East Fork Little Miami River
Watershed Action Plan

Stonelick Creek Watershed Action Plan

January 2009

Stonelick Creek State Park, Stonelick Lake

East Fork Watershed Collaborative
P.O. Box 549, 1000 Locust Street Owensville, OH 45160-0549

Table of Contents

Table of Contents (continued)

Table of Contents

Appendices

List of Figures

List of Figures (continued)

List of Tables

Stonelick Creek Watershed Action Plan

Chapter One

Introduction

East Fork
WATERSHED COLLABORATIVE

PO Box 549
Owensville, OH 45160
clermontswcd.org/WatershedPrograms.aspx

CHAPTER 1: INTRODUCTION

Historically, environmental regulatory agencies have addressed water quality concerns by focusing on the discharges from “point sources,” the direct discharges from industrial facilities and municipal wastewater treatment plants. While controlling these discharges has significantly improved water quality in many streams, many others - including many streams within the East Fork Little Miami River watershed - remain impaired. Other possible sources of impairment include stormwater runoff, failing septic systems, and runoff from agricultural fields. To successfully manage pollutant loadings so that streams are “fishable, swimmable and drinkable” (the goals of the Clean Water Act), a watershed must be addressed as a whole, and all potential sources of pollution taken into account.

In 2000, the Soil and Water Conservation Districts in Brown, Clermont, Clinton and Highland Counties partnered with Clermont County to participate in the Ohio Department of Natural Resources Watershed Planning Program. A grant was received to fund a Watershed Coordinator for the East Fork Little Miami River Watershed, and the East Fork Watershed Collaborative was born.

The East Fork Watershed Collaborative (EFWC or “the Collaborative”) has accepted the responsibility for developing a watershed action plan (WAP) for the entire East Fork Little Miami River watershed. Due to the size of the East Fork watershed (500 mi^2 or almost 320,000 acres), and the variability in land use and stream conditions in various parts of the East Fork watershed, the EFWC made a decision to divide the overall watershed into smaller, more manageable subwatersheds for the purpose of planning. The subwatersheds selected as planning units are the Lower East Fork watershed, the Stonelick Creek watershed, the Stonelick Creek watershed, the East Fork Lake Tributaries, and the East Fork Headwaters (Figure 1).

Subwatershed plans will focus on concerns unique to each subwatershed, providing a detailed description of subwatershed characteristics and stream conditions, causes and sources of water quality impairment, and specific recom-

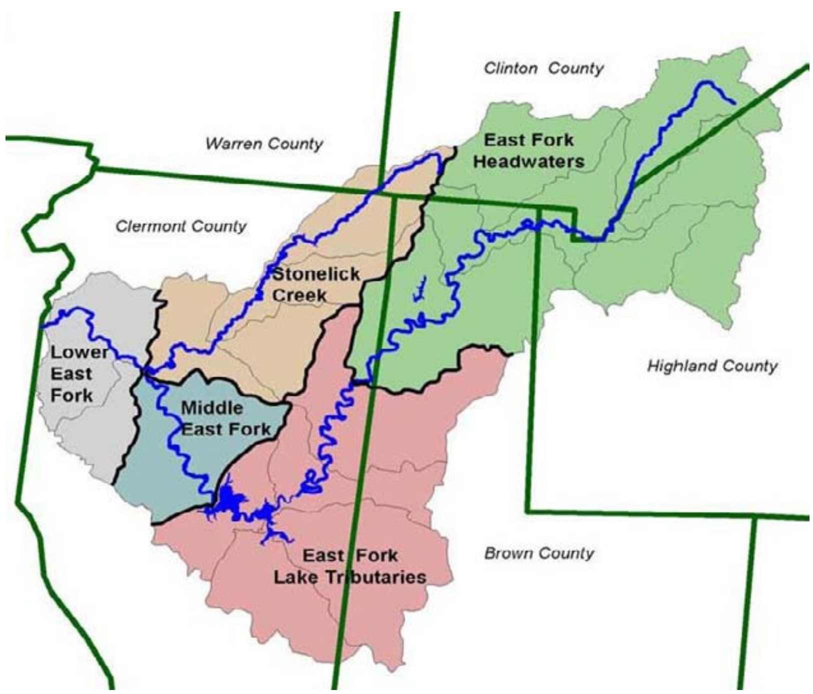


Figure 1. East Fork watershed planning units

mendations on how those impairments might be addressed.

A watershed plan for the Lower East Fork was submitted to and endorsed by Ohio EPA and Ohio Department of Natural Resources (ODNR) in 2003. The Headwaters watershed plan was submitted to and endorsed by OEPA and ODNR in May 2006. The East Fork Lake Tributaries watershed plans was submitted and endorsed in September 2006. The EFWC is currently developing, and expecting to complete by December 2007, watershed plans for the Stonelick Creek subwatershed. Our final Watershed Action Plan for the East Fork Little Miami River will integrate the five subwatershed plans into a coherent whole, highlighting the connections and differences among the subwatersheds.

Stonelick Creek Watershed Action Plan

This document represents the action plan for the Stonelick Creek subwatershed, which consists of the entire East Fork drainage area upstream of Stonelick Creek, downstream to its confluence with the East Fork Little Miami River in Clermont County. This plan contains the following sections:

- a watershed inventory, focusing on geology, soils, biological features, water resources, land use, point sources and non-point sources of pollution, and alterations to natural habitat;
- a summary of water resource quality in the Stonelick Creek and its tributaries;
- a summary of community water management goals and interests;
- a discussion of watershed impairments including an identification and quantification of potential pollutant sources, and recommended watershed restoration and protection goals.

The development of the Stonelick Creek Watershed Action Plan (Stonelick WAP) was truly a team effort, with input from dozens of partners and participants. Some of those contributions are described here.

Watershed Inventory

The inventory requirements to receive Ohio EPA and ODNR endorsement are outlined in the Appendix 8 update (Ohio EPA, 2003) to "*A Guide to Developing Local Watershed Action Plans in Ohio*" (Ohio EPA, 1997). A wide variety of data sources must be tapped to complete the inventory. This WAP inventory includes information contributed by:

- Clermont County GIS Department;
- Farm Service Agencies of Clermont County;
- Soil and Water Conservation District of Clermont County;
- Clermont County Health District;
- Ohio Department of Natural Resources, US Geological Survey, U.S. EPA, and Ohio EPA;
- Clermont County Office of Environmental Quality (OEQ), Clermont Stormwater Management Department, Ohio-Kentucky-Indiana (OKI) Regional Council of Governments, and the Little Miami River Partnership.

(Apologies to those not mentioned.)

Water Resource Quality

Use attainment and water quality information was compiled from Ohio EPA and Clermont OEQ data.

Community Water Resource Management Interests

The success of any plan requires buy in from those with the ability to implement the recommendations of the plan. For the Stonelick Creek WAP, every effort was made to involve local community members (landowners, business owners, elected officials, county agency staff, …) in defining the local water management goals, and developing appropriate strategies for meeting both water quality and water quantity

The East Fork Watershed Collaborative

The East Fork Watershed Collaborative was formed in 2001 to provide local agencies, groups and individuals the opportunity to collaboratively plan and implement water quality improvement projects. The Collaborative's mission is "to enhance the biological, chemical and physical integrity of the East Fork Little Miami River and its tributaries."

The Collaborative is an informal organization (i.e., no application has been made for legal non-profit status), structured to minimize hierarchy/ bureaucracy while maintaining effectiveness and accountability. The EFWC Steering Committee consists of representatives from four counties and five subwatersheds within the East Fork Little Miami River watershed. Four of the Steering Committee members are directly appointed by the Board of Commissioners from Brown, Clermont, and Highland counties. Four additional members represent the Soil and Water Conservation Districts of Brown, Clermont, Clinton and Highland counties. The final five Steering Committee members represent the five subwatershed planning areas (Lower East Fork, Stonelick Creek, Stonelick Creek, East Fork Lake Tributaries, and East Fork Headwaters) by contributing knowledge about agriculture, industry, and other community resources and activities in the region. The Steering Committee is responsible for defining the scope and direction of the Watershed Program, providing direction to the Watershed Coordinator, and acting as liaison between the Collaborative and the local community.

Through a grant received from the Ohio Department of Natural Resources, the Clermont County Soil and Water Conservation District hired a Watershed Coordinator for the East Fork Little Miami River in December 2000. The Watershed Coordinator's position is supplemented with funding from the Clermont County Commissioners and the Soil and Water Conservation Districts from Brown, Clinton and Highland Counties. Anyone wishing to receive more information about this plan or the East Fork watershed in general can contact the East Fork Watershed Coordinator at (513) 732-7075.

EFWC Goals:

- Provide direction and assistance to the East Fork Watershed Coordinator.
- Provide guidance to the stakeholder groups involved in the development and implementation of the adopted watershed action plan.
- Administer the terms and conditions of the ODNR – Watershed Coordinator Grant Assist in the prioritization of recommendations in the watershed action plan.
- Help identify funding opportunities that will assist in accomplishing the established objectives of the action plan.
- Periodically reassess the stated objectives of the action plan and provide an evaluation of on-going efforts.
- Periodically reassess changing conditions and needs in the watershed and oversee necessary revisions to the plan.
- Serve as an informational resource for interested constituents relating the needs, conditions, and opportunities within the East Fork Watershed.
- Provide technical assistance to the groups, organizations, and individuals in the watershed that are involved in activities effecting water quality and land use activities in the watershed.
- Provide a forum for discussions across political boundaries about opportunities to improve water quality and the use of the resources throughout the East Fork Watershed.

EFWC Measures of Success:

Improvement in water quality in the East Fork Watershed Increased public awareness of water quality in the East Fork Watershed Degree of Implementation of recommendations from the Watershed Action Plan Viability of the East Fork Collaborative and stakeholder groups Increased usage of BMPs in the East Fork Watershed Extent of protection and restoration provided to the riparian corridor in the East Fork Watershed Decreased duplication in administrative efforts to protect water quality in the East Fork Watershed.

management objectives. Public meetings were used to review water quality information and sources of impairment, and to identify local water management challenges and interests.

The participatory process is more fully detailed in Chapter 4; Community Water Management Goals and Interests. A detailed list of stakeholders that participated in the planning process is provided in Chapter 4.

Watershed Restoration and Protection Goals

Chapter 5 of this document is where the rubber hits the road. This chapter describes water quality impairments by stream segment, details watershed management and restoration goals, and outlines recommended strategies (the who, what, where, when, how and how to pay) to meet the goals. The goals and strategies were developed and prioritized by key Stonelick Creek stakeholders.

The action plan, as well as a wide range of educational materials, are available at the East Fork watershed page (clermontswcd.org/WatershedPrograms.aspx).

Local Endorsement

Once the Watershed Action Plan has been fully endorsed by Ohio EPA and ODNR, the Collaborative will present the action plan to: the Board of Commissioners of Clermont County; the Villages Councils of Owensville, Newtonsville and Blanchester; the Trustees of Stonelick, Wayne, Goshen, Jackson, Union, Miami, Perry, Marion, and Harlan Townships during open public sessions. After each presentation, the appropriate Board or Council will either formally endorse the plan or make recommendations for any needed revisions. EFWC partners will review the watershed plan annually, and update the plan as needed.

Implementation and Evaluation

The implementation of any watershed plan requires the cooperation of landowners, local governments, local businesses and other stakeholders. The East Fork Watershed Collaborative continues to seek partners in implementing practices and programs that will improve water quality in the Stonelick Creek and its tributaries. Many such activities are described in this document; however, the Collaborative will revisit this document with our project partners on an annual basis to measure progress toward our goals, to review whether our goals and priorities are still appropriate, to solicit additional resources, and to direct available resources where they are most needed. For a summary of previous watershed efforts and ongoing implementation projects sponsored by the East Fork Watershed Collaborative, see Appendix A.

Information and Education

The information and education component will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the non-point source management measures that will be implemented.

Education and Outreach Component

The Collaborative and its partners have a strong education component in place for Stonelick Creek. The primary objective is to raise awareness about water quality and watershed management in the Stonelick Creek subwatershed. Education and outreach will be conducted as a joint effort between: East Fork watershed coordinator, Clermont Soil and Water Conservation District, OSU Extension, Farm Bureau, Clermont County Health District, Clermont County Water and Sewer District, Clermont County Office of Environmental Quality, and other EFWC partners. Current and complementary education and outreach programs in the entire East Fork Watershed are summarized in Appendix A. Education and Outreach management actions, resources, time frame, and performance indicators can be found in Chapter 5; Watershed Recommendations.

Information Component

All records and documents pertaining to the entire East Fork Watershed will be kept by Clermont Soil and Water Conservation District (SWCD) and Clermont Office of Environmental Quality (OEQ). The Watershed Action Plans, watershed management reports, water quality data, soil survey data and information on local projects can be accessed through the Clermont SWCD and OEQ offices.

Final documents of the Stonelick Creek WAP will be available on CD at Clermont Soil and Water Conservation District, Clermont OSU Extension office, and will be downloadable from the OEQ website at: www.oeq.net and from Clermont SWCD web site at:
clermontswcd.org/WatershedPrograms.aspx

Final copies will also be sent to local library branches in the Stonelick Creek region of Clermont County. To receive a copy of the Stonelick Creek Watershed Action Plan contact the East Fork Watershed Collaborative at (513) 732-7075.

Stonelick Creek Watershed Action Plan

Chapter Two

Watershed Inventory

PO Box 549
Owensville, OH 45160
clermontswcd.org/WatershedPrograms.aspx

CHAPTER 2:
WATERSHED INVENTORY

A number of factors - both natural and anthropogenic - influence the quantity and quality of water in our streams. These factors include: the underlying geology and the soils that formed over thousands of years; the local climate and, in particular, precipitation; the type and location of surface water bodies including wetlands, lakes, reservoirs, streams and rivers; land use; and point and non-point sources of pollution. The purpose of a watershed inventory is to catalog these factors in a way that helps us understand the natural and human impacts on the condition of our water resources.

Location

The Stonelick Creek watershed is a sub-watershed of the East Fork Little Miami River watershed, which is over 500 square miles in total area and encompasses portions of Highland, Clinton, Warren, Brown, and Clermont Counties. The Stonelick Creek watershed is approximately 77 square miles (49,275 acres) in total area and is located in the north western portion of the East Fork. Approximately 85% (41,877 ac) of the watershed is located within Clermont County, 7% (3,516 ac) in Clinton County, 5% (2,506 ac) in Brown County and 2% (1,214 ac in Warren County (Figure 2).

Geology

Geology influences watershed management in several ways. As an example, different bedrock materials and overlying soils have different levels of susceptibility to erosion by water (erodibility). Also, the composition of the bedrock material and soils are primary natural factors governing the shape and slope of the stream bed and, ultimately, the depth and velocity of water running through the channel. In addition, porous material such as sand, gravel or limestone can act as a conduit and/or reservoir for ground water, whereas solid bedrock, clays and shales serve as barriers to subsurface water flow.

The underlying geology of the Stonelick Creek watershed is primarily interbedded shale and limestone of Ordovician age (450 million years ago). This bedrock is overlain by Illinoian glacial cover and a relatively shallow layer of loess from a few to as much as 40 inches in depth.

The glacial cover in the Stonelick Creek is a clayey till of Illinoian Age (Figure 3). This clay layer is situated above the bedrock but below the soil, often creating an impermeable layer preventing infiltration into the bedrock below. The glacial cover of the Illinoian till plains is generally

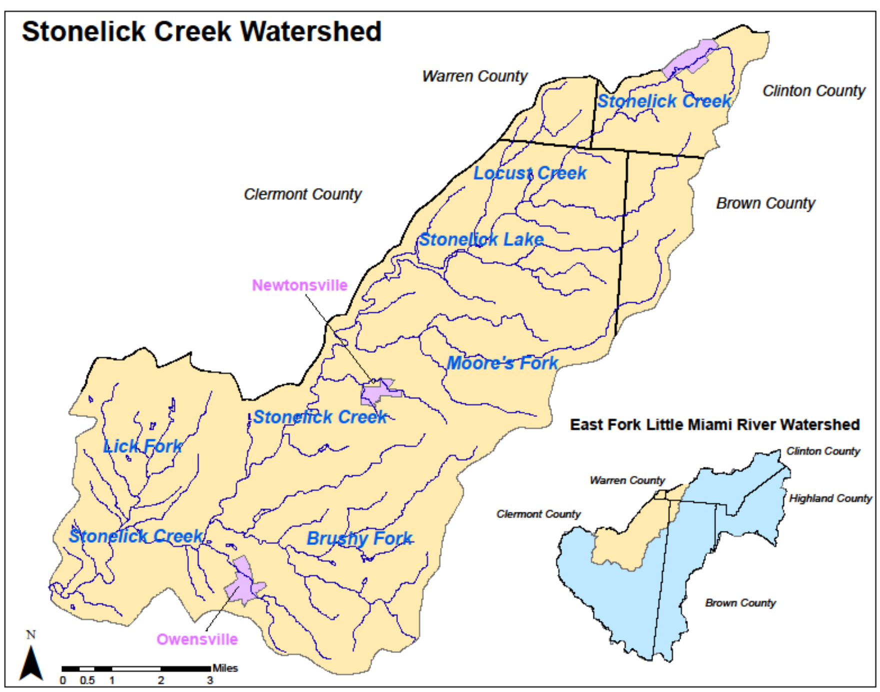


Figure 2. Location of the Stonelick Creek Watershed.

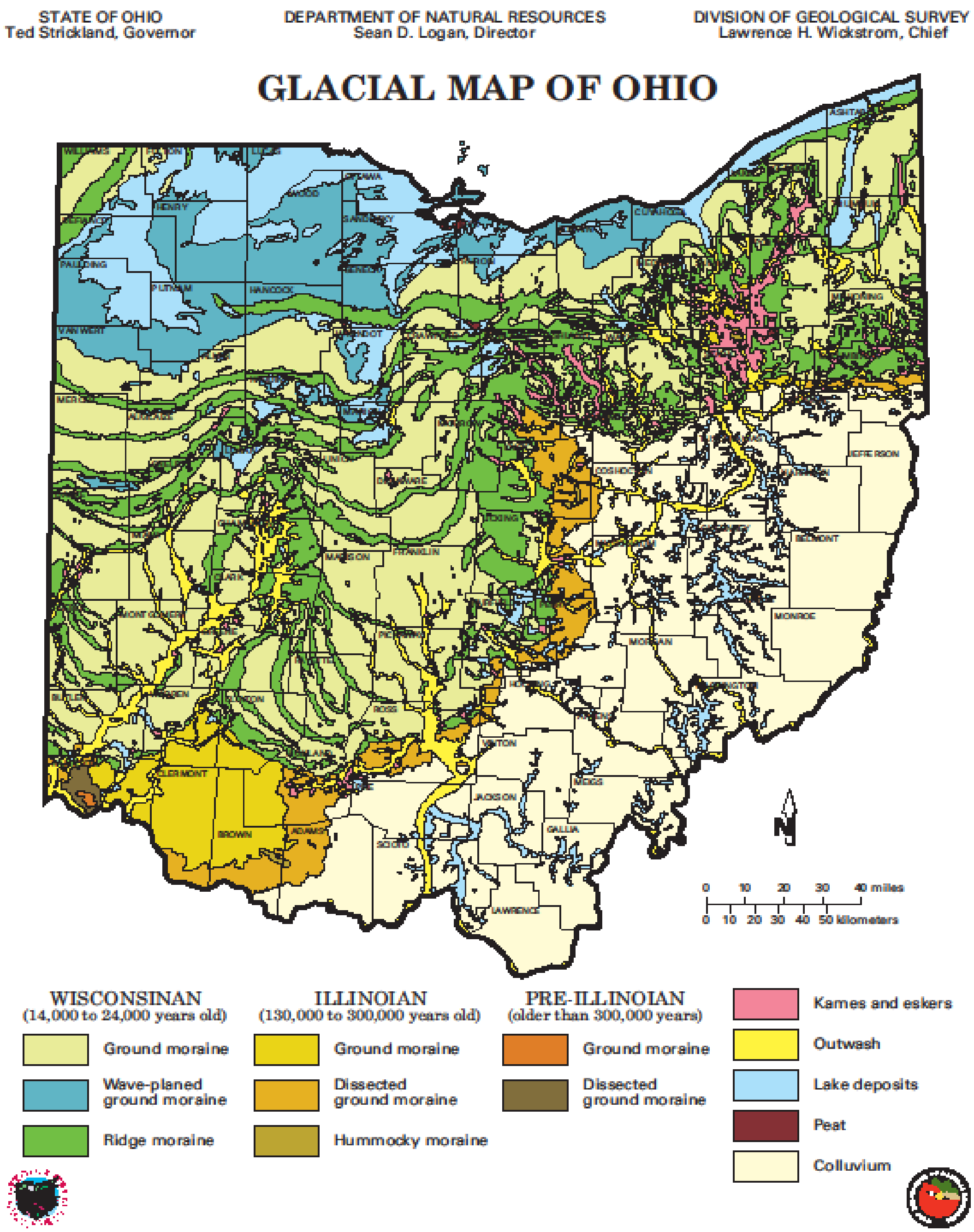


Figure 3. Glacial Geology of Ohio. (Image provided by Ohio Department of Natural Resources, Division of Geologic Survey)

10 to 30 feet thick, covered with a loess cap of 18 -40 inches in depth. The levelness and poor permeability of the Illinoian till plains create an ideal environment for crayfish, and this area is sometimes called the "Crawdad Flats."

Slope also affects runoff and erosion rates. Level areas tend to store water in depressions — whether puddle, wetland or ditch — slowing the rate of runoff and encouraging infiltration or evaporation. Steeper topography yields more runoff, faster surface water flow and increased erosion, increasing the potential for surface runoff to carry eroded soil to water bodies. Similarly, steeper stream channels have higher stream velocity that, in turn, can increase streambank erosion. A map of slope for the Stonelick Creek watershed is shown in Figure 4.

Soils

Soil plays an extremely important role in watershed management. For example, in many watersheds soils act as natural water filters. Certain soil types are prone to flooding or erosion, affecting runoff rates and sedimentation. An understanding of soil types, with their benefits and limitations, leads to more effective land use management. The following paragraphs provide a summary of soil characteristics in the Stonelick Creek watershed.

The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) in conjunction with ODNR Division of Soil and Water Conservation identified six soil associations (i.e., groups of soil series found in conjunction). Figure 5 illustrates the distribution of

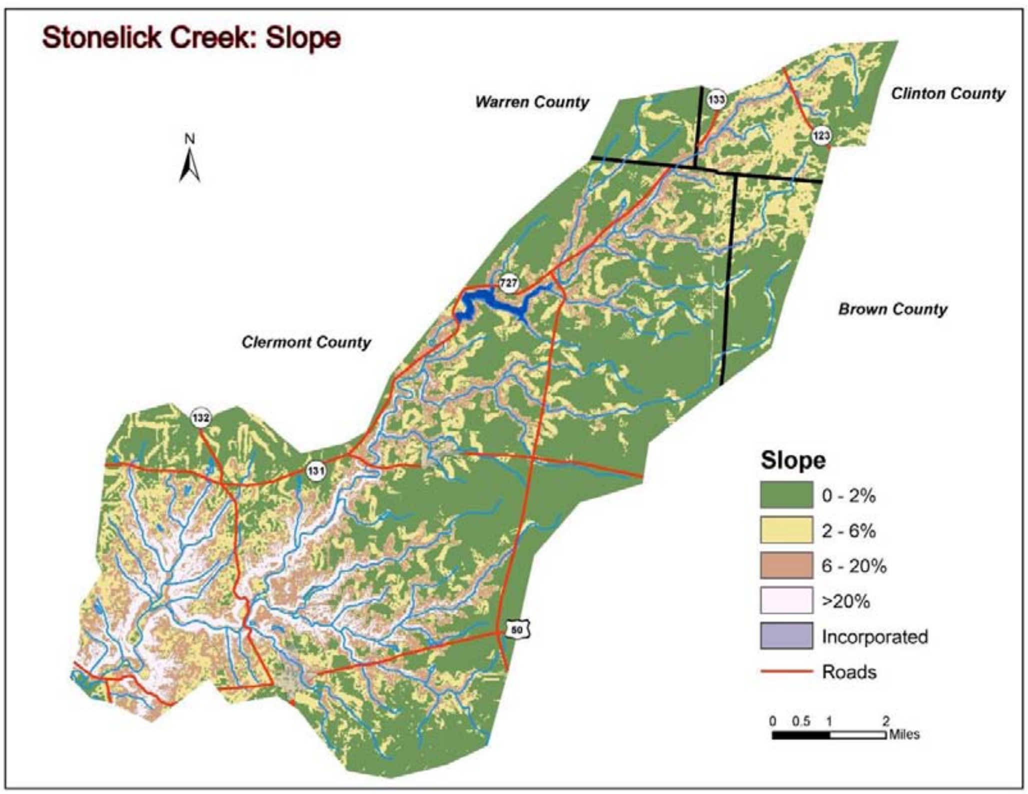


Figure 4. Slope map of the Stonelick Creek Watershed.

soil associations within the Stonelick Creek watershed. [Note: A finer level of detail, including maps of individual soil series, can be seen in the Soil Surveys of the individual counties. Contact your county Soil and Water Conservation District to obtain a copy.]

Table 1 describes the most common soil series in the Stonelick Creek watershed, and provides information on the permeability, drainage and runoff characteristics of each.

Clermont soils are considered hydric, meaning they have similar characteristics to wetlands. Found on nearly level terrain, they generally are poorly drained, have very slow permeability and runoff rates, and experience surface ponding and seasonal wetness. The constant wetness of the soil can become a severe limitation for farming practices. Despite this, however, Clermont soils that have been adequately drained are generally used for row crops and pastures. Clermont soils also limit the effective placement of on-site septic systems, as the constant soils moisture prevents the effluent from infiltrating.

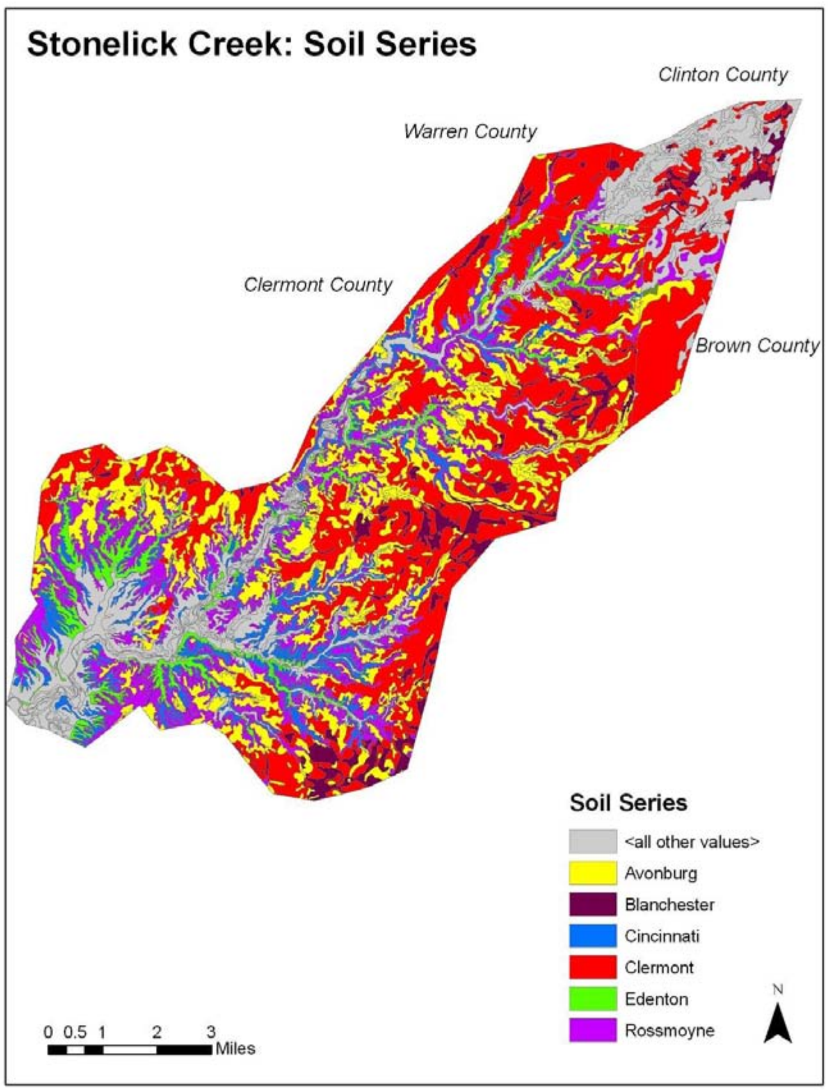


Figure 5. Soil Map of the Stonelick Creek Watershed.

Avonburg soils consist mostly of clay material, and therefore have a very slow permeability and are poorly drained. These soils are found on nearly level terrain causing runoff to be somewhat slow. Seasonal wetness can also become a limitation for agriculture and the placement of on-site septic systems.

The Rossmoyne soils are generally found on sloped upland ridge tops. Because of the slope, these soils are moderately well drained, however the soil itself has a moderately slow permeability. Some soils types within the this series can be found on relatively steep slopes, causing increased erosion rates. Similar to the Clermont and Avonburg soils, the Rossmoyne soils have a seasonal high water table, which often prevents water from infiltrating following seasonal rains.

Biological Features

The native vegetation of the Stonelick Creek watershed is composed mainly of deciduous hardwood forest, though species composition varies based on soil moisture. In the better drained areas, swamp white oak, red oak, beech, sugar maple and hickory are dominant, with elm, ash, black walnut, honey locust, and sweet gum also

Soil Series	Permeability	Drainage	Runoff	Seasonal High Water table (Ft)	Topography	% Soil Type in Watershed
Clermont Silt loam (Ct)	Very slow	Poorly drained	Slow	0—1/2	Nearly level	32%
Avonburg Silt loam (AvA, AvB, AvB2, AwA)	Very slow	Somewhat poorly drained	Slow to medium	1/2—1 1/2	Nearly level to gently sloping	20%
Rossmoyne Silt loam (RpB, RpB2, RpC2, RpA, RtB)	Slow	Moderately well drained	Medium to rapid	1 1/2—2 1/2	Nearly level to sloping	17%
Cincinnati Silt loam (CcB, CcB2, CcC2, CcD2, CkD3)	Moderately slow	Well drained	Medium to rapid	>3	Gently sloping	7%
Blanchester Silt loam (Bc)	Very slow	Poorly drained	Very slow to ponded	0—1/2	Nearly level	5%
Edenton Loam (EbC2, EbD2, EbE2, EcE3, EbG3)	Moderately slow	Well drained	Rapid to very rapid	>3	Sloping to very steep	5%

Table 1. Common Soil Associations found in the Stonelick Creek watershed.

present. Much of the watershed lies within the wetter, level areas of the Illinoian till plains where the dominant species are pin oak, soft maples, ash, elm, and swamp oak with beech and sweetgum also present. Sycamore, boxelder, hackberry, willow and cottonwood were common in bottomland forests.

The Ohio Department of Natural Resources, Division of Natural Areas and Preserves maintains a list of rare, threatened and endangered species in the State of Ohio, including endangered species of fish and macroinvertebrates. Species found in Stonelick Creek are summarized in Table 2 (also see Figure 7).

It is important to note that these are confirmed occurrences of these species, and other rare plant and animal species are likely present in the watershed, but haven't been identified. Occurrences of rare plant and animal species may be reported to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves.

Invasive Nonnative Species

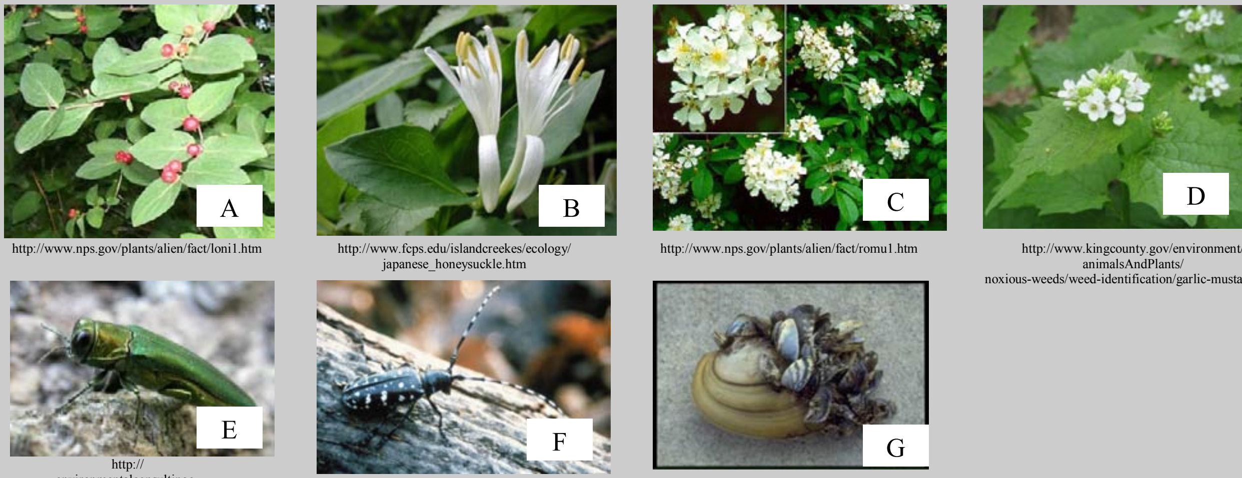
Numerous invasive plant species occur throughout the East Fork Watershed. Common invasives include bush honeysuckle (*Lonicera* species), Japanese honeysuckle (*Lonicera japonica*), multi-flora rose (*Rosa multiflora*), and garlic mustard (*Alliaria petiolata*) (see Figure 7). Other known invasives include the Autumn and Russian Olive (*Elaeagnus spp.)* and the Tree of Heaven (*Ailanthus altissima*). There are other invasive species, such as the Purple Loosestrife (*Lythrum salicaria),* which are not yet prevalent in the watershed, however still pose a threat of proliferating and dominating the landscape.

Figure 6. Photo of *Anodonta grandis*
Image: http://.marietta.edu/~biol/

Invasive plants have negative impacts on native vegetation and animals within the watershed. Bush and Japanese honeysuckle out-compete and displace native plants and alter natural habitats by decreasing light availability and depleting soil moisture and nutrient content. Exotic bush honeysuckle compete with native plants for polli-

Common Name	Scientific Name	Federal Status	State Status	Location
Rare Plant List				
Beech-Oak-Red Maple Forest			High quality community	Stonelick State Park
Northern Fox Grape	*Vitis labrusca L.*	Species of Concern		East Fork Watershed
Southern Wapato	*Lophotocarpus calycinus*		Potentially Threatened	Stonelick State Park
Sparse-Lobe Grape Fern	*Botrychium biternatum*		State Threatened	Stonelick State Park
Rare Animal List				
Stout Floater	*Anodonta grandis corpulenta*		Potentially Threatened	East Fork Watershed

Table 2. List of rare, endangered or threatened species in the Stonelick Watershed



http://www.nps.gov/plants/alien/fact/loni1.htm

http://www.fcps.edu/islandcreekes/ecology/japanese_honeysuckle.htm

http://www.nps.gov/plants/alien/fact/romu1.htm

http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/garlic-mustard.aspx

http://environmentalconsultingohio.files.wordpress.com/2012/03/eab-adult.jpg?w=300&h=200

http://www.fallrivertrees.org/Asian%20Long%20Horned%20Beetle%202.gif

Figure 7. Common Invasive Species of the East Fork Watershed: A) Bush Honeysuckle: B) Japanese Honeysuckle; C) Multi-flora Rose; D) Garlic Mustard; E) Emerald Ash Borer; F) Asian Long-horned Beetle; G) Zebra Mussels

nators, resulting in reduced seed set for native species. Unlike native shrubs, the fruits of exotic bush honeysuckles are carbohydrate-rich and do not provide migrating birds with the high-fat content needed for long flights.

Multiflora rose forms dense thickets, excluding most native shrubs and herbs from establishing and may be detrimental to nesting of native birds. This species was once suggested by Soil and Water Conservation Districts for living fences and wildlife habitat, however it is no longer encouraged.

Garlic mustard invades areas disturbed by human activities and appears to be aided by white-tailed deer that prefer to eat native wildflowers and leave garlic mustard untouched. Garlic mustard displaces many native spring wildflowers such as spring beauty, wild ginger, bloodroot, Dutchman's breeches, toothworts and trilliums that occur in the same habitat. It is also credited with the decline of the West Virginia white butterfly because chemicals in garlic mustard appear to be toxic to the butterfly's eggs.

Invasive plant species are not the only threat to the East Fork Watershed. The Emerald Ash Borer (*Agrilus planipennis)*, is an invasive wood-boring insect that threatens native North American ash trees throughout Ohio and elsewhere across the Midwest. The Emerald Ash Borer (EAB) infests saplings and fully mature ash trees (Fraxinus spp.). Since the EAB was first identified in 2003, forty four counties, including Clermont County, have become infested with the insect and placed under quarantine. In an effort to slow the spread of the EAB, residents within quarantined counties are prohibited from moving ash trees, parts of an ash tree, and all hardwood firewood from a quarantined county to a non-quarantined county without a compliance agreement from the Ohio Department of Agriculture (Ohio State University Extension).

Zebra mussels *(Dreissena polymorpha*) are another invasive species rapidly spreading throughout the Midwest (Figure 7) . Zebra mussels and a related species, the Quagga mussel, are small, fingernail-sized mussels native to the Caspian Sea region of Asia. They are tolerant of a wide range of environmental conditions and have now spread to parts of all the Great Lakes, the Mississippi River, and the Ohio River. Zebra mussels clog water-intake systems of power plants and water treatment facilities, as well as irrigation systems, and the cooling systems of boat engines. They have severely reduced, and may eliminate native mussel species. No zebra mussels or Quagga mussels have been found in the East Fork Watershed. It is important, however, to continue to monitor the watershed for the presence of these aquatic invasives.

East Fork Mussel Population

In addition to the threat of invasive species, research has shown that poor water quality and habitat loss are contributing to the decline of the East Fork mussel population (Hoggarth and Goodman, 2007). Research done between 1990-91 and 2006-07 on 10 sites in the East Fork yielded a decline in the Mussel-Index of Biological Integrity (M-IBI) scores (see description below). While some reaches retained their mussel diversity, the East Fork population as a whole was determined to be aging and less diverse. It appears that the former mussel community is being replaced by a few opportunistic mussel species that use the freshwater drum as a host (*L. fragilis, P. alatus, T. truncate).* The executive summary of the Hoggarth study is included in Appendix B.

Climate and Precipitation

The entire East Fork watershed has a temperate climate characterized by well-defined winter and summer seasons. Historically, the coldest month is January, which has an average daily temperature of 26 degrees F, and average daily maximum and minimum temperatures of 35 and 18 degrees F, respectively (data taken from climate station at Hillsboro in central Highland County). The warmest month is July, with an average daily temperature of 74 degrees F, and maximum and minimum temperatures of 83 and 64 degrees F, respectively.

The average annual total precipitation ranges from 41-43 inches. Of this, about 17 inches (~40 percent) falls during the growing season between May and August. The months with the least amount of precipitation are January, February and October, all with average monthly totals of less than 3.0 inches. The wettest months, on average, are March, May, July, and August, each with average monthly precipitation amounts greater than 4.0 inches. Before June, rainfall events are typically more widespread, caused by frontal systems moving through the area. In the hotter months of July, August and the beginning of September, rainfall is more spotty in coverage, as convective, “pop-up” thunderstorms in the afternoon are common.

Surface Water

For purposes of this Watershed Action Plan, the Stonelick Creek watershed is defined as the land area draining water to Stonelick Creek and its tributaries, downstream to the confluence with

Ohio EPA’s Biotic Indices

Ohio EPA established biotic indices for both fish and macroinvertebrates as a means to assess any impacts on these populations. The Index of Biological Integrity (IBI) is a numerical index that characterizes the condition of the fish community and is based on a set of “metrics” that measure different components of the fish population. Examples of different metrics would be the total number of species or percent sunfish found during a particular survey. Likewise, the Invertebrate Community Index (ICI) is based on a separate set of metrics that characterizes the macroinvertebrate community. Each “catch” for a survey is assessed, and each metric is scored (1, 3 or 5 for fish; 2, 4 or 6 for macroinvertebrates). The metric scores are then added together to give the resulting index.

The IBI in the Hoggarth Study was modified to measure the mussel communities. M-IBI scores that ranged 10-19 = Poor; 20-29 = Fair; 30-39 = Good; 40-50 = Excellent.

the East Fork Little Miami River in Clermont County. Stonelick Creek is located within the 11-digit Hydrologic Unit Code (HUC): 05090202-130, as defined by Ohio EPA, and consists of four 14-digit HUCs (Figure 9).

Stonelick Creek, a major tributary to the East Fork, is 22.9 miles in total length and has a total drainage area of 77 square miles. Stonelick Creek is designated as a Warm Water Habitat (WWH) stream and a State Resource Water (SRW), due to the presence of the reservoir (Stonelick Lake) at Stonelick State Park. The reservoir at Stonelick State Park was completed in 1950 and is approximately 200 acres in total area.

The four sub-watersheds of Stonelick Creek include Lick Fork (050902021304), Brushy Fork (050902021302), Moore's Fork (050902021303), and Locust Creek (050902021301). All of the streams in these sub-watersheds, with the exception of Locust Creek, are designated as warmwater habitat streams and are designated for Primary Contact Recreation (PCR). Locust Creek has not been assigned an aquatic life use designation by Ohio EPA.

Ohio EPA has limited data for the Stonelick Creek watershed. Assessments conducted in 1998 included segments of Stonelick Creek and Lick Fork. Clermont County has conducted some monitoring along Stonelick Creek and its tributaries. Data and information collected from Clermont County's monitoring is discussed in Chapter 3.

Village of Blanchester Public Water System

The Village of Blanchester draws some of its public water from the upper reaches of Stonelick Creek. The Village of Blanchester Public Water System serves a population of approximately 4,500 people with approximately 1,600 service connections. The water treatment system obtains its water from 3 different intakes on 3 difference streams: Stonelick Creek, West fork of the East Fork and Whitacher Run (Figure 8). See Appendix for more information.

Wetlands

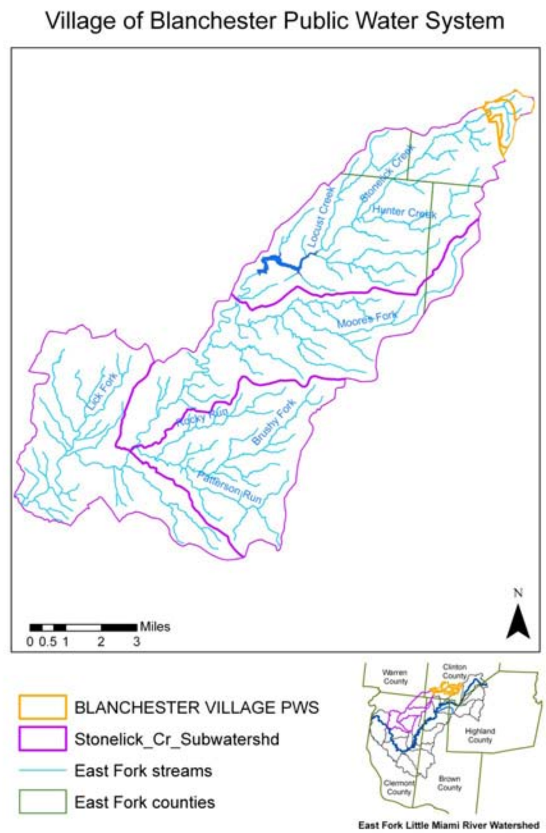
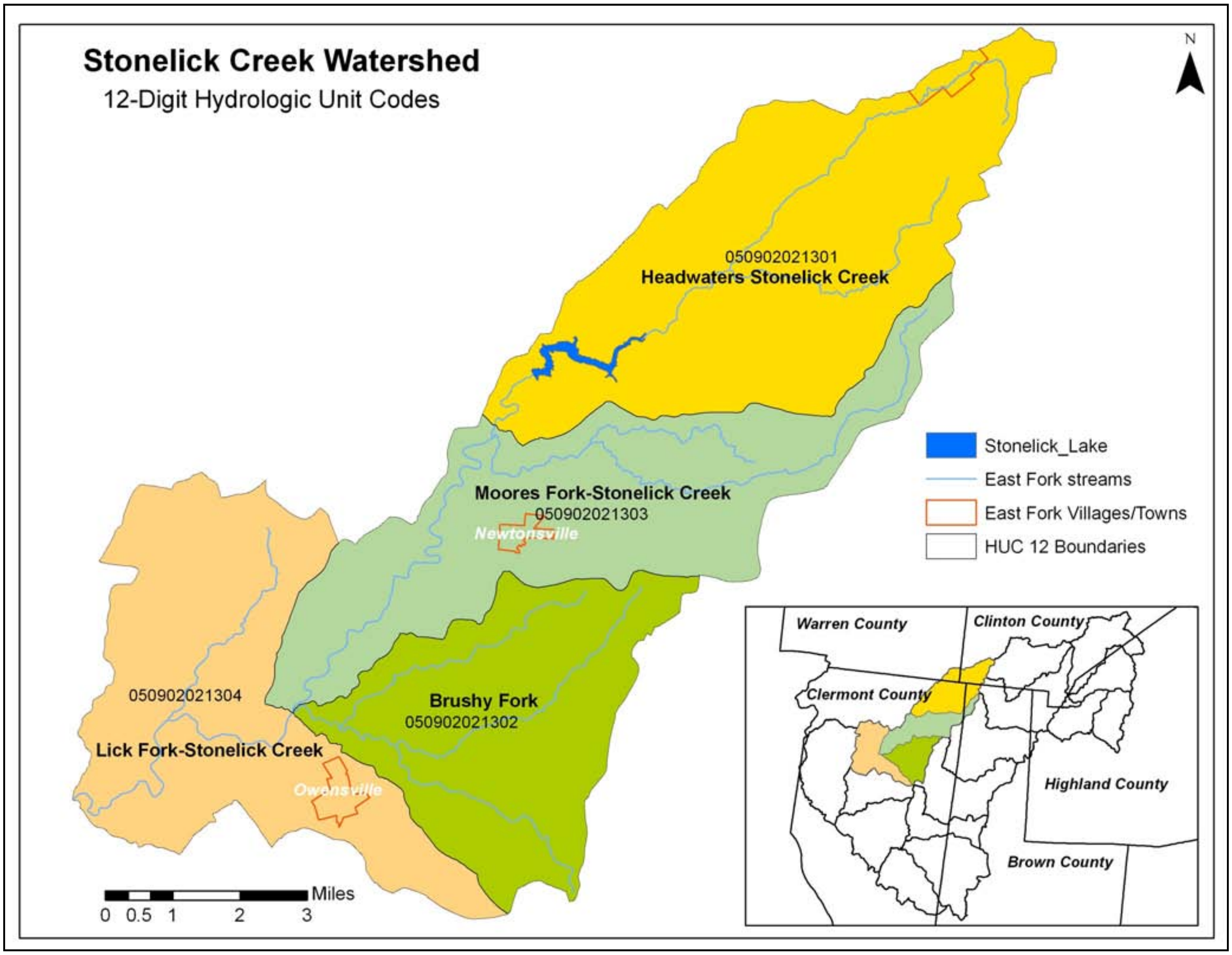


Figure 8. Village of Blanchester Public Water System (Source Water Protection Area)

Most of the identified wetlands within the Stonelick Creek watershed are small and isolated. According to the National Wetlands Inventory, there are approximately 2,861 acres of wetland in the watershed. A map that depicts the location and the percentage of different types of wetlands in Stonelick Creek is shown in Figure 10.

Ground Water

The majority of aquifers in Stonelick Creek are poor sources of ground water. The bedrock con-



12-digit HUC	Name	Description
050902021301	Locust Creek sub-watershed: Stonelick Creek Headwaters	Stonelick Creek Headwaters, upstream Moore's Fork
050902021303	Moore's Fork sub-watershed: Middle Stonelick Creek	Stonelick Creek, Moore's Fork to upstream Brushy Fork
050902021302	Brushy Fork sub-watershed	Brushy Fork
050902021304	Lick Fork sub-watershed	Stonelick Creek, downstream Brushy Fork

Figure 9. Stonelick Creek 14-digit Hydrologic Units

-sists of interbedded plastic shales and thin limestone layers and seldom yields more than three

gallons per minute. The glacial cover ranges from 20 to 50 feet thick and is mainly clay. The two highest yielding aquifers in the Stonelick Creek are located within the Brushy Fork sub-watershed, just east of Owensville. These aquifers contain sand and gravel deposits of limited thickness and extent, and yield around 10 gallons per minute (Figure 11).

Ground water areas sensitive to pollution in the Stonelick Creek watershed are primarily located within riparian reaches and aquifer systems. There are no high risk areas located in Stonelick Creek. It is important to monitor areas for ground water pollution. See Appendix C for ODNR Ground Water Pollution Maps for Clermont County.

Land Use

Land use and water resources are inextricably linked. Land use decisions are often based on environmental factors, such as the quantity and quality of local water resources (as well as soils, topography, etc…). In turn, land use activities have direct impacts on streams, rivers, and lakes by affecting water quantity and quality. Understanding the bidirectional relationship between land use and water resources is vital to restoring and maintaining watershed health. The following sections present a summary of land use in the Stonelick Creek watershed based on the 2002 land use data.

It is important to note that these figures are based on 2002 land use data. The area of land used for forest and agriculture has undoubtedly declined since that time because of widespread

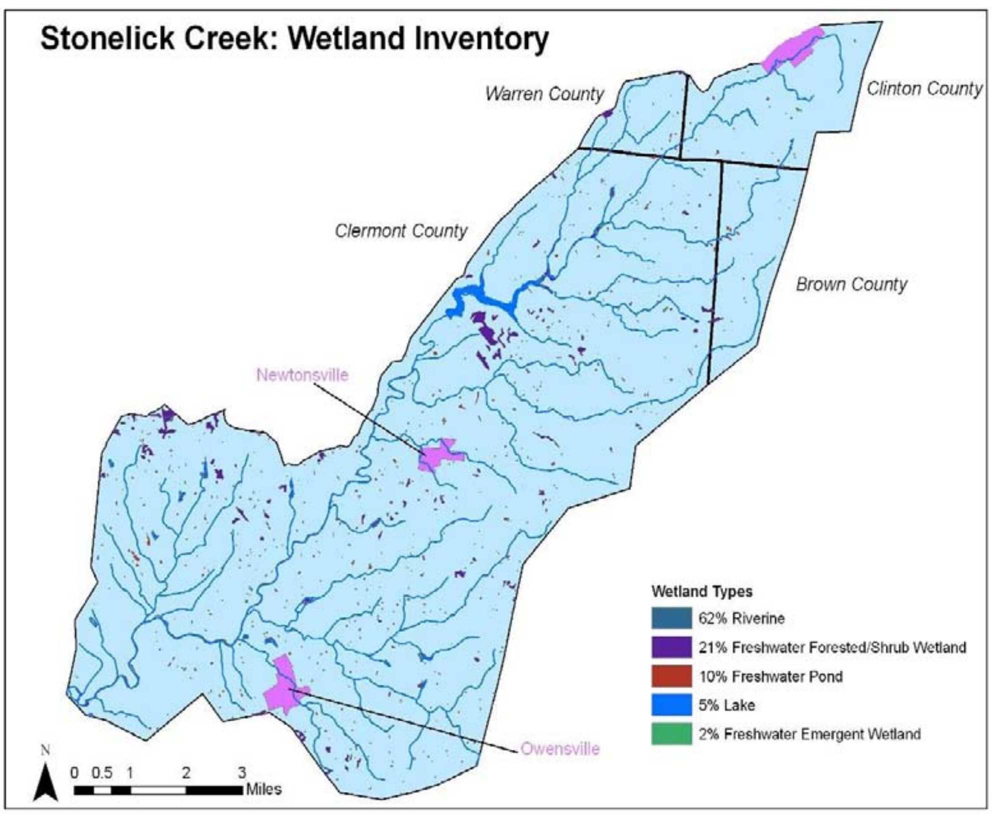


Figure 10. Stonelick Creek Wetlands Inventory (based on data from the National Wetlands Inventory)

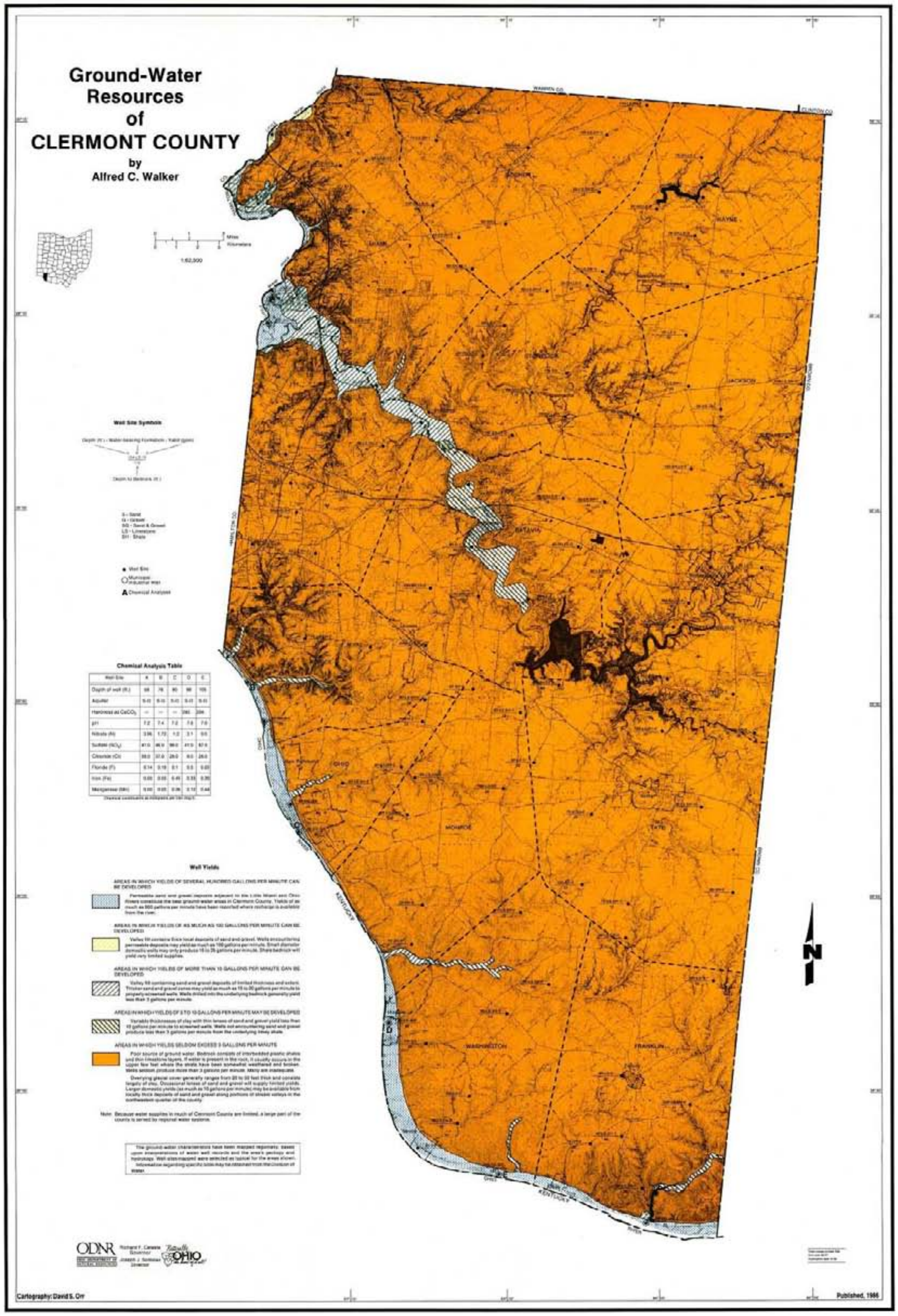


Figure 11. Ground Water Resource Map for Clermont County.
[source: http://www.ohiodnr.com/water/gwrmaps/counties/CLERMONT.htm]

rural residential development. However, forest cover and agriculture remain the dominant land uses in the Stonelick Creek watershed (Figures 12, 13). The water management consequences of this type of unplanned rural development, sometimes referred to as “rural sprawl,” are not fully understood.

Agriculture

Based on the 2002 land use data, agriculture accounts for approximately 67% (33,520 acres) of the land use in the Stonelick Creek watershed (Figure 13). There is approximately 19,152 acres of row crops and 14,368 acres of the agricultural land is classified as pastureland, including natural grassland prairies or fields.

Forest

According to the land use data, forested areas comprise approximately 29% (14,272 acres) of the watershed. Forested areas typically support a healthy watershed. Root systems help to prevent soil erosion, aiding water infiltration into the soil while preventing excess sediments from entering water bodies. Forested areas along streambanks help to increase the stability of the stream channel by preventing erosion. Riparian forestation also provides shade to streams, which helps maintain desirable water temperatures and dissolved oxygen levels.

Current Residential, Commercial and Industrial Development

The Stonelick Creek Watershed is sparsely populated and largely underdeveloped compared to the more densely populated Middle and Lower East Fork sub-watersheds. The population of Stonelick Creek is estimated to be 11,045 residents (Figure 2-14). Residential (low and high intensity) land use, combined with commercial and industrial development accounts for less than 3% (1,068 acres) of the land cover.

Within the Stonelick Creek Watershed, the majority of development historically has been concentrated around the Villages of Owensville and Newtonsville; however the siting of manufactured homes on large rural lots has become an increasingly popular alternative for homebuyers. Developed lands, particularly commercial developments, are notable because of their high percentage of impervious area.

Land Use Data Source

The land use data source used is from the 2002 high spatial resolution (4m x 4m) land use / land cover (LULC) dataset created by the USEPA for the entire Little Miami River watershed from remotely sensed imagery and made available by the USGS. This LULC classification was derived from 82 flight lines of Compact Airborne Spectrographic Imager (CASI) hyperspectral imagery acquired from July 24 through August 9, 2002 via fixed wing aircraft. Categories within this classification included water (both lentic and lotic), forest, corn, soybean, wheat, dry herbaceous vegetation, grass, urban barren, rural barren, urban / built, and unclassified. See sidebar on following page for detailed descriptions of all LULC classifications.

Reference: Troyer, M.E., J. Heo and H. Ripley. 2006 Classification of High Spatial Resolution, Hyperspectral Remote Sensing Imagery of the Little Miami River Watershed in Southwest Ohio, USA. U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Cincinnati, OH.

Land Cover Categories

From: ***Classification of High Spatial Resolution, Hyperspectral Remote Sensing Imagery of the Little Miami River Watershed in Southwest Ohio, USA*.**
Prepared by USEPA Office of Research and Development

Lentic: Open water associated with still water systems, such as lakes, reservoirs, potholes, and stock ponds. Such bodies typically do not have a defined channel or associated floodplain.

Lotic: Open water associated with running water systems, such as rivers or streams. Such waterways typically have a defined channel and an associated floodplain.

Forest: Contains either or both deciduous and coniferous trees in any degree of mixture. Single stemmed, woody vegetation with canopy spanning greater than 4 meters and tree canopy accounting for 25-100% of the cover.

Corn: Area under cultivation of food and fiber, where corn is the primary crop.

Soybean: Area under cultivation of food and fiber, where soybean is the primary crop.

Wheat: Area under cultivation of food and fiber, where wheat is the primary crop.

Dry Herbaceous: Dominated by dry and/or less vigorous herbaceous vegetation; herbaceous vegetation accounts for more than 25% of the ground cover. This class mainly includes naturally occurring and unmanaged herbaceous vegetation, and dried out, unhealthy, or stressed croplands. Dry herbaceous vegetation prevailed in croplands, as well as, "Other Agriculture" lands (fallow, hay, pasture, or natural grassland prairies or fields), due to drought in the Summer of 2002, Dry herbaceous vegetation had little chlorophyll content and very similar spectral signatures without regard to vegetative species.

Grass; Dominated by cultivated grasses planted in developed settings for recreation, erosion control, or aesthetics purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.

Urban Barren; Composed of bare soil, rock, sand, silt, gravel, or other earthen material with little (less than 25%) or no vegetation within urban areas. Examples include exposed soil in urban areas and constructions sites.

Rural Barren; Composed of bare soil, rock, sand, silt, gravel, or other earthen material with little (less than 25%) or no vegetation in rural areas. Typically fallow fields are included in this class too.

Urban/Built; Areas covered by structures and impervious surfaces in urban, suburban, and rural areas. Typically buildings, parking lots, and paved roads.

Unclassified; This class includes areas of image gaps among flight-lines and cloud cover where land cover classification was not feasible.

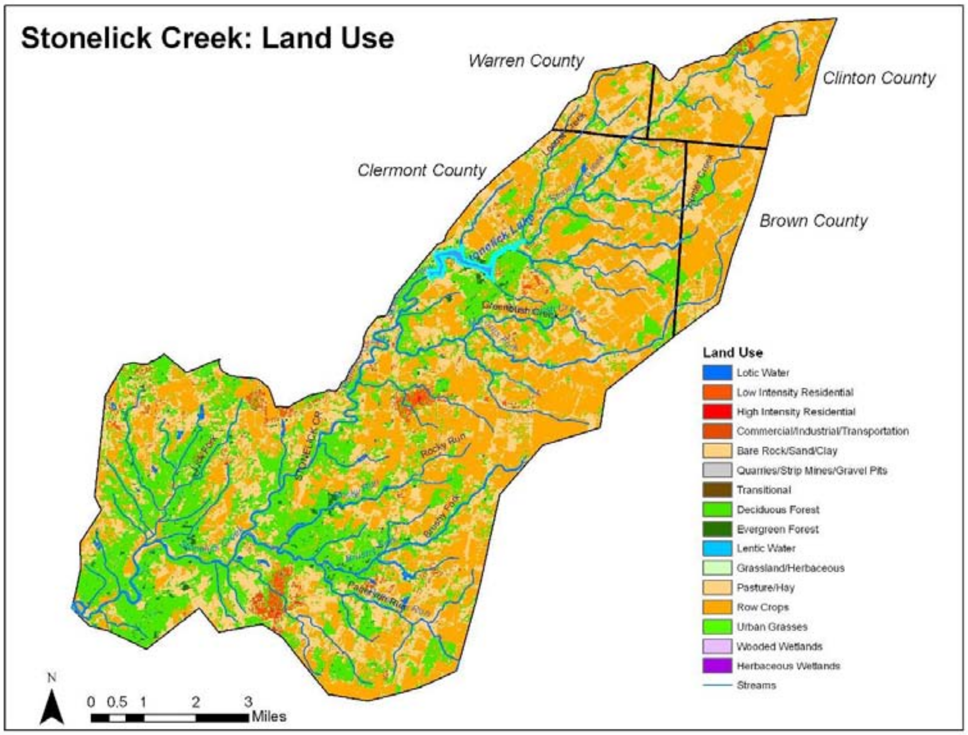


Figure 12. General land cover in Stonelick Creek

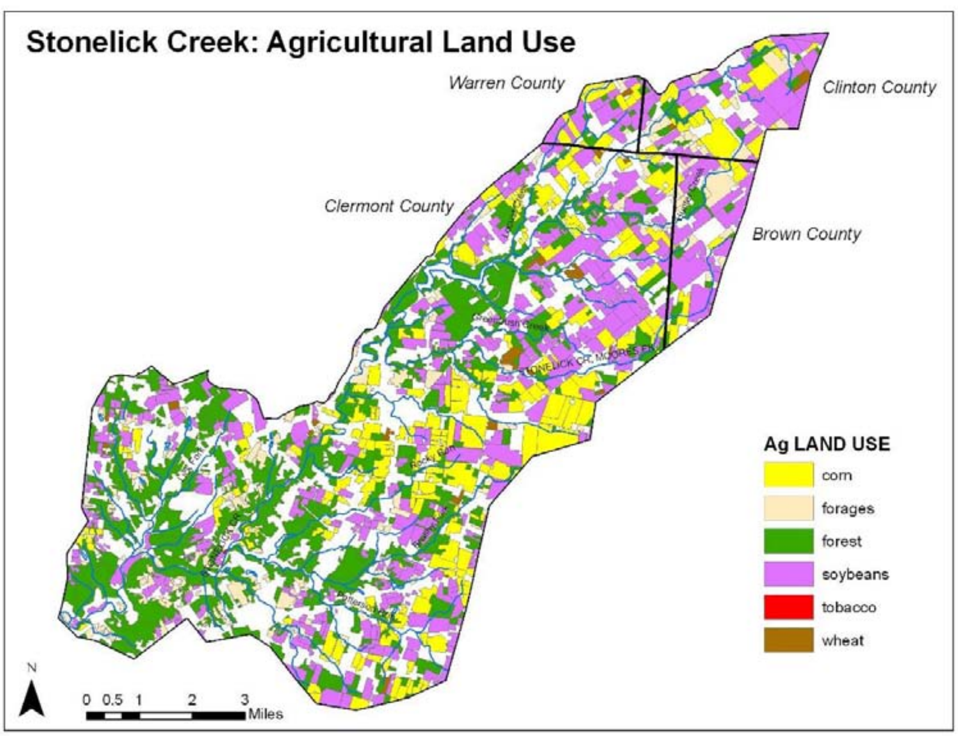


Figure 13. Agricultural land use in Stonelick Creek

Similar to the Middle East Fork watershed, the Stonelick Creek watershed is transitioning from a rural setting to a more urban and suburban setting. Urban growth in Clermont County has been spurred by an expanding transportation network connecting eastern Hamilton County (Greater Cincinnati) to western Clermont County. The expansion of urban growth in Clermont County will have significant impacts on the landscape in the Stonelick Creek sub-watershed.

Future Trends in Residential, Commercial, Industrial and Transportation Development

The Eastern Corridor Project

The Eastern Corridor Project, a regional and multi-modal transportation project, is a major investment in the local transportation network that will impact western Clermont County, including the Stonelick Creek sub-watershed. The project area extends from the Cincinnati Central Business District/riverfront redevelopment area in Hamilton County, east to the I-275 outerbelt in Clermont County. While the multi-modal project includes plans for extended bus service, bike trails, and a new commuter rail line, the crux of the project involves expanding interstate highway connectivity. Access improvements and road expansion along SR 32 in Eastgate will directly affect the following communities: Amelia, Batavia, Milford, Batavia Township, Miami Township, Pierce Township, Stonelick Township, and Union Township.

The multi-modal transportation improvements proposed for the Eastern Corridor will further improve connectivity in the area by providing better connections to the interstate system and better links from the area's economic centers in Cincinnati and Hamilton County to developing residential areas in eastern Hamilton and western Clermont County. Clermont County is currently the only Cincinnati suburb not directly connected by interstate highway to the employment and economic core of Cincinnati and Hamilton County. As growth continues in Clermont County, pressure will be exerted on the Stonelick Creek watershed from the south as the State Route 32 corridor is expanded.

Community Planning

In 2008, the Clermont County Planning Department began working towards developing a Comprehensive Plan for the County. This initiative was modeled after the Ohio Kentucky-Indiana Regional Council of Government's (OKI) Regional Policy Plan—a guide for developing long range growth management plans.

Planning for growth and development in Clermont County has been initiated by the Townships. In the early 2000s, many of the local Townships began developing Growth Management Plans and Land Use plans in anticipation of continued growth and development. Stonelick Township, Wayne Township, and Jackson Township (all located within Clermont County), occupy the largest area within the Stonelick Creek watershed (Figure 15). All three of these Townships have developed land use/ growth management plans.

The 2000 Census showed that the majority of growth within Clermont County is occurring within the townships and not the unincorporated municipalities. The boom in residential construction during the late 1980's and early 1990's may have peaked and population growth may be more modest for the foreseeable future. Thus, some of the estimates for expected population growth and land use changes outlined in the Townships' plans may not reflect the current trends in development. However, any future changes in population growth and land use changes that does occur within the townships (and the Stonelick Creek watershed) will depend on a number of factors including roadway improvements, utility and infrastructure expansion, and the overall state of the economy.

Stonelick Creek Demographics

The population characteristics of the Stonelick Creek watershed were obtained using US census data from the years 1990 and 2000.

Data from the 2000 census indicates that approximately 11,045 residents live within the watershed. The average population density in the Stonelick Creek is about 0-25 people per square mile (Figure 14). For comparison, the Lower East Fork Watershed (see Figure 1, p 10), located in the eastern suburbs of Cincinnati (Eastgate, Union Township, Miami Township, Milford), has a population density of 1590 people/sq mi. Based upon this average population density, approximately 10,700 residents live within the Clermont County portion of the watershed, along with 125 residents in Brown County, 150 residents in Clinton County, and 75 residents in Clinton County. Population growth in the watershed is concentrated near the Villages of Owensville and Newtonsville.

Reference: U.S. Census Bureau Website (www.census.gov)

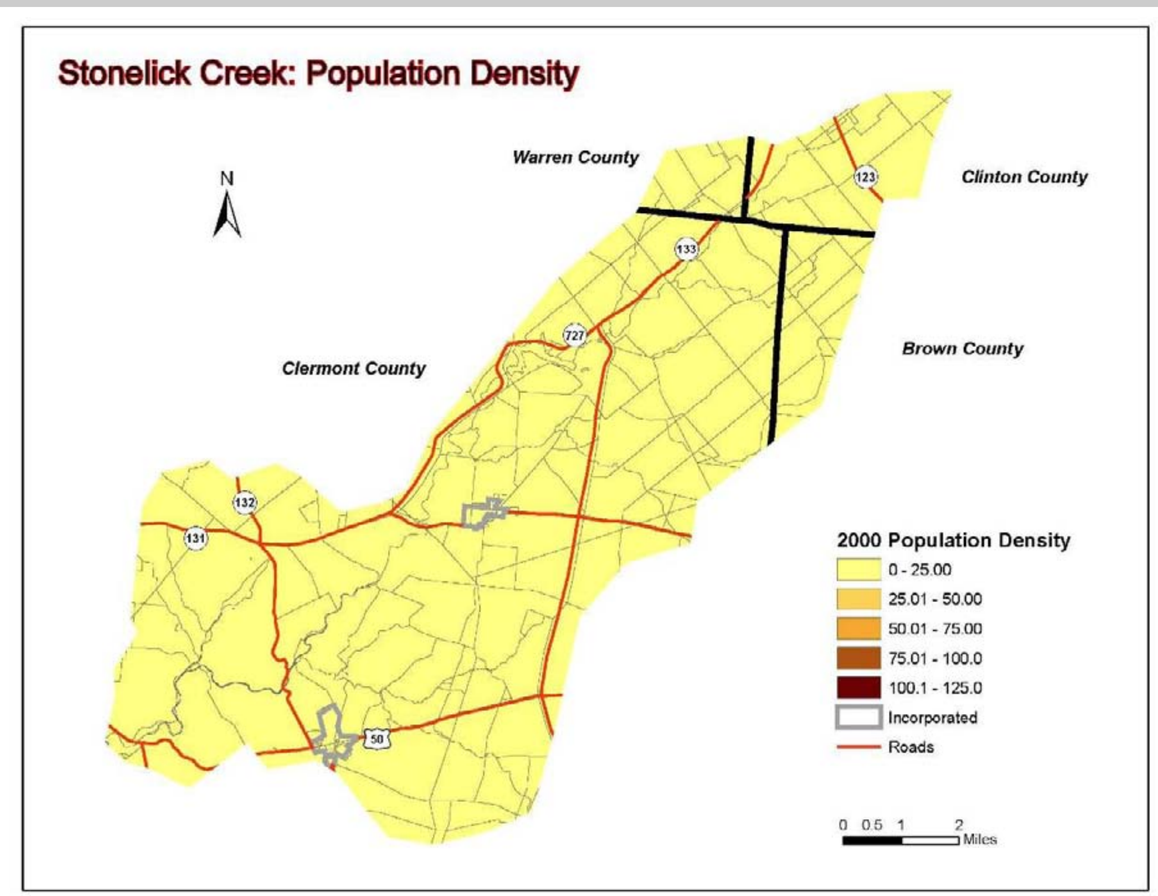


Figure 14. Population Density in the Stonelick Creek watershed.

Stonelick Township

Agriculture and forested lands account for 35% and 52% of the land use in Stonelick Township. Rural residential land use, which is scattered throughout the Township, accounts for 10% of the existing land use. Potential changes in land use were mapped according to land capacity and demand (Figure 16). This map excludes areas with known environmental constraints, such as the 100year floodplain, wetland areas and steep slopes (>15%).

While it was noted that future transportation projects will impact the Township and the watershed, the capacity for expanding utility infrastructure will also dictate the level and location of development. The extension of sewer and water lines are confined by topography and the high costs of future expansion. As such, the Township cannot support anything more than a semi-rural level of development within the next ten years at a minimum.

Comparisons of the 1990 and 2000 U.S. Census show that Stonelick Township has the eighth fastest growth in Clermont County with an annual growth rate of 2.42% . This accounts for 3% of all the growth in Clermont County townships. Projections of future population through 2020 show an increase in the number of Stonelick Township residents that ranges between 6,222 and 7,912. The amount of land available for development can easily accommodate this range of growth while maintaining the rural character of the Township.

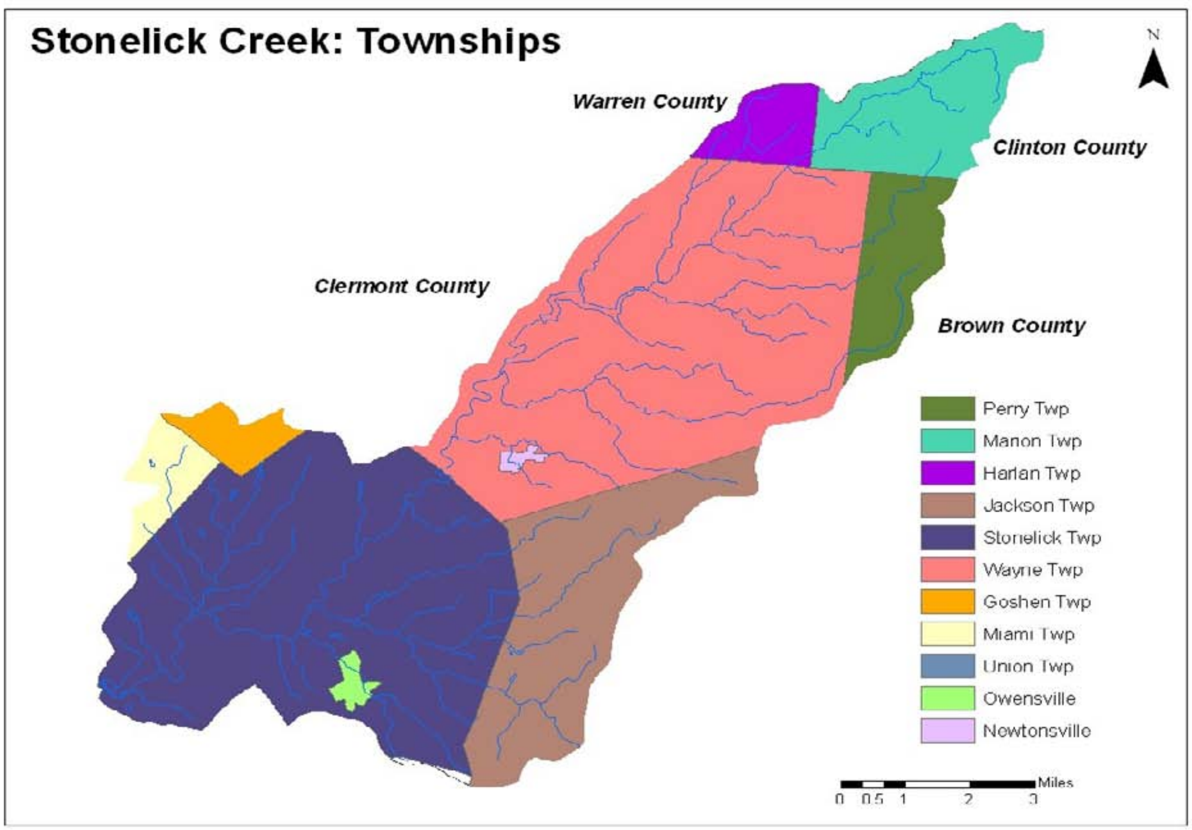


Figure 15. Townships located within the Stonelick Creek watershed.

Wayne Township

Growth occurring in the Cincinnati metropolitan region is impacting many townships in Clermont County. However, Wayne Township is not currently experiencing as much of this growth due to its north-easterly location. Current and future development is dependent on growth that occurs in neighboring townships and Clermont County.

The majority of the residential and commercial development is located in the lower portion of the Township near the Village of Newtonsville. Land use in Wayne Township is dominated by agriculture. There is also a high percentage of residential, recreational, and vacant land. Stonelick State Park and the Deer Track Golf Course are located in Wayne Township.

Potential growth and land use changes within Wayne Township are likely to be dependent on the extension of existing infrastructure and service availability. Currently, there is no sewer system in the township and the water system is primarily located near Newtonsville. There is approximately 1,200 acres of vacant land suitable for development in the vicinity of Newtonsville, where Clermont County has plans to extend sewer service.

Jackson Township

According to the 2000 Census, Jackson Township has a population of 2,576 residents and has one of the slowest rates of population growth in the County. The population increased a slight 4.6 % from 1990 to 2000, compared to the 19% increase for all of Clermont County for the same time period.

Agricultural land represents the largest percentage of land use. Jackson Township has

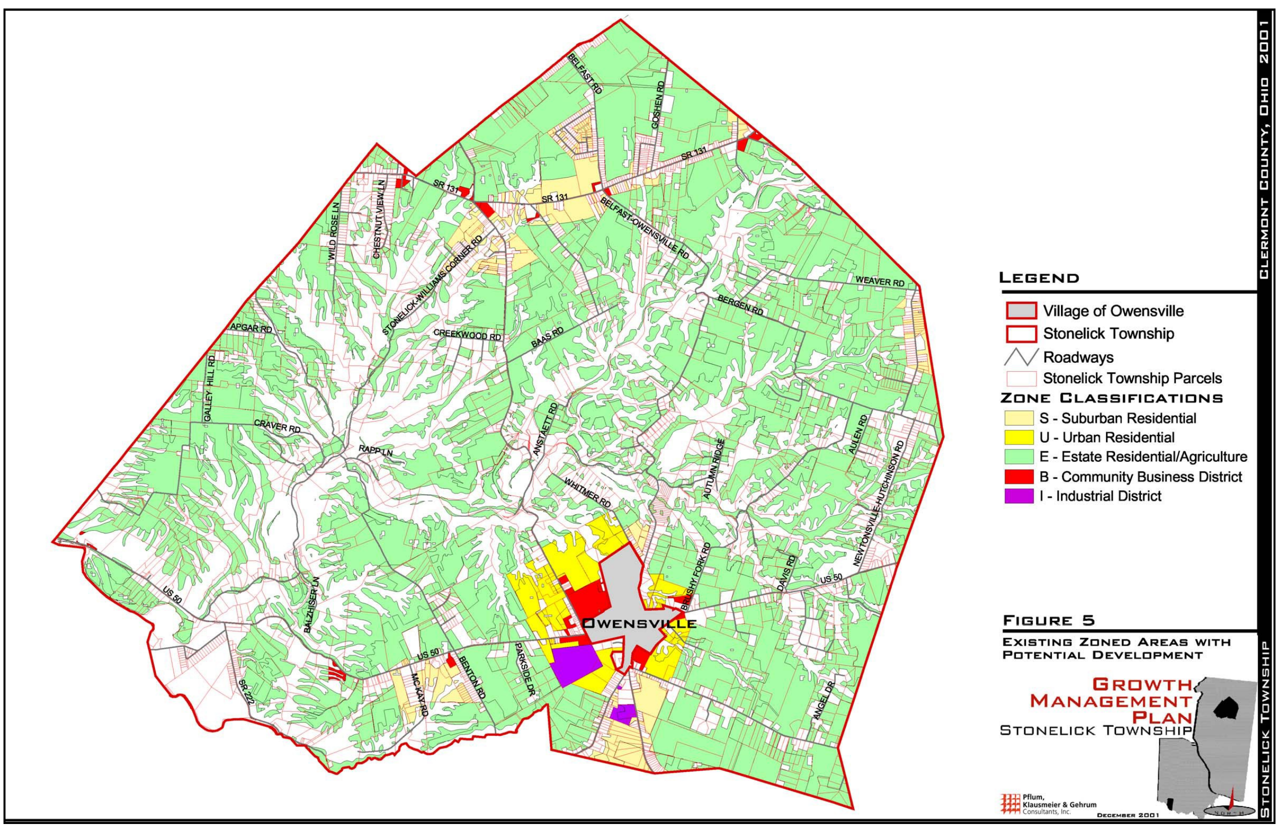


Figure 16. Stonelick Township zoning map

Economic Development: Improving Transportation and Enhancing our Economy

No industry impacts the quality of everyday life and the success of business more than transportation. Most of us recognize that increasing traffic congestion affects all of us, whether we are residents or business owners, by imposing unnecessary time delay, air pollution, safety and other costs upon travelers and business operations.

Adequate transportation facilities and supporting infrastructure are crucial for ensuring Clermont County's economic health and maintaining its competitiveness. The Clermont County Transportation Improvement District (CCTID) recognizes the changing nature of manufacturing, markets, trade and technologies has had dramatic impacts on the needs for movement of people, goods and services. These impacts have created new opportunities for economic growth in some areas but also risks of economic loss elsewhere.

Quite simply, future needs will likely not match the configuration of our transportation facilities and services developed 30+ years ago. Increasing globalization and international trade have led to new growth in movement of goods to and from marine ports, airport and border gateways, as well as new patterns of truck freight flow through our communities.

CCTID, realizing that our economic competitiveness is at stake, has begun to develop strategies, plans and construction projects to address not only the mobility needs of the people in our communities, but to address transportation's role in supporting the long-term economic well-being of our communities.

Clermont County Transportation Improvement District (CCTID)

The Clermont County Transportation Improvement District (CCTID) was established in June 2006, pursuant to O.R.C. 5540, by the Board of Clermont County Commissioners to foster increased collaboration with local partner jurisdictions, and other county, regional, state and federal agencies to implement a regional approach to transportation improvements in support of economic development in Clermont County.
CCTID is structured to provide combined technical, legal and financial capability to link transportation investments that foster economic development in Clermont County. All of the information provided in this section can be found on the CCTID website: http://tid.clermontcountyohio.gov/default.aspx

Environmental Stewardship: Improving Transportation and Enhancing our Environment

We all recognize that we need safe, efficient and effective transportation systems that connect us to our economy and built environment...our places of employment, churches, schools, recreation and shopping, as well as access to markets, suppliers and customers.

But it is increasingly clear that we must also recognize the importance and value of our connections to our natural environment as we jointly plan and develop our future transportation systems.

To minimize impacts on our environment, the Clermont County Transportation Improvement District (CCTID) and its partners are developing context-sensitive solution approaches and common-sense watershed-based mitigation strategies. By focusing on protecting and enhancing our environment, we can link important habitats, maintain and enhance our environment, and combine wetland mitigation and stream restoration and preservation with transportation investments.

CCTID is moving forward with the development of proactive environmental stewardship strategies that provide for broader mitigation strategies that support corridor or watershed based approaches and develops transportation investments that contribute to environmental stewardship through enhancing our green infrastructure.

Green Infrastructure

Green infrastructure is a strategically planned and managed network of natural areas, conservation lands, and working lands with conservation value that supports native species, maintains natural ecological processes, sustains air and water resources, and contributes to the health and quality of life for our communities and people.

The green infrastructure network encompasses a wide range of landscape elements:

- ***natural areas*** - such as wetlands, woodlands, streams and waterways, floodplains, hillsides and wildlife habitat;
- ***conservation lands*** - such as public and private nature preserves, open space, greenways, and parks; and
- ***working lands of conservation value*** - such as rivers and streams, woodlands, farms, and nurseries, as well as utility areas such as storm water management facilities.

Green infrastructure is an essential component of the CCTID advanced mitigation planning concept protecting important ecological, cultural and historic resources while supporting the corridor-wide transportation and economic development strategy.

By incorporating strategies to enhance and protect our green infrastructure into the joint planning initiative and development of our transportation systems, CCTID is developing advanced mitigation opportunities to protect our important natural environment.

Advanced Mitigation Concept

Advanced mitigation of environmental impacts (mitigation actions undertaken now in anticipation of future transportation project impacts) should be implemented during the early stages of transportation planning.

By taking a proactive approach to mitigating impacts to the environment, high-quality sites that are under threat now can be protected:

- Identify and select the best available sites for habitat and wetlands mitigation during the early planning process before transportation projects are implemented.

- Integrate habitat conservation and water quality protection with advanced mitigation strategies as elements of the corridor-wide green infrastructure.

- Integrate parks, cultural and historic sites with advanced mitigation strategies as a foundation of greenway system.

By going beyond the minimum regulatory impact mitigation requirements, this advanced mitigation planning is an important part of the comprehensive approach to community development that puts resource protection into the overall transportation funding strategy.

Mitigation Opportunities

The advanced mitigation strategy being developed by CCTID is a continuation of land use visioning work, Green Infrastructure Planning, Tier 1 studies and resource agency and public input, to provide opportunity for a watershed-based mitigation approach and coordination with local watershed and conservation programs.

This coordination effort supports the watershed management objectives outlined in Chapter 5 (Watershed Recommendations), incorporates objectives of Clermont County's Project XLC Phase I agreement and Phase II Stormwater Management Planning, and is also being structured as part of the CCTID local match contribution to transportation improvements through an integrated funding approach.

A number of advanced mitigation opportunities have been developed to date and have been posted to Ohio EPA Mitigation Clearinghouse website to facilitate the exchange of information about potential sites for wetland and stream mitigation. Interested parties submit information on the Ohio EPA Data Sheet and Ohio EPA enters that information into a database. Submitted projects may be viewed by anyone interested in finding potential mitigation areas by clicking on the Map (see below).

http://www.epa.state.oh.us/dsw/MCH/map_index.html the highest percentage of agricultural land compared to the other townships in Clermont County. Surveys that were conducted during the land use planning process showed that township residents value the rural character of their communities and many expressed concern over the future of agriculture in the township and county.

There are three water services providers in Jackson Township: Brown County, Clermont County, and Western Water. The Clermont Water & Sewer District has plans for water line improvements, however there is no sewer service available in Jackson Township. The lack of utility infrastructure may limit future development. In the fall of 2008, Jackson Township updated their land use plan and is the first Clermont County township to implement a riparian set-back ordinance.

Potential Sources of Pollution-Non-point Source Inventory

Several factors determine the impact from non-point sources of pollution including type and characteristics of contaminants, the concentration of contaminants, soil type, percent of impervious surface, amount of rain, and the presence of buffers or other best management practices (BMPs). The primary sources of non-point source pollution in the Stonelick Creek watershed are discussed below.

Agriculture—Row Crop Production

Agriculture represents nearly 70% (33,520 acres) of the land use in the Stonelick Creek watershed, although it is not a major economic driver or way of life in the watershed. While it is often considered to be more ecologically sound than residential or commercial development, agriculture can have significant impacts on water quality. The heavy use of fertilizers and pesticides can contribute nitrogen, phosphorus and toxic chemicals to surface waters via storm water runoff and soil erosion. Conventional tillage practices can also contribute excess sediments through accelerated topsoil erosion. Sedimentation has the potential to alter the path and flow regime of a stream. Over time, these factors can significantly impair water quality and stream habitat.

Corn and soybeans are the dominate crops cultivated in the watershed. The general trend for crop rotation is a three year rotation of corn and soybeans. This rotation is preferable, as the high residue components left over from corn increase soil tilth and organic content. However, the low permeability and high moisture content of the Clermont soils leads many farmers to an alternative crop rotation of continuous soybean. Current and future commodity prices also influence crop rotation. Increased market demands for ethanol

Point Sources vs. Non-point Sources of Pollution

Potential pollution sources are classified as either "point sources" or "non-point sources." Point sources are very concentrated sources of pollution, typically "end-of-pipe" discharges such as wastewater treatment plant effluent. Non-point source pollution is used to describe the many sources of pollution—such as runoff from agricultural fields, suburban lawns or parking lots— associated with stormwater runoff. Even though some areas—for example septic systems, chemical handling areas on farms, and feedlots—have a higher concentration of potential pollutants, they are still treated as non-point sources because contaminants are typically carried to surface water in stormwater runoff.

or soy will often determine which crop is planted. There is no irrigation utilized in the watershed, primarily due to a lack of adequate water resources.

As noted by the local NRCS and FSA agents, the majority of farmers report practicing no-till (NT) farming. NT farming preserves crop residue on the land and leaves the soil intact, which in turn, enhances nutrient content and reduces soil erosion. Research that examines the long-term effects of NT farming is needed to gain a better understanding of how this practice affects the chemical, biological and physical attributes of the Clermont soils.

Local farmers also report the need to apply heavy doses of pesticides. The residues from chemicals that are used to control weeds, insects and fungi can impair water quality. See Appendix D for a complete analysis on chemical use and tillage practices in the East Fork watershed.

Agriculture—Livestock Production

Table 3 lists estimates of the type and number of livestock in the Stonelick Creek watershed. These are best estimates based on current information from USDA-FSA. Anybody familiar with agriculture in the area is aware of how quickly livestock demographics change based on family economics, markets, government programs, weather, and other factors. The trend is toward a few much larger livestock production facilities and away from the middle-sized operations of the recent past. Many farmers who produced some livestock in the 1980's and 90's have completely given up livestock production in favor of row-crop production. However, there still are quite a number of farmers that only have a few to a few dozen head, kept to take advantage of pasture or existing facilities.

There are a number of smaller livestock operations in the Stonelick Creek watershed that have resulted from the influx of hobby farmers into Clermont County. The individuals who run these operations sometimes lack the knowledge and experience needed for proper livestock management. As a result, inadequate animal housing and improper waste disposal can become significant issues, particularly in the smaller tributaries. Although these operations are small in scale, the collective impacts to the watershed can be detrimental. It is difficult to determine the exact number of these small-scale livestock operations. There are no registrations or licenses required to raise livestock and the majority of operators do not utilize local government programs. Thus, the estimates provided in table 2-4 likely underestimates the actual number of livestock in the watershed.

Overgrazing is a common issue for small livestock operations due to the limitation of space. The USDA recommends that livestock managers provide a minimum 2.5 acre area per animal unit (1,000 lbs). Most of the small operations also lack adequate feeding sites. Feeding sites should have gravel or concrete armors to prevent soil compaction, erosion and nutrient runoff. Grazing estimates for the entire Stonelick watershed

	Livestock – Type and Number						
Watershed	Alpacas	Beef Cattle	Dairy Cattle	Sheep & Goats	Horses	Swine	Total
Stonelick Creek	55	537	394	51	203	1230	2470

Table 3. Estimate of livestock in the Stonelick Creek watershed

could not be determined.

Livestock on pastures have the potential to contribute excess pollutant loadings to streams in the absence of appropriate management practices. The most important practice is to fence livestock out of streams, leaving a buffer area that settles out sediment and treats animal waste contained in the runoff. Local agricultural agents report that the majority of livestock operators in the Stonelick Creek do not restrict livestock access to streams.

Typical pollutants of concern from livestock production include suspended sediments and excess nutrients, resulting in the organic enrichment of surface waters. The decomposition of animal matter and excreta (as measured by BOD5) depletes oxygen supplies in water bodies, which in extreme cases can be depleted to a point that aquatic life can no longer be sustained. Furthermore, the flushing of animal excreta into lakes and streams can potentially introduce pathogens (bacteria and viruses) into the water supply, and create a contact hazard for recreational users. Potential pollutants generated by different types of livestock are presented in Table 4.

Larger livestock facilities like feedlots and hog barns offer a broader set of challenges. At the production facility, animal wastes are highly concentrated. Great care must be taken to contain animal wastes until they can be applied properly to crop ground or composted. There are no large livestock facilities located in the Stonelick Creek watershed.

Horse Farms

Based on USDA-FSA livestock information, there are several small horse facilities in the Stonelick Creek watershed. Though most horse farms probably have little impact on water quality, the number of complaints and the sight of poorly maintained horse pastures reflects the limited knowledge that some new horse owners have about managing horses and their waste. Harsha Lake (also known as East Fork Lake) has a number of trails for horseback riding and many recreational riders travel from outside the area to use these services.

Household Sewage Treatment Systems

There are approximately 3,608 household sewage treatment systems (HSTS) - more commonly called septic systems or on-site wastewater

Livestock Type	Size	Total Manure Production	Total Solids	BOD5	N	P_2O_5	K_2O
	lb	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Dairy Cow	1200	98	12.5	2.0	0.49	0.20	0.39
Beef Cattle	1000	60	6.9	1.6	0.34	0.25	0.29
Finish Hog	200	13	1.2	0.4	0.09	0.07	0.07
Sow w/litter	375	33	3.0	1.0	0.23	0.17	0.18
Sheep	100	4	1.0	0.1	0.05	0.02	0.04
Horse	1000	45	9.4	-	0.27	0.10	0.20

Table 4. Manure production and characteristics for common livestock animals

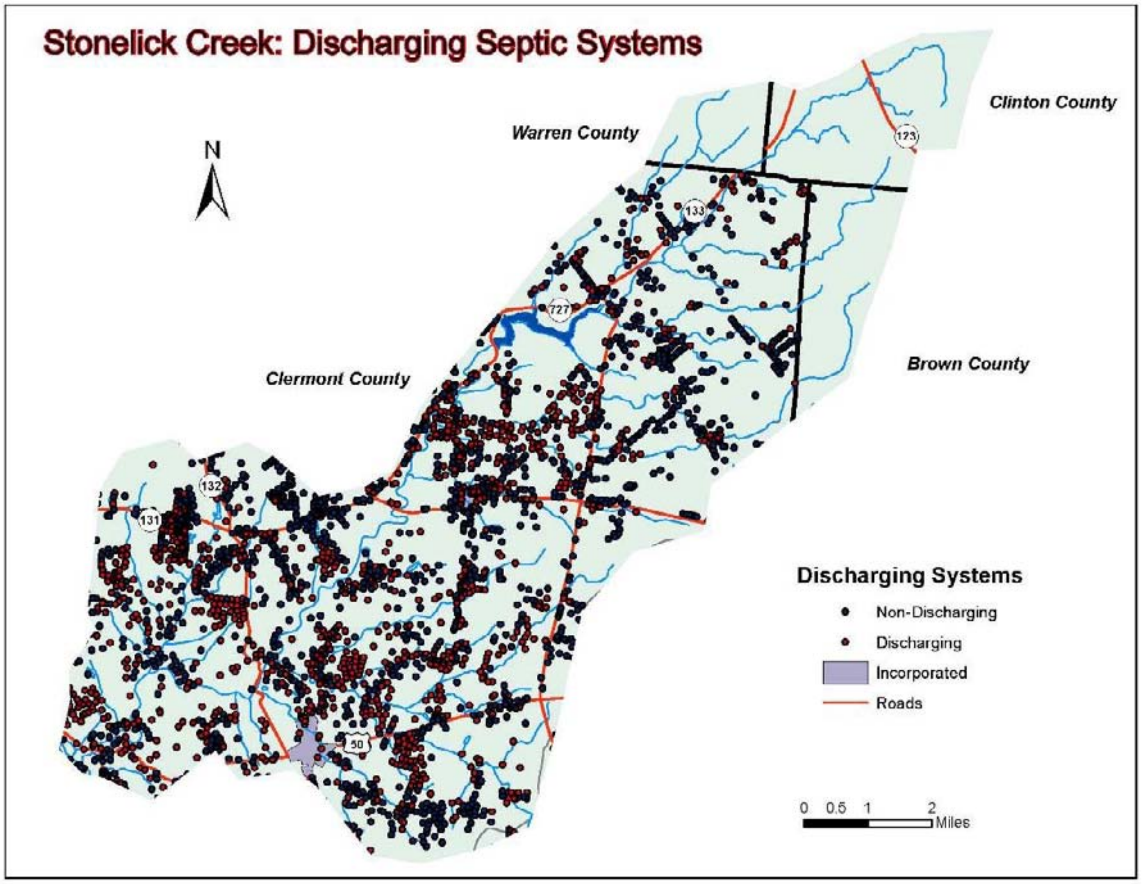


Figure 17. Inventory of home septic systems in Stonelick Creek.

treatment systems - in the Stonelick Creek watershed (Figure 17). Of the estimated 3,608 HSTSs, there are 1,332 discharging systems recorded by the Clermont County Health Department. A percentage of all HSTS systems are not providing adequate wastewater treatment due to a variety of reasons that include poor design, poor construction, or installation of a system inappropriate for the soil type (e.g., leach field treatment system on Clermont soil). When a HSTS is not providing adequate treatment of wastewater, untreated sewage will collect on the ground surface or be carried directly to a ditch or stream. Failing septic systems are a serious public health concern because of the potential that people will come into direct contact with untreated sewage in yards, ditches or streams.

Stormwater runoff will carry the untreated sewage with its high concentration of nutrients into streams causing organic enrichment, excessive algal growth, and loss of dissolved oxygen. The flushing of untreated sewage into lakes and streams can potentially introduce pathogens (bacteria and viruses) into the water supply, and create a contact hazard for recreational users.

Some local estimates put the percentage of failing systems in the Stonelick Creek watershed at 10%, which means that 133 of the 1,332 discharging systems are failing. Many of these failing systems are simply older systems that were installed when our knowledge of HSTS was limited and before HSTS were adequately regulated. State and county laws and standards regulating the design and siting of on-site systems have been periodically updated to reflect our increased understanding of how these systems work (or don't work) in a given environment. More specific information on septic systems may be found in the Home Sewage Treatment System Improvement Plan for Clermont County.

Urban Stormwater Runoff

Growth can be important to the vitality of neighborhoods and towns. It can have beneficial impacts for communities in terms of economics and community structure. However, growth and development that occur without environmental planning can create numerous challenges with stormwater management such as localized flooding and degraded stream quality. Urbanization increases the amount of impervious surfaces in the watershed, increases the runoff and pollutant loads, and potentially results in the impairment of streams. Based on 2002 land use data, it has been estimated that the Stonelick Creek watershed has approximately 1,068 acres of impervious surface, which accounts for an estimated 2-3% of the total land use (see sidebar for watershed classifications based on percent of impervious cover). In order for a balance to exist between growth and the environment, water quality concerns should be taken into consideration during the planning stages of development.

Phase II Storm Water Management Program

By March 2003, the Ohio Environmental Protection Agency (OEPA) required communities within urbanized areas to develop storm water management plans and to apply for coverage under the agency's Phase II storm water general permit. The goal of the Phase II program is to minimize the water quality problems that result from storm water runoff. These regulations affect 15 communities in Clermont County, including the County itself. The Clermont County Storm Water Department coordinates the implementation of the Clermont County Storm Water Management Plan (visit www.clermontstorm.net/ to review the plan) for 14 of the 15 Phase II communities including all those in the Stonelick Creek watershed (Figure 18). Ohio EPA has identified the lower section of the East Fork as a rapidly developing watershed; this 157 square mile drainage area, downstream of Harsha Dam to the mouth, includes the Stonelick Creek watershed.

Illicit Solid Waste Disposal

Population growth and populations in general can also contribute to illicit solid waste disposal (e.g., litter and dumping). Many roadways are lined with litter and spatially dotted with illicit dumping sites. Unfortunately, many of these dumping sites are located adjacent to streams and within stream valleys. Because of the size and nature of illicit solid waste disposal it is difficult to calculate the enormity and location of illicit solid waste dispersal within a watershed. However, this does not mean such a problem can be ignored.

The East Fork Watershed Collaborative with direct assistance from local soil and water conservation districts and solid waste districts are working closely to address this issue. Numerous educational programs have been established to spread awareness concerning litter prevention and the threat of illicit dumping in or near streams. Other programs have been established to engage the pubic in illicit solid waste removal.

Potential Sources of Pollution — Point Source Inventory

Any time that contaminated or "waste" water is discharged from the end of a pipe, the pollution is termed "point source pollution." That water has typically received treatment to meet certain water quality standards that were designed to minimize its impact on the stream. Point sources have historically been one of the biggest culprits in stream pollution and degradation of water quality.

Impervious Area and Non-point Source Pollution

Higher amounts of impervious area are associated with commercial, industrial and even residential land uses. Impervious area is any surface which does not allow the infiltration of rainwater. Typical examples include roofs, road surfaces, parking lots, driveways and sidewalks. Studies have shown that as little as 10% percent impervious cover in a watershed can be linked to stream degradation, with degradation becoming more severe as the impervious area increases. Watersheds are often classified based on their percent of impervious surfaces. Those with the least amount of impervious area tend to have the highest quality streams; and those with the greatest amount of impervious area typically have degraded conditions. The Center for Watershed Protection has classified watersheds with impervious cover of less than 10% as sensitive; 10-25% as degraded or impacted; greater than 25% as non-supporting of aquatic life.

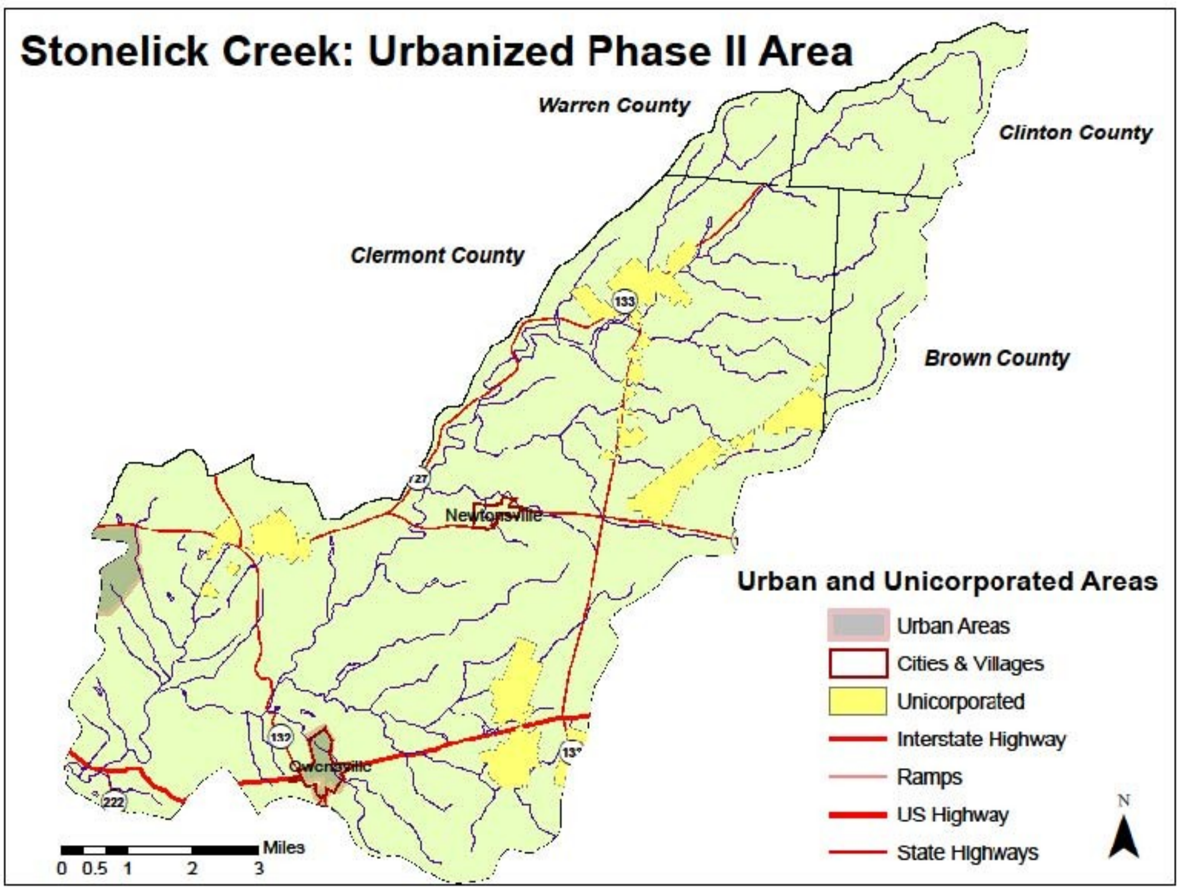


Figure 18. Stonelick Creek Phase II areas

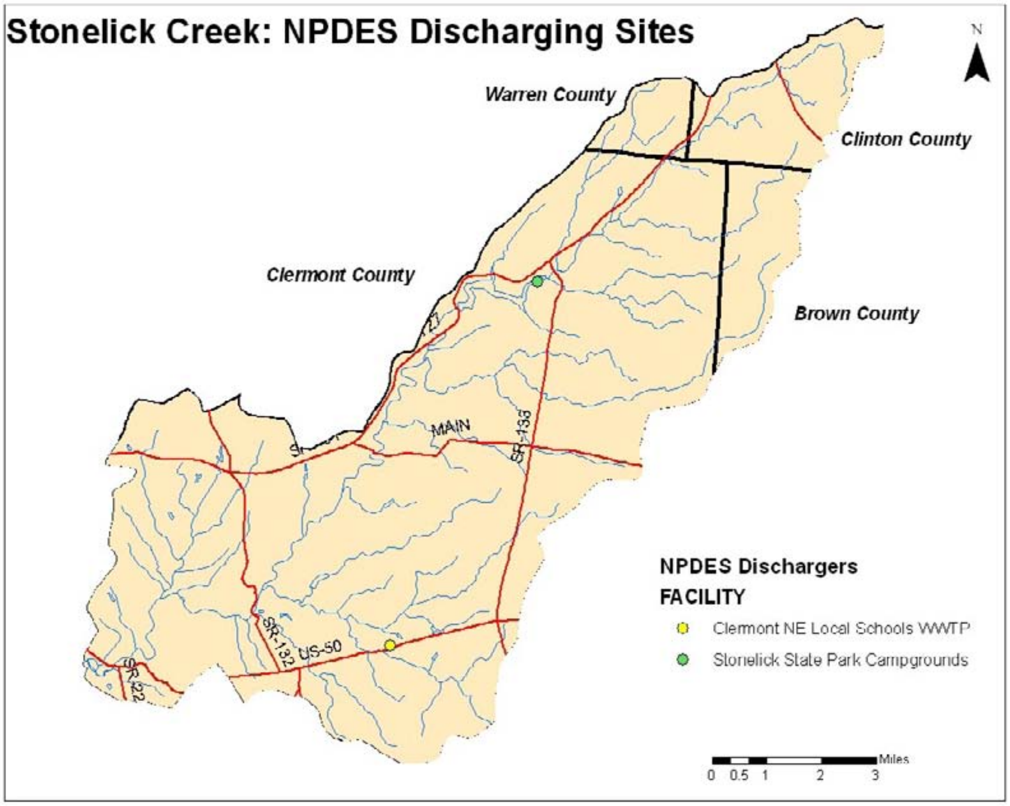


Figure 19. Location of NPDES discharging sites

In response to the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) was created to regulate the quality of water from factories and wastewater treatment facilities. Now those facilities have to conduct regular monitoring of pipe effluent and meet strict environmental standards. These discharge "hot spots" still have an impact on water quality because of water temperature, nutrients, metals, and other contaminants. This is especially true during summer low stream flow when the waste water discharges may make up a large percentage of stream flow.

Within the Stonelick Creek watershed there are two point-source dischargers permitted by Ohio EPA (see Figure 19). The permitted dischargers include:

- Stonelick State Park (campgrounds)
- Clermont Northeast School

The Stonelick State Park wastewater treatment facility is located south of the campgrounds above Stonelick Lake; its effluent loadings are based on an average deign flow of .030 million gallons per day (MGD). Clermont Northeastern's wastewater facility discharges to Patterson Run (Brushy Fork sub-watershed); its effluent loadings are based on an average design flow of .040 MGD.

Physical Stream Characteristics

The East Fork Watershed Collaborative currently has limited data on physical stream characteristics in the Stonelick Creek watershed. Ohio EPA does not collect direct measures of stream morphology, though some qualitative indicators are recorded as part of the Qualitative Habitat Evaluation Index (QHEI) outlined in Chapter 3. It should be noted that conducting a comprehensive inventory and detailed assessment of physi-

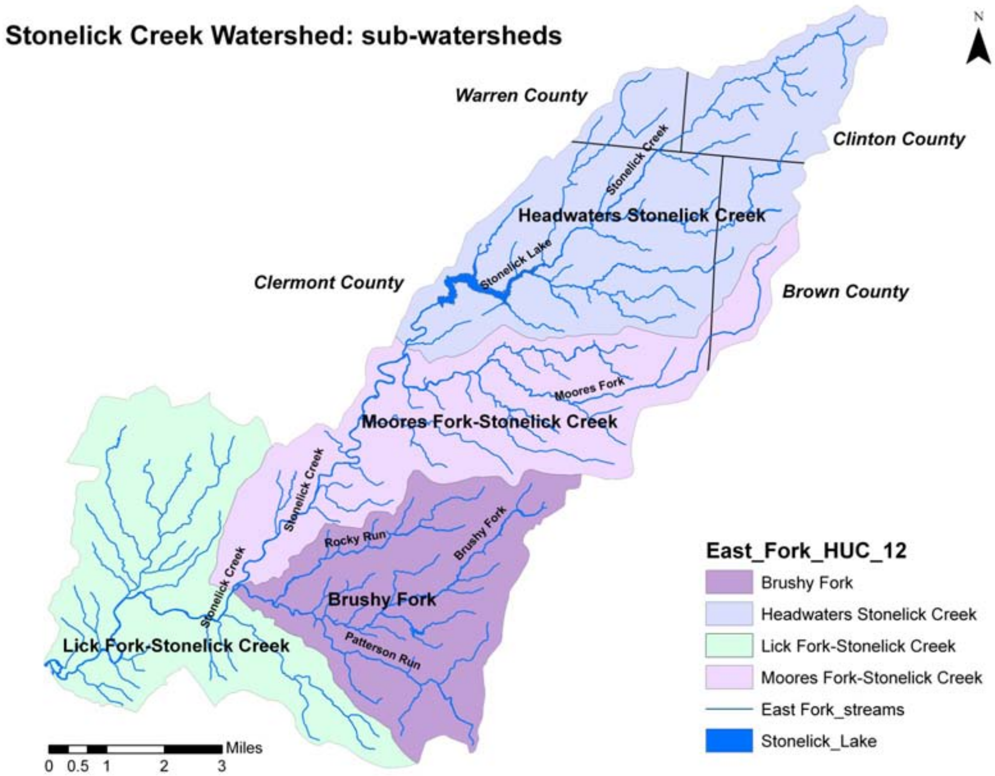


Figure 20. Stonelick Creek sub-watersheds

cal stream characteristics was identified as a priority during watershed planning for the Stonelick Creek (see Chapters 4 & 5).

Stonelick Creek Watershed

Stonelick Creek, a Warm Water Habitat (WWH) stream, is 22.9 miles in total length and has a drainage area of 77 square miles. Land use in the watershed is dominated by agriculture and forested land. In Ohio EPA's 1998 assessment, 5.4 miles of Stonelick Creek were determined to be in "Full, but Threatened" attainment of its aquatic life use designation, 9.10 miles were in "Partial" attainment, 2.0 miles were listed in "Nonattainment" and the remaining 6.4 miles were not assessed.

As shown in Figure 20, there are four sub-watersheds within the Stonelick Creek watershed: Lick Fork (HUC 050902021304), Brushy Fork (HUC 050902021302), Moore's Fork (HUC 050902021303), and Locust Creek (HUC 050902021301).

In 2001, Clermont County hired a consulting firm to conduct Rosgen Level I and Level II assessments for streams in the County[1] (Figures 21, 22 and Table 5). Rosgen Level I assessments were conducted for the Clermont County portion of the Stonelick Creek watershed. Rosgen Level II assessments were conducted at sampling sites in the Brushy Fork and Lick Fork sub-watersheds. Information from the Rosgen assessments, along with GIS and field observations, were used to determine the physical characteristics of

1. The Rosgen Level I and II Assessments were conducted by Tetra Tech, Inc. in 2001.

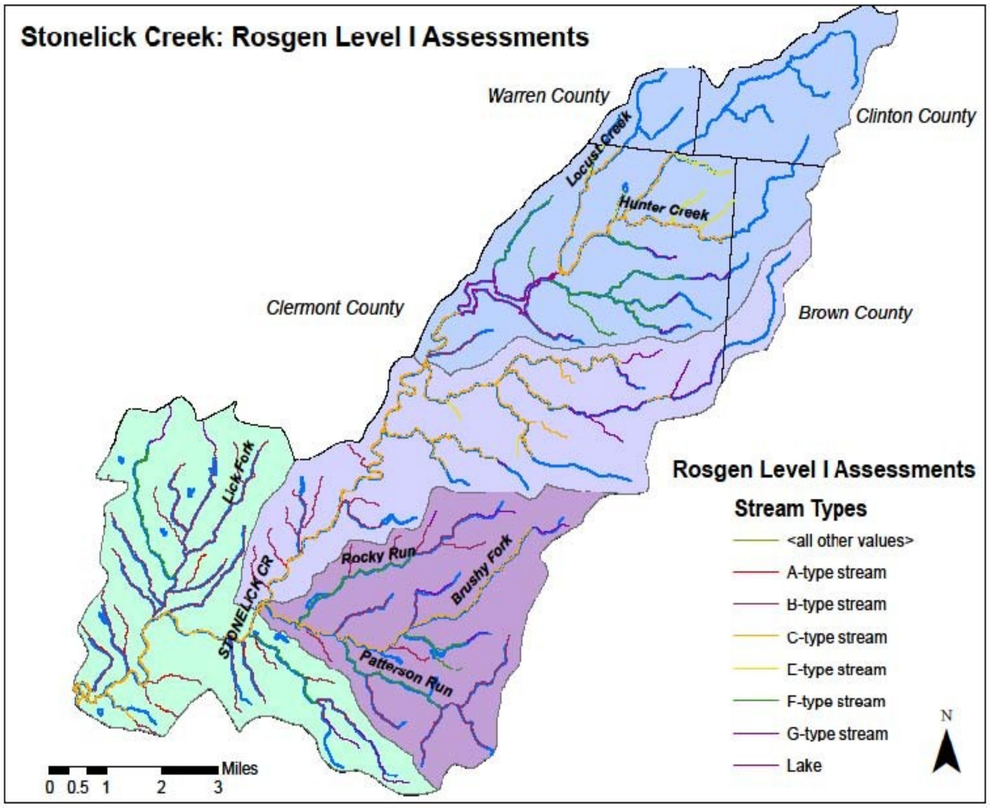


Figure 21. Rosgen Level I Assessment in Stonelick Creek

Stonelick Creek and its major tributaries (see Appendix E for the Rosgen Assessments summary).

According to the Rosgen Level I Assessments there are many stream types in the Stonelick Creek watershed. Under this classification system, streams are rated on their level of stability based on channel pattern, slope, and shape. The results of this analysis show that 44% of the streams in the Stonelick watershed are C-type streams. C-types are considered to be stable streams that retain connection to the floodplain. C-type streams can also be slightly entrenched and described as having sinuous channels and a riffle-pool morphology.

The riparian habitat of Stonelick Creek and its tributaries were assessed using high resolution aerial photographs from 2009. No riparian levees were observed in the watershed.

Aerial images show that the lower and middle sections of Stonelick Creek have good to excellent forested riparian buffers. The riparian zone narrows as the stream meanders near farm fields, roadways and residential developments. In these areas the riparian buffer ranges from 0 to 35 feet in width. There is approximately 1,100 noncontiguous linear feet of streambank with minimal to no riparian protection. Aerial photographs also show a number of sand bars and islands in the middle and lower section of Stonelick Creek, which may indicate high rates of sedimentation.

The upper section of the watershed, above Stonelick Lake, has excellent forested riparian habitat. There are sections of stream that lack

Rosgen Stream Classification

The Rosgen stream classification system is a methodology used to describe streams and stream behavior based on basic hydrologic and morphological parameters (Rosgen, 1996). It uses a hierarchy of four assessment levels ranging from a broad geomorphic characterization (Level I) to detailed reach-specific hydraulic and sediment relationships (Level IV).

A Level I assessment classifies streams based on broad geomorphic stream characteristics. This characterization provides a framework for initial delineation of stream types and assists in setting priorities for more detailed assessments. A Level II (morphological) characterization provides a more detailed description based on field determined stream reach information. Level II information can be used as a basis for management interpretations. The third (Level III or "state") characterization level utilizes additional field observations and parameters to provide a description of stream conditions in terms of current and potential natural stability, and provides an assessment of the extent of departure from the natural potential. The fourth (Level IV or validation) assessment level is used to verify the assessment of stream condition, potential, and stability obtained in the Level III assessment.

The Rosgen stream classification system provides a consistent methodology for comparing physical stream characteristics and stream behavior. In the Clermont County study, only Level I and Level II evaluations were performed.

Rosgen stream classifications are performed to:

- Obtain physical stream data using a consistent methodology
- Classify and compare streams based on observed data
- Identify impacted stream channels
- Correlate physical stream characteristics to water quality and biological data
- Quantify stream stability and erosion rates
- Describe stream behavior

The data obtained from the different assessment levels can be used to:

- Predict stream response to major storm events
- Predict stream erosion rates and sediment loads
- Predict stream response to road and bridge construction
- Predict stream response to urbanization practices (e.g., housing developments, construction sites)
- Provide guidance in performing stream restorations.

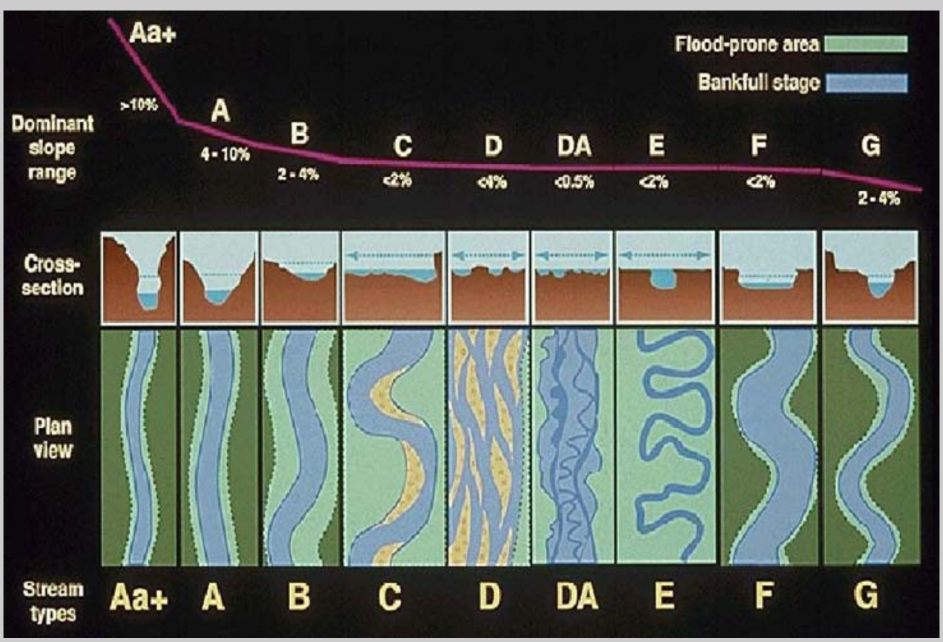


Figure 22. Rosgen Stream Classification Types

Rosgen Type	Slope Range	Sinuosity Range	Observed in Clermont County?	Notes
A	4- 10%	1.0-1.1	Yes	Steep, entrenched, cascading step-pool systems. High energy and debris transport in depositional soils, stable in bedrock and boulder channels. Typically stable.
Aa+	>10%	1.0-1.2	No	Very steep. Entrenched, cascading step-pool systems. Vertical steps with deep scour pools. This type includes waterfalls. Typically stable.
B	2 - 4%	>1.2	Yes	Moderately entrenched, step-pool systems, on moderate slops. Typically stable.
C	<2%	>1.4	Yes	Slightly entrenched, sinuous channels connected to floodplains. Riffle-pool morphology with point bar formation on inside bends. Typically stable.
D	<4%	N/A	No	Found in broad valleys, slightly entrenched, unstable multi-thread channel. High bedload. Typically very unstable.
DA	<0.5%	Highly Variable	No	Broad, low-gradient multi-thread channels typically draining extensive wetland complexes. Typically stable.
E	<2%	>1.5	Yes	Very sinuous, stable channels typically found in broad open fields. Riffle pool morphology. Narrow and deep (low width-depth ratio).
F	<2%	>1.4	Yes	Entrenched channel with high bank erosion rates. Low gradient with a riffle-pool or run-pool morphology. Typically unstable.
G	2 - 4%	>1.2	Yes	Gullies, typically with step-pool morphology. Moderate slopes. High bed load. Typically unstable.

Table 5. Rosgen Assessments of Clermont County Streams (Tetra Tech, 2001)

adequate riparian protection, mainly near farm fields and residential areas. There is approximately 2,300 noncontiguous linear feet of stream with little to no riparian protection. Similar to the middle and lower reaches of Stonelick Creek, the upper section reaches retain connection to the floodplain and the stream has a high degree of sinuosity. There are also a number of sand bars and islands in the channel, a possible indication of excess sediments moving through the stream system.

Sites of streambank erosion were identified by comparing aerial photographs from 2004 and 2009. There is one downstream segment of Stonelick Creek that is undergoing significant streambank and channel erosion. This site is located in the Lick Fork sub-watershed, near the confluence of Stonelick Creek and the East Fork mainstem south of U.S. Route 50 (Figures 23, 24). There is approximately 1.5 miles or more of streambank and channel erosion occurring along Stonelick Creek with an average depth ranging between 5-12 feet. The stream is migrating towards Stonelick-Olive Branch Road, threatening the stability of the road and mobile homes adjacent to the stream. Erosion has worsened over the last few years and the stream has become severely entrenched. In 2008, the County Engineers attempted to protect the road by stabilizing the stream banks with rip rap and root wads. This site is a high priority for restoration.

Stonelick State Park

In 1950, the Ohio Department of Natural Resources completed construction of a dam on the western side of Stonelick Lake. The water surface area at normal pool is around 200 acres. The depth of the lake at the time of construction was 25 feet, however soil erosion that has occurred over the years has filled in the lake to one-half of its original depth. Water quality monitoring conducted in the early 1990s revealed excessive levels of fecal coliform, which were attributed to several sources including the Park's wastewater system and home sewage treatment systems in the area. In the mid-1990s, the lake was dredged to restore the contamination levels to safe levels for wildlife and recreation, and also to foster vessel safety (Ingram, 1993).

Brushy Fork

The mainstem of Brushy Fork is 7.2 miles in total length and has a drainage area of 15.2 square miles. The two main tributaries of Brushy Fork include Rocky Run and Patterson Run.

A Rosgen Level II assessment was performed on an unnamed Stonelick Creek tributary in the Brushy Fork sub-watershed , just downstream of Owensville Village (Figures 2-26, 2-27). The watershed size at this site was 2.5 square miles. Over 60% of land at this site was determined to be agricultural, with some low intensity residential land located near Owensville. A majority of the land in this area is zoned for single family residential (or, estate); much of the agricultural land in this watershed may become low intensity residential lots.

The Rosgen Level II designation at the stream site was determined to be F4. F-types are typically unstable streams that are described as entrenched with low gradient riffle-pool patterns and high bank erosion rates. While these stream types can have high erosion rates, significant erosion was not observed at this site. F4 streams are typical F streams with a water surface slope less than 2 percent and gravel bed material.

The Rosgen Level I assessment for the Brushy Fork sub-watershed indicated that there are several different classes of streams. The majority of streams are B-type (47%), along with 23% C-type, 20% F-type and 10% G-type. The upstream areas appeared to have more B-type streams that flow through smaller, forested tributaries. B-type streams are considered stable streams that are moderately entrenched, step-pool systems with moderate slopes. Similarly, C-type streams are also considered stable, slightly entrenched with sinuous channels connected to floodplains. Conversely, F-type streams are

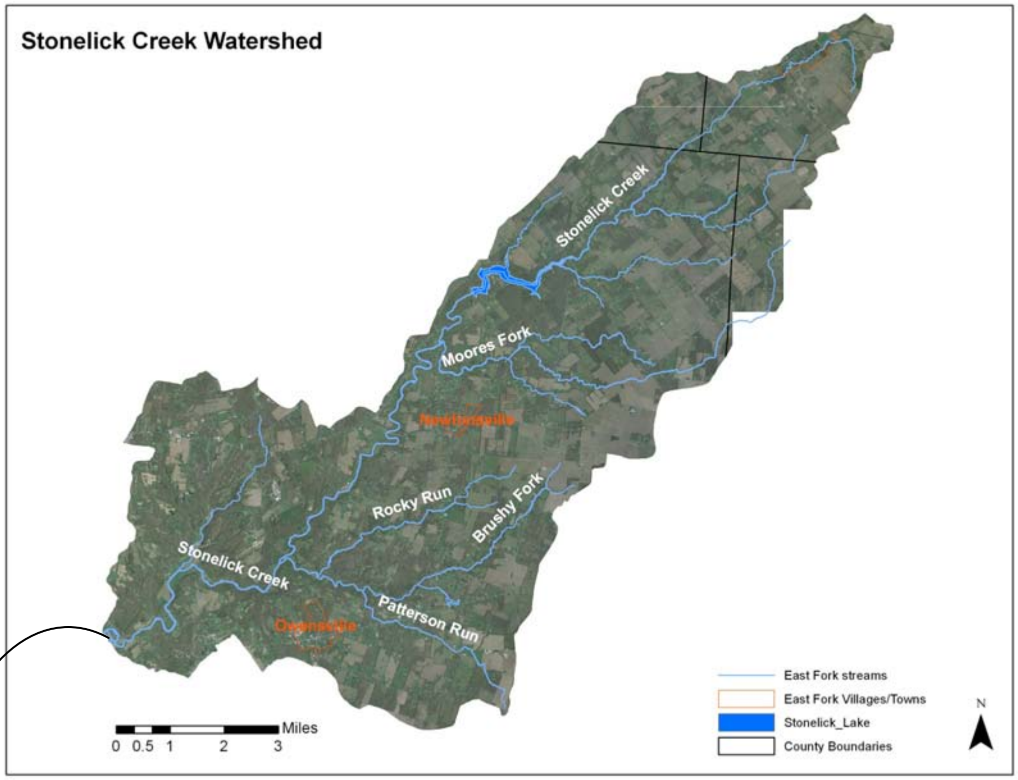


Figure 23. Aerial view of the Stonelick Creek Watershed

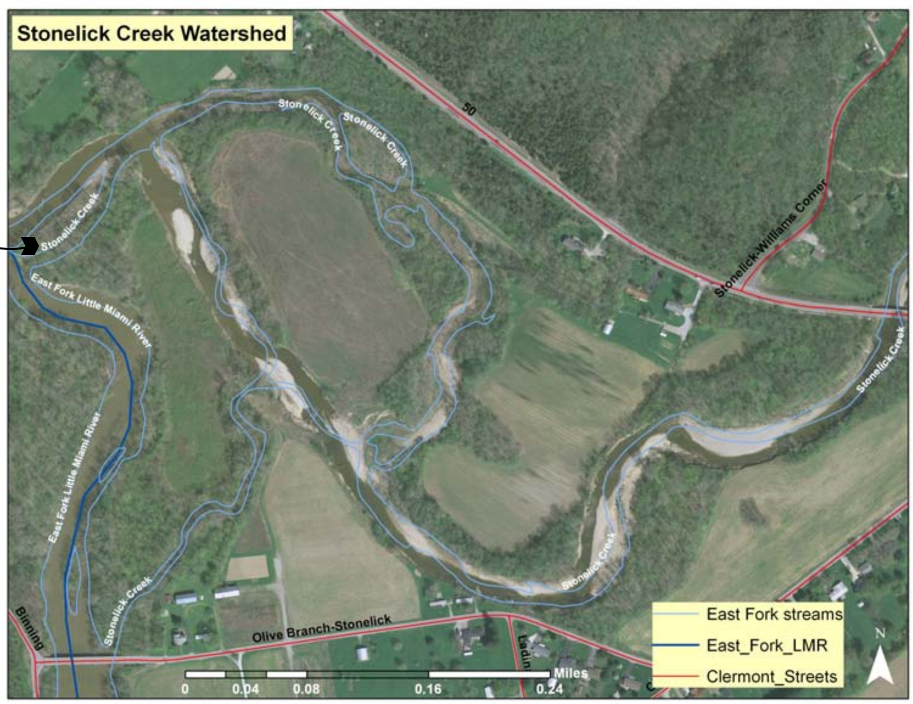


Figure 24. Stonelick Creek/East Fork Confluence (High Priority Restoration Site)

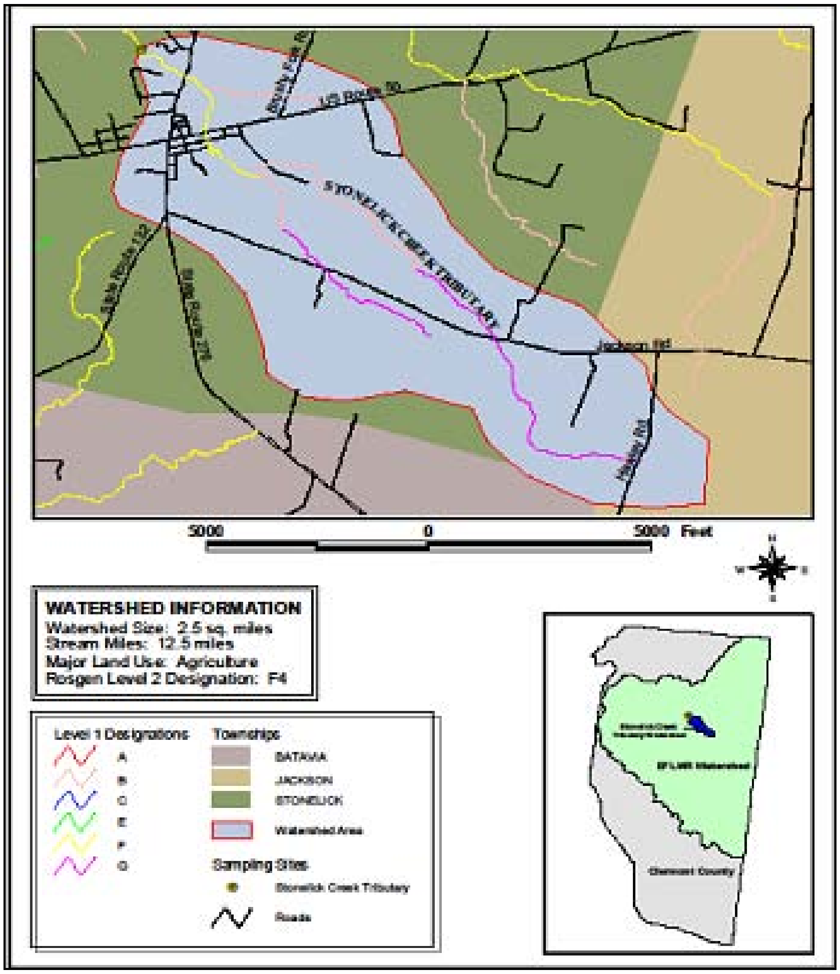


Figure 25. Rosgen Level II Assessment in Brushy Fork

considered unstable streams with entrenched channels and high bank erosion rates. These unstable areas are found mostly along Rocky Run and Patterson Run.

The lower section of Brushy Fork has sufficient forested riparian habitat, however riparian protection narrows along roadways and agricultural areas. There is approximately 2,300 noncontiguous linear feet along Brushy Fork with minimal riparian protection against the surrounding agricultural land use.

The middle and upper portions of Brushy Fork have good to excellent forested riparian habitat. The riparian zone narrows and vegetation becomes sparse along Brushy Fork Rd., where the stream meanders near agricultural fields and homes. There is approximately 1,200 non-contiguous linear feet of stream that has minimal to no riparian protection.

Figure 26. Rosgen Assessment Site in Brushy Fork

The Cedar Trace Golf Club in the Brushy Fork sub-watershed. The golf course is approximately 100 acres in total area and is located in the mid-upper reaches along Brushy Fork and an unnamed tributary.

Rocky Run

Rocky Run is 5.3 miles in total length and is the larger of the two main tributaries in the Brushy Fork sub-watershed. The lower section of Rocky Run has good to excellent forested riparian habitat, however the riparian zone narrows near roadways (Titus Rd, Bergen Rd.). There is approximately 150 feet of streambank armoring near Bergen Rd. The middle section of the watershed has fair-good riparian protection. Riparian buffers narrow as the stream meanders through farm fields. There is approximately 4,500 noncontiguous linear feet of stream with little to no riparian protection located east of Newtownsville-Hutchinson Rd.

Riparian habitat is minimal in the upper reaches of Rocky Run. There is approximately 5,500 non-contiguous linear feet of stream with little to no riparian protection. Agriculture is the primary land use in the uppermost portion of the watershed and Rocky Run appears to be channelized and functioning as a drainage system for the surrounding farm fields.

Patterson Run

Patterson Run is 4.1 miles in total length. The lower section of Patterson Run has good forested riparian habitat, with some narrow buffers in sections where the stream meanders near roadways (SR 50). Riparian protection in the middle portion of the watershed is fair, however the riparian zone significantly diminishes in the upper watershed. There is approximately 9,500 noncontiguous linear feet of stream with little to no riparian protection. Similar to the upper portion of the Rocky Run watershed, Patterson Run is lacking adequate riparian protection against the surrounding agricultural land use.

Lick Fork

Lick Fork is a tributary of Stonelick Creek and is 3.7 miles in total length. A Rosgen Level II assessment was done in the Lick Fork sub-watershed near the northern border of the EFLMR watershed, east of Milford and northwest of Owensville. The watershed size at this sampling site was 6.5 square miles and the dominant land use in the assessment area was agriculture and forested lands. This area includes Goshen, Miami, and Stonelick Townships, which have zoned the area for agriculture and estate residential use. There are also small portions zoned for suburban residence and small-scale commercial development.

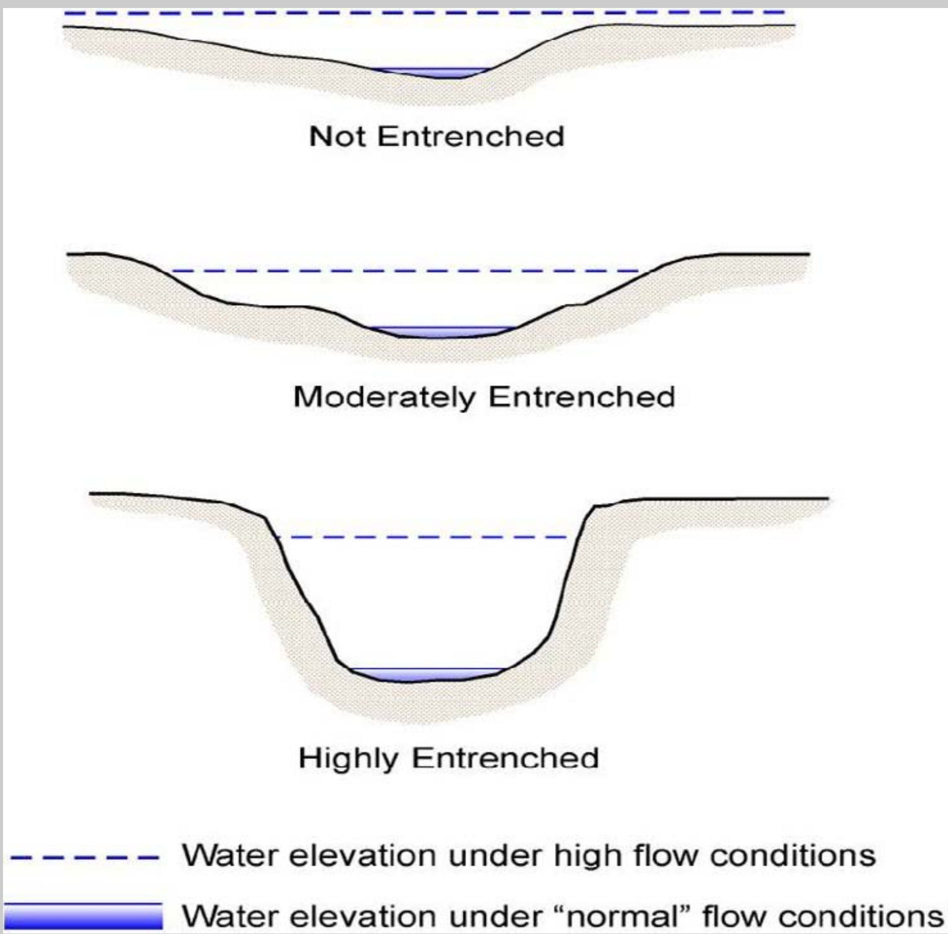
The Rosgen Level II assessment conducted at the sampling site along Lick Fork (Figure 2-28) classified it as a B4c type stream. This classification indicated a moderately entrenched riffle-pool system, with low sinuosity, a predominately gravel channel bottom, and a water surface slope of less than 2 percent. Large cobbles were located throughout the stream in this reach where the stream flows through an agricultural field and several large residential lots.

The Rosgen Level I assessment for the entire Lick Fork sub-watershed showed that 60% of streams were B-type, 13% F-type, 11% C-type, and 8% G-type. G-type streams in the headwaters are classified as such because they flowed through agricultural areas and were assessed to have low width to depth ratios, which is typical of G-type streams. These headwater reaches may be functioning as agricultural ditches. B-type steams indicate moderately entrenched step-pool systems with low sinuosity. A large tributary located west of the sampling site is classified as F-type due to significant entrenchment.

Stream Morphology and Floodplain Access

More and more, scientists, engineers, environmental professionals and landowners are realizing the importance of stream channel form - also called stream morphology - to the maintenance of water quality. Channel form - channel size and shape, access or lack of access to a floodplain, presence of alternating pools and riffles - dictates how the stream handles both water and sediment. This is especially important during larger storm events when both flow and sediment loads are at their highest.

Streams that have the ability to overflow their banks during high flows dissipate much of the erosive energy of those high flows, and deposit some of the entrained sediment onto the floodplain. Conversely, highly entrenched streams (i.e., those that cannot access their floodplain during most high flows) contain and concentrate the erosive energy of high flows within the stream channel.



Entrenchment Describes a Stream’s Ability to Access its Floodplain Under High Flow Conditions.

Riparian habitat in the lower section of Lick Fork is generally good. There is minimal riparian protection near the confluence of Lick Fork and Stonelick Creek. Upstream of the confluence, riparian protection narrows as Lick Fork runs parallel to Stonelick-Williams Corner Road. There is approximately 500 feet of armoring along the streambank near the cross section of Stonelick-Williams Corner Road and Mt. Zion Road. Additionally, there is approximately 2,600 noncontiguous linear feet of stream that has minimal to no riparian against the surrounding agricultural land use in the lower section of the watershed.

The riparian zone increases through the middle and upper portions of the watershed. Overall, the middle and upper portion of the watershed have good to excellent forested riparian habitat. There are several sections of stream where the riparian zone narrows, typically near agricultural or residential areas. There is approximately 1,120 linear feet of stream located north of SR 131 that has little to no riparian protection.

Figure 27. Rosgen Assessment Site in Lick Fork

Moore's Fork

Moore's Fork is a tributary of Stonelick Creek. It is 10 miles in total length and has a drainage area of 12.3 square miles. The Rosgen Level I assessment for this area indicated that the majority of streams were C-type streams (60%). This stream type has a well developed floodplain and is consider stable.

Additionally, there approximately 24% B-type streams and 14% G-streams. B-type streams, typically stable streams, are moderately entrenched with a step-pool system on moderate slopes. G-type streams are characterized as gullies, with a step-pool morphology and moderate slopes. These streams types, found mostly in the headwater streams, often have a high bed load and are typically unstable.

Moore's Fork has fair to good riparian habitat in the lower section of the watershed. There is approximately 500 feet of rock armoring along the streambanks near Meek Road. In the middle and upper section of the watershed, riparian protection diminishes as the stream runs through agricultural fields and residential areas. In the middle and upper watershed, there is approximately 10,000 non-contiguous linear feet of stream with minimal to no riparian protection. These sections of stream are found primarily near agricultural fields, where farming is occurring near the edge of the streambank. The stream has lost its sinuosity in these sections.

Greenbush Creek

Greenbush Creek is a tributary of Moore's Fork and is 3.2 miles in total length. The lower and middle portion of the Greenbush Creek have adequate forested riparian protection, however the riparian zone narrows and vegetation cover decreases through agricultural and residential areas. Riparian habitat diminishes in the upper portion of the watershed. There is approximately 3,000 linear feet of stream lacking riparian protection against the surrounding agricultural land use.

Locust Creek

Locust Creek is one of two tributaries located in the Locust Creek sub-watershed. It is 4.3 feet in total length; it has not been assessed by Ohio EPA and currently has no aquatic life use designation.

The Rosgen Level I assessment for the Locust Creek sub-watershed indicated that the majority of streams were C-type streams (38%) and F-type (27%). C-type streams are generally stable, slightly entrenched streams with sinuous channels.

The Rosgen Level I assessment for this watershed indicated that the majority of streams are C-type streams (50%). C-type streams are generally stable, slightly entrenched, sinuous channels connected to floodplains. This type is generally found along the main stem of Stonelick Creek. Although C-type streams are considered stable, they can be destabilized by flow and land use and are therefore susceptible to the effects of upstream development. F-type stream characteristics include entrenched channels with high bank erosion rates, and a low gradient with a riffle-pool or run-pool morphology. These streams are unstable and found primarily in the southern portion of the Locust Creek sub-watershed.

Locust Creek has fair to good riparian habitat throughout its stretch. The riparian zone narrows as the stream flows through agriculture fields and residential areas, particularly in the upper reaches of the stream. There is approximately 3,500 noncontiguous linear feet of stream with minimal riparian habitat.   A significant segment of stream without riparian habitat is located near Jordan Road.

Hunter Creek

Hunter Creek is the other main tributary of Stonelick Creek located in the Locust Creek sub-watershed. It is 5 miles in total length. Hunter Creek has fair to good riparian habitat throughout; however, there are several segments with little to no riparian habitat. These segments of stream are found primarily along farm fields. There is approximately 10,500 contiguous linear feet that lacks adequate riparian habitat.

Community Resources

Clermont County has led and participated in numerous regional and local utility, land use and transportation planning initiatives These initiatives include: 208 Water Quality Management Plan developed by Ohio-Kentucky-Indiana Council of Governments *(available through OKI Council of Governments)*; Eastern Corridor - Green Infrastructure Plan; Ohio 32 Corridor Vision Plan (*available through OKI Council of Governments)*; Clermont County Wastewater Master Plan *(available through Clermont County Water Resources Department)*; and Clermont County Thoroughfare Plan *(available through Clermont County Engineers Office).*

Each of these initiatives, developed with stakeholder input, over a long period of time, addresses the need and a vision for protecting water quality in the Stonelick Creek watershed and beyond. Each initiative has considerable merit on an individual basis, but the consistent theme and broad stakeholder participation provides additional weight to the direction and value of a local vision. Notably, the Eastern Corridor - Green Infrastructure Plan included an advanced mitigation strategy that addressed the need to provide mitigation in advance of transportation projects for both primary and secondary impacts. The plans advance the concept of creating sustainable economic growth, balanced with sustainable environmental qualities, to insure high quality of life for the community.

East Fork River Sweep

To increase community awareness concerning the park, including colonies of dense flying litter and other debris that end up in our waterways, the East Fork Watershed Collaborative hosts a community clean up event each spring. The East Fork River Sweep began in 1992 and is held in various Clermont County sections of the East Fork watershed including; East Fork Lake, Stonelick Lake, Sycamore Park, Valley View Foundation, and along several miles of the East

Fork mainstem. Each year, hundreds of community volunteers participate to sweep over ten miles of streambank and shoreline within the East Fork watershed (Figures 2-28, 2-29).

Figure 28. East Fork River Sweep volunteers

Sustainable Activities

The East Fork Watershed Collaborative works with local partners whenever possible to promote recreational activities in the watershed. Activities like fishing, canoeing and kayaking provide opportunities for public education and outreach. For example, the Collaborative participates each year in the Great Outdoor Weekend by hosting a canoe float and water sampling demonstration in the East Fork. These types of events/activities are an important component of the Collaborative's long-range education plans, as they encourage people to get outdoors and enjoy local natural resources, and also help the Collaborative build relationships within communities. Establishing relationships and sharing information with local citizens is key to building awareness and promoting action in the watershed communities.

Figure 29. East Fork Canoe Adventure (Great Outdoor Weekend)

Stonelick State Park

Stonelick State Park is situated in the northwestern portion of Clermont County in Wayne Township. The park includes 1,058 acres of land and 200 acres of Stonelick Lake. It provides a wide variety of recreational activities including hunting, hiking, fishing, swimming and boating (Figure 2-30).

A number of unique plant and animal species can be found in Stonelick Park. One of the most interesting features of the park is its high quality beech-oak-red maple forest community. There is also a significant stand of sweet gum trees, which co-dominates the woodlands of Stonelick with beech and maple. A number of uncommon wildflowers can be found in the park, including colonies of dense flying star, purple fringeless orchid and Virginia mint.

Golf Courses

There are three golf courses located in the Stonelick Creek watershed (Figure 2-30). The Stonelick Hills Golf Course is located in the Lick Fork sub-watershed (Sherilyn Rd.), the Cedar Trace Golf Club is located in the Brushy Fork

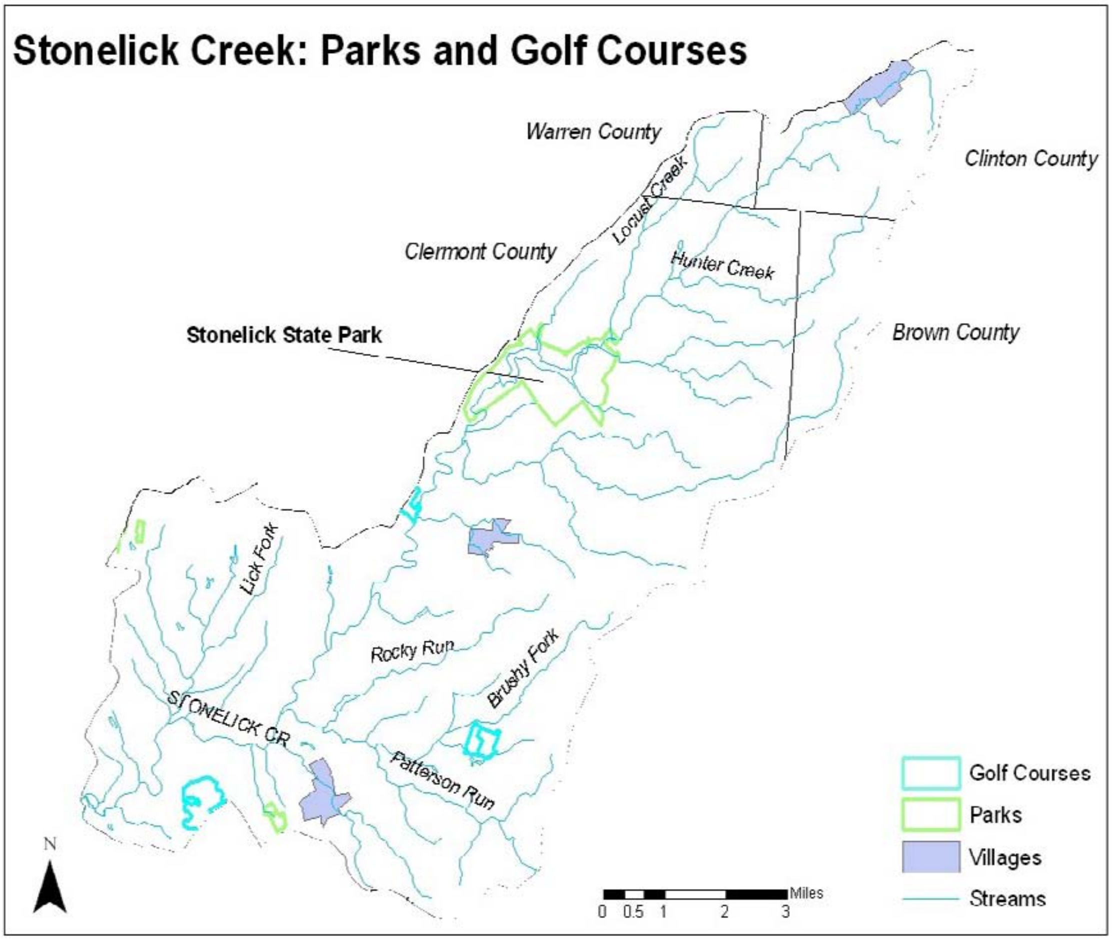


Figure 30. Location of parks and golf courses in the Stonelick Creek watershed

sub-watershed and portions of the Deer Track Golf Course are located along Stonelick Creek in the Moore's Fork sub-watershed (northeast of Newtonsville). Golf courses have been known to contribute to water quality impairments due to nutrient and herbicide/pesticide runoff. To date, neither Ohio EPA or Clermont County have attributed any water quality impairments to these courses.

Cultural Resources

There is an abundance of cultural resources within the Stonelick Creek watershed that increase the quality of life for residents in the watershed.

History

The Stonelick Creek watershed is located almost entirely within Clermont County. Clermont County was established in 1800 and is the eighth oldest county in Ohio and the eleventh oldest county in the Northwest Territory.

The East Fork watershed region has a rich historical past. A number of Native American tribes called this area home, include the Shawnee, Miami, Delaware, Mingo, Ottawa, Cherokee, and Wyandot. The last Native American village in the area was located in Clermont County two miles south of Marathon in Jackson Township, along the mouth of Grassy Run on the East Fork of the Little Miami River. The Wyandot lived there until 1811. That location was the site of the largest frontier battle in Clermont County, the Battle of Grassy Run, where pioneer Simon Kenton clashed with Shawnee warrior, Tecumseh, on April 10, 1792.

The East Fork watershed region played an important role in the Underground Railroad due to its geography near the Ohio River across from the slave owning states of Kentucky and Virginia. A number of villages in Clermont County gave refuge to slaves, including Batavia, New Richmond, Moscow, Williamsburg and Bethel. Clermont County was one of the first places that slaves could rest and be safe.

In addition to the important historical peoples and events that occurred in the watershed, the area also has a rich heritage rooted in agriculture. Farming has been and continues to be a vital component in our state's economy. In the late 1800s and early 1900s, many farmers in southwest Ohio were growing corn, wheat, oats, potatoes and tobacco. Farmers also raised livestock, including sheep, cattle and pigs. Many of the early factories and industries in southwest Ohio grew from the surrounding agriculture. Cincinnati, for example, became known as "Porkopolis" in the 1800s once the city was established as a leader in pork processing (Ohio History Central.org).

Shifts in the economy have influenced changes in land use throughout southwest Ohio and the East Fork watershed. Over the last few decades, much of the farmland in the East Fork has been developed for residential, commercial, and/or industrial use. The majority of these land use changes have occurred in the lower section of the watershed within Clermont County and have primarily impacted the Lower East Fork and Middle East Fork sub-watersheds. Although these types of land use changes are spreading throughout the watershed, agriculture continues to be an integral part of many East Fork communities.

Village of Owensville

The Village of Owensville is located in Stonelick Township, Clermont County, Ohio, approximately 20 miles from downtown Cincinnati. Originally known as Boston, the village was settled in 1832 and renamed Owensville by William Owens the first postmaster. The Village is approximately 77 acres in total area and is home to approximately 850 residents (U.S. Census Bureau).

Village of Newtonsville

The Village of Newtonsville is located in Wayne Township, Clermont County, Ohio. The Village was established in 1838 by Stephen Whitaker and Cornelius Washburn. Newtonsville has a total area of 128 acres and has approximately 527 residents (U.S. Census Bureau).

Village of Blanchester

The Village of Blanchester is located primarily in Clinton County and touches the southeastern border of Warren County. The Village was established in 1832. It is located in Marion Township and is approximately 3.0 mi^2 in total area with approximately 4,00 residents. The upper segments of Stonelick Creek flow through the southern border of the Village (U.S. Census Bureau).

Stonelick Creek Watershed Action Plan

Chapter Three

Water Resource Quality

PO Box 549
Owensville, OH 45160
clermontswcd.org/WatershedPrograms.aspx

CHAPTER 3:
WATER RESOURCE QUALITY

The primary source of water quality data for the East Fork watershed is the Ohio EPA database, developed over the last 30 years by the Ohio EPA Ecological Assessment Unit. The Ohio EPA data are supplemented here by monitoring data collected by the Clermont County Office of Environmental Quality.

Use Attainment Status

The 2008 Integrated Water Quality Monitoring and Assessment Report prepared by Ohio EPA provides the agency's most recent assessment of the Stonelick Creek subwatershed, defined in the report as the area draining upstream of Stonelick Creek to the confluence with the East Fork Little Miami River. The Stonelick Creek watershed drainage area is approximately 77 square miles and includes four major tributaries: Lick Fork, Brushy Fork, Moore's Fork and Locust Creek. Only Stonelick Creek and Lick Fork have been assessed by Ohio EPA. This chapter summarizes the status of these streams that have been assessed in terms of meeting their use designations (e.g., aquatic life use support, contact recreation use support) based on water quality and biological data collected by the state and the county.

Stonelick Creek and its tributaries, with the exception of Locust Creek, are designated as Warm Water habitat (WWH) streams. Locust Creek currently does not have an aquatic life use designation. All of the tributaries to the East Fork Little Miami River (with the exception of Dodson Creek in the headwaters) are designated for Primary Contact Recreation (PCR).

Ohio EPA's assessment of the Stonelick Creek watershed is based on data last collected in 1998. An assessment of Stonelick Creek and Lick Fork is provided in the agency's 2000 *Ohio Water Resources Inventory* 305(b) report. Stonelick Creek is 22.9 miles in total length. Based on Ohio EPA's 1998 assessment, approximately 5.4 miles of Stonelick Creek were found to be in "Full, but Threatened" attainment of the river's use designation (WWH), while 9.10 miles were listed in "Partial" attainment, and 2.0 miles were listed in "Non-attainment" (Figure 31). The remaining 6.4 miles were not assessed.

According to Ohio EPA, areas of non-attainment occurred upstream from Stonelick Lake and in reaches midway between Stonelick Lake and the mouth. Land use in the upper watershed is primarily agricultural. The causes of impairment were listed as nutrient runoff, organic enrichment, flow alteration, and other unknown causes. The sources of those causes included non-irrigated crop production, home sewage treatment systems and the impoundment that created Stonelick Lake. Attainment of the WWH designation was restricted to the lower reaches of the stream.

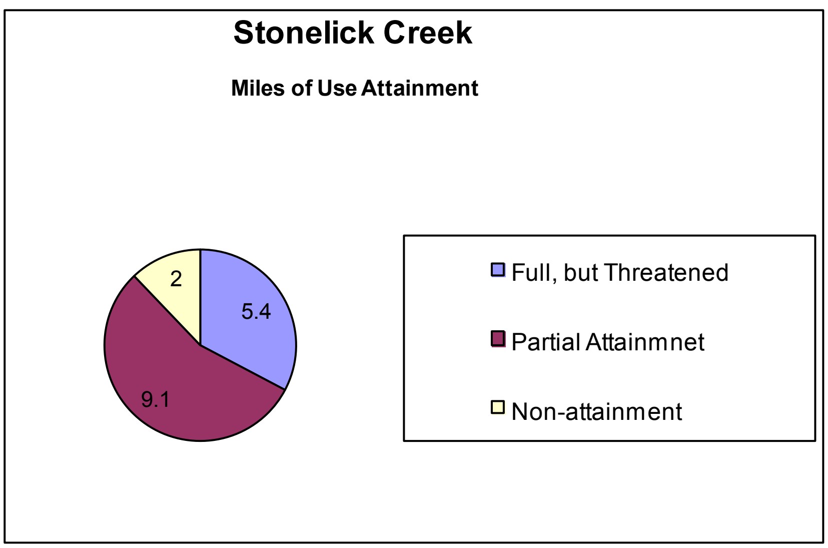


Figure 31. Stonelick Creek Aquatic Life Use Attainment

The Ohio EPA also assessed .6 miles of Lick Fork, a tributary to Stonelick Creek. While Ohio EPA reported a very good fish community at one site along Lick Fork, the entire length of the stream was found to be in "Full, but Threatened" attainment of its WWH aquatic life use designation. According to Ohio EPA, pathogens and organic enrichment (low dissolved oxygen) were listed as causes, or threats, to the attainment status of Lick Fork (Table 3-1). The primary source of those causes was identified as failing home sewage treatment systems.

Sample Site Identification

River Miles are an easy and accurate way to identify sampling locations. River miles are measured in terms of distance (in tenths of a mile) from the stream "mouth." In Fourmile Run, river mile 0.0 (RM 0.0) would be the point where the creek enters the East Fork
Little Miami River. River miles increase as you move upstream. Many of Clermont County's sampling sites are named using river miles. For example, EFRM75.3 indicates samples collected at East Fork River Mile 75.3.

According to Ohio EPA's 2006 Integrated Water Quality Monitoring and Assessment Report, the status of PCR use in this watershed is not impaired. However, there is a fish consumption advisory in effect for the entire length of the East Fork Little Miami River. The advisory recommends that fish consumption be limited to one meal per month for the following species: channel catfish, flathead catfish, rock bass, smallmouth bass and spotted bass. In general, the Ohio Department of Health advises that all persons limit consumption of sport fish caught in all Ohio waterbodies to one meal per week, unless there is a more restrictive advisory in place.

Summary of Stream Conditions

The Ohio EPA has collected and compiled data from several locations on Stonelick Creek, beginning in 1982, and performed a survey on Lick Creek in 1997. Clermont County has also conducted a number of studies in the watershed, including biological surveys at three sites on Stonelick Creek beginning in 1998. The county also performed a biological survey on Brushy Fork in 2003. The following paragraphs summarize the findings from these studies.

Stream Biology

The Ohio Environmental Protection Agency (OEPA) conducted biological surveys in the Stonelick Creek sub- watershed in 1982, 1984, 1987, 1993 and 1998. A list of the Ohio EPA sampling stations, types of biological surveys conducted, and years conducted, is presented in Table 3-2.

During 1998, Clermont County conducted macroinvertebrate and fish surveys at two sites on Stonelick Creek, above and below the confluence of Newtonsville Creek (RM 10.7 and RM 10.6 respectively). In 1999, the

Impairment:	Nutrients	Flow Alteration	Organic Enrichment	Pathogens	Other Unknown Causes
Stonelick Creek	X	X	X		X
Lick Fork			X	X	

Table 6. Causes of Impairment in the Stonelick Creek watershed.

Sampling Station	Location	1982	1984	1987	1993	1998
RM 1.0	US 50 bridge over Stonelick Creek	F/M			M	F/M
RM 1.09	Upstream US 50 Bridge				M	
RM 1.2	Adj. Stonelick –Williams Corner Road	M	F	F	F	
RM 3.1	Downstream Benton Road Bridge	M			F	
RM 5.2	Downstream SR 132 Bridge	M	M	F		
RM 5.3	Upstream SR 132 Bridge			F		
RM 8.0	Bergen Road Bridge	F				
RM 9.8	Downstream side of SR 131 Bridge					F/M
RM 16.7	SR 133 Bridge above Stonelick Lake				F	
RM 17.7	Near intersection of SR 727 & Martin Road			M	M	F/M
RM 19.0	Lucas Road @ SR 133	F				
RM 20.0	Johnson Road Bridge				F	

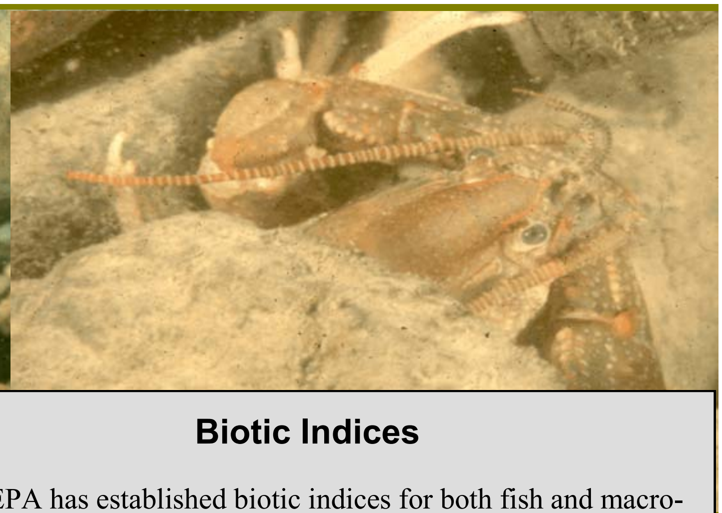
*** F = Fish M= Macroinvertebrates**

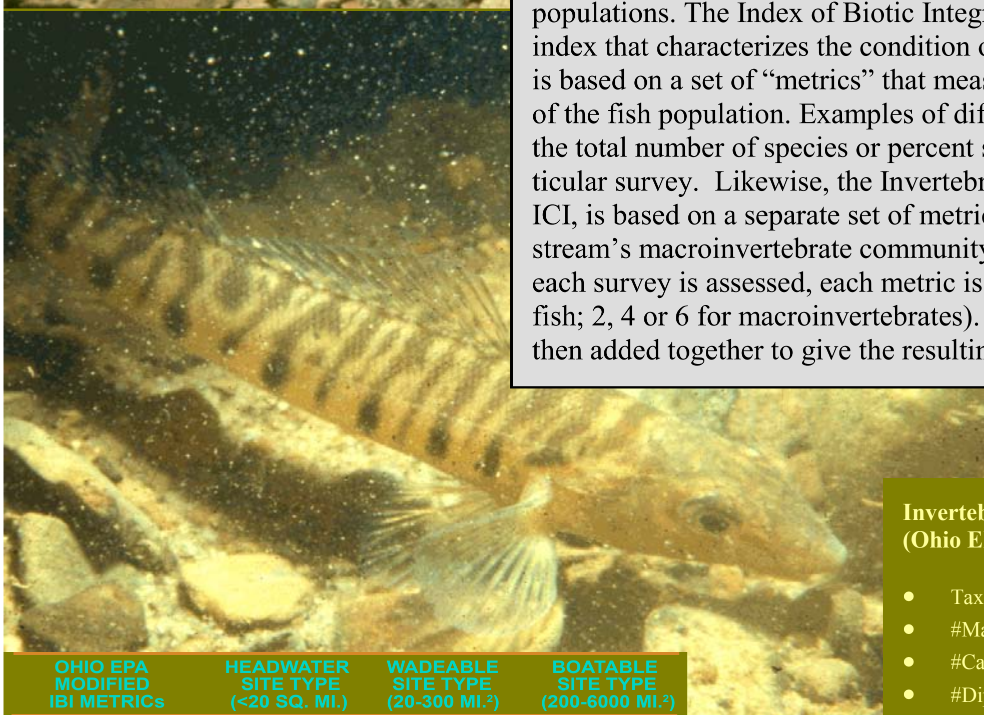
Table 7. Ohio EPA biological sampling locations in the Stonelick Creek watershed

Sampling Station	Location	1998	1999	2000	2001	2006
RM 2.0	Steel Bridge @ Stonelick-Williams Corner		F/M	F/M	F/M	
RM 10.5	100 m below Newtonsville Creek					F/M
RM 10.6	Just below Newtonsville Creek	F/M		F/M		
RM 10.7	Above Newtonsville Creek @ SR 727	F/M				F/M
RM 20.1	Lucas Road @ SR 133		M			

*** F = Fish M= Macroinvertebrates**

Table 8. Clermont County biological sampling locations in the Stonelick Creek watershed





Biotic Indices

Ohio EPA has established biotic indices for both fish and macroinvertebrates as a means to directly assess any impacts on these populations. The Index of Biotic Integrity, or IBI, is a numerical index that characterizes the condition of the fish community and is based on a set of "metrics" that measure different components of the fish population. Examples of different metrics would be the total number of species or percent sunfish found during a particular survey. Likewise, the Invertebrate Community Index, or ICI, is based on a separate set of metrics that characterizes the stream's macroinvertebrate community. After the "catch" for each survey is assessed, each metric is given a score (1, 3 or 5 for fish; 2, 4 or 6 for macroinvertebrates). The metric scores are then added together to give the resulting index.

OHIO EPA MODIFIED IBI METRICs	HEADWATER SITE TYPE (<20 SQ. MI.)	WADEABLE SITE TYPE (20-300 MI.^{2})	BOATABLE SITE TYPE (200-6000 MI.^{2})
1. Total Native Species	X	X	X
2. #Darter Species		X	
#Darters + Sculpins	X*		
%Round-bodied Suckers			X*
3. #Sunfish Species		X	X
#Headwater Species	X*		
%Pioneering Species	X*		
4. #Sucker Species		X	X
#Minnow Species	X*		
5. #Intolerant Species		X	X
#Sensitive Species	X*		
6. %Tolerant Species	X	X	X
7. %Omnivores	X	X	X
8. %Insectivores	X	X	X
9. %Top Carnivores		X	X
10. %Simple Lithophils	X*	X*	X*
11. %DELT Anomalies	X	X	X
12. Number of Individuals	X	X	X

* - Substitute for original IBI metric described by Karr (1981) and Fausch et al. (1984)

Invertebrate Community Index (Ohio EPA 1987; DeShon 1995)

- Taxa Richness
- #Mayfly taxa
- #Caddisfly taxa
- #Dipteran taxa
- %Mayflies
- %Caddisflies
- %Tanytarsini Midges
- %Other Diptera/Non-Insects
- %Tolerant taxa
- Qualitative EPT taxa
- 6,4,2,0 metric scoring categories.
- 0 to 60 scoring range.
- Calibrated on regional basis.

Biological Criteria

Ohio EPA has established separate biocriteria for five ecoregions in the State of Ohio. The Stonelick Creek sub-watershed lies within the Interior Plateau ecoregion. Ohio EPA has designated Stonelick Creek and all of its tributaries as “Warmwater Habitat” (WWH). To meet the WWH criteria in the Interior Plateau ecoregion, the Index of Biotic Integrity (IBI) scores used to rate the fish communities must be equal to or greater than 40.

The health of the macroinvertebrate community is measured using Ohio EPA’s Invertebrate Community Index, or ICI. For the East Fork, ICI scores of 30 or greater must be attained to meet EPA’s criterion for WWH streams. Scores within four index points of either IBI or ICI criteria are said to be in “non-significant departure” of the criteria, meaning that these streams would still be in compliance with Ohio’s biological criteria. For example, WWH streams with IBI scores as low as 36 and ICI scores as low as 26 would still meet state standards.

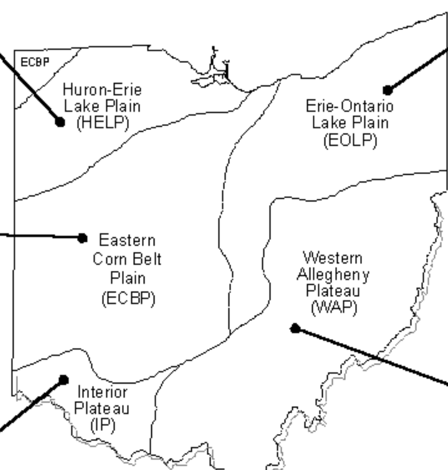
Ohio Biological Criteria Adopted May 1990
(OAC 3745-1-07; Table 7-14)

Huron Erie Lake Plain (HELP)

Use	Size	IBI	MIwb	ICI
WWH	H	28	NA	34
	W	32	7.3	34
	B	34	8.6	34
MWH-C	H	20	NA	22
	W	22	5.6	22
	B	20	5.7	22
MWH-I	B	30	5.7	NA

Erie Ontario Lake Plain (EOLP)

Use	Size	IBI	MIwb	ICI
WWH	H	40	NA	34
	W	38	7.9	34
	B	40	8.7	34
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA



Eastern Corn Belt Plains (ECBP)

Use	Size	IBI	MIwb	ICI
WWH	H	40	NA	36
	W	40	8.3	36
	B	42	8.5	36
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA

Western Allegheny Plateau (WAP)

Use	Size	IBI	MIwb	ICI
WWH	H	44	NA	34
	W	44	8.4	34
	B	40	8.6	34
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-A	H	24	NA	30
	W	24	5.5	30
	B	24	5.5	30
MWH-I	B	30	6.6	NA

Interior Plateau (IP)

Use	Size	IBI	MIwb	ICI
WWH	H	40	NA	30
	W	40	8.1	30
	B	38	8.7	30
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA

Statewide Exceptional Criteria

Use	Size	IBI	MIwb	ICI
EWH	H	50	NA	46
	W	50	9.4	46
	B	48	9.6	46

county conducted macroinvertebrate surveys at river mile 2.0 at the Stonelick-Williams Corner Road bridge, and river mile 20.1, at Lucas Road and SR 133. Two fish surveys were also performed in 1999 at RM 2.0. In 2000, macroinvertebrate and fish surveys were performed at RM 2.0 and RM 10.6, while only the RM 2.0 locations was surveyed for macroinvertebrates and fish in 2001 (Table 3.2). The county also performed a macroinvertebrate survey at Lick Fork river mile 0.1 in 2001, and performed macroinvertebrate surveys at Brushy Fork river mile 2.4 in 2001, 2002 and 2003. This site was also surveyed for fish on two occasions in 2003. In 2006, the county conducted macroinvertebrate and fish surveys above (RM10.7) and below (RM 10.5) the confluence of Newtonsville Creek (RM10.6) (Table 3-3).

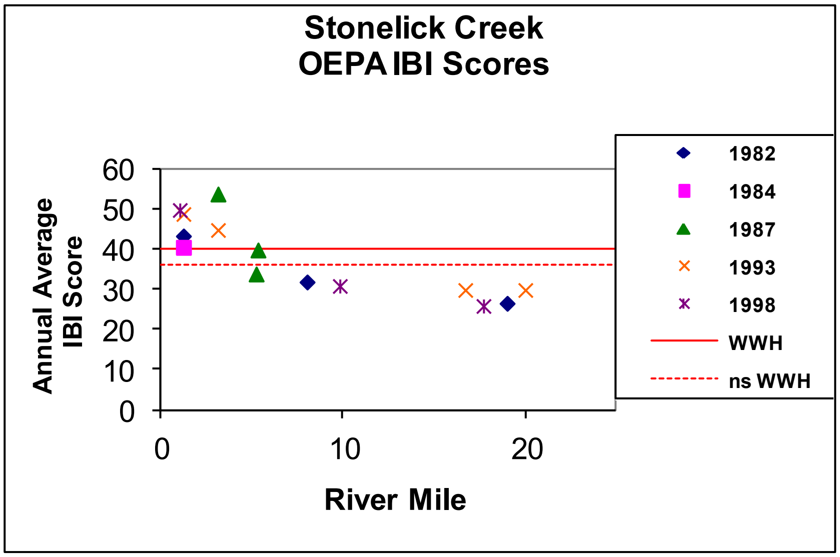


Figure 32. Ohio EPA Index of Biotic Integrity (IBI) Scores, Stonelick Creek

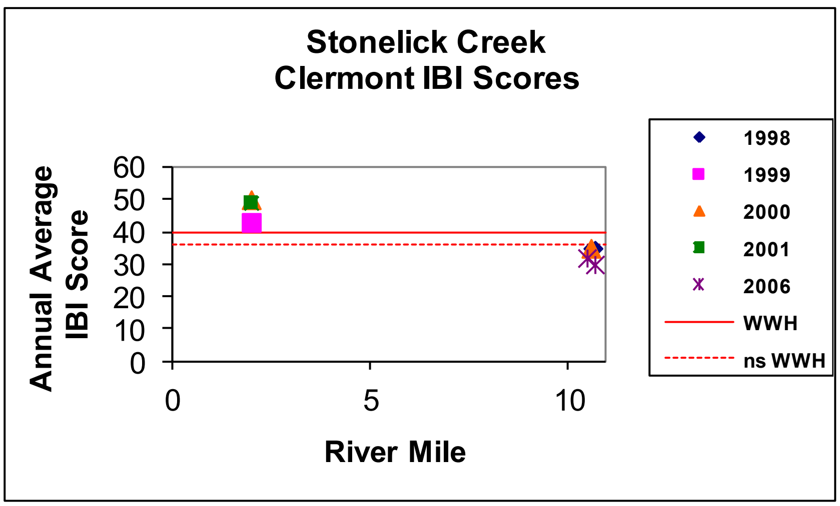


Figure 33. Clermont County Index of Biotic Integrity (IBI) Scores, Stonelick Creek (1997-2001)

Fish Survey Result

Figure 3.2 shows the results of the OEPA fish surveys performed in the Stonelick Creek subwatershed in 1982, 1984, 1987, 1993, and 1998. As shown in Figure 3.2, the data clearly show a trend of improving biological integrity moving downstream through the watershed. None of the IBI scores above river mile 8.0 meet the state standard for WWH, while all of the surveys performed below river mile 5.2 exceeded the WWH criteria value of 40.

The county's fish survey data, presented in Figure 3.3, show this same spatial trend, with upstream IBI scores in non-attainment, while downstream surveys all resulted in IBI scores above the WWH criteria.

Two fish surveys were performed in Brushy Fork at river mile 2.4 in 2003, and both surveys resulted in very low IBI scores (24 for the July 17 survey and 22 for the September 10 survey). The reason for these low scores is unknown. Fish surveys performed at Lick Fork river mile 0.1 in 2001 resulted in IBI scores of 50 and 54, indicating very good fish communities in this tributary.

DELT Anomalies

One of the metrics used in calculating the IBI is a rating based on the percentage of Deformities, Eroded fins, Lesions and Tumors – also known as DELT anomalies – found on fish. Metric scores of 1, 3 or 5 are given based on the percent DELT anomalies seen in a sample collection, with a score of 1 indicating more anomalies, and a score of 5 indicating few to none. The Ohio EPA's DELT scores range from an annual average value of 3.0 to 5.0. In 1998, all of the sites sampled had DELT scores of 5.0, the highest value possible. There does not appear to be any consistent spatial trend in any of the sampling years.

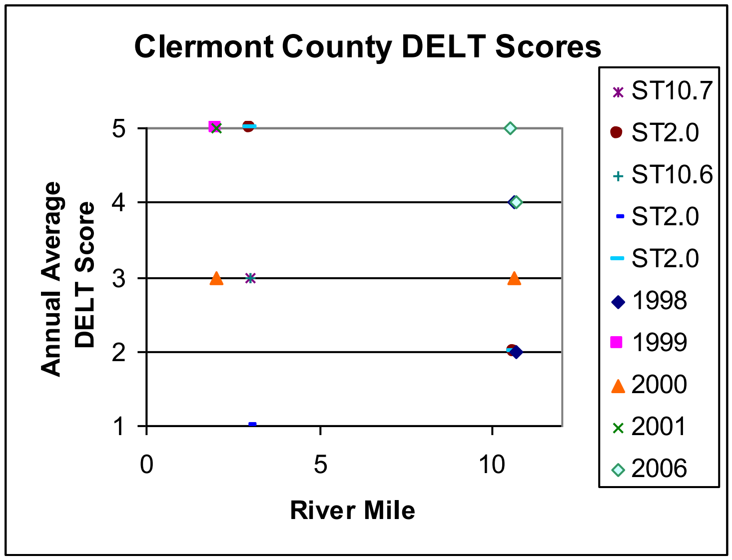


Figure 34. Clermont County DELT Scores, Stonelick Creek (1997 - 2001)

The DELT scores associated with fish surveys performed by Clermont County from 1997 through 2006 are presented in Figure 3.4. Unlike the OEPA data, there does appear to be a spatial trend in the data, with annual average DELT scores slightly higher at the downstream sampling location. However, with only seven annual average values representing fourteen total data points, it is difficult to determine how much significance to place on this observation.

Macroinvertebrate Survey Results

Results of macroinvertebrate surveys performed by the Ohio EPA in the Stonelick Creek sub-watershed are presented in Figure 3.5. The macroinvertebrate communities appear to be healthier at the downstream locations, with the lone upstream site (RM 17.7 in 1993) failing to meet the WWH criteria value of 30.

It should be noted that, while a total of eight macroinvertebrate surveys were performed by OEPA in Stonelick Creek from 1982 to 1998, only five resulted in ICI scores. For all other sampling events, no ICI score could be calculated. This is most often due to the fact that, for most of these small tributary streams, summer flows are too low to allow the prolonged deployment of the artificial substrates used for ICI sampling. As a result, the streams are usually sampled using kick net sampling, the results of which can only be used to make qualitative assessments of macroinvertebrate community health.

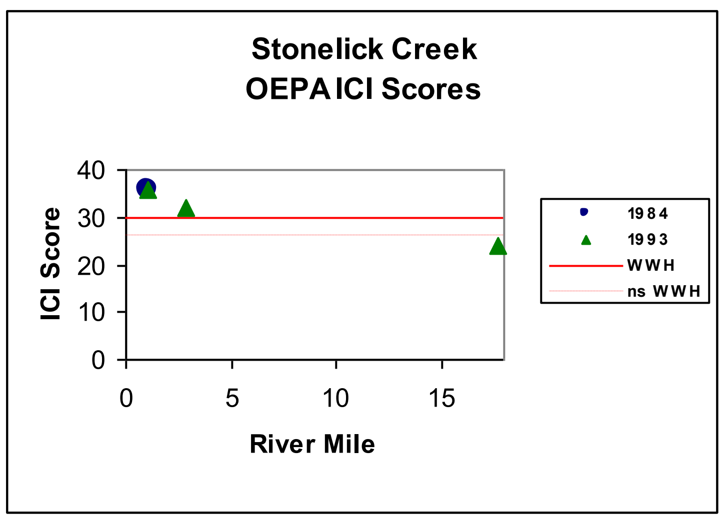


Figure 35. OEPA ICI Scores, Stonelick Creek (1997 - 2001)

OEPA has developed a Qualitative Community Tolerance Value (QCTV) rating system for small tributary systems, which assesses the environmental tolerance or sensitivity of the macroinvertebrate community using tolerance values that are assigned to each taxon. The range of tolerance values, 0 = poor to 60 = excellent, is the same as the ICI scoring range. Macroinvertebrate communities in the Interior Plateau ecoregion, which includes Stonelick Creek are considered to be in "excellent" or "good" condition if their QCTV scores are at or above 39.20, while communities scoring below 34.85 are considered to be in the "fair" to "poor" range. QCTV values that clearly fall between these two values are considered to be in "indeterminate." Based on this, the site at river mile 1.0 received a narrative rating of "excellent" in 1982 and "very good" in 1998. The site at river mile 9.8 received a rating of "good" in 1998, and the upstream site at river mile 17.7 received a "fair" rating in 1998. This is consistent with the spatial trend in the ICI scores in Figure 3.5.

Of the nine macroinvertebrate surveys that Clermont County performed in Stonelick Creek from 1998 through 2006, only two resulted in ICI scores, with both surveys being performed at river mile 2.0. The site scored a 34 in 2000, exceeding the WWH criteria value of 30, but only scored a 24 in 2001. The same site scored a QCTV narrative rating of "excellent" in 1999. The site at river mile 10.5 received a "good" rating in 2006. The site at river mile 10.6 scored narrative ratings of "poor" in 1999 and was "indeterminate" in 2000. The site just upstream at river mile 10.7 received a narrative rating of "fair" in 1998 and "good" in 2006, while the most upstream site at river mile 20.1 received a narrative rating of "poor" in 1999. Once again, the data trend shows a healthier biological communities in the downstream reaches of the stream, although the low ICI score at river mile 2.0 in 2001 is a concern, as this is the most recent survey in Stonelick Creek and represents a site that had previously scored much better.
Macroinvertebrate surveys performed by the county at Lick Fork river mile 0.1 in 2001 and Brushy Creek river mile 2.4 in 2001, 2002, and 2003 all resulted in qualitative assessments. The Lick Fork site received a narrative rating of "indeterminate," as did the Brushy Fork site in 2001. In 2002, the Brushy Creek location received a narrative rating of 'poor", but improved to a rating of "good" in 2003.

Habitat Evaluations

Ohio EPA field crews typically assess the quality of stream habitat when they conduct fish or macroinvertebrate surveys using the state's Qualitative Habitat Evaluation Index (see Sidebar). Since 1984, EPA crews completed 10 habitat surveys in the Stonelick Creek sub-watershed (Figure 3.6). Only two sites (RM 16.7 in 1993 and RM 9.8 in 1998) had QHEI scores below 60. Also, while all of the assessments performed in the lower reaches of Stonelick Creek resulted in QHEI scores above 60, there were also sites in the upper reached (RM 20.0 in 1993 and RM 17.7 in 1998) that scored in this range. Therefore, it is unlikely that poor habitat is solely responsible for the low IBI and ICI scores observed in the upper reaches of Stonelick Creek. A habitat assessment performed by OEPA at Lick Fork river mile 0.6 in 1997 resulted in a QHEI score of 70.5. This site also had an average IBI value that year of 46.0, well exceeding the WWH criteria value of 40.

Clermont County also performed habitat assessments at two locations on Stonelick Creek RM 2.0 and RM 10.6) in 2000, one (RM 2.0) in 2001, and two (RM 10.5 and RM 10.7) in 2006. All sites had QHEI scores in the 70-90 range. While the RM 2.0 location had an annual average IBI score of 50 in 2000 and 49 in 2001, both well exceeding the WWH criteria value of 40, the upstream locations (RM 10.5, RM 10.6, and RM10.7) had annual average IBI score of 32, 35, and 30 respectively, despite good QHEI scores ranging from 71 to 90. This indicates that something other than habitat is causing non-attainment in this reach of the stream.

The Qualitative Habitat Evaluation Index

The Qualitative Habitat Evaluation Index, or QHEI, is a physical habitat index designed to provide a quantified evaluation of stream characteristics that are important to fish and macroinvertebrates. The QHEI is composed of six separate measures, or metrics, each of which are scored individually and then summed to provide the total QHEI score. The metrics include: substrate type and quality; presence of different types of instream cover and the overall amount of cover available; channel morphology; the quality of the riparian buffer zone and extent of bank erosion; the quality of the pool, glide and/or riffle-run habitats; and stream gradient (the elevation drop through the sampling area). The maximum QHEI score possible is 100. Streams with a QHEI of 80 or greater typically have a very good chance at meeting Exceptional Warmwater Habitat (EWH) criteria. If QHEI scores are less than 60, it is generally difficult for streams to achieve the Warmwater Habitat (WWH) criteria.

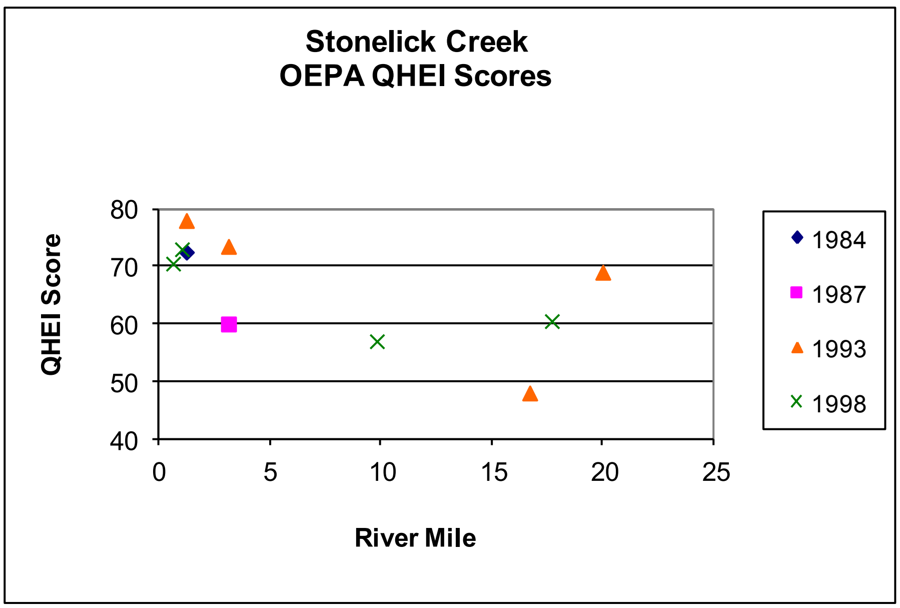


Figure 36. OEPA QHEI Scores, Stonelick Creek watershed (1984 - 1998)

An assessment performed at Lick Fork RM 0.1 in 2001 resulted in a QHEI score of 63.3. This site had very high IBI scores of 50 and 54 in the two surveys performed that year. Conversely, the site at Brushy Fork RM 2.4 had relatively low QHEI scores o 55.5 and 52.5 in two assessments performed in 2003, consistent with the low IBI scores of 24 and 22 in the two surveys performed that year at this location.

In examining the OEPA data, IBI scores and QHEI scores tended to follow each other relatively closely, i.e. the better the habitat, the better the fish community (Figure 3.7). Obvious exceptions include RM 3.1 of Stonelick Creek Run surveyed by OEPA in 1998, which had a high IBI score of 54 with a QHEI score of 60, while Stonelick Creek RM 17.7, surveyed by OEPA in 1998, received an IBI of 26 despite a similar QHEI score of 60.5. Discrepancies of this nature indicate situations in which the observed impairment in biological community structure was likely due to factors other physical habitat alteration. It is interesting to note that, despite the individual anomalies, the trend line associated with the data results in an IBI score of 36.5 (within 4 points of the WWH criteria value of 40) when the QHEI is 60.

In comparing IBI scores to QHEI values in the Clermont County data set, the relationship is less clear, Sampling at the downstream location (RM 2.0) resulted in extremely high annual average IBI scores (50 in 2000 and 49 in 2001), with good QHEI scores of 74.5 in 2000 and 74.8 in 2001. However, the upstream locations (RM 10.5, RM 10.6 and RM 10.7) failed to met the Warmwater Habitat IBI criteria, even with QHEI scores of 90, 71, and 90 respectively. As previously stated, this indicates that factors other than habitat are resulting in water quality impairment.

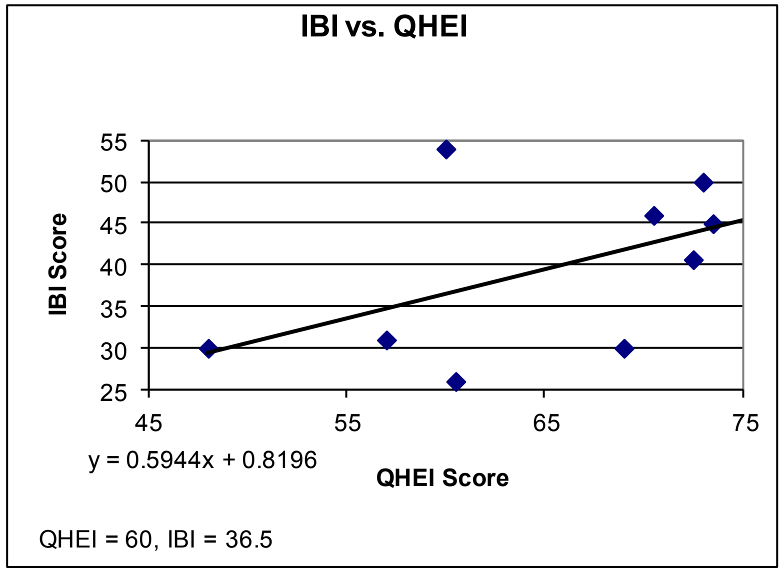


Figure 37. Relationship between QHEI Scores and IBI Scores for Stonelick Creek watershed

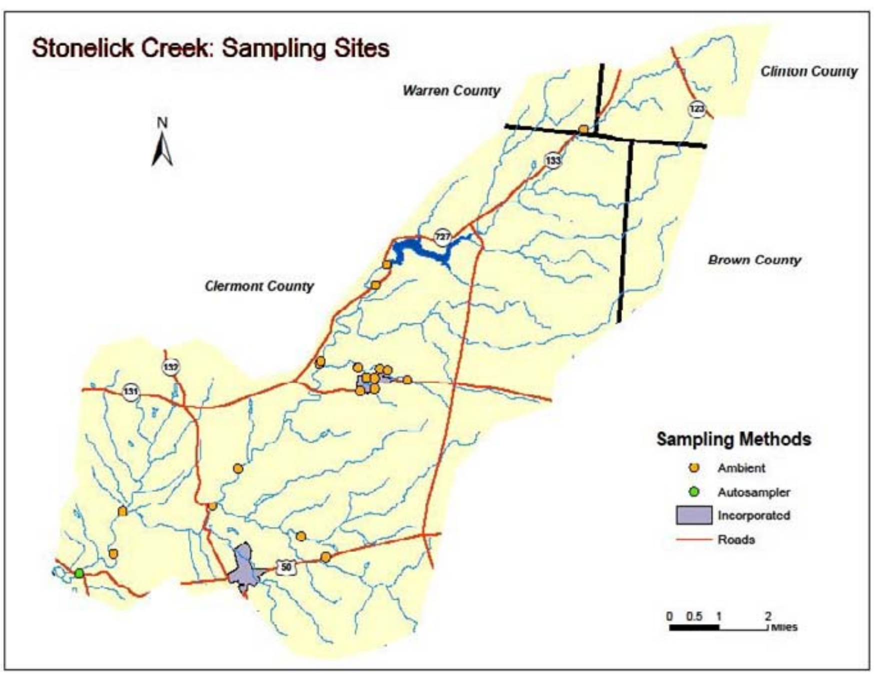


Figure 38. Clermont County sampling sites in the Stonelick Creek watershed

Nutrients

The two nutrients of primary interest to water quality managers are nitrogen (N) and phosphorus (P). While these elements are essential nutrients for many aquatic plants, high concentrations can lead to excessive plant growth. This is usually followed by massive die-offs which result in large amounts of detrital matter, the bacterial degradation of which can ultimately deplete the water of its oxygen, leading to anoxic conditions incapable of supporting aquatic life. Nutrients can enter streams from agricultural sources (fertilizer application to row-crops and pasture/feed-lot run-off), from failing or improperly maintained home sewage treatment systems, or from improperly treated sewage from municipal wastewater treatment plants.

Nitrogen exists in several forms in the aquatic environment. These include nitrate, nitrite, ammonia, and organic nitrogen. Organic nitrogen includes such natural materials as proteins and peptides, nucleic acids and urea, and numerous synthetic organic materials. Phosphorus occurs in streams almost solely as phosphates. These are classified as orthophosphates, condensed phosphates, and organically bound phosphates. Orthophosphates are a primary component of many agricultural fertilizers.
In an effort to identify potential sources of nutrient contamination, water quality managers will often sample streams not only for total nitrogen and total phosphorus, but also for the various forms in which these elements exist in the aquatic environment

Water Chemistry – Clermont County Assessments

Clermont County collected water chemistry data from various locations in the Stonelick Creek sub-watershed from 1996 through 2006. This involved collecting grab samples at these locations periodically over the April-October sampling season in an effort to characterize stream chemistry under a broad range of environmental conditions. In addition, a number of wet weather surveys were performed at Stonelick Creek, river mile 1.0 and at Newtonsville Creek river mile 0.9 from 1999 through 2002. Finally, two dry weather surveys were conducted in 2006 and 2007 in the waters around the Village of Newtonsville in an effort to identify illicit discharges contributing to high fecal contamination in Newtonsville Creek (Figure 3-8). Parameters of interest to the county fall into five general categories: Nutrients, Suspended Solids, Bacteria, Organic Enrichment/ Dissolved Oxygen, and Metals.

<u>Nutrients</u>

Ohio EPA has established water quality criteria for some nutrients, while criteria for others have not yet been developed. Criteria have been established for ammonia based on its toxicity to aquatic life. Ammonia-nitrogen (NH3-N) has a more toxic form at high pH and a less toxic form at low pH, un-ionized ammonia (NH3) and ionized ammonia ($NH4^+$), respectively. In addition, ammonia toxicity increases as temperature rises. Therefore, criteria values also vary by temperature and pH. For Exceptional Warmwater Habitats, these values range from a high of 13 mg/L in low pH/low temperature conditions to a low of 0.7 mg/L for high temperature/high pH conditions. For Warmwater Habitat, criteria values range from a high of 13.0 mg/L to a low of 1.1 mg/L.

Criteria for nitrites/nitrates and total phosphorus have not been established; however, criteria development for these parameters is in progress. One possible source for numeric nutrient targets is a technical bulletin published by Ohio EPA entitled “Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (Ohio EPA, 1999). The nutrient criteria proposed in this document for different drainage areas and use designations are listed in Table 3.3. For the mainstem of the East Fork Little Miami River in the Lake Tributaries sub-watershed, the EWH Small River criteria would be applicable, while all of the tributaries in the sub-watershed would be classified as WWH Wadable streams.

Total Kjeldahl Nitrogen (TKN) is a measure of the concentration of organic nitrogen and ammonia in a stream. To date, the Ohio EPA has not established criteria values for TKN. Likewise, there are currently no criteria values for orthophosphates.

Suspended Solids

Suspended solids are defined as that material in a water sample that can be retained by a filter. Waters with high amounts of suspended solids tend to be more turbid and, therefore, aesthetically unsatisfactory for purposes such as bathing. They also tend to be less palatable as a source of drinking water. Currently, the Ohio EPA does not have in-stream criteria values for suspended solids.

Bacteria

Fecal Coliform and *E. coli* provide information regarding the extent to which streams are being contaminated by human or animal waste. They are primarily used to determine if streams are meeting their primary contact recreation use, i.e. are the waters safe for people to use for swimming and other recreational activities. Ohio EPA has established Fecal Coliform criteria for all streams designated for primary contact recreation use, including all those monitored by Clermont County. The current Fecal Coliform criteria are:

- Geometric mean based on not less than five samples in a 30-day period shall not exceed 1000 colony forming units (cfu) per 100 mL.
- Fecal Coliform content shall not exceed 2000 cfu/100 mL in more than 10 percent of the samples collected in a 30-day period.

Ohio EPA has also established *E. coli* criteria for all streams designated for primary contact recreation use. The current *E. coli* criteria are:

- Geometric mean based on not less than five samples in a 30-day period shall not exceed 126 colony forming units (cfu) per 100 m.
- *E. coli* content shall not exceed 298 cfu/100 mL in more than 10 percent of the samples collected in a 30-day period.

While the data collected by Clermont County cannot be directly compared to the criteria due to the frequency of sampling, the criteria can still be used as a guideline to assess stream conditions.

Organic Enrichment/Dissolved Oxygen

Clermont County determines organic enrichment in its streams by measuring carbonaceous biological oxygen demand (CBOD5). CBOD5 represents a measure of the amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter. This represents the potential of organic contaminants

Stream type	Drainage Area	Proposed NO3-NO2	Proposed TP
WWH Headwaters	DA < 20 mi^2	1.0 mg/L	.08 mg/L
WWH Wadable	20 mi2 < DA < 200 mi^2	1.0 mg/L	.10 mg/L
WWH Small River	200 mi2 < DA < 1000 mi^2	1.5 mg/L	.17 mg/L

Table 9. Ohio EPA suggested nutrient criteria (taken from *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams,* Ohio EPA, 1990)

to strip life-supporting oxygen from the stream through these processes. The Ohio EPA currently does not have criteria values for CBOD5. A more direct measure of this type of impact is the determination of actual dissolved oxygen concentrations in the stream. Dissolved oxygen criteria for both EWH and WWH streams have been established by Ohio EPA. Criteria include:

- Minimum in-stream concentration of 4.0 mg/L for WWH streams; 5.0 for EWH streams;
- Minimum 24-hour average concentration of 5.0 mg/L for WWH streams; 6.0 for EWH streams.

Metals

Many metals are toxic to aquatic life, some at relatively low concentrations. In order to avoid chronic toxicity, the Ohio EPA criteria state that concentrations must not exceed 2.5 ug/L for cadmium, 86 ug/L for chromium, 9.3 ug/L for copper, 6.4 ug/L for lead, 470 ug/L for nickel, and 120 ug/L for zinc (assuming a hardness of 100 mg/L).

Results – Ambient Sampling

Ambient sampling results for the four locations on Stonelick Creek (RM 1.0, RM 5.7, RM 13.4 and RM 14.3) are presented in Table 3.4 - Table 3.7, while Tables 3.8 - Table 3.10 present the results of ambient sampling on three tributaries to Stonelick Creek (Brushy Fork, Lick Fork, and Newtonsville Creek).

Nutrients

In Stonelick Creek, annual average ammonia concentrations were below OEPA criteria values for all sites and all years. While annual average nitrite/nitrate concentrations were below the proposed OEPA WWH wadable criteria value of 1.0 mg/L at all sites for all years, phosphorus concentrations exceeded the proposed OEPA WWH wadable criteria value of 0.1 mg/L in most instances, particularly in the upstream reaches of the creek (Figure 3.9). The tributaries to Stonelick Creek showed a similar pattern, with ammonia and nitrite/ nitrate data below existing or proposed criteria values, but all of the annual average phosphorus values exceeding the proposed OEPA WWH headwaters criteria value of 0.8 mg/L.

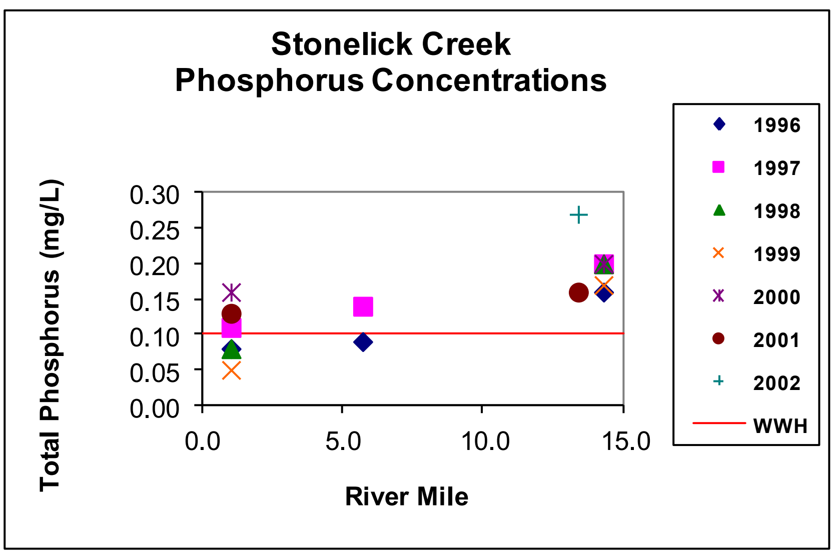


Figure 39. Phosphorus concentrations in the Stonelick Creek watershed (Clermont County sampling data)

Suspended Solids

There do not appear to be any spatial or temporal trends in the suspended solids data from the ambient monitoring program. For those years in which a sampling location had an average value slightly higher than the norm, it was usually due to a high value associated with a single sampling event that followed a heavy rainfall. As no existing or proposed criteria values exist for this parameter, it is difficult to interpret the potential impact of these results.

Bacteria

Clermont County analyzed water samples for fecal coliform in 1996 and 1997. Beginning in 1998, the county started analyzing samples for *E. coli*. None of the annual geometric mean values for fecal coliform exceeded the OEPA criteria value of 1000 c.f.u./100 mL. Only two annual geometric means (Stonelick Creek RM 1.0 in 2000 and Stonelick Creek RM 13.4 in 2002) exceeded the OEPA criteria value of a geometric mean greater than 126 c.f.u./100 mL. None of the tributaries had annual geometric means exceeding this value.

PARAMETER	1996	1997	1998	1999	2000	2001
Ammonia (mg/L)	0.10	0.10	0.11	0.07	0.10	0.10
Nitrate/Nitrite (mg/L)	0.31	0.45	0.29	0.10	0.34	0.66
Total Kjeldahl Nitrogen (mg/L)	0.84	0.88	0.61	0.76	0.71	0.77
Ortho-phosphorus (dissolved) (mg/L)	0.05	0.02	0.03	0.04	0.08	0.05
Total Phosphorus (mg/L)	0.08	0.11	0.08	0.08	0.16	0.13
Suspended Solids (mg/L)	10.96	4.70	10.04	7.98	19.28	14.22
E. coli. (c.f.u./100 mL)				66.83	224.89	52.79
Fecal Coliform (c.f.u./100 mL)	58.09	112.96				
$CBOD_5$ (mg/L)	2.09	2.13	2.06	1.64	2.22	2.20
Dissolved Oxygen (mg/L)	9.52	9.13	7.85	6.86	7.86	8.38
Cadmium (ug/L)	0.26	0.21				
Chromium (ug/L)	0.57	1.93				
Copper (ug/L)	3.93	8.84	3.86	2.38	8.25	6.63
Lead (ug/L)	1.48	6.99	1.25	1.95	2.23	2.28
Nickel (ug/L)	1.29	4.06				
Zinc (ug/L)	17.08	11.02	12.36	7.23	162.49	20.00

E. coli and Fecal Coliform values are geometric means.
Green = Meets Existing or Proposed Criteria for this Parameter
Red = Does Not Meet Existing or Proposed Criteria for this Parameter
Black = No Existing or Proposed Criteria for this Parameter

Table 10. Stonelick Creek, RM 1.0 Ambient Sampling Data-Annual Average Values

PARAMETER	1996	1997
Ammonia (mg/L)	0.10	0.10
Nitrate/Nitrite (mg/L)	0.10	0.52
Total Kjeldahl Nitrogen (mg/L)	0.83	1.06
Ortho-phosphorus (dissolved) (mg/L)	0.07	0.06
Total Phosphorus (mg/L)	0.09	0.14
Suspended Solids (mg/L)	6.62	4.99
Fecal Coliform (c.f.u./100 mL)	46.61	92.47
$CBOD_5$ (mg/L)	2.08	2.44
Dissolved Oxygen (mg/L)	5.39	7.96

Fecal Coliform values are geometric means.
Green = Meets Existing or Proposed Criteria for this Parameter
Red = Does Not Meet Existing or Proposed Criteria for this Parameter
Black = No Existing or Proposed Criteria for this Parameter

Table 11. Stonelick Creek, RM 5.7 Ambient Sampling Data-Annual Average Values

PARAMETER	2001	2002
Ammonia (mg/L)	0.11	0.12
Nitrate/Nitrite (mg/L)	0.33	0.34
Total Kjeldahl Nitrogen (mg/L)	0.93	1.20
Ortho-phosphorus (dissolved) (mg/L)	0.07	0.08
Total Phosphorus (mg/L)	0.16	0.27
Suspended Solids (mg/L)	13.97	38.80
E. coli. (c.f.u./100 mL)	42.67	232.11
$CBOD_5$ (mg/L)	2.22	3.08
Dissolved Oxygen (mg/L)	5.70	

E. coli values are geometric means.
Green = Meets Existing or Proposed Criteria for this Parameter
Red = Does Not Meet Existing or Proposed Criteria for this Parameter
Black = No Existing or Proposed Criteria for this Parameter

Table 12. Stonelick Creek, RM 13.4 Ambient Sampling Data-Annual Average Values

PARAMETER	1996	1997	1998	1999	2000
Ammonia (mg/L)	0.18	0.20	0.15	0.11	0.20
Nitrate/Nitrite (mg/L)	0.18	0.70	0.23	0.23	0.42
Total Kjeldahl Nitrogen (mg/L)	1.11	1.39	1.17	1.18	1.54
Ortho-phosphorus (dissolved) (mg/L)	0.07	0.06	0.06	0.08	0.07
Total Phosphorus (mg/L)	0.16	0.20	0.20	0.17	0.20
Suspended Solids (mg/L)	13.57	9.87	25.49	16.21	15.47
E. coli. (c.f.u./100 mL)			56.07	14.02	121.09
Fecal Coliform (c.f.u./100 mL)	49.33	46.61			
$CBOD_5$ (mg/L)	2.89	2.71	2.93	2.59	2.73
Dissolved Oxygen (mg/L)	6.54	8.06	6.41	5.13	5.43

E. coli and Fecal Coliform values are geometric means.
Green = Meets Existing or Proposed Criteria for this Parameter
Red = Does Not Meet Existing or Proposed Criteria for this Parameter
Black = No Existing or Proposed Criteria for this Parameter

Table 13. Stonelick Creek, RM 14.3 Ambient Sampling Data-Annual Average Values

PARAMETER	2001	2002	2003
Ammonia (mg/L)	0.10		
Nitrate/Nitrite (mg/L)	0.46	0.33	0.33
Total Kjeldahl Nitrogen (mg/L)	0.70	0.96	0.61
Ortho-phosphorus (dissolved) (mg/L)	0.07	0.07	0.05
Total Phosphorus (mg/L)	0.12	0.13	0.09
Suspended Solids (mg/L)	6.62	6.21	4.03
$CBOD_5$ (mg/L)	2.08	2.22	2.00

Green = Meets Existing or Proposed Criteria for this Parameter
Red = Does Not Meet Existing or Proposed Criteria for this Parameter
Black = No Existing or Proposed Criteria for this Parameter

Table 14. Brushy Fork, RM 2.4 Ambient Sampling Data-Annual Average Values

PARAMETER	1996	1997	2001
Ammonia (mg/L)	0.10	0.10	0.10
Nitrate/Nitrite (mg/L)	0.56	0.41	0.52
Total Kjeldahl Nitrogen (mg/L)	0.82	0.73	0.53
Ortho-phosphorus (dissolved) (mg/L)	0.10	0.04	0.06
Total Phosphorus (mg/L)	0.13	0.08	0.13
Suspended Solids (mg/L)	168.18	1.39	5.73
E. coli. (c.f.u./100 mL)			104.45
Fecal Coliform (c.f.u./100 mL)	317.80	160.66	
$CBOD_5$ (mg/L)		2.03	2.00
Dissolved Oxygen (mg/L)		7.50	8.30

E. coli and Fecal Coliform values are geometric means.
Green = Meets Existing or Proposed Criteria for this Parameter
Red = Does Not Meet Existing or Proposed Criteria for this Parameter
Black = No Existing or Proposed Criteria for this Parameter

Table 15. Lick Fork, RM 0.1 Ambient Sampling Data-Annual Average Values

PARAMETER	1997	1998	1999	2000	2001
Ammonia (mg/L)	0.10	0.10	0.13	0.27	0.12
Nitrate/Nitrite (mg/L)	0.36	0.49	0.25	1.11	0.48
Total Kjeldahl Nitrogen (mg/L)	0.84	0.67	0.95	1.07	0.94
Ortho-phosphorus (dissolved) (mg/L)	0.09	0.10	0.14	0.27	0.25
Total Phosphorus (mg/L)	0.18	0.19	0.23	0.37	0.28
Suspended Solids (mg/L)	14.90	14.71	13.78	13.54	
E. coli. (c.f.u./100 mL)		71.72	229.04	951.42	429.45
Fecal Coliform (c.f.u./100 mL)	153.63				
$CBOD_5$ (mg/L)	2.25	2.05	1.45	2.33	2.23
Dissolved Oxygen (mg/L)	6.59	6.40	4.48	6.30	6.38
Cadmium (ug/L)	0.31				
Chromium (ug/L)	1.08				
Copper (ug/L)	4.64				
Lead (ug/L)	5.81				
Nickel (ug/L)	3.29				
Zinc (ug/L)	17.73				

E. coli and Fecal Coliform values are geometric means.
Green = Meets Existing or Proposed Criteria for this Parameter
Red = Does Not Meet Existing or Proposed Criteria for this Parameter
Black = No Existing or Proposed Criteria for this Parameter

Table 16. Newtonsville Creek, RM 0.9 Ambient Sampling Data-Average Annual Values

It is particularly interesting to note that, in describing Lick Fork in its 2000 *Water Quality Resource Inventory*, the OEPA stated that "Clermont County data revealed significant bacterial exceedences, most likely caused by failing onsite residential systems". However, an examination of the county's fecal coliform data for 1996 and 1997 revealed only three samples out of a total of forty-one with values greater than 2000 c.f.u./100 mL, well below the 10% threshold in the OEPA criteria. In neither year did the geometric mean approach the 1000 c.f.u./100 mL threshold.

Metals

Ambient water samples from Stonelick Creek RM 1.0 were analyzed for numerous metals from 1996 through 2001, including six (cadmium, chromium, copper, lead, nickel and zinc) for which the OEPA has criteria values (2.5 ug/L, 86 ug/L, 9.3ug/L, 6.4 ug/L, 470 ug/L and 120 ug/L respectively). Annual Average values for these metals are included in Table 3.4. No single sample exceeded the OEPA criteria value for cadmium, chromium, or nickel in any year. While none of the samples collected in 1996 exceeded OEPA criteria values for any metal tested, three of the ten samples tested for copper in 1997 exceeded the OEPA criteria value of 9.3 ug/L, while six of the eight samples tested for lead exceeded the criteria value of 6.4 ug/L. In 1998, only one sample exceeded the criteria value for copper, while one sample in 1999 exceeded the criteria value for lead. All other samples were compliant for all metals. In 2000, three of the eleven samples analyzed for copper had values exceeding 9.3 ug/L, while six of the eleven samples analyzed for zinc exceeded the OEPA criteria value of 120 ug/L. This is the only year in which the zinc criteria value was exceeded in any sample. The reason for these exceedences is not known. There were no lead exceedences in 2000. In 2001, two of the twelve samples analyzed for copper exceeded the 9.3 ug/L criteria value. All other samples were compliant. The source(s) of these metals, and any possible impacts on biological communities are unknown at this time.

Results – Wet Weather Sampling

Wet weather sampling involves collecting water samples as streams rise, peak, and subside after a major rainfall event within the watershed. They are intended to detect contaminants that are flushed into the streams in high concentrations via non-point source runoff during these events but which would enter at levels below detection limits, if at all, under other conditions. From 1999 through 2002, wet weather sampling took place at Stonelick Creek, RM 1.0 at the US 50 bridge (Table 3.12), and at Newtonsville RM 0.9, just downstream of the Village of Newtonsville (Table 3.12).

As expected, annual average contaminant concentrations were generally higher in wet weather sampling events than in those samples collected on a bi-weekly basis independent of weather conditions. In particular, Total Phosphorus levels were well above proposed OEPA in-stream criteria for all 99 wet weather samples collected at the Newtonsville RM 0.9 location from 1999 through 2002. At the Stonelick, RM 1.0 location, 61 of the 73 samples exceeded this limit. Nitrite/Nitrate concentrations exceeded OEPA criteria values much less frequently, with most annual average values below or just slightly above the proposed criteria value of 1.0 mg/L.
Another contaminant of concern in examining these data is *E. coli*. As shown in Tables 3.12 and 3.13, annual geometric mean E. coli counts for both sampling locations exceeded the OEPA 30-day geometric mean criteria value of 126 c.f.u./100 mL. In most cases, the exceedences were quite large. This is particularly true in Newtonsville Creek, where the sampling location is just downstream from the un-sewered Village of Newtonsville. One explanation for these high values would be that the home sewage treatment systems in use by residents of the Newtonsville area are failing to adequately treat their waste, which is then running off into the stream during rain events.

Ammonia (mg/L)	1999	2000	2001*	2002
Rising	0.11	0.10	0.10	0.28
Peak	0.10	0.23	0.10	0.39
Falling	0.10	0.22		0.33
Total Kjeldahl Nitrogen	1999	2000	2001*	2002
Rising	1.17	2.72	2.63	1.69
Peak	1.65	2.04	2.02	2.11
Falling	1.47	2.11		1.77
Nitrite/Nitrate (mg/L)	1999	2000	2001*	2002
Rising	0.23	0.46	0.71	0.67
Peak	0.39	1.02	0.70	0.90
Falling	0.42	1.03		1.02
Ortho-Phosphate (mg/L)	1999	2000	2001*	2002
Rising	0.05	0.07	0.12	0.16
Peak	0.07	0.11	0.14	0.19
Falling	0.09	0.14		0.20
Total Phosphorus (mg/L)	1999	2000	2001*	2002
Rising	0.44	1.19	2.31	0.52
Peak	0.81	1.09	1.41	0.81
Falling	0.62	1.05		0.64
Suspended Solids (mg/L)	1999	2000	2001*	2002
Rising	183.31	732.55	834.00	113.02
Peak	397.86	416.44	1420.00	238.45
Falling	181.42	374.03		117.53
E. coli (c.f.u./100 mL)	1999	2000	2001*	2002
Rising	276.23	3287.86	7900.00	2354.26
Peak	1134.26	5602.96	23000.00	2582.63
Falling	732.96	5122.88		5429.90
$CBOD_5$ (mg/L)	1999	2000	2001*	2002
Rising	4.04	2.73	6.00	5.29
Peak	3.29	2.64	5.30	5.67
Falling	3.47	3.13		4.98

* indicates single sampling event
E. coli values are geometric means.
Green = Meets Existing or Proposed Criteria for this Parameter
Red = Does Not Meet Existing or Proposed Criteria for this Parameter

Table 17. Stonelick Creek, RM 1.0 Wet Weather Sampling-Annual Average Values

Results – Dry Weather Sampling,

In order to better understand the situation in Newtonsville creek, the county conducted two dry weather surveys in 2006 and 2007. By conducting these surveys under summer low-flow conditions (no rain in the precedent 72 hours), illicit discharges would not be diluted by storm water runoff and, therefore, would be more easily identified.

The first sample (NEWTN2.5) is upstream of the village where the stream flows under SR 131. The designation comes from the fact that this location is 2.5 miles upstream of the confluence of Newtonsville Creek with Stonelick Creek. The next site (NEWTN1.9) is located where the stream passes under Newtonsville Road, and is

Ammonia (mg/L)	1999	2000	2001	2002
Rising	0.28	0.17	0.12	0.19
Peak	0.39	0.44	0.21	0.17
Falling	0.33	0.53	0.10	0.24
Total Kjeldahl Nitrogen (mg/L)	**1999**	**2000**	**2001**	**2002**
Rising	1.69	1.67	1.36	1.19
Peak	2.11	2.11	1.71	1.32
Falling	1.77	2.21	1.28	1.83
Nitrite/Nitrate (mg/L)	**1999**	**2000**	**2001**	**2002**
Rising	0.67	0.85	0.64	0.71
Peak	0.90	0.97	0.81	0.53
Falling	1.02	0.95	0.67	1.82
Ortho-Phosphate (mg/L)	**1999**	**2000**	**2001**	**2002**
Rising	0.16	0.21	0.24	0.20
Peak	0.19	0.23	0.46	0.25
Falling	0.20	0.23	0.33	0.29
Total Phosphorus (mg/L)	**1999**	**2000**	**2001**	**2002**
Rising	0.52	0.61	0.57	0.46
Peak	0.81	0.66	0.73	0.57
Falling	0.64	0.96	0.51	0.71
Suspended Solids (mg/L)	**1999**	**2000**	**2001**	**2002**
Rising	113.02	136.21	128.12	102.53
Peak	238.45	134.67	233.24	80.60
Falling	117.56	219.68	50.56	101.67
***E. coli* (c.f.u./100 mL)**	**1999**	**2000**	**2001**	**2002**
Rising	1262.59	5833.27	9449.14	1186.59
Peak	2528.51	6185.88	14244.12	10026.60
Falling	2530.96	5585.56	10379.38	14866.07
$CBOD_5$ (mg/L)	**1999**	**2000**	**2001**	**2002**
Rising	5.29	2.89	4.65	4.73
Peak	5.67	3.60	5.60	4.30
Falling	4.98	3.45	4.64	6.50

E. coli values are geometric means.
Green = Meets Existing or Proposed Criteria for this Parameter
Red = Does Not Meet Existing or Proposed Criteria for this Parameter
Black = No Existing or Proposed Criteria for this Parameter

Table 18. Newtonsville Creek, RM 0.9 Wet Weather Sampling-Annual Average Values

1.9 miles upstream of the confluence with Stonelick Creek. Moving downstream from here, the next site is identified as NWTSWO02. This is a storm-water outfall at the end of Cross Street that is connected to the stream via an open channel approximately 100 meters in length. The site identified as NWTSWO03 is another storm-water outfall sampled immediately north of Main Street. It is connected to the main stem of Newtonsville Creek by an open channel approximately 335 meters in length. Downstream from here, we find sampling locations identified as NWTSWO01, a stormwater out-fall entering the stream just upstream of Cedarville Road, and NEWTN0.9, an in-stream sample taken just upstream of the Cedarville

Road bridge 0.9 miles upstream of the confluence with Stonelick Creek. Three additional sites are located on un-named tributaries to Newtonsville Creek. One of these sites (NWTUT0.2) is located 0.2 miles upstream of the confluence of the tributary with Newtonsville

Creek, where the tributary passes under Main Street. The other two sites (NWTUTE.3 and NWTUTW.2) are located on an eastern branch of the tributary 0.3 miles upstream of the point where the tributary forks, and on a western branch 0.2 miles upstream of the fork, respectively. Both of these sites are accessed from Wright Street. Results of the surveys conducted in the Newtonsville area are presented in Table 3.14 and Table 3.15.

NO2-NO3 was detected in all samples, with 11 samples having concentrations greater than the OEPA's proposed criteria value of 1.0 mg/L. Specifically, the stormwater outfall (NWTSWO02) and one of the tributary sites (NWTUT0.2) had average NO2-NO3 concentrations above the proposed criteria value. In addition the other two storm water outfalls (NWTSWO01, NWTSWO03) and the main stem sites (NEWTN0.9, NEWTN1.9, NEWTN2.5) had individual measurements exceeding the proposed criteria value of 1.0 mg/L. All measurements at NWTUTE.3 and NWTUTW.2 were below this value.

The ortho-phosphorus and total phosphorus data present a somewhat different picture. While two of the stormwater outfalls (NWTSWO02 and NWTSWO03) have the highest phosphorus concentrations, the third outfall (NWTSWO01), located just upstream of the Cedarville Road bridge, has the lowest phosphorus concentrations of any of the samples. Also, phosphorus concentrations are higher in the main stem of Newtonsville Creek in the village (NEWTN1.9) than they are downstream at the Cedarville Road bridge (NEWTN0.9), unlike the NO2-NO3 values, likely due to the low mobility of phosphorus during low flow. It should be noted that, while the OEPA has not proposed a criteria value for ortho-phosphate, for all but two of the sites sampled in these surveys (NWTSWO01, NWTUTE.3), total phosphorus concentrations in every sample exceeded the proposed criteria value of 0.1 mg/L.

There are no existing or proposed criteria values

Sampling Site	NO_2—NO_3	Ortho-P	TP
NEWTN2.5	0.67 (0.0-1.13)	0.31 (0.22-0.46)	0.92 (0.49-1.54)
NEWTN1.9	0.51 (0.10-1.11)	0.76 (0.30-1.80)	1.36 (0.74-2.23)
NWTSWO02	1.83 (0.23-4.18)	0.69 (0.23-1.36)	1.37 (0.34-2.71)
NWTSWO03	0.81 (0.0-1.75)	3.16 (1.34-4.50)	5.47 (4.34-7.72)
NWTSWO01	0.84 (0.04-1.40)	0.08 (0.03-0.19)	0.29 (0.01-1.01)
NEWTN0.9	0.55 (0.0-1.21)	0.20 (0.10-0.31)	0.28 (0.18-0.33)
NWTUT0.2	1.06 (0.10-2.33)	1.20 (0.18-2.72)	1.37 (0.34-2.42)
NWTUTE.3	0.24 (0.0-0.62)	0.05 (0.01-0.15)	0.14 (0.04-0.19)
NWTUTW.2	0.50 (0.10-0.79)	0.83 (0.06-2.72)	0.75 (0.35-1.59)

E. coli values are geometric means.
Green = Meets Existing or Proposed Criteria for this Parameter
Red = Does Not Meet Existing or Proposed Criteria for this Parameter
Black = No Existing or Proposed Criteria for this Parameter

Table 19. Nutrient Results from 2006 and 2007 Newtonsville Dry Weather Surveys-2006-2007 Average Values and Ranges

for Total Suspended Solids and, as often observed under low flow conditions, suspended sediment values were relatively low compared to concentrations typically observed following rain events. However, on July 24th, TSS values were 145, 337, and 739 mg/l for sites NWTUTW.2, NEWTN0.9, and NWTSWO01 respectively. These three sites also had very high *E. coli* values on this date as well. These high values may correspond to contamination from untreated sewage or livestock from houses or fields that drain to these sites.

As stated previously, Ohio EPA criteria states that the *E. coli* geometric mean, based on not less than five samples collected over a 30-day period, cannot exceed 126 colony forming units (c.f.u.) per 100 mL, and *E. coli* content cannot exceed 298 c.f.u./100 mL in more than 10% of the samples. Since the dry weather surveys only involved four sampling events in two years, results of the survey cannot be compared to these criteria values from a regulatory perspective, but the criteria values can still serve as a useful benchmark, and are used in this capacity in this report. As shown in Table 3.15, while several sites exceed a geometric mean of 126 c.f.u./100 mL, two of the stormwater outfalls (NWTSWO02 and NWTSWO03) have extremely high geometric mean *E. coli* values (2,983 c.f.u./100 mL and 28,161 c.f.u./100 mL respectively), suggesting some form of bacterial contamination in these stormwater conveyances. High *E. coli* concentrations in the main stem samples may be due to runoff from these storm-water outfalls, the general influence of failing on-site home sewage treatment systems (HSTSs), or the presence of livestock nearby. One interesting observation is the high *E. coli* value at NWTUT0.2, the un-named tributary sampled at Main Street (geometric mean = 5,864 c.f.u./100 mL), given the fact that *E. coli* values in both branches of the tributary just upstream of this location have lower geometric means than very little development of any kind in this part of the watershed, but the "spike" in contaminants observed at NWTUT0.2 may be due to the influence of an undetected outfall in the area. This may warrant further investigation.

In general, the high nutrient and fecal contaminant concentrations observed in at least two of the stormwater outfalls within the Village of Newtonsville support earlier speculation that on-site HSTSs are not providing adequate treatment and are allowing partially treated sewage to enter the Newtonsville Creek watershed. Of particular concern is the fact that these outfalls are connected to the stream via open channels that flow through the village and are easily accessible by the residents of the village and their pets. With fecal contaminant concentrations orders of magnitude greater than state Primary Contact standards, this poses a significant risk

Sampling Site	TSS	*E.coli*
NEWTN2.5	39.1 (15.0-59.7)	225 (66-580)
NEWTN1.9	13.9 (6.5-20.0)	84 (10-1,000)
NWTSWO02	46.4 (0.2-74.0)	2,983 (1,355-14,000)
NWTSWO03	46.2 (18.0-78.0)	28,161 (8,000-241,960)
NWTSWO01	187.3 (1.5-739.0)	374 (15-54,620)
NEWTN0.9	92.6 (4.4-337.0)	658 (85-24,477)
NWTUT0.2	28.2 (9.7-52.8)	5,864 (900-141,360)
NWTUTE.3	25.1 (10.8-53.2)	19 (1-290)
NWTUTW.2	62.1 (9.7-145.0)	711 (230-3,873)

E.coli values reported in #/100ml as geometric means and ranges

Table 20. Results from 2006 Newtonsville Dry Weather Surveys– 2006-2007 Average Values and Ranges

of illness to residents of the village. The county is currently investigating options that would minimize or eliminate this risk. Options currently being considered include connection of the village to centralized sewers serviced by an existing wastewater treatment plant, or construction of a package treatment plant near the village. Input from the village and its residents will be an integral part of the decision-making process as the county moves forward in these efforts.

Results – Wastewater Treatment Plant Monitoring

Samples from the Clermont Northeastern High School's wastewater sewage treatment plant effluent were collected on a bi-weekly schedule from May through October of 2006. These samples were collected in order to determine what contribution, if any, the plant is making to pollutant loads in Brushy Fork Creek and Stonelick Creek. Table 3.11 shows the results from this sampling event.

Nitrate-nitrite levels exceeded the Ohio EPA proposed criteria of 1.0 mg/l once in August with a concentration of 1.07 mg/l. Nitrate concentrations were below 1.0 mg/l on other sampling dates and the average nitrate-nitrite concentration was only 0.67 mg/l . Orthophosphate concentrations averaged 0.4 mg/l, which is relatively low. The average total-phosphate concentration of 0.09 mg/l was above OEPA's recommended criteria of 0.08 mg/l for headwater WWH.

Suspended solids were consistently low in all five sampling events. The average suspended solids concentration in the summer of 2006 was 4.10 mg/l.

E. coli levels were greater than the Ohio EPA criteria of 126 c.f.u. / 100ml on all four sampling occasions. The geometric mean was 530.94 c.f.u. / 100 ml.

The water quality of the effluent from Clermont Northeastern High School's wastewater treatment plant was generally good. However, because sampling occurred over the summer, this data might not reflect the actual loading from the plant during the school year. It should also be noted that these samples were collected at or very near the point of discharge into the streams, and the Ohio EPA criteria values are based on in-stream concentrations outside the mixing zone for a point source discharge, so direct comparisons to these criteria values are not appropriate.

PARAMETER	25-May-06	19-Jul-06	15-Aug-06	14-Sep-06	19-Oct-06	Average
Nitrate/Nitrite (mg/L)	**0.86**	0.40	**1.07**	**0.48**	**0.53**	**0.67**
Ortho-phosphorus (dissolved) (mg/L)	0.02	0.02	0.09	0.02	0.04	0.04
Total Phosphorus (mg/L)	**0.05**	**0.05**	**0.08**	**0.05**	**0.23**	**0.09**
Suspended Solids (mg/L)	6.50	3.40	1.30	5.20	3.70	4.02
E. coli (c.f.u./100 mL)		**1500.00**	**430.00**	**440.00**	**280.00**	**530.94**

E. coli values are geometric means.
Green = Meets Existing or Proposed Criteria for this Parameter
Red = Does Not Meet Existing or Proposed Criteria for this Parameter
Black = No Existing or Proposed Criteria for this Parameter

Table 21. Clermont Northeastern High School WastewaterTreatment Plant effluent monitoring.

Stonelick Creek Watershed Action Plan

<u>Chapter 4</u>

Community Water Management Goals & Interests

East Fork
WATERSHED COLLABORATIVE

PO Box 549
Owensville, OH 45160
clermontswcd.org/WatershedPrograms.aspx

CHAPTER 4: COMMUNITY WATER MANAGEMENT GOALS AND INTERESTS

For any plan to be implemented, the recommendations must be in the interest of the individuals and organizations (including businesses and local governments) that make up the community.

This chapter summarizes the water management interests, issues and concerns that were identified by a broad group of stakeholders who live and work in the Stonelick Creek watershed. In response to those interests, a series of water management goals were developed, and a broad suite of strategies were identified to achieve those water management goals. The strategies introduced in this chapter also serve as the basis for the recommended actions to achieve water quality goals outlined in Chapter 5 - Watershed Recommendations. This chapter begins with a description of the process used to identify water management interests, issues and concerns, and then to develop the goals and strategies to address those areas of need.

Stonelick Creek Stakeholder Involvement Process

Planning for the Stonelick Creek subwatershed was initiated by the East Fork Watershed Collaborative in 2002, however a change in priorities shifted the planning focus to the other four East Fork subwatersheds. Stonelick planning resumed in 2007, and then again in 2009, after the hiring of a new watershed coordinator. The process for identifying community water management goals and interests for the Stonelick Creek was based on the planning processes used for the other sub-watersheds. Due to the geography of the Stonelick Creek planning region many of the stakeholders located in the watershed were involved in the planning for other subwatersheds. Therefore, the Collaborative decided to review the issues, interests, and water management goals identified during those planning processes and assess their applicability toward Stonelick Creek. This was the first step in the Stonelick Creek planning process, the process was followed by several steps:

Invitation to Participate in the Planning Process

The watershed coordinator made every effort to meet with each county board of commissioners, township board and village council to describe the watershed planning effort and to invite their participation in the planning process. We requested representation from each board. We also extended the same invitation to county agencies (SWCDs, county engineers, health districts, planning departments,...), businesses, developers, interest groups, and individual landowners in the watershed (see page 4-2 for complete invitation list).

Issue Identification

The Collaborative held Stonelick Creek planning meetings on August 23, 2003 and August 8, 2007. The 2003 meeting accomplished three major tasks: (1) stakeholders were given a summary of the watershed inventory, (2) an exhaustive list of water management interests, issues and concerns was generated (Table 41), and (3) the issues were organized into groupings of related issues and strategies were developed for addressing the issues. The meeting held in August 2007 provided an opportunity for stakeholders to provide input on the recommended management strategies which were created based on the stakeholders' interests, issues and concerns. The community members who participated represented county, township, and village governments, as well as other diverse interests.

It is important to note that many of the issues identified during this process were similar to those identified during the planning meetings for the other subwatersheds. These watershed action plans can be viewed and downloaded at clermontswcd.org and www.oeq.net.

Stonelick Creek Issue Framing Meeting Invitation List

Eric Averwater
James J. & Faye E. Miller
Jerry & Wanda Glancy
Gerald Norton
Ron & Jeri Murray
Mark & Frances Johnson
Ray Sebastian, Clermont County Building Official Lee Ottaway, Stonelick Township Zoning Inspector John Hanley, Stonelick Township Trustee
Kermit Beckworth, Jr., Stonelick Township Trustee Skeets Humphries, Stonelick Township Trustee Tracy Sumner, Stonelick Township Fiscal Officer Harold Grossnickle, Jr., Wayne Township Trustee Don Wilson, Wayne Township Trustee
Dennis Elchlinger, Wayne Township Trustee
Sandra Borchers, Wayne Township Fiscal Officer Greg Snider, Wayne Twnsp Zoning Administrator Rick Porter, Wayne Township Zoning Inspector Dawn & Gerald Werner
Elizabeth & William Smith
Kevin Pringle, Village of Newtonsville
Christina Chambers, Village of Newtonsville
Phillip Peterson, Village of Newtonsville
Chris Dauner, East Fork State and Stonelick State Parks' Manager
John Gillespie, Assistant Park Manager Stonelick State Park
Dave Zagurny, USACE East Fork Lake Park Manager
Melvin Kipp, Owner Kipp's Gravel
Marlene Bauer, Village of Owensville
Shirley Shipley, Village of Owensville
Carol Huhn, Village of Owensville
John Matthews, Village of Owensville
Joseph Bailey, Village of Owensville
Paul McEvoy, Village of Owensville
Cheryl Housh, Village of Owensville
Scott Lahrmer, Asst. County Administrator, Clermont County Commissioners
David Spinney, County Administrator, Clermont County Commissioners
Mary Walker, Clermont County Commissioner
Bob Proud, Clermont County Commissioner
Scott Croswell, Clermont County Commissioner
Tom Yeager, Director of Utilities, Clermont County Water & Sewer District
Joseph Uecker, Ohio House of Representatives
Wayne Jacobs, Miami Valley Rifle & Pistol Club
Hugh Trimble, Ohio EPA, Division of Surface Water
Lori Hillman, NRCS, Clermont County District Conservationist
Paul Braasch, Director of Adams/Brown Solid Waste District, Clermont Office of Environmental Quality Program Director
Dennis McMullen, Program Manager, Clermont Office of Environmental Quality
John McMannus, Clermont County Stormwater Department
Paul Berringer, District Administrator, Clermont Soil and Water Conservation District
Steve Anderson, Clermont County Farm Service Agency
Harold S. Herron, Jackson Township Trustee
Joseph P. Speeg, Jackson Township Trustee
Paul G. Werring, Jackson Township Trustee
Harold L. Herron, Jackson Township Fiscal Officer Bruce Privett, Jackson Township Zoning Inspector Sheila Waterfield, District Administrator Brown Soil and Water Conservation District
Chris Rogers, District Technician Brown Soil and Water Conservation District
Josh Will, District Technician Clermont Soil and Water Conservation District
Christy Hardin, Administrative Assistant Clinton Soil & Water Conservation District
Bob Coblentz, NRCS District Conservationist, Clinton County
Joel LeGris, NRCS District Conservationist, Brown County

Stonelick Creek Watershed Issue Framing Meeting
August 8, 2007
Sign-In Sheet

East Fork Watershed Collaborative

Name	Affiliation	Phone number	email
Wade Hawes	Clermont County, Stormwater	732-7874	whawes@co.clermont.oh.us
Paul Braasch	Clermont OEQ	732-7745	pbraasch@co.clermont.oh.us
Dennis McMullen	Clermont OEQ	732-7894	dmcmullen@co.clermont.oh.us.
Scot Lahrner	Clermont County BCC	732-7394	SLAHRNER@co.clermont.oh.us
Tom Yeager	CLERMONT CO.	732-7930	tyeager@co.clermont.oh.us
David Spinney	Clermont Co	732-7300	dspinney@co.clermont.oh.us
DAVID ZAGURNY	PRIVATE CITIZEN	732-9105	David.T.Zagurny@USACE.ARMY.MIL
Paul Berringer			
[illegible]	TRUSTEE	732-3532	[illegible]
Nancy Cochran	intern SWCD	732-7075	NancyEC@bgsu.edu
Jason Brown	Watershed Coordinator	732-7075	

Figure 40. Participant list for August 8, 2007 Watershed Issue Framing Meeting

Strategy Development and Prioritization

During the 2007 Stonelick Creek planning meeting, each participant was given a Watershed Action Form (Figure 4-2) developed by the watershed coordinator. The form included a general set of recommendations based on the identified causes and sources of impairment. Each participant used the form to: (1) rank the importance of watershed action recommendations and (2) provide additional comments or suggestions for management strategies. Time was allotted during the meeting for participants to fill out the forms, followed by a period for discussion. Upon completion of this process each form was carefully reviewed by the watershed coordinator and applied toward the recommended actions set forth in Chapter 5. The priority rankings given to each impairment or threat was carefully weighed from each form and represented in Chapter 5.

The factors that went into their priority determination included: 1) the importance of the action for achieving the stated goal; 2) the return on investment (i.e., are we accomplishing a lot with the resources used); 3) the "doability" (person or entity available and willing to take leadership, funding or personnel available to accomplish the task, community and/or political support {or opposition}, etc.); and 4) opportunistic within a strategic approach based on water quality goals and cost effectiveness.

The Issues

Table 4-1 summarizes the water management interests, issues and concerns identified during the Stonelick Creek planning meetings. The critical issues identified for the Stonelick Creek subwatershed focus primarily on pollution caused by nonpoint source runoff. These issues are discussed in further detail in Chapters 2 and 5 Watershed Inventory and Watershed Management Recommendations.

Target Area	Causes of Impairment	Sources of Impairment
Stonelick Creek Watershed	Suspended solids Phosphorus Stream Instability Habitat alterations Water quantity Pathogens Heavy Metals Illicit spills Illicit solid waste Pesticide Other chemical applications	Row crop agriculture Livestock agriculture On-site wastewater systems Storm water runoff Construction activities Private landowner activities

Table 22. Causes and sources of impairment Identified during Stonelick stakeholder meetings

Objective	Action	Resources	Rank High Medium Low	Comments
	Monitoring and Assessment			
Determine use attainment status of all non-assessed streams and rivers	Conduct Aquatic Life Use assessment of listed streams using Ohio EPA protocols and Ohio EPA Level 3 certified data collectors	Ohio EPA staff, Ohio EPA 319 grant, USEPA grant or similar grant		
Evaluate habitat quality of all non-assessed streams and rivers	Conduct Qualitative Habitat Evaluation Index (QHEI) assessment of each stream	Ohio EPA staff as part of water quality analysis described above; or watershed coordinator or other qualified evaluator using existing resources		
Evaluate morphological status and stream stability of all streams and rivers	Conduct physical and morphological assessment of each stream using Rosgen Level III assessment or equivalent	Watershed coordinator and/or other qualified evaluator using existing resources; or Ohio EPA 319 grant or other similar grant		
Inventory 100 percent of riparian corridor along all streams and rivers	Using aerial photos and field verification, map width, land use, and vegetation of all riparian cor-ridors	Watershed coordinator or other partners using existing re-sources; or Intern project or uni-versity class project		
	Accurately map floodplains for all streams	FEMA or USACE grant for major streams; watershed coordinator or other qualified evaluator for minor tributaries; seek grant $$		
Identify specific causes and sources of impairment	Develop citizen monitoring program - involve schools, Farm Bureau, volunteers, …; potentially form local environmental group for testing, education, ...	Watershed coordinator, partners, volunteers using existing programs (e.g., schools, AWARE, Saturday Snapshot, …) and grants		
	Develop complete and accurate land use inventory; use inventory to identify potential point and non-point sources; map HSTS - note failing or improper systems	Watershed coordinator and partners using existing resources, Health Districts		
	Establish long-term monitoring stations in Stonelick watershed; collect water quality and rainfall data	EFLMR Monitoring and Assessment Team, volunteer monitors; seek grants to fund program		
	Get flow data to be able to calculate loadings	Watershed coordinator and partners using existing resources; or grants, interns, USEPA, ...		
	Measure water quality using Ohio EPA primary contact recreation criteria	Watershed coordinator, partners, volunteers using existing programs resources and grants		

Figure 41. Stonelick Creek Watershed Recommendations ranking/comment form

East Fork Watershed Collaborative

The East Fork Watershed Collaborative was created with two primary goals in mind. The goal to help maintain the water quality in the East Fork Little Miami River watershed is captured in our mission statement, “to protect and enhance the chemical, physical and biological integrity within the East Fork Little Miami River and its tributaries.” But the Collaborative also supports the community in achieving their broader water management goals.

The following were identified by East Fork Watershed Collaborative partners as the primary roles and responsibilities of the Collaborative:

- Serves as a forum to discuss water resource management across jurisdictional boundaries
- Develops watershed plans
- Monitors water quality Implements community water quality improvement projects
- Identifies and secures funding for water quality projects
- Educates those who live, work and recreate in the East Fork watershed
-

For more information about the collaborative see Chapter 1 (p. 3) and Appendices A and G.

Recommended Actions

Meeting participants provided several recommended actions concerning the identified issues provided in Table 4-1. These recommended actions were incorporated into the problem statements and action tables provided in Chapter 5; Watershed Recommendations (Tables 4-2, 4-3). It should be noted that a draft of Chapter 5; Watershed Recommendations, was sent out to several stakeholders for a final review before the Stonelick Watershed Action Plan was submitted for the State’s review.

Implementation

Stakeholder involvement is an ongoing process. The Watershed Action Plan is considered a living document and modifications to the existing plan shall reflect the changing conditions with the Stonelick Creek communities. Thus, continued participation from key stakeholders will be critical as implementation occurs.

Once the Stonelick Creek plan is endorsed, we will meet with key stakeholders to create a five year work plan to implement projects based on the listed criteria. A work plan will accomplish three things: (1) Create a list of implementation projects ranked in order of feasibility; (2) Develop a timeframe for implementation; (3) Establish stakeholder working groups for specific implementation projects. The stakeholder working groups will have a minimum of three working group meetings at the beginning, middle and end of each project. Additional communication will be facilitated through ad hoc meetings and quarterly email updates. At the end of the five year implementation phase, all stakeholders will meet again to assess progress within the watershed.

Monitoring & Assessment

- Better studies to identify specific problems
- More stream/water quality data
- Put date to use

Protection of Habitat and Natural Systems Services

- Stream corridor protection
- Natural channel migration
- Streambank erosion
- Channelization
- Habitat degradation

Land Use

- Land use planning and zoning
- Open space preservation
- Population growth and cost of services

Storm water/ Runoff

- Non-point source pollution
- Runoff from development
- Rain gardens, green infrastructure (future development)

Wastewater/Sewers/Septics

- Raw sewage in stream
- Failing Household Sewage Treatment Systems (HSTS)
- Grant money available for repair of failing HSTSs
- Control Bacteria
- Changing EPA requirements
- No additional requirements without funding to meet requirements
- Wastewater treatment plants/sludge applications

Water Quality (General)

- Water quality—agricultural or urban
- Meet Ohio EPA standards
- Increase number of streams attaining all uses
- Don't create new problems
- Be responsible for our actions and interactions

Education

- Raise awareness about watersheds
- K-12 educational programming
- Adult education
- Stormwater education

Miscellaneous/Other

- Unauthorized dump sites
- Spills & accidents
- Pay for services provided
- Financing projects
- Recreation
- Stream temperature
- Livestock (horses)
- Salt entering streams from roadways
- Runoff from Golf Courses
- Analysis of "no-till" practices; how many acres and how effective

Table 23. Watershed management interests, issues and concerns identified by Stonelick Creek stakeholders.

Recommended Actions

- Determine Baseline Water Quality of All Streams
- Improve Water Quality to Meet Use Attainment in All Streams
- Develop Complete and Accurate Land Use Inventory
- Riparian and Floodplain Protection through Fee-Simple Purchase and Conservation Easements
- Encourage Open Space and “Green Space (i.e., pervious surfaces)
- Improve Storm Water Runoff Quality
- Reduce Flood Peaks and Flood Damage
- Reduce Solid Waste in Streams
- Promote and Implement Best Management Practices (BMPs)
- Evaluate Effectiveness of Current Best Management Practices (BMPs)
- Increase Number of Farms Using Conservation Plans
- Maintain Properly Functioning Household Sewage Treatment Systems
- Minimize Water Quality Impairments from Wastewater Treatment, Hauling and Sludge Management
- Conduct Physical/Morphological Assessment of All Streams
- Conduct Habitat Assessments using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA
- Organize, Manage and Communicate Data Efficiently and Professionally
- Establish and Follow Data Quality Protocols
- Evaluate Effectiveness of Practices
- Raise Awareness about Water Quality and Watershed Management
- Implement Riparian Setbacks and Conservation Development Practices
- Perform Livestock Inventory
- Homeowner Education Concerning HSTS Function, Drainage, Riparian/Floodplain Protection, and Lawn Fertilizer Application
- Improve Storm Water Regulations
- Expand Centralized Sewers and HSTS Monitoring
- Improve Enforcement of Construction Site Erosion/Sediment Regulations and Storm Water Controls.

Table 24. Recommended actions identified for the Stonelick Creek watershed.

Community Survey

The people-side of watershed protection is indeed the most important factor to ensuring the long-term health of our water resources. The Stonelick Creek Watershed Action Plan was written to establish a process for water resource protection, and also to provide a strategy for fostering watershed stewardship within the Stonelick Creek communities. As the Collaborative moves forward with implementation, community outreach will continue to be an integral part in achieving the desired goals for the watershed. The milestones by which the Collaborative measures success will not only include physical and biological improvements to the river and streams, but will also include the positive changes in attitudes and behaviors of the people living in the East Fork. By working with local partners to garner public support, the Collaborative will also work to effect change on the policy-side of watershed protection, which will also be an important measure of success.

The Collaborative will develop a “Watershed Awareness Survey,” to measure social outcomes of watershed initiatives. The survey will be constructed to measure individual awareness, interest and willingness to participate in watershed protection. It can be utilized as a pre– and post– measure to determine the effectiveness of outreach efforts. The findings from these surveys will hopefully lend insight into how and where the Collaborative should focus its efforts, and also provide a list of willing landowners/citizens, who may be included in future initiatives.

Stonelick Creek Watershed Action Plan

Chapter 5

Watershed Management Recommendations

PO Box 549
Owensville, OH 45160
clermontswcd.org/WatershedPrograms.aspx

CHAPTER 5: WATERSHED MANAGEMENT RECOMMENDATIONS

The previous chapters provided the context within which watershed management activities take place, described potential point and non-point sources of pollution (Chapter 2), provided a detailed summary of existing water quality conditions (Chapter 3), and summarized the goals and interests of Stonelick Creek watershed stakeholders (Chapter 4). This chapter integrates the information from the earlier chapters and presents a set of recommendations designed to help Stonelick Creek streams meet their use attainment. The chapter also includes other recommendations designed to achieve a broader set of water management goals.

Management strategies for the Stonelick Creek watershed were developed through a number of stakeholder meetings. Those strategies and the process by which they were developed are summarized in Chapter 4, and further detailed in Appendix A. Within this chapter, the strategies are applied to a given stream segment or subwatershed based on the primary causes or sources of impairment. Where sources of impairment have not been identified, or for those streams for which no water quality data exist, additional monitoring and assessment activities are recommended.

Table 5-1 summarizes the assessments done by the Ohio EPA in 1998 which identify the causes and sources of stream impairment in the Stonelick Creek watershed by stream segment. Probable sources are listed for each cause of impairment. For example, organic enrichment and pathogens are listed as the causes of impairment for Lick Fork and the probable source is failing home septic systems. Information from the Ohio EPA's recent stream assessments were used to determine stream conditions in the Stonelick watershed and develop action steps to maintain or improve the health of those streams.

In addition to Ohio EPA's assessments, information was collected from local resources and studies to further assess the health of the Stonelick streams. In 2007, the East Fork Watershed Collaborative (EFWC) completed a watershed management study to determine the primary causes for non-attainment of water quality in the East Fork. The goal of this study was to determine whether a locally-led TMDL (Total Maximum Daily Load) would be an appropriate way to address the primary causes of impairment. Two related approaches were used to better understand the reasons for biological impairment: the Stressor Identification model and biostatistical modeling. The Stressor Identification approach utilized a weight-of-evidence process that considered the universe of potential stressors and evaluated the relative probability of each one to contribute to the observed biological impairment. Alternatively, a biostatistical modeling approach relied upon statistical evaluations of the relationships between available biological, physical, and chemical water quality data (see Appendix F).

Data collected from the Collaborative's 2007 study, along with Ohio EPA's data and other local sources of information were used to determine the major causes and sources of impairment in the Stonelick Creek watershed (Figure 5-1). The following pages include summaries for each Stonelick Creek sub-watershed (14 digit Hydrologic Units) that describe the use attainment status of each stream and the causes and sources of impairments. Problem statements were developed for each cause of impairment. Following each problem statement is a list of goals and objectives that address the sources of impairment, along with a list of recommended management strategies designed to maintain full support of the streams' designated uses. Each management strategy includes potential costs and sources of funding, a time frame for implementation, and measurable performance goals.

The goals and objectives for each problem statement focus on reducing pollution loading in each sub-watershed. Pollution loadings were calculated using two models: the StepL Model and LSPC Model (see descriptions on the following page.). The StepL and LSPC Model are useful tools that can be utilized to provide a general calculation of pollutant loading by sub-watershed. These calculations are not precise numeric targets, but rather provide general estimates to be used as a guide in watershed management.

The StepL Model calculates pollution loading estimates based on the runoff volume and pollutant concentrations in runoff water as influenced by land use and management practices. These estimates were used to develop the problem statements, goals and objectives for each sub-watershed. The LSPC Model estimates were performed for the Collaborative's 2007 water-

Target Area	Causes of Impairment	Sources of Impairment
Stonelick Creek*	Habitat Alterations, Organic Enrichment, Other Unknown Cause(s)	Dam Construction, Agriculture, Unknown Source(s)
Lick Fork*	Organic enrichment, Pathogens	Onsite septic systems
Locust Creek	Not Assessed	Agriculture, onsite septic systems
Brushy Fork	Unknown	Agriculture, onsite septic systems
Rocky Run	Unknown	Agriculture, onsite septic systems
Patterson Run	Unknown	Agriculture, crop production, livestock pasture/feedlots, stream bank modification, onsite septic systems
Moores Fork	Unknown	Agriculture, crop production, livestock pasture feedlots, onsite septic systems
Greenbush Creek	Unknown	Agriculture, crop production, livestock pasture/feedlots, onsite septic systems.
Hunter Creek	Unknown	Agriculture, crop production, livestock pasture/feedlots, streambank modification, onsite septic systems

Table 25. Target Area Summary for the Stonelick Creek Watershed. [Source: Ohio Water Resource Inventory. Ohio EPA, 2000]

* It is important to note that Stonelick Creek and Lick Fork were the only streams assessed by Ohio EPA in 1998. The suspected causes and sources of impairment listed for the other tributaries are based on general data/information for the watershed.

shed management study. These estimates, along with other useful data and information were included in the watershed summaries and used primarily as supplemental information.

Pollution load reduction estimates were calculated using US EPA's Region 5 Model, which measures the amount of pollutants removed when best management practices are applied in the watershed.

The first table that follows presents a set of general recommendations for managing water quality and water quantity throughout the entire Stonelick Creek watershed. This extensive set of strategies and recommendations developed through the stakeholder process provides evidence of the complex nature of watershed management, and of the cumulative impact of varying human activities.

Pollution Loading and Reduction Estimates

STEPL Model

STEPL employs simple algorithms to calculate nutrient and sediment loads from different land uses. It computes watershed surface runoff, nutrient loads, and a 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. For each watershed, the annual nutrient loading is calculated based on the runoff volume and pollutant concentrations in the runoff water as influenced by land use distribution and management practices. The annual sediment load is calculated based on the Universal Soil Loss Equation and the sediment delivery ration.

Region 5 Model

An Excel workbook that provides a gross estimate of sediment and nutrient load reductions from the implementation of agricultural and urban BMPs. The algorithms for non-urban BMPs are based on the "Pollutants controlled: Calculation and documentation for Section 319 watersheds training manual" (Michigan Department of Environmental Quality, June 1999). The algorithms for urban BMPs are based on the data and calculations developed by Illinois EPA. Region 5 Model does not estimate pollutant load reductions for dissolved constituents.
Reference: http://it.tetratech-ffx.com/stepl/

LSPC Model

LSPC is the Loading Simulation Program in C++, a watershed modeling system that includes streamlined Hydrologic Simulation Program Fortran (HSPF) algorithms for simulating hydrology, sediment, and general water quality on land as well as a simplified stream transport models. LSPC has been widely used for assisting with TMDL calculation and source allocations. LSPC was designed to handle very large-scale watershed modeling applications. The model has been successfully used to model watershed systems composed of over 1,000 subwatersheds.

Reference: http://www.epa.gov/athens/wwqtsc/index.html

As shown in the following action tables for Stonelick Creek and the sub-watersheds, some of the management strategies are relatively inexpensive and easier to accomplish, while others are more expensive and complex. The Collaborative and its partners will continue to search for potential funding sources for these projects, and investigate alternative management strategies if funds are not available.

Updates to this action plan will be made as new funding sources and management strategies are identified.

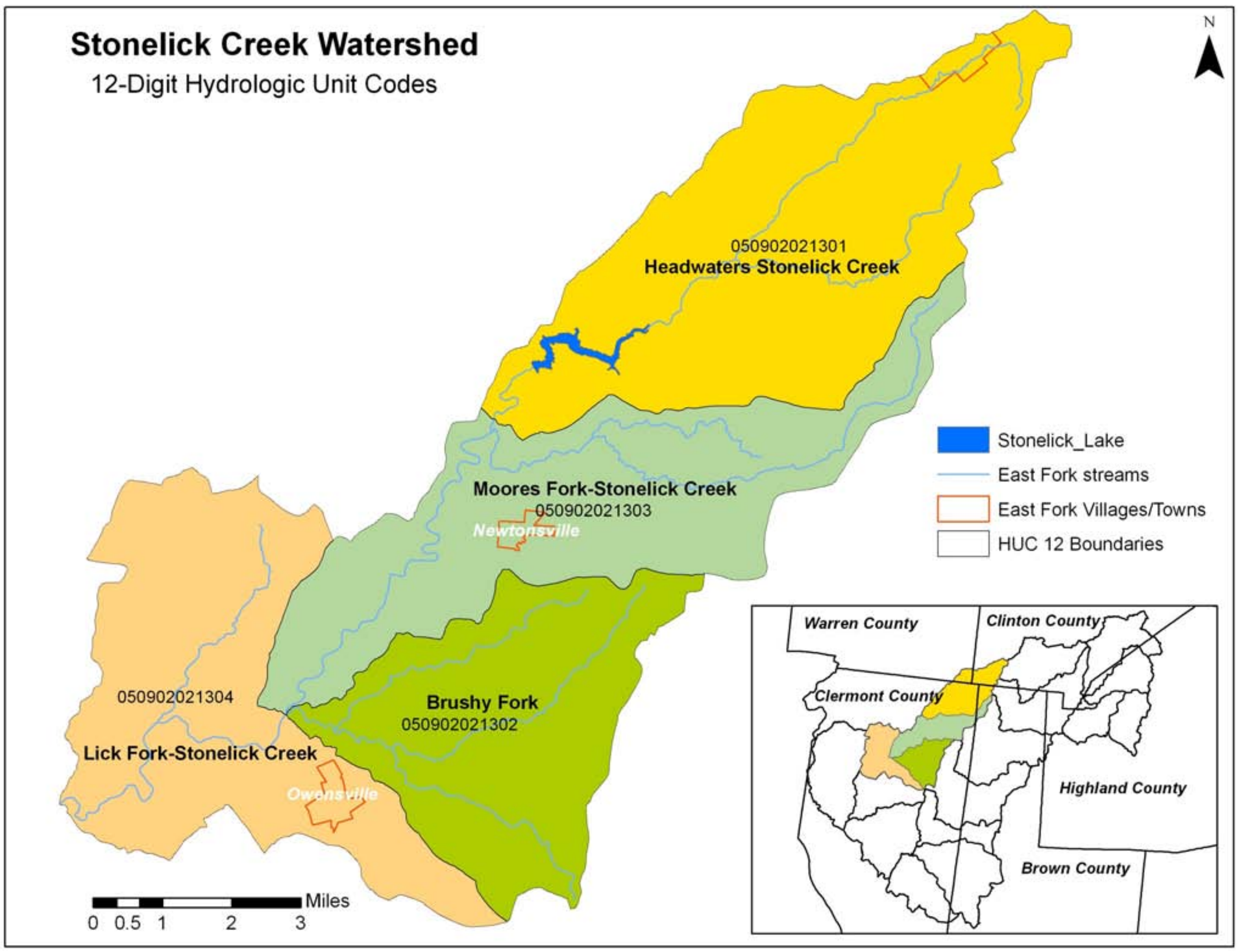


Figure 42. 12-digit Hydrologic Unit Codes (HUC-12s) of Stonelick Creek.

[Note: HUC-12s are a set of numerical identifiers used by government agencies to identify and communicate information about individual streams and watersheds.

Stonelick Creek Watershed
Subwatershed Planning Unit Drainage Area: 77 mi^2
Aquatic Life Use Designation: WWH

Background

The Stonelick Creek sub-watershed planning unit covers 77 mi^2 (49,275 acres) in Clermont, Brown, Clinton, and Warren Counties. Ohio EPA's assessment of specific stream segments in the Stonelick Creek watershed can be found in the agency's 2000 Ohio Water Resources Inventory 305 (b) report. Stonelick Creek, a major tributary of the East Fork Little Miami River, flows southwest 22 miles from its origin in Clinton County to its confluence with the East Fork mainstem in Clermont County. There are four main tributary systems that flow into Stonelick Creek: Locust Creek, Moore's Fork, Brushy Fork, and Lick Fork. All the tributaries, with the exception of Locust Creek, are designated as Warm Water Habitat (WWH) streams. Locust Creek currently has no aquatic life use designation.

Ohio EPA's 2008 Integrated Water Quality Report on the Stonelick Creek watershed listed the following as high magnitude causes of impairment: nutrients, siltation, organic enrichment, flow alteration, direct habitat alterations, and other unknown causes. The high magnitude sources of impairment include: non-irrigated crop production, home septic systems, dredging (development), dam construction, streambank modification/destabilization (development), and other unknown sources[1].

One of the most significant findings of the EFWC's 2007 watershed study revealed that the biological criteria in currently impaired streams is more dependent on addressing habitat factors than reducing pollutant loadings. In-stream habitat features, such as vegetative cover and the depth of pools in the stream (as measured by the QHEI—Qualitative Habitat Evaluation Index), were the main factors influencing biological health (diversity and abundance of fish and bugs). Flashiness (or the frequency and rapidity of short term changes in streamflow) was also found to be strongly correlated to fish scores and therefore the control of stormwater runoff should be a high priority. Another interesting finding of the biostatistical analysis showed a weak relationship between biological impairment and nutrient concentrations in the watershed, even though nutrients have long been considered one of the primary reasons for non-attainment.

Agriculture is the dominant land use in the Stonelick Creek watershed. Row crop agriculture and livestock operations can contribute significant amounts of nutrients, sediment, and pathogens to the streams. In addition to delivering pollutants, agriculture operations can significantly alter the soil profile. Soil compaction from animals and farm equipment reduces infiltration and increases surface runoff. Lack of vegetative cover decreases surface roughness, exposes soil particles to erosive forces, and allows for faster transport of water and pollutants to the stream system. Some farmers use tile drainage systems to lower the water table, which increases the fraction of subsurface flow but delivers higher concentrations of dissolved pollutants such as nitrate.

Several of the sub-watersheds in the Stonelick Creek watershed are expected to undergo land use changes over the next 20 years. The primary transitions will likely be from agricultural to urban/residential land uses. Relative to row crop agriculture, urban land uses typically have more vegeta-

1. Unless otherwise noted, all assessments referenced in this chapter were conducted by Ohio EPA scientists.

tive cover on pervious surfaces (e.g. lawns, parks, etc.), so the transition from agriculture to urban land use sometimes results in a decrease in sediment loading post-development. During the construction phase, however, sediment loading can far exceed that of row crop agriculture. Also, the increase in the amount of impervious surfaces (roads, parking lots, buildings, etc…) significantly alters site hydrology, which can impact stream morphology, leading to unstable streams, bank and channel erosion, siltation, and habitat modifications. Urbanization also tends to lead to a loss of riparian corridor vegetation, which can increase stream temperatures, reduce filtering capacity, and destabilize streambank soils.

Watershed management and the protection of water quality require a combination of strategies, generally grouped as regulatory and non-regulatory options. Regulatory options are those that involve government action and include approaches such as zoning, subdivision, and construction regulations. Nonregulatory options may involve government actions, but not in the form of a development regulation. For example, local governments or other organizations may acquire land, conduct monitoring, and encourage better site design using low impact development or conservation design principles, and educate homeowners about good watershed stewardship and best housekeeping practices. The management strategies to address impairments in the Stonelick Creek watershed include a combination of regulatory and non-regulatory options.

Problem Statement

Nutrients, siltation, organic enrichment, flow alteration, direct habitat alterations, and other unknown causes are impairing the Stonelick Creek watershed. Municipal point sources, combined sewer overflows, sanitary sewer overflows, nonirrigated crop production, sewer line construction, non-point urban runoff, development, dam construction, and other unknown sources are the sources of impairment. Of the streams in the watershed, only two out of the five primary tributary systems have been assessed to determine their use attainment.

Goal

The goal for the Stonelick Creek sub-watershed is to reach full attainment of the aquatic life use designation for Stonelick Creek and tributary systems by reducing the impacts of nutrients, siltation, organic enrichment, flow alteration, direct habitat alterations, and other unknown causes.

Objectives

Monitoring and Assessment

1. Determine the use attainment status of all non-assessed streams in Stonelick Creek
2. Determine habitat quality of the Stonelick Creek and tributaries
3. Complete a morphological and stream stability assessment for Stonelick Creek and tributaries
4. Identify and map priority target areas in Stonelick Creek
5. Inventory and evaluate Best Management Practices in Stonelick Creek
6. Organize, manage and communicate data efficiently and professionally
7. Establish and follow data quality protocols

Manage Water Quality and Water Quantity

1. Improve water quality and manage storm water runoff
2. Restore natural flow regime to the river where feasible
3. Restore or maintain natural character of the landscape
4. Increase public awareness and promote watershed stewardship

The table that follows presents a set of general recommendations for managing water quality and water quantity throughout the entire Stonelick Creek watershed. This extensive set of strategies and recommendations developed through the stakeholder process provides evidence of the complex nature of watershed management, and of the cumulative impact of varying human activities.

MONITORING AND ASSESSMENT				
OBJECTIVE	**ACTION**	**RESOURCES**	**TIME FRAME**	**PERFORMANCE INDICATORS**
Determine use attainment status of all non-assessed streams in the MEF	Conduct Aquatic Life Use assessment of listed streams using OEPA protocols and Level 3 certified data collectors	OEPA staff, SWCDs, Clermont OEQ, partners; Seek funding	2013-2018	Use attainment status determined and reported in technical support document
Determine and monitor habitat quality of MEF mainstem and tributaries	Conduct Qualitative Habitat Evaluation Index (QHEI) assessments of each stream	OEPA staff, or qualified data collector using existing resources	2013-2018	QHEIs completed; reports included in technical support document
Complete a morphological and stream stability assessment for the mainstem and tributaries	Conduct physical and morphological assessment of each stream using Rosgen Level III assessment or equivalent	Watershed coordinator, with qualified evaluator/ consultant; Ohio EPA 319, WRRSP, or other similar grant	2013-2015	Physical and morphological assessment completed and reported in technical support document
Identify and map priority target areas	Use remote sensing, aerial imagery and field measurements to identify changes in land use, floodplain, instream/ corridor impairments; Identify potential point and non-point pollution sources	Watershed coordinator, SWCDs, Clermont County staff, OSU Extension, other local partners; FEMA or USACE grant for major streams, other similar grants;	2013	Map of priority target areas
	Create GIS layer of failing or improper HSTS's, and other illicit discharges	Watershed Coordinator, SWCDs, Clermont Health Dept., local partners; existing resources	2013	Identify and correct failing or improper HSTS's, and other illicit discharges

MONITORING AND ASSESSMENT				
OBJECTIVE	**ACTION**	**RESOURCES**	**TIME FRAME**	**PERFORMANCE INDICATORS**
Identify and map priority target areas (continued)	Develop citizen monitoring program— enlist and involve local volunteers	Watershed Coordinator, local programs and organizations (schools, environmental group etc…); seek grants/ funding	2013-2018	Establish effective citizen monitoring program in East Fork
	Establish 1-2 monitoring stations in Stonelick Creek to collect water quality, flow, and rainfall data at the confluence of major tributaries; Measure water quality using OEPA's primary recreational contact criteria	Watershed Coordinator, Clermont OEQ & Storm Water, SWCDs, volunteer monitors; Seek grants to fund monitoring stations and data analyses	2013-2018	Monitoring stations, flow analyses for all tributaries, recreational use status determination
Inventory and evaluate Best Management Practices in the MEF	Inventory practices in use in Stonelick Creek	Watershed Coordinator, SWCDs, Clermont Storm Water, NRCS, FSA and partners	2013-2016	Completed inventory of BMPs in Stonelick Creek
	Conduct windshield survey during storm events Conduct end-of-field or end of pipe water quality sampling Create and distributed BMP effectiveness survey to land owners Conduct literature/ research review BMP effectiveness	Watershed Coordinator, volunteer monitors, interns and partners; Existing resources or seek grants/ funding	2013-2016	BMP effectiveness database

MONITORING AND ASSESSMENT (continued)				
OBJECTIVE	**ACTION**	**RESOURCES**	**TIME FRAME**	**PERFORMANCE INDICATORS**
Organize, manage and communicate data efficiently and professionally	Form permanent sub-committee of the East Fork Watershed Collaborative to monitor and assess watershed management Develop clear monitoring and assessment goals for the watershed	Watershed Coordinator, partners; Existing resources or watershed grants	2010	EFLMR M&A Team established Goals developed and documented
	Create data clearinghouse for storing/ analyzing data; Develop good supporting data (land use, livestock, BMPs, septic systems) Geolocate all data (make GPS, digital cameras available to volunteer monitors)	Watershed Coordinator, M&A Team, volunteers, SWCDs, Clermont OEQ & Storm Water, partners; Existing resources and seek grants	2013-2018	Updated/accurate data and maps; user-friendly water quality database
	Create watershed reports and make available to interested parties Develop recommendations based on data analyses for watershed management	EFLMR M&A Team	Ongoing	Catalog of water quality reports available for technical and lay audiences; Recommendations for future implementation
Establish and follow data quality protocols	Implement standard data checks/audits via unbiased sources to validate data and findings	EFLMR M&A Team	Ongoing	Complete data audit plan for M&A Team

MANAGE WATER QUALITY AND QUANTITY				
OBJECTIVE	**ACTION**	**RESOURCES**	**TIME FRAME**	**PERFORMANCE INDICATORS**
Improve water quality and manage storm water runoff	Maintain or enhance riparian corridors and stream buffers	Landowners with assistance from watershed coordinator and all partners; NRCS programs, land trusts, Clean Ohio Funds, WRRSP, other similar grants	Ongoing	Miles/percentages and widths of riparian corridors protected within watershed Pollutant load reductions
	Improve soil quality and infiltration through agriculture BMPs (No-till farming, cover crops, etc..) Increase number of farms using nutrient management and conservation plans	Landowners with assistance from watershed coordinators and all partners, education and promotion; NRCS and FSA programs; agricultural consultants seek grants	Ongoing	Contact list of landowners implementing BMP practices Number of acres under management plans
	Manage urban/suburban stormwater runoff by implementing green infrastructure (porous pavement, bioretention, etc…) Implement balanced growth, land use planning	SWCDs, Clermont Storm Water, Watershed Coordinator, Clermont OEQ, partners, volunteers; Clermont SWCD Rain Garden Program, Phase II program, seek grants/local funding	2013-2018	Impervious surfaces <10% in watershed, improved water quality, # of urban/suburban BMPs implemented Low Impact Development workshop and list of participating developers/planners LID demonstration project
	Inventory, repair/replace failing HSTSs Build upon existing homeowner education program	Homeowners, Clermont County Health District, Watershed Coordinator, partners; Existing resources, seek low-interest/cost-share funds, similar grants	2013-2018	Repair/replace 20% failing septic systems Educational materials for homeowners, developers, realtors

MANAGE WATER QUALITY AND QUANTITY (continued)				
OBJECTIVE	**ACTION**	**RESOURCES**	**TIME FRAME**	**PERFORMANCE INDICATORS**
Improve water quality and manage storm water runoff (continued)	Minimize water quality impairments from wastewater treatment plants, other dischargers with effective technologies and monitoring Effective regulation, registration and testing of septic haulers; proper application or disposal of septage	OEPA, local elected officials, Clermont County, Clermont Health District, partners; Low interest loans, cost-share for WWTP upgrades	Ongoing	Meet NPDES criteria No reports of illicit discharges or improper handling of septic waste
	Develop and implement sediment control plans at all quarries	Quarries with assistance from ODNR, Watershed Coordinator and partners; Existing resources	2013-2018	Water quality improvements; surface drainage or storm water basins
Restore natural flow regime to the river (where feasible)	Restore impaired stream banks, in-stream habitat	Watershed Coordinator, OEPA, local partners; OEPA 319, other similar grants	2013-2018	Restore natural flow, habitat—enhanced biocriteria/habitat scores (IBI, ICI, QHEI)
	Develop low-impact, volunteer log jam management program	Landowners, Watershed Coordinator, SWCDs, Clermont County Engineers, and partners; Seek grants	2013-2018	Tools and tracking system to identify and remove log jams without degrading habitat

MANAGE WATER QUALITY AND QUANTITY				
OBJECTIVE	**ACTION**	**RESOURCES**	**TIME FRAME**	**PERFORMANCE INDICATORS**
Maintain natural character of the landscape and rural livelihood	Promote land use planning, balanced growth and farmland preservation	Clermont County Planning Dept., local elected officials, zoning boards, land trusts Existing resources	Ongoing	Land use plans and zoning ordinances, regulations that consider water quality and quantity; acres of farmland preserved
Increase public awareness and promote watershed stewardship	Enlist Stonelick Creek residents in existing conservation programs and practices	Watershed Coordinator, SWCDs, Clermont Storm Water, Clermont Health Dept., NRCS, FSA, local partners; Existing resources, grants	Ongoing	Numbers of active citizens, land owners; acreage land conserved/preserved; miles stream/corridor protected
	Form permanent subcommittee of the East Fork Watershed Collaborative to monitor and assess watershed management	Develop clear monitoring and assessment goals for the watershed	2013	EFLMR M&A Team established Goals developed and documented
	Develop citizen monitoring program— enlist and involve local volunteers	Watershed Coordinator, local programs and organizations ; Seek grant	2013-2018	East Fork citizen monitoring program
	Coordinate volunteer clean-up events Educational canoe floats Coordinate other events to encourage watershed recreation	Watershed Coordinator, Adams/Clermont Solid Waste District, SWCDs, volunteers, partners; State litter clean-up grants, other grants	Ongoing	Miles of “Clean” streams; tons of garbage collected; Miles of “Adopted” waterway; # of participants; # of watershed events held

MANAGE WATER QUALITY AND QUANTITY (continued)				
OBJECTIVE	**ACTION**	**RESOURCES**	**TIME FRAME**	**PERFORMANCE INDICATORS**
Increase public awareness and promote watershed stewardship (continued)	Develop Watershed Awareness Survey to measure attitudes/ behaviors/interest in communities	Watershed Coordinator, SWCDs, Clermont Storm Water, local universities, partners; Existing resources (internship, thesis project), seek funding	2013	Survey complete
	Develop and distribute information on homesite drainage	SWCDs, Watershed Coordinator, realtor associations, homebuilder associations	Ongoing	Completed materials and distribution infrastructure
	Develop and distribute information on HSTS operation; Educate citizens about costs, accountability and responsibility for sewage treatment	County health districts, Watershed Coordinator	Ongoing	Completed materials and distribution; Fewer complaints about sewage treatment costs
	Media outreach and education: press releases, articles	Watershed Coordinator, EF M&A Team, Clermont SWCD, Clermont OEQ	Ongoing	Articles published, news stories
	Produce newsletters, field days Produce reports on watershed activities Produce outreach materials related to watershed protection (septic maintenance, fertilizer use, etc…)	Watershed Coordinator, SWCDs, OSU Extension, Farm Bureau and all EFWC partners	Ongoing	Newsletter reports, Minimum 2 field days/ workshops each year Outreach materials developed and distributed to target audiences

HUC-11: 05090202-13

Stonelick Creek
OEPA Waterbody ID #: OH 53 8
Drainage Area: 77.6 mi^2
Aquatic Use Designation: WWH

Background

Stonelick Creek is the largest tributary to the East Fork Little Miami River and is designated as a warmwater habitat stream. It is 22 miles in total length and has a drainage area of 77 square miles (49,274 acres). Land use in the watershed is dominated by agriculture, with 42% (20,862 acres) of cropland and 29% (14,368 acres) of pastureland. Forested lands account for 29% (14,272 acres) of the watershed. Land use changes due to population growth and development are expected within the next twenty years.

Stonelick State Park is located in the north central area of the watershed. The park covers 1,058 acres in the watershed including 200 acres of Stonelick Lake. The Stonelick State Park Campgrounds is one of two permitted dischargers in the watershed. The wastewater treatment works facility is located above Stonelick Lake; its effluent loadings are based on an average design flow of .030 million gallons per day (MGD). The Clermont Northeastern School District is the other permitted discharger located along Patterson Run (Brushy Fork sub-watershed). Clermont Northeastern's effluent loadings are based on an average design flow of .040 MGD. Neither Ohio EPA or Clermont County have detected any significant pollutant loadings from these facilities.

In Ohio EPA's 1998 assessment, 5.4 miles of Stonelick Creek were found to be in Full, but Threatened attainment of its aquatic life us designation, 9.10 miles were in Partial attainment, and 2.0 miles were in Non-attainment; the remaining 6.5 miles were not assessed. Attainment was restricted to the lower reaches of the stream. Areas of non-attainment occurred upstream from Stonelick Lake and in reaches midway between Stonelick Lake and the mouth. Land use in the upper watershed is primarily agricultural. Impairments seem to be caused by agriculture-related stresses and problems with failing home septic systems. The primary causes of impairment include nutrients, organic enrichment, flow alteration, and other unknown causes. Nonirrigated crop production, failing home septic systems, dam construction, and other unknown sources were listed as the sources of impairment.

According to the Rosgen Level I assessments (2001) there are approximately 44% of C-type streams found in the Stonelick Creek watershed. C-type streams are generally stable streams that retain connection to the floodplain. The riparian habitat along Stonelick Creek was assessed with aerial photographs from 2009. There is good to excellent riparian habitat in the lower and middle portions of the watershed. The riparian zone narrows as the stream meanders near farm fields, roadways and residential developments. In these areas the riparian buffer ranges from 0 to 35 feet in width. There is approximately 1,100 noncontiguous linear feet of streambank with minimal to no riparian protection. Aerial photographs also show a number of sand bars and islands in the middle and lower section of Stonelick Creek, which may indicate an imbalance in sediment transport.

The upper section of the watershed (above Stonelick Lake) has excellent forested riparian habitat.

However, there are several stretches of stream (near farm fields and residential areas) that lack adequate riparian habitat. There is approximately 2,300 linear feet of stream with little to no riparian protection. Similar to the middle and lower reaches of Stonelick Creek, the upper section retains connection to the floodplain and has a high degree of sinuosity. There are also a number of sand bars and islands in the channel, a possible indication of excess sediments moving through the tributary systems.

Stonelick Creek was included in the Collaborative's 2007 watershed study. The Stressor Identification Model identified nutrients (phosphorus, nitrate) and upstream habitat as the primary causes of aquatic life impairment. The LSPC modeling analysis showed that the primary sources of nutrients are runoff from row crops and pasture/hay grasslands, while the primary sources of sediment are row crops and unquantified streambank erosion. Additional information from local experts (also included in the report), indicated that there is poor habitat in the reach from the Stonelick dam (~ river mile 14) downstream to State Route 131. There is more bank erosion in the downstream reaches of Stonelick Creek. The upstream stretches of Stonelick Creek are more impacted by failing home septic systems and sporadic new construction.

There are approximately 1,332 discharging home septic systems in the Stonelick Creek watershed[2]. Data provided by the Clermont and Clinton County Health Districts indicate that an estimated 10% of the home septic systems are failing and contributing nutrients and pathogens to Stonelick Creek and its tributaries.

Sites of streambank erosion were identified by comparing high resolution aerial photographs from 2004 and 2009. There is one downstream segment of Stonelick Creek that is undergoing significant streambank and channel erosion. This site is located in the Lick Fork sub-watershed, near the confluence of Stonelick Creek and the East Fork mainstem south of U.S. Route 50 (Figures 5-2 and 5-3). There is approximately 1.5 miles or more of stream-bank and channel erosion occurring along Stonelick Creek with average depth ranging between 5-12 feet. The stream is migrating towards Stonelick-Olive Branch Road, threatening the stability of the road and mobile homes adjacent to the stream. Erosion has worsened over the last few years and the stream has become severely entrenched. In 2008, the County Engineers attempted to protect the road by stabilizing the streambanks with rip rap and root wads. This site is marked as a high priority for restoration and protection.

Gully formations were also identified using aerial images (2004, 2009). Sites that showed identifiable gully formations along Stonelick Creek were recorded and included in the watershed land use inventory to be included in the StepL pollution loading calculations. These calculations are based on land use data (including estimates of streambank erosion), estimates of failing home septic systems, and the number of livestock operations in the sub-watershed. According to the StepL model there is approximately 290 tons of nitrogen, 57 tons of phosphorus, and 21,293 tons of sediment delivered to Stonelick Creek each year.

The StepL model estimates that cropland is the leading source of nutrients and sediments, contributing 185 tons of nitrogen, 45 tons of phosphorus, and 18,333 tons of sediment each year. Pas-

2. It is important to note that the number of discharging septic systems reported here is an underestimation of the actual number of discharging systems in the Stonelick Creek watershed.

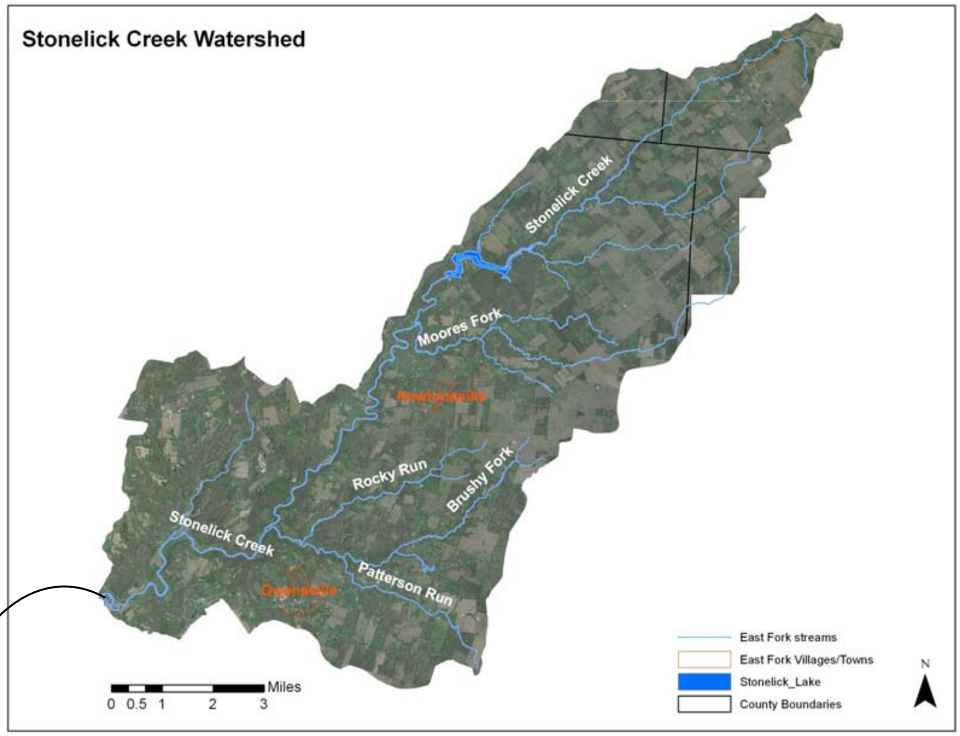


Figure 43. Aerial of the Stonelick Creek Watershed

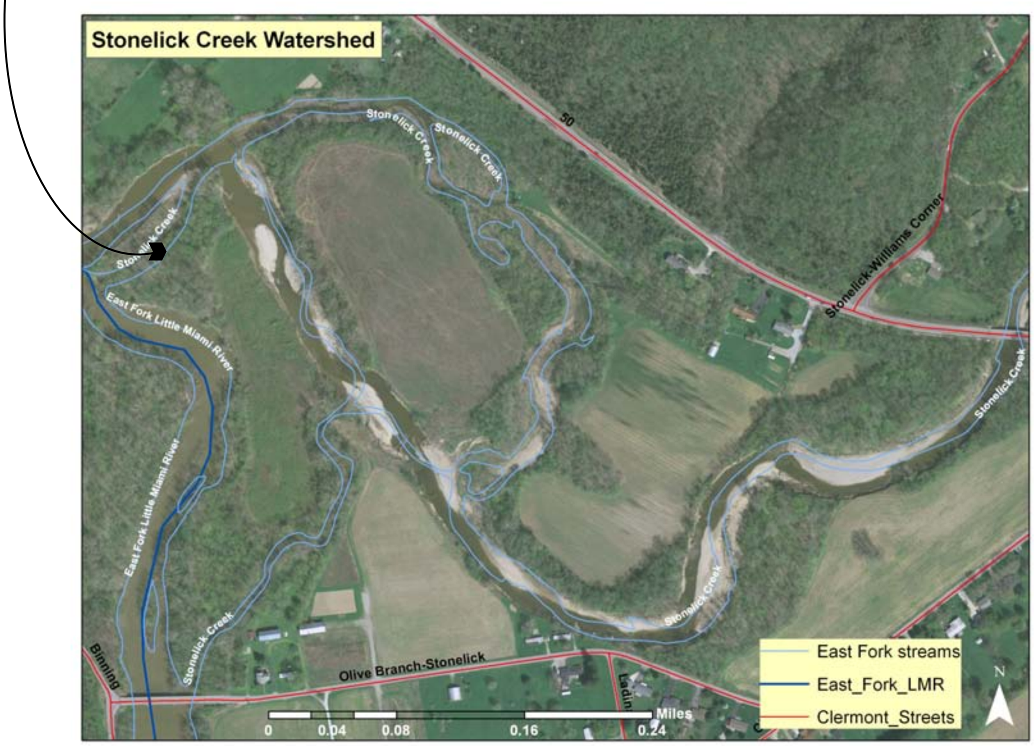


Figure 44. Stonelick Creek/East Fork Confluence (High Priority Restoration Site)

tureland is contributing an estimated 93 tons of nitrogen, 8 tons of phosphorus, and 2,516 tons of sediment, while urban land uses are contributing 5.4 tons of nitrogen, 1 ton of phosphorus, and 251 tons of sediment each year. In addition, home septic systems are contributing 2 tons of nitrogen, 1 ton of phosphorus and an unquantified amount of pathogens annually.

Problem Statement #1

Nonpoint source runoff from row crops and pastureland (and streambank erosion) are contributing 278 tons of nitrogen, 53 tons of phosphorus, and 20,849 tons of sediment to Stonelick Creek each year.

Goal

To reduce nitrogen, phosphorus, and sediment loadings from agricultural runoff by 50%.

Objectives

1. Reduce nitrogen loadings by 139 tons per year.
2. Reduce phosphorus loadings by 27 tons per year.
3. Reduce sediment loadings by 10,425 tons per year.

Stonelick Creek Problem Statement #1				
Objective	**Action**	**Resource Costs**	**Time Frame**	**Performance Indicators**
Reduce nitrogen load-ing by 139 tons/yr; phosphorus loading by 27 tons/yr; sediment loadings by 10,425 tons/yr	Establish permanent conservation easement program and protect 5 miles (50' width) of riparian corridor	Landowners, Watershed Coordinator, SWCDs, Clermont Park District, Clermont OEQ, NRCS, FSA; WRRSP, CRP, CREP, related programs, Estimate $2-8,000 per acre easement/ purchase	2013-2018	Reduce nitrogen loadings by 270 lbs/yr; Reduce phospho-rus loadings by 120 lbs/yr; Reduce sediment loadings by 90 tons/yr
	Restore 3,400 linear feet riparian cor-ridor (50' width) with conservation easements or land purchases	Landowners, Watershed Coordinator, SWCDs, Clermont Park District, Clermont OEQ, NRCS, FSA; WRRSP, CRP, CREP, related programs Estimate $2,000-8,000 per acre ease-ment/ purchase Riparian restoration $110-$150 per acre to construct; $10-15 acre to maintain	2013-2018	Reduce nitrogen by 36 lbs/yr Reduce phospho-rus by 16 lbs/yr Reduce sediment by 12 tons/yr
	Restore and protect 10,000 linear feet of stream-bank/ channel erosion along Stonelick Creek (near confluence with EFLMR)	Landowners, Watershed Coordina-tor, SWCDs, local partners; Natural Channel Design: $200-$500/ linear foot; Conservation Easements: $2,000-8,000 per acre Riparian restoration $110-$150 per acre to construct; $10-15 acre to maintain WRRSP, similar funding sources	2013-2018	Reduce nitrogen loadings by 2 tons/ yr; Reduce phospho-rus loadings by 1 ton/yr; Reduce sediment loadings by 1,700 tons/yr

Stonelick Creek Problem Statement #1				
Objective	**Action**	**Resource Costs**	**Time Frame**	**Performance Indicators**
Reduce nitrogen loading by 139 tons/yr; phosphorus loading by 27 tons/yr; sediment loadings by 10,425 tons/ yr	Establish permanent conservation easement program and protect 5 miles (50' width) of riparian corridor	Landowners, Watershed Coordina-tor, SWCDs, Clermont Park District, Clermont OEQ, NRCS, FSA; WRRSP, CRP, CREP related pro-grams, Estimate $2-8,000 per acre ease-ment/purchase	2013-2018	Reduce nitrogen loadings by 270 lbs/yr; Reduce phospho-rus loadings by 120 lbs/yr; Reduce sediment loadings by 90 tons/yr
	Restore 3,400 linear feet riparian cor-ridor (50' width) with conservation easements or land purchases	Landowners, Watershed Coordina-tor, SWCDs, Clermont Park District, Clermont OEQ, NRCS, FSA; WRRSP, CRP, CREP, related programs Estimate $2,000-8,000 per acre ease-ment/purchase Riparian restoration $110-$150 per acre to construct; $10-15 acre to maintain	2013-2018	Reduce nitrogen by 36 lbs/yr Reduce phospho -rus by 16 lbs/yr Reduce sediment by 12 tons/yr
	Restore and protect 10,000 linear feet of stream-bank/ channel erosion along Stonelick Creek (near confluence with EFLMR)	Landowners, Watershed Coordina-tor, SWCDs, local partners; Natural Channel Design: $200-$500/ linear foot; Conservation Easements: $2,000-8,000 per acre Riparian restoration $110-$150 per acre to construct; $10-15 acre to maintain WRRSP, similar funding sources	2013-2018	Reduce nitrogen loadings by 2 tons/ yr; Reduce phospho-rus loadings by 1 ton/yr; Reduce sediment loadings by 1,700 tons/yr

Stonelick Creek Problem Statement #1				
Objective	**Action**	**Resource Costs**	**Time Frame**	**Performance Indicators**
Reduce nitrogen load-ing by 139 tons/yr; phosphorus loading by 27 tons/yr; sediment loadings by 10,425 tons/yr	Install addi-tional 20 acres grassed waterways throughout watershed	Watershed Coordinator, SWCDs, NRCS, FSA, local partners; CRP, CREP, related programs; Estimate: $5,000-$10,000/ac Seek additional funding	Ongoing	Document acres of grassed waterways; Calculate load reductions with Region 5 Model
	Implement prescribed grazing on 2,800 ac (20%) of pastureland	Landowners, Watershed Coordinator, SWCDs, NRCS, FSA, local partners EQIP, related programs; Estimate: $15/acre; Seek funding	Ongoing	Develop prescribed grazing plan for 2,800 acres Reduce nitrogen by 2 tons/yr; Reduce phosphorus by 1 ton/yr Reduce sediment by 827 tons/yr
	Target 5 livestock producers in watershed where livestock have stream access; Install live-stock fencing; waste storage facility	Watershed Coordinator, SWCDs, NRCS, FSA, local partners; EQIP, CRP, CREP, related programs; Estimate: Livestock fencing $2.00/lf installation, $.10-.20/ft maintenance (depending on material); Waste storage facilities: $1.50 ft3-$3.00 ft^3	Ongoing	Document linear feet of fence, number of waste storage facilities; Calculate load reductions with Region 5 Model

Problem Statement #2

Nonpoint urban runoff is contributing 5.4 tons of nitrogen, 1 ton of phosphorus and 251 tons of sediment to Stonelick Creek each year.

Goal

To reduce pollutant loadings from urban runoff by 50% and minimize future land use impacts.

Objectives

1. Reduce nitrogen loading from urban runoff by 3 tons per year.
2. Reduce phosphorus loading from urban runoff by .5 tons per year.
3. Reduce sediment loading from urban runoff by 126 tons per year.

Stonelick Creek **Problem Statement #2**				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen loading by 3 tons/ yr; phos-phorus by .5 tons/ year; re -duce sediment by 126 tons/yr	Implement Balanced Growth land use planning strategies; Identify priority conservation areas, priority development areas;	Watershed Coordinator, SWCDs, Townships, local partners	Ongoing	Maintain impervious surface near 10%; Map priority conser-vation areas, priority development areas;

Stonelick Creek Problem Statement #1				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen loading by 3 tons/yr; phos -phorus by .5 tons/ year; reduce sediment by 126 tons/yr	Implement urban BMPs: Install 10 bioretention/rain gardens; 200 rain barrels; Install/retrofit demonstration green roof and permeable pavement Bioswale/ Vegetated filter strips demonstration project	Watershed Coordinator, SWCDs, Clermont Stormwater Dept., Townships, local partners U.S. EPA Urban BMP Performance Tool Clermont SWCD homeowner rain garden grants, Seek Funding Estimates: bioretention/rain gardens: $7-$30 per sq. ft.; rain barrels = $14-19 per sq. ft; green roof (extensive) = $9-16 per sq. ft., (intensive) = $17-33 per sq.ft.; permeable pavement = $3-7 per sq. ft.	2013-2018	Install 10 bioretention/ rain gardens; 200 rain barrels; Develop 1 green roof demonstration project Develop 1 permeable pavement demonstration project Develop 1 bioswale demonstration project Calculate stormwater runoff reduction, pollutant removal (Region 5 Model)
	Draft and adopt riparian setback ordinance Draft and adopt Low-Impact Development ordinance	Watershed Coordinator, SWCDs, Townships, local part-ners	2013-2018	Maintain impervious surface below 10%; Maintain and enhance riparian corridor protection; Develop 1 Low Im-pact Development demonstration project; Adopt at least 1 riparian setback ordinance Calculate stormwater runoff reduction, pollutant removal

Problem Statement #3

Failing home septic systems are contributing 2 tons of nitrogen, 1 ton of phosphorus and an unquantified amount of pathogens to Stonelick Creek each year.

Goal

To reduce the nutrient loading by 75%; Identify and mitigate sources of pathogen loading.

Objectives:

1. Reduce nitrogen loading from failing HSTSs by 1.5 tons/year and phosphorus by .52 tons/year.
2. Maintain pathogen loading in range suitable for Primary Contact Recreation (PCR)).

Stonelick Creek Problem Statement #3				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen loading by 3 tons/ yr; phos-phorus by .5 tons/ year; re -duce sediment by 126 tons/yr	Implement Balanced Growth land use planning strategies; Identify priority conservation areas, priority development areas;	Watershed Coordinator, SWCDs, Townships, local part-ners	Ongoing	Maintain impervious surface near 10%; Map priority conservation areas, priority development areas;

Stonelick Creek Problem Statement #3				
Objective	**Action**	**Resource Costs**	**Time Frame**	**Performance Indicators**
Reduce nitrogen loading by 1.5 tons/yr; phosphorus by .52 tons/yr; Reduce pathogen loading	Conduct inventory/ inspections of HSTSs in Stonelick Creek; Develop an effective homeowner education program	Health Districts (Clermont, Clinton, Brown, Warren Counties), Watershed Coordinator, partners; Seek grants/funding	Ongoing	Complete inventory HSTSs in Stonelick Creek; Record # of individuals reached through education and outreach
Maintain pathogen loading in range suitable for PCR	Monitor Stonelick Creek and tributaries to assess impacts from HSTSs, point source dischargers and other sources	Clermont OEQ, SWCDs, Watershed Coordinator; Existing resources; seek additional funding	Ongoing	E. coli standards within range suitable for PCR (below 161 colony forming units (cfu) per 100 ml for seasonal geometric mean or below 523 for single sample).
	Implement effective WWTP technologies and monitoring to reduce pollutant loading	OEPA, WWTPs, partners; Low interest loans, cost-share for WWTP upgrades	Ongoing	Meet NPDES permit limits; Reduce pathogen loading

Problem Statement #4

Streambank modification caused by development is contributing an un-quantified amount of sediment and pollutants to Moore's Fork each year.
Goal

To reduce sediment and pollutant loading.

Objectives:

1. Control storm water runoff from new construction sites
2. Control storm water runoff from existing developments

Stonelick Creek Problem Statement #4				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Control storm water runoff from new construction sites	Implement effective sediment and erosion control measures	Clermont Planning Dept., SWCDs, Clermont Storm Water Dept., partners Construction Best Management Guide for Clermont County	Ongoing	Document the number of BMPs and effectiveness
	Implement post-construction BMPs:	Clermont Planning Dept., SWCDs, Clermont Storm Water Dept., partners; Sanitation District No. 1 of Northern Kentucky and Louisville Metropolitan Sewer District regional BMP manuals	Ongoing	New Zoning ordi nances, structural BMPs; Calculate load re-ductions with Region 5 Model

HUC-12: 050902021301
Locust Creek Sub-watershed OEPA Waterbody ID #: OH 53-8.1, OH 53-15
Drainage Area: 24 mi^2
Aquatic Use Designation: No Designation

Background

The Locust Creek sub-watershed is approximately 15 square miles (15, 402 acres) in total area. There are two main tributaries in the sub-watershed that drain directly to Stonelick Creek: Hunter Creek and Locust Creek (Figure 5-4). Hunter Creek is 4.7 miles in total length, has a drainage area of 4 square miles, and is designated as warmwater habitat. Locust Creek is 4.3 miles in total length, has a drainage area of 3.3 square miles, and has not yet been assigned an aquatic life use designation. Neither tributary has been assessed by Ohio EPA.

Because there is limited data on the Locust Creek sub-watershed, future monitoring in this sub-watershed will be a priority. Ohio EPA has determined that areas of non-attainment along Stonelick Creek occurred in the Locust Creek sub-watershed. Locust Creek and Hunter Creek may be contributing to the impairment in the upstream reaches of Stonelick Creek.

Land use in the Locust Creek sub-watershed is dominated by agriculture and forested land. Cropland accounts for 46% (7,126 acres) of the land use, pastureland accounts for 32% (4,971 acres), and forestland accounts for 18% (2,879 acres). There is also approximately .02% (191 acres) of urban land. There is one horse farm identified in the sub-watershed that houses five horses.

Locust Creek has fair to good riparian habitat throughout its stretch. The riparian zone narrows through agriculture fields and residential areas, particularly in the upper reaches of the stream. There is approximately 3,500 noncontiguous linear feet of stream with minimal to no riparian habitat. The longest stretch of stream that lacks riparian protection is located near Jordan Road. Hunter Creek has fair to good riparian habitat throughout is stretch, however there are several stretches that have minimal to no riparian protection. These stretches of stream are found primarily near agricultural areas. There is approximately 10,500 contiguous linear feet that lacks adequate riparian protection against the surround agricultural land use.

Locust Creek was included in the 2001 Rosgen Level I assessments of Clermont County streams (Figure 5-5). The Locust Creek sub-watershed is characterized by C-type streams, which are generally stable, slightly entrenched, sinuous channels connected to floodplains. Although C-type streams are considered stable, they can be destabilized by flow and land use changes and are therefore susceptible to the effects of upstream development. The sub-watershed also has many F-type streams, which are defined by entrenched channels with high bank erosion rates, and a low gradients with a riffle-pool or run-pool morphology. These stream are unstable and found primarily in the southern portion of the Locust Creek sub-watershed.

There are approximately 135 discharging home septic systems in the Locust Creek sub-watershed. Of those discharging systems, approximately 10% (14 HSTS) are failing and contributing nutrients and pathogens to the tributaries.

The StepL model was used to calculate pollution loading estimates for the entire sub-watershed based on land use data, estimates of failing home septic systems and the number of livestock operations in the sub-watershed. According to these estimations, the Locust Creek sub-watershed is receiving 116 tons of nitrogen, 23 tons of phosphorus, and 7,464 tons of sediment each year. The causes and sources of pollutant loadings have not yet been determined. However, the StepL calculations indicate that the majority of pollution loading in the sub-watershed is caused by runoff from cropland, pastureland, urban land, and failing home septic systems. Recommendations for Locust Creek focus on those primary sources of pollution

The StepL model estimates that cropland is the leading source of nutrients and sediments, contributing 82 tons of nitrogen, 20 tons of phosphorus, and 6,548 tons of sediment each year. Pastureland is contributing an estimated 32 tons of nitrogen, 2.8 tons of phosphorus, and 834 tons of sediment, while urban land uses are contributing 1 ton of nitrogen, .15 tons of phosphorus, and 45 tons of sediment each year. In addition, home septic systems are contributing .2 tons (419 lbs) of nitrogen and .08 tons (164 lbs) of phosphorus annually.

Problem Statement #1

Nonpoint runoff from row crops and pastureland (and streambank erosion) are contributing 114 tons of nitrogen, 22.8 tons of phosphorus, and 7,418 tons of sediment to Locust Creek each year.

Goal:

To reduce nutrient and sediment loading from agriculture by 50%.

Objectives

1. Reduce nitrogen loadings by 57 tons per year.
2. Reduce phosphorus loadings by 11 tons per year.
3. Reduce sediment loadings by 3,709 tons per year.
4. Determine the aquatic life use designation of Locust Creek.

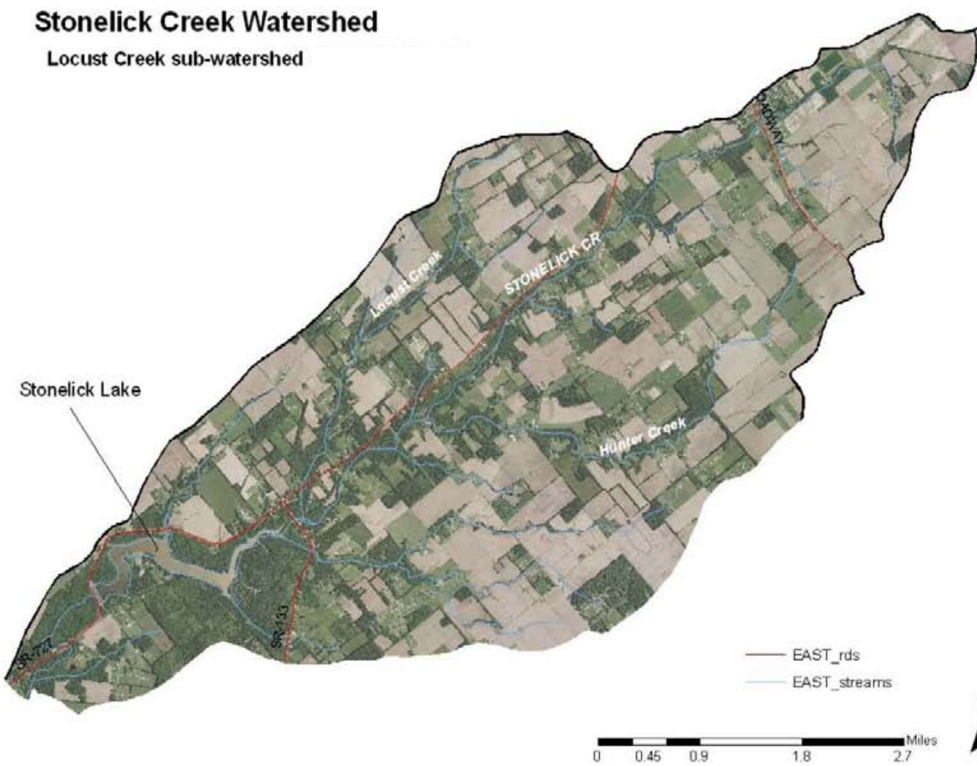


Figure 45. Rosgen Level I Assessments for Locust Creek sub-watershed

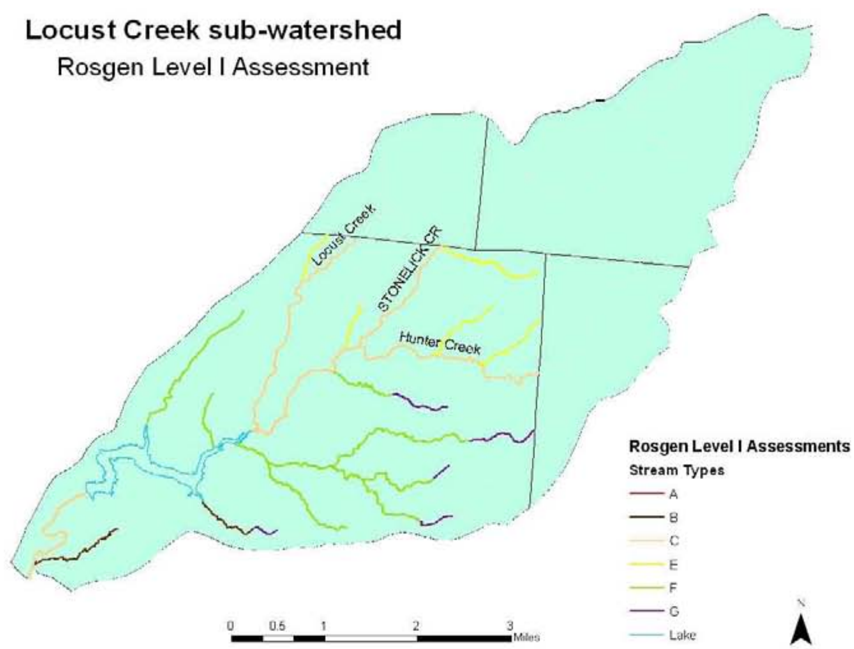


Figure 46. Rosgen Level I Assessments for Locust Creek sub-watershed

Locust Creek sub-watershed Problem Statement #1				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen by 57tons/yr; phosphorus by 11 tons/ yr; sediment by 3,709 tons/ yr	Restore 14,000 linear feet riparian corridor (50’ width) with conservation easements or land purchases;	Landowners, Watershed Coordinator, SWCDs, Clermont Park District, Clermont OEQ, NRCS, FSA; CRP, CREP, WRRSP, related programs Estimate $2,000-8,000 per acre easement/purchase Riparian restoration $110-$150 per acre to construct; $10-15 acre to maintain	2013-2018	Reduce nitrogen by 144 lbs/yr; Reduce phosphorus by 64 lbs/yr; Reduce sediment by 48 tons/yr
	Establish permanent conservation easement program and protect 2 miles (50 ft width) of riparian cor-ridor	Landowners, Watershed Coordinator, SWCDs, Cler-mont Park District, Clermont OEQ, NRCS, FSA; WRRSP, CRP, CREP, related programs Estimate $2,000-8,000 per acre easement/purchase	2013-2018	Reduce nitrogen by 108 lbs/yr; Reduce phosphorus by 48 lbs/ yr; Reduce sediment by 36 tons/yr
	Implement cover crops, conservation tillage on 700 acres (10%) of cropland	Watershed Coordinator, SWCDs, NRCS, FSA, local partners; EQIP, related programs; Cover Crops $30/acre Conservation Tillage $15/ac Seek funding sources	Ongoing	Reduce nitrogen by 1.4 tons/yr; Reduce phosphorus by .7 tons/yr; Reduce sediment by 1,400 tons/yr

Locust Creek sub-watershed Problem Statement #1				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen by 57tons/ yr; phosphorus by 11 tons/ yr; sediment by 3,709 tons/ yr	Install filter strips, riparian buffer strips on 400 acres of cropland	Watershed Coordinator, SWCDs, NRCS, FSA, local partners; CRP, CREP, related programs; Estimate: $155/acre	Ongoing	Reduce nitrogen by 2 tons/yr; Reduce phosphorus by 1 ton/yr; Reduce sediment by 1,200 tons/yr
	Implement prescribed grazing on 500 ac (10%) of pastureland	Landowners, Watershed Coordinator, SWCDs, NRCS, FSA, local partners EQIP, related programs Estimate: $15/acre Seek funding	Ongoing	Reduce nitrogen loading by 435 lbs/ yr; Reduce phosphorus loading by 218 lbs/yr; Reduce sediment by 135 tons/yr
	Install 1 acre grassed waterways (35'buffer) along identi-fied gully formations along Locust Creek	Watershed Coordinator, SWCDs, NRCS, FSA, local partners; CRP, CREP, related programs; Estimate: $5,000-$10,000/ac (including costs for construction, tiling, and rock checks) Seek funding	Ongoing	Reduce nitrogen by 127 lbs/yr; Reduce phosphorus by 62 lbs/yr; Reduce sediment by 62 tons/yr

Locust Creek sub-watershed Problem Statement #1				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen by 57tons/ yr; phospho-rus by 11 tons/yr; sedi-ment by 3,709 tons/yr	Install additional 2 acres grassed wa-terways (35' buffer)	Watershed Coordi-nator, SWCDs, NRCS, FSA, local partners; CRP, CREP, related programs; Esti-mate: $5,000-$10,000/ac Seek additional funding	Ongoing	Document acres of grassed water-ways; Calculate load reductions with Region 5 Model
Determine the aquatic life use designation for Locust Creek	Perform aquatic life assessments (IBI, ICI, QHEI)	Ohio EPA, Cler-mont OEQ, Water-shed Coordina-tor	Ongoing	Aquatic Life Use Designation Lo-cust Creek

Problem Statement #2

Nonpoint urban runoff is contributing 1 ton of nitrogen, .15 tons of phosphorus, and 45 tons of sedi-ment to Locust Creek each year.

Goal

To reduce pollutant loadings from urban runoff by 75% and minimize future land use impacts.

Objectives

1. Reduce nitrogen loading from urban runoff by .75 tons per year.
2. Reduce phosphorus loading from urban runoff by .4 tons per year.
3. Reduce sediment loading from urban runoff by 33 tons per year.

Locust Creek sub-watershed Problem Statement #2				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen loading by .75 tons/yr; phosphorus loadings by .4 tons/ yr; sediment loadings by 33 tons/yr	Implement Balanced Growth land use planning strategies; Identify priority conservation areas, priority development areas;	Watershed Coordinator, SWCDs, Townships, local partners	Ongoing	Maintain impervious surface near 10%; Map priority conservation areas, priority development areas
	Implement urban BMPs: Install 3 bioretention/ rain gardens; 50 rain barrels; Bioswale demonstration project	Watershed Coordinator, SWCDs, Clermont Stormwater Dept., Townships, local partners U.S. EPA Urban BMP Performance Tool; Clermont SWCD homeowner rain garden grants, Seek Funding Estimates: bioretention/rain gardens: $7-$30 per sq. ft.; rain barrels = $14-19 per sq. ft; bioswales: $1-3 per sq. ft	2010-2018	Calculate storm water runoff reduction, pollutant removal
	Draft and Implement riparian setback ordinance	Watershed Coordinator, SWCDs, Townships, local partners	2013-2018	Maintain and enhance riparian corridor protection; Adopt at least 1 riparian setback ordinance Calculate stormwater runoff reduction, pollutant removal

Problem Statement #3

Failing home septic systems are contributing .2 tons (419 lbs) of nitrogen and .08 tons (164 lbs) of phosphorus each year.

Goal

To reduce pollutant loadings from failing HSTSs by 100%.

Objectives:

1. Reduce nitrogen loading from failing HSTSs by .2 tons per year.
2. Reduce phosphorus loadings from failing HSTSs by .07 tons per year.
3. Maintain pathogen loading in range suitable for Primary Contact Recreation (PCR)

Locust Creek sub-watershed **Problem Statement #3**				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen by 57tons/ yr; phospho-rus by 11 tons/yr; sedi-ment by 3,709 tons/yr	Install addi-tional 2 acres grassed wa-terways (35' buffer)	Watershed Coordi-nator, SWCDs, NRCS, FSA, local partners; CRP, CREP, related programs; Esti-mate: $5,000-$10,000/ac Seek additional funding	Ongoing	Document acres of grassed water-ways; Calculate load reductions with Region 5 Model
Determine the aquatic life use designation for Locust Creek	Perform aquatic life assessments (IBI, ICI, QHEI)	Ohio EPA, Cler-mont OEQ, Water-shed Coordina-tor	Ongoing	Aquatic Life Use Designation Lo-cust Creek

Locust Creek sub-watershed Problem Statement #3				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen by .2 tons/yr; phosphorus by .8 tons/yr;	Conduct in- inventory/ inspections HSTSs in Stonelick Creek; Build upon existing homeowner education program	Health Districts (Clermont, Clinton, Brown, Warren Counties), Watershed Coordinator, partners; Seek grants/funding;	Ongoing	Complete inventory HSTSs in Stonelick Creek; Record # of individuals reached through education/ outreach;
Maintain pathogen levels in range suit-able for PCR	Monitor Stonelick Creek and tributaries to assess im-pacts from HSTSs , point source dischargers, and other sources	Clermont OEQ, SWCDs, Watershed Coordinator; Existing resources; seek addi-tional funding;	Ongoing	E. coli standards within range suitable for PCR (below 161 colony forming units (cfu) per 100 ml for sea-sonal geometric mean or below 523 for single sample)
	Implement effective WWTP technologies and monitoring to reduce pollutant loading	OEPA, WWTPs, partners; Low interest loans, cost-share for WWTP upgrades	Ongoing	Meet NPDES permit limits; Reduce pathogen loading

HUC-12: 050902021303

Moore's Fork sub-watershed
OEPA Waterbody ID #: 53-13, 53-14
Drainage Area: 19 mi^2
Aquatic Use Designation: WWH

Background

The Moore's Fork sub-watershed is 19 square miles (12,389 acres) in total area and includes two tributaries: Moore's Fork and Greenbush Creek (Figure 5-6). Moore's Fork is a tributary of Stonelick Creek located in the central portion of the watershed east of Newtonsville. It is 10 miles in total length and has a drainage area 12.3 square miles. Greenbush Creek is a tributary of Moore's Fork and is 3.2 miles in total length and has a drainage area of 2.3 square miles. Both Moore's Fork and Greenbush Creek are designated as warmwater habitat.

Land use in Moore's Fork is dominated by agriculture and forested land. Of the agricultural land uses, approximately 5,646 acres (45%) are cropland and 3,567 acres (28%) are pasture-land. There are also 2,827 acres (22%) of forested land and 300 acres (2%) of urban land.

Although the streams in the Moore's Fork sub-watershed were not included in recent assessments, Ohio EPA has noted that Moore's Fork and its tributaries are impacted by nonpoint source runoff. The suspected sources of nonpoint runoff include agriculture, crop production, livestock pasture/feedlots, home septic systems, and streambank modification from development.

The Rosgen Level I assessment for Moore's Fork indicated that the majority of streams are C-type streams (60%) (Figure 5-7). This stream type is stable with a well developed floodplain. Additionally, there are approximately 24% of B-type and 14% of G-type streams in the watershed. B-type streams, are stable, moderately entrenched streams with a step-pool system and moderate slopes. G-type streams are characterized as gullies, with a step-pool morphology and moderate slopes. These streams types, found mostly in the headwater streams, often have a high bed load and are typically unstable.

Moore's Fork has fair to good riparian habitat in the lower section of the watershed. There is approximately 500 feet of rock armoring along the streambanks near Meek Road. In the middle and upper section of the watershed, riparian protection diminishes as the stream runs through agricultural fields and residential areas. There is approximately 10,000 noncontiguous linear feet along Moore's Fork with little to no riparian protection. Moore's Fork has lost its sinuosity in its upper reaches.

Greenbush Creek generally has good forested riparian habitat throughout, however the riparian zone narrows as the stream flows near agricultural fields and development. There is approximately 3,000 noncontiguous linear feet in the middle and upper reaches that lack adequate riparian protection. Similar to Moore's Fork, these sections of stream are found in agricultural areas where farming is occurring near the edge of the streambank.

There are approximately 419 discharging home septic systems located in Moore’s Fork. Of those discharging systems, approximately 10% (42) are failing systems that are contributing nutrients and pathogens to the streams.

Pollution loading estimates were calculated using StepL based on the land use data, estimates of home septic systems and livestock. According to these estimates, Moore’s Fork is receiving 91 tons of nitrogen, 19 tons of phosphorus, and 6,202 tons of sediment each year.

The StepL model estimates that cropland is the leading source of nutrients and sediments, contributing 65 tons of nitrogen, 16 tons of phosphorus, and 5,463 tons of sediment each year. Pastureland is contributing an estimated 23 tons of nitrogen, 2 tons of phosphorus, and 630 tons of sediment, while urban land uses are contributing 1.5 tons of nitrogen, .2 ton of phosphorus, and 71 tons of sediment each year. In addition, home septic systems are contributing .6 tons (1,302 lbs) of nitrogen and .2 tons (510 lbs) of phosphorus annually.

Problem Statement #1

Nonpoint source runoff from row crops and pastureland (and streambank erosion) is contributing 88 tons of nitrogen, 18 tons of phosphorus, and 6,093 tons of sediment to Moore’s Fork each year.

Goal

To reduce nutrient and sediment loadings by 50%.

Objectives

1. Reduce nitrogen loadings 44 tons per year.
2. Reduce phosphorus loadings by 9 tons per year.
3. Reduce sediment loadings from agriculture 3,046 tons per year.

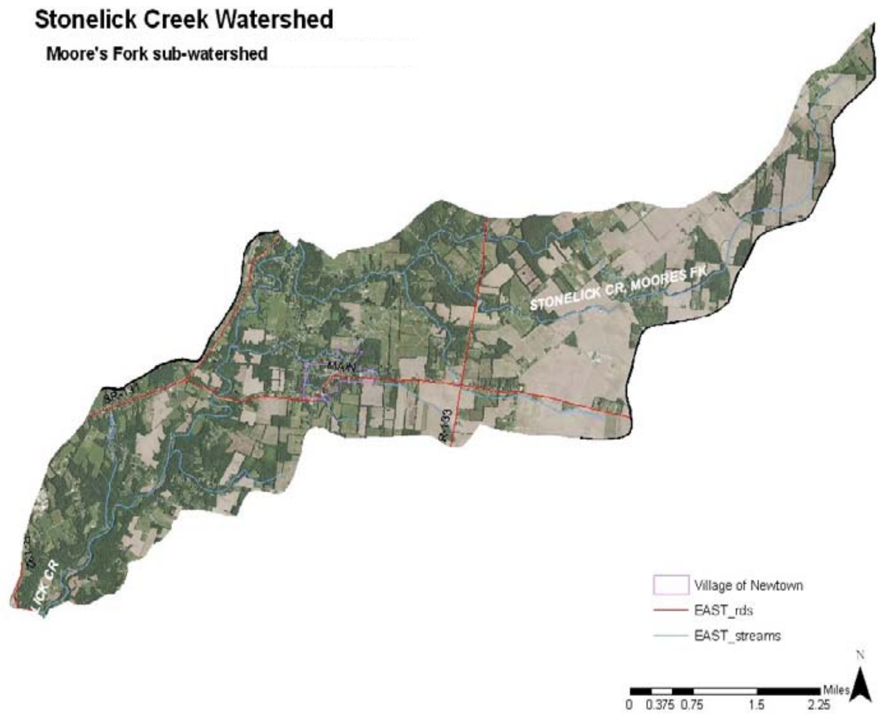


Figure 47. Aerial view of the Moore's Fork sub-watershed

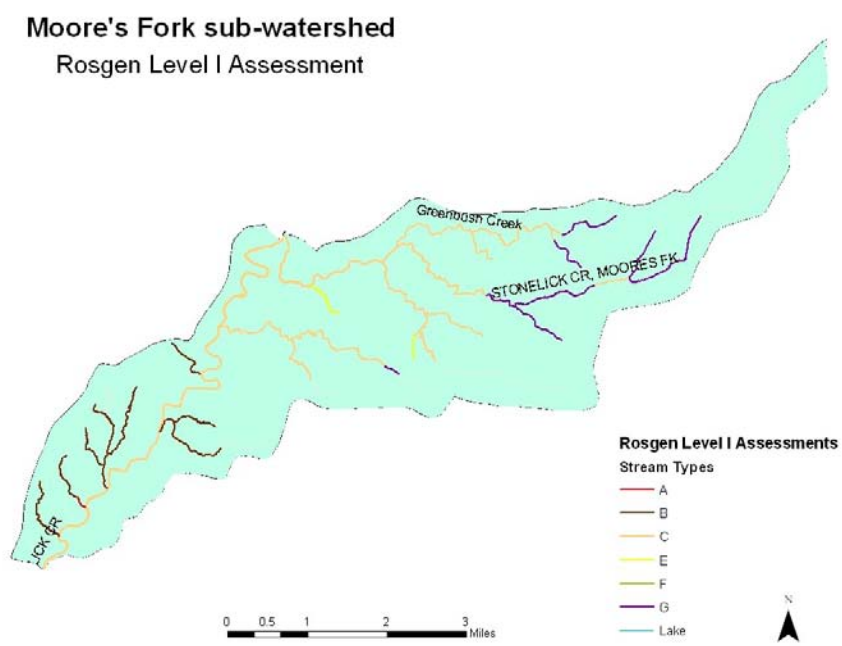


Figure 48. Rosgen Level I Assessments for the Moore's Fork sub-watershed

Moore's Fork sub-watershed Problem Statement #1				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce ni-trogen by 44 tons, re-duce phos-pho-rus by 9 tons, reduce sediment by 3,046 tons/yr	Restore 13,000 (noncontiguous us) linear feet ri-parian corridor (50' width) with conser-vation easements or land purchases;	Landowners, Watershed Coordinator, SWCDs, Cler-mont Park District, Cler-mont OEQ, NRCS, FSA; CRP, CREP, WRRSP Estimate $2,000-8,000 per acre easement/purchase Riparian restoration $110-$150 per acre to construct; $10-15 acre to maintain	2010-2018	Reduce nitrogen by 135 lbs/yr; Reduce phospho-rus by 60 lbs/yr; Reduce sediment by 45 tons/yr
	Establish per-manent con-servation ease-ment program and protect 2 miles (50 ft width) of riparian corridor	Landowners, Watershed Co-ordinator, SWCDs, Cler-mont Park District, Cler-mont OEQ, NRCS, FSA; CRP, CREP, WRRSP Estimate $2,000-8,000 per acre easement/purchase	2013-2018	Reduce nitrogen by 108 lbs/yr; Reduce phospho-rus by 48 lbs/yr; Reduce sediment by 36 tons/yr
	Implement cover crops, conserva-tion tillage on 560 acres (10%) of cropland	Watershed Coordinator, SWCDs, NRCS, FSA, local partners; EQIP, related programs; Cover Crops $30 per acre Conservation Tillage $15 per acre Seek funding sources	Ongoing	Reduce nitrogen by 1.1 tons/yr; Re-duce phosphorus by 1,120 lbs/ yr; Reduce sediment by 1,120 tons/yr

Moore’s Fork sub-watershed Problem Statement #1				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce ni-trogen by 44 tons, reduce phos-phorus by 9 tons, reduce sedi-ment by 3,046 tons/ yr	Install filter strips, riparian buffer strips on 400 acres of cropland	Watershed Coordinator, SWCDs, NRCS, FSA, local partners; CRP, CREP, related pro-grams; Estimate: $155/ac	Ongoing	Reduce nitrogen by 2 tons/yr; Reduce phospho-rus by 1 ton/yr; Reduce sediment by 1,200 tons/yr
	Implement pre-scribed grazing on 350 ac (10%) of pastureland	Landowners, Watershed Coordinator, SWCDs, NRCS, FSA, local partners EQIP, related programs	Ongoing	Reduce nitrogen loading by 385 lbs/ yr; Reduce phospho-rus loading by 193 lbs/ yr; Reduce sediment by 121 tons/yr
	Install .2 ac grassed water-ways (35’buffer) along identified gully formations along	Watershed Coordinator, SWCDs, NRCS, FSA, local partners; CRP, CREP, re-lated pro-grams; Estimate: $5,000-$10,000/ ac Seek funding	Ongoing	Reduce nitrogen by 115 lbs/yr; Reduce phospho-rus by 57 lbs/yr Reduce sediment by 57 tons/yr
	Install additional 2 acres grassed wa-terways (35’ buffer)	Watershed Coordinator, SWCDs, NRCS, FSA, local partners; CRP, CREP, related pro-grams; Estimate: $5,000-$10,000/ ac Seek funding	Ongoing	Document acres of grassed water-ways; Calculate load re-ductions with Re-gion 5 Model

Problem Statement #2

Nonpoint urban runoff is contributing 2 tons of nitrogen, .2 tons of phosphorus and 71 tons of sediment to Moore's Fork each year.

Goal

To reduce pollutant loadings from urban runoff by 75% and minimize future land use impacts.

Objectives

1. Reduce nitrogen loading from urban runoff by 1 ton per year.
2. Reduce phosphorus loading from urban runoff by .2 tons per year.
3. Reduce sediment loading from urban runoff by 54 tons per year.

Moore's Fork sub-watershed **Problem Statement #2**				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen loading by 1 ton/ yr; phosphorus loadings by .2 tons/yr; sediment loadings by 54 tons/yr	Implement Balanced Growth land use planning strategies; Identify priority conservation areas, priority development areas;	Watershed Coordinator, SWCDs, Townships, local partners	Ongoing	Maintain impervious surface near 10%; Map priority conservation areas, priority development areas;

Moore's Fork sub-watershed Problem Statement #2				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen loading by 1 ton/yr; phosphorus loadings by .2 tons/yr; sediment loadings by 54 tons/yr.	Implement urban BMPs: Install 3 bioretention/rain gardens; 50 rain barrels; Bioswale demonstration project	Watershed Coordinator, SWCDs, Clermont Storm Water Dept., local townships, partners; U.S. EPA Urban BMP Performance Tool; Clermont SWCD homeowner rain garden grants; Seek funding; Estimates: bioretention/rain gardens: $7-$30 per sq. ft.; rain barrels = $14-19 per sq. ft; bioswales: $1-3 per sq. ft.	2013-2018	Calculate stormwater runoff reduction, pollutant re-moval
	Draft and implement riparian setback ordinance	Watershed Coordinator, SWCDs, Townships, local partners	2013-2018	Maintain and enhance riparian corridor protection; Adopt at least 1 riparian setback ordinance Calculate stormwater runoff reduction, pollutant re-moval

Problem Statement #3

Failing home septic systems are contributing .6 tons (1,302 lbs) of nitrogen and .2 tons (510 lbs) of phosphorus and an unquantified amount of pathogens each year.

Goal

To reduce pollutant loadings from failing HSTSs by 75% reduce pathogen loading.

Objectives:

1. Reduce nitrogen loading from failing HSTSs by .4 tons per year.
2. Reduce phosphorus loadings from failing HSTSs by .2 tons per year.
3. Maintain pathogen loading in range suitable for Primary Contact Recreation (PCR)

Moore's Fork sub-watershed Problem Statement #3				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce ni-trogen load-ing by 976 lbs/yr, phosphorus load-ing by 382 lbs/yr	Repair/replace 21 fail-ing home sep-tic sys-tems	OEPA, Clermont County Health District, Watershed Coordinator, local part-ners; Seek funding	2013-2018	Reduce nitrogen by 910 lbs/yr; Re-duce phosphorus by 344 lbs/yr; Re-duce E. coli, fe-cal coliform counts
	Draft and Imple-ment regulations for registration and testing of septic haulers, and proper application or disposal of sep-tage	OEPA, Clermont County Health District, Watershed Coordinator, local part-ners; Existing Resources	2013-2018	Eliminate reports of illicit discharges or improper han-dling of septic waste; (Avg. 2 re-ports/yr illicit dis-charge/ improper handling)

Moore's Fork sub-watershed Problem Statement #3				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen loading by 976 lbs/yr, phosphorus loading by 382 lbs/yr	Conduct inventory/ inspections of HSTSs in Stonelick Creek; Develop an effective homeowner education program	Health Districts (Clermont, Clinton, Brown, Warren Counties), Watershed Coordinator, partners; Seek grants/funding;	Ongoing	Complete inventory HSTSs in Stonelick Creek; Record # of individuals reached through education/ outreach;
Maintain pathogen loading in range suitable for PCR	Monitor Stonelick Creek and tributaries to assess impacts from HSTSs, point source dischargers, and other sources	Clermont OEQ, SWCDs, Watershed Coordinator; Existing resources; seek additional funding;	Ongoing	E. coli standards within range suitable for PCR (below 161 colony forming units (cfu) per 100 ml for sea-sonal geometric mean or below 523 for single sample)
	Implement effective WWTP technologies and monitoring to reduce pollutant loading	OEPA, WWTPs, partners; Low interest loans, cost-share for WWTP upgrades	Ongoing	Meet NPDES permit limits; Reduce pathogen loading

Problem Statement #4

Stream bank modification caused by development is contributing an un-quantified amount of sediment and pollutants to Moore's Fork each year.

Goal:

To reduce sediment and pollutant loading caused by stream bank modification/erosion

Objectives:

1. Control storm water runoff from new construction sites
2. Control storm water runoff from existing developments

Moore's Fork sub-watershed Problem Statement #4				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Control storm water runoff from new construction sites	Implement effective sediment and erosion con-trol measures	Clermont Planning Dept., SWCDs, Clermont Storm Water Dept., partners Construction Best Management Guide for Clermont County	Ongoing	Document the number of BMPs and effectiveness
	Implement post-construction BMPs:	Clermont Planning Dept., SWCDs, Clermont Storm Water Dept., partners; Sanitation District No. 1 of Northern Kentucky and Louis-ville Metropolitan Sewer District regional BMP manuals	Ongoing	New Zoning ordinances, structural BMPs; Calculate load reductions with Re-gion 5 Model

HUC-12: 050902021302
Brushy Fork sub-watershed
OEPA Waterbody ID #: OH 53-10, OH 53-11, OH 53-12
Drainage Area: 15.2 mi^2
Aquatic Use Designation: WWH

Background

The Brushy Fork sub-watershed is located in the southern portion of the Stonelick watershed and is approximately 15.2 square miles (9,546 acres) in total area (Figure 5-8). Brushy Fork is a tributary to Stonelick Creek and is 7.2 miles in total length. Rocky Run and Patterson Run are two tributaries that drain to Brushy Fork; Rocky Run is 5.3 miles in total length and Patterson Run is 4.1 miles in total length (Figures 5-8 and 5-9). All the streams are designated as warmwater habitat.

Land use in the Brushy Fork sub-watershed is dominated by row crop agriculture with some livestock production. Row crop agriculture accounts for 38% (3,701 acres) of the land use and pasture accounts for 27% (2,584 acres). There is also 32% (3,088 acres) of forested land in Brushy Fork. There are three separate cattle farms located in Brushy Fork with 35 head of cattle and 1 horse farm that houses 25 horses. Land use changes due to population growth and development are expected within the next twenty years.

Brushy Fork and its tributaries were not include in Ohio EPA's recent assessments, however the agency does have some general information on suspected or known causes and sources of impairment. Rocky Run is identified as being impacted by nonpoint source runoff caused by agriculture and failing home septic systems. Brushy Fork and Patterson Run are also impacted by agriculture and failing home septic systems. There are approximately 349 discharging home septic systems in Brushy Fork. Of those discharging systems, approximately 10% (35) are failing and contributing nutrients and pathogens to the streams.

The Rosgen Level I assessment for Brushy Fork indicated there are several different classes of streams in the watershed (Figure 5-9). The majority of streams are B-type (47%), C-type (23%), and F-type (20%). The upstream areas appeared to have more B-type streams that flow through smaller, forested tributaries. B-type streams are considered stable streams that are moderately entrenched, step-pool systems with moderate slopes. Similarly, C-type streams are also considered stable, slightly entrenched with sinuous channels connected to floodplains. Conversely, F-type streams are considered unstable streams with entrenched channels and high bank erosion rates. These unstable areas are found mostly along Rocky Run and Patterson Run.

The Clermont Northeastern (CNE) School wastewater treatment facility discharges to Patterson Run. The wastewater facility effluent loadings are based on an average design flow of .040 MGD. To date, neither Ohio EPA or Clermont County have attributed any water quality impairments to CNE's wastewater facility.

The East Fork Watershed Collaborative included Brushy Fork in the 2007 Watershed Management

Study. Analysis of ICI And IBI scores indicated that Brushy Fork is impaired. The Stressor Identification Process concluded that the primary aquatic life stressors in Brushy Fork are habitat (modifications) and possibly ionic stress caused by high salinity. Recommendations from the study focus on improving riparian habitat, controlling stormwater runoff, and collecting additional information on potential sources of salinity.

The riparian habitat of Brushy Fork, Patterson Run, and Rocky Run was assessed using 2009 aerial images. Brushy Fork has good to excellent riparian habitat throughout, with narrow zones through developed areas and farm fields. There is estimated 3,500 noncontiguous linear feet of stream with little to no riparian habitat. Patterson Run has good forested riparian habitat near the confluence with Brushy Fork, however riparian protection diminishes in the mid-upper sections of the stream. There is approximately 9,500 noncontiguous linear feet of stream with little to no riparian habitat. The longest stretches of stream that lack adequate riparian protection are found near Caudil-East Road. and Clemons Road. Similar to Patterson Run, Rocky Run has good forested riparian habitat in the lower reaches, however riparian buffers diminish in the mid-upper reaches. There is an estimated 10,000 noncontiguous linear feet of stream that lacks adequate riparian protection. The longest stretches of stream with little to no riparian habitat are found near Weaver Road and Bignam Road in the upper reaches of the watershed.

Based on the StepL Model pollution loading estimates, Brushy Fork is receiving 62 tons of nitrogen, 13 tons of phosphorus, and 4,375 tons of sediment each year. According to these calculations, cropland is the leading source of nutrients and sediments, contributing 43 tons of nitrogen, 10 tons of phosphorus, and 3,817 tons of sediment each year. Pastureland is contributing an estimated 16 tons of nitrogen, 1.5 tons of phosphorus, and 486 tons of sediment, while urban land uses are contributing .6 tons of nitrogen, .09 ton of phosphorus, and 27 tons of sediment each year. In addition, home septic systems are contributing .5 tons (1,084 lbs) of nitrogen and .2 tons (424 lbs) of phosphorus annually.

Problem Statement #1

Nonpoint source runoff from row crops and pastureland (and streambank erosion) are contributing 59 tons of nitrogen, 26 tons of phosphorus, and 4,303 tons of sediment to Moore's Fork each year.

Goal

To reduce nutrient and sediment loadings by 50%.

Objectives

1. Reduce nitrogen loadings by 29 tons per year.
2. Reduce phosphorus loadings by 13 tons per year.
3. Reduce sediment loadings 2,151 tons per year.

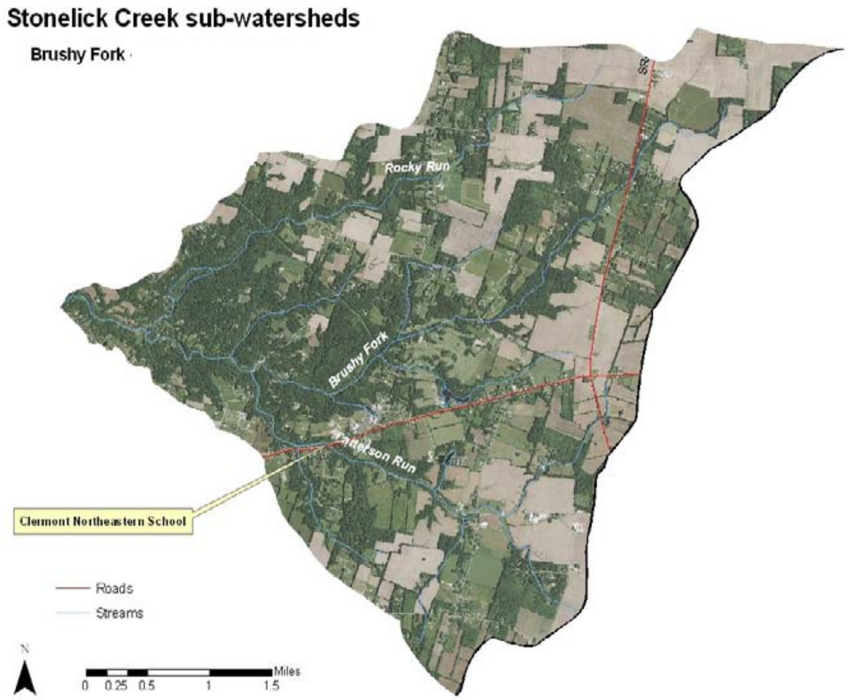


Figure 49. Aerial view of the Brushy Fork sub-watershed

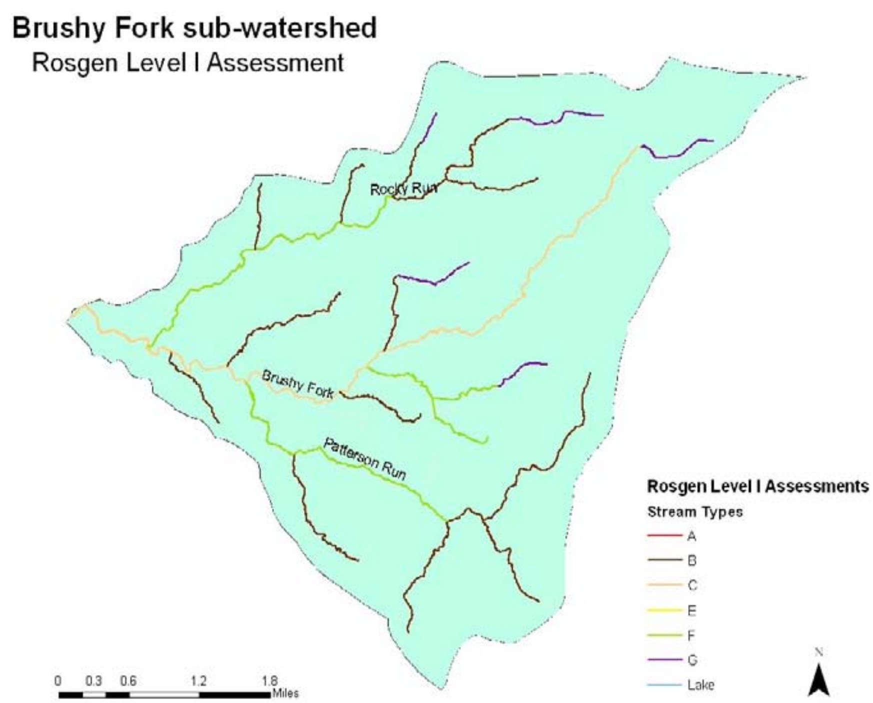


Figure 50. Rosgen Level I Assessment for the Brushy Fork sub-watershed

Brushy Fork sub-watershed Problem Statement #1				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce ni-trogen by 29 tons, phos-phorus by 13 tons, sediment by 2,151 tons	Restore 3,500 (noncontiguous) linear feet riparian corri-dor (50’ width) with conser-vation easements or land purchases along Brushy Fork;	Landowners, Watershed Coordi-nator, SWCDs, Clermont Park District, Clermont OEQ, NRCS, FSA; CRP, CREP, WRRSP Estimate $2,000-8,000 per acre easement/purchase Riparian restoration $110-$150 per acre to construct; $10-15 acre to maintain	2010-2018	Reduce nitrogen by 36 lbs/ yr; Reduce phos-phorus by 16 lbs/ yr; Reduce sediment by 12 tons/yr
	Restore 9,500 (noncontiguous) linear feet riparian corri-dor (50’ width) with conser-vation easements or land purchases along Patterson Run;	Landowners, Watershed Coordi-nator, SWCDs, Clermont Park District, Clermont OEQ, NRCS, FSA; CRP, CREP, WRRSP Estimate $2,000-8,000/acre ease-ment/ purchase; Riparian restoration $110-$150 per acre to construct; $10-15 acre to maintain	2013-2018	Reduce nitrogen by 100 lbs/yr; Reduce phos-phorus by 44 lbs/ yr; Reduce sediment by 33 tons/yr
	Restore 10,00 (noncontiguous) linear feet riparian corridor (50’ width) with conservation easements or land purchases along Rocky Run;	Landowners, Watershed Coordi-nator, SWCDs, Clermont Park District, Clermont OEQ, NRCS, FSA; CRP, CREP, WRRSP Estimate $2,000-8,000 per acre ease-ment/purchase Riparian restoration $110-$150 per acre to construct; $10-15 acre to maintain	2013-2018	Reduce nitrogen by 110 lbs/yr; Reduce phos-phorus by 48 lbs/ yr; Reduce sediment by 36 tons/yr

Brushy Fork sub-watershed Problem Statement #1				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen by 29 tons, phosphorus by 13 tons, sediment by 2,151 tons	Establish permanent conservation easement program and protect 2 miles (50 ft width) of riparian corridor	Landowners, Watershed Coordinator, SWCDs, Clermont Park District, Clermont OEQ, NRCS, FSA; CRP, CREP, WRRSP Estimate $2,000-8,000 per acre easement/ purchase	2010-2018	Reduce nitrogen by 108 lbs/yr; Reduce phosphorus by 48 lbs/yr; Reduce sediment by 36 tons/yr
	Implement cover crops, conservation tillage on 370 acres (10%) of cropland	Watershed Coordinator, SWCDs, NRCS, FSA, local partners; EQIP, related programs; Cover Crops $30 per acre Conservation Tillage $15 per acre Seek funding sources	Ongoing	Reduce nitrogen by 1,480 lbs/yr; Reduce phosphorus by 740 lbs/yr; Reduce sediment by 740 tons/yr
	Install filter strips, riparian buffer strips on 200 acres of cropland	Watershed Coordinator, SWCDs, NRCS, FSA, local partners; CRP, CREP, related programs; Estimate: $155/ac	Ongoing	Reduce nitrogen by 1,800 lbs/yr; Reduce phosphorus by 800 lbs/yr; Reduce sediment by 600 tons/yr

Brushy Fork sub-watershed Problem Statement #1				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce ni-trogen by 29 tons, phosphorus by 13 tons, sediment by 2,151 tons	Install .2 ac grassed wa-terways (35'buffer) along iden-tified gully formations along Brushy Fork, Pat-terson Run, Rocky Run	Watershed Coordinator, SWCDs, NRCS, FSA, local part-ners; CRP, CREP, related programs; Estimate: $5,000-$10,000/ac Seek funding	Ongoing	Reduce nitrogen by 115 lbs/yr; Reduce phospho-rus by 57 lbs/yr Reduce sediment by 57 tons/yr
	Install addi-tional 2 acres grassed wa-terways (35' buffer)	Watershed Coordinator, SWCDs, NRCS, FSA, local part-ners; CRP, CREP, related programs; Estimate: $5,000-$10,000/ac Seek funding	Ongoing	Document acres of grassed water-ways; Calculate load re-ductions with Re-gion 5 Model
	Implement pre-scribed grazing on 250 ac (10%) of pastureland	Landowners, Watershed Coordi-nator, SWCDs, NRCS, FSA, lo-cal partners EQIP, related programs	Ongoing	Reduce nitrogen loading by 285 lbs/ yr; Reduce phospho-rus loading by 143 lbs/ yr; Reduce sediment by 90 tons/yr

Problem Statement #2

Nonpoint urban runoff is contributing .6 tons of nitrogen, .09 tons of phosphorus, and 27 tons of sediment to Brushy Fork each year.

Goal

To reduce pollutant loadings from urban runoff by 75% and minimize future land use impacts.

Objectives

1. Reduce nitrogen loading from urban runoff by 900 lbs per year.
2. Reduce phosphorus loading from urban runoff by 135 lbs per year.
3. Reduce sediment loading from urban runoff by 20 tons per year.

Brushy Fork sub-watershed **Problem Statement #2**				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen by 900 lbs/yr; phosphorus by 187 lbs/yr; reduce sediment by 20 tons/yr	Implement Balanced Growth land use planning strategies; Identify priority conservation areas, priority development areas;	Watershed Coordinator, SWCDs, Townships, local partners	Ongoing	Maintain impervious surface below 10%; Map priority conservation areas, priority development areas;
	Implement urban BMPs: Install 3 bioretention/rain gardens; 50 rain barrels; Bioswale demonstration project	Watershed Coordinator, SWCDs, Clermont Stormwater Dept., Townships, local partners U.S. EPA Urban BMP Perform-ance Tool; Clermont SWCD homeowner rain garden grants, Seek Funding Estimates: bioretention/rain gar-dens: $7-$30 per sq. ft.; rain bar-rels = $14-19 per sq. ft; bioswales: $1-3 per sq. ft.	2013-2018	Calculate stormwater runoff reduction, pollutant removal

Brushy Fork sub-watershed Problem Statement #2				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen by 900 lbs/yr; phosphorus by 187 lbs/yr; reduce sediment by 20	Draft and Implement riparian setback ordinance	Watershed Coordinator, SWCDs, Townships, local partners	2013-2018	Maintain and enhance riparian corridor protection; Calculate storm water runoff reduction, pollutant removal

Problem Statement #3

Failing home septic systems are contributing .5 tons (1,084 lbs) of nitrogen and .2 tons (424 lbs) of phosphorus and an un-quantified amount of pathogens to Brushy Fork each year.

Goal

To reduce pollutant loadings from failing HSTSs by 75% and reduce pathogen loading.

Objectives:

1. Reduce nitrogen loading from failing HSTSs by .4 tons per year.
2. Reduce phosphorus loadings from failing HSTSs by .2 tons per year.
3. Maintain pathogen loading in range suitable for Primary Contact Recreation (PCR)

Brushy Fork sub-watershed Problem Statement #3				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen load -ing by 813lbs/yr; phosphors by 318 lbs/yr;	Repair/replace 17 failing HSTSs	OEPA, Clermont County Health District, Watershed Coordinator, local partners; Seek funding	2010-2018	Reduce nitrogen by 737 lbs/yr; Reduce phosphorus by 280 lbs/yr; Reduce E. coli, fecal coliform counts

Brushy Fork sub-watershed Problem Statement #3				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen loading by 813lbs/yr; phosphors by .318 lbs/ yr;	Conduct inventory/ inspections of HSTSs in Stonelick Creek; Build upon existing homeowner education program	Health Districts (Clermont, Clinton, Brown, Warren Counties), Watershed Coordinator, partners; Seek grants/funding;	Ongoing	Complete inventory HSTSs in Stonelick Creek; Record # of individuals reached through education/ outreach;
	Draft and Implement regulations for registration and testing of septic haulers, and proper application or disposal of septage	OEPA, Clermont County Health District, Watershed Coordinator, local partners; Existing Resources	Ongoing	Eliminate reports of illicit discharges or improper han-dling of septic waste; (Avg. 2 reports/yr illicit discharge/ improper handling)
Maintain pathogen loading in range suitable for PCR	Monitor Stonelick Creek and tributaries to assess impacts from HSTSs, point source dischargers, and other sources	Clermont OEQ, SWCDs, Watershed Coordinator; Existing resources; seek additional funding;	Ongoing	E. coli standards within range suitable for PCR (below 161 colony forming units (cfu) per 100 ml for sea-sonal geometric mean or below 523 for single sample)
	Implement effective WWTP technologies and monitoring to reduce pollut-ant loading	OEPA, WWTPs, partners; Low interest loans, cost-share for WWTP upgrades	Ongoing	Meet NPDES permit limits; Reduce pathogen loading

Problem Statement #4

Habitat loss/modifications and high levels of salinity are impairing the aquatic life in Brushy Fork.

Goal

To restore and protect in-stream and riparian habitat and maintain normal ranges of salinity in Brushy Fork.

Objectives:

1. Determine habitat impacts in Brushy Fork
2. Identify and mitigate potential sources of salinity

Brushy Fork sub-watershed **Problem Statement #4**				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Determine habitat impacts in Brushy Fork	Conduct QHEI (Qualitative Habitat Index), HHEI (Headwater Habitat Evaluation Index), or equivalent habitat assessment	OEPA, SWCDs, Clermont OEQ; Existing Resources	2013-2018	Habitat assessment for Brushy Fork
	Identify and map priority areas for con-servation, restoration	Watershed Coordinator, SWCDs, local partners Clermont GIS	2013	Map of priority target areas
Identify and mitigate potential sources of salinity	Monitor water quality Brushy Fork and tributaries; Identify any potential illicit discharges	Clermont OEQ, SWCDs, Watershed Coordinator; Existing resources; seek additional funding;	2013	Water quality analysis Brushy Fork;

HUC-12: 050902021304
Lick Fork sub-watershed OEPA
Waterbody ID #: OH 53-9 Drainage Area: 17 mi^2
Aquatic Use Designation: WWH

Background

The Lick Fork sub-watershed is 17 square miles (11,826 acres) in total area and is located near the northern border of the EFLMR watershed, east of Milford and northwest of Owensville (Figure 5-10). Lick Fork is the main tributary in the sub-watershed; it is 3.7 miles in total length and is designated as a warmwater habitat stream.

The dominate land uses in the Lick Fork sub-watershed are agriculture and forested land. There are 2,557 acres of cropland and 3,165 acres of pastureland. The three townships in the watershed (Goshen, Miami, and Stonelick Townships) have zoned most of the land in this area for agricultural and estate residential land use. Small portions have also been zoned for suburban residence, neighborhood businesses, and mobile home parks. The headwater region is flatter and more developed, whereas development in the downstream portion of the watershed is limited due to steep terrain. There are two large livestock facilities located in the Lick Run sub-watershed. One facility houses 50 alpacas and the other houses 50 horses.

Lick Fork was included in Ohio EPA’s 1998 assessment. One segment along Lick Fork was assessed (.6 miles length, drainage area of 7.4 mi^2) and was found to be in full, but threatened attainment of its aquatic life use designation. This site was reported to have a very good fish community. Organic enrichment and pathogens were identified as causes of impairment, most likely cause by failing home septic systems and agricultural runoff. Clermont County data also revealed bacterial exceedences that were attributed to failing home septic systems.

The Rosgen Level I assessment for the Lick Fork sub-watershed showed that 60% of streams are B-type, 13% F-type, and 8% G-type (Figure 5-11). G-type streams in the headwaters were classified as such because they flow through agricultural areas and were determined to have low width to depth ratios, typical of G-type streams. These headwater streams may be functioning as agricultural ditches. B-type steams indicate moderately entrenched step-pool systems with low sinuosity. A large tributary located west of the sampling site was classified as F-type due to significant entrenchment.

The Rosgen Level II assessment classified Lick Fork as a B4c type stream. This classification indicated a moderately entrenched riffle-pool system, with low sinuosity, a predominately gravel channel bottom, and a water surface slope of less than 2 percent. Large cobbles were located throughout the stream in this reach where the stream flows through an agricultural field and several large residential lots.

The riparian habitat in the Lick Fork sub-watershed was assessed with aerial photographs. Lick Fork has fair riparian habitat in its lower stretch, however there is minimal riparian protection near the confluence of Lick Fork and Stonelick Creek. Upstream of the confluence, Lick Fork runs parallel to Stonelick-Williams Corner Road and riparian protection narrows as the stream migrates toward the road. There is approximately 500 feet of armoring along the streambank near the cross section of Stonelick-Williams Corner Road and Mt. Zion Road. There is approximately 2,600 linear feet of stream that has minimal to no riparian habitat in the lower section of the watershed.

Riparian habitat improves through the middle and upper portions of the watershed. Overall, the middle and upper portions of the watershed have good to excellent forested riparian habitat. There are sections of stream where the riparian protection narrows, typically near agricultural or residential areas. There is approximately 1,120 linear feet of stream (located north of SR 131) that has little to no riparian protection.

As mentioned in Chapter 2, there is one site located along Stonelick Creek (Locust Creek subwatershed) where there is significant streambank and channel erosion. This site is located near the confluence of Stonelick Creek and the East Fork mainstem, just south of U.S. Route 50 (Figures 5-2 and 5-3). There is approximately 10,000 linear feet or more of streambank and channel erosion occurring along Stonelick Creek. Strategies to address this erosion are included in the Stonelick Creek action table.

There are approximately 429 discharging home septic systems located in the Lick Fork subwatershed. Of those discharging systems, approximately 10% (43) are failing and contributing nutrients and pathogens to the tributaries.

StepL was used to calculate pollution loadings based on land use data, estimates of home septic systems and livestock numbers. According to these estimates Lick Fork is receiving 49 tons of nitrogen, 10 tons of phosphorus, and 3,241 tons of sediment each year.

The StepL model estimates that cropland is the leading source of nutrients and sediments, contributing 27 tons of nitrogen, 7 tons of phosphorus, and 2,504 tons of sediment each year. Pastureland is contributing an estimated 18 tons of nitrogen, 2 tons of phosphorus, and 565 tons of sediment, while urban land uses are contributing 2 tons of nitrogen, .3 ton of phosphorus, and 97 tons of sediment each year. In addition, home septic systems are contributing .6 tons (1,333 lbs) of nitrogen and .3 tons (522 lbs) of phosphorus annually.

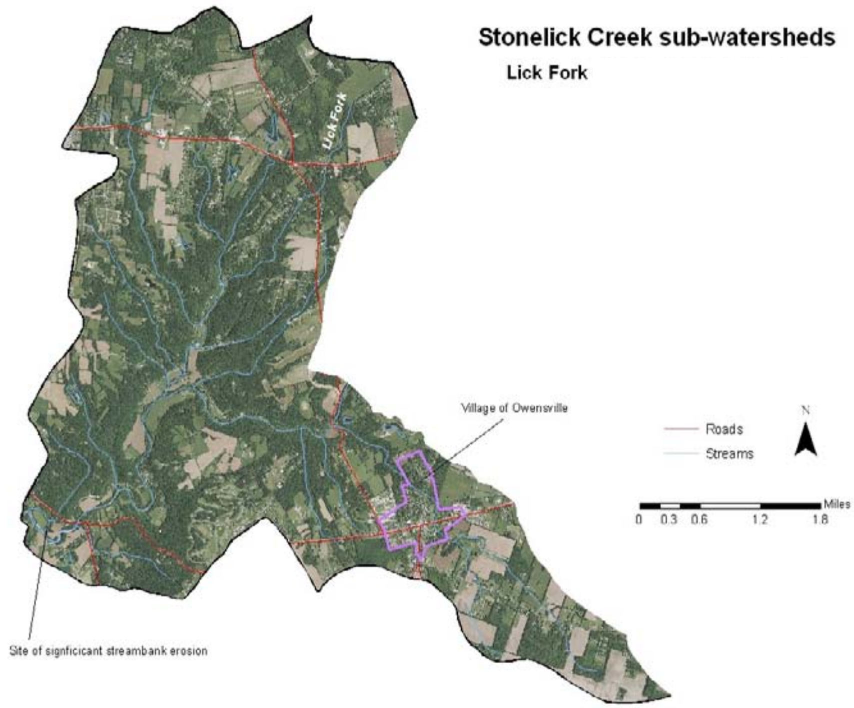


Figure 51. Aerial view of the Lick Fork sub-watershed

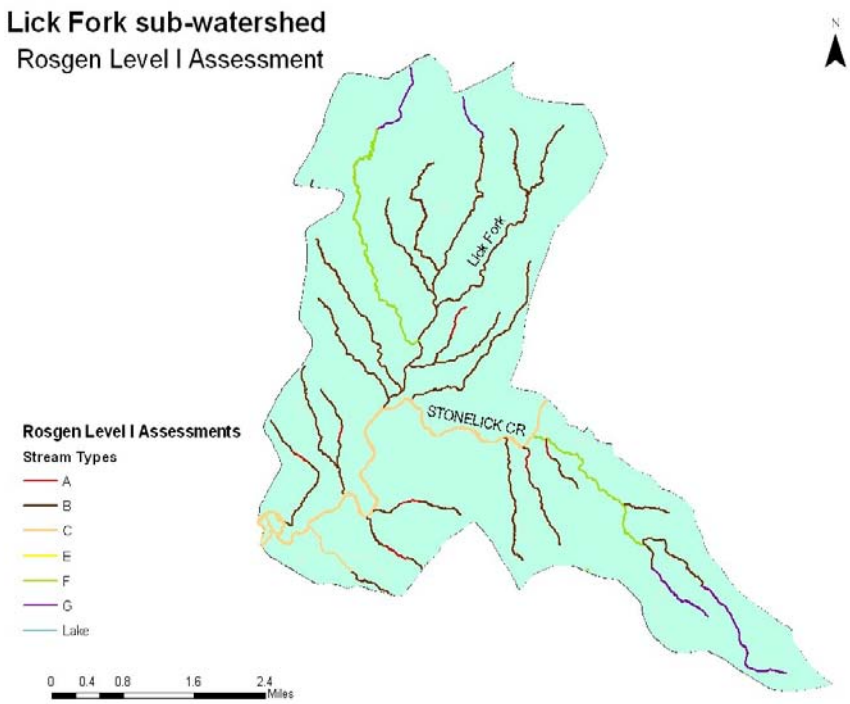


Figure 52. Rosgen Level I Assessment for the Lick Fork sub-watershed

Problem Statement #1

Nonpoint source runoff from row crops and pastureland (and streambank erosion) are contributing 45 tons of nitrogen, 9 tons of phosphorus, and 3,069 tons of sediment to Moore's Fork each year.

Goal

To reduce nutrient and sediment loadings by 50%.

Objectives

1. Reduce nitrogen loadings from agriculture by 22 tons per year.
2. Reduce phosphorus loadings from agriculture by 5 tons per year.
3. Reduce sediment loadings from agriculture 1,534 tons per year.

Lick Fork sub-watershed **Problem Statement #1**				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen by 22 tons/yr; phosphorus by 5 tons/yr; sediment by 1,534 tons/yr	Restore 2,600 (noncontiguous) linear feet riparian corridor (50' width) with conservation easements or land purchases along Brushy Fork;	Landowners, Watershed Co-ordinator, SWCDs, Clermont Park District, Clermont OEQ, NRCS, FSA; CRP, CREP, WRRSP Estimate $2,000-8,000 per acre easement/purchase Riparian restoration $110-$150 per acre to construct; $10-15 acre to maintain	2013-2018	Reduce nitrogen by 27 lbs/ yr; Reduce phosphorus by 12 lbs/ yr; Reduce sediment by 9 tons/yr
	Establish permanent conservation easement program and protect 2 miles (50 ft width) of riparian corridor	Landowners, Watershed Co-ordinator, SWCDs, Clermont Park District, Clermont OEQ, NRCS, FSA; CRP, CREP, WRRSP Estimate $2,000-8,000 per acre easement/purchase	2013-2018	Reduce nitrogen by 108 lbs/ yr; Reduce phosphorus by 48 lbs/ yr; Reduce sediment by 36 tons/yr

Lick Fork sub-watershed Problem Statement #1				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce ni-trogen by 22 tons/yr; phosphorus by 5 tons/yr; sediment by 1,534 tons/yr	Implement cover crops, conserva-tion tillage on 250 acres (10%) of cropland	Watershed Coordinator, SWCDs, NRCS, FSA, local part-ners; EQIP, related programs; Cover Crops $30 per acre Conservation Tillage $15 per ac Seek funding sources/ programs	Ongoing	Reduce nitrogen by 1,000 lbs/yr; Reduce phos-phorus by 500 lbs/yr; Reduce sedi-ment by 500 tons/yr
	Install filter strips, riparian buffer strips on 200 acres of cropland	Watershed Coordinator, SWCDs, NRCS, FSA, local part-ners; CRP, CREP, related pro-grams; Estimate: $155/ac	Ongoing	Reduce nitrogen by 1,800 lbs/yr; Reduce phos-phorus by 800 lbs/yr; Reduce sedi-ment by 600 tons/yr
	Implement pre-scribed grazing on 300 ac (10%) of pas- tureland	Landowners, Watershed Coor-dinator, SWCDs, NRCS, FSA, local partners EQIP related programs	Ongo-ing	Reduce nitrogen loading by 335 lbs/yr; Reduce phopho-rus loading by 168 lbs/yr; Reduce sedi-ment by 105 tons/yr

Problem Statement #2

Nonpoint urban runoff is contributing 2 tons of nitrogen, .3 tons of phosphorus, and 97 tons of sediment to Lick Fork each year.

Goal

To reduce pollutant loadings from urban runoff by 75% and minimize future land use impacts.

Objectives

1. Reduce nitrogen loading from urban runoff by 1.5 tons per year.
2. Reduce phosphorus loading from urban runoff by .3 tons per year
3. Reduce sediment loading from urban runoff by 72 tons per year.

Lick Fork sub-watershed Problem Statement #2				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen by 1.5 tons/yr; Phosphorus by .3 tons/ yr; sediment by 72 tons/yr	Implement Balanced Growth land use planning strategies; Identify priority conservation areas, priority development areas;	Watershed Coordinator, SWCDs, Townships, local partners	Ongoing	Maintain impervious surface below 10%; Map priority conservation areas, priority development areas;
	Implement urban BMPs: Install 3 bioretention/rain gardens; 50 rain barrels; Bioswale demonstration project	Watershed Coordinator, SWCDs, Clermont Stormwater Dept., Townships, local partners U.S. EPA Urban BMP Perform-ance Tool; Clermont SWCD home-owner rain garden grants, Seek Funding Estimates: bioretention/rain gar-dens: $7-$30 per sq. ft.; rain barrels = $14-19 per sq. ft; bioswales: $1-3 per sq. ft.	2013-2018	Calculate stormwater runoff reduction, pollutant removal

Lick Fork sub-watershed Problem Statement #2				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce ni-trogen by 1.5 tons/yr; phos-phorus by .3 tons/yr; sedi-ment by 72 tons/yr	Draft and Im-plement ripar-ian setback ordinance	Watershed Coordinator, SWCD, Townships, local partners	2013-2018	Maintain and en-hance riparian cor-ridor protec-tion; Calculate stormwater runoff reduc-tion, pollut-ant removal

Problem Statement #3

Failing home septic systems are contributing .5 tons (1,333 lbs) of nitrogen and .2 tons (522 lbs) of phosphorus and an unquantified amount of pathogens to Lick Fork each year.

Goal

To reduce pollutant loadings from failing HSTSs by 75% and reduce pathogen loading.

Objectives:

1. Reduce nitrogen loading from failing HSTSs by .5 tons per year.
2. Reduce phosphorus loadings from failing HSTSs by .2 tons per year.
3. Reduce pathogen loading from failing HSTSs.

Lick Fork sub-watershed Problem Statement #3				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitro-gen by 998 lbs/yr; phos-phorus by 390 lbs/yr	Repair/replace 21 failing HSTSs	OEPA, Clermont Health Dis-trict, Watershed Coordinator, local partners; Seek funding	2013-2018	Reduce nitrogen by 910 lbs/yr; Reduce phosphorus by 345 lbs/yr; Reduce pathogen loading

Lick Fork sub-watershed Problem Statement #3				
Objective	Action	Resource Costs	Time Frame	Performance Indicators
Reduce nitrogen by 998 lbs/yr; phosphorus by 390 lbs/yr	Draft and Implement regulations for registration and testing of septic haulers, and proper application or dis-posal of septage	OEPA, Clermont County Health District, Watershed Coordinator, local partners; Existing Resources	2013-2018	Eliminate reports of illicit discharges or improper handling of septic waste; (Avg. 2 reports/ yr illicit discharge/improper handling)
	Conduct inventory/ inspections HSTSs in Stonelick Creek; Build upon existing home-owner education program	Health Districts (Clermont, Clinton, Brown, Warren Counties), Watershed Coordi-nator, partners; Seek grants/funding;	Ongoing	Complete inventory HSTSs in Stonelick Creek; Record # of individuals reached through education/outreach;
Maintain pathogen loading in range suitable for PCR	Monitor Stonelick Creek and tributaries to assess impacts from HSTSs , point source dischargers, and other sources	Clermont OEQ, SWCD, Watershed Coordina-tor; Existing resources; Seek additional funding;	Ongoing	E. coli standards within range suitable for PCR (below 161 colony forming units (cfu) per 100 ml for sea-sonal geometric mean or below 523 for single sample)
	Implement effective WWTP technologies and monitoring to reduce pollutant loading	OEPA, WWTPs, partners; Low interest loans, cost-share for WWTP upgrades	Ongoing	Meet NPDES permit limits; Reduce pathogen loading

Stonelick Creek
Watershed Action Plan

Appendices

PO Box 549
Owensville, OH 45160
clermontswcd.org/WatershedPrograms.aspx

APPENDIX A
Summary of Previous and Current Water Quality Efforts in the East Fork Little Miami River Watershed

History of Previous Water Quality Efforts in the Watershed

Upper East Fork, Little Miami River 319 Nonpoint Source Project
In 1991 the Soil and Water Conservation District's of Brown, Clinton, and Highland Counties received a Nonpoint Source Project Grant (319) for the headwaters region of the East Fork of the Little Miami River. The duration of the project was for 36 months beginning in April 1992 and ending in March 1995. The goal of the project was to accelerate technical assistance and educational activities to improve water quality and warmwater habitat in the project watershed. The project sponsors focused on five specific objectives to reach the project goal;

1. Protect and improve water quality in the East Fork of the Little Miami River.
2. Reduce sedimentation and nutrient loading to the East Fork Reservoir.
3. Increase cooperation between health departments, agricultural agencies and other public and private groups in identifying and solving non-point source problems.
4. Monitor existing stream quality to establish baseline data for future comparison to determine effectiveness of the project.
5. Educate health department's employees on use of soils information in designing on-site wastewater treatment systems.

Clermont County 319 Nonpoint Source Project

In 1998 the Clermont County Board of County Commissioners received a Nonpoint Source Project Grant (319) to perform bank stabilization in a section of Stonelick Creek. Stonelick Creek is a major tributary of the East Fork Little Miami River. The project was coordinated and completed by the Clermont County Engineer's Office. During the months of September and October of 1998 a three hundred foot stream-bank section of Stonelick Creek was stabilized using two different bank stabilization techniques; (1) rock weirs; (2) rootwad stabilization. The section of stream that was stabilized was located above the Stonelick Covered Bridge along Stonelick Williams Corner Road in Clermont County.

Clermont County Watershed Management Program

In 1995, Clermont County completed a Wastewater Master Plan that proposed a strategy to effectively treat wastewater throughout the County. As the County developed the plan, it quickly became evident that this alone would not protect the water quality of Clermont's streams and lakes. A number of other potential pollutant sources needed to be addressed if stream quality was to be protected. A comprehensive water resources management approach was needed. Soon after the development of the Wastewater Master Plan, the County initiated a watershed management process to better characterize water quality conditions, implement control measures to protect and improve water quality, and plan for future growth while preserving Clermont's natural character and environment.
In 1996, the Clermont County Office of Environmental Quality initiated a comprehensive monitoring

program to characterize stream conditions throughout the East Fork watershed. Since the inception of the program, OEQ has:

- assessed the physical conditions of stream channels,
- conducted annual biological surveys to evaluate the fish and macro-invertebrate communities and their habitat,
- conducted annual water quality sampling to monitor various pollutants,
- established five auto-sampling stations to continuously monitor conditions and collect samples during and after periods of rain.

In 1998, the Office of Environmental Quality began hosting public stakeholder meetings at various locations in the East Fork watershed. Early meetings focused on the basics of stream quality and watershed protection. Information on why water quality is important, both in terms of economics and quality of life, were presented at these meetings. As participants at these meetings began to build an understanding of water quality and watershed management issues, the issues presented became more specific and complex. Eventually, the regular public stakeholder meetings held by OEQ became the basis for establishing the East Fork Watershed Collaborative.

In 2000, Clermont County partnered with the Clermont Soil and Water Conservation District (SWCD), as well as the SWCDs in Brown, Clinton and Highland Counties, to participate in the Ohio Department of Natural Resources Watershed Planning Program. A grant was received to fund a Watershed Coordinator for the East Fork Little Miami River Watershed. The primary responsibility of the coordinator is to guide the development and implementation of watershed action plans for the entire East Fork watershed.

Current Efforts in the Watershed to Meet Water Quality Standards

East Fork Watershed Collaborative

The East Fork Watershed Collaborative (a.k.a. EFWC or the Collaborative) was formed in 2001 to provide local agencies, groups and individuals the opportunity to collaboratively plan and implement water quality improvement projects. The Collaborative's mission is "to enhance the biological, chemical and physical integrity of the East Fork Little Miami River and its tributaries."

The EFWC Steering Committee consists of representatives from four counties and five subwatersheds within the East Fork Little Miami River watershed. The Steering Committee is responsible for defining the scope and direction of the Watershed Program, and acting as liaison between the Collaborative and the local community.

The Collaborative organizes Work Groups to achieve specific tasks as needed. The formation and facilitation of Work Groups was the primary means for soliciting citizen input for the development of the East Fork Headwaters Watershed Plan and East Fork Lake Tributaries Watershed Plan.

The East Fork Watershed Collaborative has accepted the responsibility for developing a watershed management plan for the entire East Fork Little Miami River watershed. Due to the size of the East Fork watershed (500 mi^2 or almost 320,000 acres), and the variability in land use and stream conditions in various parts of the East Fork watershed, the Collaborative made a decision to divide the overall watershed into smaller (i.e., more manageable) subwatersheds for the purpose of planning.

The subwatersheds selected as planning units are the Lower East Fork watershed, the Middle East Fork watershed, the Stonelick Creek watershed, the East Fork Lake Tributaries, and the East Fork Headwaters. Subwatershed plans focus on concerns unique to each subwatershed, providing a detailed description of subwatershed characteristics and stream conditions (including causes and sources of impairments), and specific recommendations on how those impairments might be addressed. The Watershed Management Plan for the Lower East Fork was completed, submitted to Ohio EPA and Ohio Department of Natural Resources (ODNR), and endorsed by the State in 2003. The East Fork Headwaters Watershed Management Plan was submitted in May 2006 to Ohio EPA and ODNR and received endorsement in August 2006. The East Fork Lake Tributaries Watershed Management Plan was submitted and endorsed in September 2006. EFWC is currently developing, and expecting to complete and submit to Ohio EPA and ODNR by September 2006, watershed plans for Stonelick and Middle East Fork subwatersheds. Our final watershed management plan for the East Fork Little Miami River will integrate the five subwatershed plans into a coherent whole, highlighting the connections and differences among the subwatersheds.

The watershed planning process has led to an improvement in communication and cooperation among county offices and among the affected counties, municipalities and townships. An example of this cooperation can be seen in the partnership formed among Clermont County's Office of Environmental Quality (OEQ), Water and Sewer District and Health Department to draft and submit a Section 319 grant proposal in April 2003 (see below). Another example can be seen with OEQ and the County's Department of Planning and Economic Development, which worked together to plan and host a Low-Impact Development workshop in 2005. Additionally, years of effort by Clermont County to involve stakeholders in the planning process has resulted in a close relationship with the cities, villages and townships within the County.

Lower East Fork Watershed Management Plan

The Watershed Management Plan for the Lower East Fork was completed, submitted to Ohio EPA, and endorsed by the State in 2003[2]. That endorsement was the culmination of three years work by the Collaborative partners to develop a plan that would meet local water management goals as well as bring the Lower East Fork and its tributaries into use attainment. The Collaborative partners put together a comprehensive inventory of geology, soils, land use, demographics, and biological resources within the Lower East Fork region. Using Ohio EPA data and additional data collected by Clermont County between 1996 and 2002, the LEF Plan described current water resource conditions, and water quality trends. Based on Ohio EPA assessment and local experience, causes and sources of impairment were identified for the East Fork mainstem, as well as for the five major tributaries to the Lower East Fork. The Collaborative partners developed "problem statements" for each assessed stream segment that::

- Described the water resource conditions for that segment with identified causes and sources of impairment;
- Provided loading estimates for the pollutants of concern;
- Presented goals for each pollutant of concern, that, if met, should result in attainment of the assigned use designation;
- Detailed a suite of complementary strategies to mitigate point and non-point pollutant sources, and to restore streams and protect riparian areas; each strategy included specifics on responsible entity, how the strategy will be funded, when it will be implemented, and how performance will be measured.

The Collaborative partners are now implementing the Lower East Fork Watershed Plan. It is worth noting the following activities that will contribute to improved water quality in the Lower East Fork.

- The Clermont Sewer District is in the midst of some $30,000,000 of sewer system improvements that will eliminate SSOs, remove the trunk line from Shayler Run, extend sewers to areas with high concentrations of failing septic systems, and improve the quality of discharge from the Lower East Fork WWTP;
- The Valley View Foundation has partnered with the City of Milford to solicit WRRSP and Clean Ohio Funds to permanently protect over 100 acres of floodplain and riparian corridor along the Lower East Fork;
- Lower East Fork communities have significantly increased resources devoted to the management of stormwater quantity and quality. Phase II requirements will result in measurable improvements in pre- and post-construction stormwater controls, illicit discharges, and pollution prevention/good housekeeping. The City of Milford recently established a stormwater utility to address historic stormwater management issues as well as the requirements of Phase II, and to offer incentives for BMPs that lessen the impact of stormwater runoff. Clermont County is exploring the merits of a stormwater utility and recently hired a stormwater program coordinator to implement Phase II requirements;
- The Phase II communities in Clermont County are also conducting an aggressive campaign to increase watershed literacy throughout the County and East Fork watershed. Projects include installation of watershed signs, distribution of backyard BMP flyers, storm drain labeling, newsletter and newspaper articles, ...;
- The Collaborative partners are seeking funding to implement portions of the Plan for which there are inadequate local resources; the $335,000 Lower East Fork 319 Grant described below is an example;
- In recent public meetings held in the Hall Run watershed, residents voiced strong support for the proposed project and an interest in being more involved. There appears to be an excellent opportunity to create a “Friends of Hall Run” type group to promote good watershed citizenship, and stream and riparian BMPs. This group could serve as a model for other East Fork subwatersheds and other urbanizing watersheds in Southwest Ohio.

***Lower East Fork Section 319 Grant (Restoration of Stream Function and Water Quality Improvement in Tributaries of the Lower East Fork Little Miami River*)**

The East Fork Watershed Collaborative, in partnership with Clermont SWCD, Clermont County Office of Environmental Quality, Clermont County Health District and Clermont County Sewer District, recently received a $335,000 Section 319 Grant (FY2004) to address water quality impairments in the Lower East Fork watershed. The purpose of the Lower East Fork 319 (*Restoration of Stream Function and Water Quality Improvement in Tributaries of the Lower East Fork Little Miami River*) project is to improve water quality in Hall Run and Wolfpen Run, major tributaries to the Lower East Fork Little Miami River, in an effort to fully attain their WWH status. It is also expected that water quality improvement in these major tributaries will lead to significant improvement to water quality status of the Lower East Fork Little Miami River. The project has the following goals:

- to address habitat alteration and hydromodification in Hall Run, use natural channel design and management techniques to restore and enhance hydrologic and ecological function (in-stream/riparian habitat) of a stream segment in the Hall Run headwaters;
- to address habitat alteration and hydromodification in the larger East Fork watershed, use the

stream and riparian restoration in Hall Run to demonstrate natural channel restoration and management techniques, and other riparian BMPs, that can be applied in headwater streams throughout the East Fork watershed;

- to achieve the maximum amount of environmental benefit for the resources expended, coordinate the stream restoration activities with sewer improvement projects being conducted by the Clermont County Water and Sewer District;
- to reduce the number of failing septic systems (with associated nutrient and pathogen loadings) in the Hall Run and Wolfpen Run subwatersheds, employ an aggressive outreach/educational approach to improve awareness and understanding of septic system operation and maintenance, enroll additional homeowners in the Clermont Health District's Basic System Assessment inspection program, and repair or replace failing septic systems.

East Fork Headwaters Management Plan

The Watershed Management Plan for the East Fork Headwaters was completed, submitted to ODNR/ Ohio EPA, and endorsed by the State in August 2006. That endorsement was the culmination of three years work by the Collaborative partners to develop a plan that would meet local water management goals as well as bring the Headwaters and its tributaries into use attainment. The Collaborative partners put together a comprehensive inventory of geology, soils, land use, demographics, and biological resources within the Headwaters region. Using Ohio EPA data and additional data collected by Clermont County between 1996 and 2002, the Headwaters Plan described current water resource conditions, and water quality trends. Based on Ohio EPA assessment and local experience, causes and sources of impairment were identified for the East Fork mainstem, as well as for the 20 major tributaries to the East Fork Headwaters.
The Collaborative partners developed "problem statements" for each assessed stream segment that:

- Described the water resource conditions for that segment with identified causes and sources of impairment;
- Provided loading estimates for the pollutants of concern;
- Presented goals for each pollutant of concern, that, if met, should result in attainment of the assigned use designation;
- Detailed a suite of complementary strategies to mitigate point and non-point pollutant sources, and to restore streams and protect riparian areas; each strategy included specifics on responsible entity, how the strategy will be funded, when it will be implemented, and how performance will be measured.

Highland County East Fork Watershed Water Quality Improvement Project

In 2005 Highland County Soil and Water Conservation District partnered with the East Fork Watershed Collaborative and the Highland County General Health Department to submit an application for an Ohio EPA 319 Nonpoint Source Project Grant. The application was approved and the project began January 2006. The overall purpose of the project is to improve water quality in the Highland County region of the East Fork Little Miami River watershed in an effort to fully attain designated aquatic life use status (EWH, WWH). This is a part of the East Fork Headwaters subwatershed planning area. More specifically, the project will repair or replace failing septic systems, employ an aggressive outreach/educational approach to improve awareness and understanding of septic system design, operation and maintenance, and generally, reduce the number of failing septic systems (with associated reduction of nutrient, solids and pathogen loadings) in Highland County EFLMR water-

shed. The three main objectives are given below;
Reduce nutrient, solids, and bacterial loading, and organic enrichment from failing Home Sewage Treatment Systems (HSTS) in the EFLMR watershed.
Use a broad-based education and outreach effort to improve performance of Home Sewage Treatment Systems (HSTS) in the EFLMR watershed.
Conduct water quality monitoring to collect impairment data, measure outcomes, and get volunteer citizen participation.

East Fork Lake Tributaries Watershed Management Plan

The Watershed Management Plan for the East Fork Lake Tributaries was completed, submitted to ODNR/Ohio EPA, and endorsed by the State in September 2006. That endorsement was the culmination of three years work by the Collaborative partners to develop a plan that would meet local water management goals as well as bring the Lake Tributaries and its tributaries into use attainment. The Collaborative partners put together a comprehensive inventory of geology, soils, land use, demographics, and biological resources within the Lake Tributaries region. Using Ohio EPA data and additional data collected by Clermont County between 1996 and 2002, the Lake Tributaries Plan described current water resource conditions, and water quality trends. Based on Ohio EPA assessment and local experience, causes and sources of impairment were identified for the East Fork mainstem, as well as for the 22 major tributaries in the Lake Tributaries sub-watershed.

The Collaborative partners developed “problem statements” for each assessed stream segment that:
- Described the water resource conditions for that segment with identified causes and sources of impairment;
- Provided loading estimates for the pollutants of concern;
- Presented goals for each pollutant of concern, that, if met, should result in attainment of the assigned use designation;
- Detailed a suite of complementary strategies to mitigate point and non-point pollutant sources, and to restore streams and protect riparian areas; each strategy included specifics on responsible entity, how the strategy will be funded, when it will be implemented, and how performance will be measured.

Clermont County Office of Environmental Quality

Driven by a commitment to protect the County’s existing high quality of life and to support and encourage sustainable growth, the Office of Environmental Quality (OEQ) initiated a comprehensive watershed management program in 1996 to protect the EFLMR. Since that time the County has successfully:

- collected data from a comprehensive monitoring network including biological, chemical, and physical data sets
- developed a linked watershed modeling system of the watershed, lake, and river so that future growth issues can be studied and evaluated
- evaluated management options for control of sources to preserve and enhance tributary and riverine water quality
- developed the Ecological Data Application System (EDAS) database to store and process the water chemistry, biology, and physical stream assessment data
- sponsored the formation of a stakeholder group and conducted public outreach and education

efforts, including the development of report cards summarizing water quality and trends developed a site assessment tool to evaluate the impacts of new development on water resources became a U.S. EPA Project XL Community in September 2000, and completed a Quality Management Plan in August 2001 (subsequently approved by both Ohio EPA and U.S. EPA).

National Demonstration Project for Watershed Management

In September 2003, Clermont County received a $225,000 Section 104(b)(3) grant from the U.S. Environmental Protection Agency to develop an innovative approach to identifying key priorities for improving water quality in the East Fork Little Miami River watershed. This project used a unique and innovative approach that should result in the development of more successful watershed management strategies and improved stream conditions. Under this project, the County, with the help of Tetra Tech, developed a model that provides a statistical relationship linking physical and chemical stressors to biological response (i.e., fish and macro-invertebrate indices). This will provide a more accurate representation of the sources responsible for biological impairment, and thus enable the Collaborative to develop watershed management strategies that will result in marked improvements in stream quality.

While Clermont County and Tetra Tech took the lead on the modeling effort, all counties, municipalities and townships within the watershed will be involved in the strategy and implementation development process. The public stakeholder effort is being led by the East Fork Watershed Collaborative and the East Fork Watershed Coordinator. The first public meeting was attended by over 50 people from throughout the watershed, including representatives from Brown, Clermont, Clinton and Highland Counties.

The Project was completed in June 2006. The East Fork Watershed Collaborative is now exploring the possibilities of establishing different innovative watershed management strategies, including pollutant trading and watershed permitting, to implement the targeted management strategies. If it is decided that such strategies may achieve “superior environmental performance” compared to conventional management practices, Clermont County will work with both Ohio EPA and U.S. EPA to implement these under Project XLC.

Clermont County Sewer System Improvements

Clermont County is implementing many sewer infrastructure improvements in the Lower East Fork watershed. These improvements are detailed in the “Clermont County 5-Year Wastewater Capital Improvement Plan (2003-2007)”. Several of the major projects within the Lower East Fork watershed are summarized in the attached Problem Statements from the Lower East Fork Watershed Management Plan. Those improvements include:

$2,000,000 for extension of sewers into currently unsewered areas. This includes areas with concentrations of failing septic systems in the Hall Run and Wolfpen Run subwatersheds;

$6,000,000 for update of sewer mains and removal of all SSOs from the Hall Run subwatershed to be completed 2006;

$20,000,000 for replacement of the trunk line in Shayler Creek to be completed in 2007;

Renovation of the Lower East Fork WWTP to be completed in 2007.

NPDES Phase II Stormwater Program

A total of 15 communities in Clermont County, including the County itself, were designated as urbanized areas and thus required to submit a Phase II stormwater management plan to Ohio EPA by

March 10, 2003. Early in 2002, a group of leaders from affected communities formed a Stormwater Task Force to help the County, municipalities and townships meet the Phase II requirements. This group determined that the most cost effective and efficient approach for addressing the requirements was to develop and implement a regional approach that utilized existing programs to the greatest extent practical. As a result, 13 of the 15 communities jointly developed and submitted a stormwater management plan and applied for a Phase II general permit in March 2003. Only the City of Loveland, which is located in portions of three separate counties, and Tate Township, which applied for an exemption (as only 0.09 square miles are within the urbanized area), did not participate. The amount of cooperation among the different communities illustrates the type of commitment necessary to solve water management problems at a watershed scale.

Since the submittal of the plan, several projects are underway to implement the six minimum controls. There is an extensive public education and notification in place. Many of these activities are being implemented by the East Fork Watershed Collaborative, as well as the Clermont County Soil and Water Conservation District (SWCD) and the Office of Environmental Quality (OEQ). One particular program of note is the joint stormwater web site developed by OEQ and graduate students from Miami University's Institute of Environmental Sciences. The web site can be viewed at www.oeq.net/sw/. In addition, the students provided a review of county, municipal and township pollution prevention programs already in place and made recommendations to each community for improvement. This project was completed in May 2004. While the number of projects contained in the County's stormwater management plan are too numerous to discuss in detail, two deserve special notice. These include a regional stormwater best management practice (BMP) manual being developed by Clermont County, Northern Kentucky Sanitation District, and Louisville MSD, and a Low Impact Development workshop hosted by the Clermont County Storm-water Department and the Center for Watershed Protection in February of 2005.

Regional Stormwater BMP Manual

In 2003, the Clermont County Office of Environmental Quality began a joint effort with the Sanitation District No. 1 of Northern Kentucky and the Louisville & Jefferson County (KY) Metropolitan Sewer District to develop a regional manual of post-construction stormwater management practices. By combining resources, the three agencies are able to develop a product they would not have been able to complete alone. This manual will include information for a variety of BMPs with details on their cost, installation procedures, maintenance requirements, and their effectiveness at reducing the levels of different stormwater pollutants. This manual will serve as a valuable resource for local planning departments and members of the development community as they design post-construction stormwater controls for new development. Currently, the manual is in its final draft form and is being reviewed by representatives of three cooperating agencies. A final manual will be available by the end of 2005.

Low Impact Development Workshop

As mentioned in Ohio EPA's 2004 Integrated Water Quality Monitoring and Assessment report, urban runoff is one of the primary sources of stream impairment in the East Fork watershed. Clermont County is seeking to work cooperatively with local planning departments, zoning commissions and members of the development community to address the problem of stormwater runoff. As part of this effort, the Clermont County received an Ohio Environmental Education Fund grant from Ohio EPA in the amount of $11,850 to conduct a low impact development workshop in the early part of

2005. Through this grant, the County contracted with the Center for Watershed Protection to lead the workshop. The agenda for the workshop was developed by an organizational committee comprised of local planners, developers, engineers, and representatives of the Homebuilders Association.

On the day following the workshop, Clermont OEQ hosted a tour of developments that have successfully used designs to minimize stormwater impact. This workshop and tour provided the development community (including planners, developers, engineers, contractors, and zoning and code enforcement officials) with information that will enable them to meet Phase II permit requirements, minimize problems associated with flooding, and become more involved in the watershed management process.
The workshop and tour was held in February 2005, with attendance just over 100. Educational materials, including a workshop CD, were provided as part of the workshop.

Education and Outreach

The East Fork Watershed Collaborative applied for and received two grants to purchase canoes to use for the East Fork river Sweep, Adopt-a-Waterway and other educational programs. The Collaborative received a $11,160 grant from the Boating Safety Education Program of the Ohio Department of Natural Resources, Division of Watercraft, and a $4,980 grant from the Ohio Environmental Education Fund to purchase 16 canoes, two canoe trailers, life vests, and paddles. With the purchase of the canoes mentioned above, the East Fork Collaborative is looking to expand our Adopt-a-Waterway program. Groups of any size (companies, non-profits, civic organizations) can adopt a stream segment of 2-3 miles length, similar to the Adopt-a-Highway program. The Collaborative provides canoes, trash bags, gloves and trash pick-up for two events each year. There are about 40 “canoeable” miles of the East Fork that could be adopted, and a number of smaller tributaries that would also benefit from an annual clean-up.

On June 14 of 2005, the Clermont County Green Team (Park District, Office of Environmental Quality, Soil and Water Conservation District) teamed with the Harsha Lake U.S. Army Corps of Engineers office and Batavia Township to remove 104 tires from the East Fork River near Elklick Road. The Collaborative is also hosting educational canoe floats on the East Fork during which local elected officials, other community leaders and landowners learn more about how streams function. During two floats in summer of 2005 attendees heard a historical overview of the area, with a special emphasis on the East Fork River, from Rick Crawford a Clermont County historian. They also discussed opportunities for managing stormwater quantity and quality, and canoed two miles of the East Fork Little Miami River. Stream biologists from the Ohio Department of Natural Resources used an electrical shocking technique to sample the type of fish found in this segment of the East Fork. The biologists shared what they found, highlighting fish species indicative of the good water quality in the East Fork.

As part of a region-wide public awareness campaign called Project SIGNS, watershed signs with tributary names have been posted at about 30 stream crossings in the East Fork Watershed, and about 250 stream crossings throughout the Tri-state area. The Collaborative received a $1000 Watershed Awareness to Watershed Action (WAWA) grant from the ODNR to purchase and install watershed signs at stream crossings in the upper portion of the East Fork watershed.

East Fork Website

The East Fork Little Miami River Watershed website is a useful tool for informing and involving the local communities. Information on local projects, programs and events is included, and the Watershed Action Plans are available to be viewed and downloaded. There are maps and general descriptions of the East Fork, as well as links to other educational resources pertaining to water resource protection.

To bolster the website as a tool for communication and action, the Collaborative plans to make updates that will allow visitors to sign up as Collaborative Extension members. Visitors who sign-up as members will receive the East Fork Newsletter, email announcements of upcoming event and information on volunteer opportunities. The aim is to capture the contact information of interested individuals, provide opportunities for watershed action, and ultimately, build a database of local contacts to establish a community network within the watershed. Additional upgrades and visual enhancements will also be added to the website as resources become available.

APPENDIX B

Report on a reexamination of the mussels of the Little Miami River and its major tributaries: Final Report, end of year two

Michael A. Hoggarth and Marshall H. Goodman Department of Life and Earth Sciences Otterbein College Westerville, Ohio 43081 Final Report 15 November 2007

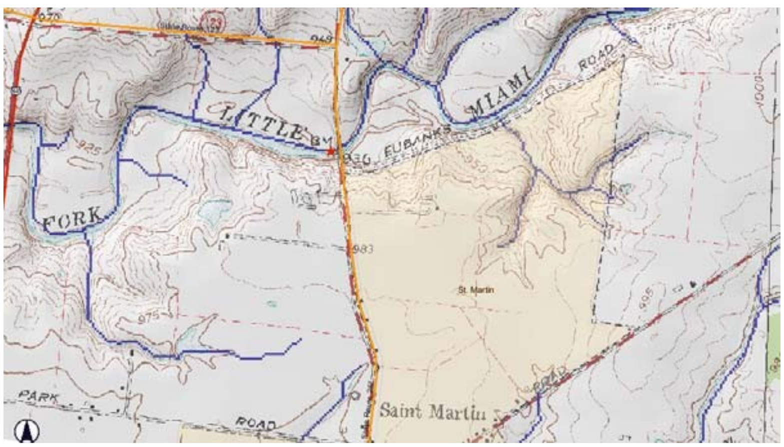
Executive Summary

During the summers of 1990 and 1991 Hoggarth (1992) examined the mussels of the Little Miami River system by sampling mussels at 105 sites throughout the watershed. The objective of the current study was to reexamine the best of those sites in order to determine the existing mussel resources in the watershed. A total of 26 sites were sampled in the mainstem, 10 sites were sampled in the East Fork, three sites were sampled in Todd's Fork, and two sites were sampled in Caesar Creek. Most of these sites were sampled in 1990/91. During that original study, Hoggarth (1992) noted that the mussel fauna in the river was at a crossroads: one third of the 35 extant species were in no danger of being lost, one third were in danger of being extirpated, and one third were represented by non-viable populations. He warned that if water quality and habitat quality were allowed to suffer, the mussel fauna would suffer as well.

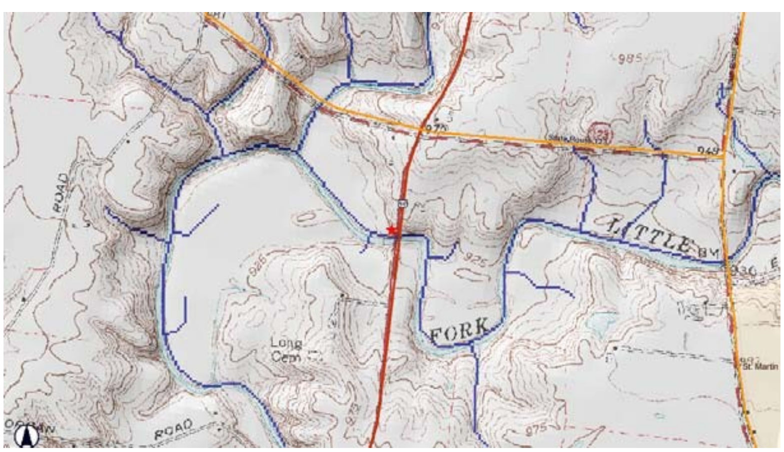
The current study confirms these earlier dire warnings. The mussel faunas of all four streams examined during this study have declined. The upper mainstem (headwaters) has lost most of its original diversity including headwaters species of mussels not found in the lower reaches of the river. The middle section of the mainstem was degraded in 1990/91 and it has not improved. The lower reaches have more diverse mussel faunas, but much of this diversity is due to the introduction of species of mussels that use the freshwater drum as host. These species have been increasing in numbers and distribution throughout the state. The East Fork has experienced similar species loss and species replacement. Todd's Fork and Caesar Creek have essentially lost all of their mussels (at least from the lowermost five kilometers of Todd's Fork and from the dam to the mouth of Caesar Creek). Both of these reaches supported good mussel faunas in 1990/91. A Mussel-IBI constructed in part to compare the historic community structure with the recent data demonstrates a nearly 10 point (one fifth the value of the index) decline from 1990/91 to 2006/07 in the mainstem and the East Fork and a 20 point decline in Todd's Fork and Caesar Creek. Water quality problems appear to be the most significant problems threatening the mussels in the mainstem and the East Fork, while competition with introduced mollusks (*Corbicula fluminea* and *Dreissena polymorpha*) appear to have negatively impacted the mussels in Caesar Creek, and habitat quality (especially excessive siltation) appears to be the most significant factor limiting the mussels in Todd's Fork.

Still there were some positive discoveries during the current study. Two species of mussels thought to be extirpated from the system (Hoggarth, 1992) were found alive in the mainstem (*Megalonaias nervosa* and *Actinonaias ligamentina*). The former species is an Ohio Endangered Species. In addition, *Quadrula nodulata* (Ohio Endangered Species) was found in the mainstem and the East Fork. In addition to these discoveries, some reaches of the mainstem and the East Fork have retained their mussel diversity and either scored as well or better on the Mussel-IBI than they did in 1990/91. The most significant recommendations made in this report are to fix the sedimentation issues in Todd's Fork and improve water quality throughout the system. The midsection of the mainstem was unsuitable for mussels in 1990/91 and it still is today. Improving water quality will give the mussels in the lower reach of the mainstem access to reaches in the upper watershed as well as the tributary streams. Providing connectivity among the mussels and fish will improve both resources.

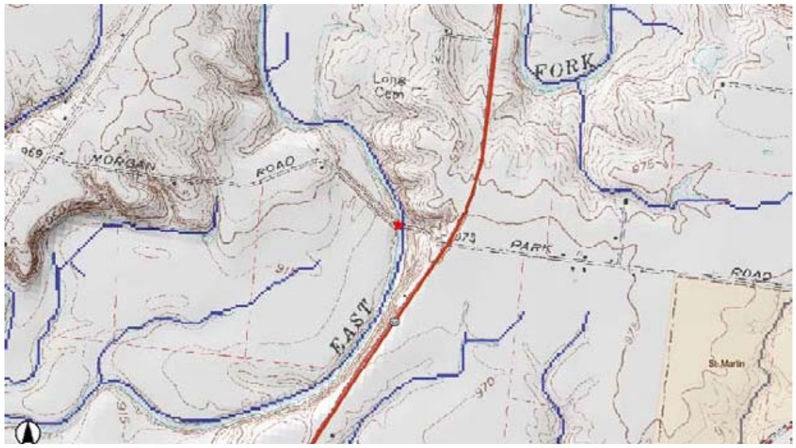
East Fork Sampling Sites



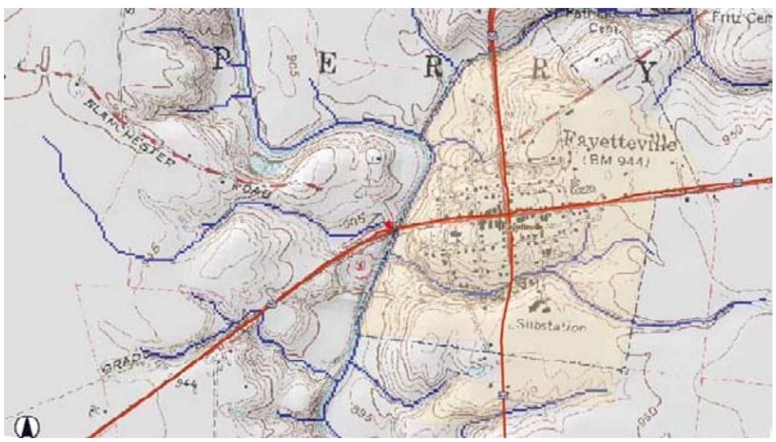
Site 19



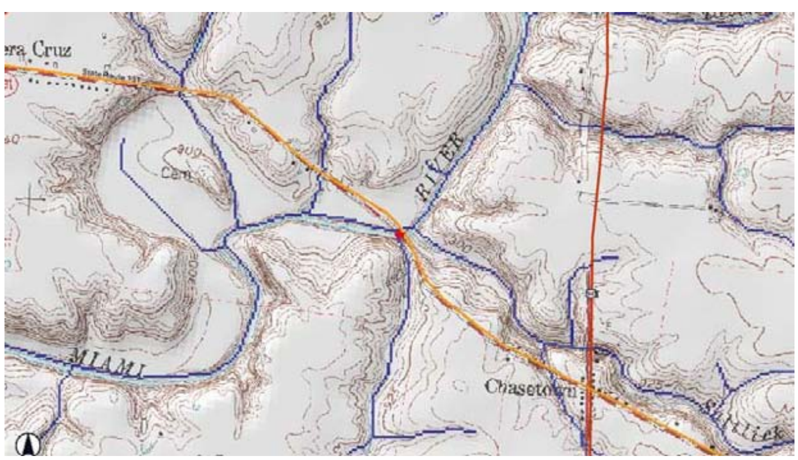
Site 20



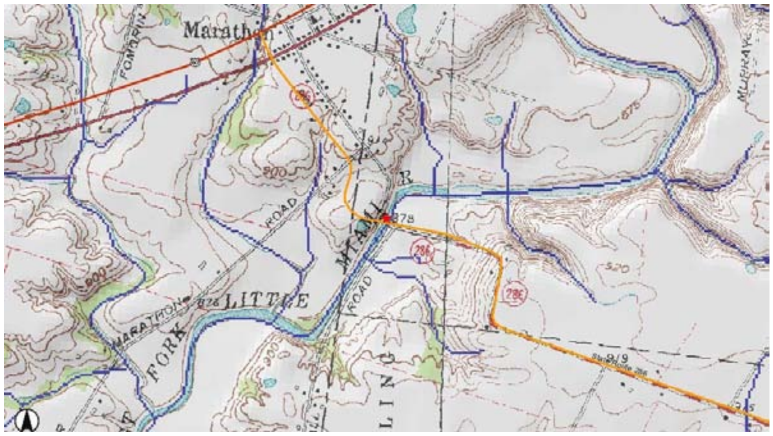
Site 21



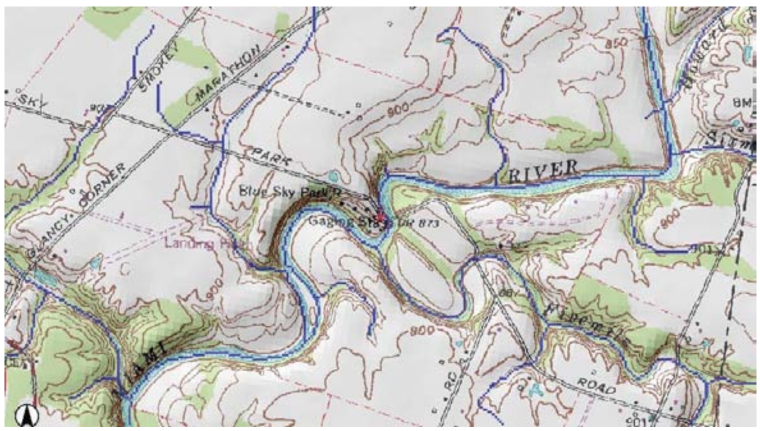
Site 22



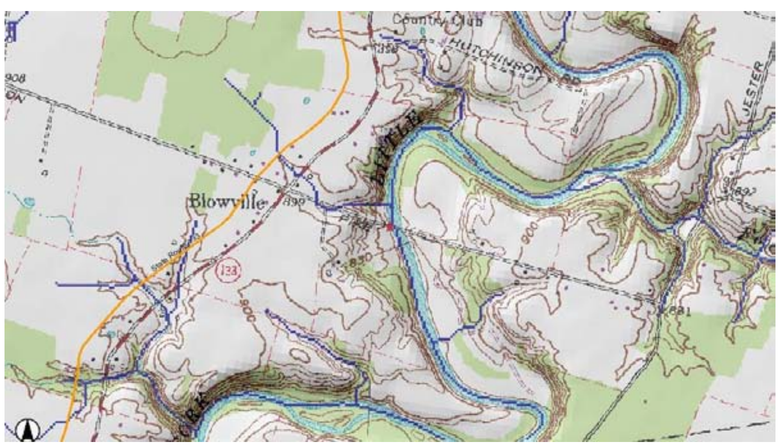
Site 23



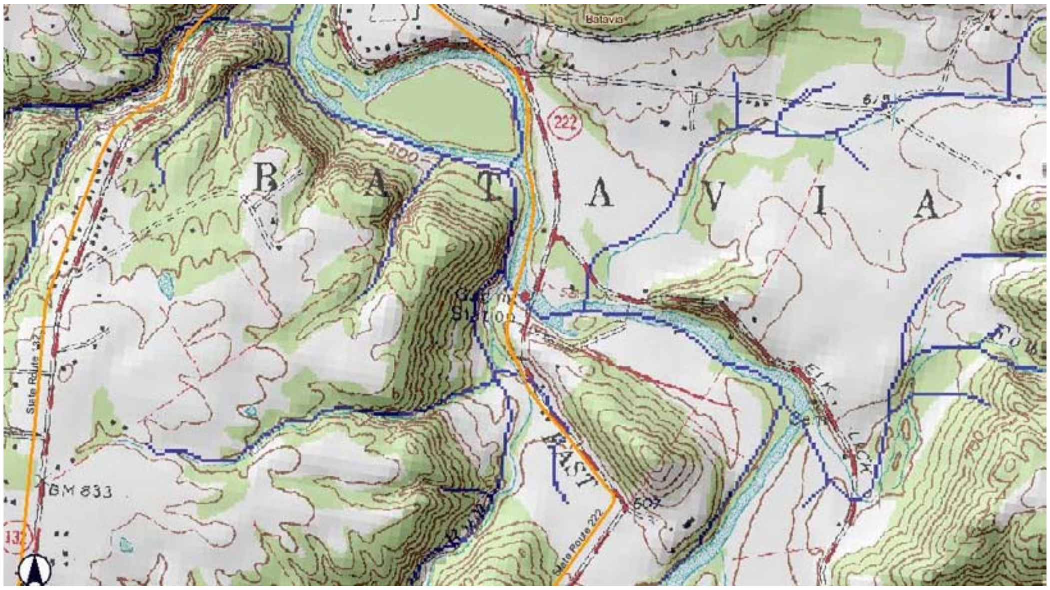
Site 24



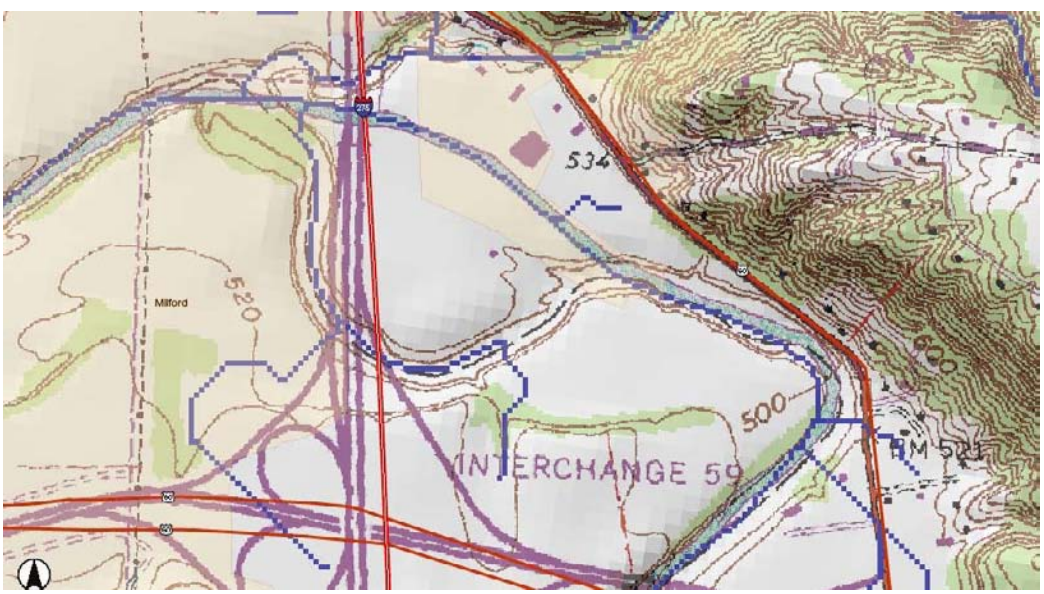
Site 25



Site 26

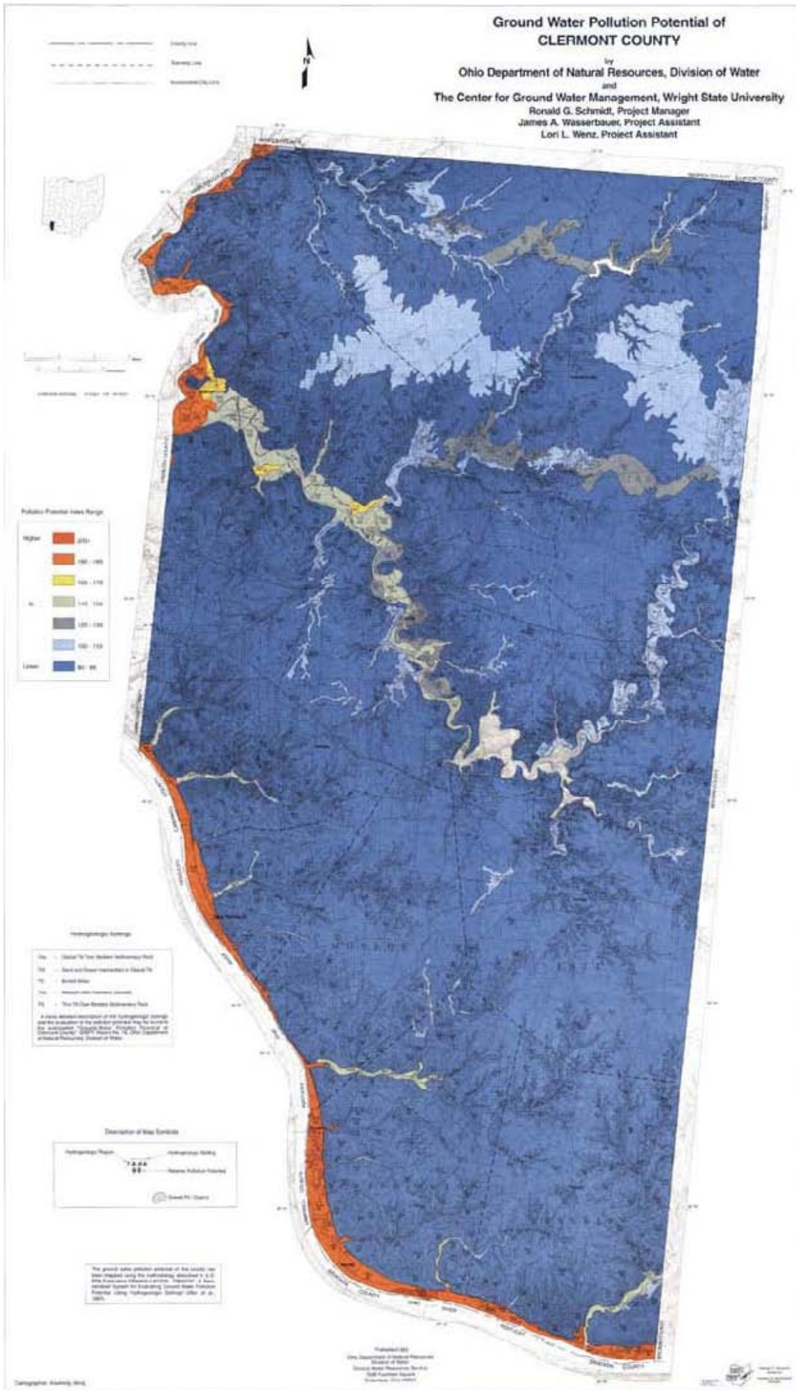


Site 27



Site 105

APPENDIX C
Ground Water Pollution Potential Map for Clermont County



Source: http://www.dnr.state.oh.us/water/gwppmaps/

APPENDIX D Chemical Use Analysis and Tillage Practices of the Entire East Fork Little Miami River Watershed

This Appendix presents the chemical use analysis data of agriculture, horticulture, and highway/infrastructure chemical use throughout the entire East Fork Little Miami River watershed obtained during the 1997 Land Use and Chemical Analysis study conducted by Clermont SWCD and OSU Extension completed in May 1999.

Agricultural Chemical Use Analysis

Preserving and improving the quality of the water resources of the EFLMR watershed are two key goals. With the increasing demands upon Lake Harsha to be a reliable source of clean, safe drinking water, it is imperative that a proactive approach be taken to ensure that this valuable resource be maintained. With 50 percent of the watershed being in some form of agricultural utilization, efforts are certainly needed to address concerns that are associated with this industry.

Corn acreage within the watershed was 47,685 in 1997. Based on the information collected, 90 percent to 95 percent of this acreage received some form of atrazine herbicide. Most farmers are using the chemicals at the rate of two pounds of active ingredient per acre. This would indicate that between 43,000 and 45,500 acres will have atrazine applied for weed control. This would translate to atrazine applications between 86,000 and 91,000 pounds. Harness was another herbicide that was used on the remaining 2,300 to 4,500 acres. Harness and atrazine are restricted pesticides and have a ground water advisory statement.

Table I provides an inventory of chemicals associated with corn production and the estimated total amount of each herbicide applied in the watershed during 1997.

Table I Estimated Chemical Use in Watershed - Corn Production

Chemical Name	% Use Watershed	Total Acres	Total Amount
Etrazine 4L (Bladex & Atrazine)	46%	1,897	2,371 qts.
Bicep II (Dual II & Atrazine)	36%	1,477	2,954 qts.
Harness	12%	519	519 qts.
Lariat (Lasso & Atrazine)	4%	159	636 qts.
2,4-D	2%	71	35 qts.
Total	100%	4,123	N/A

Herbicides

Atrazine is the corn herbicide that has received considerable attention regarding water quality. Restrictions regarding the use of this chemical have increased in recent years. Farmers are more aware of the concerns surrounding the use of this herbicide. Restrictions are in place that limits application within 200 feet of a lake or reservoir. A 66 foot buffer strip has been established for application near a stream. If the land is highly erodible, the 66 foot buffer zone must be planted in a cover crop. For mixing and loading, a 50 foot set back is required to protect wells and streams.

With the financial pressure and small profit margins (or no profit) that has existed for the past three years, the use of atrazine is likely to continue. Atrazine currently provides the best weed control for the dollar spent. As the Roundup Ready corn becomes more available and affordable, this technology should become more acceptable. Farmers are aware of the concerns surrounding atrazine and do not want more restrictions or the complete loss of this valuable herbicide. Chemicals are expensive and farmers can not afford to waste money.

Other herbicides applied within the watershed are Dual II, Bladex, 2,4-D, Lasso, Harness and Roundup. These chemicals are typical applied with atrazine or in a pre-mix combination.

Nearly double that of the corn acreage, soybeans were the major crop grown in the watershed during 1997. The 88,823 acres represents 56 percent of the total production agricultural land. The herbicide of choice is Roundup. With the advantages that exist with Roundup from an economic stand point, weed control results and reduced labor costs, the use of this technology will continue to increase. In 1999, there could be a 65 percent to 75 percent use of Roundup Ready soybean across the watershed. In those areas where the utilization of this technology has lagged behind, the trend is that more farmers are adopting this method. The areas of the watershed that produce the majority of the soybean are presently utilizing this technology on 75 percent of the acreage. With the advantages associated with the use of Roundup from both the farmers' viewpoint and a water quality standpoint, this certainly presents an encouraging picture for the future.

Due to the combination of herbicides such as Tricept, Squadron, Turbo and Canopy the total amount of each specific chemical is more difficult to determine. For example, Sencor was applied to 19 acres not 111 because of the pre-mix Turbo. Sceptor was applied to a total of 1,819 acres not 481 acres due to the application of Squadron and Tricept. The survey did not indicate a large number of acres with Roundup even though there is an extensive amount of Roundup Ready soybean being grown in the watershed.

Table II lists the estimated chemical use in the watershed for the production of soybeans.

Table II Estimated Chemical Use in Watershed for Soybean Production

Chemical Name	Total Acres	Total Amount
Canopy (Classic & Lexone)	1,346	210 qts.
Turbo (Sencor & Dual II)	1,048	1,376 qts.
Dual II	334	443 qts.
Sencor	111	42 qts.
Squadron (Sceptor & Prowl)	329	494 qts.
Tricept (Sceptor & Treflan)	1,009	1,160 qts.
Sceptor	481	32 qts.
Assure II	542	13 qts.
Roundup	247	247 qts.
Lasso	104	234 qts.
Pursuit	203	25 qts.

Fertilizers

Fertilizers are also a concern when considering water quality. Based on the Ohio Agricultural Statistics and Ohio Department of Agriculture Annual Report an expected yield of 140 bushels is reasonable for the watershed. The Tri-State Fertilizer Recommendations for corn for this desired yield would be 160 pounds of nitrogen per acre. Data collected would indicate that farmers (83 percent) are using 200 plus pounds per acre. Based on the corn acreage of 47,780, nitrogen application is between 7,644,800 and 10,511,600 pounds of actual nitrogen in the watershed. Corn is very dependent upon nitrogen for high yields. It would appear that farmers are applying too much nitrogen. Applying 220 pounds of nitrogen per acre should produce 180 plus bushels per acre. This would appear to be a waste of money for the farmers and may be exposing the water resources to nearly 3,000,000 pounds of nitrogen that is not required. An educational effort is necessary to inform farmers regarding this matter.

Phosphorus is the second major nutrient of concern. The recommendations for phosphorus are harder to state in an across the board application due to varying levels of soil fertility, pH and the cation exchange capacity of the soil. To produce one bushel of corn, phosphorus is required at the 0.37 pounds per acre (P_2O_5) rate. This is strictly a maintenance level of production. To produce 140 bushels of corn per acre a farmer would need to apply 52 pounds of actual phosphorus per acre. If average fertility levels (30 to 60 pounds/acre) exist in the field then this application rate would be adequate. Application rates can exceed 100 pounds per acre if soil fertility levels are low. If soil fertility is below average (20 pounds available/acre), to produce a 140 bushel yield would require an additional 75 pounds of actual phosphorus.

Based on the data collected from the farmers' survey and the vendors' responses, farmers would appear to be applying excessive phosphorus. This data would indicate that 70 percent of farmers are applying phosphorus at the rate of 90 pounds or more per acre. Application of 100 pounds or more are being applied by 63 percent of the farmers surveyed. If application rates were reduced by 40 pounds/acre across the watershed there would be a reduction of 1,911,200 pounds of actual phosphorus applied.

The third nutrient of concern is potassium. Corn harvested as grain removes 0.27 pounds of K_2O/acre. However, to make a potassium application recommendation that would be applicable to all farms is more difficult than phosphorus. The reason being the numerous combinations of soil fertility level, cation exchange capacity, and desired yield. An average soil test would have a soil fertility level of 200 to 260 pounds/acre, a CEC of 10 and desired yield of 140 bushels /acre. An application of 60 pounds/acre of actual potassium would be required. Data collected would indicate that farmers are applying too much potassium. Vendors stated that farmers are applying between 100 to 140 pounds/acre. The surveys indicated that farmers are applying potassium at the rate of 120 to 149 pounds/acre (27 percent) and 150+ pounds/acre (68 percent). It would appear that double the recommended amount of potassium is being applied. A reduction of 60 pounds/acre would result in 2,866,800 pounds of potassium not being applied.

As stated previously, some farmers could be applying higher rates of phosphorus and potassium to their corn crop to provide nutrients for the next year's soybean crop. Not all farmers utilize this farming practice. A corn/soybean rotation is not practiced by all farmers. Excessive nitrogen is being applied and it is very likely that phosphorus and potassium are being applied at rates that are higher than recommended.

Farmers in the watershed are producing 88,729 acres of soybean. Approximately 75 percent of this acreage receives zero nitrogen. The remaining acres have less then 30 pounds/acre of nitrogen applied. The impact on water quality is not a concern.

Phosphorus is removed at the rate of 0.80 pounds/bushel produced. A typical field would need 30 to 40 of P_2O_5 pounds/acre to produce a yield range of 40 to 50 bushel/acre. The vendors indicated that farmers are purchasing between 50 to 90 pounds of phosphorus per acre. Farmers indicated that they are utilizing 60 to 100 pounds/acre (64 percent), 30 to 59 pounds/ acre (20 percent) and 0 to 29 pounds/acre (16 percent). Based on this information, farmers are applying phosphorus at rates that are excessive. If 70 percent of farmers would reduce their application rate by 40 pounds/acre there would be a reduction of 2,484,412 pounds across the watershed.

Soybeans remove potassium at the rate of 1.40 pounds/bushel harvested. A yield of 40 to 50 bushels/acre would consume 56 to 70 pounds/acre. Tri-State Fertilizer Recommendation for a field with average fertility characteristics of 200 to 260 available K and a CEC of 10, producing a 40 to 50 bushels/acre yield would be 75 to 90 pounds/acre. The vendors indicated that farmers are applying potassium at the rate of 75 to 110 pounds/acre. The survey indicated that 29 percent of the farmers are applying K at the recommended rate. Application rates of 150 to 180 pounds/acre were being utilized by 47 percent of the farmers surveyed. An additional 8 percent were applying K at the rate of 120 to 149 pounds/acre. This would suggest that 55 percent of the farmers are applying excessive K. If application rates would be reduced by 50 pounds/acre in the highest application range, a 2,085,131 pound reduction would result. Additional reduction would occur if the additional 8 percent would bring their application rates more in line with recommendation levels.

Wheat production is limited in the watershed. Few chemicals are utilized in the production of the wheat crop. Fertilizer usage falls in the recommended range. The impact upon water quality would be very limited.

Tobacco acreage is extremely small in the watershed. The use of fertilizers can be heavy, especially nitrogen. Chemical usage for insect and disease control is more prevalent than for other crops. Due to the small acreage the overall impact to water resources is limited.

Forage production is not utilizing fertilizers and chemicals to any great extent. The impact on the watershed is very limited.

Horticultural Chemical Use Analysis

This section addresses the status of chemical application by homeowners and horticultural businesses in comparison to the official recommendations of Ohio State University Extension. This section is divided by the types of horticultural operations including home lawn care, grounds maintenance, golf course, nursery/greenhouse, fruits, and vegetables.

Home Lawn Care

Home lawn care involves many horticultural practices such as proper grass selection, seeding, mowing, water, core aeration in addition to lawn fertilization, weed control, and pest management. Typically a recommended fertilization program is a four step program. Fertilizers should be applied once in May, once in July, once in September, and once more in November. However, if someone only fertilizes their lawn once, late fall fertilization should be the best option. If two lawn fertilizations are made, fertilization once in late fall, and once in spring would work well. Fertilizer ratios of 3-1-2 to 5-1-2 are preferred. The recommended rate is about 0.5 to 1.5 pounds actual nitrogen per 1,000 sq. ft. One recommended fertilizer for home lawn is the one with N-P-K ration of 24-4-12 at 2 to 4 pounds per 1,000 sq. ft.

The fertility programs used by national lawn care companies are typically 4 to 5 steps, similar to what Ohio State University Extension recommends for a high maintenance program. The fertility programs by local lawn care companies varied greatly based on the knowledge of business owners. There is a great deal of fertilizer application misuse by both homeowners and some lawn care companies. One good example is the application of fertilizers 10-10-10 or 19-19-19 for grasses instead of recommended N-P-K ratios of 3-1-2 to 5-1-2. This practice resulted in the over application of phosphorus and potassium, and under application of nitrogen. Some of the commercial blends like Scotts' or TrueGreen ChemLawn lawn fertilizers have too much nitrogen, and too little phosphorus and potassium.

Weed control programs in home lawns are pretty standard. Many homeowners applied pre-emergent herbicides for the control of crabgrasses in late winter to early spring as recommended by manufactures. For broadleaf weeds, many homeowners or commercial companies applied 2,4-D, Dicamba, and MCPP as recommended. However, these products were put down too early resulting in the application of additional herbicides later in the season. Best timing for dandelion control is when it reaches puffball stage. That developmental stage is typically May.

For insect control such as white grubs, misuse of insecticides is much more widespread. Many garden centers start selling grub control chemicals in spring. That leads to the application of many insecticides at the wrong time. The correct timing for most grub control materials is in late July and early August. One chemical that should be applied earlier is GrubEx. The proper timing for GrubEx is mid May.

Grounds Maintenance

Many grounds maintenance companies are involved in mulching, fertilization, weed control, and pesticide. There is a very large variation among these companies in terms of the levels of expertise. There are many hundreds of ornamental plant species with 10 to 15 common insect and disease problems. Misdiagnosis does occur and leads to misapplications of pesticides. The companies we received survey responses from did not seem to fall in that category since they make use of Extension offices, attend pesticide applicator training, and tend to follow recommendations by Ohio State University Extension.

Golf Courses

Golf course superintendents go through intensive training each year since golfers and greens committees demand perfection. Several pesticides and fertilizers are applied on the golf courses. Most of golf courses follow the recommendations by Ohio State University Extension very closely. Based on the survey received from one golf course superintendent in Brown County, it appears that very little misuse exists.

Nursery/Greenhouses

There are several small nurseries and greenhouses located in the watershed. Many bulletins have been developed for specific crops in the floriculture industry by Ohio Florists' Association in close cooperation with Extension specialists at Ohio State University. Most nursery and greenhouse growers tend to spray less than what are recommended in OSU Extension bulletins. For example, there are bulletins on geraniums, garden mums, bedding plants, and hanging baskets. With nurseries, growers can grow an assortment of trees, shrubs, perennials, ground covers, and ornamental grasses. No two growers have identical crop makeup in either nurseries or greenhouses, especially with smaller operations. Many growers will purchase plants from other growers (to resale), in addition to the plants they grow themselves. Generally chemical application by our greenhouse and nursery growers is very low, mainly due to higher tolerance to insects, diseases, and weeds compared to that of flower growers in Western parts of Cincinnati or nursery growers in Lake County, the nursery capital of the mid-west.

Fruits

The recommended spray programs are listed in the OSU Extension bulletins “Commercial Tree Fruit Spray Guide” and “Commercial Small Fruit and Grape Spray Guide.” A typical spray program for apple trees is listed in Table III.

Table III Spray Program for Apple Trees

Developmental Stages	Insecticides	Fungicides
Dormant to silver tip	None	Bordeaux mix plus oil and Ridomil 2E if needed
Green Tip	Apollo SC at 4-8 fl. oz for mite control	Benlate 50 WP at 8-12 oz./acre or fungicides
Half-inch green	Thiodan 3 EC at 2.67 - 4 qt./acre or other insecticides	None
Tight cluster	Savey 50 WP at 4-8 fl./acre or other miticides	Mancozeb 80 WP at 3 lbs./acre or other fungicides
Pink	Carzol 92% SP at 2 lbs. Per acre or other insecticides.	Bayleton 50 DF at 2-8 oz plus Captan at 6 lbs. per acre or other fungicides
Bloom	None to save honeybees!	Fungicides plus Streptomycin 17 W at 2 lbs. per acre
Petal Fall	Guthion 50 WP at 2-3 lbs. Per acre and Lannate 90 SP at 1 lb. per acre	Nova 40 WP at 5-8 oz. per acre
First and second cover	Ziram 76 DF at 6-8 lbs. per acre or other insecticides	Mancozeb 80 WP at 3 lbs. per acre or other fungicides
Third cover	Sevin EXL at 3-4 qt. per acre or other insecticides	Captan 50 WP at 6 lbs. per acre or other fungicides
Summer cover sprays	Imidan 70 WP at 2.13 - 5.3 lbs. per acre or other insecticides	Captan 50 WP at 6 lbs. per acre or other fungicides

Spray programs are developed from many years of field research. In the watershed, fruit growers with significant acreage follow the spray programs very closely. The common fruits grown in the watershed are apples, pears, peaches, blackberries, blueberries, and raspberries. Growers with few fruit trees and bushes sprayed very little since they do not depend on the fruit production as a significant source of their income.

In general, successful fruit growers make use of both soil testing and tissue testing for their fertilizer recommendations. The desirable soil test maintenance levels are listed in Table IV.

Table IV Desirable Soil Test Maintenance Levels

Nitrogen	Phosphorus	Potassium
40 to 150 lbs. of N per acre	30 - 90 lbs. of available P per acre	200 - 400 lbs. of exchange-able K per acre

A fruit grower in Clermont County did not apply fertilizers in his orchard in 1997 while another grower in Highland County (outside the watershed) applied 250 pounds. of nitrogen, 125 pounds of phosphorus, and 125 pounds of potassium. One grower experienced severe under fertilization while the other experienced over application of nitrogen and phosphorus.

Vegetables

Common vegetables grown in the watershed are tomatoes, peppers, pumpkins, green beans, and sweet corns. Chemicals labeled for each crop are different. The fertility program for tomatoes is listed in Table V.

Table V Fertility Program for Tomatoes

Nitrogen	Phosphorus (P_2O_5)	Potassium (K_2O)
Broadcast 60-80 lb N/A prior to planting. Sidedress with an additional 30-60 lb N/A with calcium nitrate.	100-175 lbs.	200-350 lbs.

Vegetables are definitely not pest free. There are many pesticides that need to be applied on vegetable crops if high quality crops are expected. Vegetable growers seem to have applied much fewer chemicals than the OSU Vegetable Production Guide called for. This is likely due to a combination of economics and good pesticide management practices. Most vegetable growers sell their crops at local farmers' markets where consumers are willing to accept some imperfections on the produce.

Generally the pesticides applied by horticultural businesses in the watershed were minimal. Fertilizers represent the largest percentage of chemical input in both commercial horticulture and residential areas. In the future, we might see more small farms specializing in horticultural crops especially flowers, vegetables, trees and shrubs, and sod. We might see more housing developments, and possibly more golf courses. Education of small scale farmers, developers, and homeowners will be critical to maintain and improve the water quality in the watershed.

Highway and Infrastructural Chemical Use Analysis
Based upon the estimated 310 miles of major highway within the EFLMR total watershed, application of 2,973 tons of salt and 822 gallons of 2.5 percent active ingredient Roundup Pro are estimated to have been applied.

Conservation Tillage

Sediment is another source of water pollution. Conservation tillage is the number one defense against sediment. Reducing soil loss also decreases the potential pollution problems associated with fertilizers and pesticides. Conservation tillage is designed to leave residue on the soil surface. The residue protects the soil surface from erosion by absorbing the energy of raindrops, thus reducing soil particle detachment. Residue reduces surface crusting and sealing which improve water infiltration. A third benefit of residue is the slowing of the velocity of the runoff water. This can allow particles in the runoff to be redeposited.

Conservation tillage leaves residue that is important in reducing runoff. Due to the protection that residue can provide, it was important to determine the type of tillage practices that farmers were using. Farmers were asked to state the type of tillage system that they had selected for each field that they were farming. The three tillage practices that farmers were ask to choose from were conventional, minimum, and no-till. The data collected are shown in Table VI.

Table VI Tillage Practice by Crop in Acres and Percent

Tillage Practice	Corn	Soybean	Wheat
No-till	878 (21.2%)	704 (15.2%)	120 (60%)
Minimum	338 (8.2%)	1,969 (42.6%)	82 (40%)
Conventional	2,925 (70.6%)	1,946 (42.1%)	0
Total	4,141	4,619	200

Corn producing farmers are still using conventional tillage (71 percent) in the majority of their operations. The heavy, wet soils that make up a large portion of the watershed create difficulties for farmers when using either a no-till or minimum tillage practice. Compaction is another concern when working wet soils in early spring. Soybean producing farmers have adopted conservation tillage practices more extensively. Roundup Ready soybean have aided in the transition to either no-till or minimum tillage practices. The later planting dates can allow the soil to dry out more. The wheat crop for which information was available indicates extensive use of conservation tillage practices.

APPENDIX E

Analysis of Physical Stream Characteristics in the Middle East Fork , Clermont County

Prepared for:
Clermont County Office of Environmental Quality
2275 Bauer Road
Batavia, Ohio 45103

Prepared by:
Tetra Tech, Inc.
Cleveland, Ohio
Laurel, Maryland
Fairfax, Virginia

November 9, 2001

Over the past six years, Clermont County has developed and maintained a comprehensive watershed monitoring program for the East Fork of the Little Miami River (EFLMR). Integrating both ambient and wet weather water quality data with biological monitoring, this program has provided a comprehensive system for determining the baseline water quality and ecological health of the EFLMR. One additional component of watershed health previously not evaluated is the physical, or geomorphic, condition of the streams draining to the EFLMR. Information on stream physical conditions can be very useful for obtaining a better understanding of overall watershed health, identifying areas of altered or degraded physical habitat, and developing the data necessary to understand how land use change might affect the physical characteristics of county streams.

This Appendix details a preliminary evaluation of stream channel conditions the Stonelick Creek Watershed located within Clermont County using the Rosgen Level I and II stream classification system. In this section, a description of each assessment reach is provided. Also included is a description of upstream land use and riparian area characteristics at the sample reach. A picture is also included, although technical difficulties resulted in some sites not being photographed. Finally, any available water quality or biological data are presented.

Rosgen Stream Classification

The Rosgen stream classification system is a methodology used to describe streams and stream behavior based on basic hydrologic and morphological parameters (Rosgen, 1996). It uses a hierarchy of four assessment levels ranging from a broad geomorphic characterization (Level I) to detailed reach-specific hydraulic and sediment relationships (Level IV).

A Level I assessment classifies streams based on broad geomorphic stream characteristics. This characterization provides a framework for initial delineation of stream types and assists in setting priorities for more detailed assessments. A Level II (morphological) characterization provides a more detailed description based on field determined stream reach information. Level II information can be used as a basis for management interpretations. The third (Level III or "state") characterization level utilizes additional field observations and parameters to provide a description of stream conditions in terms of current and potential natural stability, and provides an assessment of the extent of departure from the natural potential. The fourth (Level IV or validation) assessment level is used to verify the assessment of stream condition, potential, and stability obtained in the Level III assessment. The Rosgen stream classification system has been found to provide a consistent methodology for comparing physical stream characteristics and stream behavior. In this study, only Level I and Level II evaluations were performed.

Rosgen stream classifications are performed to:

- Obtain physical stream data using a consistent methodology
- Classify and compare streams based on observed data
- Identify impacted stream channels
- Correlate physical stream characteristics to water quality and biological data
- Quantify stream stability and erosion rates
- Describe stream behavior

The data obtained from the different assessment levels can be used to:

- Predict stream response to major storm events
- Predict stream erosion rates and sediment loads
- Predict stream response to road and bridge construction
- Predict stream response to urbanization practices (e.g., housing developments, construction sites)
- Provide guidance in performing stream restorations.

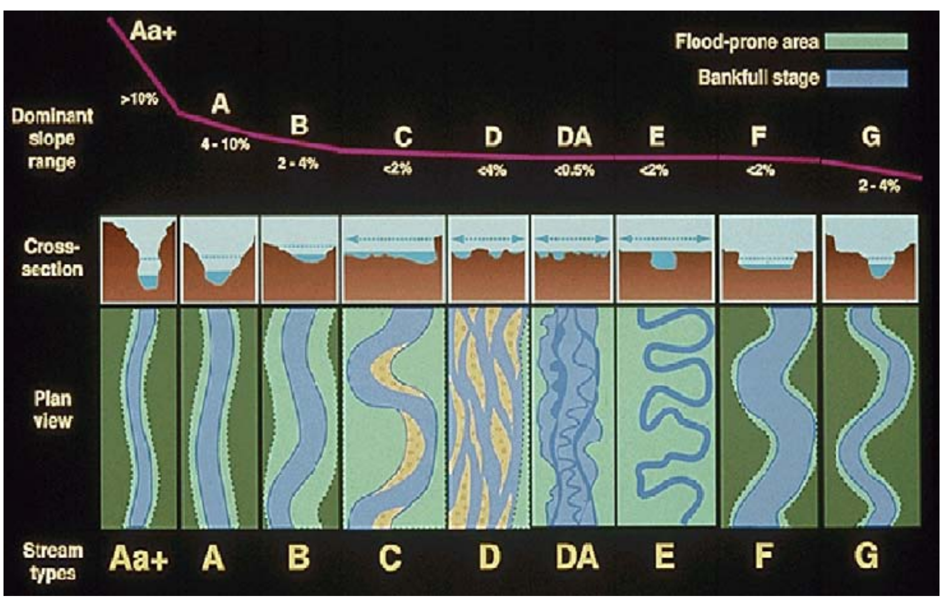


Figure E-1. Rosgen Level 1 Stream Types (Rosgen, 1996).

Rosgen Type	Slope Range	Sinuos-ity Range	Observed in Clermont County?	Notes
A	4- 10%	1.0-1.1	Yes	Steep, entrenched, cascading step-pool systems. High energy and debris transport in depositional soils, stable in bedrock and boulder channels. Typically stable.
Aa+	>10%	1.0-1.2	No	Very steep. Entrenched, cascading step-pool systems. Vertical steps with deep scour pools. This type includes waterfalls. Typically stable.
B	2 - 4%	>1.2	Yes	Moderately entrenched, step-pool systems, on moderate slops. Typically stable.
C	<2%	>1.4	Yes	Slightly entrenched, sinuous channels connected to floodplains. Riffle-pool morphology with point bar formation on inside bends. Typically stable.
D	<4%	N/A	No	Found in broad valleys, slightly entrenched, unstable multi-thread channel. High bedload. Typically very unstable.
DA	<0.5%	Highly Variable	No	Broad, low-gradient multi-thread channels typically draining extensive wetland complexes. Typically stable.
E	<2%	>1.5	Yes	Very sinuous, stable channels typically found in broad open fields. Riffle pool morphology. Narrow and deep (low width-depth ratio).
F	<2%	>1.4	Yes	Entrenched channel with high bank erosion rates. Low gradient with a riffle-pool or run-pool morphology. Typically unstable.
G	2 - 4%	>1.2	Yes	Gullies, typically with step-pool morphology. Moderate slopes. High bed load. Typically unstable.

Figure D-2. Rosgen Level 1 Stream Type Descriptions and Occurrence in the Clermont County portion of the watershed.

Lick Fork

The Lick Fork sampling site was the largest watershed evaluated in this study (6.5 square miles). It is located near the northern border of the EFLMR watershed east of Milford City and northwest of Owensville Village. There were 47.5 miles of streams upstream of the sampling site. Most of the land in the Lick Fork watershed is used for agricultural (52 percent) and forest (43 percent) land. The three townships in the watershed (Goshen, Miami, and Stonelick Townships) have zoned most of the land in this area for agricultural and estate residential land use. Small portions have also been zoned for suburban residence, neighborhood businesses, and mobile home parks. The State Route 131 corridor near Owensville Village has been zoned as a suburban residence area and has the potential to be heavily developed. The development potential in the downstream portion of the watershed is limited due to steep terrain, however, the headwater region is flatter and is more developed.

Basin Geomorphic Condition

At the sampling site, the stream was classified as a B stream. The B stream is a moderately entrenched step-pool system with low sinuosity. G and F streams were also classified in other parts of the Lick Fork watershed. The Rosgen Level I analysis showed that 64 percent of the streams were B streams, 29 percent F streams, and 7 percent G streams. The large tributary located to the west of the sampling site was classified as an F stream due to significant entrenchment that was observed during field work. Near the headwaters, G streams were classified because they were flowing through agricultural areas and were believed to have low width to depth ratios (typical of G streams). These headwater streams may be nothing more than agricultural ditches.

The stream at the sampling site was classified as a B4c stream. A B4c stream has all the characteristics of a Rosgen Level I B stream, a predominately gravel channel bottom, and a water surface slope of less than 2 percent. However, a riffle-pool system was observed instead of a step-pool system (Figures 16 and 17). This is most likely due to the low water surface slope found here (0.8 percent). Large cobbles were located throughout the stream along this reach. The stream flowed through an agricultural field and several large residential lots. The fields were generally mowed down to the stream banks. Water quality was sampled on Lick Fork approximately 4000 feet downstream from the Rosgen sampling site in 1996 and 1997. However, sediment, turbidity, biological, or habitat data were not collected at that time.

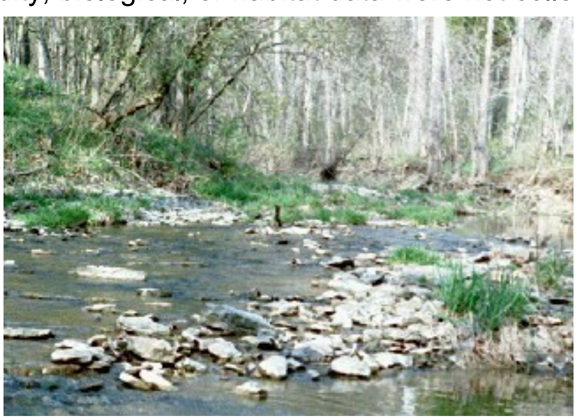


Figure D-3. Riffle pattern observed at Lick

Figure D-4. Pool observed downstream of riffle along Lick Fork

Stonelick Creek Tributary

This Stonelick Creek tributary flows through a largely agricultural area in Stonelick Township. The Rosgen Level II assessment was performed downstream of Owensville Village. The watershed size at this site was 2.46 square miles. At the sampling site, the stream flowed through a wide valley and had very little flow at the time of the sampling (Figure 43). Over 60 percent of the land in this watershed is agricultural land, with some low intensity residential land located near Owensville. Most of the land in this watershed is zoned for estate residence, which indicates that much of the agricultural land in this area may become low intensity residential lots.

Basin Geomorphic Condition

The Rosgen Level I analysis indicated that there were several different classes of streams in this watershed. The stream at the sampling site was classified as an F stream. However, upstream there appeared to be B streams and G streams. The B streams flowed through smaller, forested tributaries while the G streams were located in agricultural areas. F streams are typically entrenched and have a riffle-pool system. These streams can have high erosion rates, however, large erosional features were not observed at the sample site. B streams are similar to F-streams but are not as entrenched. G streams are also entrenched streams but tend to be narrower and deeper. In Clermont County, G streams are generally found in agricultural areas near the headwaters regions. The Rosgen Level II designation for this site was F4. F4 streams are typical F streams with a water surface slope less than 2 percent and gravel bed material. No other data were available at this site

Figure D-5. Stonelick Creek sampling site

APPENDIX F

A National Demonstration Project for Watershed Management: An Innovative Approach to Identifying Key Priorities for Improving Water Quality in the East Fork Little Miami River Watershed

Prepared by the East Fork Watershed Collaborative
April 18, 2007

EXECUTIVE SUMMARY

The East Fork Little Miami River (EFLMR) watershed covers approximately 500 square miles in southwestern Ohio, from its headwaters in rural Clinton, Highland, and Brown counties to its confluence with the Little Miami River in suburban western Clermont County. In 1975, the U.S. Army Corps of Engineers impounded the East Fork by constructing an earthen dam at River Mile 20.5, creating a 2,160 acre reservoir (Harsha Lake) stretching approximately ten miles upstream from the dam. Based on surveys conducted in 1982 and 1998, the Ohio Environmental Protection Agency (Ohio EPA) has determined that various waterbodies in the EFLMR watershed are not meeting their use attainment goals. As a result, the EFLMR was placed on the state's impaired waters list in 2006 and designated for Total Maximum Daily Load (TMDL) development. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. The process of formulating TMDLs is therefore a method by which impaired waters are identified and restoration solutions are developed and implemented to meet the goals of the Clean Water Act.

To address the water quality impairments identified in the EFLMR watershed, Clermont County, together with the other counties, villages and townships that comprise the East Fork Watershed Collaborative (the Collaborative), are taking the lead in developing a watershed-wide TMDL. This unique and innovative approach is the first such community-lead TMDL project in the state of Ohio, and is one of very few nationwide. Developing a locally-lead TMDL provides the Collaborative an opportunity to build upon ongoing activities, to ensure that local concerns are adequately addressed during TMDL development, and to possibly secure additional funding for protecting and improving water resources.

Two parallel and related approaches were used to better understand the reasons for biological impairment in the EFLMR watershed. The Stressor Identification approach utilized a weight-of-evidence process that considered the universe of potential stressors and evaluated the relative probability of each one to contribute to the observed biological impairment. Alternatively, a biostatistical modeling approach relied upon statistical evaluations of the relationships between available biological, physical, and chemical water quality data. One of the significant findings of this analysis was that meeting the biological criteria in currently impaired streams will be more dependent on addressing habitat factors, such as improving instream QHEI cover and pool scores, than reducing pollutant loadings. Flashiness

(or the frequency and rapidity of short term changes in streamflow) was also found to be strongly correlated to fish scores and therefore the control of stormwater runoff should be a high priority in the watershed. Another interesting finding was that there is not a strong relationship between biological impairment and nutrient concentrations in the watershed, even though nutrients have long been considered one of the primary reasons for non-attainment). The finding that habitat and flashiness are among the most important variables in controlling biological health in the EFLMR poses some challenges with regard to TMDL development. This is because the

U.S. EPA has made a determination that some categories of water quality impairment, including flow and habitat alterations, are best resolved through measures other than TMDLs. TMDLs instead are required to address impairments caused by discrete “pollutants,” such as nutrients and sediment, which are thought be less important causes of impairment in the EFLRM watershed. A traditional TMDL developed for the EFLMR watershed would therefore focus on controlling pollutant loads when the Collaborative believes the focus should instead be on addressing flow and habitat problems in the watershed. This focus on pollutant loads would also translate into revised permit limits for the point sources in the watershed which, in turn, would require that resources that otherwise could be devoted to improving flow and habitat conditions would need to focus on reducing pollutant loads.

For these reasons, the Collaborative eventually decided to not pursue a locally-lead TMDL and will instead pursue a phased watershed management plan. Phase 1 will consist of implementing projects and programs that are already in development or have already been committed to. Additional non-point source controls will also be identified and implemented during Phase 1 that focus on the tributaries to the EFLMR and the primary headwater areas that have been found to be in non-attainment of their aquatic life uses. During Phase 1, preference will be given to tributary nonpoint source controls that improve stream habitat, decrease stream flashiness, and control the loadings of high priority pollutants. The Collaborative believes that many currently impaired streams can be brought into attainment as a result of Phase 1 activities.

During Phase 2, an enhanced level of controls will be focused on tributaries to the EFLMR where habitat and flow improvements have already been made but biological attainment has still not yet been achieved. Phase 2 nonpoint source controls will likely include those that control high priority pollutants (even if they do not also improve habitat or address flashiness). Water quality trading might also begin to take place during Phase 2 or a watershed-based permit might be finalized, depending on the decisions made in Phase 1. The final phase of implementation will be the adoption of all controls necessary to fully meet water quality standards, whether those are currently existing standards or new standards identified during Phase 2. Phase 3 has been set up to coincide with Ohio EPA’s schedule to re-assess the EFLMR in 2012 and, if the watershed is still impaired, to develop an agency -lead TMDL by 2014.

APPENDIX G

East Fork Watershed Collaborative Operational Procedures

The East Fork Watershed Collaborative protects and enhances the biological, chemical and physical integrity of the East Fork Little Miami River and its tributaries.

The Collaborative is an informal citizen/agency organization. The Collaborative members work together to:

- Serve as a forum to discuss water resource management across jurisdictional boundaries
- Develop and implement watershed plans
- Monitor water quality
- Implement community projects
- Identify and secure funding for water quality projects
- Educate those who live, work and recreate in the watershed

The Clermont SWCD is the primary grant sponsor and fiscal agent for the Watershed Coordinator grant.

The Clermont SWCD:
- Employs, houses and provides support to the Watershed Coordinator
- Acts on recommendations of the Steering Committee

The Steering Committee defines the scope and direction of the East Fork watershed program, and acts as the liaison between the East Fork Watershed Collaborative and local communities.

The Steering Committee:
- Conducts strategic planning and defines the goals for the organization
- Directs the Watershed Coordinator where to focus attention and how to implement the plans
- Evaluates the performance of the Watershed Coordinator
- Approves watershed plans/revisions
- Serves as the body that submits watershed plans to the State/local leadership for formal adoption
- Tracks progress on watershed activities including watershed plan implementation
- Reports to local officials including SWCD Boards and County Commissioners
- Represents the Collaborative at events and activities
- Ensures long-term funding for the Watershed Coordinator and East Fork Watershed Program
- Has ultimate decision-making responsibility for the Collaborative
- The Steering Committee meets Quarterly
- The Steering Committee will have 14 members consisting of the following: a representative from each of Brown, Clermont, Clinton and Highland SWCDs (4); a representative of Clermont Office of Environmental Quality (1); a County Commissioner (or their representative) from each of Brown, Clermont, Clinton and Highland Counties (4); and a citizen representative from each of the five subwatershed planning areas (5)
- Subwatershed citizen representatives may be nominated by any Steering Committee member;

the subwatershed citizen representatives are selected from among the nominees by simple majority vote of the Steering Committee; the citizen representatives will serve a two-year term

The Advisory Committee works with the Watershed Coordinator to plan and execute the watershed planning and implementation process.

The Advisory Committee:

- Provides ongoing input, advice, and direction to the Watershed Coordinator
- Works closely with the Watershed Coordinator to plan, organize, and facilitate public meetings and other events
- Determines extent of water quality concerns specific to sub-watersheds
- Identifies specific water management concerns and opportunities
- Determines what local data should be included in the Resource Inventory for Subwatersheds
- Works closely with the Watershed Coordinator to implement plans
- Tracks water quality improvement

The Advisory Committee meets monthly or as needed to meet Collaborative planning requirements. **Participation on the Advisory Committee is open (i.e., anyone can serve), but will include at least: a representative from each of Brown, Clermont, Clinton and Highland SWCDs (4); a representative of Clermont Office of Environmental Quality; a citizen representative from each of the five subwatershed planning areas; and a representative from each of OSU Extension, Ohio EPA and Ohio Department of Natural Resources.**

Work Teams meet as needed to identify needs, develop goals, and propose technical, policy and educational strategies to address specific water quality issues (wastewater, stormwater, …)

- The Work Teams are formed and meet as needed to meet Collaborative requirements
- Participation on Work Teams is open (i.e., anyone can serve).

EFWC Meetings

The EFWC meetings are structured in a round table format where members are given an opportunity to express their views. All EFWC meetings are advertised and open to the public. Decisions are approved upon consensus of the group.

APPENDIX H

Executive Summary
Drinking Water Source Assessment for the Village of Blanchester

Drinking Water Source Assessment for the Village of Blanchester

Protecting Ohio's Drinking Water Sources

OhioEPA

SUMMARY

Source Water Assessment and Protection. The following report for the Village of Blanchester Public Water System was compiled as part of the Source Water Assessment and Protection Program for Ohio. This program is intended to identify drinking water protection areas and provide information on how to reduce the risk of contamination of the waters within those areas. The goal of the program is to ensure the long term availability of abundant and safe drinking water for the present and future citizens of Ohio.

The Safe Drinking Water Act Amendments of 1996 established the national Source Water Assessment and Protection Program, targeting drinking water sources for all public water systems in the United States. A public water system is a facility that provides drinking water to 15 or more service connections or that regularly serves at least 25 people a day for at least 60 days a year, whether from an underground well or spring, or from an above ground stream, lake, or reservoir. The requirement does not address residential wells or cisterns. In Ohio there are approximately 5,800 public water systems.

Background. The Village of Blanchester operates a community public water system that serves a population of approximately 4,500 people with approximately 1,600 service connections. The water treatment system obtains its water from three different intakes on three different streams - Whitacher Run, Stonelick Creek and West Fork of the East Fork of the Little Miami River. All of these streams are in the Little Miami River Watershed. The water treatment plant design capacity is 800,000 gallons per day based upon current filtration capacity. The plant produces 133 million gallons of treated water per year.

Protection Areas. The drinking water source protection area for the Village of Blanchester Public Water System is shown in the following figure. This report includes the results of an inventory of all known or identified contaminant sources within the drinking water source protection area. The inventory was conducted by Ohio EPA with the assistance of Blanchester Public Water System staff. Possible threats to the surface water sources include agricultural runoff from row crop agriculture, runoff from new construction, inadequate septic systems in the watershed, cemeteries, and leaking underground tanks.

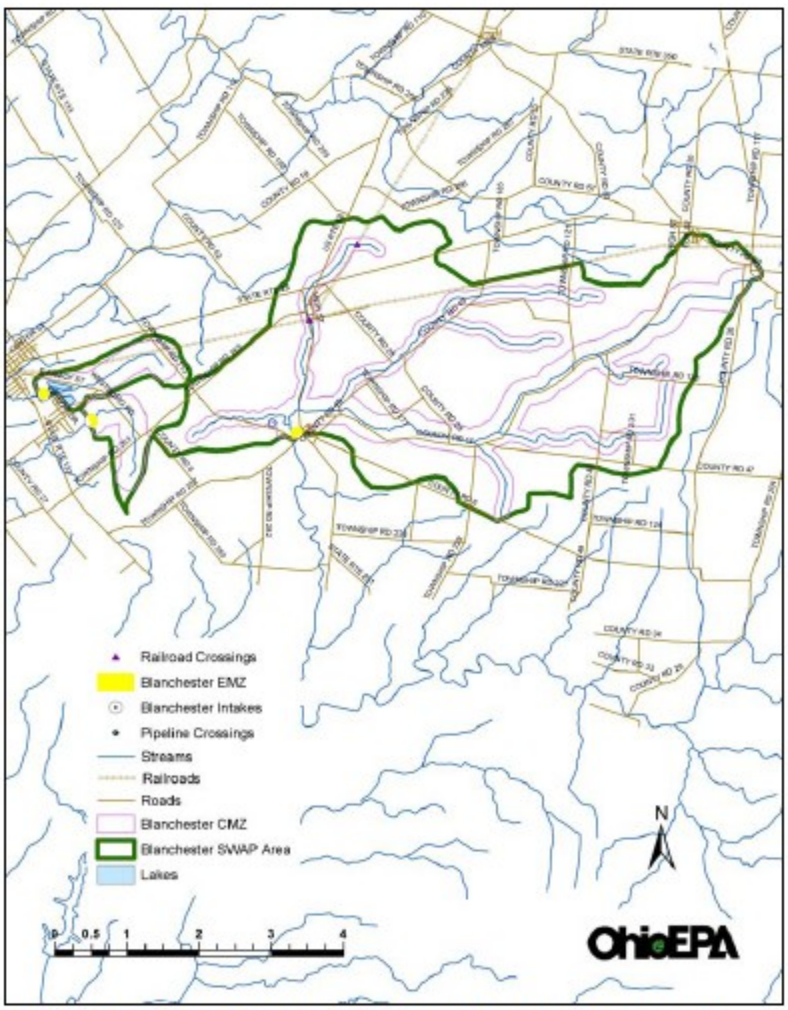
Protective Strategies. The ultimate goal of source water assessment is implementation of protective strategies that will better protect the drinking water source. Strategies for protecting Whitacher Run, Stonelick Creek and West Fork of the East Fork of the Little Miami River should include controlling runoff from urban and agricultural areas, controlling septic discharges and coordinating with local emergency response agencies.

The Village of Blanchester and other jurisdictions comprising the protection areas are encouraged to develop a local protection plan to protect the sources of drinking water or to update current emergency management plans as applicable. Local watershed planning efforts are underway in the Little Miami River watershed to guide stream restoration and protection activities. These efforts ultimately help to protect drinking water sources. Guidance on how to form a Drinking Water Source Protection Team and protection plan is available from Ohio EPA by calling (614) 644-2752.

For More Information. Additional information on protective strategies and how this assessment was completed is included in the detailed Drinking Water Source Assessment Report for the Village of Blanchester.

For information on how to obtain a copy of this report, please visit Ohio EPA's Source Water Assessment and Protection Program Web page at http://www.epa.state.oh.us/ddagw/pdu/swap.html or contact the Village of Blanchester Public Water System for a copy.

Current information on the quality of the treated water supplied by the Village of Blanchester Public Water System is available in the Consumer Confidence Report (CCR) for the Village of Blanchester Public Water System. The CCR is distributed annually and reports the most current detected contaminants and any associated health risks from data collected during the past five years. Consumer Confidence Reports are available from the Village of Blanchester Public Water System



Summary Figure - Village of Blanchester drinking water source protection area.

References

Christian, A. D. and S. I. Guttman. 2000. *Final Report: Invertebrate Community Index Assessment of The East Fork Little Miami River, Clermont County, Ohio. Summer Sampling 2000.* Department of Zoology. Miami University. Oxford, Ohio.

Grimm, E. and Guttman, S.I. 2000. *Index of Biological Integrity (IBI) Assessment. East Fork Little Miami River, Clermont County, Ohio. Summer Sampling 2000.* Miami University. Oxford, Ohio.

Hoggarth, M.A. and M.H. Goodman. 2007. *Report on a reexamination of the mussels of the Little Miami River and its major tributaries.* Otterbein University, Department of Life and Earth Sciences.

Ingram, T. I. 1993. *A preliminary investigation into the bacteriological water quality problems of Stonelick Lake State Park, Ohio.* Journal of Environmental Health, Vol. 55, 1993.

Rosgen, D. 1996. *Applied River Morphology*. Printed Media Companies, Minneapolis.

Tetra Tech. 2001a. *2000 Water Quality Report – Supplement to the East Fork Little Miami River Water Quality Assessment Report for Clermont County, Ohio*. March 2001. Tetra Tech, Inc. Cleveland, Ohio.

Tetra Tech. 2001b. Clermont County Ambient Water Quality Monitoring Program - East Fork of the Little Miami River: Five-Year Status and Trends. July, 2001. Tetra Tech, Inc. Cleveland, Ohio.

Website References:

Agriculture and Farming in Ohio. Ohio History Central: http:// www.ohiohistorycentral.org/entry.php?rec=1579

Stonelick State Park. Ohio Department of Natural Resources, Division of Parks: http:// ohiodnr.com/parks/stonelck/tabid/789/Default.aspx

Low Impact Development Fact Sheets. University of Florida: http://buildgreen.ufl.edu/LID_fact_sheets.htm

Emerald Ash Borer. Ohio State University: http://ashalert.osu.edu/

Demographic Information: U.S. Census Bureau: http://www.census.gov/