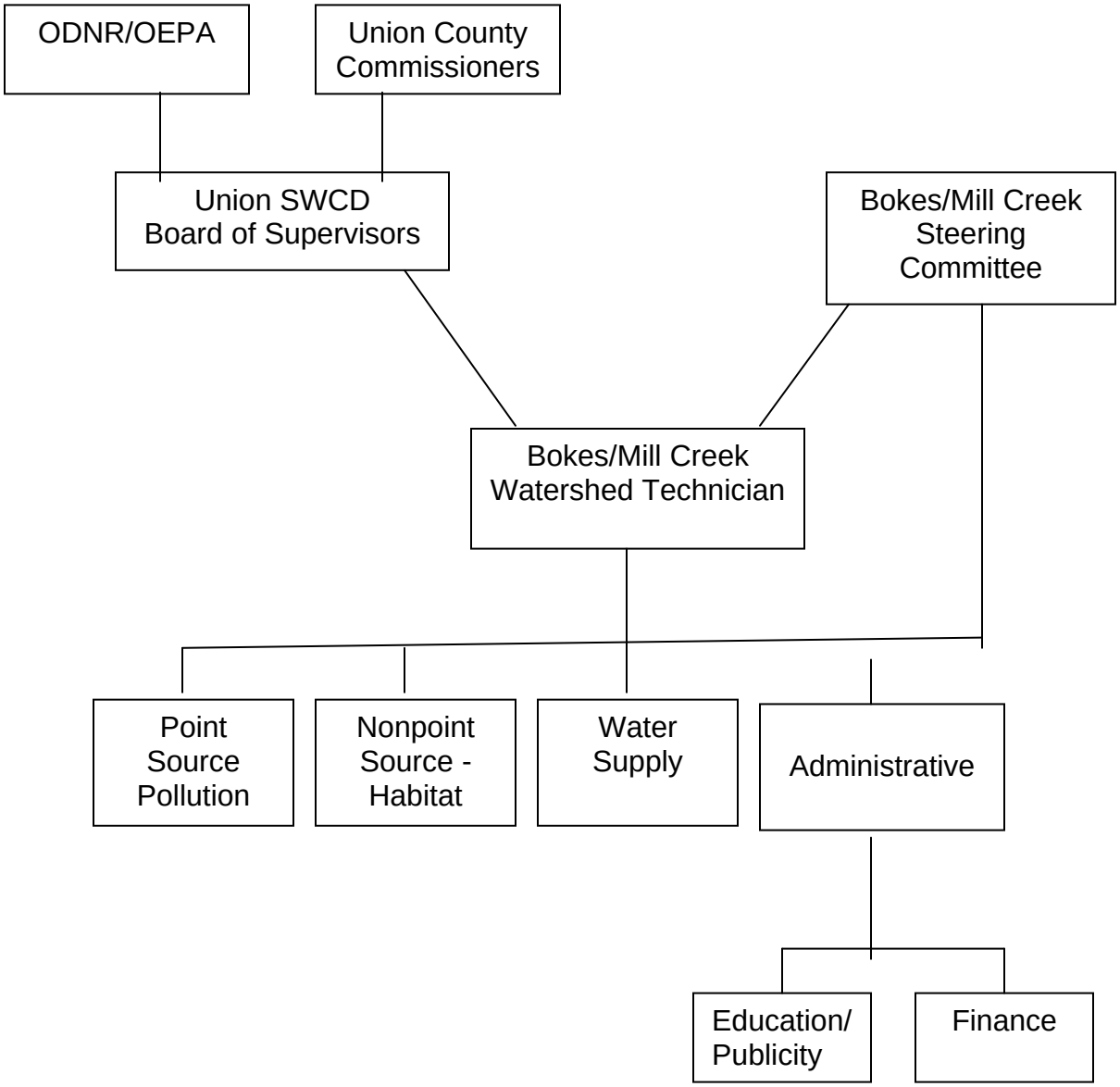
In April 2003, the Bokes/Mill Creek Watershed Partnership and Union SWCD formally submitted the draft Bokes/Mill Creek Watersheds Inventory and Action Plan to the Ohio Environmental Protection Agency and Ohio Department of Natural Resources for endorsement. Over the course of monthly steering committee meetings, the diverse members of the steering committee have been asked their opinion. Members of the steering committee and subcommittees contributed comments and, by consensus, submitted the plan. It was an informal request.

Missing from the planning process – Due to many other watershed projects in the county, Logan County SWCD, OSU Extension and the Logan County Health Department have not been involved with the planning process for Bokes/Mill, and we have not received much participation from them.

As we move into action plan implementation, the same structure will be kept as before in just planning. There will be a more formal decision making process though.
The Partnership will be informed of implementation efforts by reading the effort summaries that I mail to all mailing list subscribers.

TMDL information – throughout the TMDL process, presentations were given to the steering committee monthly on the progress and completion of the TMDL. Similarly, the subcommittees also received regular updates. This shared information has been documented in the meeting minutes that are mailed out.

Figure 1. Organizational Structure of the Bokes/Mill Creek Watershed Partnership



**Steering Committee Representatives**
A diverse group of individuals, organizations and businesses are represented on the Bokes/Mill Creek Steering Committee. All decision making occurs through consensus. They include:

- Agricultural community (Bokes Creek and Mill Creek)
- City of Columbus, Division of Water (Bokes Creek and Mill Creek)
- City of Marysville (Mill Creek)
- Farm Credit Services (Bokes Creek)
- Leesburg Township Trustee (Bokes Creek)
- Local landowners (Bokes Creek and Mill Creek)
- Marysville Water Treatment Plant (Mill Creek)
- Mill Creek Township Trustee (Mill Creek)
- Ohio Division of Wildlife (Bokes Creek and Mill Creek)
- Ohio Environmental Council
- Ohio Environmental Protection Agency
- Pheasants Forever (Bokes Creek)
- Union County Engineer (Bokes Creek and Mill Creek)
- Union SWCD (Bokes Creek and Mill Creek)
- York Township Trustee (Bokes Creek)

**Subcommittees**
In addition, four volunteer subcommittees, comprised of local landowners, businesses, industries and municipalities, have been formed to address specific pollution concerns: 1) Administrative, 2) Nonpoint Source – Habitat, 3) Point Source Pollution and 4) Water Supply. Like the steering committee, the subcommittees operate by consensus. There is an open invitation to all stakeholders who may be interested in joining a subcommittee.

- The **Administrative** subcommittee manages the education/publicity and finances of the Bokes/Mill Creek Watershed Partnership. The subcommittee strives to heighten community awareness of the Bokes Creek and Mill Creek watersheds through educational programs and events (watershed tours, storm drain stenciling projects, stream monitoring programs, etc.).

  The subcommittee also secures funding from grants, donations, etc. to support the day-to-day activities, events and programs of the Partnership (tours, incentives for conservation practices, etc.).

  Chaired by the Bokes/Mill Creek Watershed Technician, other subcommittee representatives include:

  - Delaware General Health District
  - Delaware Soil and Water Conservation District
  - Marysville Schools
  - North Union Schools

    - Union Soil and Water Conservation District

- The **Nonpoint Source – Habitat** subcommittee strives to reduce the frequency of flooding due to logjams, in addition to improving water quality by reducing sediment and nutrient loading in Bokes Creek and Mill Creek through the implementation and promotion of conservation practices. Other goals of the subcommittee include restoring more natural stream flow in the watersheds and decreasing the negative impacts of sedimentation on habitat.

  An agricultural community member chairs this subcommittee. Other representatives include:

    - Agricultural community
    - Leesburg Township Trustee
    - Pheasants Forever
    - Ohio Division of Wildlife
    - Ohio Environmental Council
    - Ohio Environmental Protection Agency
    - Union Soil and Water Conservation District

- The **Point Source Pollution** subcommittee outlines ways to decrease point source pollution from entering local waterways.

  Chaired by a representative from the Union County Engineers office, the following representatives also serve on the subcommittee:

    - Union County Engineer
    - Union County Health Department
    - Delaware General Health District
    - Scotts Company
    - Marysville Wastewater Treatment Plant
    - Ohio Environmental Protection Agency

- The main goals of the **Water Supply** subcommittee include increasing awareness of streams as sources of drinking water, reducing nutrient runoff in Bokes Creek and Mill Creek and developing a formal communications process for regulatory agencies and emergency response representatives within the watersheds area.

  The Marysville Water Treatment Plant operator chairs this subcommittee, and the following support the subcommittee:

    - Marysville Water Treatment Plant
    - Union SWCD
    - City of Marysville

The steering committee will continue to communicate about priority water quality issues and solutions with constituents in their organizations by word of mouth, the most powerful tool.

**Tracking Plan Implementation and Revisions**

Implementation projects within the watershed must be tracked in order to evaluate the goals and action items that are fulfilled. The Watershed Technician will work with the Natural Resources Conservation Service (NRCS) and Farm Service Agency (FSA) in recording the USDA cost share programs and Scioto Conservation Reserve Enhancement Program (CREP) acreage being implemented in the watershed. The programs to track specifically will be the Environmental Quality Incentives Program (EQIP) and Scioto CREP. An agreement has been made with Robin Sweeney, NRCS District Conservationist to provide the Watershed Technician with information regarding program sign-ups and enrollments to track progress. Updates will be recorded and acreage will be calculated to revise further planning within the watershed. The enrolled acreage will also be used to evaluate accomplishments and goals from the plan's action items. The Soil and Water Information Management System (SWIMS) will also be utilized to record and track implementation in the watershed. This will involve using SWIMS to record the clients, illustrate the project using GIS, and setting up initiatives within the watershed. Plan progress will be communicated through the Bokes/Mill Partnership meetings and email list. Feedback from the public on implementation progress will be obtained during the Bokes/Mill Partnership meetings and other public involvement events. The Watershed Action Plans will be reviewed and updated as needed, depending on projects and development. An overall plan review will be performed by the Watershed Technician every 2 years.

# Acronyms

## The following acronyms are frequently used throughout the watershed action plan

- *BMP* – Best Management Practice
- *CREP* –Conservation Reserve Enhancement Program
- *CRP* – Conservation Reserve Program
- *CSP* – Conservation Security Program
- *E.M.A*. – Emergency Management Agency
- *EQIP* – Environmental Quality Incentives Program
- *FIP* – Forest Incentive Program
- *FSA* – Farm Service Agency
- *LUC Planning Commission* – Logan-Union-Champaign Planning Commission
- *Mg/l* – Milligrams per liter
- *Marysville WTP* – Marysville Water Treatment Plant
- *Marysville WWTP* – Marysville Wastewater Treatment Plant
- *NRCS* – Natural Resource Conservation Service
- *ODA* – Ohio Department of Agriculture
- *ODNR* – Ohio Department of Natural Resources
- *Ohio EPA* – Ohio Environmental Protection Agency
- *Oxbow River* – Oxbow River and Stream Restoration
- *RM* – River Mile
- *Scotts Co.* – The Scotts Company
- *SIP* – Stewardship Incentive Program
- *SRVF* – Scioto River Valley Federation
- *Steering Committee* – Bokes/Mill Creek Watershed Partnership Steering Committee
- *Super CREP* – Super Conservation Reserve Enhancement Program (combines CREP and other Farm Bill Programs, i.e. EQIP)
- *Union SWCD* – Union Soil and Water Conservation District
- *Watershed Technician* – Bokes/Mill Creek Watershed Technician
- *WHIP* – Wildlife Habitat Incentives Program
- *WRP* – Wetlands Reserve Program

# Section Two
## Project Setting

## Natural Features and Characteristics

### Physical Geology

Located in central Ohio, Bokes Creek and Mill Creek flow into the Scioto River, which provides the drinking water supply for City of Columbus residents. Spanning across three counties, Bokes Creek and Mill Creek originate in Logan County, flow east over Union County and cross into Delaware County before outleting into the Scioto River. Their watersheds occupy 21% of Logan County, 63% of Union County and 16% of Delaware County (Figure 2). Combined, the land use in the watersheds is characterized as:

Figure 2. Bokes Creek and Mill Creek Watersheds in Central Ohio (Meenach, 2001).

- Agriculture: 82%
- Wooded: 15%
- Shrub/Scrub: 1%
- Urban: 0.6%
- Wetlands: 0.5%
- Barren (quarries): 0.3%
- Open Water: 0.2%

The headwaters of Bokes Creek and Mill Creek in Logan County are predominantly rural; however, large egg production facilities have operated in the Bokes Creek headwater region since 1977.

### Development in the Bokes/Mill

Although the land contained in the watersheds is presently rural, the proximity to Columbus increases the susceptibility of urban sprawl, especially in Union and Delaware Counties. The rapid development of lots for home construction is spreading throughout the watersheds. In Union County, the Mill Creek watershed has been experiencing accelerated growth in several townships from 2000 – 2002: Darby (35 new home construction sites), Dover (28), Liberty (89), Mill Creek (24) and Taylor (25). In Paris Township (23), the new Mill Valley subdivision has been constructed adjacent to Mill Creek. The increase in impervious surface (i.e. roads, rooftops, sidewalks) within close proximity to Mill Creek may promote increased stormwater runoff and erosion, flushing more sediment and urban contaminants into the stream.

The Bokes Creek watershed is experiencing less rapid growth than the Mill Creek watershed; however, York Township in Union County (21) has also had an increase in its number of home construction sites within the past few years.

One of the most rapidly developing counties in the state, Delaware County is a mix of rural and urban cultures, although the Bokes Creek and Mill Creek watersheds are still rural in this county. Both Bokes Creek and Mill Creek cross the Delaware County line before outleting into the Scioto River.

**Geology**

Characterized by Silurian bedrock and a topography that reflects glacial deposition, the Bokes Creek and Mill Creek watersheds are found within the Central Lowlands physiographic region. Approximately 14,000 to 24,000 years ago, the Wisconsinan glacier moved over the sedimentary bedrock to influence soil development. Soils within the watersheds are characterized by high lime glacial drift, till and lake sediments.

The landscape was shaped by ground moraines, which created nearly level land, and end moraines, which created steeper slopes. According to Steve Stolte of the Union County Engineers, the highest point in Union County measures 1,100 feet above sea level. The lowest point, measuring 907 feet above sea level, occurs where Mill Creek crosses the Union/Delaware County line.

The slopes of end moraines host soils with high erosion potential, and glacial lake beds host soils of slow permeability. Soil drainage, potential for erosion and permeability are influenced by texture and slope of the parent glacial materials, and may provide limitations for cultivation, construction and septic treatment. If the soil limitations for these uses are exceeded, the water quality of Bokes Creek and Mill Creek may be impacted (Ohio EPA, 2002).

**Riparian Protection and Stream Gradient**

Riparian protection is a priority for Bokes and Mill Creek Watershed. Riparian borders along the stream provide a storage area for flood waters, and reduce the amount of pollution entering into the stream channel. Forested riparian areas and established riparian corridors should be considered priorities for protection from development. Riparian protection should be implemented along with floodplain protection to prevent any land use and resource problems or issues. Riparian areas are considered when

assessing the quality of the stream using the Ohio EPA's Qualitative Habitat Evaluation Index (QHEI).

Stream gradient is a driving factor for the type of habitat a stream supports. The gradient influences the amount of energy the stream is channeling. The amount of energy the stream has, affects how quickly the stream recovers from flood events. Generally, a stream with more power recovers quickly from flooding. However, steep gradients can increase erosion through downcutting and headcuts. Therefore, headwater streams likely have a steeper gradient, which becomes more level as it converges. This pattern is seen with Table 1. The gradient for the main channel of Bokes Creek and Mill Creek is much less steep than the headwaters/tributaries adjoining the main channel.

Table 1: Stream gradient and slope for Bokes Creek, Mill Creek, and tributaries

| **STREAM NAME** | **AVERAGE STREAM GRADIENT** | **PERCENT OF SLOPE** |
|---|---|---|
| | Height/length=avg. stream gradient | Vertical distance/horizontal distance x 100= % of slope |
| Bokes Creek | 132'/ 39.7 mi = 3.32 ft/mi | 132'/ 209,616' x 100 = 0.06% |
| East Fork West Mansfield Tributary | 34'/ 2.67 mi = 12.73 ft/mi | 34'/ 14,097' x 100 = 0.24% |
| Powderlick Run | 80'/ 5.1 mi = 15.69 ft/mi | 80'/ 26,928' x 100 = 0.30% |
| Brush Run | 78'/ 3.2 mi = 24.37 ft/mi | 78'/ 16,896' x 100 = 0.46% |
| Mill Creek | 144'/ 37.8 mi = 3.81 ft/mi | 144'/ 199,584' x 100 = 0.07% |
| Crosses Run | 24'/ 3.8 mi = 6.31 ft/mi | 24'/ 20,064' x 100 = 0.12% |
| Blues Creek | 86'/ 12.5 mi = 6.88 ft/mi | 86'/ 66,000' x 100 = 0.13% |
| Phelps Run | 56'/ 5.0 mi = 11.2 ft/mi | 56'/ 26,400' x 100 = 0.21% |
| Otter Run | 32'/ 4.4 mi = 7.27 ft/mi | 32'/ 23,232' x 100 = 0.14% |

**Soils**

The floodplain soils of Bokes Creek and Mill Creek are Genesee-Eel-Shoals-Fox association. Defined by poorly to well-drained soils, this soil association formed in medium or fine textured material. The soil is prone to flooding, is seasonally wet and presents major limitations for on-site wastewater treatment systems, although the watersheds are dotted with residential and commercial septic systems (Ohio EPA, 2001). In addition, the Union County Soil Survey Narrative states that all soils present within the county are severe and not suitable for on-site septic systems, even though

clusters of septic systems are located in Magnetic Springs and York Center (Bokes Creek watershed) and Raymond and Peoria (Mill Creek watershed). Soils attribute data will be utilized for placement of BMPs. Soils attribute data can be found at the following URL, http://www.ncgc.nrcs.usda.gov/products/datasets/ssurgo/. Below is a chart indicating the alluvial soil types in Union County.

Table 2. Alluvial Soils of Union County

| Soil Type | Soil Type Abbrev | Parent Material | Landform | Position |
|---|---|---|---|---|
| Algiers Silt Loam | Ag | Alluvium | Floodplains | Flats & Oxbows |
| Eel Silt Loam | Ee | Alluvium | Floodplains | Flats & Slight Rises |
| Genesee Silt Loam | Gn | Alluvium | Floodplains | Flats & Slight Rises |
| Ross Silt Loam | Ro | Alluvium | Floodplains | Flats & Slight Rises |
| Shoals Silt Loam | Sh | Alluvium | Floodplains | Flats & Oxbows |
| **Sloan** Silty Clay Loam | So | Alluvium | Floodplains | Flats, Depressions, Oxbows |

**Bold** Denotes Hydric Soil Type

**Climate**

The Union County climate is characterized by hot summers and cold winters, with average summer temperatures of 80.1 degrees Fahrenheit and winter temperatures of 27.4 degrees Fahrenheit. Summer weather is significantly sunnier, with 60% sunshine compared to 36% sunshine in the winter. The average humidity is 59%, with higher humidity levels in the evening. The average snowfall is 23.0 inches per year (National Cooperative Soil Survey, 2002).

According to the OSU Extension Service, precipitation is similar among the three counties, with Delaware and Logan Counties averaging 36 inches annually and Union County averaging 35.9 inches per year, all less than the state average of 38 inches. Most precipitation falls during the months of May through July, with the driest months being February and October (Hixson and Brown, 2001; Gamble, Boone and Brown, 2002; Putnam, Boone and Brown, 2002).

**Wetlands**

Wetlands have a demonstrated capability to filter contaminants and sediments from water. When positioned adjacent to streams, wetlands prevent nonpoint source

pollution from degrading stream water quality. Nonpoint source pollution occurs when rain or melting snow flow across the land and wash contaminants (fertilizers, pesticides, etc.) into local streams. If properly maintained, wetlands intercept runoff and store contaminants without undergoing degradation themselves. In addition, wetland vegetation keeps stream channels intact by slowing runoff and also lowers the temperature of stream water by providing streamside shading.

By including wetland establishment in the watershed action plan; stream water quality may be improved by preventing contaminants from reaching Bokes Creek and Mill Creek. Wetlands store excess floodwaters and provide habitat for wildlife. At this time, all constructed wetlands are located upland, and not in the riparian corridor. These upland wetlands reduce surface water runoff spikes and thus offer floodwater storage. Upland wetlands are instrumental at intercepting surface water runoff, and when water reaches the wetland, it is purified in the wetland. Filter strips are also present around the wetland. No wetlands at this time have been specifically designed to restore floodplain function. Most wetland pool acres range from two – four acres in size at pool design. Estimated loading reductions have not been quantified – though water clarity is greatly improved due to a reduction in sediment. Wetlands have been constructed based on wildlife and habitat interest of landowners. While wetlands have been filled at a rapid pace throughout Ohio, Union County has been proactive in the creation of approximately 4 wetlands per year. Since 1989, 36 wetlands have been established in the Bokes Creek and Mill Creek watersheds in Union County: seven in the Bokes Creek watershed and 29 in the Mill Creek watershed. No wetlands are present in the watersheds in Logan (Bob Stoll, 2003) and Delaware Counties (Tom Edwards, 2003). The average cost share for wetland establishment is $8,000 per wetland.

Although inspections of established wetlands are not currently conducted, the Union SWCD plans to initiate a wetland-monitoring program within the next couple of years. The monitoring program would most likely consist of post wetland construction and structure integrity assurances, such as muskrat damage prevention and repair, and random macroinvertebrate sampling (John Rockenbaugh, 2003). Below is a table that illustrates an inventory of wetlands within the watershed, specific to Union County, which was compiled in 2007 by Union SWCD's Wildlife Specialist, John Rockenbaugh.

Table 3. Bokes and Mill Watershed Wetland Inventory

**Bokes & Mill Creek Wetlands (30)**

| No. | Name | Wetland Acres | Flood-plain | Upland | Program | Costs |
|---|---|---|---|---|---|---|
| 1 | Lyle Blankenship | 2.0 | | X | USFWS | 1,250.00 |
| 2 | Jerry Meyers | 1.6 | | X | CCRP | 10,010.00 |
| 3 | Conie-Dugger | 176.86 | | X | WRP | 81,590.00 |
| 4 | Jim Rush | 8.06 | | X | WRP | 4,030.00 |
| 5 | Keckley Rural Life Center | 38.0 | | X | WRP | 33,554.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | Brad & Debbie Gilbert | 36.03 | | X | WRP | 10,713.25 |
| 7 | CountryTyme | 1.0 | | X | Own | NA |
| 8 | Jerry Kneubel | 3.0 | | X | USFWS | 2,460.00 |
| 9 | Mike Kralik | 5.0 | | X | CCRP | 3,222.25 |
| 10 | Steve & Peg Heimbush | 5.0 | | X | CCRP | 4,336.25 |
| 11 | Bob Schwyn | 43.0 | | X | WRP | 19,238.82 |
| 12 | Harold Tillman | 2.5 | | X | USFWS | 2,575.00 |
| 13 | Bob Hunt | 5.0 | | X | DOW | 8,231.00 |
| 14 | Catherine Rockenbaugh | 22.6 | | X | WRP | 2,350.00 |
| 15 | Joe Morgan | 2.3 | | X | CCRP | 2,396.00 |
| 16 | Joe Morgan | 4.2 | X | | CCRP | 6,051.10 |
| 17 | Joe Morgan | 8.0 | | X | CCRP | 9, 071.00 |
| 18 | Joe Morgan | 31.26 | | X | CCRP | 41,210.00 |
| 19 | Joe Morgan | 1.5 | | X | CCRP | 2,190.00 |
| 20 | Turkey Run Inc c/o Paul Sipp | 1.5 | | X | USFWS | 1,420.00 |
| 21 | GlenOaks Farm | 6.6 | | X | CCRP | 10,636.00 |
| 22 | Doug Crusey | 14.5 | | X | CCRP | 33,614.50 |
| 23 | Dan Crusey | 19.15 | | X | WRP | 9,637.50 |
| 24 | Dan Goodrich | 17.24 | X | | WRP | 11,195.00 |
| 25 | Gary Cunningham | 2.0 | X | | CCRP | 6,062.00 |
| 26 | Steve Robinson | 2.1 | X | | USFWS | 1,653.00 |
| 27 | Ward | 4.9 | | X | USFWS | 7,120.00 |
| 28 | Sam Norris | 2.2 | | X | USFWS | 1,549.00 |
| 29 | Doug Cooper | 10.1 | | X | CCRP | 12,155.00 |
| 30 | Don Cullman | 12.0 | | X | CCRP | 6,029.50 |
| | | ~488.4 | 4 | 26 | | 334,301.42 |

CCRP: USDA Continuous Conservation Reserve Program
DOW: Division of Wildlife Private Lands Program
USFWS: US Fish & Wildlife Service Private Lands Program
WRP: USDA NRCS Wetland Reserve Program

**Stream Morphology**

Stream morphology is the study of how a stream moves and the relationship it has with its streambank. Based on Rosgen's level II classification system, to classify streams. The classification is based on 1) mean bankfull depth, 2) maximum bankfull depth, 3) bankfull width, 4) flood-prone area width, 5) channel sinuosity, 6) mean channel slope or water surface slope, and 7) median channel material size. For our purposes, channel material size was not done. The stream types commonly found in the Bokes Creek, Mill Creek and their tributaries are described below (Ward and Trimble, 2003).

- **Rosgen Type C Stream** – slightly entrenched, meandering systems that are characterized by a well-developed floodplain. They typically have a riffle-pool bedform and a wide width to depth ratio. These streams are considered stable.

- **Rosgen Type E Stream** – low width to depth ratio, wide range of sinuosity. Meadow streams are Type E streams. These streams are very stable because they have well developed floodplains with dense (often grassy) vegetation that helps to stabilize there near vertical banks.
- **Rosgen Type F Stream** – Entrenched systems that normally exhibit bed slopes less than 2 percent.
- **Rosgen Type G Stream** – Deeply entrenched systems that have bed slopes of 2 to 4 percent.

Restoration priority areas can be set according to the morphology which influences the amount of power the stream possesses. In Bokes Creek, a priority area is Powderlick Run, which has on-going active restoration efforts incorporating Natural Channel Design. In Mill Creek the priority areas include Crosses Run and Blues Creek. Crosses Run also has an on-going active restoration including Natural Channel Design.

Blues Creek is primarily used for agricultural drainage, and has a relatively low gradient and stream power to provide the ability for sediment transport and storage. The low gradient and power also inhibit the natural formation of features such as riffles, runs, pools, and meanders. Incorporating these natural channel designs could be a significant cost, which should be considered for restoration potential. A cost effective option could be passive restoration which would include restoring the active floodplain at or below the bankfull discharge state (2 stage design), or restoring the floodplain 5 times the width of the bankfull width.

**Water Resources Usage**

The Ohio Department of Resources, Division of Water monitors water withdrawal facilities, such as the Marysville Water Treatment Plants, with the capacity to withdraw more than 100,000 gallons per day (70 gallons per minute). As illustrated in Table 4, Logan and Union Counties withdraw between 0-5 million gallons of water per day (MGD), and Delaware County withdraws between 5-25 million gallons of water per day. Water withdrawal is categorized into 5 different uses:

- **Agriculture/Irrigation** – Waters suitable for irrigation and livestock watering without treatment.
- **Industrial** – Waters suitable for commercial and industrial use, with or without treatment.
- **Miscellaneous**
- **Power**
- **Public Water Supply** – Waters suitable for human consumption, with conventional treatment.

Table 4. Water Withdrawal Uses for Delaware, Logan and Union Counties (ODNR, 2000).

| | *Ag/Irrigation* | *Industrial* | *Misc.* | *Power* | *Public Water Supply* | *Total Withdrawal Per Day* |
|---|---|---|---|---|---|---|
| ***Delaware County*** | >1 MGD | >5-25 MGD | >.5-1 MGD | 0 MGD | >5 – 25 MGD | >5-25 MGD |
| ***Logan County*** | >.5 – 1 MGD | >0-1 MGD | >0-.1 MGD | 0 MGD | >1 –5 MGD | >0-5 MGD |
| ***Union County*** | >.1 - .5 MGD | >1-5 MGD | 0 MGD | 0 MGD | >1-5 MGD | >0-5 MGD |

Within the next five years, a reservoir will be constructed to serve the increasing water supply needs for City of Marysville residents, unincorporated communities and industries located in central Union County. Water will be drawn from Mill Creek to maintain the water depth of the reservoir, necessitating the need for less well water, which typically has a hardness 3X that found in Mill Creek (Ohio EPA, 2002). To maintain the reservoir, an increased amount of water will be drawn from Mill Creek during times of higher flow and quality, usually in winter months. High flow also occurs in spring months, but the water quality is poor due to high rates of nutrient runoff (Per communication, Fred McCreary, WTP Supervisor).

**100 Year Floodplains**

Appendix 4 illustrates the 100 year floodplains along Bokes Creek and Mill Creek. The floodplain is the area expected to be inundated by a 100-year flood, with a one percent chance per year that flooding will occur. Contrary to popular belief, it is not a flood occurring once every 100 years.

**Threatened and Endangered Species**

According to John Rockenbaugh (2002), Wildlife Specialist with the Union SWCD, several endangered or rare animal species have made their home within the Mill Creek watershed (Tables 5, 6 and 7). There are no documented sightings of endangered or rare animals in the Bokes Creek watershed.

Table 5. Endangered Amphibian Species in the Mill Creek Watershed.

| Species | Status | Year | Township | Location |
|---|---|---|---|---|
| Blue Spotted Salamander (*Ambysroma laterale)* | Endangered | December 2001 | Paris | Northwest Parkway (near Cradler-Turner Rd.) |

Table 6. Declining and Endangered Bird Species in the Mill Creek Watershed.

| Species | Status | Year | Township | Location |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| American Bittern *(Botaurus lentiginosus)* | Endangered | Spring 1998 | Paris | Between SR 245 and SR 33 |
| Bald Eagle* *(Haliaeetus leucocephalus)* | Endangered | Spring 1997<br><br>October 1999<br><br>Spring 2000 | Paris<br><br>Darby and Paris<br><br>Paris | Northwest Parkway (near Cradler-Turner Rd.)<br><br>Scottslawn Rd. (between Industrial Parkway and SR 736)<br><br>Northwest Parkway (near Cradler-Turner Rd.) |
| Barn Owl *(Tyto alba)* | Endangered | Summer 2001 | Dover<br><br>Paris | Fish Rd. (unconfirmed report)<br><br>Navin Rd. |
| Green Heron** *(Butorides virescens)* | Declining | Summer 2002 | Paris<br><br>Paris | Northwest Parkway (near Cradler-Turner Rd.)<br><br>Westlake - Lee Rd. |
| Meadowlark** *(Sturnella magna)* | Declining | Summer 2002 | Paris | Northwest Parkway (near Cradler-Turner Rd.) |
| Northern Harrier *(Circus cyaneus)* | Endangered | June 2001 | Taylor and York | Yearsley Rd. |
| Osprey* *(Pandion haliaetus)* | Endangered | November 2001 | Paris | Northwest Parkway (near Cradler-Turner Rd.) |
| Sandhill Crane (*Grus Canadensis)* | Endangered | December 2001 | Paris | Northwest Parkway (near Cradler-Turner Rd.) |

Although the populations of Green Herons and Meadowlarks are listed as declining by the Breeding Bird Survey, both are still common throughout the Bokes Creek and Mill Creek watersheds. Union County is a prime location to witness the migratory path of many bird species (i.e. Northern Harriers) as they travel from Canada and northern Michigan to southern winter locations. At this time, there is no documented nesting activity for Bald Eagles and Osprey within the Bokes Creek and Mill Creek watersheds, and that is attributed to sightings of them during their migratory periods.

* Sighted within the watershed, but no documented nesting activity
** Listed as 'declining species' by the Breeding Bird Survey

Table 7. Rare and Threatened Mammal Species in the Mill Creek Watershed.

| Species | Status | Year | Township | Location |
|---|---|---|---|---|
| American Badger *(Taxidae taxus)* | Rare | 2002 | Dover<br><br>Paris | Near Mill Creek SR 36 East<br><br>SR 36 (West of Marysville) |
| River Otter *(Lutra Canadensis)* | Threatened | August 2002 | Liberty and Taylor | In Mill Creek (section from Cotton Slash Rd. and Wheeler - Green Rd.) |

**Water Related Recreational Activities within the Bokes/Mill Creek Watersheds.**
In the context of the watersheds' existing and potential water-related recreational activities, they are active and expanding. The City of Marysville has located many of its parks in the riparian areas and floodplains of Mill Creek. Easily accessible, the low-impact creek-side trails are convenient to hikers, bikers, runners, birders, and other wildlife enthusiasts. Those who fish, find easy ingress and egress. The Marysville City Parks are user-busy throughout the day with those in search of recreational activities along Mill Creek.

Voluntary conservation practices, like the Conservation Reserve Program (CRP) and The Scioto Conservation Reserve Enhancement Program (CREP), are proving recreationally beneficial throughout both watersheds in terms of both non-consumptive and consumptive wildlife pursuits. In annual population growth Union County is the fourth fastest growing county in Ohio. Paradoxically it ranks ninth in total CRP acres and second in CRP wetland practice acres in Ohio. This is a remarkable accomplishment.

To date, the riparian-friendly Scioto CREP conservation practices now total over 4,000 acres – many of them in the Bokes Creek and Mill Creek watersheds. This includes over 1300 acres of CP21 native warm season grass and cool season grass Filter strips and over 544.9 acres of wetland-related practices. Historically, voluntary conservation practices contribute to increased recreational use and of course increased water quality.

## History

**Overview**
Bokes Creek and Mill Creek are part of the larger Scioto River watershed and Ohio River watershed. Both Bokes Creek and Mill Creek flow into the Scioto River upstream of the City of Columbus, which then flows south until outleting into the Ohio River.

Early nineteenth century Ohio was crisscrossed by a network of migration routes, with a major migration route passing through south central Ohio and up the Scioto River. The Scioto River provided a natural highway for north to south travel, and the Scioto trail, worn by Indians, stretched from the northern Sandusky Bay to the mouth of the Scioto River at the Ohio River (W.H. Beers and Co., 2002).

Indian trails followed high ground, and these trails, along with other natural waterways (i.e. Bokes Creek, Mill Creek and other tributaries to the Scioto River), later paved the way for early settlers. Migration to Ohio was frequent due to its temperate climate and mix of hills, valleys, forest and prairies.

Union County, Ohio (Figure 3) was established on April 1, 1820 and received its name from its "union" with parts of other counties (Delaware, Franklin, Logan and Madison) and an old Indian territory. Streams in Union County, originating in hilly Logan County, slope to the southeast towards the Scioto River (W.H. Beers and Co., 2002). The county was popular during the nineteenth century for its Magnetic Springs in the Bokes Creek watershed, which was believed to have curing powers.

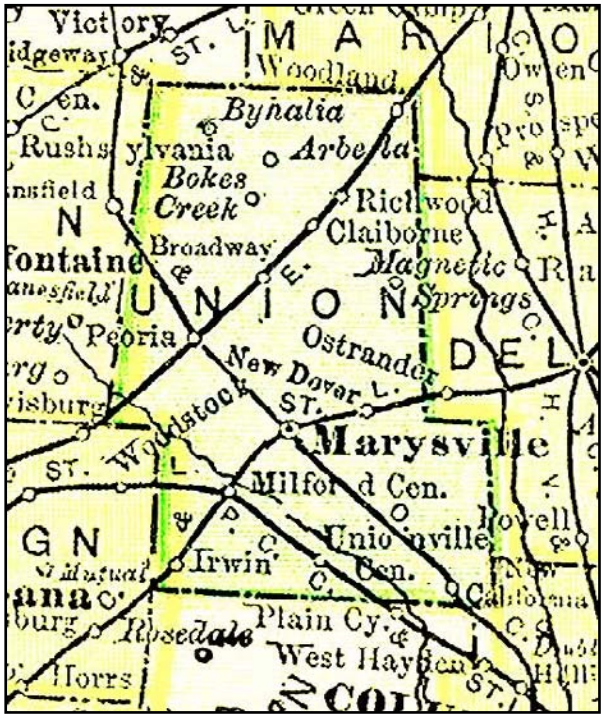



Figure 3. Map of Union County, Ohio in 1895 (Livingston County MIGenWeb, 2002).

**Bokes Creek Watershed**
In 1825, the first settlements were formed in Magnetic Springs along the high banks of Bokes Creek and other area streams. Early settlers believed the land away from the streams was too low and wet to farm, and that many years would elapse before others would attempt to farm it. Trees were plentiful and considerable underbrush canvassed the landscape. White and black walnut trees dotted the streambanks and beech, sugar, hickory, white oak, white ash, burr oak, red oak and red elm were present in the uplands. The earliest settlers were lured to the area by the abundant game animals, including deer. The dense woods also housed swarms of bees, which yielded enough wild honey for every

pioneer in the area to have on their dinner table. Others migrated to the region in pursuit of the rich lands for agriculture (W.H. Beers and Co., 2002).

In 1879, a resident named J.E. Newhouse discovered a magnetic spring of water in his park, Green Bend Garden (Bix, 2002). Springs were not abundant in Magnetic Springs, but the mineral water discovered was of excellent quality and possessed strong medicinal properties (W.H. Beers and Co., 2002).

Informed by a minister that he would be committing a sin if the water was not used to heal the ill, Mr. Newhouse formed Newhouse and Co. and opened the Magnetic Springs Bath House. During the summer, ten thousand people in poor health visited Magnetic Springs, with 500 baths provided by the Bath House daily. Even President Grover Cleveland had the magnetic water shipped to Washington D.C. to be served at the White House (Bix, 2002).

Eight hotels were built to accommodate the influx of guests and cure-seeking people. Magnetic Springs continued to prosper until World War II, when advances in medicine and drugs made mineral bath treatments a cure of the past (Bix, 2002).

In 2002, Magnetic Springs was approved for an Ohio Historical Marker, the first in Union County. The marker will include text detailing the past of Magnetic Springs (Bix, 2002).

**Mill Creek Watershed**

Early pioneers set up cabins along Mill Creek, where soils consisted of clay and the land was densely forested with sugar, hickory, oak, beech, elm and walnut trees. The land was flat and very wet, but by ditching and draining the land became suitable for farming.

Mill Creek was named for the early mills in Delaware and Union Counties for which it generated power. A Mill Creek tributary, Blues Creek, was named for an individual named Blue that was dunked into its waters while participating in an early surveying party.

Originally called Shady City due to its maple tree-lined streets, the City of Marysville, the largest city housed within the Mill Creek watershed and Union County, was later named for the daughter of the city's founder, Sammuel W. Cuthbertson in 1820 (W.H. Beers and Co., 2002).

## Current Land Ownership and Management

**Bokes Creek**

The land uses in the Bokes Creek watershed are portrayed in Appendix 5. Agriculture is the predominant land use within the Bokes Creek watershed, although a few livestock operations are present. Even though primarily focused on corn and soybean production, wheat and hay are also harvested. The crop estimates for the Bokes Creek watershed in Union County are 30% corn, 60% soybean and 10% wheat. No-till farming is prevalent on wheat and soybean fields, and continues to expand (Ohio EPA, 2002).

Two large egg farms operate in Logan and Union Counties, including Heartland Egg Farm in eastern Logan County and Daylay and Mad River Egg Farms in Union County (Ohio EPA, 2002). Table 8 indicates other livestock operations inventoried in summer 2007 (See Appendix 12 for more detail).

Table 8. Bokes Watershed Livestock Inventory

| Sub-watershed | County | Township | # cattle | # horses | # hogs | # sheep | # goats | # chickens | # total | # total for sub-watershed |
|---|---|---|---|---|---|---|---|---|---|---|
| A | Logan | Bokescreek | | | | 20 | | 1 mil + | 1,000,020 | |
| A | Union | York | 44 | 30 | | | | | 74 | 1,000,094 |
| B | Union | York | | | 2,000 | | | 7 mil + | 7,002,000 | 7,002,000 |
| C | Union | York | 20 | | | | | | 20 | |
| C | Union | Leesburg | 127 | 47 | 100 | 75 | | | 349 | |
| C | Delaware | Scioto | 20 | 5 | | | | | 25 | 394 |

The City of Columbus, Division of Water purchased 26 acres of conservation easements along Powderlick Run as part of the Bokes Creek Water Quality Enhancement Project. With the establishment of 26 easement acres, approximately 0.04 stream miles are permanently protected. Many of the acres are located on Daylay Egg Farm property, while the remaining acres were purchased from voluntary landowners.

The City of Columbus also owns White Sulphur Lake, a 39-acre quarry lake used to supplement stream flows for the Scioto River (drinking water source for City of Columbus) during periods of extreme drought. In addition to the quarry itself, the City of Columbus also owns and manages the areas immediately surrounding White Sulphur Lake in order to prevent drinking water pollution (Ohio EPA, 2002).

**Mill Creek**

Eighty percent of the land in the Mill Creek watershed is privately owned and farmed. The land use map in Appendix 7 also indicates that, as in the Bokes Creek watershed, the largest land use in the Mill Creek watershed is agriculture. Agricultural activities are

primarily focused on corn and soybean production, in addition to wheat and hay (Ohio EPA, 2002). Table 9 indicates the livestock operations inventoried in summer 2007 (See Appendix 13 for further detail).

Table 9. Mill Watershed Livestock Inventory

| **Sub-watershed** | **County** | **Township** | **# cattle** | **# horses** | **# hogs** | **# sheep** | **# goats** | **# chickens** | **# total** | **# total for sub-watershed** |
|---|---|---|---|---|---|---|---|---|---|---|
| A | Logan | Perry | 218 | | 800 | | | | 1,018 | |
| A | Union | Liberty | 107 | 87 | | 30 | 49 | | 273 | |
| A | Union | Taylor | 300 | 18 | | | | | 318 | |
| A | Union | Paris | 10 | 61 | | 5 | | | 76 | 1685 |
| B | Union | Paris | 282 | 5 | | 40 | | | 327 | |
| B | Union | Dover | 490 | 12 | 200 | 130 | | | 832 | |
| B | Union | Millcreek | 305 | 15 | 75 | | | | 395 | |
| B | Delaware | Scioto | | 4 | | | | | 4 | |
| B | Delaware | Concord | | 15 | | | | | 15 | 1,573 |
| C | Union | Paris | 50 | | | | | | 50 | 50 |
| D | Union | Taylor | 70 | | | | | | 70 | |
| D | Union | Leesburg | 50 | 17 | 5,400 | | | | 5,467 | |
| D | Union | Dover | 21 | 23 | 20 | 20 | | | 84 | |
| D | Delaware | Scioto | 10 | 5 | | | | | 15 | 5,636 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

Eleven city parks occupy 201 acres in Marysville, with 66% of the total park land bordering Mill Creek in a rapidly developing area of the City: Schwartzkopf Park (7.5 acres), Mill Creek Park (56 acres), Mill Valley Park (16 acres), McCarthy Park (9 acres) and Central Park, which is currently under construction (45 acres). There are plans to connect all of the city parks via a bicycle path/nature trail system.

In western Delaware County, 138.5 acres are dedicated as the Blues Creek Preserve in Ostrander. Blues Creek, a tributary to Mill Creek, meanders through the Blues Creek Preserve until it reaches Mill Creek. Although still under construction, the Preserve opened to the public in 2000 and portrays a range of habitats, including wetlands, woods and grassland.

Two golf courses lie within the Mill Creek watershed. With high levels of fertilizer and herbicide typically applied to maintain weed-free and green lawns, golf courses are a potential hot spot for nonpoint source pollution. The golf courses within the watershed include:

- Blues Creek Golf Course on SR 4 (Union County)
- Golf Course on Penn Road near Ostrander (Delaware County)

The Eagle Creek Leadership and Challenge Center Company**,** a 50-acre team building activity center, is located in Delaware County.  A high-ropes course is visible at the confluence of Mill Creek and one of its tributaries, Eagle Creek.

## Socioeconomic Conditions

The Bokes Creek and Mill Creek watersheds stretch from Logan County, across Union County and outlet into the Scioto River in Delaware County. Together, their watersheds occupy 21% of Logan County, 63% of Union County and 16% of Delaware County (Appendix 2). The percentage of watershed in each county was used to estimate % population.

**Logan County**
According to the 2000 United States Census Bureau, the population of Logan County has increased by 8.7% from 1990 to 2000, with approximately 46,023 people in 2001. Of this total population, it is estimated that approximately 9,665 people live inside the watershed boundaries. The population consists of the following age groups:

- Under 5 years: 6.9%
- 6 – 17 years: 26.7%
- 18 – 64 years: 47.5%
- 65+ years: 13.9%

The Union County Comprehensive Plan states that the majority of eastern Logan County is proposed for agriculture, with the exception of the West Mansfield area in the Bokes Creek watershed (1999).

Townships:

- Mill Creek Watershed:
  - Perry
  - Rush Creek
  - Jefferson

- Bokes Creek Watershed:
  - Bokes Creek
  - Perry
  - Rush Creek

Important facts for Logan County (2001 Ohio Agricultural Statistics and Ohio Department of Agriculture Annual Report):

Agriculture:
Land in farms – 225,000 ac.
Number of farms – 940
Average farm size – 239 ac.
Total 2000 cash receipts - $53,859,000

Average 2000 cash receipts per farm – $56,103

The 2000 United States Census Bureau indicates that the average Logan County annual income is $41,479 and the average value of a single-family home is $88,300.

The levels of education for Logan County residents, ages 25+ years, consist of:

- 83.6% High School graduate
- 11.5% Bachelor's degree or higher

**Union County**

The 2000 United States Census Bureau states that out of Ohio's 88 counties, Union County was ranked third in the rate of population change from 1990 to 1995, with a population increase of 14.3% to 42, 793 people in 2001. It is estimated that 63% of this population, or 26,960 people, reside in the Bokes Creek and Mill Creek watersheds. The population of Union County is comprised of the following age groups:

- Under 5 years: 7.6%
- 6 – 17 years: 27.6%
- 18 – 64 years: 44.8%
- 65+ years: 9.6%

The county's proximity to the City of Columbus has acted as a stimulus for urban sprawl, which most likely explains the large population increase in the past few years. Specifically, Darby, Dover, Liberty, Mill Creek, Paris and Taylor Townships have experienced rapid growth. To maintain control of development while preserving the rural character of Union County, a comprehensive plan was created in 1999, which suggests that increased development results in higher land prices (Union County Comprehensive Plan, 1999).

In 1995, the City of Marysville, the largest municipality in Union County and the Mill Creek watershed, had a population of 14,000 people. Magnetic Springs, the largest municipality in the Bokes Creek watershed, had a population of 381 people.

The average annual salary in Union County is $51,743, and the average home value is $128,800. The levels of education for Union County residents, ages 25+ years, consist of:

- 86% High School graduate
- 15.9% Bachelor's degree or higher

In 1992, Union County generated $77.8 million in agricultural sales. The trend has been towards larger farming operations in Union County, while the number of full-time farmers has decreased by 23% (Union County Comprehensive Plan, 1999).

Other important facts for Union County are listed below:

- **Agriculture**
  Land in farms…….238,000 acres
  Number of farms…….830 farms
  Average farm size……..287 acres
  Total cash receipts……...$74,291,640.00
  Average cash receipts per farm……..$89,508.00

- **Taxes**
  Taxable value of real property……..$479,196,980.00
  Residential…….$270,373,290.00
  Agricultural……$93,791,060.00
  Industrial……..……..$60,762,060.00
  Commercial……..$54,270,570.00
  Ohio personal income tax liability……..$17,334,773.00
  Average per return……$1,052.63

Townships:

- Mill Creek Watershed:
  - Darby – Zoning and subdivision regulations
  - Dover – Zoning and subdivision regulations
  - Liberty – Zoning and subdivision regulations
  - Mill Creek – Zoning and subdivision regulations
  - Paris – Zoning and subdivision regulations
  - Taylor – Zoning and subdivision regulations

- Bokes Creek Watershed:
  - Leesburg – Zoning and subdivision regulations
  - Taylor – Zoning and subdivision regulations
  - Washington – Zoning and subdivision regulations
  - York – Zoning and subdivision regulations

**Delaware County**
From 1990 to 2000, the population of Delaware County increased 64% to include 119,752 people. Of this county population, it is estimated that 19,160 people reside in the Bokes Creek and Mill Creek watersheds. The population of Delaware County is comprised of:

- Under 5 years: 7.9%
- 6 - 17 years: 28.2%

- 18 - 64 years: 44.3%
- 65+ years: 8.2%

According to the 2000 United States Census Bureau, the average annual income in Delaware County is $67,258, and the average value of a single-family home is $190,000. The levels of education for Delaware County residents, for ages 25+ years, are:

- 92.9% High School graduate
- 41% Bachelor's degree or higher

Intended to guide land development through the year 2010, the Delaware County Master Plan Goals includes identifying and preserving natural, historic and cultural resources, preserving rural character, promoting balanced land use practices and managing development based on current infrastructure (Union County Comprehensive Plan, 1999).

Townships:

- Mill Creek Watershed:
  - Scioto
  - Concord

- Bokes Creek Watershed:
  - Scioto
  - Thompson

Important facts for Delaware County (2001 Ohio Agricultural Statistics and Ohio Department of Agriculture Annual Report):

Agriculture
Land in farms – 175,000 ac.
Number of farms – 750
Average farm size – 233 ac.
Total 2000 cash receipts - $48,205,000
Average 2000 cash receipts per farm - $62,603

# Water Quality

## Stream Use Designation

Generally, Bokes Creek and Mill Creek are designated recreational waterbodies and Warmwater Habitats by the Ohio EPA (some tributaries may have different designations –see Sections 3 and 4). The mainstem of Bokes Creek and the majority of Mill Creek and its tributaries are designated primary contact recreation, indicating that they are suitable for full body contact (i.e. swimming or canoeing). The tributaries of Bokes Creek are designated secondary contact recreation, or partial body contact (i.e. wading). The secondary contact designation is necessary because the tributaries are too small and shallow for full body contact. As recreational waterbodies, the streams must meet water quality standards for either fecal coliform bacteria or E. coli bacteria.

With treatment, Bokes Creek and Mill Creek also meet drinking water standards and are suitable for irrigation and livestock watering (without treatment). The waterbodies (i.e. streams or lakes) within the Bokes Creek and Mill Creek watersheds are classified by one of the following designations:

- **Exceptional Warmwater Habitat (EWH)** – (i.e. White Sulphur Lake in the Bokes Creek watershed) the highest stream designation, indicating the cleanest water. EWH supports "unusual and exceptional" communities of fish and macroinvertebrates, and may include threatened or endangered species.

- **Warmwater Habitat (WWH)** – (i.e. mainstem of Bokes Creek) describes fish and aquatic macroinvertebrates that are typically found in Ohio streams, and is the priority improvement target for many streams throughout Ohio.

- **Modified Warmwater Habitat (MWH)** – (i.e. channel maintained headwaters of Blues Creek) irreversible habitat modifications are evident, in addition to an increasing presence of fish and macroinvertebrates that are tolerant to pollution.

- **Limited Resource Water (LRW)** – (i.e. BMY Tributary is small and extensively ditched) defined by limited, non-diverse fish and macroinvertebrate species. LRW streams are unable to support healthy, diverse aquatic populations due to natural background conditions or altered, human-induced conditions. The LRW designation is temporary; if habitat conditions are improved, the stream can be upgraded to another designation.

## Causes and Sources of Water Quality Impairment

The *causes* of water pollution are the actual factors that affect the aquatic life use (i.e. low dissolved oxygen, silt). *Sources* of water quality impairment are the activities or entities from where the pollutant originated (i.e. wastewater treatment plant, agriculture).

The causes and sources of pollution impairing the water quality of Bokes Creek and Mill Creek, as listed in the 2000 Ohio Water Resource Inventory Appendices to Volume I Appendix A2-30 include:

- **Siltation** – Sediment destroys fish habitat by 1) covering spawning/feeding areas, 2) eliminating food sources, and 3) reducing sunlight infiltration; therefore, decreasing photosynthesis.

- **Nutrients** (i.e. phosphorous, nitrogen) – Nutrient enrichment causes excessive algae and aquatic plant growth, which chokes waters and depletes oxygen levels. High nitrate levels in drinking water causes methoglobinemia, a blood disease in infants.

- **Habitat alterations/modifications** (i.e. riparian tree removal, dredging) – Streambanks become unstable and lack of riparian cover causes an increase in stream water temperature. Habitat modifications also contribute to gully erosion, reduced infiltration, increased upland surface runoff and transport of contaminants, increased streambank erosion and impaired habitat.

- **Unknown toxicity** (i.e. urban runoff, wastewater treatment plants, industrial discharges) – Leads to degradation of drinking water supplies and toxic effects on wildlife.

- **Agriculture** – Field runoff and soil erosion increase nutrient levels in streams.

- **Animal holding/management areas and feedlots** – Nutrients from manure or unrestricted access to streams increase in-stream nutrient levels and siltation.

According to the same source, other impairments include:

- **Organic enrichment** – Decomposition of human and animal waste and plant/animal matter in the stream depletes oxygen levels.

- **Low dissolved oxygen** – Dissolved oxygen may be depleted to below the threshold necessary to maintain aquatic life.

- **Other habitat alterations**

- **Non-irrigated crop production**

- **Channelization**

**Phosphorous Levels**

High levels of phosphorous are a water quality impairment in the Bokes Creek and Mill Creek watersheds. Elevated phosphorous levels promote the excessive growth of

algae and other aquatic plants. As the plant population continues to bloom, the light can no longer penetrate the stream water and reach the plants. The plants begin to die, depleting life-sustaining dissolved oxygen. As dissolved oxygen levels drop, fish and macroinvertebrate populations die off.

Tables 10 and 11 outline the phosphorous levels of Bokes Creek and Mill Creek, as determined by the Ohio EPA in 2002. The Bokes Creek and Mill Creek Total Maximum Daily Load plans focus on decreasing phosphorous levels, and the target levels were set to provide a measurable goal for water quality standards.

Table 10. Phosphorous Loading to Bokes Creek (Ohio EPA, 2002).

| Stream Section | Median (mg/l) | Target (mg/l) | % Reduction |
|---|---|---|---|
| **Bokes Creek** (Brush Run to the Scioto River) | 0.14 | 0.11 | 18.5% |
| **Bokes Creek** (Headwaters to Brush Run) | 0.49 / 0.23 | 0.58 / 0.07 | - / 69.6% |
| **Powderlick Run** | 1.32 / 0.83 | - / 0.07 | - / 91.6% |
| **Brush Run** | - | 0.07 | - |
| **West Fork West Mansfield Tributary** | 0.45 | 0.07 | 84.4% |
| **North Fork West Mansfield Tributary** | 0.23 / 0.36 | 0.58 / 0.07 | - / 80.3% |
| **South Branch West Fork West Mansfield Tributary** | 0.16 | 0.07 | 56.3% |
| **Smith Run** | 0.12 | 0.07 | 41.7% |

Table 11. Phosphorous Loading to Mill Creek (Ohio EPA, 2002).

| Stream Section | Median (mg/l) | Target (mg/l) | % Reduction |
|---|---|---|---|
| **Mill Creek** (Headwaters to Otter Run) | 6.76 | 5.0 | N/A |
| **Mill Creek** (Otter Run to Scioto River) | 4.61 | 5.0 | 8% |
| **Crosses Run** | 0.44 | 0.11 | 75% |
| **North Branch Crosses Run** | 1.20 | 0.11 | 91% |

## Previous Studies and Planning Efforts

A number of plans, studies and conservation programs have been ongoing for many years in the Bokes Creek and Mill Creek watersheds. These plans and programs are designed to promote wiser use of the land while improving the water quality of local streams. Two programs, the Environmental Quality Incentives Program (EQIP) and the proposal for the Super Conservation Reserve Enhancement Program (Super CREP) specifically target nutrient reduction.

**Local Plans**

- **Logan – Union – Champaign County Regional Plan**
  This regional plan was developed in 1970 to address transportation, housing and natural resources in guiding development. The planning commission adopted the theory of concentric ring development, which is based on the assumption that growth will take place on the existing urban periphery and that population density will be highest in the urban core areas. Concentric ring development is proposed for the Marysville focus area. The Plan also states that agricultural land use will continue to dominate the tri-county area. Greenways are recommended for the floodplain areas of streams and larger greenbelt areas are suggested to surround the Marysville focus area. The Plan proposes that implementation occur through development of master plans at the local level, the adoption of zoning and subdivision regulations and the use of capital improvements programming (Union County Comprehensive Plan, 1999).

- **Union County Comprehensive Plan**
  In 1999, a comprehensive plan was developed for Union County. The plan states that in addition to maintaining the rural character of the county, natural resources are an important feature and municipalities should strengthen regulations to better manage the impacts of development. Strategies involve promoting Best Management Practices in development regulations, maintaining and enhancing stream buffers (recommends that major creeks have a 50 foot buffer; other tributaries have a 25 foot buffer), and encouraging protection of wetlands and forests (Union County Comprehensive Plan, 1999).

- **Union Soil and Water Conservation District: 2006 and 2007 Annual Plan of Operations**
  According to the 2006 and 2007 Annual Plans of Operations, a goal for the Union SWCD and NRCS is to work with collaborating organizations and additional residents in the Bokes Creek and Mill Creek watersheds to develop a watershed action plan. Action items include promoting the implementation of conservation programs, producing watershed restoration strategies, representing the Union SWCD during Ohio EPA's TMDL development and pursuing funding for innovative projects (i.e. streambank stabilization, wetlands for municipal waste)

(Union Soil and Water Conservation District, 2002; Union Soil and Water Conservation District, 2003).

**Water Resource Studies**

- **Stream Flow Rates**
  Data on stream flow is used to determine periods of maximum and minimum pollutant dilution, which can be used to analyze pollutant loads. Precipitation, stream length and slope, ground water recharge areas and reservoirs can influence stream flow. Stream flow, or lack of, may be indicative of water quality. In general, less stream flow offers less contaminant dilution; therefore, yielding higher in-stream pollution levels. The U.S. Geological Survey operated a stream gauging station to monitor daily stream flow on Bokes Creek from May 1982 to September 1997. The study concluded that the months of February and April have the highest rates of stream flow at 111 cubic feet per second, and the lowest rate of flow at 7.96 cubic feet per second is evident in September.

  From June 1982 to September 1997, the U.S. Geological Survey also monitored the streamflow of Mill Creek. They determined that Mill Creek's swiftest flow of 323 cubic feet per second generally occurs in March, due to melting snows, and the slowest flow of 24.3 cubic feet per second occurs in September, after warm summer temperatures and use of streams for crop irrigation.

- **Groundwater Recharge Rates**
  The Ohio Department of Natural Resources, Division of Water and the United States Geological Survey conducted a study to estimate the rate at which precipitation reaches (recharges) the groundwater in the Bokes Creek and Mill Creek watersheds. In general, the study found that watersheds with less than 36.6 in/yr of precipitation have recharge rates of 6 in/year or less. In addition, soils with very low infiltration rates commonly have groundwater recharge rates of 5 in/year or less (Dumouchelle and Schiefer, 2002).

  Long-term monitoring stations were established near Warrensburg (Delaware County) to analyze the streamflow of Bokes Creek from 1983 to 1996, and near Bellpoint (Delaware County) to study Mill Creek from 1943 to1998. In addition to monitoring stream flow, the study found that the predominate soils in the Bokes Creek and Mill Creek watersheds are characterized by low or very low infiltration rates. Layered or clay-based soils obstruct infiltration, and have moderately fine or fine textures, a high water table, or are shallow over an impervious layer. The Bokes Creek watershed has 35.5 in/yr of precipitation, yielding a 5 in/yr groundwater recharge rate, and the Mill Creek watershed has 36 in/yr precipitation rate and a 4 in/yr recharge rate (Dumouchelle and Schiefer, 2002).

- **Ohio Wesleyan University**
  In Spring 2001, students enrolled in the Departments of Zoology and Botany/Microbiology at Ohio Wesleyan University conducted a water quality

study of the Upper Scioto River watershed. The students monitored the water chemistry of Bokes Creek, Mill Creek, Blues Creek and other Scioto River tributaries, as well as the quality of the water in drainage tile outlets. Sixteen samples were collected from the Scioto River and five Scioto River tributaries; however, the number of samples collected specifically from Bokes Creek, Mill Creek and Blues Creek is not documented. The study concluded that the levels of pH, conductivity, nitrates, phosphates and iron in drainage tile outlets were higher than those present in Bokes Creek and Mill Creek; therefore, indicating tile runoff as a potential source of nutrients (Grossman and Fraifogl, 2001). The conductivity readings show that all the tributaries were within the eutrophic range of 300-1000 umhos, showing that the major tributaries are not making vastly greater contributions to pollution levels in the Scioto. For ph, all streams were in the accepted range of 5.0 – 9.0. For phosphates – it showed all the creeks were above the safe limit of 0.1 ppm. The nitrate readings were all below the accepted maximum of 10 mg/l, with the highest reading of nitrates of streams studied was found in Bokes Creek. This provides further evidence that tile drains are sources of nutrients to the river. For alkalinity, the safe measure is 500 ppm, and all the streams were below this. This suggests that the Scioto River receives most of its alkalinity from tile drains and surface erosion rather than from ground water.
For iron, the drinking water standard is 0.3 ppm – none of the streams met the goal. This proves that the Scioto River and all its tributaries are very high in iron, probably all from groundwater seepage and runoff from the soil. Most of the water quality data collected fell within the U.S.P.H.S. acceptable limits of stream quality in central Ohio. Iron content is usually high because of concentrations found in the tills and soils, which could pose a threat to drinking water.
Phosphates are an important plant nutrient, but can be in excess due to sewage and agricultural drainage. Levels are high in all sites with tile drains that receive water from agricultural fields. Nitrates come from tile drains and agricultural runoff, and are dangerous because they can lead to serious health problems. It's likely that fertilizers add a significant amount of dissolved substances to the streams in the study area, since the region is prime agricultural land. BMPs and the prevention of tile drain runoff will alleviate pollutants. Add riparian corridors to the channelized portion of the stream to reduce the nutrient levels if tile drains are allowed to seep across the vegetated zone. Perhaps tile drains could feed into marshes or lagoons where plants could sequester nutrients before they reach the stream and are lost from the fields.

Table 12. Ohio Wesleyan University Water Chemistry Data

| **Stream** | **Average Conductivity (Umhos)** | **pH** | **Phosphate (mg/l)** | **Nitrates (mg/l)** | **Alkalinity (mg/l)** | **Iron (mg/l)** |
|---|---|---|---|---|---|---|
| Blues | 525 | 7.75 | .3 | 5.5 | 120 | 0.6 |
| Bokes | 575 | 7.9 | .475 | 7.35 | 175 | 0.65 |
| Mill | 600 | 8 | .6 | 4.5 | 170 | 0.5 |

| Sample Location | Average Conductivity (Umhos) | pH | Phosphate | Nitrate | Alkalinity | Iron |
|---|---|---|---|---|---|---|
| Scioto River | 625 | 8.35 | .27 | 6.75 | 255 | .44 |
| Tile Effluent in Tributaries | 1350 | 7.8 | .4 | 15 | 290 | .3 |

- **City of Columbus, Division of Water**
  The City of Columbus has been monitoring the water quality of Bokes Creek and Mill Creek for many years. The nutrients tested for include nitrates, ammonia, phosphates and phosphorous. In addition to the nutrients previously listed, the City of Columbus began testing atrazine levels in 2000

  Water quality violations or exceedances have occurred, and any adverse impacts to the City of Columbus drinking water. Violations documented for nitrates and atrazine are listed in the Tables below. A nitrate violation is a concentration over 10 ppm. An atrazine violation is a concentration over 3 ppm. Info gathered from Columbus Division of Water and Marysville Water Treatment Plant. Source Water Protection Alliances Between Water Utilities and Agricultural Operations – water from Scioto River is stored in 2 small reservoirs (combined capacity is 8 billion gallons) spring flush atrazine concentrations may be high in Griggs and 0'Shaugnessy Reservoirs – but these reservoirs have a much shorter detention time (combined about 2 weeks nominal residence time). Powdered activated carbon (pac) for atrazine control is not cost prohibitive due to short detention time. The primary contaminant of concern in this watershed is nitrate, which can rise to concentrations of 10-12 ppm for several weeks nearly every year. CDW became concerned about elevated nitrate levels in the early 1980s, and in 1982 conducted monitoring that indicated nonpoint sources contributed 85% - 95% pf nitrate loads to the Scioto. Further testing revealed high nitrate levels in tile drain effluent. A 319 grant from EPA led by USWCD and OSU extension met with greater farmer acceptance – the project helped to increase farmers' awareness of nitrate losses and showed that split applications could help reduce nitrate export while maintaining crop yields.

  The Marysville Water Treatment Plant also did a study from 1997 – 2001 on atrazine concentrations in Mill Creek. When too much atrazine is present, the WTP switches from surface water to ground water and well water supplies.

Table 13. Bokes Creek Violations

| Date | Location | Nitrate (ppm) | Atrazine (ppb) |
|---|---|---|---|
| 1-22-90 | Bokes Creek | 16.2 | |
| 1-26-90 | | 10.7 | |
| 2-7-90 | | 11.6 | |
| 4-3-90 | | 11.5 | |
| 5-7-90 | | 14.8 | |
| 5-14-90 | | 15.1 | |
| 5-16-90 | | 10.7 | |
| 6-11-90 | | 10.5 | |
| 7-16-90 | | 12.9 | |
| 7-17-90 | | 11 | |
| 7-18-90 | | 10.4 | |
| 6-17-91 | | 22.4 | |
| 6-24.91 | | 10.7 | |
| 2-25-92 | At SR 257 | 15.2 | |
| 3-3-92 | At SR 257 | 13 | |
| 3-20-92 | At SR 257 | 18.3 | |
| 3-23-92 | At SR 257 | 16.4 and 17 | |
| 3-25-92 | At SR 257 | 16.8 | |
| 4-21-92 | | 11.5 | |
| 4-23-92 | SR 257 | 14.3 | |
| 4-24-92 | SR 257 | 14 | |
| 4-27-92 | Bokes Creek | 11.2 | |
| 4-30-92 | Bokes Creek | 10.9 | |
| 6-2-92 | SR 257 | 27.9 | |
| 6-9-92 | SR 257 | 12.7 | |
| 6-11-93 | | 13 | |
| 6-22-93 | | 13.7 | |
| 6-29-93 | | 13.1 | |
| 6-30-94 | SR 257 | 27 | |
| 7-7-94 | SR 257 | 13.5 | |
| 1-18-95 | SR 257 | 13.1 | |
| 10-4-96 | | 13.2 | |
| 5-6-97 | | 10.9 | |
| 8-6-01 | | | 3.05 |

| | | | |
|---|---|---|---|
| 10-1-01 | | | 4.69 |

Table 14. Mill Creek Violations

| | | Nitrate (ppm) | Atrazine (ppb) | | | | |
|---|---|---|---|---|---|---|---|
| 6-2-92 | | 16.9 | | | | | |
| 6-11-93 | | 10.9 | | | | | |
| 5-27-97 | Mill at WTP | | 17.4 | | | | |
| 6-9-97 | Mill at WTP | | 7.1 | | | | |
| 6-22-98 | Mill at WTP | | 4.24 | | | | |
| 4-20-99 | Crosses Run | | 14.04 | | | | |
| 4-20-99 | North Hin @Mill Creek | | 3.22 | | | | |
| 5-24-99 | Mill Creek | | >15.03 | | | | |
| 7-2-99 | Mill Creek | | 6.90 | | | | |
| 5-19-00 | Mill Creek | | >15 | | | | |
| 5-25-00 | Mill at WTP | | 7.42 | | | | |
| 6-7-00 | SR N Mill Creek | | 9.30 | | | | |

- **Ohio Environmental Protection Agency**
  - **Technical Support Document**
    Every five years, the Ohio EPA conducts a comprehensive study of the biological, chemical and physical study of Bokes Creek and Mill Creek. Four evaluations are regularly conducted:

    - **Qualitative Habitat Evaluation Index (QHEI)** – evaluates stream characteristics by looking at the ability of the habitat to support diverse, aquatic animal life. QHEI evaluates the type and quality of the substrate, amount of in-stream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality, and stream gradient. These scores typically range from 20 to 100, with a higher score indicating better stream habitat.

- **Index of Biological Integrity (IBI) –** measures fish species diversity and species populations. Scores range from 0 to 60, with higher scores indicating more diversity. To be in attainment of water quality standards and meet WWH designation, Bokes Creek and Mill Creek should have a score of 40 or greater.

- **Modified Index of Well Being (MIwb)** – factors out 13 pollution tolerant species of fish and includes fish mass analysis. When examined with the IBI, an even clearer picture of fish health emerges. If a high IBI is coupled with a low MIwb, it is suggested that there are a variety of species, but individual fish may be smaller than what is expected, thereby indicating the fish are not maturing fully. For WWH, the MIwb should measure 8.3 or greater.

- **Invertebrate Community Index (ICI) –** measures the macroinvertebrate (aquatic bug) species living in a stream. Like the IBI, scores range from a 0 to 60, with higher scores indicating healthier, more diverse insect populations. Bokes Creek and Mill Creek, as WWH streams, should have a score of 36 or greater to be in attainment of water quality standards.

- **Total Maximum Daily Loads**
  A Total Maximum Daily Load (TMDL) plan is developed for polluted streams that fail to meet water quality standards, like Bokes Creek and Mill Creek. The TMDL examines the pollution causes and sources that are impacting streams, and then designs clean up plans. TMDLs were completed on Bokes Creek and Mill Creek in 2002.

**Local Programs**

- **County Health Departments**
  The Union County Health Department has a history of identifying and documenting old, failing and unmaintained residential and commercial septic systems in the Bokes Creek and Mill Creek watersheds. The Health Department annually inspects both residential and commercial septic systems to identify problem systems. Through their experience, approximately 30-35% of aeration systems need repair and replacement each year, especially in the Magnetic Springs and West Mansfield areas within the Bokes Creek watershed. The Health Department staff also responds to other system requests and complaints, and then provides repairs or replacements as needed. In the past six years, the Health Department has issued and approved between 70-100 permits each year for replacement and/or upgrading of existing and failing systems.

  In 2003, the Delaware County Health Department began identifying and documenting failing septic systems within the Bokes Creek and Mill Creek

watersheds. By February 2007, the Delaware County Health Department has inspected 2,000 septic systems and found 120 systems failing (approximately a 6% failure rate). After discussion with Registered Sanitarians of Union, Logan, and Delaware Health Departments, they felt that the Delaware failure rate of 6% would be a good way to estimate the number of failing systems in the Bokes/Mill watershed. However, Delaware County consists of less older homes than Logan and Union Counties. After consulting w/ the local health department sanitarians, it was discovered that septic system permits were typically not issued for homes before 1950, therefore it could be assumed that areas with many homes built before 1950 will have a higher rate of failing septic systems. In Logan County, 36% of the homes in the Bokes/Mill Watershed were built prior to 1950. In Union County, 29.6% of the homes in the Bokes/Mill Watershed were built prior to 1950. However, only 14.5% of homes in Delaware County within the Bokes/Mill watershed were built prior to 1950. The difference in the percentage of age of homes within the 3 counties needed to be accounted for in addition to the Delaware county 6% septic system failure rate. In order to estimate the number of failing systems within the watershed, the number of unsewered homes in the townships that were researched, as well as the age of homes. The Delaware failure rate of 6% was applied to the number of unsewered homes, and then a pro-rate was applied depending on the percentage of homes that were built prior to 1950. This estimation is described in the table below:

Table 15. Bokes and Mill Watershed Septic Inventory

| **Watershed** | **County** | **Township** | **Houses w/ Septic** | **6% failure rate (# of systems)** | **# of failing systems (pro-rated)** |
|---|---|---|---|---|---|
| Bokes and Mill | Logan | Rush Creek (partial) | 220 (excluding areas not in watershed) | 13.2 | 33 |
| Bokes | Logan | Bokes Creek | 197(excluding West Mansfield) | 11.82 | 29 |
| Mill | Logan | Perry | 400 | 24 | 60 |
| Bokes and Mill | Union | Taylor | 449 | 26.94 | 55 |
| Bokes | Union | York | 405 | 24.3 | 50 |
| Mill | Union | Liberty | 532 | 31.92 | 65 |
| Bokes | Union | Leesburg | 550 | 33 | 67 |
| Mill | Union | Paris | 505 (excluding Marysville) | 30.3 | 62 |
| Mill | Union | Dover | 712 | 42.72 | 87 |
| Mill | Union | Mill Creek | 446 | 26.76 | 55 |
| Mill | Delaware | Scioto | 746 (excluding | 44.76 | 45 |

| | | | | | |
|---|---|---|---|---|---|
| | | | Ostrander) | | |

Sewered communities within the watershed are West Mansfield in Logan County (254 houses), Marysville in Union County (3, 305 houses), and Ostrander in Delaware County (147 houses). See Appendix 15 for a map of sewered communities.

- **Ditch Maintenance Programs**

**Logan County**
Table 16 indicates the two ditches under county maintenance in Logan County.

**Union County**
In 2000, the Union SWCD assumed management of the county ditch maintenance program from the Union County Engineers office (Table 8). The program manages the spraying and mowing of 18 miles of petitioned ditches in the Bokes Creek and Mill Creek watersheds within Union County. Spraying and mowing prevents woody vegetation from growing adjacent to or inside the ditch channel. Currently, mowing is being phased out from the county ditch maintenance program. The locations of maintained ditches in Union and Delaware Counties are illustrated in Appendix 9.

A switchgrass pilot project was established in 2002 on Tobey Run, a small tributary to Mill Creek. Switchgrass seeds were planted along the ditch banks at a width of 15 feet per bank, for a combined width of 30 feet. Switchgrass filter strips will also be implemented along ditches that require repair or ditches that are petitioned in the future. By buffering sediment and field runoff, switchgrass prevents sediments, phosphorous and atrazine (a drinking water violation) from washing into local streams. Switchgrass also provides habitat for ground nesting birds and small mammals. Although we had hoped for a successful project, we soon realized that we needed greater promotion of the switchgrass program. Landowners, mistaking the switchgrass for weeds, mowed and decimated the plantings. Loading reduction? Switchgrass was donated from Division of Wildlife – the seed costs Division of Wildlife approximately $5/lb. And $30/acre. How many work hours were included.

**Delaware County**
Only two ditches are under county maintenance in Delaware County.

Table 16. Ditches Under County Maintenance.

| Ditch | Watershed | Approximate Maintenance Length | County | Township | Year | Notes |
|---|---|---|---|---|---|---|
| Richardson Ditch | Bokes Creek | N/A | Union | York | 1961 | Consists of a tile outlet - no existing county maintained ditches within the Bokes Creek watershed |
| Beach Open Ditch | Mill Creek | 1 mile | Union | Paris | Unknown | Existing scrub berm stretches greater than 15 feet |
| Blues Creek Ditch | Mill Creek | 7 miles | | Taylor and Leesburg | 1958 | In 2003 - bank stabilization utilizing riprap and switchgrass seed planting is scheduled for 6 miles of Blues Creek. The streambank stabilization will begin at the furthest downstream section of Blues Creek under county maintenance and extend upstream to the beginning of the Blues Creek. One mile of switchgrass filter strips have already been established along the section of Blues Creek from Wolford-Maskill Road to Martin-Welch Road. |
| Dun's Run Ditch | Mill Creek | 6.25 miles | Union | Dover | 1960 | - |
| Long Ditch | Mill Creek | 1 mile | Union | Mill Creek | 1961 | Located in a predominantly residential area |
| Pleasant Road Subdivisio | Mill Creek | 0.25 miles | Union | Dover | 1990 | Primarily a retention basin; mowing is the only maintenance |

| | | | | | | |
|---|---|---|---|---|---|---|
| n Ditch | | | | | | |
| Tobey Run | Mill Creek | 1.50 mile | Union | Liberty | 1973 | Summer 2002 – initiated switchgrass pilot project |
| Willis Ditch | Mill Creek | 0.75 mile | Union | Taylor | 1962 | May be an option for future switchgrass establishment |
| McColloch Ditch | Bokes Creek | 3300 ft. | Logan | Bokes Creek | 1975 | N/A |
| Anderson Ditch | Bokes Creek | 1900 ft. | Logan | Bokes Creek | 1952 | N/A |
| DeGood Ditch | Bokes Creek | 1.94 miles | Delaware | | 1959 | 500 ft of tile – will be dipping out ¼ mile of the ditch in the upper reaches. |
| Wilson-Rosso-Lowe Ditch | Mill Creek | 0.04 miles | Delaware | | 2003 | This is a new ditch that will be going on maintenance in November 2003. Approximately 0.06 miles of waterway and tile are upstream of ditch. 25-foot easements from top of bank planted with fescue and perennial ryegrass. |

- **Environmental Quality Incentives Program**
  In 2002, the Union SWCD received $547,000.00 in Environmental Quality Incentives Program (EQIP) funding for landowners in the Bokes Creek, Mill Creek and Darby Creek watersheds. This funding, to be used as cost share for livestock management and nutrient management practices, will be fully utilized within three years and has the potential to decrease nutrient loadings into local streams by 20%. Priority funding is given to landowners who utilize practices adjacent to Bokes Creek, Mill Creek and Darby Creek.

- **Conservation Reserve Program**
  In addition to EQIP, the Union SWCD has implemented other conservation programs throughout the Bokes Creek and Mill Creek watersheds for many years. The Conservation Reserve Program (CRP) creates conservation buffers on crop- and pastureland and has been established in the Bokes Creek and Mill Creek watersheds for the past 15 years. CRP practices filter runoff to remove sediment and contaminants and improve water quality.

- **Super Conservation Reserve Enhancement Program**
  The Ohio Department of Natural Resources, in partnership with many other conservation organizations, including the Union SWCD, is developing a proposal for a Super Conservation Reserve Enhancement Program (Super CREP) for the 29-county Scioto River watershed, including Bokes Creek and Mill Creek, by December 2002. CREP offers high incentive rates and sign-up bonuses to landowners who voluntarily take cropland out of production and establish conservation practices, such as filter strips, riparian buffers and wetland restoration. The Super CREP proposal merges CRP practices with other Farm Bill programs, and will offer a wide range of practices, from traditional CRP type practices to others that specifically address nutrients (i.e. EQIP).

# Section 3
## Bokes Creek Watershed

## Bokes Creek Watershed

**Overview**
Bokes Creek:

- USGS hydrologic unit: 05060001-060
- State 305(b) identification numbers: OH35-15 and OH35-18

The Bokes Creek watershed envelops 84.2 square miles, or 53,900 acres, in Logan, Union and Delaware Counties. Although **5.74 miles** of the stream **meet water quality standards**, they are considered threatened. As land use changes occur throughout the watershed, the threatened stream section has the potential to become polluted and no longer meet water quality standards. By identifying the Best Management Practices that are currently and effectively implemented in this stream section, they can be promoted throughout the entire watershed. In summary, continue doing what is being done, and apply these practices to the stream section not meeting water quality standards (Ohio EPA, 2002).

Approximately **20.05 miles** reach **partial water quality standards** and **11.71 stream miles** are **not attaining water quality standards** (Table 17). Stream sections that were not monitored totaled 2.40 miles (Ohio EPA, 2002).

With an average slope of 9.7 feet/mile, Bokes Creek flows over 39.7 miles from its headwaters in Logan County across Union County to its confluence with the Scioto River in Delaware County. In the Bokes Creek watershed, the percentage of deciduous land from the headwaters in Logan County to the mouth in Delaware County decreases from 24% to 6% coverage (Ohio EPA, 2001).

Table 17. Stream Characteristics of Bokes Creek Watershed (Ohio EPA, 2001).

| Stream | Length (miles) | Drainage area (square miles) | Designation* |
|---|---|---|---|
| **Bokes Creek** | 39.7 | 84.2 | MWH (RM 37.3 – 35.51)<br><br>WWH (RM 35.5 – mouth) |
| **North Fork West Mansfield Tributary** | 8.8 | 8.8 | MWH (RM 6.1 – 4.51)<br><br>WWH (4.5 – mouth) |
| **West Fork West Mansfield Tributary** | 2.5 | 5.2 | WWH |
| **East Fork West Mansfield Tributary** | 2.67 | 1.6 | WWH |
| **South Branch West Fork West Mansfield Tributary** | 2.40 | 2.8 | WWH |
| **Tributary to Powderlick Run** | 1.77 | | WWH |
| **Powderlick Run** | 5.1 | 3.84 | LRW (River Mile 5.1 – 3.01)<br><br>WWH (River Mile 3.0 – mouth) |
| **Smith Run** | 4.9 | 5.94 | WWH |
| **Brush Run** | 3.2 | 3.38 | WWH |

*Stream designation is described on page 25.

Appendix 5 illustrates the land use within the Bokes Creek watershed:

- Row crop agriculture: 81.0% (primarily corn, soybeans and wheat)
- Grazing land (pasture/hay): 11.6%
- Deciduous forest: 6.5%
- Impervious surface (low intensity residential and commercial/industrial/transportation areas): 0.4%
- Wetlands: 0.4%
- Open water (i.e. lakes and streams): 0.1%

The Bokes Creek watershed is used predominantly for crop-based agriculture, with the percentage of row crop agriculture increasing from 47% in the headwaters of Bokes Creek to 85% near its confluence with the Scioto River (Ohio EPA, 2001). The primary

soil association is Blount-Wetzel-Morley-Pewamo-Milton, and is characterized by nearly level and sloping land, poorly to well drained soils formed on uplands, moderately fine textured glacial till, and seasonally wet. The soils also present major limitations for on-site wastewater treatment systems, even though clusters of septic systems are present in York Center and Magnetic Springs (Soil Survey of Union County, Ohio, 2002). Ten percent of the watershed is considered Highly Erodible Land (Ohio EPA, 2002).

In addition to agriculture, several livestock operations and point source wastewater treatment plants are present within the watershed. The livestock operations include Heartland Egg Farm in eastern Logan County (North Fork West Mansfield Creek), and Daylay and Mad River Egg Farms (Powderlick Run) in Union County. Egg production waste application to agricultural fields is a major contributor of high nutrient levels in the watershed, especially along Powderlick Run and Brush Run. The West Mansfield Wastewater Treatment Plant is a point source plant on Bokes Creek. Waste from the WWTP is land applied, yielding high nutrient runoff rates. Failing on-site septic systems (i.e. York Center and Magnetic Springs) have also contributed to high nutrient levels in Bokes Creek (Ohio EPA, 2001).

Atrazine was found in ten of fourteen sample sites within the Bokes Creek watershed. Although there is no criteria guideline for atrazine, the lowest concentration to show chronic effects to aquatic fish and macroinvertebrates was 20 ug/l. All atrazine concentrations identified at sample sites were 1.0 ug/l or less (Ohio EPA, 2001).

**Critical Areas and Stream Segments**

To better identify the specific pollution sources and causes affecting the Bokes Creek watershed, the watershed has been divided into three stream segments or critical areas:

- **Critical Area A: Headwaters of Bokes Creek to Powderlick Run Confluence** (Figure 4) Bokes Creek originates in hilly Logan County (RM 39.7) and flows into Union County where it meets the Powderlick Run tributary (RM 20.76). The predominant land use within the critical area is agriculture. To aid in accelerating runoff from farm fields, habitat alteration, such as stream channelization and riparian tree removal, is a standard occurrence. Bokes Creek and its tributaries within this critical area are considered

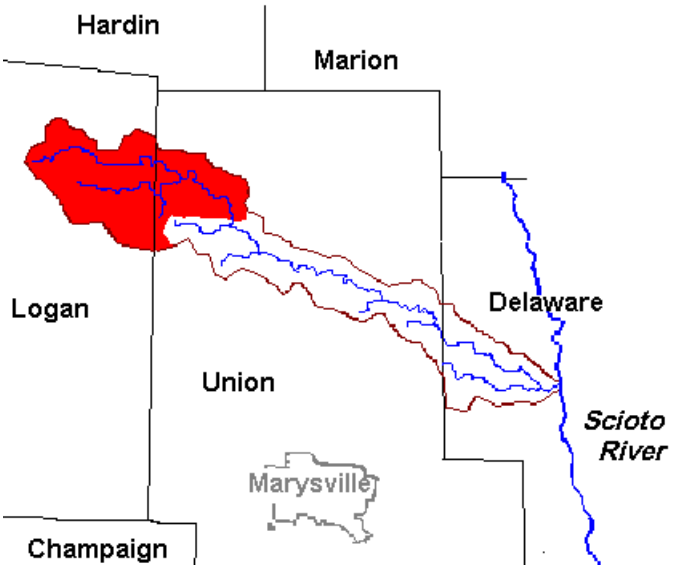



Figure 4. Map of Bokes Creek Critical Area A (Meenach, 2001).

WWH (Tables 18 and 19), with the exception of the headwaters that only meet MWH qualifications (Ohio EPA, 2002).

Several tributaries are located within the critical area:

- **North Fork West Mansfield Tributary** (Logan and Union Counties) – Originates in Logan County and crosses the border of Union County to meet with Bokes Creek. Land application of manure from Weaver's Heartland Egg Farm (eastern Logan County) has probably caused nutrient enrichment.

- **West Fork West Mansfield Tributary** (Logan and Union Counties) – Runoff from the West Mansfield WWTP sprayfield (RM 0.9) contributes to high nutrient levels.

- **South Branch West Fork West Mansfield Tributary** (Logan County) – Dam construction contributes a slight degree of impairment to the tributary.

- **East Fork West Mansfield Tributary** (Union County)

Sources of water quality impairments include:
- Agriculture
- Storm runoff
- Sedimentation
- Septic systems
- Cattle encroachment

Causes of water quality impairment include:
- Nutrients (phosphorous)
- Habitat alteration
- Siltation
- Organic enrichment/low dissolved oxygen
- Flow alteration
- Ammonia

In addition, point sources of pollution include the Heartland/Weaver Egg Farm, sprayfield application at the West Mansfield Wastewater Treatment Plant and the Rockhold Quarry. Ohio EPA issued the Rockhold Quarry an NPDES permit in 2002, which will regulate the discharge for pH and Total Suspended Solids. Although, it appears that Bokes Creek benefits from the increased flow generated by the quarry, and in fact meets water quality standards downstream from the quarry from RM 26.5 – 20.76.

Although this section is meeting water quality standards, Bokes Creek from RM 26.5 – 20.76 (near Yearsley Rd., just upstream of Powderlick Run) is considered threatened. Presently the stream section reaches water quality standards, but nutrients, organic enrichment and sediment from upstream tributaries (i.e. North Fork West Mansfield Tributary), as well as storm runoff may lessen the water quality in the future.

Table 18. Aquatic Life Use Attainment Status of Bokes Creek Sites Sampled From June to October 1999 (Ohio EPA, 2001).

| Bokes Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meet Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 36.3 | MWH | 26 | N/A | Poor | 12.0 | No | SR 292 |
| 35.1 / 35.0 | WWH | 28 | N/A | Fair | 42.5 | No | Dst. Logan Co. Rd. 120 |
| 31.8 / 31.9 | WWH | 28 | N/A | Fair | 47.5 | No | West Mansfield – Mt. Victory Rd. |
| 27.0 / 27.3 | WWH | 34 | 8.6 | Fair | 63.0 | Partial | Dst./Ust. Phelps Rd. |
| 21.3 / 21.2 | WWH | 40 | 8.1 | 36 | 62.5 | Yes | Yearsley Rd. (Ust. Powderlick Run) |

Table 19. Aquatic Life Use Attainment Status of Bokes Creek Tributary Sites Sampled From June to October 1999 (Ohio EPA, 2001).

| Tributary | Designation | IBI | MIwb | ICI | QHEI | Meet Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| West Fork West Mansfield Tributary (RM 1.0) | WWH | 26 | N/A | Marginally Good | 39.0 | No | Ust. SR 47 |
| South Branch West Fork West Mansfield | WWH | - | N/A | Poor | 51.0 | No | Newton-Perkins Rd. near mouth |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Tributary (RM 0.1) | | | | | | | |
| East Fork West Mansfield Tributary (RM 0.3)* | WWH | 20 | N/A | - | - | No | SR 47 |
| North Fork West Mansfield Tributary (RM 5.6) | MWH | 12 | N/A | Poor | 15.0 | No | Farm Rd. off Logan County Rd. 26 |
| North Fork West Mansfield Tributary (RM 3.8 / 4.0) | WWH | 30 | N/A | Poor | 30.5 | No | Co. Rd. 142 |
| North Fork West Mansfield Tributary (RM 1.3) | WWH | 32 | N/A | Fair | 51.0 | No | January Rd. |

* Sampled in 1981.

- **Critical Area B: Powderlick Run: Bokes Creek Tributary**
  Powderlick Run (Figure 5) is a highly channelized tributary to Bokes Creek in Union County. Stretching across five miles, the stream drains almost four square miles of land. According to the Ohio EPA, a 92% reduction in phosphorous and a 67% reduction in ammonia are necessary for the stream to meet water quality standards (2002).

Figure 5. Map of Bokes Creek Critical Area B (Meenach, 2001).

  In 1999, the stream designation from River Mile 5.1 – 3.01 was demoted from WWH to Limited Resource Water (LRW). LRW indicates that the stream cannot support anything but a limited, non-diverse fish and macroinvertebrate community due to very altered habitat conditions that result from human activity. The LRW designation is temporary, and has the potential to be upgraded to WWH if habitat is improved. The remaining section of Powderlick Run, from River Mile 3.0 to the mouth, is still classified as WWH (Table 20).

  One tributary is located within the critical area:

  - **Tributary to Powderlick Run** – Meets Powderlick Run at the Powderlick Run/Bokes Creek confluence. According to the 2002 Bokes Creek TMDL, Mad River Egg Farm experienced an egg wash water spill.

  The sources of impairment that affect the water quality in the Powderlick Run critical area include:

  - Agriculture
  - Storm runoff nutrients from egg farm manure applications
  - Septic systems
  - Sedimentation
  - Cattle encroachment

  The causes of water quality impairments include:

  - Nutrients

- Habitat alteration – In 1999, the downstream reach of stream was dredged and the channel was deepened.
- Organic enrichment/low dissolved oxygen
- Siltation
- Flow alteration

Contaminated runoff from Daylay Egg Farm #1, #2, #3 and Mad River Egg Farm also contribute to the impaired water quality of Powderlick Run.

Table 20. Aquatic Life Use Attainment Status of Powderlick Run Sites Sampled From June to October 1999 (Ohio EPA, 2001).

| Powderlick Run (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 4.8 / 4.8 | LRW | 22 | N/A | Very poor | 31.0 | No | Storms Rd. (Dst. Daylay Farm #3) |
| 3.7 / 3.7 | LRW | 24 | N/A | Poor | 27.0 | Yes | Easternmost Crossing at Davis Rd. (Ust. Daylay Farm #2) |
| 3.4 / 3.3 | LRW | 18 | N/A | Very Poor | 39.5 | No | SR 739 (Dst. Daylay Farm #2 and Ust. Daylay Farm #1) |
| 2.1 | WWH | 24 | N/A | Poor | 45.0 | No | West Crossing at Powderlick Run |
| 1.8 / 1.6 | WWH | 12 | N/A | 0 | 60.5 | No | Ust. Powderlick Run (west of Fawley Rd.) |
| 1.2 | WWH | 0 | N/A | 4 | - | No | Dst. Powderlick Rd. (east of Fawley Rd.) |
| 1.0 / 0.9 | WWH | 18 | N/A | 6 | 23.0 | No | Ust. Cattle farms |

- **Critical Area C: Bokes Creek From the Powderlick Run Confluence to the Scioto River Confluence**
  This critical area (Figure 6) continues from the Powderlick Run confluence (RM 20.76) in Union County until outleting into the Scioto River in Delaware County (RM 0.0). Except for a 4-mile section downstream from Powderlick Run, the stream segment and tributaries in Critical Area C are classified as WWH (Tables 21 and 22) (Ohio EPA, 2002).

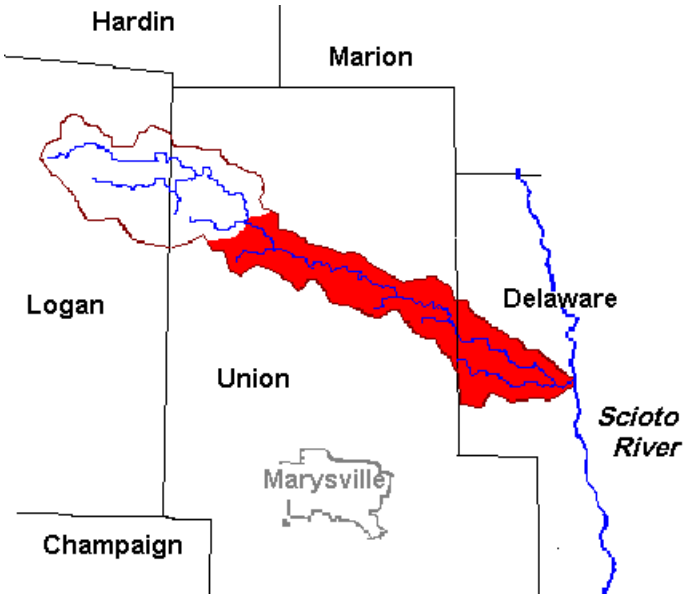



Figure 6. Map of Bokes Creek Critical Area C (Meenach, 2001).

Two tributaries are located within the critical area:

- **Brush Run** (Union County) –
  Characterized by open, unstable streambanks due to riparian removal and/or bank destabilization from unlimited cattle access and/or non irrigated crop production upstream.

- **Smith Run** (Delaware County) – Lower reaches of the stream have better riparian corridor than the upper reaches. Sends high nutrient loads and low oxygenated, poor water quality to Bokes Creek.

In addition, a large quarry is located in the Bokes Creek watershed near the Scioto River confluence. **White Sulphur Lake**, a 39-acre quarry lake owned by the City of Columbus, is used to supplement flows only during extreme drought. The water is pumped from the quarry into the Scioto River approximately once every five years. Twelve miles downstream from White Sulphur Lake, on the Scioto River, is a public water intake for the City of Columbus. The City of Columbus also owns and controls the area surrounding White Sulphur Lake, so development pressure is minimal. The water quality of White Sulphur Lake is listed as Exceptional Warmwater Habitat (EWH) (Ohio EPA, 2002).

The sources of impairment include:

- Agriculture
- Storm runoff nutrient inputs from egg farm manure
- Septic systems
- Sedimentation
- Cattle encroachment

The causes of impairment include:

- Nutrients (phosphorous)
- Siltation
- Organic enrichment/low dissolved oxygen
- Habitat alteration
- Flow alteration

Within this critical area is the unsewered community of Magnetic Springs, the Leesburg-Magnetic School Wastewater Treatment Plant and the Camp Christian Wastewater Treatment Plant. The Leesburg-Magnetic School and Camp Christian are small sanitary waste dischargers, and the cumulative loading from these sources is small. According to the Ohio EPA's 2001 Bokes Creek Technical Support Document, Camp Christian was to apply for a NPDES permit application in 1991; however, it was not until 2002 that an NPDES permit application was obtained. In addition, Leesburg-Magnetic School also obtained an NPDES application in 2002. NPDES permits will be issued by the Ohio EPA for both entities in the near future (Ohio EPA, 2002).

Table 21. Aquatic Life Use Attainment Status of Bokes Creek Sites Sampled From June to October 1999 (Ohio EPA, 2001).

| Bokes Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 20.2 / 20.4 | WWH | 34 | 7.2 | 34 | 58.5 | Partial | Adj. SR 31 (Dst. Powderlick Run) |
| 17.0 / 16.8 | WWH | 31 | 5.7 | Marginally good | 59.5 | No | Ust. Reed Ford Rd. |
| 11.4 | WWH | 42 | 7.2 | Marginally good | 67.5 | Partial | Ust. SR 4 |
| 5.6 / 5.4 | WWH | 31 | 5.9 | Good | 63.0 | Partial | Ust./Dst. Brown Rd. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.2 | WWH | 36 | 6.5 | Marginally good | 63.0 | Partial | Dst. SR 257 |

Table 22. Aquatic Life Use Attainment Status of Bokes Creek Tributary Sites Sampled From June to October 1999 (Ohio EPA, 2001).

| Tributary | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| Brush Run (RM 0.5) | WWH | 24 | N/A | - | 49.0 | No | Yearsley Rd. |
| Smith Run | WWH | 20 | N/A | Fair | 61.5 | No | Brindle Rd. |

**Point Source Dischargers**

Table 23 indicates the point source dischargers to Bokes Creek, listed from furthest upstream to downstream:

- West Mansfield Wastewater Treatment Plant (the wastewater from the treatment system is land applied to a 47 acre spray field)
- Rockhold Quarry
- Leesburg-Magnetic School
- Camp Christian Wastewater Treatment Plant

Appendix 7 illustrates the locations of point source dischargers.

Table 23. Point Source Dischargers in the Bokes Creek Watershed (Ohio EPA, 2002).

| Entity | Receiving Stream (Receiving Mile of Discharge) | Design Flow (MGD) |
|---|---|---|
| West Mansfield Wastewater Treatment Plant | South Branch West Fork West Mansfield Tributary (RM 0.9) | 0.100 |
| Rockhold Quarry | Bokes Creek (RM 25.2) | 0.077 |
| Leesburg-Magnetic School | Bokes Creek (RM 8.0) | 0.001 |
| Camp Christian Wastewater Treatment Plant | Bokes Creek (RM 6.2) | 0.015 |

**Pollutant Spills, Illicit Discharges and Fish Kills**

According to the Ohio EPA, very few reported, unpermitted releases of toxic substances have occurred in the Bokes Creek watershed. Pollutant spills negatively impact fish and aquatic macroinvertebrates. Most likely, only a small percent of spills are reported. Table 24 indicates the five pollutant spills that have occurred in the Bokes Creek watershed during the time period of January 1991 to December 1999. Table 25

portrays four fish kills have occurred, as a result of pollutant spills, from 1980 to 1999 (Ohio EPA, 2001).

Table 24. Pollutant Spills in the Bokes Creek Watershed From January 1991 to December 1999 (Ohio EPA, 2001).

| Date | Stream | Location | Material | Amount |
|---|---|---|---|---|
| 4-14-1991 | Bokes Creek | Adjacent SR 31 (Union County) | Unknown | Unknown |
| 11-10-1992 | Bokes Creek | Yearsley Rd. (Union County) | Fertilizers | Unknown |
| 5-6-1996 | Bokes Creek | Adjacent SR 37 | Unknown | Unknown |
| 2-19-1995 | Tributary to Bokes Creek | Adjacent SR 37 (Union County) | Oil | Unknown |
| 8-5-1998<br>8-6-1998 | Tributary to Powderlick Run | North of Powderlick Run Rd. | Egg wash water | Unknown |

Table 25. Water Pollution and Fish Kill Investigation Reports in the Bokes Creek Watershed From 1980 – 1999 (Ohio EPA, 2001).

| Date | Stream | RM | Number Killed | Cause |
|---|---|---|---|---|
| 6-13-1983 | Tributary to Bokes Creek (Union County) | N/A | 11,376 | Unknown |
| 7-11-1983 | Bokes Creek (Logan County) | N/A | 4,293 | Unknown |
| 7-12-1984 | Tributary to Bokes Creek (Logan County) | N/A | 55 | Unknown |
| 11-10-1992 | Bokes Creek (Union County) | 21.8 – 16.7 | 344 | Fertilizers |

# Previous Studies and Planning Efforts

## Local Concerns and Issues

- **Logjams**
  Flooding due to logjams has been a significant landowner concern for many years. In 1999, the Union SWCD applied for and was denied an Ohio EPA 319 grant to 1) remove logjams, and 2) establish grass and hardwood tree filter strips after logjam removal. The Union SWCD conducted a logjam-mapping project in 2000 to document logjam locations and degree of channel blockage.

  During 2001-2002 steering committee and subcommittee meetings, landowners suggested that severe logjams may potentially impair water quality by 1) increasing erosion and sediment delivery, 2) acting as dissolved oxygen and nutrient sinks, and 3) providing barriers to fish movement. Based upon these statements, the Ohio EPA initiated a water quality monitoring program during Summer 2002 to measure potential water quality impairments associated with logjams. To date, dissolved oxygen levels and degree of stream flow near logjams have been measured. Based upon these measurements, the preliminary Ohio EPA conclusions indicate that logjams do not impair water quality, but in fact improve water quality by 1) decreasing water flow, 2) promoting sediment deposition on the stream bed, 3) oxygenating the water as it cascades over the logjam, and 4) providing habitat. The Ohio EPA further maintains that complete removal of logjams may increase water flow, erosion and flooding downstream (Filc, 2002).

## Water Quality Monitoring

- **City of Columbus, Division of Water**
  Since 1990, the City of Columbus, Division of Water has been measuring the nutrient levels of Bokes Creek at various monitoring sites. The nutrients tested for include nitrates, ammonia, phosphates and phosphorous. In addition to the nutrients previously listed, the City of Columbus began testing atrazine levels in 2000. Regular testing indicates that the nutrient levels (especially nitrates) in Bokes Creek frequently exceed recommended limits for drinking water. Elevated nitrate levels may cause methemoglobinemia, a blood disorder characterized by impaired oxygen transport, which affects fetuses and infants (French, 2002).

- **Ohio Environmental Protection Agency**
  - **Technical Support Document**
    Approximately every five years, the Ohio EPA performs biological, chemical and physical studies on Bokes Creek and its tributaries. The most recent study was conducted in 1999. These studies are completed on a regular basis to document any changes, positive or negative, in the water quality of Bokes Creek.

- **Total Maximum Daily Loads**
  In 1995, the Ohio EPA completed a Total Maximum Daily Load (TMDL) plan on Bokes Creek. However, due to lack of public participation and a Watershed Technician to prepare a watershed action plan, the recommendations of the study were not implemented. The TMDL process was initiated for the second time in the Bokes Creek watershed in 2001.

  In 2002, the second Bokes Creek TMDL was completed simultaneously with the development of the watersheds action plan. During this TMDL, monthly updates and opportunities for feedback were provided to residents and steering committee members of the Bokes/Mill Creek Watershed Partnership.

**Water Quality Improvement Projects**

- **Bokes Creek Project**
  In 1991, the Bokes Creek Project was implemented by the Union SWCD and the Ohio State University Extension Service. The goal of the project was to reduce nitrates and pesticides in the Bokes Creek watershed. The project, focusing on nitrogen application on demonstration plots, attempted to illustrate that crop yields remain the same even when less nitrogen is applied to fields. However, due to inadequate rainfall during the growing season, yields were below average and moisture levels were too low for plants to utilize the supplied nitrogen. Additional plans to reduce nitrate levels by expanding the number of demonstration plots and incorporating manure nutrient management were not completed (Union County OCES and Union SWCD, 1991).

- **Bokes Creek Water Quality Enhancement Project**
  In 2001, the Scioto River Valley Federation, in partnership with the Union Soil and Water Conservation District, the City of Columbus Division of Water, Daylay Egg Farm, Oxbow River and Stream Restoration and the Ohio EPA, received a 319 grant to implement a natural stream channel design project along a section of Powderlick Run, a tributary to Bokes Creek in Union County.

  The project includes: 1) the construction/restoration of a headwater stream tributary to Powderlick Run, 2) the construction of a two-stage channel, 3) the implementation of Best Management Practices (BMPs) throughout the watershed, with an emphasis on Powderlick Run, 4) the chemical water evaluation of the restoration site and 5) the establishment of conservation easements along Powderlick Run. The project began construction in spring 2003, is a demonstration project to accelerate the implementation of other natural stream channel design projects. The project was scheduled for completion in 2005 (Appendix 8).

- **Daylay Egg Farm Conservation Practices**
  The Daylay and Mad River Egg Farms are egg and pullet (hens less than one year old) production facilities that were formed in the Bokes Creek watershed in 1977. Consisting of one pullet and two egg facilities in Raymond (Union County) and two pullet facilities in West Mansfield (Logan County), Daylay Egg Farm generates approximately 1,600,000 eggs per day.

  To address high nutrient levels, Daylay Egg Farm: 1) planted 25 acres of switchgrass filter strips along every Daylay owned section of Powderlick Run and Brush Run, 2) established a manure brokerage program with over 90% of raw manure used out of the Powderlick Run watershed (manure was composted from approximately 1.46 million chickens), 3) decreased all manure application rates to less than or equal to 3 dry ton/acre, 4) eliminated all NPDES dischargers, 5) stopped manure applications on fields with high phosphorous and potassium levels on Daylay property, 6) installed new belt cages at Daylay Farm # 3, 7) installed gravel drain systems along buildings at Daylay Farm # 3 to prevent storm water from becoming contaminated 8) installed grass waterways along Powderlick Run and Brush Run and 9) eliminated the need to produce filter backwash water through adjustments to their watering system.

  In spring 2003, three wetlands and one pond were constructed on Daylay property to collect stormwater runoff from the facility. Together, the wetlands and pond encompass 24 acres.

# Section 4
## Mill Creek Watershed

## Mill Creek Watershed

**Overview**
Mill Creek:

- USGS hydrologic unit: 05060001-070
- State 305(b) identification numbers: OH35-1 and OH35-9

With an average slope of 9.9 feet/mile, the 37-mile Mill Creek watershed drains 178 square miles, or 114,000 acres, in Logan, Union and Delaware Counties. The headwaters of Mill Creek rise in west central Ohio, approximately two miles southeast of Rushsylvania in Logan County, and outlets into the Scioto River at Bellpoint, Ohio in Delaware County. According to the Ohio EPA's 305(b) report, **11.5 miles** of the stream **meet water quality standards**, while **7.3 miles** are **partially meeting water quality standards**. Approximately **1.50 miles** are **not meeting standards**, and the rest of the stream was not assessed (Ohio EPA, 2000). The characteristics of Mill Creek and its tributaries are outlined in Table 26.

Appendix 5 portrays the land use within the Mill Creek watershed:

- Row crop agriculture (primarily corn, soybeans and wheat): 65.4%
- Grazing (pasture/hay): 16.1%
- Forest (i.e. deciduous, evergreen and mixed forest): 14.9%
- Impervious surface (i.e. low and high intensity residential and commercial/industrial/transportation areas): 2.1%
- Wetlands: 0.5 %
- Open water (i.e. lakes and streams): 0.2%
- Barren land (i.e. quarries/gravel pits): 0.1%

133.5 acres of land are protected by the City of Marysville Department of Parks and Recreation. Five city parks are adjacent to Mill Creek, and protect approximately 5.75 miles of stream corridor.

Table 26. Stream Characteristics of Mill Creek Watershed (Ohio EPA, 1995).

| Stream | Length (miles) | Drainage area (square miles) | Use Designation |
|---|---|---|---|
| **Mill Creek** | 37 | 178 | WWH |
| **Blues Creek** | 22.7 | 36.62 | MWH (RM 22.7 – 11.5)<br><br>WWH (RM 11.5 – mouth) |
| **Ronolds Run** | 3 | 1.62 | WWH |
| **Dry Run** | 3.3 | 3.88 | WWH |
| **Grassy Run** | 4.8 | 5.7 | WWH |
| **Dun Run** | 3.8 | 8.86 | WWH |
| **Phelps Run** | 5 | 4.32 | WWH |
| **Crosses Run** | 1.9 | 5.24 | WWH |
| **Otter Run** | 4.4 | 12.3 | WWH |
| **Otter Creek** | 5.8 | 22.4 | WWH |
| **Town Run** | 2.01 | 2.43 | WWH |
| **BMY Tributary** | 5.0 | 4.32 | LRW |
| **North Branch Crosses Run** | 2.10 | ? | WWH |
| **Eagle Creek** | | | - |

The densest tree cover is present in the Mill Creek headwaters in Logan County. Traveling downstream, the forest cover is concentrated in the riparian corridor as agriculture dominates the landscape. Recently, there has been a lot of timber buying activity, resulting in the removal of high value hardwoods, like oaks (Ohio EPA, 2002).

**Critical Areas and Stream Segments**

Like the Bokes Creek watershed, the Mill Creek watershed has been divided into critical areas and/or stream segments to better identify specific pollution sources and causes:

- **Critical Area A: Headwaters of Mill Creek to SR 31 (in Union County)**

The headwaters of Mill Creek to the confluence of Otter Run (RM 23.80) meet full water quality standards for WWH and are not listed as impaired on the Ohio EPA's Total Maximum Daily Load (TMDL) list. However, this stream section is considered threatened; its current attainment of water quality standards could decrease at any time if there are land use changes and/or septage disposal in the watershed. This stream section has historically been quick to recover from pollutant spills and fish kills, so it should be considered threatened but not impaired (Ohio EPA, 1997).

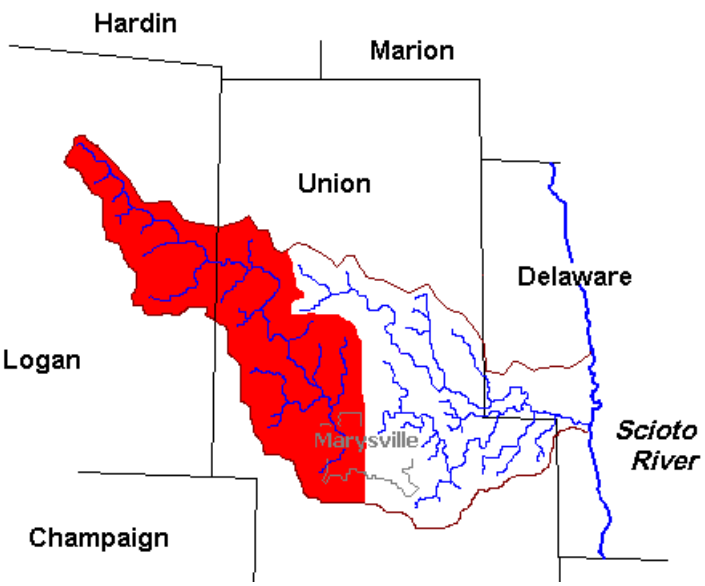



Figure 7. Map of Mill Creek Critical Area A (Meenach, 2001).

The stream section from the confluence of Otter Run (RM 23.80) to SR 31 (approximately RM 20.0) is listed on the Ohio EPA's TMDL list; however, it is currently meeting water quality standards (Table 27). This area is directly upstream of the City of Marysville and may become impacted in the future due to increased development or land use changes.

Since Critical Area A (Figure 7) is currently meeting water quality standards, the Best Management Practices that are currently implemented should be identified and promoted throughout the entire watershed. In summary, continue doing what is being done, and apply these practices to the stream sections not meeting water quality standards.

In 1995, the Ohio EPA conducted a biological and water quality study of the Mill Creek watershed. All study sites upstream of the Marysville intake were found to be fully meeting water quality standards. However, the study also found that fecal coliform counts above the primary contact criterion refer to "waters suitable for full body contact …with minimal threat to public health as a result of water quality". Most of the fecal coliform excedences were associated with point sources, septic ditches, agricultural inputs and other diffuse sources. The locations of the fecal coliform exceedences and the reported values within the protection area are listed in the following table.

Table 27. Fecal Coliform Data of Mill Creek protection areas

| | | | | Primary Contact Standard |
|---|---|---|---|---|
| River Mile | Parameter | Value | Mean | Max |
| 39.2 | Fecal Coliform | 1060/100 ml<br>2700/100 ml | 1000/100 ml | 2000/100 ml |
| 36.1 | Fecal Coliform | 1070/100 ml<br>5800/100 ml | N/A | N/A |
| 28.1 | Fecal Coliform | 7090/100 ml | N/A | N/A |
| 24.7 | Fecal Coliform | 2300/100ml | N/A | N/A |
| 19.4 | Water Plant intake | | N/A | N/A |
| 19.0 | Fecal Coliform | 2300/100 ml | N/A | N/A |

The primary contact criteria is measured as a mean or maximum value. Mean fecal coliform value is 1000 colonies per 100 milliliters (ml). The maximum value is 2000 colonies/ per 100 ml. (Drinking Water Source Assessment for the City of Marysville, 2002). Also during 1995, complaint investigations by the Union County Health Department and Ohio EPA found unsanitary conditions in tributaries to Mill Creek, near Raymond and Peoria. The source of these water quality problems is untreated or partially treated septic discharges.

Tributaries in this critical area include:

- **Otter Creek** (Logan County) – Drains an old glacial lake bed (lake bed area is characterized by poor drainage and the ditching of headwater and intermittent streams) (Ohio EPA, 2002). Lower reaches revealed good quality communities of fish and macroinvertebrates. In 1995, this tributary was visibly impacted by the construction of US 33, west of East Liberty. From County Rd. 145 and the intersection of SR 347 and “old” 33, the stream was constricted between the old and newly constructed road berms (Table 28) (Ohio EPA, 1997).

- **Otter Run** (Union County)

The potential sources of impairment include:

- Agriculture

The potential causes of impairment include:

- Organic enrichment/low dissolved oxygen

Flooding in the Mill Creek headwaters, between Walnut Grove and the intersection of SR 292 and County Road 2, is viewed by many landowners as a serious problem (Ohio EPA, 2002).

Immediately upstream of the Marysville WTP intake, at RM 19.4, a small lowhead dam creates an impoundment from which the Marysville WTP draws water (Ohio EPA, 2002).

Table 28. Aquatic Life Use Attainment Status for Mill Creek Mainstem Sites Sampled From July to September 1995 (Ohio EPA, 1997).

| Mill Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 39.1 / 39.4 | WWH | 43 | 8.1 | 28 | 61.5 | Yes | Ust. Otter Creek |
| 36.1 / 36.0 | WWH | 46 | 8.2 | 40 | 64.0 | Yes | Dst. Otter Creek |
| 28.2 | WWH | 51 | 8.8 | 42 | 71.0 | Yes | Wheeler-Green Rd. |
| 24.8 | WWH | 49 | 8.7 | 40 | 73.0 | Yes | Cotton Slash Rd. |

Table 29. Aquatic Life Use Attainment of Otter Creek From July to September 1995 (Ohio EPA, 1997).

| Otter Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 0.7 | WWH | 45 | N/A | Good | 70.5 | Yes | Dst. US 33 construction |

- **Critical Area B: Mill Creek (east of SR 31) to the Scioto River confluence** (Figure 8)
  During the low flow summer season, this section of Mill Creek is effluent dominated downstream from the City of Marysville. The Marysville Wastewater Treatment Plant contributes the majority of point source loading to Mill Creek. As the plant expands and smaller municipal and industrial discharges are tied into the sewer system and eliminated, the Marysville WWTP will continue to be the primary point source to Mill Creek (Ohio EPA, 2002).

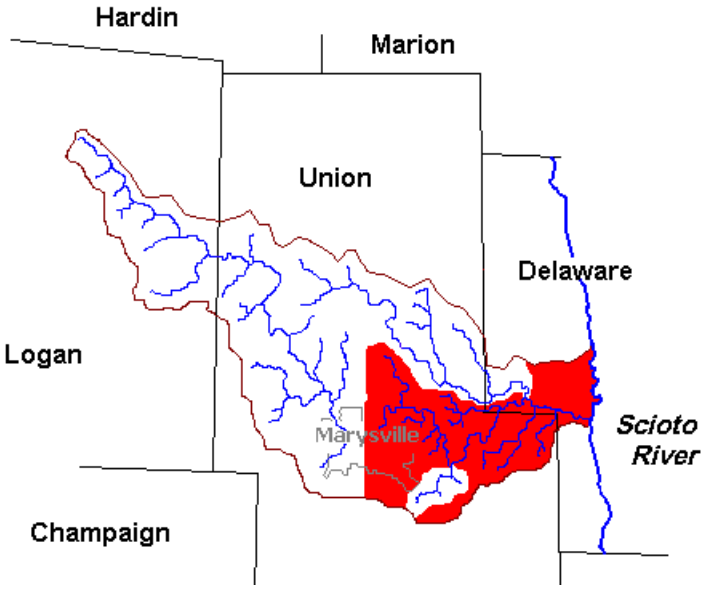



Figure 8. Map of Mill Creek Critical Area B (Meenach, 2001).

  Water quality violations include low dissolved oxygen and high levels of ammonia, total phosphorous and fecal coliform bacteria. Designated a WWH, Mill Creek reaches full attainment of water quality standards to RM 14.6, except for a slight decline to partially meet water quality standards (partial attainment) immediately downstream of Crosses Run (Table 30). The stream improves with increased distance from Crosses Run. From upstream Ostrander to the mouth at the Scioto River, the stream meets water quality standards (Ohio EPA, 2002).

  Tributaries in this critical area include:

  - **Town Run** - Town Run is a tributary that runs directly through the City of Marysville. Approximately 0.3 miles of the stream are culverted and actually flows under buildings. This culverted section acts as a sediment trap and is considered a “hot spot” of sediment contamination. Designated Secondary Contact Recreation, it is recommended that only partial body contact be used in the stream (i.e. wading). Table 31 further illustrates the water quality of Town Run at various sampling sites.

    Three tributaries drain into Town Run:

    - West Branch of Town Run Ditch
    - East Branch of Town Run Ditch
    - Bishop Ditch

Organic enrichment and low dissolved oxygen levels in Town Run were due to failing septic systems in the upper reaches of the stream. The discharges were eliminated when the City of Marysville acquired funding through the State Issue 2 program to initiate sewer service in this area (Ohio EPA, 2002).

- **BMY Tributary –** Designated a LRW habitat due to extensive channelization and small drainage size, heavy metal toxicity from the former BMY Corporation (RM 3.2) caused water quality impairment (Table 32). The BMY discharge was temporary and due to defense buildup prior to the Gulf War in the early 1990's. In the early 1990's, the company closed and will most likely not produce a similar discharge in the future (Ohio EPA, 1997).

  BMY Tributary had been extensively channelized in the 1920's, and again around 1980 Habitat modifications currently affect this tributary, and should be addressed through the watershed action plan (Ohio EPA, 2002).

Except for the Marysville WWTP, most other causes and sources of pollution to Mill Creek have diminished during the past ten years. From 1990 to 1995, sanitary sewer overflow repairs in Marysville (upstream of the WWTP) also improved water quality dramatically (Ohio EPA, 2002).

Sources of impairment:

- Marysville Wastewater Treatment Plant
- Urban runoff/landfills in Marysville

Causes of impairment:

- Organic enrichment/low dissolved oxygen
- Metals
- Priority organics
- Unknown toxicity

A small lowhead dam is present at RM 18.26, immediately upstream of the WWTP (Ohio EPA, 2002).

As development and impervious surfaces increase in the future, stormwater runoff may further impact the stream.

Table 30. Aquatic Life Use Attainment Status for Mill Creek Mainstem Sites Sampled From July to September 1995 (Ohio EPA, 1997).

| Mill Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 19.3 | WWH | 41 | 8.5 | 40 | 74.5 | Yes | Maple St. |
| 19.1 / 19.0 | WWH | 45 | 7.7 | 42 | 70.5 | Partial | Main St. |
| 18.4 /18.6 | WWH | 44 | 7.5 | 40 | 77.0 | Partial | Dst. Town Run |
| 18.2 | WWH | 37 | 6.4 | 16 | N/A | N/A | Marysville WWTP mixing zone |
| 18.1 | WWH | 39 | 6.6 | 18 | 71 | Partial | Cherry St. |
| 16.2 / 16.9 | WWH | 36 | 5.2 | 20 | 63.0 | No | Waldo Rd. |
| 14.6 | WWH | 42 | 8.5 | 44 | 68.0 | Yes | SR 36 |
| 12.0 / 12.1 | WWH | 37 | 8.3 | 42 | 78.5 | Yes | Ust. Crosses Run |
| 11.6 / 11.7 | WWH | 34 | 8.0 | 40 | 74.5 | Partial | Dst. Crosses Run |
| 6.9 | WWH | 38 | 8.6 | Good | 74.5 | Yes | Bellpoint/Hinton Mill Rd. |
| 4.4 | WWH | 49 | 9.7 | 44 | 88.5 | Yes | Ust. Ostrander WTP |
| 3.7 | WWH | 54 | 9.4 | 44 | 81.0 | Yes | Dst. WWTP and Blues Creek |
| 1. 7 / 1.6 | WWH | 51 | 9.6 | 50 | 91.0 | Yes | Near mouth |

Table 31. Aquatic Life Use Attainment Status for Town Run Sites Sampled From July to September 1995 (Ohio EPA, 1997).

| Town Run (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 0.9 / 0.8 | WWH | 26 | N/A | Fair | 45.5 | No | Ust. Eljer Plumbingware |
| 0.7 | WWH | 30 | N/A | Fair | 53.5 | No | Dst. Eljer Plumbingware |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.1 | WWH | 28 | N/A | Poor | 60.5 | No | Dst. Marysville urban |

Table 32. Aquatic Life Use Attainment Status for BMY Tributary Sites Sampled in 1990 (Ohio EPA, 1997).

| BMY Tributary (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 3.4 | LRW | 12 | N/A | - | - | No | Ust. BMY Corp. |
| 3.3 | LRW | 16 | N/A | Very poor | - | No | Dst. BMY Corp. |
| 3.3 | LRW | 12 | N/A | Very poor | 27 | No | At US 33 Rest Area |

- **Critical Area C: Crosses Run: Mill Creek Tributary** (Figure 9)
  The Scotts Company, a lawn care product manufacturer, is located on Crosses Run in Marysville. Historically, there have been numerous NPDES permit violations, storm water contamination, ammonia and pesticides contamination. In recent years, corrective measures have been initiated to prevent additional pollution to the stream. Table 33 outlines the water quality of various segments of Crosses Run.

Figure 9. Map of Mill Creek Critical Area C (Meenach, 2001).

Other tributaries within the critical area include:

- **North Branch Crosses Run –** With most of the watershed located on the Scotts Co. property, the causes and sources of impact in this stream are similar to those found in Crosses Run, including high levels of ammonia, pesticides and organic enrichment. Designated as Secondary Contact Recreation, North Branch Crosses Run is a small tributary that lacks deep pools, except when the North water dam (a spill control impoundment) is closed. A sanitary discharge to the stream was eliminated in 1998 by tying into the Marysville WWTP (Ohio EPA, 2002). The water quality of North Branch Crosses Run is shown in Table 34.

Sources of impairment:

- Scotts Company (plant operations and inadequate environmental controls)

Causes of impairment:

- Organic enrichment/low dissolved oxygen
- Pesticides
- Ammonia

Table 33. Aquatic Life Use Attainment for Crosses Run Sampling Sites during July to September 1995 (Ohio EPA, 1997).

| Crosses Run (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 2.8 | WWH | 12 | N/A | Poor | 28.0 | No | At Dairy Farm |
| 2.4 | WWH | N/A | N/A | 4 | N/A | No | Ust. Trib. / Water Dam |
| 2.1 / 2.0 | WWH | 12 | N/A | 0 | 42.5 | No | Dst. Scotts Co. |
| 0.9 / 0.6 | WWH | 12 | N/A | 6 | 73.5 | No | Dst. North Fork Crosses Run |

Table 34. Aquatic Life Use Attainment Status for North Branch Crosses Run Sampling Sites From July to September 1995 (Ohio EPA, 1997).

| North Branch Crosses Run (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 1.0 | WWH | 12 | N/A | Poor | 45.0 | No | Ust. Scotts Co. |
| 0.2 / 0.1 | WWH | 14 | N/A | 0 | 30.5 | No | Dst. Scotts Co. |

- **Critical Area D: Blues Creek** (Figure 10)
  Designated a MWH, the upper reaches of Blues Creek (upstream of SR 4) are under ditch maintenance. Downstream of SR 4, Blues Creek is not under channel maintenance and is classified a WWH (Table 35).

  Negative impacts result from agricultural land usage, siltation and past habitat alteration. The lower 2-3 miles of stream are characterized by high gradient substrates composed of boulder, cobble and exposed bedrock. Unrestricted cattle access and sediment deposition also occur in the watershed (Ohio EPA, 2002). The water quality of Blues Creek only meets water quality standards when it reaches the Village of Ostrander.

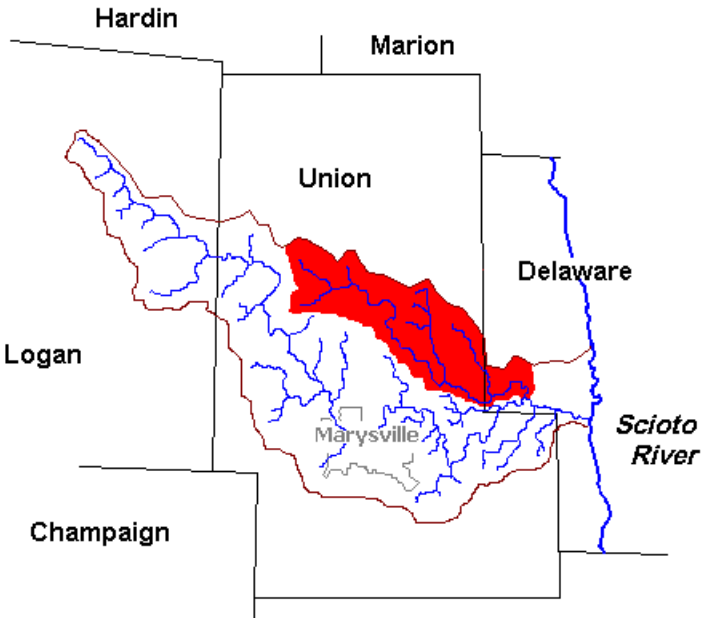


Figure 10. Map of Mill Creek Critical Area D (Meenach, 2001).

  Sources of impairment:

- Channelization
- Non irrigated crop production

Causes of impairment:

- Habitat alteration (channelization and removal of riparian vegetation)
- Organic enrichment/low dissolved oxygen

Before the construction of the Ostrander WWTP in the 1990's, Blues Creek received discharges from the unsewered Village of Ostrander. The Ostrander WWTP now dischargers directly to Mill Creek at RM 4.05 in Delaware County.

Table 35. Aquatic Life Use Attainment Status for Blues Creek Sampling Sites in 2001 (Ohio EPA, 2002).

| Blues Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 19.6 | MWH | 28 | N/A | - | 19.5 | Yes | SR 31 |
| 12.0 | MWH | 28 | N/A | - | 40.5 | Yes | SR 4 |
| 10.1 | MWH | 32 | N/A | - | 42 | No | Leeper Perkins Rd. |
| 6.7 / 6.6 | MWH | 28 | 5.3 | Good | 51 | No | Springdale Rd. |
| 4.7 | MWH | 26 | 6.6 | - | 64 | No | Blues Creek Nature Preserve |

**Point Source Dischargers**
The Ohio EPA indicates the following entities are the point source dischargers in the Mill Creek watershed (Tables 36 and 37) (Ohio EPA, 2002):

- **Municipal Wastewater Dischargers**

  - City of Marysville Wastewater Treatment Plant
  - Village of Ostrander Wastewater Treatment Plant
  - Mill Creek Estates Subdivision Wastewater Treatment Plant
  - Parrott Village Subdivision Wastewater Treatment Plant
  - ODOT Park No. 6-4 Wastewater Treatment Plant
  - Dover Estates Mobile Home Park Wastewater Treatment Plant

- Union County Home Wastewater Treatment Plant

Table 36. Municipal Wastewater Dischargers in the Mill Creek Watershed (Ohio EPA, 2002).

| Municipal Wastewater Dischargers | Receiving Stream (RM of discharge) | Amount of Flow (MGD) | Annual 2001 Average Flow (MGD) |
|---|---|---|---|
| City of Marysville Wastewater Treatment Plant | Mill Creek (RM 18.26) | 4.0 | 3.43 |
| Village of Ostrander Wastewater Treatment Plant | Mill Creek (RM 4.05) | 0.090 | 0.033 |
| Mill Creek Estates Subdivision Wastewater Treatment Plant | Mill Creek (RM 12.57) | 0.105 | 0.133 |
| Parrott Village Subdivision Wastewater Treatment Plant | Phelps Run (RM 15.29 and 4.0) | 0.020 | 0.015 |
| ODOT Park No. 6-4 Wastewater Treatment Plant | Unnamed Tributary to Mill Creek (RM 9.3 and 2.3) | 0.010 | 0.0028 |
| Dover Estates Mobile Home Park Wastewater Treatment Plant | Unnamed Tributary to Dun's Run (RM 5.5 and 3.7) | 0.025 | 0.027 |

- **Industrial Wastewater Dischargers**

  - City of Marysville Water Treatment Plant
  - Ray Lewis and Sons, Inc.
  - Nestle Foods, Inc.
  - General Industries – Plastek
  - Northwoods Stone & Asphalt Co.
  - United Rotary Brush
  - Goodyear
  - BMY – Wayne Wheeled Vehicles
  - The Scotts Company

Table 37. Industrial Wastewater Discharges in the Mill Creek Watershed (Ohio EPA, 2002).

| Industrial Wastewater Dischargers | Receiving Stream (RM of discharge) | Annual 2001 Mean Flow (MGD) |
|---|---|---|
| City of Marysville Water Treatment Plant | Mill Creek (RM 19.05) | 0.0 |
| Ray Lewis and Sons, Inc. | Mill Creek (RM 18.41) | 0.006 |
| Nestle Foods, Inc. | Mill Creek (RM 18.9) | 0.04 |
| General Industries – Plastek | Unnamed Tributary to Mill Creek (RM 13.84) | 0.0 |
| Northwoods Stone & Asphalt Co. | Unnamed Tributary to Mill Creek (RM 3.35 and 2.62) | 0.29 |
| United Rotary Brush | Phelps Run (RM 15.29 and 2.8) | 0.0014 |
| Goodyear | Unnamed Tributary to Crosses Run (RM 11.83 and 2.05) | 0.0 |
| BMY – Wayne Wheeled Vehicles | BMY Tributary (RM 9.3 and 3.2) | 0.0 |
| The Scotts Company | Crosses Run via unnamed tributary<br><br>North Branch Crosses Run | 0.0001<br><br>0.025 |

Appendix 7 illustrates the point source dischargers in the Mill Creek watershed.

**Pollutant Spills, Illicit Discharges and Fish Kills**

Pollutant spills negatively impact fish and aquatic macroinvertebrates. Most likely, only a small percent of spills are reported. Table 38 indicates the pollutant spills that occurred in the Mill Creek watershed during the time period of January 1995 to July 2001 (Ohio EPA, 1997; Ohio EPA, 2002).

Since the late 1970s, stream monitoring in the upper reaches of Mill Creek have yielded good water quality conditions. The generally good water quality has helped the stream recover after each pollutant spill. If the number of spills increase, the water quality could become impaired in the future.

In 1997, sampling performed by the Ohio EPA on Town Run discovered very high levels of DDT (dichlorodiphenyltrichloroethane) in sediments, suggesting either illegal disposal or use of the banned pesticide (Ohio EPA, 2002). DDT, a chemical pesticide used to eliminate disease carrying and crop-eating insects. was banned in 1973. DDT was

discovered to cause dysfunction in wildlife reproduction, such as thin egg shells in birds (Microsoft Encarta Online Encyclopedia, 2002).

Table 38. Pollutant Spills in the Mill Creek Watershed From January 1995 to July 2001 (Ohio EPA, 1997; Ohio EPA, 2002).

| Date | Stream | Location | Material | Amount |
|---|---|---|---|---|
| 2-26-95 | Mill Creek | Marysville WWTP | Sludge | 1000 gallons |
| 3-6-95 | Mill Creek | Marysville WTP | Lime Sludge | 1000 gallons |
| 3-9-95 | Unnamed Creek | Conrail | Diesel Fuel | 2000 gallons |
| 3-9-95 | Mill Creek | Raymond and Peoria | Sewage | Unknown |
| 5-23-95 | Blues Creek | Leeper Farms | Fertilizer | 1000 gallons |
| 6-29-95 | Crosses Run and Mill Creek | Scotts Co. | Fertilizer | Unknown |
| 9-19-95 | Mill Creek | Nestle R&D | Milk | Unknown |
| 7-14-00 | Upper reaches of Mill Creek | RM 38.0 (near Logan – Union County border) | Non-composted poultry manure | Unknown |
| 7-00 | Tributary to Mill Creek | RM 27.2 (Between Wheeler-Green Rd. and Cotton Slash Rd.) | Livestock manure | Unknown |

**The Scotts Company**

The Scotts Co., a producer of lawn care products (i.e. fertilizers), is headquartered in Marysville, OH. Their facilities are located along Crosses Run and North Branch to Crosses Run, tributaries to Mill Creek downstream of the corporation limits of the City of Marysville. Since 1995, Scotts Co. has implemented various practices to improve the water quality of North Branch Crosses Run and Crosses Run. To reduce sediment loading, the North Branch Crosses Run was routed through a new fire/sedimentation pond in 1997. Measuring 850,000 cubic feet, the fire/sedimentation pond collects approximately 60% of the stormwater from the Scotts Co. facility. The fire/sedimentation pond also provides some retention time for ammonia decay (Black, 2002).

Five sanitary treatment package plants were removed from Crosses Run and redirected to the Marysville WWTP in August 1998. To improve nutrient water management at the facility, Ponds 4 and 4A were closed by December 1999, and Ponds 5 and 5A were closed by November 2000. Landfill 3 was closed during May 2001, which removed stream sediment from a 400 feet section of Crosses Run. Pond 3 was closed in December 2001. Also in 2001, Scotts Co. eliminated a non-contact cooling water discharge to the North Branch Crosses Run (Black, 2002).

Scotts Company entered into a Consent Agreement with the State of Ohio to address the causes of stream impairment. The Consent Agreement will address impairment that is due to past practices, such as disposal of waste products, material in on-site landfills or on field broadcast areas, as well as present impairments due to stormwater runoff from the active manufacturing facilities. (Ohio EPA, 2002).

**Eljer Plumbingware**

Copper, lead and zinc contamination to Town Run were caused by the Eljer Plumbingware hazardous waste site. The site was capped and transformed into a city park in December 1999, which would eliminate the severity of heavy metals contamination (Ohio EPA, 2002).

**Ray Lewis and Sons, Inc.**

A metal plating company, Ray Lewis and Sons manufacturers plumbing fixtures from aluminum, chromium, copper, magnesium, nickel and zinc. Toxic levels of metals from process wastewater were discharged to Mill Creek in the 1970s and 1980s before being redirected to the Marysville WWTP in 1989 (Ohio EPA, 1997).

# Previous Studies and Planning Efforts

## Local Concerns and Issues

- **Town Run Flooding**

  In 2002, a $50,000 Town Run Study was completed to address flooding issues in the City of Marysville. Town Run normally receives four million gallons of water; however, during rains it receives ten million gallons or more. Dye tests were conducted to identify illegal sanitary sewer connections, with numerous violations discovered. The Ohio Reformatory for Women alone had four violations (Horns, 2002).

  The Study suggests that the City of Marysville develop a stormwater master plan to outline, estimate the cost of and schedule stormwater projects. In the future, the City of Marysville will form a storm water utility, where residents will be charged on a per house basis for the amount of impervious surface they occupy (Horns, 2002).

  An impervious surface is any surface (i.e. driveways, buildings, patios, sidewalks) that does not allow water to seep through to the soil below. The velocity of storm water runoff carrying sediments, nutrients, and pollutants to streams increases. This not only affects water quality but also can increase flooding and erosion.

  Money collected from the utility will be used to address storm water issues. Beginning in 2003, five to seven retention basins will be created to store excess water (Horns, 2002).

## Water Quality Monitoring

- **Ohio Environmental Protection Agency**
  - **Technical Support Document**

    Approximately every five years, the Ohio EPA performs biological, chemical and physical studies on Mill Creek and its tributaries. The most recent study was conducted in 1996. These studies are completed on a regular basis to document any changes, positive or negative, in the water quality of Mill Creek.

- **Total Maximum Daily Load**

  The Ohio EPA's TMDL process was initiated in Mill Creek in 2001. The TMDL process identifies sources of pollution and designs clean up plans. The TMDL, developed simultaneously with the watersheds action plan, is a written plan to improve the water quality of Mill Creek to meet water quality standards. Monthly TMDL updates and opportunities for feedback were provided to residents and steering committee members of the Bokes/Mill Creek Watershed Partnership.

- **City of Columbus, Division of Water**
  Since 1990, the City of Columbus, Division of Water has been monitoring nutrient levels in Mill Creek at various sites. The nutrients tested for include nitrates, ammonia, phosphates and phosphorous. In addition to the nutrients previously listed, the City of Columbus began monitoring atrazine levels in 1999.

- **Ohio Department of Natural Resources, Division of Water**
  Appendix 11 documents all Ohio observation wells monitored by the Ohio Department of Natural Resources, Division of Water. Two observation wells are monitored in the Mill Creek watershed (Union County) to determine fluctuations in ground water from precipitation, a potential overuse of the water and a decrease in well efficiency. Maximum well water levels are measured at hourly readings. Since February 1973 and September 1991, respectively, well water depths have been monitored in Peoria and in East Liberty.

**Water Quality Improvement Projects**

- **City of Marysville, Department of Parks and Recreation**
  In 2002, the City of Marysville, Department of Parks and Recreation requested funding to install a multi-purpose trail along Mill Creek, which would connect 3 parks, and to install canoe launches/take-outs along Mill Creek. The plan also included the planting of trees to increase the width of the riparian zone along Mill Creek.

- **Marysville Water Treatment Plant**
  The Marysville Water Treatment Plant utilizes water from Mill Creek and/or four wells to serve 15,942 people (4,042 service connections). The capacity of the stream and well water is approximately 6.5 million gal/day, although the capacity of the WTP is only 3.17 million gallons/day. On average, the Marysville WTP currently produces 1.5 million gal/day for Marysville and unincorporated communities and industries located in central Union County (Ohio EPA, 2000; Ohio EPA, 2002).

  The Marysville WTP draws water from the impoundment caused by a small lowhead dam, immediately upstream of the water plant intake (Ohio EPA, 1997).

  The water treatment processes include rapid mixing, flocculation, primary settling, recarbonation, secondary settling, sand filtration and chlorination. Supernatant from the lime sludge lagoon is released into Mill Creek, while all sludge generated at the plant is treated at the Marysville WWTP (Ohio EPA, 2000).

  A Consumer Confidence Report, distributed annually to residents by the WTP, identifies the source of drinking water, lists the contaminants detected and their

probable sources, and any associated health risks when violations occur. From January 1, 1991 to December 23, 1999, the WTP had no health based or Maximum Contaminant Level (MCL) violations. On two occasions though, the atrazine level did exceed the MCL concentration of 0.003 mg/l. The first was on June 27, 1995 at .00579 mg/l and the other on June 22, 1998 at .00424 mg/l (Ohio EPA, 2002).

Since 1997, the Marysville WTP has been monitoring levels of atrazine in Mill Creek. When atrazine levels are high, water treatment costs increase. To counteract the atrazine-rich water quality, one of two practices is conducted: 1) well water is blended with stream water to dilute the atrazine, or 2) only well water is used until atrazine levels in stream water decrease (Per communication, Fred McCreary, WTP Supervisor).

The City of Marysville utilizes ground water from four water supply wells (Table 39). The wells are lined with limestone bedrock, and due to the hardness of the ground water, are typically used in the summer months to supplement the water obtained from Mill Creek.

Table 39. Drinking Water Well Data (Ohio EPA, 2002).

| Well | Total Depth (feet) | Pump Capacity (gal/min) | Date Drilled |
|---|---|---|---|
| #1 Plant Well | 75 (approximate) | 1000 | Unknown |
| #2 Lagoon Well | 206 | 900 | 1975 |
| #3 Dam Well | 200 | 700 | 1966 |
| #4 | 232 | 500 | Unknown |

The Comprehensive Plan for Union County (1999) suggests that wellhead protection legislation be adopted and implemented to protect sources of drinking water. The comprehensive plan also calls for stricter drinking water standards and protection of Mill Creek as a source of drinking water.

In January 2002, the Union SWCD Board of Supervisors made a recommendation to the Ohio Department of Agriculture to limit the potential for drinking water contamination. The recommendation included the establishment of 1) a no-manure application area for a 500-foot semi-circle above the water plant intake and, 2) a no-manure application area for a 100-foot radius below the intake.

- **Source Water Assessment and Protection (SWAP)**
  In 2002, the Ohio EPA and the Marysville WTP conducted a SWAP study, identifying drinking water protection areas and outlining how to reduce the risk of contamination (Ohio EPA, 2002). The SWAP area consists of the entire Mill Creek watershed upstream of the water plant intake, which is located about 19 miles from the mouth of Mill Creek (Appendix 12). The

Drinking Water Source Protection Area is the area that, if a contaminant spill or leakage occurs, may travel through the watershed and reach the water plant intake.

The Protection Area is divided into:

- **Corridor Management Zone** – Area within 1,000 feet of each streambank of Mill Creek, starting from the water plant intake and extending to the location where SR 347 crosses the stream (about 10.6 miles along the stream). The corridor management zone consists of Mill Creek and its tributaries downstream from Raymond. The width of the corridor management zone along tributaries is 500 feet from each streambank, and the length is 10 miles from the water plant intake.
    - There are 30 road crossings and eight railroad crossings within the corridor management zone.

- **Emergency Management Zone** – Area in the immediate vicinity of the water plant intake in which the public water system operator has little or no time to respond to a spill.
    - There are eight road and railroad crossings within the emergency management zone.

The entire Protection Area has 149 miles of roads, 15.4 miles of railroads, for a total of 115 road and 12 rail crossings of Mill Creek or its tributaries. The Protection Area for Marysville covers 80 square miles, and is characterized as:

- 76% agriculture and lawns
- 22% wooded
- 1% shrub
- 0.6% wetlands
- 0.4% urban/impervious
- 0.3% open water
- 0.09% barren

Surface water is more prone to contamination than ground water, and the Marysville water system is considered to have a moderately high risk of contamination. Threats to surface water include: 1) runoff from row crop agriculture, 2) old, failing or unmaintained septic systems along Mill Creek, 3) new housing and commercial development that could increase runoff from roads and parking lots (i.e. metals, oils, grease, nutrients and pathogens), and 4) numerous road and rail bridges over the stream (Ohio EPA, 2002).

Stream water use may also be limited due to high turbidity or elevated concentrations of herbicides and pesticides. Fifty-nine potential contaminant sources are found in the source water protection area. Of the 59 potential contaminant sources present in the protection area, twenty of the sources are within the corridor management zone and five are within the emergency management zone (Ohio EPA, 2002).

According to the Ohio EPA (2002), surface water protection should focus on:

- Controlling septic systems, agriculture and urban runoff (with special attention to nitrates, herbicides and fecal bacteria)
- BMPs
- Preserve and restore wooded riparian areas in the protection area
- Coordinate with local emergency response agencies to detect and respond to spills and include procedures to notify the WTP
- Coordinate with Mill TMDL

Wells of ground water are protected by approximately 40 feet of clay. To protect well water, any unused and improperly sealed wells (i.e. leaking underground storage tanks) should be located (Ohio EPA, 2002).

- **Mill Creek Reservoir**
  The City of Marysville purchased land within the Mill Creek watershed to construct an off-stream public reservoir. With construction scheduled to begin in 2004, the reservoir will occupy 140 acres (Per communication, Dan Fogt, Marysville City Council). Once the reservoir is constructed, the drinking water supply will be based entirely on surface water, and the wells will only be used for emergency backup (Ohio EPA, 2002). Water will be drawn from Mill Creek at medium stream flow to fill and maintain the depth of the reservoir, and then will be transported from the reservoir to the Marysville WTP for processing (Per communication with Fred McCreary, Marysville WTP).

- **Mill Creek Signs**
  Twelve signs identifying Mill Creek as a source of drinking water were positioned at 6 different road crossings along the stream. The signs will serve to increase public awareness of streams as sources of drinking water.

- **Marysville Wastewater Treatment Plant**
  Built in 1954, the Marysville Wastewater Treatment Plant expanded to its current size in 1989. Designed for flows of 4.0 million gallons per day, basic treatment processes at the plant include primary settling, aeration, intermediate and final settling, tertiary filters and disinfection with post aeration before discharging to

Mill Creek. In April 1995, the WWTP increased its capacity to process sludge by constructing two belt filter presses for de-watering sewage and lime sludge (generated at the Marysville WTP) (Ohio EPA, 1997).

To better accommodate the growing population and address a persistent odor originating from the Marysville WWTP, plant officials are examining two possibilities: 1) expanding the current WWTP, 2) or building a new plant outside of town. An engineering study was completed in January 2003 to explore both options, although a facility will not be constructed for at least four to five years. For the time being, the WWTP has enacted a new treatment system to decrease the odor. By not allowing the waste to sit in tanks and settle, there is less opportunity for the sludge to become stagnant and create odors. Now, the sludge is transported directly to the Marion landfill within one week of being processed, when in the past, the sludge may have stayed at the WWTP for up to four months until the waste could be utilized as crop fertilizer by farmers. In addition, a study to introduce new chemicals at the WWTP to decrease odor has been initiated, although specific results have not been determined. Another odor-decreasing action includes the development of a new enclosed building for sludge storage and transfer in 2003. By preventing the sludge from getting wet, less smell will be generated (Marysville Journal-Tribune, 2002).

The Comprehensive Plan for Union County also outlines a goal for complying with NPDES permit limits for treated wastewater (1999).

# Bokes Creek Watershed Action Plan

## Bokes Creek Watershed

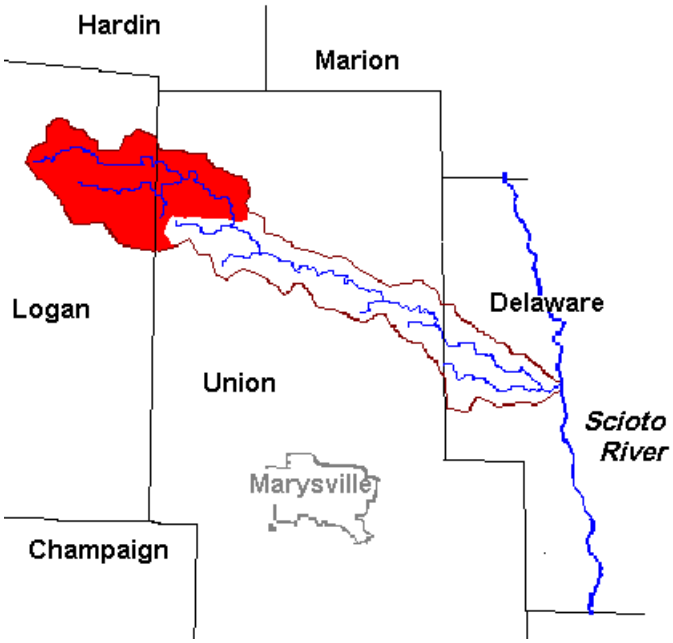
The Bokes Watershed Action Plan explains the causes of the sources of impairments. Restoration and protection goals are then determined specifically for the cause and source of impairment to the water quality of Bokes Creek. Action items are the specific tasks outlined to protect and restore Bokes Creek from the causes and sources of impairments. These items are organized according to smaller sections of the Bokes Watershed; Critical Area A, Critical Area B, and Critical Area C. Each critical area has a specific set of water quality concerns, which are addressed by the action items to be implemented.

Impairments to Bokes Creek are determined by local stakeholder input, Bokes/Mill Creek Watershed Partnership, City of Columbus, and assessments performed by Ohio EPA such as the TMDL. The restoration/protection goals and action items have been developed by the Bokes/Mill Creek Watershed Partnership. The Partnership works to ensure that the action items are effective, realistic, and achievable. The action items were developed to be acceptable to watershed stakeholders. Prioritization of action items for protection and restoration will include a preliminary assessment of soils using Natural Resources Conservation Service's (NRCS) Soil Survey Geographic (SSURGO) Database. SSURGO Soil Data Mart will be used when implementing water quality restoration or protection projects.

Public involvement and outreach is considered a high priority in achieving these action items for improved water quality of Bokes Creek. Planned educational activities

will be utilized to promote adoption of BMPs.  Major educational events include Equine Environmental Liability and Awareness Program, Septic System workshops, Groundwater/Well workshops, Source Water Environmental Education Team (SWEET) programs, Rain Garden tours/workshops, Crosses Run Stream Restoration tours/presentations, and Powderlick Run Stream Restoration tours/presentations. Indicators of success with educational events are an increase of understanding and awareness, leading to a change in behavior.

Critical Area A - Headwaters of Bokes Creek to Powderlick Run




## Physical Description:

Bokes Creek originates in hilly Logan County (RM 39.7) and flows into Union County where it meets the Powderlick Run tributary (RM 20.76). The predominant land use within the critical area is agriculture. To aid in accelerating runoff from farm fields, habitat alteration, such as stream channelization and riparian tree removal, is a standard occurrence. Bokes Creek and its tributaries within this critical area are considered WWH, with the exception of the headwaters that only meet MWH qualifications (Ohio EPA, 2002).

Several tributaries are located within the critical area:

- **North Fork West Mansfield Tributary** (Logan and Union Counties) – Originates in Logan County and crosses the border of Union County to meet with Bokes Creek. Land application of manure from Weaver's Heartland Egg Farm (eastern Logan County) has probably caused nutrient enrichment.

- **West Fork West Mansfield Tributary** (Logan and Union Counties) – Runoff from the West Mansfield WWTP sprayfield (RM 0.9) contributes to high nutrient levels.

- **South Branch West Fork West Mansfield Tributary** (Logan County) – Dam construction contributes a slight degree of impairment to the tributary.

- **East Fork West Mansfield Tributary** (Union County)

  Sources of water quality impairments include:
- Agriculture
- Storm runoff
- Septic systems
- Cattle encroachment

  Causes of water quality impairment include:
- Nutrients (phosphorous)
- Habitat alteration
- Organic enrichment/low dissolved oxygen
- Flow alteration
- Ammonia

In addition, point sources of pollution include the Heartland/Weaver Egg Farm, sprayfield application at the West Mansfield Wastewater Treatment Plant and the Rockhold Quarry. Ohio EPA issued the Rockhold Quarry an NPDES permit in 2002, which will regulate the discharge for pH and Total Suspended Solids. Although, it appears that Bokes Creek benefits from the increased flow generated by the quarry, and in fact meets water quality standards downstream from the quarry from RM 26.5 – 20.76.

Although this section is meeting water quality standards, Bokes Creek from RM 26.5 – 20.76 (near Yearsley Rd., just upstream of Powderlick Run) is considered threatened. Presently the stream section reaches water quality standards, but nutrients and organic enrichment from upstream tributaries (i.e. North Fork West Mansfield Tributary), as well as storm runoff may lessen the water quality in the future.

**Summary**

Bokes Creek (River Miles 39.7 to 20.76) is not meeting water quality standards due to excessive nutrients and habitat alteration. The short-term goal (within five years) is 30% reduction of in-stream phosphorous, nitrate, total suspended solids, atrazine, and a 30% increase in habitat. The ultimate goal (within ten years) is for this critical area to meet water quality standards for drinking water. Through various conservation programs (i.e. CRP, CREP), habitat such as warm season grass filter strips and wetlands will be established.

Target scores will be based on QHEI scores, the Ohio EPA's measure of habitat. The QHEI target score for Warmwater Habitats is 60, while the current QHEI score for this critical area is 34.

QHEI evaluates the physical characteristics of a stream segment, and measures 1) substrate (what stream bed is composed of), 2) in-stream tree cover, 3) riparian characteristics, 4) stream channel characteristics, 5) pool/riffle quality, and 6) stream gradient and drainage area.

Aquatic Life Use Attainment Status of Bokes Creek Sites Sampled From June to October 1999 (Ohio EPA, 2001).

| Bokes Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meet Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 36.3 | MWH | 26 | N/A | Poor | 12.0 | No | SR 292 |
| 35.1 / 35.0 | WWH | 28 | N/A | Fair | 42.5 | No | Dst. Logan Co. Rd. 120 |
| 31.8 / 31.9 | WWH | 28 | N/A | Fair | 47.5 | No | West Mansfield – Mt. Victory Rd. |
| 27.0 / 27.3 | WWH | 34 | 8.6 | Fair | 63.0 | Partial | Dst./Ust. Phelps Rd. |
| 21.3 / 21.2 | WWH | 40 | 8.1 | 36 | 62.5 | Yes | Yearsley Rd. (Ust. Powderlick Run) |

Aquatic Life Use Attainment Status of Bokes Creek Tributary Sites Sampled From June to October 1999 (Ohio EPA, 2001).

| Tributary | Designation | IBI | MIwb | ICI | QHEI | Meet Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| West Fork West Mansfield Tributary (RM 1.0) | WWH | 26 | N/A | Marginally Good | 39.0 | No | Ust. SR 47 |
| South Branch West Fork West Mansfield Tributary (RM 0.1) | WWH | - | N/A | Poor | 51.0 | No | Newton-Perkins Rd. near mouth |
| East Fork West | WWH | 20 | N/A | - | - | No | SR 47 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mansfield Tributary (RM 0.3)* | | | | | | | |
| North Fork West Mansfield Tributary (RM 5.6) | MWH | 12 | N/A | Poor | 15.0 | No | Farm Rd. off Logan County Rd. 26 |
| North Fork West Mansfield Tributary (RM 3.8 / 4.0) | WWH | 30 | N/A | Poor | 30.5 | No | Co. Rd. 142 |
| North Fork West Mansfield Tributary (RM 1.3) | WWH | 32 | N/A | Fair | 51.0 | No | January Rd. |

* Sampled in 1981.

Critical Area A - Headwaters of Bokes Creek to Powderlick Run

# Impairment: Nutrients* I (Agricultural Sources)

***Specifically Nitrate and Phosphorous**

**Target Areas:**

**Bokes Creek**

- **River Miles 37.3 to 35.51** - Current phosphorous levels measure 0.49 ppm, below the target level of 0.58 ppm. The Best Management Practices that are presently implemented in this stream section should be identified and applied in the rest of the watershed.
- **River Miles 35.51 to 20.76**

**North Fork West Mansfield Tributary**

- **River Miles 6.1 to 4.51** - Phosphorous levels measure 0.23 ppm, below the target of 0.58 ppm.
- **River Mile 4.5 to the mouth at Bokes Creek**
- **Weaver Heartland Egg Farms**

**West Fork West Mansfield Tributary**

- **West Mansfield Wastewater Treatment Plant sprayfield**

**South Branch West Fork West Mansfield Tributary**

## Problem Statement

Agriculture contributes nutrients and pesticides to the stream through runoff and improper application of fertilizer and/or pesticides. Nutrients may enter the stream if over application of fertilizers and pesticides occur. Two pathways for nutrients to enter into a stream are 1) runoff through soil erosion and 2) groundwater leaching. Improper manure application may also be a source of nutrient loading into a stream.

Agricultural practices of fertilizer and pesticide application are a primary source of the nutrient loads in Bokes Creek RM 35.51 to 20.76. In the North Fork West Mansfield Tributary (RM 4.5 to mouth of Bokes Creek), nutrient loading is occurring from runoff associated with land application of manure from Weaver's Heartland Egg Farm (eastern Logan County). Runoff from the West Mansfield WWTP sprayfield (RM 0.9) contributes to high nutrient levels in the West Fork West Mansfield Tributary. Dam construction contributes a slight degree of impairment to the tributary of the South Branch West Fork West Mansfield Tributary.

## Goals

- From the Bokes Creek headwaters to the Powderlick Run confluence (RM 39.7 to 31.8), reduce in-stream phosphorus levels by 30% in the next five years.
- The BMPs of RM 37.3 to 35.51 of Bokes creek, which is in attainment, should be identified and applied to the rest of the watershed.

- RM 35.51 to 20.76—Decrease phosphorus levels from 0.23 ppm to 0.16 ppm, and from 0.17 ppm to 0.12 ppm within five years. The ultimate goal is to decrease phosphorous levels to 0.07 ppm and 0.06 ppm within ten years.
- North Fork West Mansfield Tributary, RM 4.5 to the mouth at Bokes Creek—Decrease phosphorous levels from 0.36 ppm to 0.25 ppm within five years. The ultimate goal is to decrease phosphorous levels to 0.07 ppm within ten years
- West Fork West Mansfield Tributary—Decrease phosphorous levels from 0.45 ppm to 0.32 ppm within five years. The ultimate goal is to decrease phosphorous levels within ten years.
- South Branch West Fork West Mansfield Tributary—Decrease phosphorous levels from 0.16 ppm to 0.11 ppm within five years. The ultimate goal is to decrease phosphorous levels to 0.09 ppm within five years.

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote and implement 120 acres of conservation crop rotation | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $12.00 / ac | Scioto CREP and CRP | 120 acres of conservation crop rotation implemented<br><br>~30 acres of conservation crop rotation installed per year<br><br>258 lb/yr phosphorus |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | load reduction<br><br>516 lb/yr nitrogen load reduction |
| Promote and Implement 85 acres of Critical Area Planting | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA | Critical area seeding w/ earthmoving ($600/ac)<br><br>Critical area seeding w/o earthmoving ($400/ac) | Scioto CREP, and CRP | 85 acres of critical area planting are implemented<br><br>~20-21 acres of critical area planting implemented per year<br><br>189 lb/yr phosphorus load reduction<br><br>378 lb/yr nitrogen load reduction |

| | | | | | |
|---|---|---|---|---|---|
| Promote and Implement 2,250 ft of Fencing | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners | Barbed Wire Fence ($2.25/ft) | CRP | 2,250 ft of fencing implemented |
| Promote and implement 120 acres of Field Border (CP 33 Quail Habitat Seeding or Warm Season Grass mix) | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA, Division of Wildlife, Pheasants Forever | CP 33 Quail Habitat Seeding ($225/ac)<br><br>Warm Season Grass ($200/ac) | CP 33 Bobwhite Quail Initiative<br><br>CRP | 120 acres of field border installed<br><br>~30 acres of field border installed per year<br><br>258 lb/yr phosphorus load reduction<br><br>516 lb/yr nitrogen load reduction |
| Promote and implement 85 acres of nutrient management | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners | Nutrient management ($5.00/ac)<br><br>Nutrient management w/ precision (grid) farming ($10.00/ac) | EQIP and CRP | 85 acres enrolled<br><br>189 lb/yr phosphorus load reduction<br><br>378 lb/yr nitrogen load reduction |
| Promote and implement 200 acres of Filter Strips | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering | Cool Season Grasses ($135/ac)<br><br>Warm Season | Scioto CREP and CRP | 200 acres of filter strips implemented<br><br>~50 acres of |

| | | | | | |
|---|---|---|---|---|---|
| | | Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA | Grasses w/ chemical treatment ($200/ac)<br><br>Warm Season Grasses w/o chemical treatment ($150/ac) | | filter strips implemented per year<br><br>413 lb/yr phosphorus load reduction<br><br>772 lb/yr nitrogen load reduction |

| | | | | | |
|---|---|---|---|---|---|
| Promote and create 1 comprehensive nutrient management plan | 2009 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners | $500-$1,500 per plan (depending on # and type of animals, AUs) | EQIP Cost incentives | 1 comprehensive nutrient management plan created |
| Promote and implement 120 acres of prescribed grazing | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $12.00/ac | Scioto CREP and CRP | 120 acres of prescribed grazing implemented<br><br>~30 acres of prescribed grazing implemented per year<br><br>258 lb/yr phosphorus load reduction<br><br>516 lb/yr nitrogen load reduction |
| Promote and build 1 Waste Storage | 2009-2014 | **Logan and Union SWCDs**, | Maximum cost of $31,000 for | EQIP cost incentives | Waste Storage Facility built |

| | | | | | |
|---|---|---|---|---|---|
| Facility | | NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | cost incentives | | |
| Promote and implement waste utilization (under nutrient management plans) | 2009 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | ~$1,000 per plan (depending on # and type of animals)<br><br>$6.00/ac (greater than 50 ppm)<br><br>$30.00/ac (less than or equal to 50 ppm) | EQIP cost incentives | Waste Utilization included and implemented in nutrient management plan<br><br>1 nutrient management plan implemented |
| Promote and build 1 Agrichemical Handling Facility | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | Maximum cost of $40,000 for cost incentives | EQIP cost incentives | Agrichemical Handling Facility built |
| Promote and Implement 120 acres of Conservation Cover (warm season grass mix most commonly used by NRCS and FSA) | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, | $200/ac | Scioto CREP and CRP | 120 acres of conservation cover implemented<br><br>~30 acres of conservation cover installed per year |

| | | | | | |
|---|---|---|---|---|---|
| | | ODA, Ohio EPA, Division of Wildlife | | | 258 lb/yr phosphorus load reduction<br><br>516 lb/yr nitrogen load reduction |
| Promote and implement 5 Grassed Waterways (Grass WW) | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | Grass WW, no tile ($3.25-$5.00/ft)<br><br>Blind inlet ($700)<br><br>Riser inlet ($210)<br><br>Buffer strips adj. to WW, cool season mix ($135/ac)<br><br>Mulch netting ($0.05/sq. ft)<br><br>Erosion Control Blanket ($0.10 sq. ft)<br><br>Rock Check ($140-$155)<br><br>Stone Centered | CRP | 5 Grass WW constructed<br><br>~1-2 Grass WW constructed per year |

| | | | | | |
|---|---|---|---|---|---|
| | | | Outlet ($65-80) | | |
| Initiate Water Pollution Control Loan Fund program | Continuous | **Union SWCD,** NRCS, Watershed Technician, Steering Committee | Time spent in initiating and promoting program.<br><br>Funding dependant upon participants | Ohio EPA | Initiated Water Pollution Control Loan Fund program<br><br>Increased # of voluntary landowners in program<br><br>Increased # of voluntary landowners with implemented BMPs |
| Water quality monitoring | Continuous | **Ohio EPA**, Columbus Division of Water | Ohio EPA grants, City of Columbus time spent monitoring, Cost of lab analysis | Ohio EPA | Documented changes in water quality<br><br>Reductions in phosphorus and nitrogen levels |
| Promote and implement 2 wetland creations | 2009-2014 | **Union and Logan SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife | Chain link fence along dike for rodent control ($0.75/sq ft) Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 2 wetland created |

| | | | | | |
|---|---|---|---|---|---|
| Promote and implement 2 wetland restorations | 2009-2014 | **Union and Logan SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife | Chain link fence along dike for rodent control ($0.75/sq ft) Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 2 wetlands restored |
| Promote and implement 1 wetland enhancement | 2009-2014 | **Union and Logan SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife | Chain link fence along dike for rodent control ($0.75/sq ft) Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 1 wetland enhanced |
| Hold meetings to inform landowners of government conservation | Continuous | **Land Heritage Trust of Union County,** | Cost of meetings | Land Heritage Trust of Union County, | 1 meeting held with approximately 15 attendees |

| | | | | | |
|---|---|---|---|---|---|
| programs | | Union SWCD, FSA, OSU Extension, NRCS | | NRCS USDA | Increased # of participants in government conservation programs |

Critical Area A - Headwaters of Bokes Creek to Powderlick Run

# Impairment: Nutrients* II and Total Suspended Solids (Sewage Sources)

***Specifically Nitrate**

**Target Areas:**

**York Center**

**West Mansfield Areas**

## Problem Statement

Old, failing and unmaintained septic systems in York Center and West Mansfield areas contribute to high in-stream nitrate levels. Loadings of nitrate and total suspended solids have resulted from these failing or possibly non-existent household sewage treatments systems (HSTS). Total suspended solids (TSS) can impair water quality, habitat, and biology of a stream. TSS can also be a source of bacteria, especially when dealing with solids from improper sewage treatment systems. Smothering of habitats and aquatic life within the stream can occur with excessive TSS loading.

The Union County Health Department has a history of identifying and documenting old, failing and unmaintained residential and commercial septic systems in the Bokes Creek. The Health Department annually inspects both residential and commercial septic

systems to identify problem systems. Through their experience, approximately 30-35% of aeration systems need repair and replacement each year, especially in the York Center and West Mansfield areas within the Bokes Creek watershed. The Health Department staff also responds to other system requests and complaints, then provides repairs or replacements as needed. In the past six years, the Health Department has issued and approved between 70-100 permits each year for replacement and/or upgrading of existing and failing systems.

**Goals**

- Decrease in-stream nitrate levels resulting from an annual average of 5.62 ppm to 3.93 ppm (30%) within five years
- Decrease in-stream total suspended solid levels from 16 ppm to 11.2 ppm (30%) within five years

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Review and inspect all septic systems<br><br>Repair 55% of failing septic systems | 2009-2014 | **Logan County and Union County Health Departments** | $4,000 total (i.e. inspection cost and time) | Fees | Reviewed and inspected all septic systems<br><br>Repaired 55% of failing septic systems |

| | | | | | |
|---|---|---|---|---|---|
| Explore funding options for septic maintenance and repair<br><br>Options include: Water Pollution Control Loan Fund Program, DEFA low interest loan program, | Continuous | **Watershed Technician,** Logan and Union County Health Departments, Union SWCD | Time spent for research by watershed tech.<br><br>Funding dependant upon participants | State, local, Ohio EPA | Obtained funding<br><br>Initiated Water Pollution Control Loan Fund program<br><br>Replaced or upgraded septic systems<br><br>Decreased # of failing septic systems |
| Promote responsible septic system maintenance | Continuous | **Logan and Union County Health Departments,** Watershed Technician, Steering Committee, Union SWCD | Cost of workshops | State, OEPA OEEF | Two workshops held<br><br>70% of workshop participants indicated increased understanding of septic systems<br><br>50% of workshop participants indicated they would have septic system inspected<br><br>200 brochures distributed |

Critical Area A - Headwaters of Bokes Creek to Powderlick Run

# Impairment: Sedimentation

**Target Areas:**

**Bokes Creek**

- **River Miles 37.3 to 31.8**
- **River Miles 35.51 to 20.76**- this stream segment is currently meeting a QHEI (habitat) score of 62, above the target of 60 for warmwater habitats (WWH). The existing habitat needs to be examined and applied throughout the rest of the watershed.

**North Fork West Mansfield Tributary**

- **River Miles 6.1 to 4.51**
- **River Mile 4.5 to the mouth at Bokes Creek**

**West Fork West Mansfield Tributary**

**South Branch West Fork West Mansfield Tributary**

### *Problem Statement*

Sedimentation is identified as a cause of impairment in Bokes Critical Area A, because of its excessive loading from agriculture, specifically non-irrigated croplands. Erosion

from crop fields and pastures is a primary source of sediment loading into Bokes Critical Area A. "OAC Rule 3745-1-04 (A) states that all waters of the state shall be free from suspended solids and other substances that enter the waters as a result of human activity and that will settle to form objectionable sludge deposits, or that will adversely affect aquatic life," (Ohio EPA Bokes TMDL, 2002).

"To target the impact of sediments upon the habitat and biological community, Ohio EPA used the Qualitative Habitat Evaluation Index (QHEI) scores as a surrogate for sediment load. Reductions in sediments will result in improvements in the habitat and an improvement in assimilative capacity and biological community, and this will be reflected in improved QHEI scores and improved biotic communities. The QHEI target for warmwater habitat is greater than or equal to 60," (Ohio EPA Bokes TMDL, 2002).

QHEI scores are low for the indicated target areas, with the exception of Bokes Creek River Mile 31.8 to 20.76. The low QHEI scores indicate that the sediment loads from agricultural practices are impairing the habitat and biology of the stream. The QHEI scores for the target areas are:

- **Bokes Creek River Miles 37.3 to 31.8** – QHEI 34
- **Bokes Creek River Miles 31.8 to 20.76** – QHEI 62
- **North Fork West Mansfield Tributary:**
    - **River Miles 6.1 to 4.51** – QHEI 15
    - **River Miles 4.5 to 3.00** – QHEI 31

    - **River Miles 2.9 to mouth** – QHEI 52

- **West Fork West Mansfield Tributary** – QHEI 38
- **South Branch West Fork West Mansfield Tributary**
    - **River Miles 2.42 to mouth** – QHEI 52

## Goals

- Bokes Creek, River Miles 37.3 to 31.8 – Increase QHEI (habitat) scores from 34 to 44.2 within five years. The ultimate goal is to increase QHEI to 60 within 10 years.
- Bokes Creek, River Miles 31.8 to 20.76 – Examine this existing habitat and use as a reference to apply throughout the rest of Critical Area A.
- North Fork West Mansfield Tributary, River Miles 6.1 to 4.51 – Increase QHEI scores from 15 to 19.5 within five years. The ultimate goal is to increase QHEI scores to 60 within ten years.
- North Fork West Mansfield Tributary, River Miles 4.5 to 3.00 – Increase QHEI scores from 31 to 40.3 within five years. The ultimate goal is to increase QHEI scores to 60.
- North Fork West Mansfield Tributary, River Miles 2.9 to mouth – Increase QHEI scores from 52 to 60 within five years.
- West Fork West Mansfield Tributary – Increase QHEI scores from 38 to 49.4 within five years. The ultimate goal is to increase QHEI scores to 60 within ten years.

- South Branch West Fork West Mansfield Tributary, River Miles 2.42 to mouth – Increase QHEI scores from 52 to the target of 60 within five years.
- Critical Area A of Bokes Creek has a predicted average annual soil loss of 4.90 ton/acre/year – Decrease predicted average annual soil loss to 2.45 ton/acre/year by 2011

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote and build 2 access roads | 2009-2014 | **Logan and Union SWCDs**, Steering Committee, NRCS, FSA, Watershed Technician, voluntary landowners | Culvert for drainage ($10.00/ft)<br><br>Surface Treatment – Gravel ($1.60/sq. ft)<br><br>Livestock Stream Crossing ($3.50/sq.ft)<br><br>Culvert crossing only ($13.50/ft) | EQIP cost incentives, CRP | 2 access roads built |

| | | | | | |
|---|---|---|---|---|---|
| Promote and implement 10 acres Heavy Use Area Protection | 2009-2014 | **Logan and Union SWCDs**, Steering Committee, NRCS, FSA, Watershed Technician, voluntary landowners | Gravel ($25,000/ac)<br><br>Concrete ($60,000/ac) | CRP, EQIP cost incentives | 10 acres of Heavy Use Area Protection implemented |
| Promote and implement 120 acres of conservation crop rotation | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $12.00/ac | Scioto CREP, and CRP | 120 acres of conservation crop rotation implemented<br><br>~30 acres of conservation crop rotation installed per year<br><br>152 tons/yr sediment load reduction |
| Promote and implement 85 acres of critical area planting | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA | Critical area seeding w/ earthmoving ($600/ac)<br><br>Critical area seeding w/o earthmoving ($400/ac) | Scioto CREP, and CRP | 85 acres of critical area planting are implemented<br><br>~20-21 acres of critical area planting implemented per year<br><br>113 ton/yr sediment load reduction |
| Promote and implement 120 acres of field border (CP 33 Quail Habitat | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, | CP 33 Quail Habitat Seeding ($225/ac)<br><br>Warm | CP 33 Bobwhite Quail Initiative, and CRP | 120 acres of field border installed<br><br>~30 acres of field border |

| | | | | | |
|---|---|---|---|---|---|
| Seeding or Warm Season grass mix) | | Watershed Technician, voluntary landowners, ODA, Ohio EPA, Div. of Wildlife, Pheasants Forever | Season Grass ($200/ac) | | installed per year<br><br>152 tons/yr sediment load reduction |
| Promote and implement 200 acres of Filter Strips | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA | Cool Season grasses ($135/ac)<br><br>Warm Season grasses w/ chemical treatment ($200/ac)<br><br>Warm Season grasses w/o chemical treatment ($150/ac) | Scioto CREP, and CRP | 200 acres of filter strips implemented<br><br>~50 acres of filter strips implemented per year<br><br>155 ton/yr sediment load reduction |
| Promote and implement 120 acres of prescribed grazing | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $12.00/ac | Scioto CREP, and CRP | 120 acres of prescribed grazing implemented<br><br>~30 acres of prescribed grazing<br><br>152 tons/yr sediment load reduction |
| Promote and implement 120 acres of conservation cover (warm season grass mix most | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed | $200/ac | Scioto CREP, and CRP | 120 acres of conservation cover implemented<br><br>~30 acres of conservation |

| | | | | | |
|---|---|---|---|---|---|
| commonly used by NRCS and FSA) | | Technician, voluntary landowners, ODA, Ohio EPA, Div. of Wildlife | | | cover installed per year<br><br>152 tons/yr sediment load reduction |
| Water quality monitoring | Continuous | **Ohio EPA**, Columbus Division of Water (turbidity), City of Marysville, Oxbow Stream Restoration | Cost of labor and lab analysis. | Ohio EPA | Documented changes in water quality |
| Reduce construction site runoff through administration of construction site review processes and require the use of Best Management Practices (BMP) according to ODNR "Rainwater Manual" | Continuous | **SWCD and Engineers Offices** for site reviews and sediment control regulations | Cost of staff time<br><br>$2,000 for an educational breakfast for homeowners and builders to inform them of BMPs and sediment control regulations | SWCD, educational funds, City of Marysville | Number of site reviews completed<br><br>Site sediment controls and BMPs in place<br><br>Breakfast held |

Critical Area A - Headwaters of Bokes Creek to Powderlick Run

# Impairment: Atrazine

## Target Areas:

All areas of Critical Area A – Headwaters of Bokes Creek to Powderlick Run

## Problem Statement

The predominance of atrazine applications for agricultural pesticide purposes in Critical Area A has resulted in high in-stream concentrations of atrazine. Atrazine, a commonly used herbicide, is predominately used in conjunction with conservation tillage to prevent soil erosion. High atrazine concentrations can impair water quality and the aquatic life within the stream. According to the U.S. EPA, health hazards of exposure to the maximum contamination level (MCL) of 3 parts per billion (ppb) of atrazine can vary based the length of exposure time. Short term exposure to atrazine at levels above the MCL can cause health effects that include: heart, lung, and kidney congestion, low blood pressure, muscle spasms, weight loss as well as damage to adrenal glands. The U.S. EPA also states that over long-term: atrazine has the potential to cause the

following effects from a lifetime exposure at levels above the MCL: weight loss, cardiovascular damage, retinal and some muscle degeneration; cancer.

Excessive spraying of atrazine in fields can be a source of atrazine runoff into nearby streams. Herbicides containing high amounts of atrazine increase the concentration of atrazine in nearby streams. Using low atrazine concentration pesticides are an alternative that have less of an impact than high atrazine concentration herbicides. Lack of riparian areas also allows more atrazine to enter into the stream. Current concentration of the in-stream atrazine level is 0.56 ppb. This level needs to be reduced to protect water quality and the aquatic life of Critical Area A.

## Goals

- Entire area of Critical Area A – Decrease in-stream atrazine levels from an annual average of 0.56 ppb to 0.39 ppb (30%) within five years.

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote and implement 200 acres of filter strips | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary | Cool season grasses ($135/ac)<br><br>Warm season grasses w/ chemical | Scioto CREP, and CRP | 200 acres of filter strips implemented<br><br>~50 acres of filter strips implemented per year |

| | | | | | |
|---|---|---|---|---|---|
| | | landowners, ODA, Ohio EPA | treatment ($200/ac)<br><br>Warm season grasses w/o chemical treatment ($150/ac) | | |
| Promote and build 1 Agrichemical Handling Facility | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | Max. cost of $40,000 for cost incentives | EQIP | Agrichemical Handling Facility built |
| Promote and implement 2 wetland creations | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife | Chain link fence along dike for rodent control ($0.75/sq ft)<br><br>Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 2 wetlands created |
| Promote and implement 2 | 2009-2014 | **Logan and Union** | Chain link fence along | WHIP, Scioto | 2 wetlands restored |

| | | | | | |
|---|---|---|---|---|---|
| wetland restorations | | **SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife | dike for rodent control ($0.75/sq ft)<br><br>Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | CREP, and CRP | |
| Promote and implement 2 wetland enhancements | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife | Chain link fence along dike for rodent control ($0.75/sq ft)<br><br>Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 1 wetland enhanced |
| Promote and implement 5 Grassed | 2009-2014 | **Logan and Union SWCDs**, | Grass WW, no tile ($3.25- | CRP | 5 Grass WW constructed |

| | | | | | |
|---|---|---|---|---|---|
| Waterways (Grass WW) | | NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $5.00/ft)<br><br>Blind inlet ($700)<br><br>Riser inlet ($210)<br><br>Buffer strips adj. to WW, cool season mix ($135/ac)<br><br>Mulch netting ($0.05/sq. ft)<br><br>Erosion Control Blanket ($0.10 sq. ft)<br><br>Rock Check ($140-$155)<br><br>Stone Centered Outlet ($65-80) | | ~1-2 Grass WW constructed per year |
| Promote and offer cost incentives for low-atrazine herbicides | 2009-2014 | **Watershed Technician**, NRCS, Steering Committee, Logan and Union SWCDs, OSU Extension, voluntary | Time spent by Watershed Technician and others<br><br>Funding dependant upon participants | NRCS, SWCD, OSU extension, local | Increased # of acres utilizing low-atrazine herbicides<br><br>Decreased in-stream atrazine levels |

| | | | | | |
|---|---|---|---|---|---|
| | | landowners | | | |
| Initiate Water Pollution Control Loan Fund program | Continuous | **Logan and Union SWCDs,** NRCS, Watershed Technician, Steering Committee, voluntary landowners | Funding dependant upon participants<br><br>Time spent on promotion | Ohio EPA | Initiated Water Pollution Control Loan Fund program<br><br>Increased # of voluntary landowners enrolled in program<br><br>Increased # of voluntary landowners with implemented BMPs |
| Water quality monitoring | Continuous | **Columbus Division of Water** | Cost of sampling and lab analysis | Columbus, Ohio EPA | Documented changes in atrazine levels |

Critical Area B – Powderlick Run: Bokes Creek Tributary

**Physical Description:**

Powderlick Run is a highly channelized tributary to Bokes Creek in Union County. Stretching across five miles, the stream drains almost four square miles of land. According to the Ohio EPA, a 92% reduction in phosphorous and a 67% reduction in ammonia are necessary for the stream to meet water quality standards (2002).

In 1999, the stream designation from River Mile 5.1 – 3.01 was demoted from WWH to Limited Resource Water (LRW). LRW indicates that the stream cannot support anything but a limited, non-diverse fish and macroinvertebrate community due to very altered habitat conditions that result from human activity. The LRW designation is temporary, and has the potential to be upgraded to WWH if habitat is improved. The remaining section of Powderlick Run, from River Mile 3.0 to the mouth, is still classified as WWH.

One tributary is located within the critical area:

- **Tributary to Powderlick Run** – Meets Powderlick Run at the Powderlick Run/Bokes Creek confluence. According to the 2002 Bokes Creek TMDL, Mad River Egg Farm experienced an egg wash water spill.

The sources of impairment that affect the water quality in the Powderlick Run critical area include:

- Agriculture
- Storm runoff nutrients from egg farm manure applications
- Sedimentation

The causes of water quality impairments include:

- Nutrients
- Habitat alteration – In 1999, the downstream reach of stream was dredged and the channel was deepened.
- Organic enrichment/low dissolved oxygen
- Siltation
- Flow alteration

Contaminated runoff from Daylay Egg Farm #1, #2, #3 and Mad River Egg Farm also contribute to the impaired water quality of Powderlick Run.

## Summary

Powderlick Run, a tributary to Bokes Creek at River Mile 20.76, is not meeting water quality standards due to high nutrient levels, sedimentation and habitat alteration. The short-term goal (within five years) is a 30% reduction of in-stream phosphorous, nitrate,

total suspended solids, atrazine and sedimentation, and a 30% increase in habitat. The ultimate goal (within ten years) is for this critical area to meet water quality standards. Through various conservation programs (i.e. CRP, CREP), habitat such as warm season grass filter strips and wetlands will be established.

Since sedimentation often correlates with poor habitat, target scores will be based on QHEI scores, the Ohio EPA's measure of habitat. QHEI evaluates the physical characteristics of a stream segment, and measures 1) substrate (what stream bed is composed of), 2) in-stream tree cover, 3) riparian characteristics, 4) stream channel characteristics, 5) pool/riffle quality, and 6) stream gradient and drainage area. The QHEI target score for Warmwater Habitats is 60. The following table indicates the QHEI scores form various sampling sites within the Powderlick Run critical area.

Aquatic Life Use Attainment Status of Powderlick Run Sites Sampled From June to October 1999 (Ohio EPA, 2001).

| Powderlick Run (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 4.8 / 4.8 | LRW | 22 | N/A | Very poor | 31.0 | No | Storms Rd. (Dst. Daylay Farm #3) |
| 3.7 / 3.7 | LRW | 24 | N/A | Poor | 27.0 | Yes | Easternmost Crossing at Davis Rd. (Ust. Daylay Farm #2) |
| 3.4 / 3.3 | LRW | 18 | N/A | Very Poor | 39.5 | No | SR 739 (Dst. Daylay Farm #2 and Ust. Daylay Farm |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | #1) |
| 2.1 | WWH | 24 | N/A | Poor | 45.0 | No | West Crossing at Powderlick Run |
| 1.8 / 1.6 | WWH | 12 | N/A | 0 | 60.5 | No | Ust. Powderlick Run (west of Fawley Rd.) |
| 1.2 | WWH | 0 | N/A | 4 | - | No | Dst. Powderlick Rd. (east of Fawley Rd.) |
| 1.0 / 0.9 | WWH | 18 | N/A | 6 | 23.0 | No | Ust. Cattle farms |

Critical Area B – Powderlick Run: Bokes Creek Tributary

# Impairment: Nutrients* I (Agricultural Sources)

***Specifically Phosphorous**

## Target Areas:

**Tributary to Powderlick Run** – No data on current phosphorous levels is available, but the target is 0.07 ppm.

**Powderlick Run**

- **River Miles 5.10 to 3.01**
- **River Miles 3.0 to mouth at Bokes Creek**

### *Problem Statement*

Concentrated manure applications contribute to high in-stream phosphorous levels. River Miles 5.10 to 3.01 in Powderlick Run have high phosphorous levels (1.32 ppm), as well as River Miles 3.0 to mouth at Bokes Creek (0.83 ppm), and the tributary to Powderlick Run. The target level for phosphorous in the Powderlick Run of Bokes Creek is 0.07 ppm. The highly channelized stream did not facilitate productive nutrient assimilation. The stream was prone to manure runoff impairments because of the channelization. The high phosphorous levels contributed to the Limited Resource

Water (LRW) designation for River Miles 5.10 to 3.01 in Powderlick Run. Water quality and aquatic life have been impaired because of the high levels of Phosphorous.

### *Goals*

- Reduce in-stream phosphorous levels by 30% within five years
- Tributary to Powderlick Run—Attain phosphorous levels of 0.07 ppm
- Powderlick Run, River Miles 5.10 to 3.01—Decrease phosphorous levels from 1.32 ppm to 0.92 ppm within five years. The ultimate goal is to decrease phosphorous levels to 0.07 ppm.
- Powderlick Run, River Miles 3.0 to mouth at Bokes Creek—Decrease phosphorous levels from 0.83 ppm to 0.58 ppm within five years. The ultimate goal is to decrease phosphorous levels to 0.07 ppm within ten years.

### *Action Items*

- Promote BMPs through conservation programs (i.e. CREP, CRP, CSP, EQIP, WHIP, WRP).
    - Livestock exclusion
    - Nutrient management
        - Precision Farming
    - Tile valves

- Implement a natural stream channel design project along 1000 linear feet of Powderlick Run.
    - Construct a two-stage channel
    - Construct a headwater stream tributary to Powderlick Run
    - Evaluate chemical water quality
    - Establish 26 acres of conservation easements along Powderlick Run
- Create stormwater ponds and wetlands to control stormwater discharges
- Establish switchgrass filter strips
- Initiate Water Pollution Control Loan Fund Program (low interest loans) for voluntary landowners to implement agricultural and livestock BMPs
- Implement CREP for the Scioto River Watershed
    - Grass filter strips
    - Riparian forest buffers
    - Wetland restoration
- Water quality monitoring to document changes

### *Implementation Strategies/Task Table*

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote BMPs through conservation | Continuous | **Oxbow River**, Watershed Technician, Union SWCD, | Time spent and labor costs of Oxbow River | Ohio EPA, NRCS | Increased # of voluntary landowners with |

| | | | | | |
|---|---|---|---|---|---|
| programs | | SRVF, Daylay, Ohio EPA, Columbus Division of Water, voluntary landowners, Nonpoint Source – Habitat Subcommittee | Time spent on promotion | | implemented practices<br><br>Increased # of practices implemented<br><br>Increased # of voluntary landowners with implemented 1) livestock exclusion fencing, tile valves, and 3) precision farming<br><br>Decreased in-stream phosphorous levels |
| Implement a natural stream channel design project | Spring 2005-2008 | **Oxbow River**, Watershed Technician, Union SWCD, SRVF, Daylay, Ohio EPA, Columbus Division of Water | $332,000 project cost | 319 grant (Ohio EPA) | Completed natural stream channel design project<br><br>Increased stream IBI<br><br>Decreased in-stream phosphorous levels |
| Create stormwater ponds and wetlands to control storm water discharges | 2004-2008 | **Daylay**, Union SWCD, voluntary landowners | $15,000 | Daylay and 319 grant (Ohio EPA) | Created stormwater ponds and wetlands<br><br>Decreased stormwater runoff |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | Decreased in-stream phosphorous levels |
| Establish switchgrass filter strips | Continuous | **Daylay**, Union SWCD, voluntary landowners, Nonpoint Source – Habitat Subcommittee | Time spent by Daylay staff | N/A | Established switchgrass filter strips<br><br>Decreased in-stream phosphorous levels |
| Initiate Water Pollution Control Loan Fund program | Continuous | **Union SWCD,** NRCS, Watershed Technician, Steering Committee, voluntary landowners | Time spent by SWCD and NRCS staff | N/A | Initiated Water Pollution Control Loan Fund program<br><br>Increased # of voluntary landowners in program<br><br>Increased # of voluntary landowners with implemented BMPs |
| Implement CREP for the Scioto River watershed | Continuous | **ODNR**, Union SWCD, Watershed Technician, NRCS, FSA, voluntary landowners | Time spent on promotion<br><br>Funding dependant upon participants | Federal, local funds (i.e. Scotts Co.) | CREP is implemented<br><br>Increased # of voluntary landowners enrolled<br><br>Increased # of acres enrolled<br><br>Increased # of voluntary |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | landowners with implemented 1) grass filter strips, 2) riparian forest buffers, and 3) wetland restoration<br><br>Decreased in-stream phosphorous levels |
| Water quality monitoring | Continuous | **Ohio EPA**, Columbus Division of Water | $27,000 | Ohio EPA 319 grant | Documented changes in water quality |
| Establish approximately 80 acres of streamside buffer habitat to reduce the amount of nutrients and pesticides and increase QHEI scores | April 2004-December 2007 | **USDA-NRCS** Conservation Reserve Program | Approximately $8,000 for CRP to set aside 80 acres of cropland to establish a buffer area (50 ft min.) for about 15 miles of riparian area needed | USDA-NRCS | Acres established and protected through CRP. Land and Stream is protected<br><br>Improved QHEI scores |

Critical Area B – Powderlick Run: Bokes Creek Tributary

# Impairment: Nutrients* II (Agricultural Sources)

***Specifically Nitrate and Ammonia**

## Target Areas:

**Tributary to Powderlick Run**

**Powderlick Run**

- **River Miles 5.10 to 3.01**
- **River Miles 3.0 to mouth at Bokes Creek**

## Problem Statement

Concentrated manure applications and agricultural runoff contribute to high in-stream nitrate levels and ammonia levels. The annual average of nitrate levels within the Powderlick Run is 5.62 ppm, and the annual average of ammonia levels is 2.7 ppm. The highly channelized stream did not facilitate productive nutrient assimilation. The stream was prone to manure runoff impairments because of the channelization. The high nitrate and ammonia levels contributed to the Limited Resource Water (LRW) designation for River Miles 5.10 to 3.01 in Powderlick Run. Water quality and aquatic life have been impaired because of the high levels of nitrate and ammonia

### *Goals*

- Decrease in-stream nitrate levels from an annual average of 5.62 ppm to 3.93 ppm (30%) within five years
- Decrease in-stream ammonia levels from 2.7 ppm to target level of 2.2 ppm within five years

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote and Implement 20 acres of Critical Area Planting | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA | Critical area seeding w/ earthmoving ($600/ac)<br><br>Critical area seeding w/o earthmoving ($400/ac) | Scioto CREP, and CRP | 20 acres of critical area planting are implemented<br><br>103 lb/yr nitrogen load reduction |
| Promote and implement 30 acres of Field Border (CP 33 Quail Habitat Seeding or Warm Season Grass mix) | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA, Division of Wildlife, Pheasants Forever | CP 33 Quail Habitat Seeding ($225/ac)<br><br>Warm Season Grass ($200/ac) | CP 33 Bobwhite Quail Initiative<br><br>CRP | 30 acres of field border installed<br><br>148 lb/yr nitrogen load reduction |

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|---|---|---|---|---|---|
| Promote and implement 20 acres of nutrient management | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners | Nutrient management ($5.00/ac)<br><br>Nutrient management w/ precision (grid) farming ($10.00/ac) | EQIP and CRP | 20 acres enrolled<br><br>103 lb/yr nitrogen load reduction |
| Promote and implement 80 acres of Filter Strips | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA | Cool Season Grasses ($135/ac)<br><br>Warm Season Grasses w/ chemical treatment ($200/ac)<br><br>Warm Season Grasses w/o chemical treatment ($150/ac) | Scioto CREP and CRP | 80 acres of filter strips implemented<br><br>~20 acres of filter strips implemented per year<br><br>338 lb/yr nitrogen load reduction |
| Promote and create 1 comprehensive nutrient management plan | 2009 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners | $500-$1,500 per plan (depending on # and type of animals, AUs) | EQIP Cost incentives | 1 comprehensive nutrient management plan created |
| Promote and build 1 Waste Storage Facility | 20092014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, | Maximum cost of $31,000 for cost incentives | EQIP cost incentives | Waste Storage Facility built |

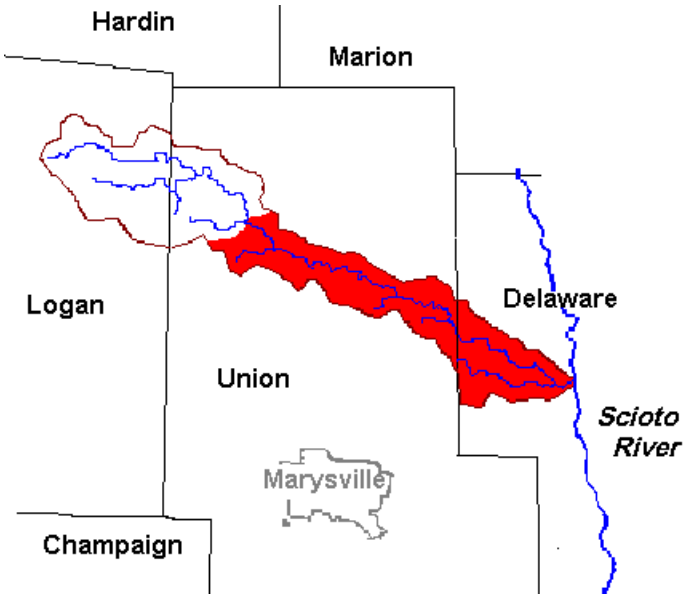
| | | | | | |
|---|---|---|---|---|---|
| | | voluntary landowners, ODA | | | |
| Promote and implement waste utilization (under nutrient management plans) | 2009 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | ~$1,000 per plan (depending on # and type of animals)<br><br>$6.00/ac (greater than 50 ppm)<br><br>$30.00/ac (less than or equal to 50 ppm) | EQIP cost incentives | Waste Utilization included and implemented in nutrient management plan<br><br>1 nutrient management plan implemented |
| Promote and Implement 20 acres of Conservation Cover (warm season grass mix most commonly used by NRCS and FSA) | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA, Division of Wildlife | $200/ac | Scioto CREP and CRP | 20 acres of conservation cover implemented<br><br>103 lb/yr nitrogen load reduction |
| Initiate Water Pollution | Continuous | **Union SWCD,** | Time spent in initiating | Ohio EPA | Initiated Water Pollution |

| | | | | | |
|---|---|---|---|---|---|
| Control Loan Fund program | | NRCS, Watershed Technician, Steering Committee | and promoting program.<br><br>Funding dependant upon participants | | Control Loan Fund program<br><br>Increased # of voluntary landowners in program<br><br>Increased # of voluntary landowners with implemented BMPs |
| Water quality monitoring | Continuous | **Ohio EPA**, Columbus Division of Water | Ohio EPA grants, City of Columbus time spent monitoring, Cost of lab analysis | Ohio EPA | Documented changes in water quality<br><br>Reductions in phosphorus and nitrogen levels |
| Promote and implement 1 wetland creations | 2009-2014 | **Union and Logan SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife | Chain link fence along dike for rodent control ($0.75/sq ft) Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 1 wetland created |
| Promote and implement 1 | 2009-2014 | **Union and Logan** | Chain link fence along | WHIP, Scioto | 1 wetland restored |

| | | | | | |
|---|---|---|---|---|---|
| wetland restorations | | **SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife | dike for rodent control ($0.75/sq ft) Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | CREP, and CRP | |
| Promote and implement 1 wetland enhancement | 2009-2014 | **Union and Logan SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife | Chain link fence along dike for rodent control ($0.75/sq ft) Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 1 wetland enhanced |
| Hold meetings to inform landowners of government conservation programs | Continuous | **Land Heritage Trust of Union,** Union SWCD, FSA, OSU Extension, NRCS | Cost of meetings | Land Heritage Trust of Union County, NRCS USDA | 1 meeting held with approx. 15 attendees<br><br>Increased # of participants in government conservation programs |

## Critical Area C – Bokes Creek from the Powderlick Run Confluence to the Scioto River Confluence

### Physical Description:




This critical area continues from the Powderlick Run confluence (RM 20.76) in Union County until outleting into the Scioto River in Delaware County (RM 0.0). Except for a 4-mile section downstream from Powderlick Run, the stream segment and tributaries in Critical Area C are classified as WWH (Ohio EPA, 2002).

Two tributaries are located within the critical area:

- **Brush Run** (Union County) –
  Characterized by open, unstable streambanks due to riparian removal and/or bank destabilization from unlimited cattle access and/or non irrigated crop production upstream.

- **Smith Run** (Delaware County) – Lower reaches of the stream have better riparian corridor than the upper reaches. Sends high nutrient loads and low oxygenated, poor water quality to Bokes Creek.

In addition, a large quarry is located in the Bokes Creek watershed near the Scioto River confluence. **White Sulphur Lake**, a 39-acre quarry lake owned by the City of Columbus, is used to supplement flows only during extreme drought. The water is pumped from the quarry into the Scioto River approximately once every five years.

Twelve miles downstream from White Sulphur Lake, on the Scioto River, is a public water intake for the City of Columbus. The City of Columbus also owns and controls the area surrounding White Sulphur Lake, so development pressure is minimal. The water quality of White Sulphur Lake is listed as Exceptional Warmwater Habitat (EWH) (Ohio EPA, 2002).

The sources of impairment include:

- Agriculture
- Storm runoff nutrient inputs from egg farm manure
- Septic systems
- Sedimentation
- Cattle encroachment

The causes of impairment include:

- Nutrients (phosphorous)
- Siltation
- Organic enrichment/low dissolved oxygen
- Habitat alteration
- Flow alteration

## Summary

Bokes Creek (River Miles 20.76 to 0.00) is not meeting water quality standards due to high nutrient levels, sedimentation and habitat alteration. The short-term goal (within five years) is a 30% reduction of in-stream phosphorous, nitrates, total suspended solids, atrazine and sedimentation, with a habitat increase of 30%. The ultimate goal (ten

years) is for this critical area to meet water quality standards for drinking water. Through various conservation programs (i.e. CRP, CREP), habitat such as wetlands will be established.

This section of Bokes Creek is riddled with logjams, many of which are clustered at River Mile 8.0 in the Village of Magnetic Springs. Logjams form in the area of Magnetic Springs due to the natural narrowing of the stream and inability of large debris to be flushed out.

Since sedimentation often correlates with poor habitat, target scores will be based on QHEI scores, the Ohio EPA's measure of habitat. The QHEI target score for Warmwater Habitats is 60, while the current QHEI score for this critical area is 34.

QHEI evaluates the physical characteristics of a stream segment, and measures 1) substrate (what stream bed is composed of), 2) in-stream tree cover, 3) riparian characteristics, 4) stream channel characteristics, 5) pool/riffle quality, and 6) stream gradient and drainage area.

Aquatic Life Use Attainment Status of Bokes Creek Sites Sampled From June to October 1999 (Ohio EPA, 2001).

| Bokes Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 20.2 / | WWH | 34 | 7.2 | 34 | 58.5 | Partial | Adj. SR 31 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 20.4 | | | | | | | (Dst. Powderlick Run) |
| 17.0 / 16.8 | WWH | 31 | 5.7 | Marginally good | 59.5 | No | Ust. Reed Ford Rd. |
| 11.4 | WWH | 42 | 7.2 | Marginally good | 67.5 | Partial | Ust. SR 4 |
| 5.6 / 5.4 | WWH | 31 | 5.9 | Good | 63.0 | Partial | Ust./Dst. Brown Rd. |
| 0.2 | WWH | 36 | 6.5 | Marginally good | 63.0 | Partial | Dst. SR 257 |

Aquatic Life Use Attainment Status of Bokes Creek Tributary Sites Sampled From June to October 1999 (Ohio EPA, 2001).

| **Tributary** | **Designation** | **IBI** | **MIwb** | **ICI** | **QHEI** | **Meets Water Quality Standards?** | **Site Location** |
|---|---|---|---|---|---|---|---|
| Brush Run (RM 0.5) | WWH | 24 | N/A | - | 49.0 | No | Yearsley Rd. |
| Smith Run | WWH | 20 | N/A | Fair | 61.5 | No | Brindle Rd. |

# Critical Area C – Bokes Creek from the Powderlick Run Confluence to the Scioto River Confluence

## Impairment: Nutrients* I (Agricultural Sources)

***Specifically Nitrate and Phosphorous**

### Target Areas:

**Brush Run**—No data is available on current phosphorous levels, but the target is 0.07 ppm.

**Smith Run**

### *Problem Statement*

Agriculture contributes nutrients to the stream through runoff and improper application of manure. Nutrients may enter the stream if over application of fertilizers. Two pathways for nutrients to enter into a stream are 1.) Runoff through soil erosion and 2.) Groundwater leaching. Even proper application of fertilizer can be a source of nutrient loading into a stream; however nutrient loading is more likely to occur from over application. Concentrated manure applications contribute to high in-stream nutrient levels. Smith Run has phosphorous levels of 0.12 ppm, and the target phosphorous level is 0.07 ppm. The annual nitrate level average is 5.62 ppm for Critical Area C of Bokes Creek. These high nitrate and phosphorous levels negatively impact water quality and aquatic life.

## Goals

- Brush Run—achieve target phosphorous level of 0.07 ppm
- Smith Run—Decrease phosphorous levels from 0.12 ppm to 0.08 ppm within five years. The ultimate goal is to decrease phosphorous levels to 0.07 ppm within ten years
- Reduce in-stream phosphorous levels in this critical area from 0.14 ppm to 0.11 ppm within five years
- Decrease in-stream nitrate levels from an annual average of 5.62 ppm to 3.93 ppm (30%) within five years

### *Implementation Strategies/Task Table*

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote and implement 150 acres of conservation crop rotation | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $12.00 / ac | Scioto CREP and CRP | 150 acres of conservation crop rotation implemented<br><br>~35 acres of conservation crop rotation installed per year<br><br>315 lb/yr phosphorus load reduction<br><br>630 lb/yr nitrogen load reduction |

| | | | | | |
|---|---|---|---|---|---|
| Promote and Implement 85 acres of Critical Area Planting | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA | Critical area seeding w/ earthmoving ($600/ac)<br><br>Critical area seeding w/o earthmoving ($400/ac) | Scioto CREP, and CRP | 85 acres of critical area planting are implemented<br><br>~20-21 acres of critical area planting implemented per year<br><br>189 lb/yr phosphorus load reduction<br><br>378 lb/yr nitrogen load reduction |
| Promote and Implement 2,250 ft of Fencing | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners | Barbed Wire Fence ($2.25/ft) | CRP | 2,250 ft of fencing implemented |
| Promote and implement 150 acres of Field Border (CP 33 Quail Habitat Seeding or Warm Season Grass mix) | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA, Division of Wildlife, Pheasants Forever | CP 33 Quail Habitat Seeding ($225/ac)<br><br>Warm Season Grass ($200/ac) | CP 33 Bobwhite Quail Initiative<br><br>CRP | 150 acres of field border installed<br><br>~35 acres of field border installed per year<br><br>315 lb/yr phosphorus load reduction<br><br>630 lb/yr nitrogen load reduction |

| | | | | | |
|---|---|---|---|---|---|
| Promote and implement 100 acres of nutrient management | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners | Nutrient management ($5.00/ac)<br><br>Nutrient management w/ precision (grid) farming ($10.00/ac) | EQIP and CRP | 100 acres enrolled<br><br>219 lb/yr phosphorus load reduction<br><br>438 lb/yr nitrogen load reduction |
| Promote and implement 400 acres of Filter Strips | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA | Cool Season Grasses ($135/ac)<br><br>Warm Season Grasses w/ chemical treatment ($200/ac)<br><br>Warm Season Grasses w/o chemical treatment ($150/ac) | Scioto CREP and CRP | 400 acres of filter strips implemented<br><br>~100 acres of filter strips implemented per year<br><br>771 lb/yr phosphorus load reduction<br><br>1441 lb/yr nitrogen load reduction |
| Promote and create 1 comprehensive nutrient management plan | 2009 | **Logan and Union SWCDs, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners** | $500-$1,500 per plan (depending on # and type of animals, AUs) | EQIP Cost incentives | 1 comprehensive nutrient management plan created |
| Promote and implement 120 acres of prescribed grazing | 2009-2014 | **Logan and Union SWCDs, NRCS, FSA, Steering Committee,** | $12.00/ac | Scioto CREP and CRP | 120 acres of prescribed grazing implemented<br><br>~30 acres of |

| | | | | | |
|---|---|---|---|---|---|
| | | **Watershed Technician, voluntary landowners, ODA** | | | prescribed grazing implemented per year<br><br>258 lb/yr phosphorus load reduction<br><br>516 lb/yr nitrogen load reduction |
| Promote and build 1 Waste Storage Facility | 2009-2014 | **Logan and Union SWCDs, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA** | Maximum cost of $31,000 for cost incentives | EQIP cost incentives | Waste Storage Facility built |
| Promote and implement waste utilization (under nutrient management plans) | 2009 | **Logan and Union SWCDs, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA** | ~$1,000 per plan (depending on # and type of animals)<br><br>$6.00/ac (greater than 50 ppm)<br><br>$30.00/ac (less than or equal to 50 ppm) | EQIP cost incentives | Waste Utilization included and implemented in nutrient management plan<br><br>1 nutrient management plan implemented |
| Promote and build 1 Agrichemical Handling Facility | 2009-2014 | **Logan and Union SWCDs, NRCS, FSA, Steering Committee,** | Maximum cost of $40,000 for cost incentives | EQIP cost incentives | Agrichemical Handling Facility built |

| | | | | | |
|---|---|---|---|---|---|
| | | **Watershed Technician, voluntary landowners, ODA** | | | |
| Promote and Implement 150 acres of Conservation Cover (warm season grass mix most commonly used by NRCS and FSA) | 2009-2014 | **Logan and Union SWCDs, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA, Division of Wildlife** | $200/ac | Scioto CREP and CRP | 150 acres of conservation cover implemented<br><br>~35 acres of conservation cover installed per year<br><br>315 lb/yr phosphorus load reduction<br><br>630 lb/yr nitrogen load reduction |
| Promote and implement 5 Grassed Waterways (Grass WW) | 2009-2014 | **Logan and Union SWCDs, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA** | Grass WW, no tile ($3.25-$5.00/ft)<br><br>Blind inlet ($700)<br><br>Riser inlet ($210)<br><br>Buffer strips adj. to WW, cool season mix ($135/ac) | CRP | 5 Grass WW constructed<br><br>~1-2 Grass WW constructed per year |

| | | | | | |
|---|---|---|---|---|---|
| | | | Mulch netting ($0.05/sq. ft)<br><br>Erosion Control Blanket ($0.10 sq. ft)<br><br>Rock Check ($140-$155)<br><br>Stone Centered Outlet ($65-80) | | |
| Initiate Water Pollution Control Loan Fund program | Continuous | **Union SWCD, NRCS, Watershed Technician, Steering Committee** | Time spent in initiating and promoting program.<br><br>Funding dependant upon participants | Ohio EPA | Initiated Water Pollution Control Loan Fund program<br><br>Increased # of voluntary landowners in program<br><br>Increased # of voluntary landowners with implemented BMPs |
| Water quality monitoring | Continuous | **Ohio EPA, Columbus Division of Water** | Ohio EPA grants, City of Columbus time spent monitoring, Cost of lab analysis | Ohio EPA | Documented changes in water quality<br><br>Reductions in phosphorus and nitrogen levels |
| Promote and implement 2 wetland creations | 2009-2014 | **Union and Logan SWCDs, NRCS, FSA,** | Chain link fence along dike for rodent | WHIP, Scioto CREP, and CRP | 2 wetland created |

| | | | | | |
|---|---|---|---|---|---|
| | | **Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife** | control ($0.75/sq ft) Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | | |
| Promote and implement 2 wetland restorations | 2009-2014 | **Union and Logan SWCDs, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife** | Chain link fence along dike for rodent control ($0.75/sq ft) Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 2 wetlands restored |
| Promote and implement 1 wetland enhancement | 2009-2014 | **Union and Logan SWCDs, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of** | Chain link fence along dike for rodent control ($0.75/sq ft) Excavation ($2.75/cu yd)<br><br>Tile blocking ($50) | WHIP, Scioto CREP, and CRP | 1 wetland enhanced |

| | | | | | |
|---|---|---|---|---|---|
| | | **Wildlife** | Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | | |
| Hold meetings to inform landowners of government conservation programs | Continuous | **Land Heritage Trust of Union County, Union SWCD, FSA, OSU Extension, NRCS** | Cost of meetings | Land Heritage Trust of Union County, NRCS USDA | 1 meeting held with approximately 15 attendees<br><br>Increased # of participants in government conservation programs |

# Critical Area C – Bokes Creek from the Powderlick Run Confluence to the Scioto River Confluence

## Impairment: Nutrients* II and Total Suspended Solids (Sewage Sources)

***Specifically Nitrate**

### Target Area:

**Magnetic Springs**

### *Problem Statement*

Old, failing and unmaintained septic systems in the Magnetic Springs area contribute to high in-stream nitrate levels. Loadings of nitrate and total suspended solids have resulted from these failing or possibly non-existent household sewage treatments systems (HSTS). Total suspended solids (TSS) can impair water quality, habitat, and biology of a stream. TSS can also be a source of bacteria, especially when dealing with solids from improper sewage treatment systems. Smothering of habitats and aquatic life within the stream can occur with excessive TSS loading. The annual average for nitrate levels in Bokes Critical Area C is 5.62 ppm, and the annual average for TSS levels is 17.75 ppm.

**Goals**

- Reduce in-stream nitrate levels from an annual average of 5.62 ppm to 3.93 ppm (30%) within five years
- Reduce in-stream TSS levels from 17.75 ppm to 12.43 ppm (30%) within five years.

## *Implementation Strategies/Task Table*

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Review and inspect all septic systems<br><br>Repair 55% of failing septic systems | 2009-2014 | **Logan County and Union County Health Departments** | $4,000 total (i.e. inspection cost and time) | Fees | Reviewed and inspected all septic systems<br><br>Repaired 55% of failing septic systems |
| Explore funding options for septic maintenance and repair<br><br>Options include: Water Pollution Control Loan Fund Program, DEFA low interest loan program, | Continuous | **Watershed Technician,** Logan and Union County Health Departments, Union SWCD | Time spent for research by watershed tech.<br><br>Funding dependant upon participants | State, local, Ohio EPA | Obtained funding<br><br>Initiated Water Pollution Control Loan Fund program<br><br>Replaced or upgraded septic systems<br><br>Decreased # of failing septic |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | systems |
| Promote responsible septic system maintenance | Continuous | **Logan and Union County Health Departments,** Watershed Technician, Steering Committee, Union SWCD | Cost of workshops | State, OEPA OEEF | Two workshops held<br><br>70% of workshop participants indicated increased understanding of septic systems<br><br>50% of workshop participants indicated they would have septic system inspected<br><br>200 brochures distributed |

# Critical Area C – Bokes Creek from the Powderlick Run Confluence to the Scioto River Confluence

## Impairment: Sedimentation

### Target Areas:

**Smith Run**—(River Miles 4.90-2.70) No data is available on current QHEI (habitat) scores for the upper reaches of Smith Run, but the target is 60.

### *Problem Statement*

There is increased sedimentation due to habitat alteration in Smith Run. Sedimentation is identified as a cause of impairment in Bokes Critical Area C, because of its excessive loading from agriculture and from channelization/habitat alteration. Erosion from crop fields and pastures is a primary source of sediment loading into Bokes Critical Area C. "OAC Rule 3745-1-04 (A) states that all waters of the state shall be free from suspended solids and other substances that enter the waters as a result of human activity and that will settle to form objectionable sludge deposits, or that will adversely affect aquatic life," (Ohio EPA Bokes TMDL, 2002).

"To target the impact of sediments upon the habitat and biological community, Ohio EPA used the Qualitative Habitat Evaluation Index (QHEI) scores as a surrogate for

sediment load. Reductions in sediments will result in improvements in the habitat and an improvement in assimilative capacity and biological community, and this will be reflected in improved QHEI scores and improved biotic communities. The QHEI target for warmwater habitat is greater than or equal to 60," (Ohio EPA Bokes TMDL, 2002).

### *Goals*

- Within five years, improve habitat by 30%; therefore decreasing sedimentation
- Smith Run -- Achieve the target QHEI (habitat) score of 60

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote and build 2 access roads | 2009-2014 | **Logan and Union SWCDs**, Steering Committee, NRCS, FSA, Watershed Technician, voluntary landowners | Culvert for drainage ($10.00/ft)<br><br>Surface Treatment – Gravel ($1.60/sq. ft)<br><br>Livestock Stream Crossing ($3.50/sq.ft)<br><br>Culvert crossing only ($13.50/ft) | EQIP cost incentives, CRP | 2 access roads built |
| Promote and implement 15 | 2009-2014 | **Logan and Union** | Gravel ($25,000/ac) | CRP, EQIP cost | 15 acres of Heavy Use |

| | | | | | |
|---|---|---|---|---|---|
| acres Heavy Use Area Protection | | **SWCDs**, Steering Committee, NRCS, FSA, Watershed Technician, voluntary landowners | Concrete ($60,000/ac) | incentives | Area Protection implemented |
| Promote and implement 150 acres of conservation crop rotation | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $12.00/ac | Scioto CREP, and CRP | 150 acres of conservation crop rotation implemented<br><br>~35 acres of conservation crop rotation installed per year<br><br>185 tons/yr sediment load reduction |
| Promote and implement 85 acres of critical area planting | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA | Critical area seeding w/ earthmoving ($600/ac)<br><br>Critical area seeding w/o earthmoving ($400/ac) | Scioto CREP, and CRP | 85 acres of critical area planting are implemented<br><br>~20-21 acres of critical area planting implemented per year<br><br>113 ton/yr sediment load reduction |
| Promote and implement 150 acres of field border (CP 33 Quail Habitat Seeding or Warm Season grass | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary | CP 33 Quail Habitat Seeding ($225/ac)<br><br>Warm Season Grass ($200/ac) | CP 33 Bobwhite Quail Initiative, and CRP | 150 acres of field border installed<br><br>~35 acres of field border installed per year |

| | | | | | |
|---|---|---|---|---|---|
| mix) | | landowners, ODA, Ohio EPA, Div. of Wildlife, Pheasants Forever | | | 185 tons/yr sediment load reduction |
| Promote and implement 400 acres of Filter Strips | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA | Cool Season grasses ($135/ac)<br><br>Warm Season grasses w/ chemical treatment ($200/ac)<br><br>Warm Season grasses w/o chemical treatment ($150/ac) | Scioto CREP, and CRP | 400 acres of filter strips implemented<br><br>~100 acres of filter strips implemented per year<br><br>284 ton/yr sediment load reduction |
| Promote and implement 120 acres of prescribed grazing | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $12.00/ac | Scioto CREP, and CRP | 120 acres of prescribed grazing implemented<br><br>~30 acres of prescribed grazing<br><br>152 tons/yr sediment load reduction |
| Promote and implement 150 acres of conservation cover (warm season grass mix most commonly used by NRCS and | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, | $200/ac | Scioto CREP, and CRP | 150 acres of conservation cover implemented<br><br>~35 acres of conservation cover installed per year |

| | | | | | |
|---|---|---|---|---|---|
| FSA) | | ODA, Ohio EPA, Div. of Wildlife | | | 185 tons/yr sediment load reduction |
| Water quality monitoring | Continuous | **Ohio EPA**, Columbus Division of Water (turbidity), City of Marysville, Oxbow Stream Restoration | Cost of labor and lab analysis. | Ohio EPA | Documented changes in water quality |
| Reduce construction site runoff through administration of construction site review processes and require the use of Best Management Practices (BMP) according to ODNR "Rainwater Manual" | Continuous | **SWCD and Engineers Offices** for site reviews and sediment control regulations | Cost of staff time<br><br>$2,000 for an educational breakfast for homeowners and builders to inform them of BMPs and sediment control regulations | SWCD, educational funds, City of Marysville | Number of site reviews completed<br><br>Site sediment controls and BMPs in place<br><br>Breakfast held |

# Critical Area C – Bokes Creek from the Powderlick Run Confluence to the Scioto River Confluence

## Impairment: Atrazine

### Target Areas:

All areas of Critical Area C – Bokes Creek form the Powderlick Run Confluence to the Scioto River Confluence

### *Problem Statement*

The predominance of atrazine applications for agricultural pesticide purposes in Critical Area C has resulted in high in-stream concentrations of atrazine. High atrazine concentrations can impair water quality and the aquatic life within the stream. Excessive spraying of atrazine in fields can be a source of atrazine runoff into nearby streams. Pesticides containing high amounts of atrazine increase the concentration of atrazine in nearby streams. Using low atrazine concentration pesticides are an alternative that have less of an impact than high atrazine concentration pesticides. Lack of riparian areas also allows more atrazine to enter into the stream. Current concentration of the in-stream atrazine level is 0.56 ppb. This level needs to be reduced to protect water quality and the aquatic life of Critical Area C.

### Goal

- Entire area of Critical Area C – Decrease in-stream atrazine levels from an annual average of 0.56 ppb to 0.39 ppb (30%) within five years

## Implementation Strategies/Task Table

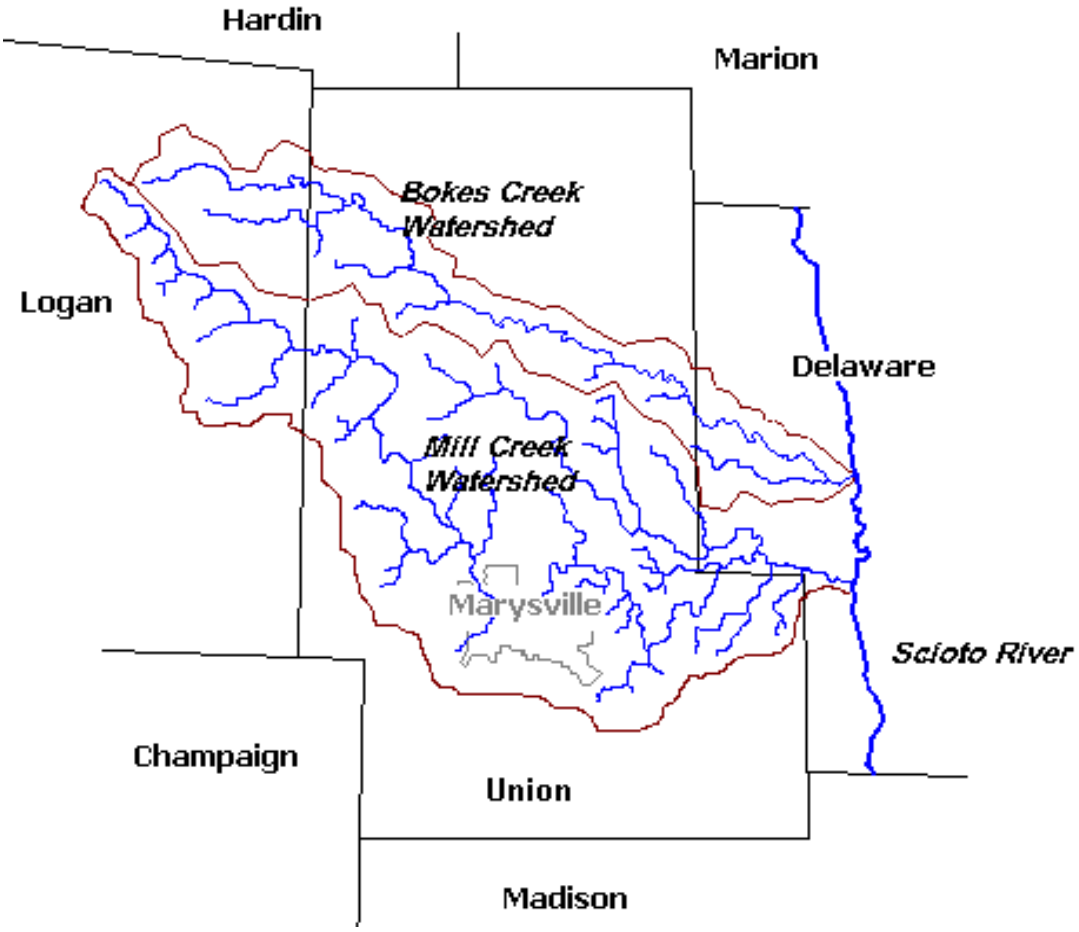
| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote and implement 400 acres of filter strips | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Ohio EPA | Cool season grasses ($135/ac)<br><br>Warm season grasses w/ chemical treatment ($200/ac)<br><br>Warm season grasses w/o chemical treatment ($150/ac) | Scioto CREP, and CRP | 400 acres of filter strips implemented<br><br>~100 acres of filter strips implemented per year |
| Promote and build 1 Agrichemical Handling Facility | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | Max. cost of $40,000 for cost incentives | EQIP | Agrichemical Handling Facility built |
| Promote and implement 2 wetland creations | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, | Chain link fence along dike for rodent control ($0.75/sq ft)<br><br>Excavation ($2.75/cu | WHIP, Scioto CREP, and CRP | 2 wetlands created |

| | | | | | |
|---|---|---|---|---|---|
| | | Division of Wildlife | yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | | |
| Promote and implement 2 wetland restorations | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of Wildlife | Chain link fence along dike for rodent control ($0.75/sq ft)<br><br>Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 2 wetlands restored |
| Promote and implement 1 wetland enhancement | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, Division of | Chain link fence along dike for rodent control ($0.75/sq ft)<br><br>Excavation ($2.75/cu yd) | WHIP, Scioto CREP, and CRP | 1 wetland enhanced |

| | | | | | |
|---|---|---|---|---|---|
| | | Wildlife | Tile blocking ($50)<br><br>Tile search/ Trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | | |
| Promote and implement 5 Grassed Waterways (Grass WW) | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | Grass WW, no tile ($3.25-$5.00/ft)<br><br>Blind inlet ($700)<br><br>Riser inlet ($210)<br><br>Buffer strips adj. to WW, cool season mix ($135/ac)<br><br>Mulch netting ($0.05/sq. ft)<br><br>Erosion Control Blanket ($0.10 sq. ft)<br><br>Rock Check ($140-$155) | CRP | 5 Grass WW constructed<br><br>~1-2 Grass WW constructed per year |

| | | | | | |
|---|---|---|---|---|---|
| | | | Stone Centered Outlet ($65-80) | | |
| Promote and offer cost incentives for low-atrazine herbicides | 2009-2014 | **Watershed Technician**, NRCS, Steering Committee, Logan and Union SWCDs, OSU Extension, voluntary landowners | Time spent by Watershed Technician and others<br><br>Funding dependant upon participants | NRCS, SWCD, OSU extension, local | Increased # of acres utilizing low-atrazine herbicides<br><br>Decreased in-stream atrazine levels |
| Initiate Water Pollution Control Loan Fund program | Continuous | **Logan and Union SWCDs,** NRCS, Watershed Technician, Steering Committee, voluntary landowners | Funding dependant upon participants<br><br>Time spent on promotion | Ohio EPA | Initiated Water Pollution Control Loan Fund program<br><br>Increased # of voluntary landowners enrolled in program<br><br>Increased # of voluntary landowners with implemented BMPs |
| Water quality monitoring | Continuous | **Columbus Division of Water** | Cost of sampling and lab analysis | Columbus, Ohio EPA | Documented changes in atrazine levels |

# Mill Creek Watershed Action Plan



The Mill Watershed Action Plan explains the causes of the sources of impairments. Restoration and protection goals are then determined specifically for the cause and source of impairment to the water quality of Mill Creek. Action items are the specific tasks outlined to protect and restore Mill Creek from the causes and sources of impairments. These items are organized according to smaller sections of the Mill Watershed; Critical Area A, Critical Area B, Critical Area C, and Critical Area D. Each critical area has a specific set of water quality concerns, which are addressed by the action items to be implemented.

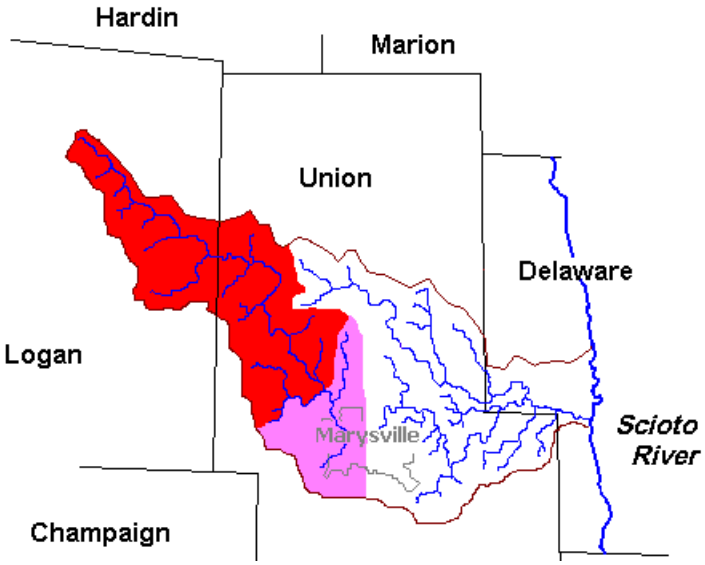
Impairments to Mill Creek are determined by local stakeholder input, Bokes/Mill Creek Watershed Partnership, City of Columbus, and assessments performed by Ohio EPA such as the TMDL. The restoration/protection goals and action items have been developed by the Bokes/Mill Creek Watershed Partnership. The Partnership works to ensure that the action items are effective, realistic, and achievable. The action items were developed to be acceptable to watershed stakeholders. Prioritization of action items for protection and restoration will include a preliminary assessment of soils using Natural Resources Conservation Service's (NRCS) Soil Survey Geographic (SSURGO) Database. SSURGO Soil Data Mart will be used when implementing water quality restoration or protection projects.

Public involvement and outreach is considered a high priority in achieving these action items for improved water quality of Mill Creek. Planned educational activities will

be utilized to promote adoption of BMPs.  Major educational events include Equine Environmental Liability and Awareness Program, Septic System workshops, Groundwater/Well workshops, Source Water Environmental Education Team (SWEET) programs, Rain Garden tours/workshops, Crosses Run Stream Restoration tours/presentations, and Powderlick Run Stream Restoration tours/presentations. Indicators of success with educational events are an increase of understanding and awareness, leading to a change in behavior.

## Critical Area A – Headwaters of Mill Creek to SR 31

### Physical Description




The headwaters of Mill Creek to the confluence of Otter Run (RM 23.80) meet full water quality standards for WWH and are not listed as impaired on the Ohio EPA's Total Maximum Daily Load (TMDL) list. However, this stream section is considered threatened; its current attainment of water quality standards could decrease at any time if there are land use changes and/or septage disposal in the watershed. This stream section has historically been quick to recover from pollutant spills and fish kills, so it should be considered threatened but not impaired (Ohio EPA, 1997).

The stream section from the confluence of Otter Run (RM 23.80) to SR 31 (approximately RM 20.0) is listed on the Ohio EPA's TMDL list; however, it is currently meeting water quality standards. This area is directly upstream of the City of Marysville and may become impacted in the future due to increased development or land use changes.

Since Critical Area A is currently meeting water quality standards, the Best Management Practices that are currently implemented should be identified and promoted throughout the entire watershed. In summary, continue doing what is being done, and apply these practices to the stream sections not meeting water quality standards.

In 1995, the Ohio EPA conducted a biological and water quality study of the Mill Creek watershed. All study sites upstream of the Marysville intake were found to be fully meeting water quality standards. However, the study also found that fecal coliform counts above the primary contact criterion refer to “waters suitable for full body contact …with minimal threat to public health as a result of water quality”. Most of the fecal coliform exceedance was associated with point sources, septic ditches, agricultural inputs and other diffuse sources. The locations of the fecal coliform exceedences and the reported values within the protection area are listed in the table below.

| | | | | Primary Contact Standard |
|---|---|---|---|---|
| River Mile | Parameter | Value | Mean | Max |
| 39.2 | Fecal Coliform | 1060/100 ml<br>2700/100 ml | 1000/100 ml | 2000/100 ml |
| 36.1 | Fecal Coliform | 1070/100 ml<br>5800/100 ml | N/A | N/A |
| 28.1 | Fecal Coliform | 7090/100 ml | N/A | N/A |
| 24.7 | Fecal Coliform | 2300/100ml | N/A | N/A |
| 19.4 | Water Plant intake | | N/A | N/A |
| 19.0 | Fecal Coliform | 2300/100 ml | N/A | N/A |

The primary contact criteria are measured as a mean or maximum value. Mean fecal coliform value is 1000 colonies per 100 milliliters (ml). The maximum value is 2000 colonies/ per 100 ml. (Drinking Water Source Assessment for the City of Marysville, 2002). Also during 1995, complaint investigations by the Union County Health Department and Ohio EPA found unsanitary conditions in tributaries to Mill Creek, near Raymond and Peoria. The source of these water quality problems is untreated or partially treated septic discharges.

Tributaries in this critical area include:

- **Otter Creek** (Logan County) – Drains an old glacial lake bed (lake bed area is characterized by poor drainage and the ditching of headwater and intermittent streams) (Ohio EPA, 2002). Lower reaches revealed good quality communities of fish and macroinvertebrates. In 1995, this tributary was visibly impacted by the construction of US 33, west of East Liberty. From County Rd. 145 and the intersection of SR 347 and "old" 33, the stream was constricted between the old and newly constructed road berms (Table 19) (Ohio EPA, 1997).

- **Otter Run** (Union County)

The potential sources of impairment include:

- Agriculture

The potential causes of impairment include:

- Organic enrichment/low dissolved oxygen

Many landowners view flooding in the Mill Creek headwaters, between Walnut Grove and the intersection of SR 292 and County Road 2, as a serious problem (Ohio EPA, 2002).

Immediately upstream of the Marysville WTP intake, at RM 19.4, a small low head dam creates an impoundment from which the Marysville WTP draws water (Ohio EPA, 2002).

## Summary

Mill Creek, from its headwaters to Otter Run (River Miles 48.87 to 23.80), is meeting water quality standards and is not listed on the Ohio EPA's TMDL list.

The stream segment from Otter Run to SR 31 (River Miles 23.80 to 20.0) is also meeting water quality standards, but is listed on the Ohio EPA's TMDL list. This stream section was included in the watershed action plan because it includes the source water protection area for the City of Marysville's drinking water.

Since this critical area is meeting water quality standards, the conservation practices that are implemented in this region should be identified, and applied throughout the rest of the watershed (i.e. where water quality is not being met). This critical area is also defined by good quality riparian habitat.

Coordination with the Marysville Water Treatment Plant and its Source Water Assessment Program (SWAP), intended to protect the City of Marysville's drinking

water supply, will better achieve goals of water quality protection. SWAP identifies the land that is critical for drinking water protection, and outlines how to reduce the contamination risk of the water within those areas.

Aquatic Life Use Attainment Status for Mill Creek Mainstem Sites Sampled From July to September 1995 (Ohio EPA, 1997).

| Mill Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 39.1 / 39.4 | WWH | 43 | 8.1 | 28 | 61.5 | Yes | Ust. Otter Creek |
| 36.1 / 36.0 | WWH | 46 | 8.2 | 40 | 64.0 | Yes | Dst. Otter Creek |
| 28.2 | WWH | 51 | 8.8 | 42 | 71.0 | Yes | Wheeler-Green Rd. |
| 24.8 | WWH | 49 | 8.7 | 40 | 73.0 | Yes | Cotton Slash Rd. |

Aquatic Life Use Attainment of Otter Creek From July to September 1995 (Ohio EPA, 1997).

| Otter Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 0.7 | WWH | 45 | N/A | Good | 70.5 | Yes | Dst. US 33 construction |

# Impairment: Land Use Changes

## Target Areas:

**All areas of Critical Area A – Headwaters of Mill Creek to SR 31**

## Problem Statement

Land use changes may threaten existing water quality. The City of Marysville is experiencing rapid growth and development. The increase in construction and development may negatively impact the natural habitats of Critical Area A in Mill Creek. Sedimentation of nearby waterways is often associated with the construction and development as a result of urban expansion. A change in the quality of existing habitat may also change the existing water quality of Critical Area A in Mill Creek. Protection of water quality in Critical Area A is extremely important, especially in the stream segment from Otter Run to SR 31 (RM 23.80 to 20.0), because it serves as a source water protection area for the City of Marysville's drinking water.

## Goals

- To maintain attainment of Critical Area A according to current water quality standards
- Otter Run to SR 31 (RM 23.80 to 20.0) – protect as a source water protection area for the City of Marysville's drinking water
- Examine what practices are working to protect water quality in Critical Area A, and apply those in the rest of the Mill Creek watershed

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Coordinate with Marysville SWAP | Continuous | **Marysville WTP**, Water Supply Subcommittee, Watershed Technician | Time spent by Marysville WTP and Watershed Technician | City of Marysville | Initiated SWAP<br><br>Established voluntary easements |
| Project Site along Bellville Road: Restore ditch floodplain and convert to a stream channel | Completed 2003 | **Union SWCD**, ODNR, Scotts, voluntary landowners (Elmer Heyob) | $8,837.50 | Union SWCD, Div. of Wildlife, Scotts, landowner | 500 ft long by 50 ft wide wetland and 700 ft of floodplain, 30 ft. wide w/ a 3 ft. wide meandering stream channel excavated within it. |
| Project Site along 31: Overwide Channel designed by Dan Mecklenburg, | 2009 | **Meijer, BBC&M** | Funding dependant on cost of mitigation Meijer decides | Meijer | 998 linear feet of stream channel designed and implemented |

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| approx. 998 linear ft. | | | | | as overwide channel |
| Promote and implement 225 acres of filter strips | 2009-2014 | **Logan and Union SWCDs**, Steering Committee, NRCS, OSU Extension, Watershed Technician, voluntary landowners | Cool Season Grasses ($135/ac)<br><br>Warm Season Grasses w/ chemical treatment ($200/ac)<br><br>Warm Season Grasses w/o chemical treatment ($150/ac) | Scioto CREP and CRP | 225 acres of filter strips implemented<br><br>~56 acres of filter strips implemented per year<br><br>171 ton/yr sediment reduction |
| Monitor water quality | Continuous | **Marysville WTP**, Columbus Division of Water, Ohio EPA | Cost of sampling and lab analysis | Marysville, Columbus, Ohio EPA | Water quality requirements met |
| Coordinate with City of Marysville on contractor and developer education on Phase II stormwater six BMPs | Continuous | **Watershed Technician and City of Marysville** | Time spent by Watershed Technician<br><br>Cost of educational events | City of Marysville, Ohio EPA, educational funds | BMPs being carried out by contractors and developers |
| Host an annual Contractor's Breakfast for City of Marysville to update | 2009 | **Watershed Technician** | Cost of hosting breakfast | City of Marysville, Ohio EPA educational funds | Record # of attendees<br><br>Contractors are updated on current stormwater |

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| contractors of stormwater regulations and BMPs | | | | | regulations<br><br>BMPs are carried out to protect source water protection areas. |
| Maintain updated through the County Engineer's office about future construction and development plans to write possible mitigation projects before construction begins | Continuous | **Watershed Technician and County Engineers,** ODOT | Time spent by Watershed Technician<br><br>Funding of grant dependant upon mitigation project proposal | ODOT, Ohio EPA | Watershed Technician remains informed of future construction and development and mitigation projects are proposed. |

# Impairment: Maple St. Low Overhead Dam

**Target Area**: **Maple St. low overhead dam by Schwartzkopf park**

## Problem Statement

The low overhead dam is negatively impacting the quality of the water and habitat along this section of Mill Creek. It impedes the natural channel flow of the stream, decreases dissolved oxygen levels, and reduces in-stream and riparian habitat. Ohio EPA's habitat and attainment goals are reduced because of the low overhead dam. Removal of the dam would lead to great benefits for the quality of Mill Creek.

## Goals

- Increase ICI and IBI scores
- Create higher dissolved oxygen levels
- Improve stream habitat (QHEI scores)
- Result in natural, stable channel conditions

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Apply for Ohio EPA's 319 grant program for federal funding to support the dam removal | 2009 | **Watershed Technician**, Marysville City Council, Marysville WTP | Time spent by Watershed Technician<br><br>Estimate of Dam Removal at time by consultant | Ohio EPA, City of Marysville | RFP sent and grant awarded |
| Work with City of Marysville to find local match for grant | 2009-2011 | **Watershed Technician** | Time spent by Watershed Technician, and City of Marysville | City of Marysville | 40% match obtained, depending on project cost |
| Conduct pre and post monitoring to indicate benefits of dam removal | 2009-2011 | **Marysville WTP,** City of Columbus | $38,000 for monitoring (specifically data sondes) | City of Marysville, and City of Columbus | Data sonde info collected, QHEI, ICI, and IBI scores obtained |

# Impairment: Nutrients* I (Agricultural Sources) *Specifically Nitrate

## Target Areas:

**All areas of Critical Area A – Headwaters of Mill Creek to SR 31**

## Problem Statement

Agriculture contributes nutrients and pesticides to the stream through runoff and improper application of fertilizer and/or pesticides. Nutrients may enter the stream if over application of fertilizers and pesticides occur. Two pathways for nutrients to enter into a stream are 1) runoff through soil erosion and 2) groundwater leaching. Improper manure application may also be a source of nutrient loading into a stream.

The Marysville Water Treatment Plant regularly monitors the nitrate levels in Mill Creek. A drinking water violation occurs when nitrate levels exceed 10 ppm. According to the 2004 Water Quality Report from the Marysville WTP, the average nitrate levels measured in Mill Creek are 2.35 ppm. The low in-stream levels must be maintained to meet water quality standards for drinking water.

## Goal

- Maintain low in-stream nitrate levels to meet water quality standards for drinking water

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Coordinate with Marysville SWAP | Continuous | **Marysville WTP**, Water Supply Subcommittee, Watershed Technician | Time spent by Marysville WTP and Watershed Technician | City of Marysville | Initiated SWAP<br><br>Established voluntary easements |
| Promote and implement 130 acres of conservation crop rotation | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | $12.00/ac | Scioto CREP and CRP | 130 acres of conservation crop rotation implemented<br><br>~33 acres of conservation crop rotation installed per year.<br><br>277 lb/yr phosphorus load reduction<br><br>554 lb/yr nitrogen load reduction |
| Promote and implement 90 acres of Critical Area Planting | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary | Critical Area seeding w/ earthmoving ($600/ac)<br><br>Critical Area seeding w/o earthmoving ($400/ac) | Scioto CREP and CRP | 90 acres of Critical Area Planting implemented<br><br>~23 acres of Critical Area Planting installed per year. |

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| | | landowners | | | 199 lb/yr phosphorus load reduction<br><br>398 lb/yr nitrogen load reduction |
| Promote and implement 2,300 ft of fencing | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | Barbed Wire Fence ($2.25/ft) | CRP | 2,300 ft of fencing implemented |
| Promote and implement 130 acres of Field Border (CP 33 Quail Habitat Seeding or Warm Season Grasses mix) | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, Division of Wildlife, Pheasants Forever, voluntary landowners | CP 33 Quail Habitat Seeding ($225/ac)<br><br>Warm Season Grass ($200/ac) | CP 33 Bobwhite Quail Initiative<br><br>CRP | 130 acres of conservation crop rotation implemented<br><br>~33 acres of conservation crop rotation installed per year.<br><br>277 lb/yr phosphorus load reduction<br><br>554 lb/yr nitrogen load reduction |
| Promote and implement 90 acres of nutrient | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, | Nutrient management ($5.00/ac) | EQIP and CRP | 90 acres of Critical Area Planting implemented |

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| management | | Steering Committee, Watershed Technician, ODA, voluntary landowners | Nutrient management w/ precision (grid) farming ($10.00/ac) | | ~23 acres of Critical Area Planting installed per year.<br><br>199 lb/yr phosphorus load reduction<br><br>398 lb/yr nitrogen load reduction |
| Promote and implement 130 acres of prescribed grazing | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | $12.00/ac | Scioto CREP and CRP | 130 acres of prescribed grazing implemented<br><br>~33 acres of prescribed grazing installed per year.<br><br>277 lb/yr phosphorus load reduction<br><br>554 lb/yr nitrogen load reduction |
| Promote and build 1 Waste Storage Facility | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, | Maximum cost of $31,000 for cost incentives | EQIP cost incentives | Waste storage Facility built |

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| | | ODA, voluntary landowners | | | |
| Promote and implement waste utilization (under nutrient management plans) | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | ~$1,000 per plan (depending on # and type of animals)<br><br>$6.00/ac (greater than 50 ppm)<br><br>$30.00/ac (less than or equal to 50 ppm) | EQIP Cost Incentives | Waste Utilization included and implemented in plan<br><br>4 nutrient management plans implemented |
| Promote and build 1 Agrichemical Handling Facility | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | Maximum cost of $40,000 for cost incentives | EQIP Cost Incentives | Facility built |
| Promote and implement 130 acres of Conservation Cover (warm season grass mix most commonly used by NRCS and FSA) | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, Division of Wildlife, voluntary landowners | $200/ac | Scioto CREP and CRP | 130 acres of conservation cover implemented<br><br>~33 acres of conservation cover implemented per year<br><br>277 lb/yr phosphorus |

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| | | | | | load reduction<br><br>554 lb/yr nitrogen load reduction |
| Promote and implement 5 Grassed Waterways (Grass WW) | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners | Grass WW, no tile ($3.25-$5.00/ft)<br><br>Blind inlet ($700)<br><br>Riser inlet ($210)<br><br>Buffer strips adj. to WW, cool season mix ($135/ac)<br><br>Mulch netting ($0.05/sq. ft)<br><br>Erosion control blanket ($0.10 sq. ft)<br><br>Rock Check ($140-$155)<br><br>Stone Centered Outlet ($65-80) | CRP | 5 Grass WW constructed<br><br>1-2 Grass WW constructed per year |
| Initiate Water Pollution Control Loan | Continuous | **Union SWCD,** NRCS, Watershed | Loan dependant upon | Ohio EPA | Increased # of voluntary landowners |

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| Fund Program | | Technician, Steering Committee, Ohio EPA, voluntary landowners | participant and project | | in program w/ implemented BMPs |
| Water Quality Monitoring | Continuous | **Ohio EPA and Columbus Div. of Water** | Ohio EPA grants, City of Columbus time spent monitoring, cost of lab analysis | Ohio EPA | Documented changes in water quality such as ICI, IBI, and QHEI scores<br><br>Documented changes in phosphorus and nitrogen levels |
| Promote and implement 2 wetland creations | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, Division of Wildlife, voluntary landowners | Chain link fence along dike for rodent control ($0.75/sq. ft)<br><br>Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 2 wetlands created |
| Promote and implement 2 wetland restorations | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, | Chain link fence along dike for rodent control ($0.75/sq. ft) | WHIP, Scioto CREP, and CRP | 2 wetlands restored |

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| | | Watershed Technician, ODA, Division of Wildlife, voluntary landowners | Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | | |
| Promote and implement 1 wetland enhancement | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, Division of Wildlife, voluntary landowners | Chain link fence along dike for rodent control ($0.75/sq. ft)<br><br>Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 1 wetland enhanced |
| Hold Bokes/Mill Partnership Meetings to inform landowners of government conservation programs | 2009-2014 NRCS sign up or enrollment periods for programs | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, Land Heritage Trust of Union County, | Cost of meetings | Land Heritage Trust of Union county, NRCS, USDA | 1 meeting held about programs w/ approx. 15 attendees. |

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| | | voluntary landowners | | | |
| Promote and create 4 comprehensive nutrient management plan | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | $500-$1,500 per plan (depending on # and type of animals, AUs) | EQIP cost incentives | 4 plans created<br><br>1 plan per year implemented |
| Promote and implement 225 acres of Filter Strips | 2009-2014 | **Logan and Union SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | Cool Season Grasses ($135/ac)<br><br>Warm Season Grasses w/ chemical treatment ($200/ac)<br><br>Warm Season Grasses w/o chemical treatment ($150/ac) | Scioto CREP and CRP | 225 acres of filter strips implemented<br><br>~56 acres of filter strips implemented per year<br><br>459 lb/yr phosphorus load reduction<br><br>858 lb/yr nitrogen load reduction |

# Impairment: Nutrients* II and Total Suspended Solids (Sewage Sources) *Specifically Nitrate

## Target Areas:

**Raymond**

**Peoria**

**Septic Systems within the Marysville Source Water Protection Area**

## Problem Statement

Old, failing and unmaintained septic systems in Raymond, Peoria, and Marysville's Source Water Protection Area contribute to elevated in-stream nitrate levels. Loadings of nitrate and total suspended solids have resulted from these failing household sewage treatments systems (HSTS). Total suspended solids (TSS) can impair water quality, habitat, and biology of a stream. TSS can also be a source of bacteria, especially when dealing with solids from improper sewage treatment systems. Smothering of habitats and aquatic life within the stream can occur with excessive TSS loading. Low in-stream nitrate levels and TSS levels must be maintained to meet water quality standards for drinking water.

The Union County Health Department has a history of identifying and documenting old, failing and unmaintained residential and commercial septic systems in Mill Creek. The Health Department annually inspects both residential and commercial septic systems to identify problem systems. Through their experience, approximately 30-35% of aeration systems need repair and replacement each year, especially in Raymond and Peoria within the Mill Creek watershed. The Health Department staff also responds to other system requests and complaints, and then provides repairs or replacements as needed. In the past six years, the Health Department has issued and approved between 70-100 permits each year for replacement and/or upgrading of existing and failing systems.

## Goals

- Maintain low in-stream nitrate levels and total suspended solid levels to meet water quality standards for drinking water
- Alleviate sewage problems in the Raymond and Peoria areas

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Coordinate with Marysville SWAP | Continuous | **Marysville WTP**, Water Supply Subcommittee, Watershed Technician | Time spent for SWAP | City of Marysville | Initiated SWAP<br><br>Established voluntary easements |
| Extend sewer lines from Raymond and Peoria | 2011 | Determined by Technical Committee for sewage problems in | Not known at present time | State or local | Sewer lines are extended<br><br>Decreased in-stream |

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| | | Raymond and Peoria | | | phosphorous levels |
| Review and inspect septic systems to assure proper function<br><br>Repair 55% of failing systems | 2009-2014 | **Logan and Union County Health Departments** | $4,000 total (i.e. inspection cost and time) | Fees | Reviewed and inspected septic systems |
| Explore funding options to upgrade/repair/maintain septic systems<br><br>Options include: Water Pollution Control Loan Fund Program, DEFA low interest loan program | Continuous | **Logan and Union County Health Departments**, Watershed Technician, Technical Advisory Committee | Time of research<br><br>Funds depend on participants | State, local, Ohio EPA | Obtained funding<br><br>Initiated Water Pollution Control Loan Fund program<br><br>Upgraded septic systems<br><br>Decreased # of failing septic systems |
| Promote responsible septic system maintenance | Continuous | **Logan and Union County Health Departments**, Watershed Technician, Steering Committee, Union SWCD, voluntary landowners, | Cost of workshops | State, Ohio EPA, educational funds | Two workshops held<br><br>70% of workshop participants indicated increased understanding of septic systems<br><br>50% of workshop participants indicated they would have septic system |

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| | | | | | inspected<br><br>200 brochures distributed |
| Initiate technical committee to alleviate sewage problems in the Raymond and Peoria areas | March 2006 | **Union County Commissioners,** Engineers, Watershed Technician, Concerned Citizens | Cost of meetings and promotion | Union County and local funds | Methods determined for sewage treatment repair<br><br>Water quality improvements downstream of Raymond and Peoria as a result of alleviating sewage problems |

# Impairment: Atrazine

## Target Areas:

All areas of Critical Area A – Headwaters of Mill Creek to SR 31

## Problem Statement

The predominance of atrazine applications for agricultural pesticide purposes in Critical Area A as resulted in high in-stream concentrations of atrazine. High atrazine concentrations can impair water quality and the aquatic life within the stream. Excessive spraying of atrazine in fields can be a source of atrazine runoff into nearby streams. Pesticides containing high amounts of atrazine increase the concentration of atrazine in nearby streams. Using low atrazine concentration pesticides are an alternative that have less of an impact than high atrazine concentration pesticides. Lack of riparian areas also allows more atrazine to enter into the stream. The Marysville Water Treatment Plant regularly monitors the atrazine levels in Mill Creek. A drinking water violation occurs when atrazine levels exceed 3 ppb. The annual average of the

in-stream atrazine level is 1.25 ppb. This level needs to be reduced and maintained to protect drinking water quality of Critical Area A.

### *Goals*

- Decrease in-stream atrazine levels from an annual average of 1.25 to 0.88 ppb (30%) within five years.
- Maintain low atrazine levels (below 3 ppb) for the City of Marysville's Drinking Source Water Protection Area (Otter Run to SR 31-RM 23.80 to 20.0)

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote and implement 225 acres of filter strips | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | Cool Season Grasses ($135/ac)<br><br>Warm Season Grasses w/ chemical treatment ($200/ac)<br><br>Warm Season Grasses w/o chemical treatment ($150/ac) | Scioto CREP and CRP | 225 acres of filter strips implemented<br><br>~56 acres of filter strips implemented per year. |
| Promote and build 1 Agrichemical handling Facility | 2009-2014 | **Logan and Union SWCDs**, Steering Committee, Watershed Technician, ODA, | Max. cost of $40,000 for cost incentives | EQIP | Agrichemical Handling Facility built |

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| | | voluntary landowners | | | |
| Promote and implement 2 wetland creations | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, Division of Wildlife, voluntary landowners | Chain link fence along dike for rodent control ($0.75/sq. ft)<br><br>Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 2 wetlands created |
| Promote and implement 2 wetland restorations | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, Division of Wildlife, voluntary landowners | Chain link fence along dike for rodent control ($0.75/sq. ft)<br><br>Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 2 wetlands restored |

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|---|---|---|---|---|---|
| Promote and implement 2 wetland enhancements | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, Division of Wildlife, voluntary landowners | Chain link fence along dike for rodent control ($0.75/sq. ft)<br><br>Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 2 wetlands enhanced |
| Promote and implement 5 Grassed Waterways (Grass WW) | 2009-2014 | **Logan and Union SWCDs**, NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners | Grass WW, no tile ($3.25-$5.00/ft)<br><br>Blind inlet ($700)<br><br>Riser inlet ($210)<br><br>Buffer strips adj. to WW, cool season mix ($135/ac)<br><br>Mulch netting ($0.05/sq. ft)<br><br>Erosion control blanket | CRP | 5 Grass WW constructed<br><br>1-2 Grass WW constructed per year |

| | | | | | |
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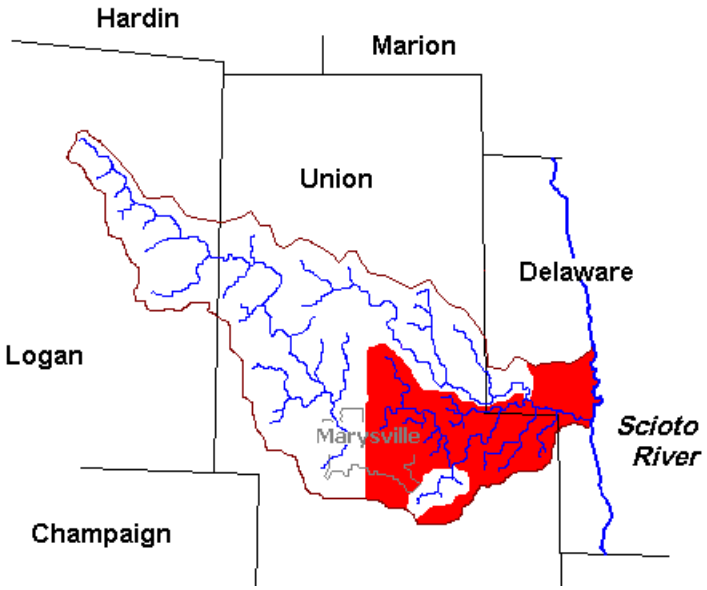
| | | | ($0.10 sq. ft)<br><br>Rock Check ($140-$155)<br><br>Stone Centered Outlet ($65-80) | | |
| Promote and offer cost incentives for low atrazine herbicides | 2009-2014 | **Watershed Technician,** NRCS, Steering Committee, Logan and Union SWCDs, OSU Ext., voluntary landowners | Cost of pesticide workshop<br><br>Explore BMP grant opportunities | NRCS, OSU extension | Increased awareness of low atrazine herbicides<br><br>Increased # of acres utilizing low atrazine herbicides |
| Initiate Water Pollution Control Loan Fund program | Continuous | **Logan and Union SWCDs,** NRCS, Watershed Technician, Steering Committee, voluntary landowners | Funds depend upon participants<br><br>Time spent on program promotion | Ohio EPA | Initiated Water Pollution Control Loan Fund program<br><br>Increased # of voluntary landowners enrolled in program<br><br>Increased # of voluntary landowners with implemented BMPs |
| Water quality monitoring | Continuous | **Marysville WTP**, Columbus Division of Water | Cost of sampling and lab analysis | Marysville, Columbus, Ohio EPA | Documented changes in water quality |

Critical Area B – Mill Creek (east of SR 31) to the Scioto River Confluence

## Physical Description:




During the low flow summer season, this section of Mill Creek is effluent dominated downstream from the City of Marysville. The Marysville Wastewater Treatment Plant contributes the majority of point source loading to Mill Creek. As the plant expands and smaller municipal and industrial discharges are tied into the sewer system and eliminated, the Marysville WWTP will continue to be the primary point source to Mill Creek (Ohio EPA, 2002).

Water quality violations include low dissolved oxygen and high levels of ammonia, total phosphorous and fecal coliform bacteria. Designated a WWH, Mill Creek reaches full attainment of water quality standards to RM 14.6, except for a slight decline to partially meet water quality standards (partial attainment) immediately downstream of Crosses Run. The stream improves with increased distance from Crosses Run. From upstream Ostrander to the mouth at the Scioto River, the stream meets water quality standards (Ohio EPA, 2002).

Tributaries in this critical area include:

- **Town Run** - Town Run is a tributary that runs directly through the City of Marysville. Approximately 0.3 miles of the stream are culverted and actually flows under buildings. This culverted section acts as a sediment trap and is considered a “hot spot” of sediment contamination. Designated Secondary Contact Recreation, it is recommended that only partial body contact be used in the stream (i.e. wading).

  Three tributaries drain into Town Run:

  - West Branch of Town Run Ditch
  - East Branch of Town Run Ditch
  - Bishop Ditch

  Organic enrichment and low dissolved oxygen levels in Town Run were due to failing septic systems in the upper reaches of the stream. The discharges were eliminated when the City of Marysville acquired funding through the State Issue 2 program to initiate sewer service in this area (Ohio EPA, 2002).

- **BMY Tributary –** Designated a LRW habitat due to extensive channelization and small drainage size, heavy metal toxicity from the

former BMY Corporation (RM 3.2) caused water quality impairment. The BMY discharge was temporary and due to defense buildup prior to the Gulf War in the early 1990's. In the early 1990's, the company closed and will most likely not produce a similar discharge in the future (Ohio EPA, 1997).

BMY Tributary had been extensively channelized in the 1920's, and again around 1980 Habitat modifications currently affect this tributary, and should be addressed through the watershed action plan (Ohio EPA, 2002).

Except for the Marysville WWTP, most other causes and sources of pollution to Mill Creek have diminished during the past ten years. From 1990 to 1995, sanitary sewer overflow repairs in Marysville (upstream of the WWTP) also improved water quality dramatically (Ohio EPA, 2002).

Sources of impairment:

- Marysville Wastewater Treatment Plant
- Urban runoff/landfills in Marysville

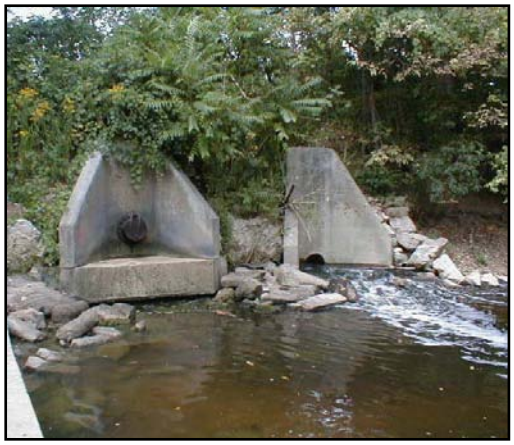
Causes of impairment:

- Organic enrichment/low dissolved oxygen
- Metals
- Priority organics
- Unknown toxicity

A small lowhead dam was present at RM 18.26 on Cherry St., immediately upstream of the WWTP (Ohio EPA, 2002). It was removed in 2004; water quality studies are necessary to observe improvements in the habitat and biological attainment.

As development and impervious surfaces increase in the future, stormwater runoff may further impact the stream.

## Summary



During the low flow summer season, this section of Mill Creek (River Miles 20.0 to 0.0) is effluent dominated downstream from the City of Marysville. The Marysville Wastewater Treatment Plant contributes the majority of pollution to Mill Creek, although stormwater runoff from impervious surfaces is also a source of increased runoff and contaminants. Habitat alteration of tributaries also impairs the water quality of Mill Creek.

Since sedimentation often correlates with poor habitat, target scores will be based on QHEI scores, the Ohio EPA's measure of habitat. The QHEI target score for Warmwater Habitats is 60, while the current QHEI score for this critical area is 34.

QHEI evaluates the physical characteristics of a stream segment, and measures 1) substrate (what stream bed is composed of), 2) in-stream tree cover, 3) riparian characteristics, 4) stream channel characteristics, 5) pool/riffle quality, and 6) stream gradient and drainage area.

Aquatic Life Use Attainment Status for Mill Creek Mainstem Sites Sampled From July to September 1995 (Ohio EPA, 1997).

| Mill Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 19.3 | WWH | 41 | 8.5 | 40 | 74.5 | Yes | Maple St. |
| 19.1 / 19.0 | WWH | 45 | 7.7 | 42 | 70.5 | Partial | Main St. |
| 18.4 /18.6 | WWH | 44 | 7.5 | 40 | 77.0 | Partial | Dst. Town Run |
| 18.2 | WWH | 37 | 6.4 | 16 | N/A | N/A | Marysville WWTP mixing zone |
| 18.1 | WWH | 39 | 6.6 | 18 | 71 | Partial | Cherry St. |
| 16.2 / 16.9 | WWH | 36 | 5.2 | 20 | 63.0 | No | Waldo Rd. |
| 14.6 | WWH | 42 | 8.5 | 44 | 68.0 | Yes | SR 36 |
| 12.0 / 12.1 | WWH | 37 | 8.3 | 42 | 78.5 | Yes | Ust. Crosses Run |
| 11.6 / 11.7 | WWH | 34 | 8.0 | 40 | 74.5 | Partial | Dst. Crosses Run |
| 6.9 | WWH | 38 | 8.6 | Good | 74.5 | Yes | Bellpoint/Hinton Mill Rd. |
| 4.4 | WWH | 49 | 9.7 | 44 | 88.5 | Yes | Ust. Ostrander WTP |
| 3.7 | WWH | 54 | 9.4 | 44 | 81.0 | Yes | Dst. WWTP and Blues Creek |
| 1. 7 / 1.6 | WWH | 51 | 9.6 | 50 | 91.0 | Yes | Near mouth |

Aquatic Life Use Attainment Status for Town Run Sites Sampled From July to September 1995 (Ohio EPA, 1997).

| Town Run (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 0.9 / 0.8 | WWH | 26 | N/A | Fair | 45.5 | No | Ust. Eljer Plumbingware |
| 0.7 | WWH | 30 | N/A | Fair | 53.5 | No | Dst. Eljer Plumbingware |
| 0.1 | WWH | 28 | N/A | Poor | 60.5 | No | Dst. Marysville urban |

Aquatic Life Use Attainment Status for BMY Tributary Sites Sampled in 1990 (Ohio EPA, 1997).

| BMY Tributary (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 3.4 | LRW | 12 | N/A | - | - | No | Ust. BMY Corp. |
| 3.3 | LRW | 16 | N/A | Very poor | - | No | Dst. BMY Corp. |
| 3.3 | LRW | 12 | N/A | Very poor | 27 | No | At US 33 Rest Area |

Critical Area B – Mill Creek (east of SR 31) to the Scioto River Confluence

# Impairment: High Influence Attribute—Sparse/No Cover

**Target Area:** Mill Creek along Waldo Rd (RM 16.2-16.8)

## Problem Statement

The section of Mill Creek along Waldo Rd (RM 16.2-16.8) is a non-attaining segment according to Ohio EPA's standards. The High Influence Attribute for this section is sparse or no cover in-stream. This causes a low habitat score, and reduces diversity of aquatic life within the stream. There are also six Moderate Influence Attributes documented in the TMDL (2003). These modified influence attributes harm habitat and wildlife scores, as well as attainment goals put forth by the EPA. Dissolved Oxygen levels are low, and the assimilative capacity within the stream is reduced by the lack of habitat and cover within Mill Creek.

## Goals

- Eliminate the High Influence Attribute of Sparse/No Cover
- Decrease Moderate Influence Attributes
- Reach Ohio EPA's attainment goals
- Elevate dissolved oxygen levels
- Increase assimilative capacity

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Apply for Ohio EPA's 319 program to request federal funds for in-stream restoration project utility | 2009-2014 | **Watershed Technician**, Union SWCD, City of Columbus, Scotts, City of Marysville | Time spent by Watershed Technician and Union SWCD staff | Ohio EPA | Grant proposal submitted<br><br>Grant awarded by March 2007 |
| Install 4+ riffle and pool sequences to increase in-stream habitat and biomass, and elevate dissolved oxygen and assimilative capacity | 2010-2012 | **Union SWCD,** environmental engineering firm after bid | $90,000 | Ohio EPA | Riffle sequences installed<br><br>High Influence Attribute eliminated<br><br>Improved habitat scores |
| Bank stabilization of eroding banks to reduce sediment loads into non-attaining segment | 2010-2012 | **Union SWCD**, environmental engineering firm after bid | $70,000 | Ohio EPA | Bank stabilization completed<br><br>Reduction in sediment loads (Approx. 40 tons/yr)<br><br>Reduction in Nitrogen (Approx. 79 pounds/yr) |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | Reduction in Phosphorus (Approx. 40 pounds/yr) |
| Data Sonde monitoring by City of Columbus | 2010-2012 | **City of Columbus** | $38,000 | City of Columbus | Monitoring results shown through data sondes<br><br>Data reported to Ohio EPA |

Critical Area B – Mill Creek (east of SR 31) to the Scioto River Confluence

# Impairment: Dense Accumulation of Trash & Debris

**Target Area:** Mill Creek along Waldo Rd (RM 16.2-16.8)

## Problem Statement

There is a massive accumulation that is acting like a dam to Mill Creek along Waldo Road on Tim White's property. Erosion and headcutting is resulting in the damming of the water. Russ Gibson, Ohio Environmental Protection Agency 319 Program Manager, stated that this accumulation of trash and debris should be removed because of its damage to the in-stream habitat. This is harmful to dissolved oxygen (DO) levels, fish passage, and in-stream macroinvertebrates.

## Goals

- Removal of trash and debris to allow for increased DO levels, increased QHEI scores, and allow fish passage

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Removal of | 2010- | **Watershed** | $75,000 | City of | Funding |

| | | | | | |
|---|---|---|---|---|---|
| trash and debris | 2012 | **Technician**, Union SWCD, City of Marysville, environmental engineering firm after bid | (quote from Oxbow) | Marysville? Or mitigation project | source achieved<br><br>Trash removed |
| Stabilize headcuts along Tim White's property | 2010-2012 | **Watershed Technician,** Union SWCD, City of Marysville, environmental engineering firm after bid | $100/sq.ft | Ohio EPA, City of Marysville?, or mitigation project | Erosion minimized from headcuts |
| Bank stabilization of eroding banks to reduce sediment loads into non-attaining segment | 2010-2012 | **Union SWCD**, environmental engineering firm after bid | $70,000 | Ohio EPA, City of Marysville?, or mitigation project | Bank stabilization completed<br><br>Reduction in sediment loads (Approx. 40 tons/yr)<br><br>Reduction in Nitrogen (Approx. 79 pounds/yr)<br>Reduction in Phosphorus (Approx. 40 pounds/yr) |

Critical Area B – Mill Creek (east of SR 31) to the Scioto River Confluence

# Impairment: Impervious Surfaces and Stormwater Runoff

## Target Areas:

**Town Run**

**City of Marysville**

**Industrial Parkway**

## Problem Statement

There is an increased risk of flooding due to an increase in impervious surfaces. Natural vegetative surfaces allow assimilation and filtration of water, as well as slow runoff down. Impervious surfaces do not allow any assimilation or filtration of water, and accelerate the pathway of the water runoff. Stormwater runoff from impervious surfaces is a concern for flooding. Flooding is an issue if there are not enough natural or vegetative surfaces to slow water down. Urban stormwater runoff contributes to high contaminant levels in-stream. Contaminants from urban stormwater include metals, organics, sediments, and unknown toxicants. These contaminants can impact our drinking water and aquatic life in the streams.

## Goals

- Create a stormwater district for City of Marysville
- Decrease risk of flooding by incorporating stormwater practices established by stormwater district

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Form a storm water utility | completed | **City of Marysville** | | Residents | Established storm water utility |
| Develop stormwater plan for Town Run | 2 phases completed, third phase should be completed by 2012 | **City of Marysville** | Cost of Tetra Tech consultants | City of Marysville | All 3 phases of the Town Run study are complete. |
| Build 5-7 retention ponds | 2008-2012 | **City of Marysville** | | | Built 5-7 retention ponds<br><br>Decreased frequency of flash flooding |
| Restore in-stream habitat features of Town Run | 2011 | **City of Marysville,** Town Run Team, Hull and Assoc. | $400,000+ | Ohio EPA 319 grant, City of Marysville | Grant awarded<br><br>In-stream restoration implemented<br><br>Decreased frequency of flash flooding |
| Promote controlled development and planning on | Continuous | **Union and Delaware SWCDs**, Watershed | Time spent on outreach | SWCDs, OSU extension, City of | Designed and implemented watershed plans and zoning for |

| | | | | | |
|---|---|---|---|---|---|
| a watershed scale | | Technician, Steering Committee, OSU Extension, LUC Planning Commission, City of Marysville | Cost of educational events | Marysville, educational funds, Ohio EPA | townships, municipalities, etc.<br><br>Followed up with developers on NPDES permits<br><br>Decreased urban runoff<br><br>Decreased in-stream contaminant levels |
| Promote nonpoint source pollution prevention | Continuous | **Watershed Technician**, Steering Committee, Delaware and Union SWCDs | Cost of educational events | Ohio EPA, educational funds, City of Marysville | Delivered three presentations per year |
| Water quality monitoring | Continuous | **Ohio EPA**, Columbus Division of Water | Cost of sampling and lab analysis | Ohio EPA, Columbus | Documented changes in water quality |

Critical Area B – Mill Creek (east of SR 31) to the Scioto River Confluence

# Impairment: Nutrients* and Total Suspended Solids (Sewage sources) *Specifically Nitrate

## Target Areas:

*Critical Area B – Mill Creek (east of SR 31) to the Scioto River Confluence*

## Problem Statement

Old, failing and unmaintained septic systems in the Critical Area B area of Mill Creek contribute to high in-stream nitrate levels. Loadings of nitrate and total suspended solids have resulted from these failing or possibly non-existent household sewage treatments systems (HSTS). Total suspended solids (TSS) can impair water quality, habitat, and biology of a stream. TSS can also be a source of bacteria, especially when dealing with solids from improper sewage treatment systems. Smothering of habitats and aquatic life within the stream can occur with excessive TSS loading.

The Union County Health Department has a history of identifying and documenting old, failing and unmaintained residential and commercial septic systems in Mill Creek. The

Health Department annually inspects both residential and commercial septic systems to identify problem systems. Through their experience, approximately 30-35% of aeration systems need repair and replacement each year. The Health Department staff also responds to other system requests and complaints, and then provides repairs or replacements as needed. In the past six years, the Health Department has issued and approved between 70-100 permits each year for replacement and/or upgrading of existing and failing systems.

## Goals

- Reduce in-stream nitrate levels from an annual average of 2.88 ppm to 2.02 ppm (30%) within five years
- Reduce in-stream TSS levels from 37.52 ppm to 26.26 ppm (30%) within five years

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Coordinate with Marysville SWAP | Continuous | **Marysville WTP**, Water Supply Subcommittee, Watershed Technician | Time spent for SWAP | City of Marysville | Initiated SWAP<br><br>Established voluntary easements |
| Extend sewer lines from Raymond and Peoria | 2011 | Determined by Technical Committee for sewage problems in Raymond and Peoria | Not known at present time | State or local | Sewer lines are extended<br><br>Decreased in-stream phosphorous levels |
| Review and inspect | 2009-2014 | **Union and** | $4,000 | Fees | Reviewed and |

| | | | | | |
|---|---|---|---|---|---|
| septic systems to assure proper function<br><br>Repair 55% of failing systems | | **Delaware County Health Departments** | total (i.e. inspection cost and time) | | inspected septic systems |
| Explore funding options to upgrade/repair/maintain septic systems<br><br>Options include: Water Pollution Control Loan Fund Program, DEFA low interest loan program | Continuous | **Union and Delaware County Health Departments**, Watershed Technician, Technical Advisory Committee | Time of research<br><br>Funds depend on participants | State, local, Ohio EPA | Obtained funding<br><br>Initiated Water Pollution Control Loan Fund program<br><br>Upgraded septic systems<br><br>Decreased # of failing septic systems |
| Promote responsible septic system maintenance | Continuous | **Union and Delaware County Health Departments**, Watershed Technician, Steering Committee, Union SWCD, voluntary landowners, | Cost of workshops | State, Ohio EPA, educational funds | Two workshops held<br><br>70% of workshop participants indicated increased understanding of septic systems<br><br>50% of workshop participants indicated they would have septic system inspected<br><br>200 |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | brochures distributed |



Critical Area B – Mill Creek (east of SR 31) to the Scioto River Confluence

# Impairment: Sedimentation

### Target Areas:

**Town Run** – River Miles 2.0 to 0.0

**BMY Tributary** – River Miles 5.0 to 0.0

## Problem Statement

There is increased sedimentation due to habitat alteration in Town Run and the BMY Tributary. Sedimentation is identified as a cause of impairment in these areas of Mill Creek, because of its excessive loading from habitat alteration. "OAC Rule 3745-1-04 (A) states that all waters of the state shall be free from suspended solids and other substances that enter the waters as a result of human activity and that will settle to form objectionable sludge deposits, or that will adversely affect aquatic life," (Ohio EPA Mill TMDL, 2002).

"To target the impact of sediments upon the habitat and biological community, Ohio EPA used the Qualitative Habitat Evaluation Index (QHEI) scores as a surrogate for

sediment load. Reductions in sediments will result in improvements in the habitat and an improvement in assimilative capacity and biological community, and this will be reflected in improved QHEI scores and improved biotic communities. The QHEI target for warmwater habitat is greater than or equal to 60," (Ohio EPA Mill TMDL, 2002).

QHEI scores are low for the indicated target areas. The low QHEI scores indicate that the sediment loads from habitat alterations are impairing the water quality and biology of the stream. The QHEI scores for the target areas are:

- **Town Run**
    - **River Miles 2.0 to 0.0** – QHEI 53.2
- **BMY Tributary**
    - **River Miles 5.0 to 0.0** – QHEI 27

## Goals

- Town Run (River Miles 2.0 to 0.0) – Increase QHEI scores from 53.2 to the target of 60 within five years
- BMY Tributary (River Miles 5.0 to 0.0) – Increase QHEI scores from 27 to 35.1 within five years. The ultimate goal is to increase QHEI scores to 60 within ten years

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote and build 2 access roads | 2009-201 | **Union and Delaware SWCDs**, Steering Committee, NRCS, FSA, Watershed Technician, voluntary landowners | Culvert for drainage ($10.00/ft)<br><br>Surface Treatment – Gravel ($1.60/sq. ft)<br><br>Livestock Stream Crossing ($3.50/sq.ft)<br><br>Culvert crossing only ($13.50/ft) | EQIP cost incentives, CRP | 2 access roads built |
| Promote and implement 30 acres Heavy Use Area Protection | 2009-2014 | **Union and Delaware SWCDs**, Steering Committee, NRCS, FSA, Watershed Technician, voluntary landowners | Gravel ($25,000/ac)<br><br>Concrete ($60,000/ac) | CRP, EQIP cost incentives | 30 acres of Heavy Use Area Protection implemented |
| Promote and implement 170 acres of conservation crop rotation | 2009-2014 | **Union and Delaware SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $12.00/ac | Scioto CREP, and CRP | 170 acres of conservation crop rotation implemented<br><br>~43 acres of conservation crop rotation installed per year |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | 206 tons/yr sediment load reduction |
| Promote and implement 85 acres of critical area planting | 2009-2014 | **Union and Delaware SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | Critical area seeding w/ earthmoving ($600/ac)<br><br>Critical area seeding w/o earthmoving ($400/ac) | Scioto CREP, and CRP | 85 acres of critical area planting are implemented<br><br>~20-21 acres of critical area planting implemented per year<br><br>113 ton/yr sediment load reduction |
| Promote and implement 170 acres of field border (CP 33 Quail Habitat Seeding or Warm Season grass mix) | 2009-2014 | **Union and Delaware SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Div. of Wildlife, Pheasants Forever | CP 33 Quail Habitat Seeding ($225/ac)<br><br>Warm Season Grass ($200/ac) | CP 33 Bobwhite Quail Initiative, and CRP | 170 acres of field border installed<br><br>~43 acres of field border installed per year<br><br>206 tons/yr sediment load reduction |
| Promote and implement 400 acres of Filter Strips | 2009-2014 | **Union and Delaware SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | Cool Season grasses ($135/ac)<br><br>Warm Season grasses w/ chemical treatment ($200/ac)<br><br>Warm Season grasses w/o | Scioto CREP, and CRP | 400 acres of filter strips implemented<br><br>~100 acres of filter strips implemented per year<br><br>284 ton/yr sediment load reduction |

| | | | | | |
|---|---|---|---|---|---|
| | | | chemical treatment ($150/ac) | | |
| Promote and implement 120 acres of prescribed grazing | 2009-2014 | **Union and Delaware SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $12.00/ac | Scioto CREP, and CRP | 120 acres of prescribed grazing implemented<br><br>~30 acres of prescribed grazing<br><br>152 tons/yr sediment load reduction |
| Promote and implement 170 acres of conservation cover (warm season grass mix most commonly used by NRCS and FSA) | 2009-2014 | **Union and Delaware SWCDs,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Div. of Wildlife | $200/ac | Scioto CREP, and CRP | 170 acres of conservation cover implemented<br><br>~43 acres of conservation cover installed per year<br><br>206 tons/yr sediment load reduction |
| Water quality monitoring | Continuous | **Ohio EPA**, Columbus Division of Water (turbidity), City of Marysville | Cost of labor and lab analysis. | Ohio EPA | Documented changes in water quality |

| | | | | | |
|---|---|---|---|---|---|
| Restore in-stream habitat features of Town Run | 2011 | **City of Marysville,** Town Run Team, Hull and Assoc. | $400,000+ | Ohio EPA 319 Grant, City of Marysville | Grant awarded<br><br>In-stream restoration implemented<br><br>QHEI raised and meets attainment |
| Reduce construction site runoff through administration of construction site review processes and require the use of Best Management Practices (BMP) according to ODNR "Rainwater Manual" | 2010 | **SWCD and Engineers Offices** for site reviews and sediment control regulations | Cost of staff time<br><br>$2,000 for an educational breakfast for homeowners and builders to inform them of BMPs and sediment control regulations | SWCD, educational funds, City of Marysville | Number of site reviews completed<br><br>Site sediment controls and BMPs in place<br><br>Breakfast held |

Critical Area C – Crosses Run: Mill Creek Tributary

## Physical Description:

The Scotts Company, a lawn care product manufacturer, is located on Crosses Run in Marysville. Historically, there have been numerous NPDES permit violations, storm water contamination, ammonia and pesticides contamination. In recent years, corrective measures have been initiated to prevent additional pollution to the stream.

Other tributaries within the critical area include:

- **North Branch Crosses Run –** With most of the watershed located on the Scotts Co. property, the causes and sources of impact in this stream are similar to those found in Crosses Run, including high levels of ammonia, pesticides and organic enrichment. Designated as Secondary Contact Recreation, North Branch Crosses Run is a small tributary that lacks deep pools, except when the North water dam (a spill control impoundment) is closed. A sanitary discharge to the

stream was eliminated in 1998 by tying into the Marysville WWTP (Ohio EPA, 2002). .

Sources of impairment:

- Scotts Company (plant operations and inadequate environmental controls)

Causes of impairment:

- Organic enrichment/low dissolved oxygen
- Pesticides
- Ammonia

## Summary

Ammonia, pesticides and organic chemicals are the primary causes and sources of impact to this critical area. Historically, there have been numerous NPDES permit violations, stormwater contamination, ammonia and pesticides contamination originating from the vicinity of the Scotts Company, a lawn care product manufacturer (River Miles 1.8 - 2.24). In recent years, several corrective measures have been initiated to prevent additional pollution to the stream, although stormwater runoff is still a problem.

In addition, habitat alteration is also impairing water quality to Crosses Run. Since sedimentation often correlates with poor habitat, target scores will be based on QHEI scores, the Ohio EPA's measure of habitat. The QHEI target score for Warmwater Habitats is 60, while the current QHEI score for this critical area is 36.

QHEI evaluates the physical characteristics of a stream segment, and measures 1) substrate (what stream bed is composed of), 2) in-stream tree cover, 3) riparian characteristics, 4) stream channel characteristics, 5) pool/riffle quality, and 6) stream gradient and drainage area.

Aquatic Life Use Attainment for Crosses Run Sampling Sites during July to September 1995 (Ohio EPA, 1997).

| Crosses Run (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 2.8 | WWH | 12 | N/A | Poor | 28.0 | No | At Dairy Farm |
| 2.4 | WWH | N/A | N/A | 4 | N/A | No | Ust. Trib. / Water Dam |
| 2.1 / 2.0 | WWH | 12 | N/A | 0 | 42.5 | No | Dst. Scotts Co. |
| 0.9 / 0.6 | WWH | 12 | N/A | 6 | 73.5 | No | Dst. North Fork Crosses Run |

Aquatic Life Use Attainment Status for North Branch Crosses Run Sampling Sites From July to September 1995 (Ohio EPA, 1997).

| North Branch Crosses Run (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 1.0 | WWH | 12 | N/A | Poor | 45.0 | No | Ust. Scotts Co. |
| 0.2 / 0.1 | WWH | 14 | N/A | 0 | 30.5 | No | Dst. Scotts Co. |

Critical Area C – Crosses Run: Mill Creek Tributary

# Impairment: Ammonia and Phosphorus

## Target Area:

**Scotts Co. – River Miles 1.8 to 2.24**

## Problem Statement

Industrial point source impacts contribute to high in-stream ammonia and phosphorous levels. Scotts Company, lawn care product manufacturer, is a point source discharger into Crosses Run. The point source discharges of ammonia and phosphorous result from the manufacturing process of the lawn care products. The high in-stream ammonia and phosphorous levels may impair water quality and biology of Crosses Run.

## Goals

- Update the NPDES permits for Scotts Co.
- Monitor ammonia levels from point source dischargers
- Manage phosphorous levels to maintain and/or improve water quality

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Issue updated NPDES permits | Completed 2006 | **Ohio EPA (Mike Sapp and Mike Galloway)**, **Scotts Co. (Mike Black)** | n/a | Scotts Co. | Updated NPDES permit issued<br><br>Decreased in-stream ammonia and phosphorous levels<br><br>Monitoring from permit achieved |
| Update NPDES permit for stormwater outfalls | Completed 2006 | **Ohio EPA (Mike Sapp and Mike Galloway), Scotts Co. (Mike Black)** | n/a | Scotts Co. | Updated NPDES permit issued<br><br>Maintained or decreased in-stream ammonia and phosphorous into stormwater outfalls |
| Water quality monitoring | October/November 2002 (Scotts Co.)<br><br>Subsequent samplings based on new NPDES permits (Scotts Co.)<br><br>Continuous | **Scotts Co.**, Ohio EPA, Columbus Division of Water | Cost of sampling and lab analysis | Scotts Co. | Decreased in-stream ammonia and phosphorous levels<br><br>Water quality changes documented |
| Crosses Run | 2 phases (4500 linear ft) | **Scotts Co.(Brenda** | $115/ft | Scotts Co., Ohio | Implemented BMPs on |

| | | | | | |
|---|---|---|---|---|---|
| Stream Restoration along Scotts Co. property | completed Spring 2006<br><br>Wetlands and buffers to be installed and more riparian restoration planned through 2012 | **Abke), and Oxbow River and Stream Restoration** | | And EPA 319 grant (for future restoration) | Scotts Co. property<br><br>Increased QHEI scores<br><br>Decreased in-stream ammonia and phosphorous levels |

Critical Area C – Crosses Run: Mill Creek Tributary

# Impairment: Pesticides and Organics

## Target Area:

**Scotts Co. – River Miles 1.8 to 2.24**

## Problem Statement

Past industrial point source practices contribute to high in-stream pesticides and organic compounds. Scotts Company, lawn care product manufacturer, had past legal point source practices before current regulations of point source discharges. Even though these point source discharge practices were in the past, the chemical make-up of certain pesticides and organic compounds is persistent, and does not easily fade over time. Highly persistent compounds have a longer lifetime of remaining in the sediments of the stream and surrounding areas, and therefore have the potential for future impacts long after those point source practices have ceased. Runoff from surrounding contaminated areas, such as landfills, may enter into the stream to produce high levels of pesticides and organic compounds.

## Goal

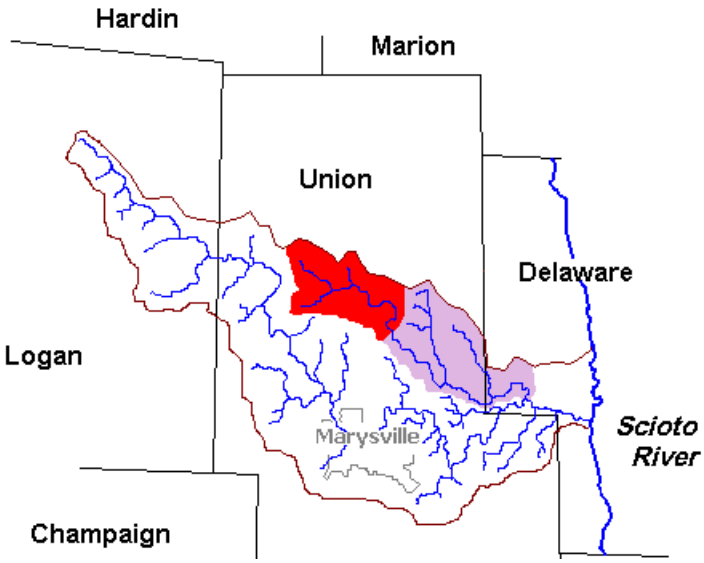
- Reduce pesticides and organic compounds through management of closed landfills and broadcast areas as prescribed in the Final Consent Order between Scotts Co. and the State of Ohio

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Compliance with Consent Order | As required by Order | **Scotts Co.**, Ohio EPA | Costs incurred by Scotts to comply | Scotts Co. | All landfills and field broadcast areas closed as per the Consent Order and monitored as required |
| Water quality monitoring | Continuous | **Scotts, Ohio EPA**, Columbus Division of Water | Cost of sampling and lab analysis | Scotts, Ohio EPA | Documented water quality changes |

## Critical Area D – Blues Creek: Mill Creek Tributary

### Physical Description:




Designated a MWH, the upper reaches of Blues Creek (upstream of SR 4) are under ditch maintenance. Downstream of SR 4, Blues Creek is not under channel maintenance and is classified a WWH.

Negative impacts result from agricultural land usage, siltation and past habitat alteration. The lower 2-3 miles of stream are characterized by high gradient substrates composed of boulder, cobble and exposed bedrock. Unrestricted cattle access and sediment deposition also occur in the watershed (Ohio EPA, 2002). The water quality of Blues Creek only meets water quality standards when it reaches the Village of Ostrander.

Sources of impairment:

- Channelization
- Non irrigated crop production

Causes of impairment:

- Habitat alteration (channelization and removal of riparian vegetation)

- Organic enrichment/low dissolved oxygen

Before the construction of the Ostrander WWTP in the 1990's, Blues Creek received discharges from the unsewered Village of Ostrander. The Ostrander WWTP now discharges directly to Mill Creek at RM 4.05 in Delaware County.

## Summary

The headwaters of Blues Creek (River Miles 19.6 to 12.0) (darker-shaded area on watershed map) are under active ditch maintenance and highly channelized. A lack of riparian vegetation yields high erosion rates, and sedimentation in the stream is a problem. High nutrient levels and unrestricted livestock access also contributes to the degradation of the stream.

Since sedimentation often correlates with poor habitat, target water quality improvement scores will be based on QHEI scores, the Ohio EPA's measure of habitat. The target QHEI scores for a Warmwater Habitat is 60, but only the lower reaches of Blues Creek are designated a Warmwater Habitat (downstream SR 4) (lighter-shaded area on watershed map). The headwaters of Blues Creek are designated a Modified Warmwater Habitat (darker-shaded area on watershed map), and the QHEI score is reaching water quality standards for that designation.

QHEI is a measure of 1) substrate (streambed composition), 2) in-stream tree cover, 3) riparian characteristics, 4) stream channel characteristics, 5) pool/riffle quality, and 6) stream gradient and drainage area.

The downstream reaches of Blues Creek (River Miles 11.9 to 0.00) (lighter shaded area) are not under active channel maintenance and have improved habitat (QHEI score of 55). The degraded conditions of the headwaters have a lasting impact on the lower reaches of Blues Creek (downstream SR 4). The Ohio EPA maintains that if improvements are made in the headwaters region of Blues Creek, then the water quality in the downstream segment will also improve.

Aquatic Life Use Attainment Status for Blues Creek Sampling Sites in 2001 (Ohio EPA, 2002)

| Blues Creek (RM of Fish/Bug Sampling Site) | Designation | IBI | MIwb | ICI | QHEI | Meets Water Quality Standards? | Site Location |
|---|---|---|---|---|---|---|---|
| 19.6 | MWH | 28 | N/A | - | 19.5 | Yes | SR 31 |
| 12.0 | MWH | 28 | N/A | - | 40.5 | Yes | SR 4 |
| 10.1 | MWH | 32 | N/A | - | 42 | No | Leeper Perkins Rd. |
| 6.7 / 6.6 | MWH | 28 | 5.3 | Good | 51 | No | Springdale Rd. |
| 4.7 | MWH | 26 | 6.6 | - | 64 | No | Blues Creek Nature Preserve |

## Critical Area D – Blues Creek: Mill Creek Tributary

# Impairment: Sedimentation

### Target Areas:

**Channelized section of Blues Creek**- upstream SR 4 (darker shaded area on watershed map)

### Problem Statement

There is increased sedimentation due to habitat alteration in the channelized section of Blues Creek. Sedimentation is identified as a cause of impairment in this section, because of its excessive loading from agriculture and from channelization/habitat alteration. Erosion from crop fields and pastures is a primary source of sediment loading into Mill Critical Area D. "OAC Rule 3745-1-04 (A) states that all waters of the state shall be free from suspended solids and other substances that enter the waters as a result of human activity and that will settle to form objectionable sludge deposits, or that will adversely affect aquatic life," (Ohio EPA Mill TMDL, 2002).

"To target the impact of sediments upon the habitat and biological community, Ohio EPA used the Qualitative Habitat Evaluation Index (QHEI) scores as a surrogate for sediment load. Reductions in sediments will result in improvements in the habitat and

an improvement in assimilative capacity and biological community, and this will be reflected in improved QHEI scores and improved biotic communities. The QHEI target for warmwater habitat is greater than or equal to 60," (Ohio EPA Mill TMDL, 2002).

## Goals

- Improve habitat by increasing the QHEI score from 34 to 42 (30%) within five years, therefore indicating a decrease in sedimentation
- The ultimate goal is to increase the QHEI score to 60 within ten years
- Initiate Water Pollution Control Loan Fund program (low interest loans) for voluntary landowners to implement agricultural and livestock BMPs.
- Implement CREP for the Scioto River watershed.
    a. Grass filter strips.
    b. Riparian forest buffers.
    c. Wetland restoration.
- Water quality monitoring to document changes

## Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote and implement 5 acres Heavy Use Area Protection (NRCS # 561) | 2009-2014 | **Union SWCD**, Steering Committee, NRCS, FSA, Watershed Technician, voluntary landowners | Gravel ($25,000/ac)<br><br>Concrete ($60,000/ac) | CRP, EQIP cost incentives | 5 acres of Heavy Use Area Protection implemented |

| | | | | | |
|---|---|---|---|---|---|
| Promote and implement 75 acres of conservation crop rotation (NRCS # 328) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $12.00/ac | Scioto CREP, and CRP | 75 acres of conservation crop rotation implemented<br><br>~19 acres of conservation crop rotation installed per year<br><br>101 tons/yr sediment load reduction |
| Promote and implement 10 acres of critical area planting (NRCS # 342) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | Critical area seeding w/ earthmoving ($600/ac)<br><br>Critical area seeding w/o earthmoving ($400/ac) | Scioto CREP, and CRP | 10 acres of critical area planting are implemented<br><br>17 ton/yr sediment load reduction |
| Promote and implement 10 acres of field border (CP 33 Quail Habitat Seeding or Warm Season grass mix) (NRCS # 386) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Div. of Wildlife, Pheasants Forever | CP 33 Quail Habitat Seeding ($225/ac)<br><br>Warm Season Grass ($200/ac) | CP 33 Bobwhite Quail Initiative, and CRP | 10 acres of field border installed<br><br>17 tons/yr sediment load reduction |
| Promote and implement 50 acres of Filter Strips (NRCS # 393) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, | Cool Season grasses ($135/ac)<br><br>Warm Season grasses w/ | Scioto CREP, and CRP | 50 acres of filter strips implemented<br><br>~13 acres of filter strips implemented |

| | | | | | |
|---|---|---|---|---|---|
| | | voluntary landowners, ODA | chemical treatment ($200/ac)<br><br>Warm Season grasses w/o chemical treatment ($150/ac) | | per year<br><br>46 ton/yr sediment load reduction |
| Promote and implement 25 acres of prescribed grazing (NRCS # 528) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA | $12.00/ac | Scioto CREP, and CRP | 25 acres of prescribed grazing implemented<br><br>~7 acres of prescribed grazing<br><br>39 tons/yr sediment load reduction |
| Promote and implement 40 acres of conservation cover (warm season grass mix most commonly used by NRCS and FSA) (NRCS # 327) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, voluntary landowners, ODA, Div. of Wildlife | $200/ac | Scioto CREP, and CRP | 40 acres of conservation cover implemented<br><br>~10 acres of conservation cover installed per year<br><br>58 tons/yr sediment load reduction |
| Water quality | Continuous | **Ohio EPA**, | Cost of labor | Ohio EPA | Documented |

| | | | | | |
|---|---|---|---|---|---|
| monitoring | | Columbus Division of Water (turbidity), City of Marysville | and lab analysis. | | changes in water quality |

# Critical Area D – Blues Creek: Mill Creek Tributary

## Impairment: Nitrate

### Target Areas:

**Channelized section of Blues Creek**- upstream from SR 4
**Blues Creek**- from SR 4 to the mouth

### Problem Statement

Concentrated manure applications and agricultural runoff contribute to high in-stream nitrate levels. The annual average of nitrate levels within Blues Creek is 0.9 ppm. The highly channelized section of Blues Creek does not facilitate productive nitrate assimilation. The stream is prone to manure runoff impairments because of the channelization and lack of habitat due to alteration. Water quality and aquatic life have been impaired because of the high levels of nitrate.

## Goals

- Create more riparian habitat and vegetation in the channelized section of Blues Creek
- Decrease nitrate levels from an annual average of 0.9 ppm to 0.63 ppm (30%) within five years

# Implementation Strategies/Task Table

| Action Item | Time Frame | Person or Agency Responsible | Resources Needed (cost) | Funding Sources | Success Indicators |
|---|---|---|---|---|---|
| Promote and implement 75 acres of Conservation Crop Rotation (NRCS # 328) | 2009-2014 | **Union SWCD**, NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | $12.00/ac | Scioto CREP and CRP | 75 acres of conservation crop rotation implemented<br><br>169 lb/yr phosphorus load reduction<br><br>338 lb/yr nitrogen load reduction |
| Promote and implement 10 acres of Critical Area Planting (NRCS # 342) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | Critical Area seeding w/ earthmoving ($600/ac)<br><br>Critical Area seeding w/o earthmoving ($400/ac) | Scioto CREP and CRP | 10 acres of Critical Area Planting implemented<br><br>28 lb/yr phosphorus load reduction<br><br>55 lb/yr nitrogen load reduction |
| Promote and implement 10 acres of Field Border (CP 33 Quail Habitat Seeding or Warm Season Grasses mix) (NRCS # 386) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, Division of Wildlife, Pheasants Forever, voluntary landowners | CP 33 Quail Habitat Seeding ($225/ac)<br><br>Warm Season Grass ($200/ac) | CP 33 Bobwhite Quail Initiative<br><br>CRP | 10 acres of conservation crop rotation implemented<br><br>28 lb/yr phosphorus load reduction<br><br>55 lb/yr nitrogen load reduction |

| | | | | | |
|---|---|---|---|---|---|
| Promote and implement 75 acres of nutrient management (NRCS # 590) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | Nutrient management ($5.00/ac)<br><br>Nutrient management w/ precision (grid) farming ($10.00/ac) | EQIP and CRP | 75 acres of Critical Area Planting implemented<br><br>169 lb/yr phosphorus load reduction<br><br>338 lb/yr nitrogen load reduction |
| Promote and implement 25 acres of prescribed grazing (NRCS # 528) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | $12.00/ac | Scioto CREP and CRP | 25 acres of prescribed grazing implemented<br><br>63 lb/yr phosphorus load reduction<br><br>126 lb/yr nitrogen load reduction |
| Promote and build 1 Waste Storage Facility (NRCS # 313) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | Maximum cost of $31,000 for cost incentives | EQIP cost incentives | Waste storage Facility built |
| Promote and implement waste utilization (under nutrient management plans) (NRCS # 633) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | ~$1,000 per plan (depending on # and type of animals)<br><br>$6.00/ac (greater than 50 ppm)<br><br>$30.00/ac (less than or | EQIP Cost Incentives | Waste Utilization included and implemented in plan<br><br>nutrient management plans implemented |

| | | | | | |
|---|---|---|---|---|---|
| | | | equal to 50 ppm) | | |
| Promote and implement 40 acres of Conservation Cover (warm season grass mix most commonly used by NRCS and FSA) (NRCS # 327) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, Division of Wildlife, voluntary landowners | $200/ac | Scioto CREP and CRP | 40 acres of conservation cover implemented<br><br>96 lb/yr phosphorus load reduction<br><br>192 lb/yr nitrogen load reduction |
| Initiate Water Pollution Control Loan Fund Program | Continuous | **Union SWCD,** NRCS, Watershed Technician, Steering Committee, Ohio EPA, voluntary landowners | Loan dependant upon participant and project | Ohio EPA | Increased # of voluntary landowners in program w/ implemented BMPs |
| Water Quality Monitoring | Continuous | **Ohio EPA and Columbus Div. of Water** | Ohio EPA grants, City of Columbus time spent monitoring, cost of lab analysis | Ohio EPA | Documented changes in water quality such as ICI, IBI, and QHEI scores<br><br>Documented changes in phosphorus and nitrogen levels |
| Promote and implement 1 wetland creation (NRCS # 658) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, Division of Wildlife, voluntary | Chain link fence along dike for rodent control ($0.75/sq. ft)<br><br>Excavation ($2.75/cu yd) | WHIP, Scioto CREP, and CRP | 1 wetland created |

| | | | | | |
|---|---|---|---|---|---|
| | | landowners | Tile blocking ($50)<br><br>Tile search/ trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | | |
| Promote and implement 1 wetland restoration (NRCS # 657) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, Division of Wildlife, voluntary landowners | Chain link fence along dike for rodent control ($0.75/sq. ft)<br><br>Excavation ($2.75/cu yd)<br><br>Tile blocking ($50)<br><br>Tile search/ trenching ($1.00/ft)<br><br>Vernal pool ($2,000) | WHIP, Scioto CREP, and CRP | 1 wetland restored |
| Hold Bokes/Mill Partnership Meetings to inform landowners of government conservation programs | 2009-2014 NRCS sign up or enrollment periods for programs | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, Land Heritage Trust of Union County, voluntary landowners | Cost of meetings | Land Heritage Trust of Union county, NRCS, USDA | 1 meeting held about programs w/ approx. 15 attendees. |
| Promote and create 1 comprehensive nutrient management plan (NRCS # 590) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | $500-$1,500 per plan (depending on # and type of animals, AUs) | EQIP cost incentives | 1 plan created |

| | | | | | |
|---|---|---|---|---|---|
| Promote and implement 60 acres of Filter Strips (NRCS # 393) | 2009-2014 | **Union SWCD,** NRCS, FSA, Steering Committee, Watershed Technician, ODA, voluntary landowners | Cool Season Grasses ($135/ac)<br><br>Warm Season Grasses w/ chemical treatment ($200/ac)<br><br>Warm Season Grasses w/o chemical treatment ($150/ac) | Scioto CREP and CRP | 60 acres of filter strips implemented<br><br>140 lb/yr phosphorus load reduction<br><br>261 lb/yr nitrogen load reduction |

# Section 7
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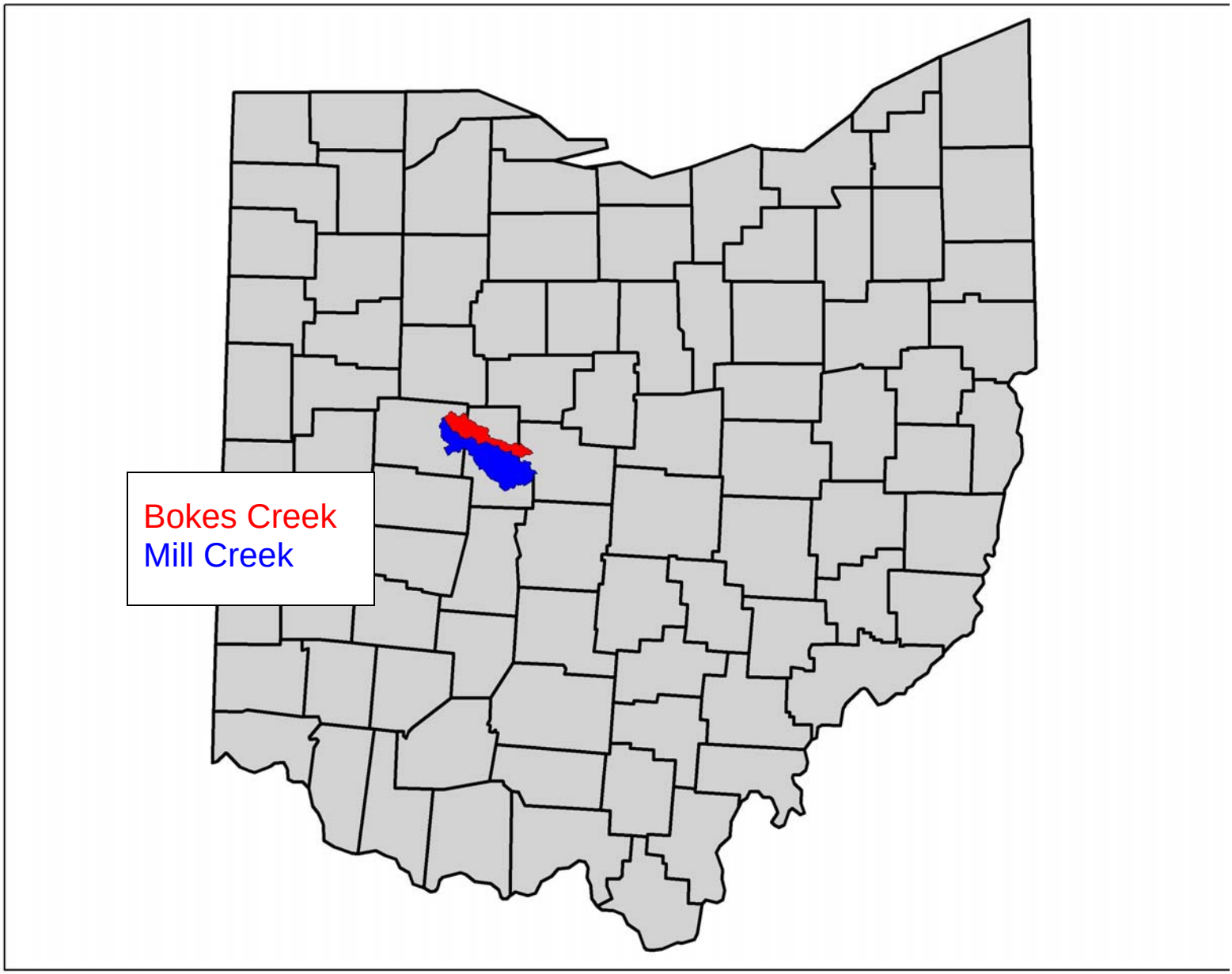
# Appendices

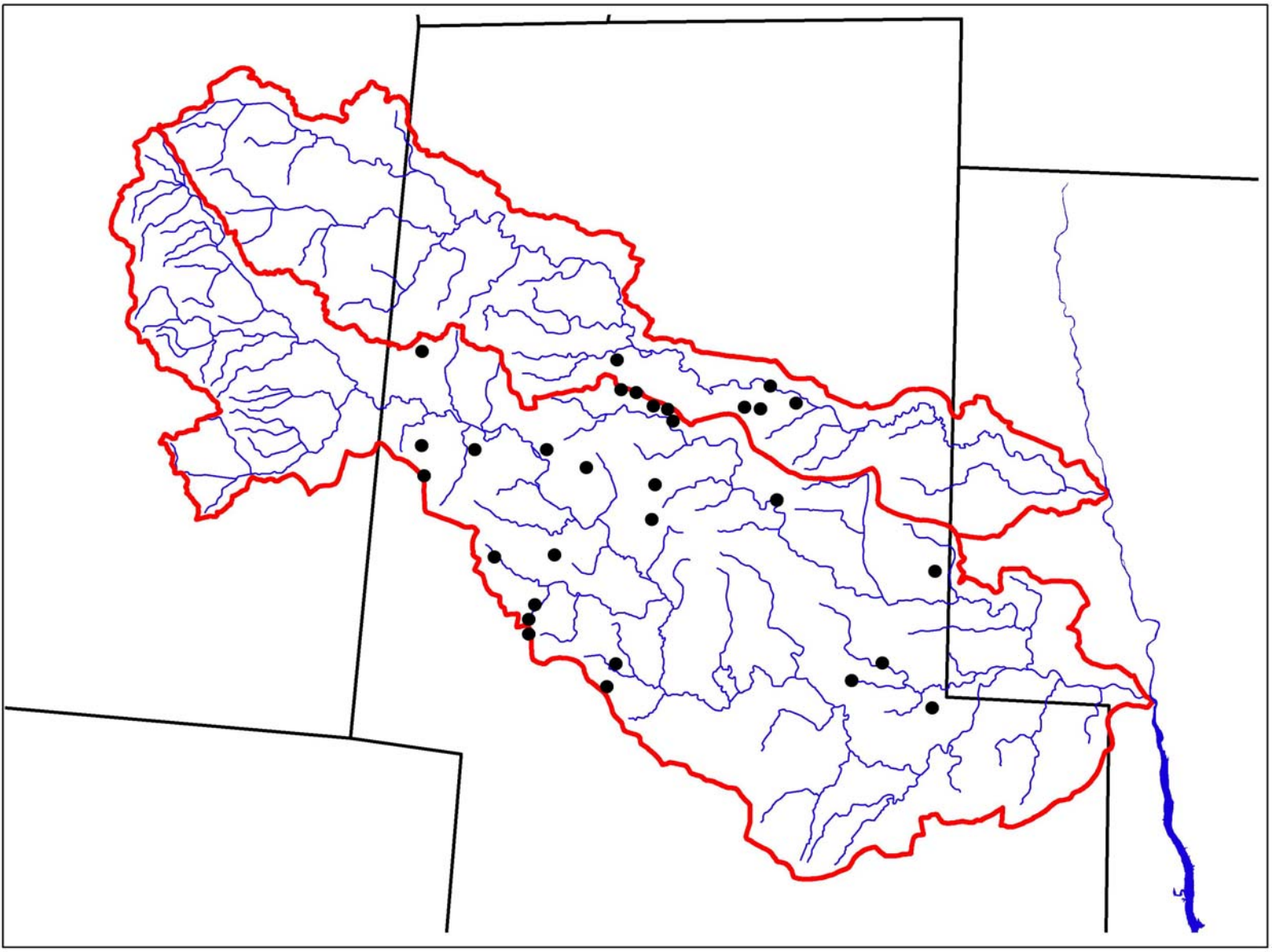
# Appendix 1

## Bokes Creek and Mill Creek Watersheds in Ohio

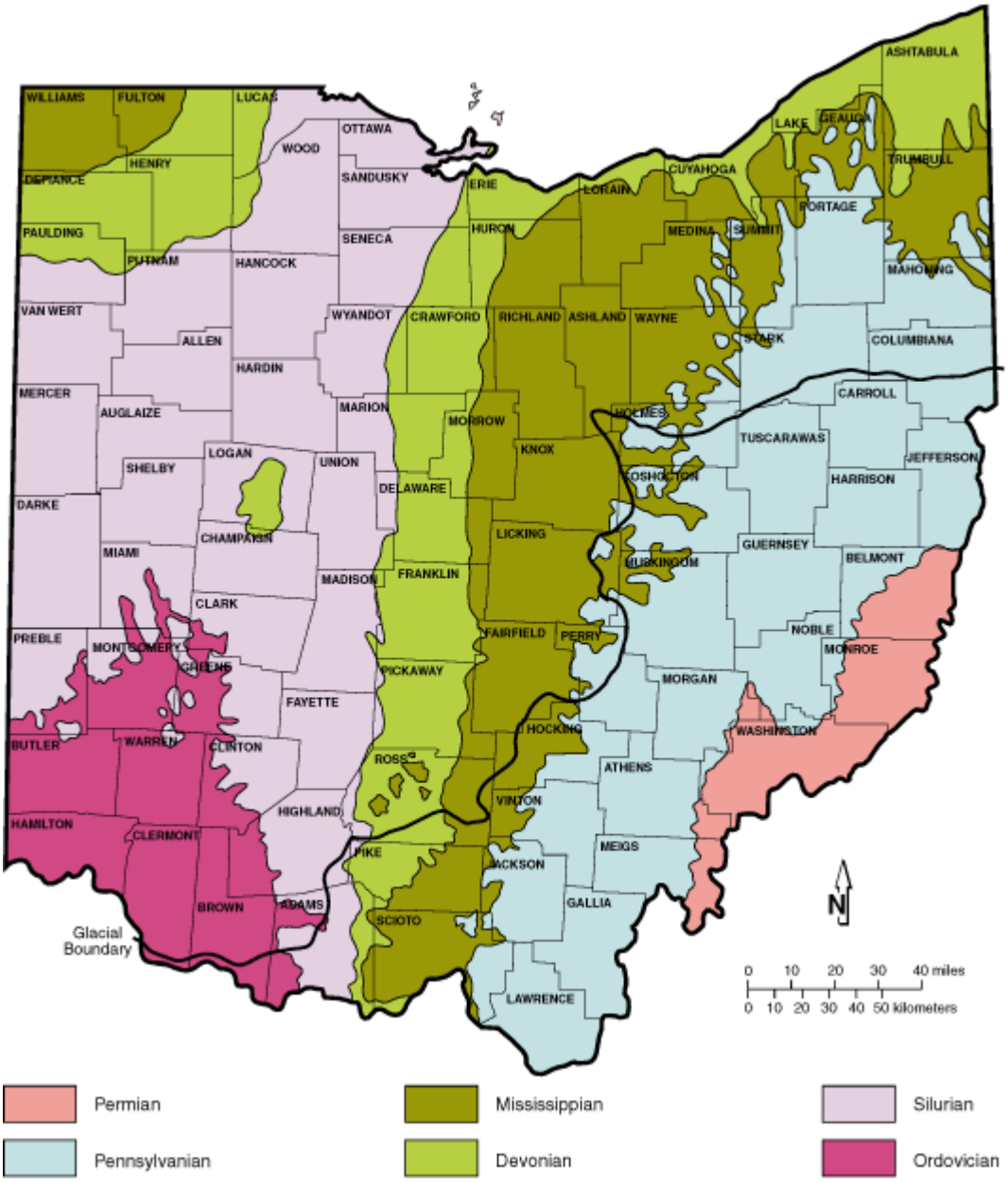


# Appendix 2

## Wetland Locations in the Bokes Creek and Mill Creek Watersheds

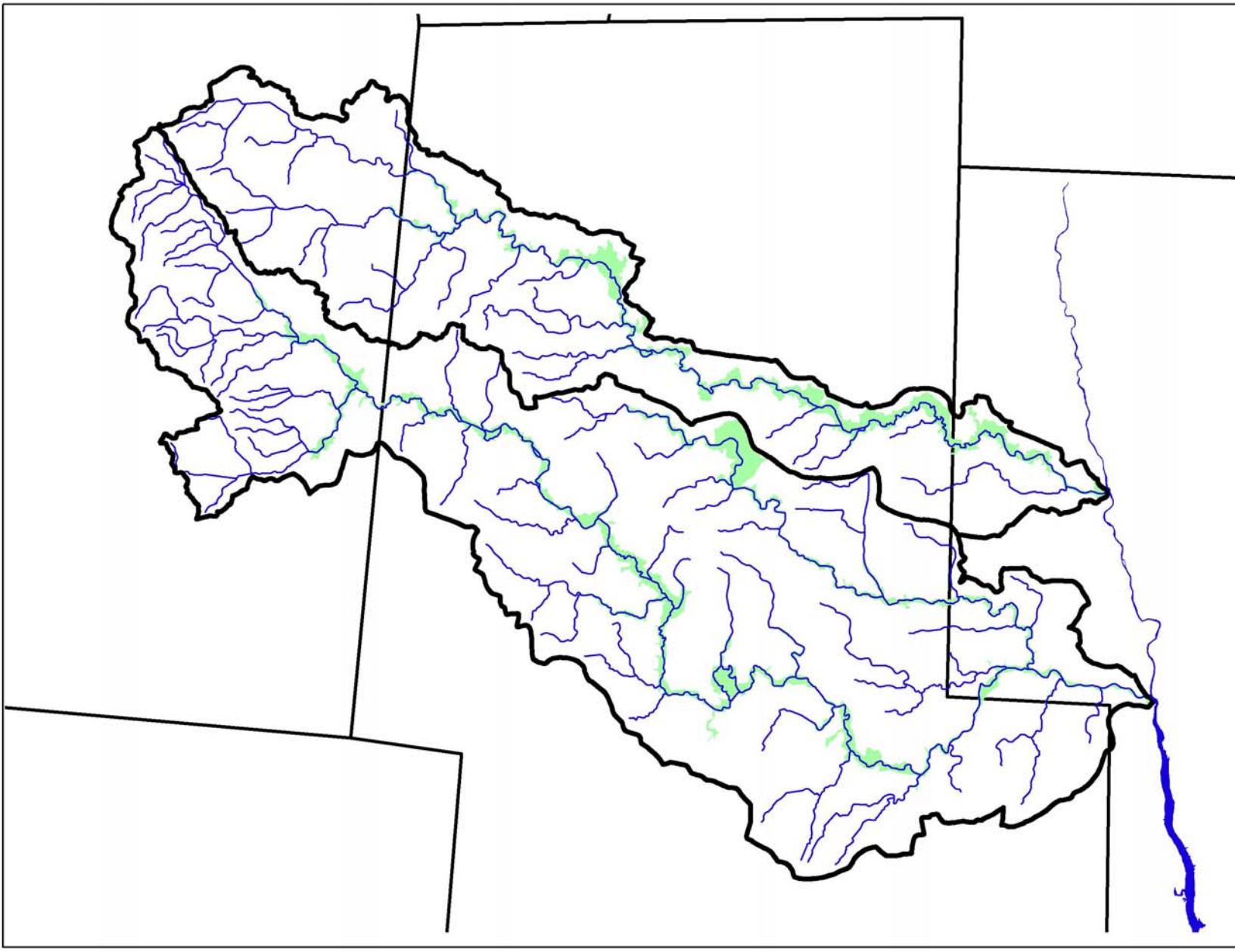


# Appendix 3
## Geologic Map of Ohio

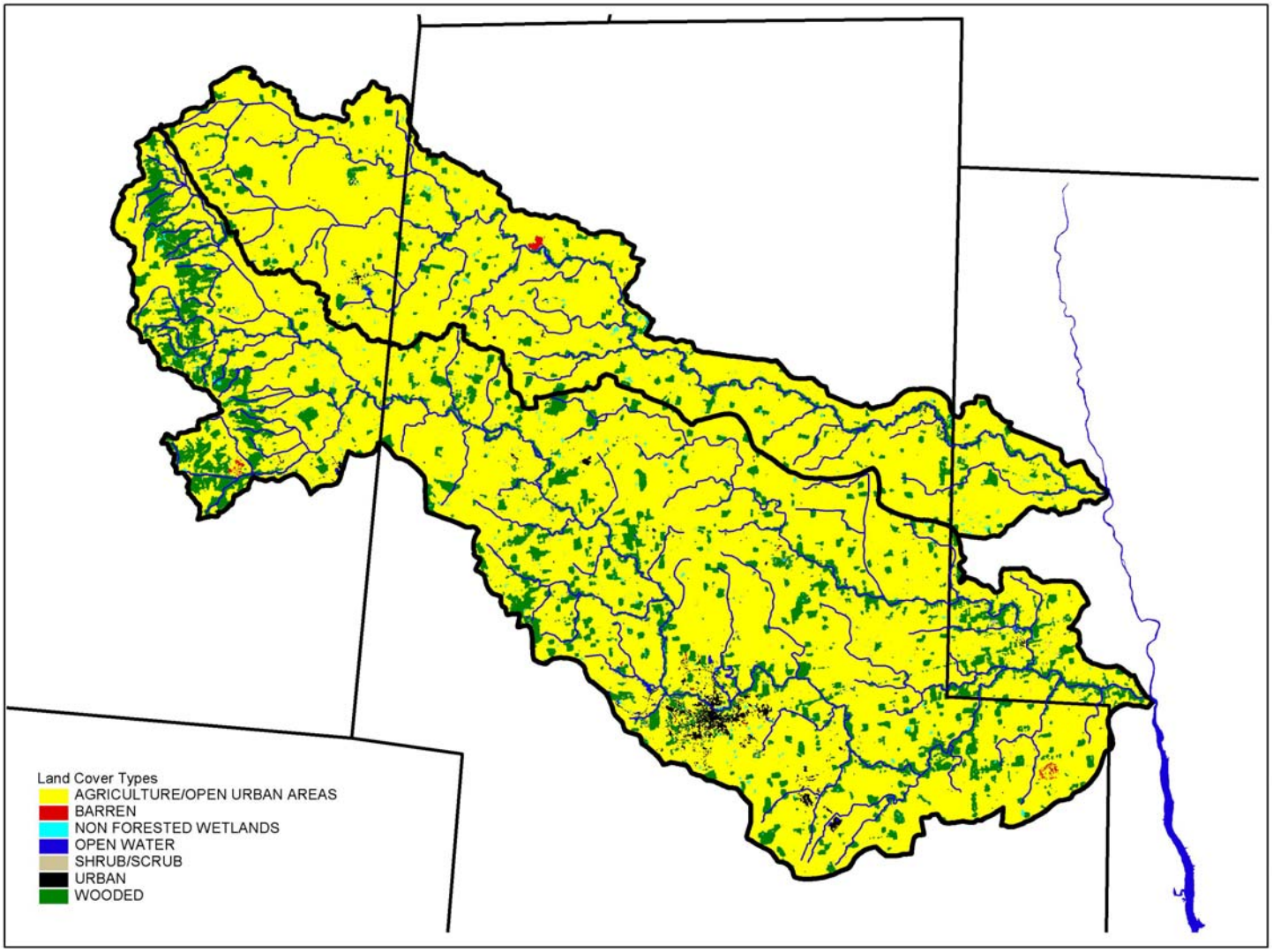



Ohio Department of Natural Resources

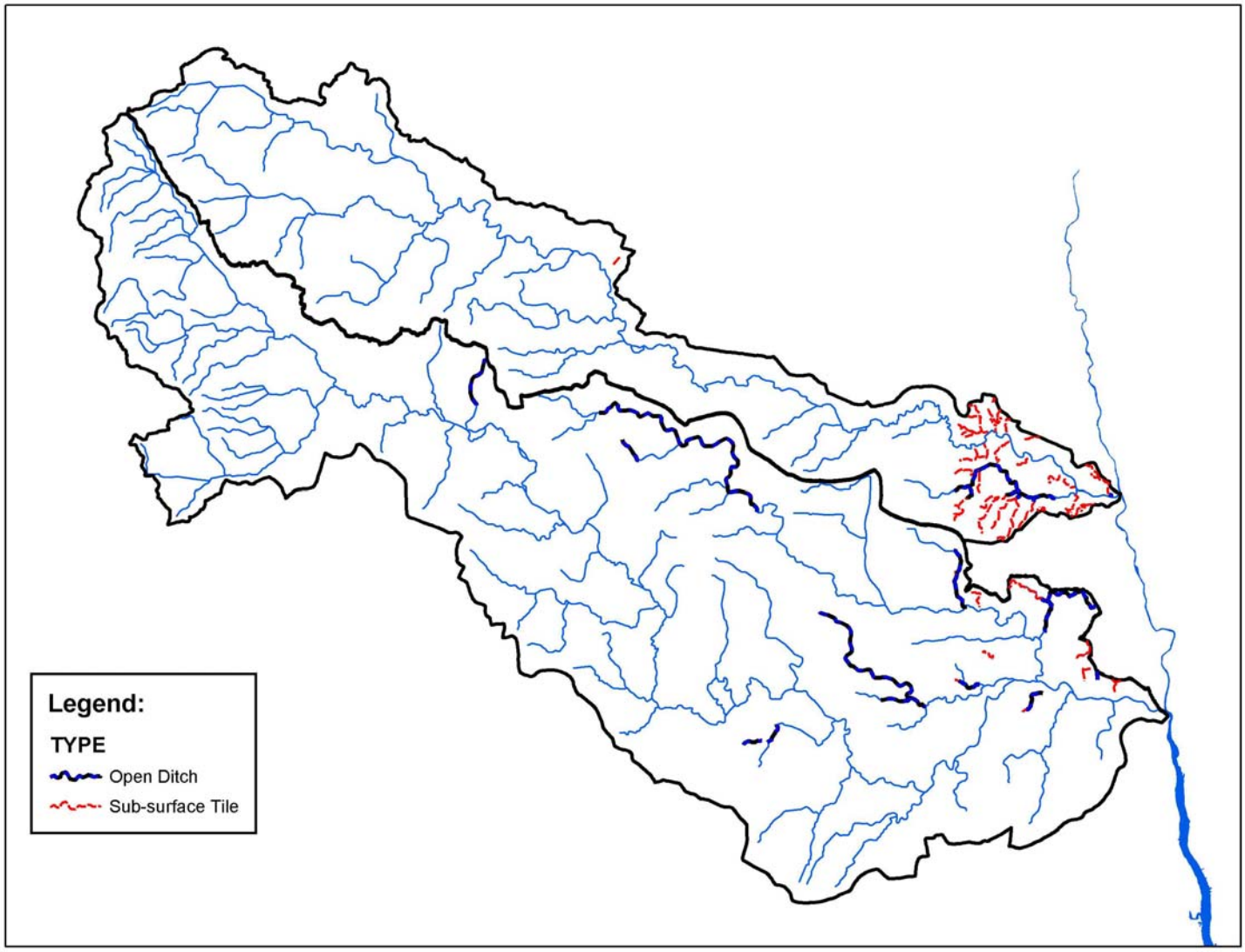
# Appendix 4
## 100 Year Floodplains



# Appendix 5
## Land Use in the Bokes Creek and Mill Creek Watersheds

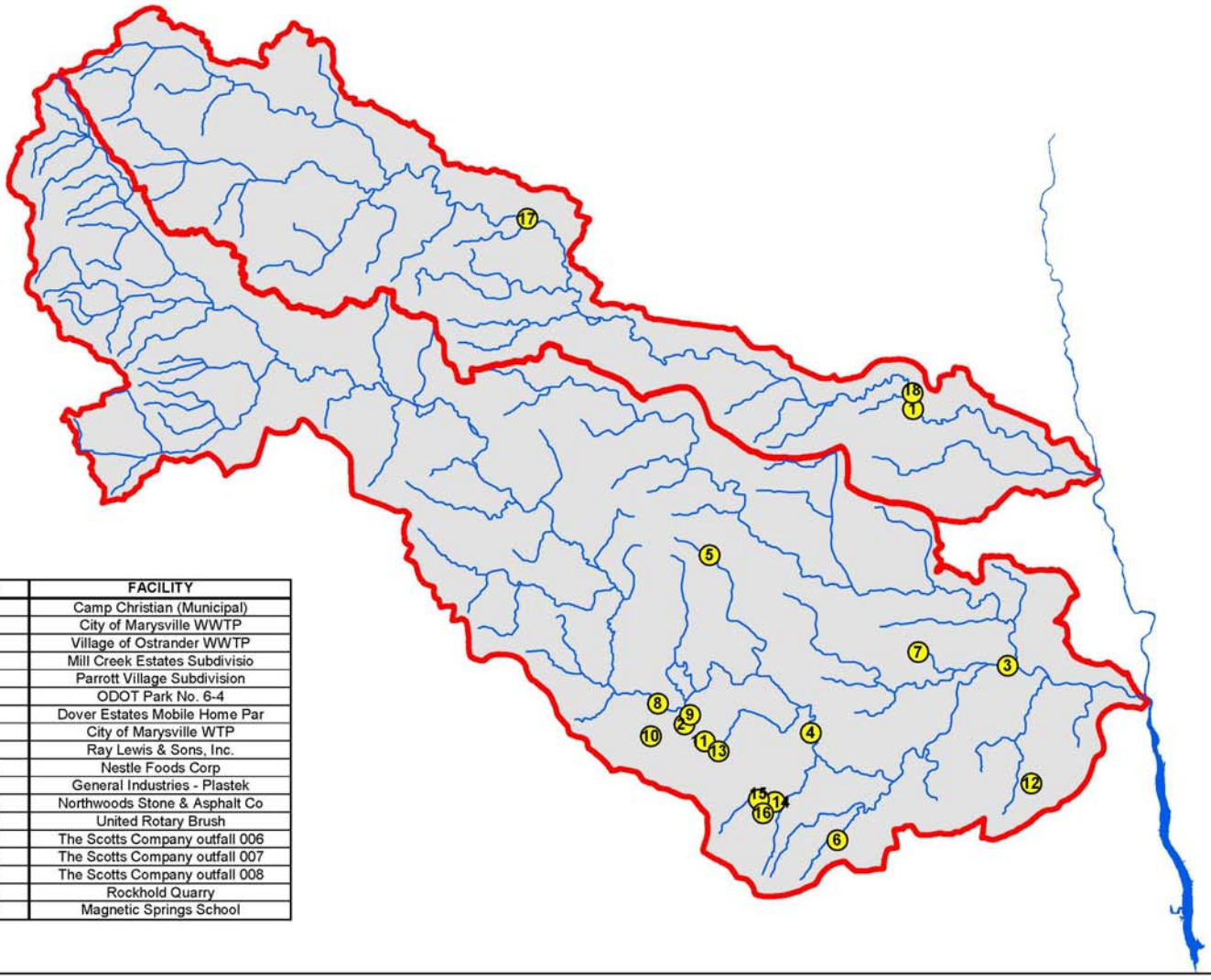


# Appendix 6
## Maintained Ditches in Union and Delaware Counties



# Appendix 7

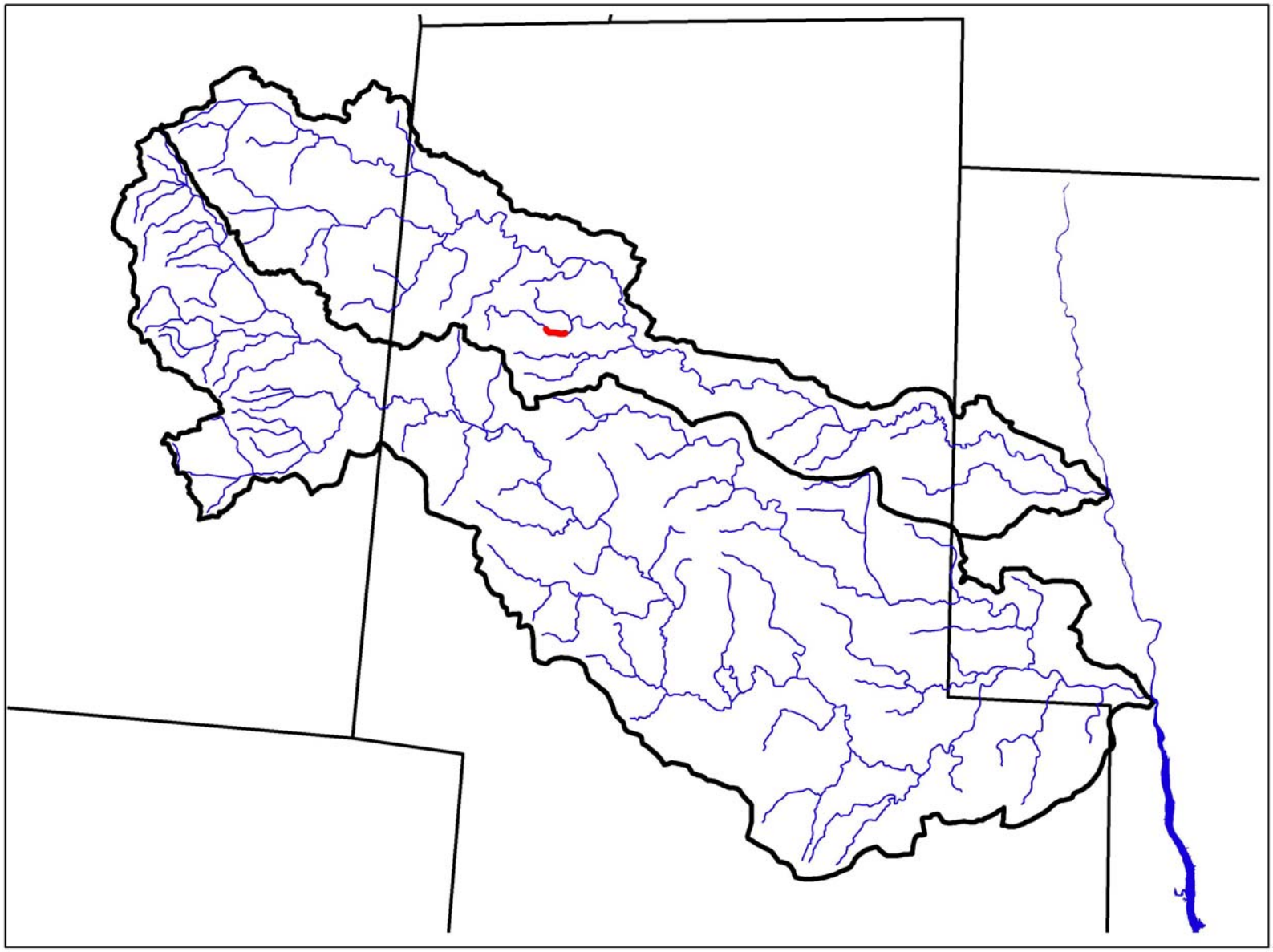
## Point Source Discharger Locations in the Bokes Creek and Mill Creek Watersheds



| ID | FACILITY |
|---|---|
| 1 | Camp Christian (Municipal) |
| 2 | City of Marysville WWTP |
| 3 | Village of Ostrander WWTP |
| 4 | Mill Creek Estates Subdivisio |
| 5 | Parrott Village Subdivision |
| 6 | ODOT Park No. 6-4 |
| 7 | Dover Estates Mobile Home Par |
| 8 | City of Marysville WTP |
| 9 | Ray Lewis & Sons, Inc. |
| 10 | Nestle Foods Corp |
| 11 | General Industries - Plastek |
| 12 | Northwoods Stone & Asphalt Co |
| 13 | United Rotary Brush |
| 14 | The Scotts Company outfall 006 |
| 15 | The Scotts Company outfall 007 |
| 16 | The Scotts Company outfall 008 |
| 17 | Rockhold Quarry |
| 18 | Magnetic Springs School |

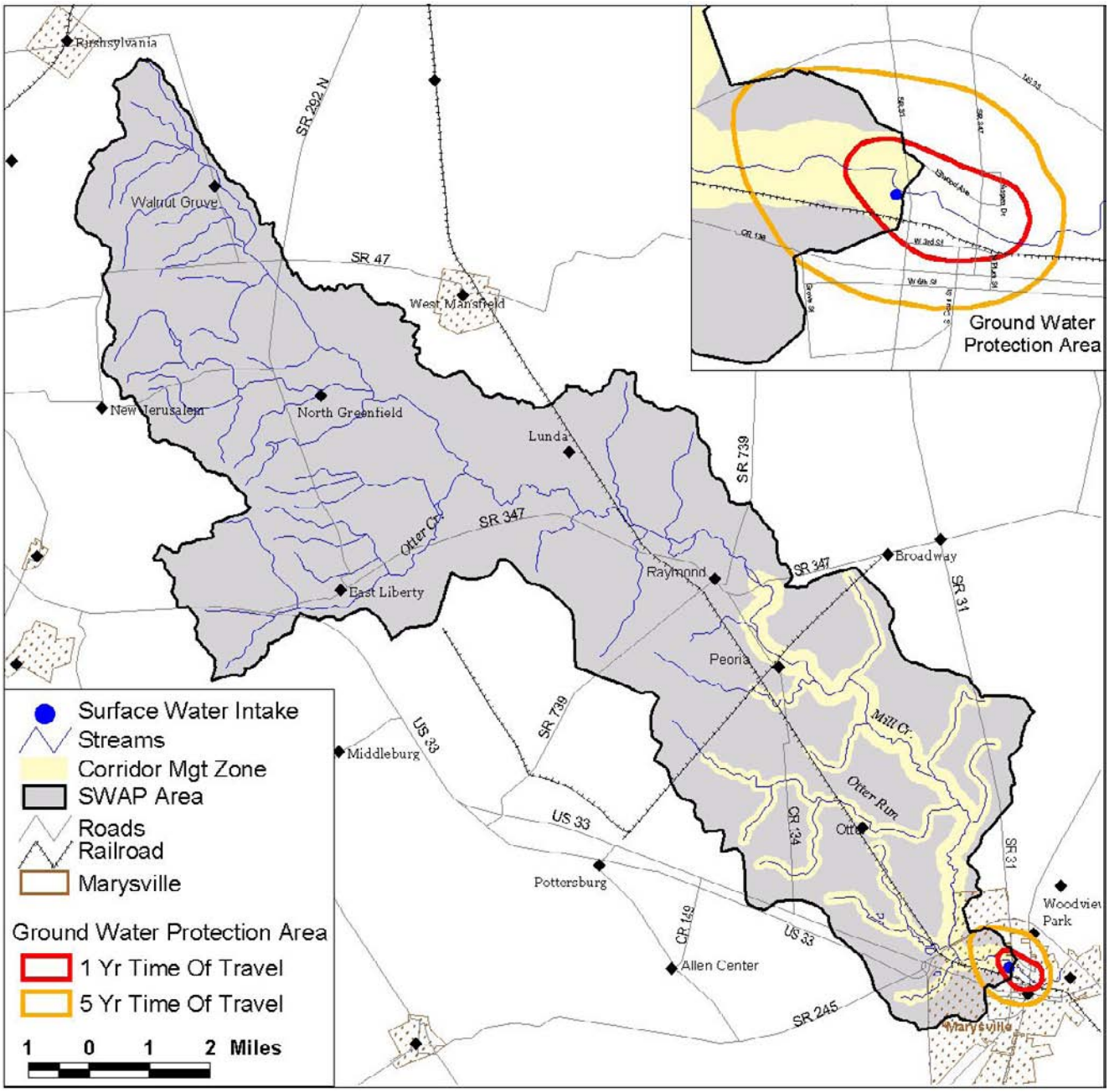
# Appendix 8

## Powderlick Run: Bokes Creek Water Quality Enhancement Project Site



# Appendix 9

## Marysville Source Water Assessment and Protection Area



# Appendix 10
## Bokes Creek Livestock Inventory

| Critical Area | County | Township | # cattle | # horses | # hogs | # sheep | # goats | # chickens | # total | # total for Critical Area |
|---|---|---|---|---|---|---|---|---|---|---|
| A | Logan | Bokes Creek | | | | 20 | | 1 mil + | 1,000,020 | |
| A | Union | York | 44 | 30 | | | | | 74 | 1,000,094 |
| B | Union | York | | | 2,000 | | | 7 mil + | 7,002,000 | 7,002,000 |
| C | Union | York | 20 | | | | | | 20 | |
| C | Union | Leesburg | 127 | 47 | 100 | 75 | | | 349 | |
| C | Delaware | Scioto | 20 | 5 | | | | | 25 | 394 |
| | | | | | | | | | | |
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# Appendix 11
## Mill Creek Livestock Inventory

| Critical Area | County | Township | # cattle | # horses | # hogs | # sheep | # goats | # chickens | # total | # total for Critical Area |
|---|---|---|---|---|---|---|---|---|---|---|
| A | Logan | Perry | 218 | | 800 | | | | 1,018 | |
| A | Union | Liberty | 107 | 87 | | 30 | 49 | | 273 | |
| A | Union | Taylor | 300 | 18 | | | | | 318 | |
| A | Union | Paris | 10 | 61 | | 5 | | | 76 | 1685 |
| B | Union | Paris | 282 | 5 | | 40 | | | 327 | |
| B | Union | Dover | 490 | 12 | 200 | 130 | | | 832 | |
| B | Union | Millcreek | 305 | 15 | 75 | | | | 395 | |
| B | Delaware | Scioto | | 4 | | | | | 4 | |
| B | Delaware | Concord | | 15 | | | | | 15 | 1,573 |
| C | Union | Paris | 50 | | | | | | 50 | 50 |
| D | Union | Taylor | 70 | | | | | | 70 | |
| D | Union | Leesburg | 50 | 17 | 5,400 | | | | 5,467 | |
| D | Union | Dover | 21 | 23 | 20 | 20 | | | 84 | |
| D | Delaware | Scioto | 10 | 5 | | | | | 15 | 5,636 |
| | | | | | | | | | | |
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# Appendix 12
## Bokes Detailed Livestock Inventory

| Critical Area | County | Township | Animal Units (AU) |
|---|---|---|---|
| A | Logan | Bokes Creek | 1,000,000+ chickens |
| A | Logan | Bokes Creek | 20 sheep |
| A | Union | York | 25 cattle/horse |
| A | Union | York | 28 horses |
| A | Union | York | 10 cattle |
| A | Union | York | 2 horses, 9 cattle |
| B | Union | York | 1,000+ hogs |
| B | Union | York | 1,000+ hogs |
| B | Union | York | 7,000,000+ chickens |
| C | Union | York | 20 cattle |
| C | Union | Leesburg | 70 cattle |
| C | Union | Leesburg | 50+ cattle |
| C | Union | Leesburg | 100+ hogs |
| C | Union | Leesburg | 35 sheep |
| C | Union | Leesburg | 4 horses |
| C | Union | Leesburg | 3 horses |
| C | Union | Leesburg | 20 horses |
| C | Union | Leesburg | 3 horses |
| C | Union | Leesburg | 10+ horses |
| C | Union | Leesburg | 30+ sheep |
| C | Union | Leesburg | 7+ cattle |
| C | Union | Leesburg | 4+ horses |
| C | Union | Leesburg | 5 horses |
| C | Union | Leesburg | 10 sheep |
| C | Delaware | Scioto | 20+ cattle |
| C | Delaware | Scioto | 5 horses |

# Appendix 13
## Mill Detailed Livestock Inventory

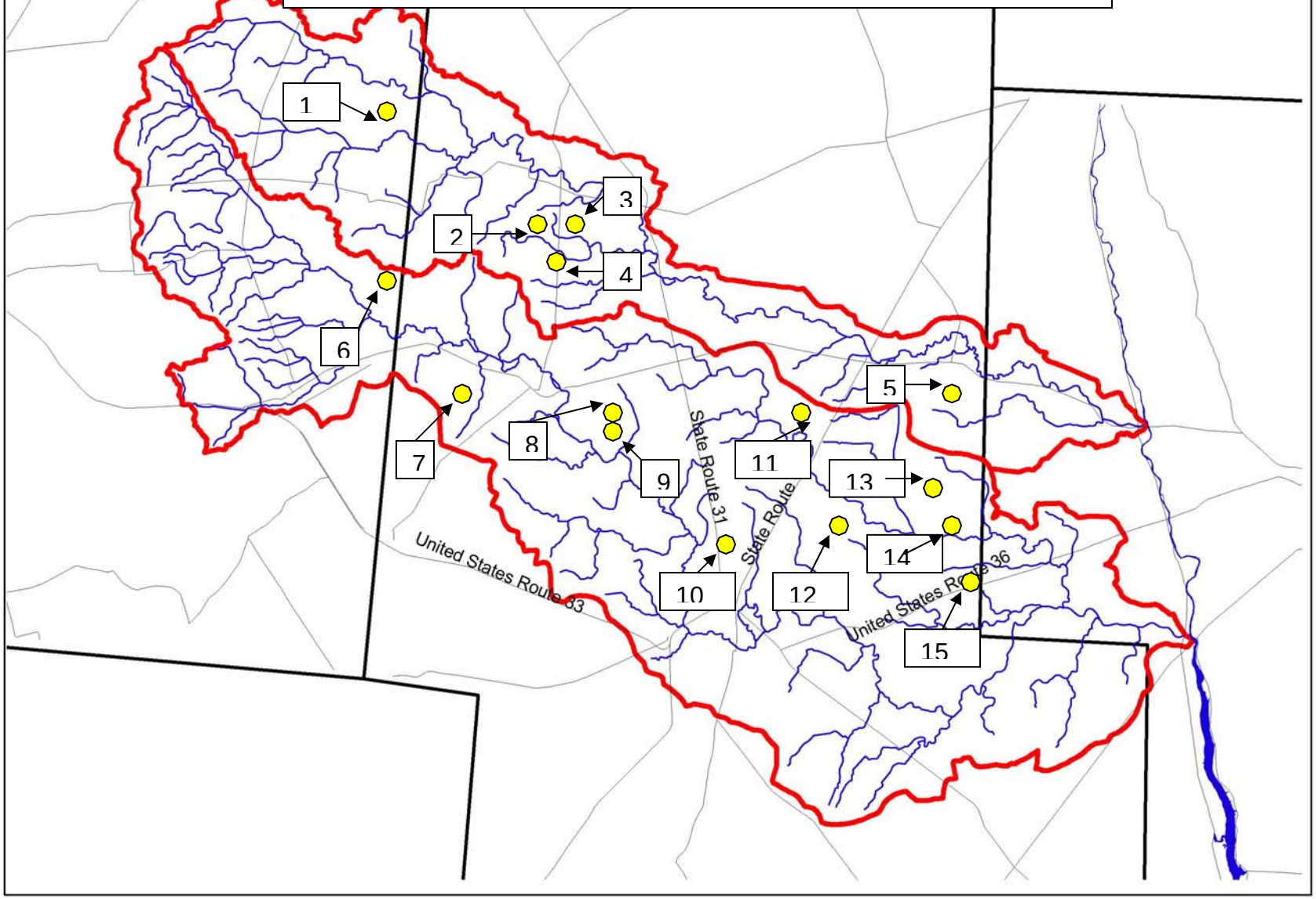
| Critical Area | County | Township | Animal Units (AU) |
|---|---|---|---|
| A | Logan | Perry | 50 cattle |
| A | Logan | Perry | 50 cattle |
| A | Logan | Perry | 25 cattle |
| A | Logan | Perry | 25 cattle/horse |
| A | Logan | Perry | 25 cattle |
| A | Logan | Perry | 40+ cattle |
| A | Logan | Perry | 3+ cattle |
| A | Logan | Perry | 800+ hogs |
| A | Union | Liberty | 30 sheep, 5 horses, 4 goats, 2 donkeys |
| A | Union | Liberty | 50+ cattle |
| A | Union | Liberty | 3 horses |
| A | Union | Liberty | 10 horses and alpacas |
| A | Union | Liberty | 10 goats |
| A | Union | Liberty | 10+ horses |
| A | Union | Liberty | 3+ cattle |
| A | Union | Liberty | 20 horses |
| A | Union | Liberty | 4+ horses |
| A | Union | Liberty | 2+ horses |
| A | Union | Liberty | 3 horses |
| A | Union | Liberty | 4+ cattle, 10+ goats |
| A | Union | Liberty | 300+ hogs |
| A | Union | Liberty | 5+ horses |
| A | Union | Liberty | 5+ horses |
| A | Union | Liberty | 5 horses |
| A | Union | Liberty | 25+ goats |
| A | Union | Liberty | 3+ horses |
| A | Union | Liberty | 5+ horses |
| A | Union | Liberty | 50+ cattle |
| A | Union | Liberty | 5 horses |
| A | Union | Liberty | 6 horses |
| A | Union | Liberty | 4 horses |
| A | Union | Liberty | 3 horses |
| A | Union | Taylor | 100 cattle |
| A | Union | Taylor | 5 horses |
| A | Union | Taylor | 200+ cattle |
| A | Union | Taylor | 10+ horses |
| A | Union | Taylor | 3 horses |

| | | | |
|---|---|---|---|
| A | Union | Paris | 10+ cattle |
| A | Union | Paris | 20+ mules & horses |
| A | Union | Paris | 5+ sheep |
| A | Union | Paris | 15+ horses |
| A | Union | Paris | 5 horses |
| A | Union | Paris | 3 horses |
| A | Union | Paris | 10 horses |
| A | Union | Paris | 3 horses |
| A | Union | Paris | 5 horses |
| B | Union | Paris | 200+cattle |
| B | Union | Paris | 20+ sheep |
| B | Union | Paris | 5 horses |
| B | Union | Paris | 20+ cattle |
| B | Union | Paris | 20+ sheep |
| B | Union | Paris | 62 cattle |
| B | Union | Dover | 100+ hogs |
| B | Union | Dover | 100+ hogs |
| B | Union | Dover | 200+ cattle |
| B | Union | Dover | 30 sheep |
| B | Union | Dover | 200+ cattle |
| B | Union | Dover | 2+ horses |
| B | Union | Dover | 20+ cattle |
| B | Union | Dover | 5+ horses |
| B | Union | Dover | 10 cattle |
| B | Union | Dover | <10 cattle |
| B | Union | Dover | 100+ sheep |
| B | Union | Dover | 10+ cattle and horses |
| B | Union | Dover | 20+ cattle and horses |
| B | Union | Dover | 20+ cattle |
| B | Union | Dover | 5 horses |
| B | Union | Millcreek | 10+ cattle |
| B | Union | Millcreek | 50+ cattle |
| B | Union | Millcreek | 30+ cattle |
| B | Union | Millcreek | 30+ cattle |
| B | Union | Millcreek | 4+ horses |
| B | Union | Millcreek | 3+ horses |
| B | Union | Millcreek | 10 cattle |
| B | Union | Millcreek | 75+ cattle |
| B | Union | Millcreek | 75+ hogs |
| B | Union | Millcreek | 3 horses |
| B | Union | Millcreek | <10 cattle |
| B | Union | Millcreek | 5+ cattle and horse |
| B | Union | Millcreek | 10 cattle |
| B | Union | Millcreek | 80+ cattle |
| B | Union | Millcreek | 5+ horses |
| B | Delaware | Scioto | 4+ horses |
| B | Delaware | Concord | 5+ horses |
| B | Delaware | Concord | 10 horses |
| C | Union | Paris | 50+ cattle |

| | | | |
|---|---|---|---|
| D | Union | Taylor | 20+ cattle |
| D | Union | Taylor | 50+ cattle |
| D | Union | Leesburg | 5,400 hogs |
| D | Union | Leesburg | 50 cattle |
| D | Union | Leesburg | 2+ horses |
| D | Union | Leesburg | 15 horses |
| D | Union | Leesburg | 10 horses |
| D | Union | Dover | 20+ cattle, 20+ hogs, 20+ sheep/goats |
| D | Union | Dover | 1+ steer, 3 horses |
| D | Union | Dover | 10+ horses |
| D | Union | Dover | 2+ horses |
| D | Union | Dover | 2+ horses |
| D | Union | Dover | 5 horses |
| D | Union | Paris | 4+ horses |
| D | Delaware | Scioto | 10 cattle |
| D | Delaware | Scioto | 5 horses |

# Appendix 14

Large Livestock Operations

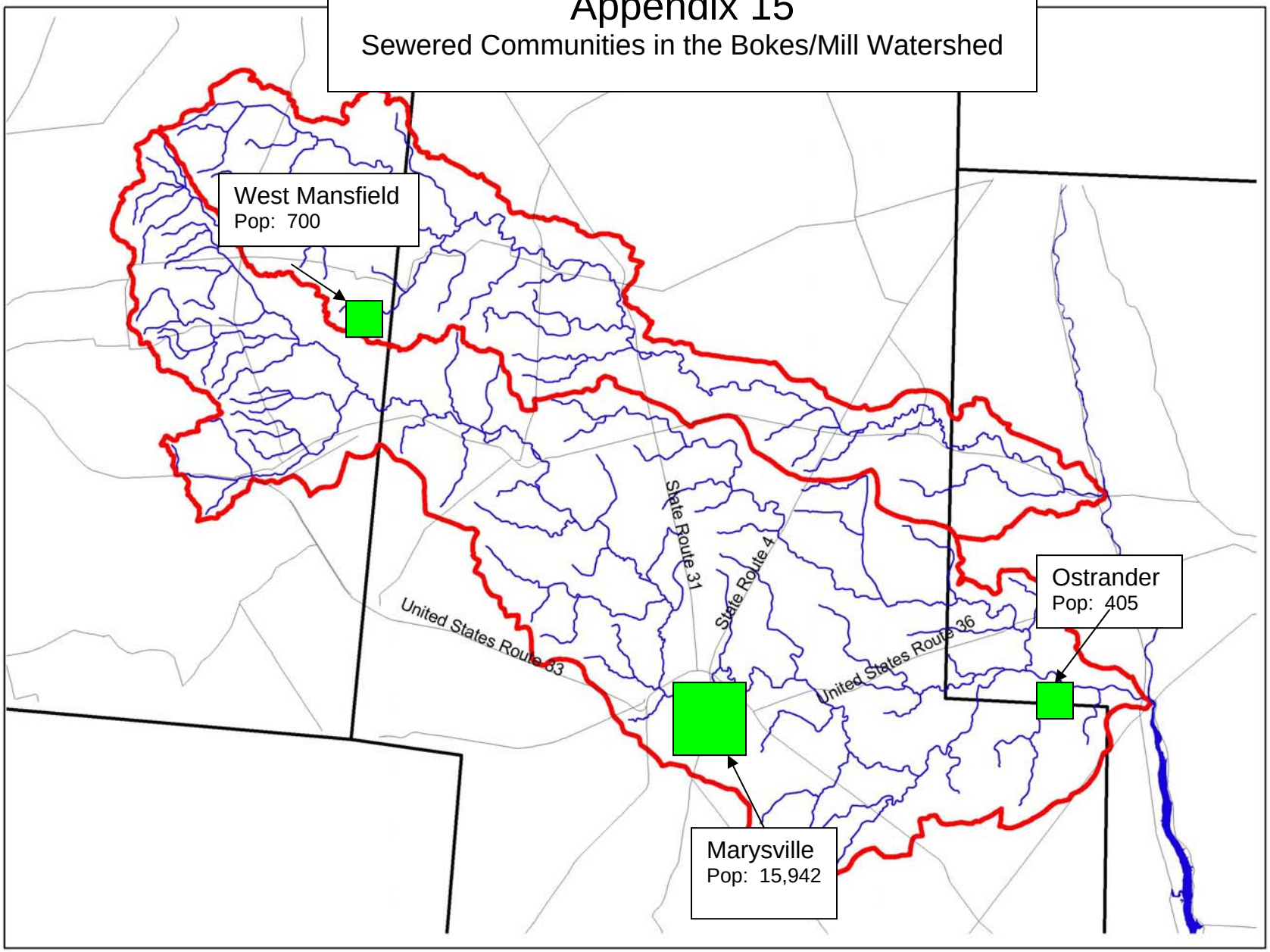


## Large Livestock Operations in the Bokes/Mill Watershed (Indicated by # on map)

| # on map | Critical Area | County | Township | Animal Units (AU) |
|---|---|---|---|---|
| 1 | Bokes A | Logan | Bokes Creek | 1,000,000+ chickens |
| 2 | Bokes B | Union | York | 1,000+ hogs |
| 3 | Bokes B | Union | York | 1,000+ hogs |
| 4 | Bokes B | Union | York | 7,000,000+ chickens |
| 5 | Bokes C | Union | Leesburg | 100+ hogs |
| 6 | Mill A | Logan | Perry | 800+ hogs |
| 7 | Mill A | Union | Liberty | 300+ hogs |
| 8 | Mill A | Union | Taylor | 100 cattle |
| 9 | Mill A | Union | Taylor | 200+ cattle |
| 10 | Mill B | Union | Paris | 200+ cattle |
| 11 | Mill D | Union | Leesburg | 5,400 hogs |
| 12 | Mill B | Union | Dover | 100+ sheep |
| 13 | Mill B | Union | Dover | 100+ hogs |
| 14 | Mill B | Union | Dover | 100+ hogs |
| 15 | Mill B | Union | Dover | 200+ cattle |

# Appendix 15

## Sewered Communities in the Bokes/Mill Watershed



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