A Comprehensive Watershed Management Plan for the Leading Creek Watershed

A collaboration of the Meigs Soil and Water Conservation District and residents of the Leading Creek Watershed

Leading Creek at River Mile 10.3

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Acronyms

ACSI	Appalachian Clean Streams Initiative
AEP	American Electric Power
AMD	Acid Mine Drainage
AMDAT	Acid Mine Drainage Abatement and Treatment Plan
AML	Abandoned Mine Lands
AWS	Agricultural Water Supply
CONSOL	Consolidated Coal Company
CRP	Conservation Reserve Program
CWH	Cold Water Habitat
DNAP	Division of Natural Areas and Preserves
EPT	*Ephemeroptera*, *Plecoptera*, and *Tricoptera*
EQUIP	Environmental Quality Incentives Program
EWH	Exceptional Warm Water Habitat
FFA	Future Farmers of America
FSA	Farm Service Agency
FWPCA	Federal Water Pollution Control Act
GPM	Gallons Per Minute
HD	Health Department
HSTS	Household Sewage Treatment Systems
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ICI	Index of Community Integrity
ILGARD	Institute for Local Government and Regional Development
IWS	Industrial Water Supply
LCIC	Leading Creek Improvement Committee
LCIP	Leading Creek Improvement Plan
LCW	Leading Creek Watershed
LRW	Limited Resource Water
LTM	Long-Term Monitoring
MIwB	Modified Index of Well Being
MOU	Memorandum of Understanding
MRM	Mineral Resources Management
MWH	Modified Warm Water Habitat
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NS	Not Sampled
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
ORAM	Ohio Rapid Assessment Method
OU	Ohio University
PCR	Primary Contact Recreation
QHEI	Qualitative Habitat Evaluation Index
RM	River Mile
SOCCO	Southern Ohio Coal Company
SWCD	Soil and Water Conservation District
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAWA	Watershed Awareness to Watershed Action

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Executive Summary

The overall purpose of the Leading Creek Management Plan is to detail the actions needed to restore streams in the Leading Creek watershed to meet their designated aquatic life use. Other objectives for the plan are to provide a comprehensive description of the chemical, physical and biological conditions in Leading Creek and its tributaries. By thoroughly characterizing current conditions, proper management activities could be selected and baseline data is available for future comparison.

The plan contains the following sections:

Chapter 1- Introduction – provides an overview of the watershed characteristics and presents a demographic summary of the area

Chapter 2- Watershed Plan Development – summarizes the partners and activities involved in the planning process

Chapter 3- Watershed Inventory – describes the geology, flora and fauna, water resources, land use, social resources, and alterations to natural habitat.

Chapter 4- Water Resource Inventory – summarizes existing water resource quality and biological integrity within the watershed.

Chapter 5- Sub-Watershed Impairments and Action Strategies – discusses major water quality impairments and identifies and quantifies the contribution of the pollutant. It also lists recommendations for watershed restoration and protection.

Chapter 6- Implementation, Evaluation, and Plan Revision – outlines the future strategy for implementing and updating the management plan.

The plan is arranged so that the water quality inventory (Chapter 4) and future recommendations (Chapter 5) are described individually for each of the seven 14-digit Hydrologic Unit Codes (HUC). While this creates some redundancy when reading the document, we felt this was the best way to organize the information so that the data can be easily obtained for each HUC in the future.

Chapter 1
INTRODUCTION

The more than 3.5 million miles of rivers and streams in the United States have tremendous economic, social, cultural, and environmental value (US Department of Agriculture, 1998). Water of sufficient quality and quantity is critical to all life. All societies, past, present, and future, depend upon adequate clean freshwater for their survival and development.

Growing appreciation of the importance of aquatic ecosystems has prompted efforts to better manage our water resources. The Clean Water Act, passed in 1972 and later amended in 1977, is often regarded as the fundamental safeguard of the nation's surface water. The purpose of the Clean Water Act is to reduce pollutants from being discharged into waterways and to maintain water quality to provide a safe environment for fishing and swimming.

Since the passage of the Clean Water Act, great progress has been made in reducing the amount of pollutants discharged from point sources such as sewage treatment facilities and industrial runoff. With the reduction of point source pollution, it has become apparent the nation's water quality will only improve if other forms of pollution, specifically, non-point sources of pollution, are also addressed. Non-point source pollution is contaminated runoff from human land-use practices such as agriculture, mining, forestry, and home septic systems. Non-point sources of pollution, combined with the loss of aquatic habitat, are now thought to be the primary sources impairing the nation's water resources (Ohio EPA, 2000a).

State regulatory agencies have limited authority to control alterations to aquatic habitat and non-point source pollution. Therefore, community based watershed management is becoming a common tool to help identify and address land-use practices that affect local water resources. Section 319 of the Clean Water Act makes federal money available to states to correct water quality impairments to surface and groundwater resources that are caused by non-point source pollution. This program and other incentive programs at the national, state, and local levels provide a means for concerned citizens, public officials, and educators to pursue projects that improve water quality.

Overview of the Leading Creek Watershed

The Leading Creek watershed consists of slightly more than 150 square miles (96,000 acres) and comprises most of the western half of Meigs County and small portions of Athens and Gallia counties (see Map 1). Leading Creek winds about 30 miles through the Appalachian foothills before discharging into the Ohio River near Middleport, Ohio. The watershed is sparsely populated with several very small communities such as Harrisonville, Langsville, Dexter, Carpenter, and Dyesville. Rutland is the largest community with 400 residents and is the only incorporated village located entirely within the Leading Creek watershed.

The following special districts serve residents within the watershed:

- Soil and Water Districts: Athens, Meigs, and Gallia Soil and Water Conservation District
- School Districts: Meigs Local School District and Alexander Local School District
- Public Water Districts: Leading Creek Conservancy District and Tuppers Plains-Chester Water District
- Public Sewage District: Rutland has a sewer system located within the village

- Regional Planning Agencies: Buckeye Hills Hocking Valley Regional Development District
- Agricultural Districts: 4 landowners totaling 459 acres
- No public park districts

There are no streams within the Leading Creek Watershed that have special designations (*i.e.* national, state wild and scenic rivers) and there are no Phase 2 stormwater communities.

The Leading Creek Watershed consists of seven 14-digit Hydrologic Unit Codes (HUCs), as defined by the United States Geological Survey (USGS) (Table 1-1 and see Map 2). The Ohio Environmental Protection Agency (Ohio EPA) has described several stream segments in the 305(b) report, the state 305(b) identification numbers are listed in Table 1-2.

TABLE 1-1. Leading Creek subwatersheds

Location of Leading Creek 14-digit HUCs	HUC number
Leading Creek headwaters to below Fivemile Run	05030202090-010
Leading Creek below Fivemile Run to above Mud Fork	05030202090-020
Mud Fork	05030202090-030
Leading Creek below Mud Fork to above Little Leading Creek	05030202090-040
Little Leading Creek	05030202090-050
Leading Creek below Little Leading Creek to the Ohio River	05030202090-060
Thomas Fork	05030202090-070

TABLE 1-2. Ohio 305(b) identification numbers in the Leading Creek Watershed

Location of 305(b) stream segments	305(b) number
Leading Creek (Headwaters to Dexter Run)	OH29 39 09-200
Leading Creek (Dexter Run to Little Leading Creek)	OH29 35 09-200
Leading Creek (Little Leading Creek to Ohio River	OH29 28 09-200
Tributary to Leading Creek (RM 20.45)	OH29 39.2 09-219
Parker Run	OH29 37 09-203
Little Parker Run	OH29 37.1 09-218
Tributary to Parker Run (RM 2.71)	OH29 37.2 09-220
Malloons Run	OH29 36 09-202
Thomas Fork	OH29 32 09-213
Little Leading Creek	OH29 34 09-201

Historic land use practices have greatly modified the current condition of Leading Creek and many of its tributaries. Decades of unregulated coal mining left more than 2,000 acres of barren surface-mined land and contamination stemming from acid mine drainage affects more than 20 miles of streams in the watershed. Extensive clearing of forestlands for agriculture and settlement left hillsides bare and exposed highly erodible soils. Today, sediment resulting from abandoned mine land, agricultural use, and streambank clearing fills many of the stream channels.

The Ohio EPA lists several sources of water quality impairments to the Leading Creek Watershed (Ohio EPA, 2000b). Sources include surface mining, subsurface mining, non-irrigated crop production, channelization, and pastureland. These sources cause multiple water quality problems, which are also listed in the 305(b) report. Causes include siltation, pH, salinity/Total Dissolved Solids/chlorides, and habitat modifications.

Other studies have also contributed helpful information about the condition of water quality and biological resources in the basin. In 1996 and 1997, Dr. Donald S. Cherry of Virginia Polytechnic Institute and State University directed a comprehensive watershed study. The authors found that system-wide, abandoned mine lands (AML) presented the single greatest risk to aquatic ecology in the watershed. In a 1985 survey of 30 Ohio counties impacted by mining, the Leading Creek Watershed ranked highest for sediment damage, acreage of sediment deposition, total erosion and erosion rate (US Department of Agriculture, 1985).

Current water quality monitoring and biological studies have allowed us to elaborate on the causes and sources of water quality pollution described in the previously mentioned studies. This information along with public input has directed the context of the management plan.

Demographics

Population

The Leading Creek Watershed is situated in Meigs (96%), Athens (2.7%), and Gallia Counties (1.4%) and lies within the 29-county Appalachian region of Ohio. The Appalachian region, known for its rolling hills, abundant natural resources, and recreation, is the least populated area in Ohio. County populations in the watershed have remained relatively constant, while the state population has nearly tripled (Table 1-3).

TABLE 1-3. Historical population growth

	Population in 1900	Population in 1930	Population in 1970	Population in 2000
Athens Co.	38,730	44,175	54,889	62,223
Gallia Co.	27,918	23,050	25,239	31,069
Meigs Co.	28,620	23,961	19,799	23,072
Ohio	4,157,545	6,646,697	10,652,017	11,353,140

Source: U.S. Bureau of the Census

According to the 2000 U.S. census data, the population of the Leading Creek Watershed is approximately 7,000 to 7,500 people (Table 1-4). The relatively low population is important to consider when reviewing the status and trends of land use, areas of development, and the number of people involved in the planning process.

TABLE 1-4. Watershed population by subwatershed

Subwatershed	Total Number Homes	Population
Leading Creek headwaters to below Fivemile Run	213	543
Leading Creek below Fivemile Run to above Mud Fork	359	915
Mud Fork	166	437
Leading Creek below Mud Fork to above Little Leading Creek	562	1495
Little Leading Creek	672	1767
Leading Creek below Little Leading Creek to the Ohio River	98	258
Thomas Fork	788	1931
TOTALS	**2858**	**7346**

Source: U.S. Bureau of the Census average household sizes and housing units

Age and sex ratios

Based on 2000 census information for Meigs County, the age category with the least number of people is the 18 to 24 age group. Only about 8% of the population falls within this group suggesting that there is an emigration of young people seeking employment and education opportunities in other areas. Sex ratios are fairly equal with 95 males for every 100 females.

Educational Attainment

Residents of the watershed tend to have lower education attainment than the state average (Table 1-5). Compared to the Ohio average, a much lower percentage of Meigs and Gallia County residents have obtained a bachelor's or a graduate degree. The exception to this is Athens County, which is influenced by Ohio University. There are no institutions of higher education located within the watershed although the University of Rio Grande and Ohio University have a nearby presence. The University of Rio Grande possesses a branch campus in the Village of Middleport just outside the watershed.

TABLE 1-5. Educational attainment for adults 25 and older

	Less than 9th grade	9th to 12th grade	High School Graduate	Some College	Associate's Degree	Bachelor's Degree	Graduate School
Athens Co.	4.3%	12.8%	34.2%	16.5%	6.5%	12.6%	13.2%
Gallia Co.	9.1%	17.2%	41.7%	15.1%	5.4%	7.0%	4.6%
Meigs Co.	8.1%	18.7%	46.6%	13.4%	5.9%	4.9%	2.5%
Ohio	4.6%	12.5%	36.1%	19.9%	5.9%	13.7%	7.5%

Source: U.S. Bureau of the Census

Economic Characteristics

The Appalachian region is one of the most economically depressed parts of the state, and that is reflected in the poverty rates and income levels of the counties that comprise the Leading Creek Watershed (Table 1-6). Approximately 11 percent of all Ohioans live below the poverty rate, but those rates approach or exceed 20 percent in the counties included in the watershed. The household median income is also considerably lower compared to the Ohio median household income.

TABLE 1-6. Income and poverty summary

	Percent of all in poverty	Median household income
Athens Co.	27.4%	$27,322
Gallia Co.	18.1%	$30,191
Meigs Co.	19.8%	$27,287
Ohio	10.6%	$40,956

Source: U.S. Bureau of the Census

Meigs County often has one of the highest unemployment rates in the state. Based on the most recent labor statistics available (August 2004), Meigs County had the highest unemployment rate in the state at 15.9%, far exceeding the statewide unemployment rate of 5.8%. It is important to consider how these economic characteristics may affect the priorities, concerns, and actions of watershed residents and how it may influence their ability to support environmental issues.

Locations of Growth

Very little residential and/or commercial development is being constructed in the watershed. The majority of existing homes in the drainage area were built at least 25 years ago. On the other hand, housing development and land conversion should be considered a potential threat to stream quality in the northern part of the Leading Creek Watershed. According to the 2000 US Census, 25% to 27% of the housing units in this area were built between 1995 to March 2000.

Previous Watershed Management Activities

Numerous biological and water quality surveys have been conducted in the watershed after Southern Ohio Coal Company (SOCCO) discharged approximately a billion gallons of untreated (or inadequately treated) mine water from the Meigs #31 Mine in 1993. The discharge devastated the aquatic life in Parker Run and the lower ~ 16.0 miles of Leading Creek. Subsequently, the Ohio EPA prepared a document that established biological recovery criteria for aquatic organisms in the affected streams (Ohio EPA, 1994).

Following the release of water from Meigs #31 Mine, the U.S. Justice Department and Southern Ohio Coal Company (SOCCO) entered into a Consent Decree and Settlement Agreement that required the development of the *Leading Creek Improvement Plan* and established a Leading Creek Improvement Account. The Leading Creek Improvement Account has provided financial support for many projects conducted in the drainage basin (see detailed list of previous and current watershed projects in the Watershed Inventory section, Chapter 3).

In addition to the Biological Endpoints document (Ohio EPA, 1994) and the *Leading Creek Improvement Plan* (Cherry *et al.*, 1999), Leading Creek's Acid Mine Drainage Abatement and Treatment plan includes water chemistry data and analysis of the effects of acid mine drainage on the chemical and biological integrity of streams in the watershed.

Chapter 2
WATERSHED PLAN DEVELOPMENT

Watershed partners

The Leading Creek Watershed Management Plan has been developed with the help of various stakeholders and government agencies. Table 2-1 lists the roles and responsibilities of each of the individuals involved in the watershed planning process. Overall, the most valuable contributions of the watershed partners have been technical assistance, resources and data, and general support for the overall purpose of the plan.

Structure, Organization, and Administration

Although there are several groups collaborating to oversee that the Leading Creek Management Plan is completed and implemented, the Meigs Soil and Water Conservation District's (SWCD) Board of Supervisors is directly responsible to ensure the creation and implementation of the plan. This governing board consists of five locally elected, unpaid officials who ultimately dictate the fiscal administration and overall direction of the project. The mission of the Meigs SWCD is to provide assistance for the wise use of our natural resources for present and future generations.

The U.S. Fish and Wildlife Service is also an instrumental partner in the Leading Creek Watershed Project. The Service oversees the selection and implementation of enhancement projects from the Leading Creek Improvement Account (see note below). This is a promising source of funding for future projects and sustained financial support for the Leading Creek Watershed Coordinator. The Leading Creek Improvement Account also financially supports a Watershed Projects Coordinator, who is responsible for conducting activities described in the *Leading Creek Improvement Plan* (Cherry *et al*., 1999).

The Leading Creek Improvement Committee (LCIC) has also been a valuable partner in the planning process. The committee consists of technical experts and is responsible for reviewing and discussing projects necessary for the implementation of the *Leading Creek Improvement Plan* (Cherry *et al.*, 1999). Because of the similarity between the goals of the LCIC and those of the management planning process, many individuals on the Leading Creek Improvement Committee also offered technical assistance and overall instruction in the development of the Leading Creek Watershed Plan.

A Memorandum of Understanding has been developed between the U.S. Fish and Wildlife Service and the Meigs SWCD that outlines the key responsibilities of each agency in the collaboration (Appendix A).

Despite earnest efforts to form a local watershed group (see description of meetings and community events below), residents have not been committed to attending meetings and have not assumed primary ownership and responsibility of the planning process. The following may help explain the difficulties with forming a grassroots organization: 1. The water quality of Leading Creek is not severely impaired; therefore, many residents may not feel a *strong* need for restoration 2. This is a poverty-stricken area with one of the highest unemployment rates in the state (~15% to ~16%); therefore, water quality may not be a priority 3. This is a very rural watershed having a population less than 8,000; therefore, it may be unreasonable to expect to form a large watershed group or to have a largely attended stakeholder meeting.

Although there is not a local grassroots watershed group, we feel this plan does reflect the attitude and concerns of watershed residents. Hundreds of local landowners have been contacted in order to obtain permission for sampling and reconnaissance, and all but one have been cooperative and most have been very supportive.

Although efforts to form a local watershed group have been unsuccessful, continued efforts will be taken to build public support. The Leading Creek Watershed Coordinator will develop a public outreach plan that will describe future actions to encourage public involvement.

TABLE 2-1. Stakeholders and partners involved in the watershed management planning process

Stakeholder Group	Individual Representative(s)	Roles and Responsiblities
Community group		
Local watershed residents	More than 200 landowners, residents and public officials throughout the watershed.	Participated in water quality survey, public meetings, and outreach activities. Allowed assess to land to conduct water quality assessments.
Educators and students	About 200 grade school and high school students Ann Sisson- Southern High School biology Butch Mitchell- SHS agriculutural science Tim Simpson- Meigs High School agricultural science Christy Lavender- Southern Elementary Amy Roush- Southern Elementary Kristin Hull- Southern Elementary Dave Barr- Southern Elementary Donna Jenkins- Rutland Elementary	Participated in and helped conduct educational and public outreach activities. Contributed supplies and finances for watershed activities.
Community volunteers	More than 50 landowners, residents and public officials	Assisted with water quality monitoring and field reconnaisance. Assisted with litter clean-ups and public outreach activities.
Non Governmental Organizations	Rural Action- National Center for the Preservation of Medicinal Herbs, Appalachian Resource Center Wysteria	Participated in community events and assisted in water quality surveys.
Elected officials		
Meigs SWCD Board of Supervisors	Bill Baer*- Chairman Pauline Atkins*- Vice Chairman/Fiscal Agent Joe Bolin*- Secretary/Treasurer and Fiscal Agent Marco Jeffers*- Member Chris Hamm*- Member	Sponsors of the project, provide financial administrative guidance
Village councils	Rutland Village Council	Participated in survey and offered opinions about water quality issues
Township trustees	Columbia, Salem, Rutland, and Salisbury Township Trustees	Participated in survey and offered opinions about water quality issues
Meigs County Commissioners	Jeff Thornton Mick Davenport James Sheets	General financial support
Government Agencies		
Meigs County Soil and Water Conservation District/ NRCS	Opal Dyer*- District Program Administrator (retired) Jim Freeman*- Wildlife Specialist/Watershed Coordinator Mike Gosnell*- AMDAT Water Sampling Technician Steve Jenkins*- District Program Administrator Vicki Morrow*- Administrative Assitant Jenny Ridenour* - Education Specialist Mike Duhl*- District Conservationist	Assisted with many aspects of the plan's development, including gathering data, conducting water quality monitoring, organizing education and outreach activities,and daily administrative activities
Meigs County Recycling and Litter Prevention	Paula Wood*	Contributed supplies and overall support for litter clean-ups
Meigs County Health Department	Keith Little* Gary Marshall*	Provided reources and data. Helped develop technical solutions
Meigs County Engineer	Eugene Triplett*	Collaborated on water sampling at the Meigs County landfill
ILGARD	Scott Miller Chip Rice	Assisted with mapping and provided technical assistance

TABLE 2-1 continued

ODNR- Division of Wildlife	Mike Greenlee*	Technical assistance with stream morphology, restoration potential of smaller streams, and restoration practices.
ODNR-Mineral Resources Management	Harry Payne Barb Flowers* Mary Ann Borch Nancy Seger*	Overall assistance with AMD related problems including technical oversight of water sampling, developing remediation methods, and provided financial support.
ODNR- Division of Soil and Water	Rob Hamilton* Constance White* Dan Mecklenberg	Technical assistance with stream morphology and sediment transport, provided reources and data.
OEPA- Division of Surface Water	Randy Spencer* Dan Imhoff* Kelly Capuzzi	Provided resources and data, develop solutions and technical assistance
Ohio University- College of Engineering	Ben Stuart Guy Riefler Tiao Chang	Researching and measuring sediment transport and deposition.
Ohio State University Extension	Jerry Iles*	Assistance with public outreach and educational activities
US Fish and Wildlife Service	Bill Kurey* Mary Knapp	General financial support
Office of Surface Mining	Max Luehrs*	Technical assistance

*Member of the Leading Creek Improvement Committee

Public Involvement, Education, and Outreach

Watershed residents have had several opportunities to participate in community events and to be involved in the planning process. Overall, we have encouraged involvement and promoted education by conducting public meetings, publishing a newsletter and several articles in the local newspaper, developing a stakeholder survey, and organizing community events.

Public Meetings

Residents in the watershed were invited to participate in public meetings conducted monthly from February 2003 to January 2004. The overall purpose of the meetings was to provide the opportunity for local citizens to participate in the planning process by expressing their concerns and suggesting solutions to water quality impairments. Local residents were also given an opportunity to learn about the history and current condition of the watershed by listening to several guest speakers. On average, about 8 residents attended the monthly meetings. The group never formalized a structure or mission and few residents were committed to regular attendance.

Because of low attendance and little participation at the monthly meetings sponsored by the Meigs SWCD, we attended meetings held by other organizations. We were present during Rutland Village council meetings and 5 township meetings, where we discussed the purpose of the Leading Creek Management Plan and learned about residents' concerns and suggestions. NOTE: These results were compiled with the "Stakeholder Survey" results and are described below.

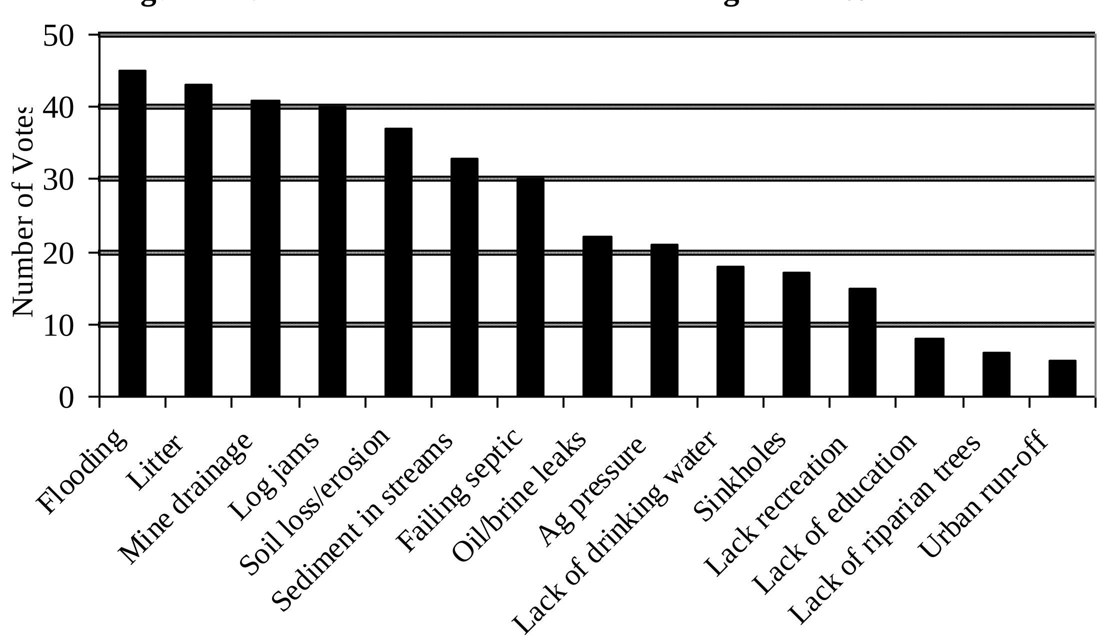
A monthly watershed meeting in August, 2003

Stakeholder Survey

A total of 67 local watershed residents participated in a survey, which was used to indicate current land/recreational uses within the watershed, list water quality impairments, and evaluate the overall condition of Leading Creek and its tributaries. Surveys were mailed to more than 600 landowners and individual residents were surveyed door-to-door and at community events.

Based on the surveys, most residents are concerned about flooding issues; litter and illegal trash dumping; abandoned mine drainage; and log jams and stream debris (Figure 2-1). These results are consistent with those voiced at public meetings, community events, and from talking with landowners along the streams. (Please note that although flooding is the highest concern to most residents, it is not within the scope of this plan to address floodplain management strategies. Residents interested in learning more about managing floodplain areas should contact the Floodplain Administrator at (740)992-2994).

Figure 2-1. Residents' Concerns in the Leading Creek Watershed



The majority of citizens (73%) also indicated that they would participate in more recreational activities in Leading Creek and its tributaries if the water quality improved.

Outreach Activities

A variety of educational activities have been completed since the Leading Creek Watershed project began. The most notable education and community outreach activities were a fish and bug sampling demonstration, two stream clean-ups, a photo contest, a fall watershed tour, and a watershed camp. Table 2-2 provides a more detailed listing of activities conducted in the watershed.

Fish and Bug Sampling Demonstration in 2003

TABLE 2-2. Summary of public outreach and educational activities conducted in the watershed

Date	Activity	Description	Number of participants
April 2003	School presentation	Spoke with 7th and 8th graders at Southern Elementary about the purpose and principles of biological and chemical sampling.	~70
April 2003	School presentation	Spoke with Meigs High School FFA about the the purpose and principles of biological and chemical sampling.	~50
April 2003	Community event	Leading Creek Stream Sweep- Collected litter along Leading Creek, Little Leading Creek, and Rutland's parks (collected 0.9 tons of litter and 54 tires)	~50
May 2003	School presentation	Spoke with 5th graders at Rutland Elementary about the basic aspects of stream conditions and the fundamentals of water quality monitoring	~50
May 2003	School presentation	Nature hike as part of the Albany kindergarden "Field Day"	~70
June 2003	Community event	Fish and Bug Sampling Demonstration- biologists used electro-shocker, nets, and seines to collect fish and macroinvertebrates	50
August 2003	Youth presentation	Spoke at Meigs County Girl Scout camp about the purpose and principles of macroinvertebrate sampling.	~70
August 2003	Community event	Organized a Watershed Photo Contest	15
October 2003	Community event	Fall Watershed Tour	20
Fall 2003	School presentation	Conducted a series of 6 presentations with 3 local high school classes where they designed and conducted experiments in AMD-impacted and un-impacted streams.	~70
April 2004	School presentation	Spoke with 5th, 7th, and 8th grade about aquatic ecosystems and then they conducted "biological surveys" of a local stream	190
April 2004	Community event	Leading Creek Stream Sweep- Collected litter along Leading Creek, Little Leading Creek, and Rutland's parks	~50
June 2004	Community event	Leading Creek Watershed Camp where about 30 kids and 15 presenters participated in various educational activities.	~45

Newsletters and Local Media

Local residents, landowners, businesses, and public officials have also been informed about the project development and relevant water quality issues through articles in the Meigs SWCD newsletter and the *Leading Creek News*, a newsletter written by staff of Meigs SWCD, watershed residents, and local educators. These newsletters have served as a great forum to notify the public about upcoming events and increase awareness of the project. In addition, all public meetings and watershed activities were published in the "community announcement" section of *The Daily Sentinel* and announced on WYVK, the local radio station. The following four articles about watershed events and the status of water quality in Leading Creek were also published in *The Daily Sentinel*:

- "Youngsters participate in Stream Camp" June 28, 2004
- "Leading Creek leads way to clean Ohio" February 15, 2004
- "Leading Creek group plans future activities" May 8, 2003
- "Soil and Water District tackles stream water quality" February 16, 2003

Endorsement and Adoption of Plan

The successful implementation of any watershed plan requires the cooperation of landowners, local governments, and other stakeholders. Several methods will be used to facilitate the adoption and endorsement of the Leading Creek Watershed Management Plan. Once the plan is completed and "endorsed" by Ohio EPA and Ohio DNR, a 5- to 10-page summary of the plan will be created. This summary will be presented to all parties who will possibly be implementing the practices and programs described in the plan. In addition, the findings of the plan will be presented to the general public at two meetings. Key stakeholders will be given the opportunity to endorse the actions within the plan at these public meetings. Attempts will be made to gain endorsement from the following groups and officials:

- Meigs County Soil and Water Conservation District
- Meigs County Health Department
- Rutland Mayor
- Rutland Village Council
- Residents owning land where projects are planned (Appendix B)
- Residents who regularly attended watershed meetings and community events (Appendix C)
- Local developers and realtors

In addition to local endorsement, there will also be a formal endorsement ceremony for elected officials, business leaders, and natural resource professionals. The following individuals will be contacted to attend:

- Meigs County Commissioners
- Rutland Mayor
- Rutland Village Council
- Ted Strickland, U.S. Congressman
- Jimmy Stewart, State Representative
- David Hanselman, Chief of Division of Soil and Water
- Lisa Morris, Division of Surface Water Chief
- Harry Payne, ACSI/AMD/Grants Manager

Upon official endorsement by Ohio EPA and Ohio DNR, the Leading Creek Improvement Committee will review the plan and consider using the updated action strategies presented in this plan in accordance with or in place of the suggestions in the *Leading Creek Improvement Plan* (Cherry *et al*., 1999).

Future Educational Goals

Education is critical to the restoration and preservation of Leading Creek and its tributaries. The lack of education and outreach in the past has, in part, lead to a general lack of awareness and appreciation for clean, healthy streams and a functioning riparian corridor. The Meigs SWCD staff plans to continue to conduct various educational programs that have been offered in the past (*e.g.* special community events, school presentations, and publications), as well as new activities, such as a canoe float, training/information sessions, and an education land lab at the Meigs SWCD farm on New Lima Road.

Canoe Float

Establishing a canoe float may enhance residents' overall appreciation for local water resources and may provide a greater understanding of the recreational opportunities that Leading Creek provides.

Training/Information Sessions

Training/Information sessions will focus on several issues that are commonly misunderstood by watershed residents. Education and training is needed about the causes of flooding, the importance of riparian vegetation, recommended grazing practices, proper maintenance of septic systems, and the effects of habitat modification.

Educational Land Lab

There is a tremendous opportunity to increase the awareness and appreciation of riparian functions and wetland ecosystems by establishing educational programs and demonstration areas at the Meigs SWCD farm.

Outline of the Plan

This document represents the long-term strategy for restoring streams within the Leading Creek watershed and educating the community about water quality. The plan contains the following sections:

Chapter 3- Watershed Inventory – describes the geology, flora and fauna, water resources, land use, social resources, and alterations to natural habitat.

Chapter 4- Water Quality Inventory – summarizes existing water resource quality and biological integrity within the watershed.

Chapter 5- Sub-Watershed Impairments and Action Strategies – discusses major water quality impairments and identifies and quantifies the contribution of the pollutant. Lists recommendations for watershed restoration and protection.

Chapter 6- Implementation, Evaluation, and Plan Revision – outlines the future strategy for implementing and updating the management plan.

Chapter 3
WATERSHED INVENTORY

Geology

The Leading Creek Watershed lies in the unglaciated Allegheny Plateau region of Southeastern Ohio. The topography of the area is characterized by steep slopes with narrow valley floors. The bedrock of the watershed includes the Conemaugh and Monogahela Formations from the Pennsylvanian Age. The majority of the watershed lies in the dissected Pennsylvanian rocks of the Conemaugh formation. The Conemaugh Group is characterized by layers of shale, siltstone, sandstone, mudstone, with lesser amounts of limestone and coal. This rock unit is concentrated in the western sections of the watershed.

The Monongahela Formation of Pennsylvanian age dominates the central and eastern parts of the watershed. The Group's rock composition consists of layers of shale, siltstone, limestone, sandstone, and coal. The Monongahela Group is characterized by its economic coal beds, and laterally extensive freshwater limestone layers (Gilmore and Bottrell, 1991). The streams in the eastern parts of the watershed (particularly within the East Branch of Thomas Fork sub-basin) are likely being buffered by the surrounding calcareous shale and thin layers of limestone creating net alkaline water conditions (US Department of Agriculture: Gordon Gilmore, personal communication).

Soils

The soil type within the watershed determines the type of natural erosion that occurs and also the various land use practices. Because soil type is very influential in terms of land use planning decisions, consideration will be given to soils, specifically the drainage class and depth to bedrock, when selecting the type and location of best management practices. The upper and middle sections of the watershed are composed of mostly siltstone, sandstone bedrock, and shale. The relevant soil associations are the Gilpin-Rarden-Aaron Association and the Upshur-Gilpin Association. Both are characterized by moderately deep, strongly sloping to steep, well-drained soils found along the ridge tops of the uplands in western Meigs County. The lower section of Leading Creek is comprised of the Chagrin-Nolin-Licking Association characterized by deep, nearly level and gently sloping, well drained soils found in the recent alluvium and lacustrine sediments, typical of floodplain topography (Gilmore and Bottrell, 1991). Table 3-1 presents characteristics of the dominant soil series found in the Leading Creek Watershed. (Note: Digitized soil information is expected to be available to the Meigs SWCD in the fall 2005. When this information becomes available, a soils map will be included in the management plan and should be consulted in the implementation process.)

TABLE 3-1. Characteristics of soil series present in the Leading Creek Watershed.

Soil Series	Permeability	Drainage	Runoff	Seasonal High Watertable (feet)	Topography
Upshur- Gilpin (UgC2, UgD, UgE)	slow	well drained	rapid	> 6.0	sloping to very steep
Omulga (OmB, OmC)	moderate above fragipan slow in fragipan	moderately well drained	medium	2.0 to 3.5	gently sloping
Orrville (Or)	moderate	somewhat poorly drained	slow	1.0 to 2.5	nearly level
Vandalia (VaC2, VaD2)	moderately slow to slow	well drained	rapid	4.0 to 6.0	sloping
Nolin (No)	moderate	well drained	slow	3.0 to 6.0	nearly level
Newark (Nk)	moderate	somewhat poorly drained	slow	0.5 to 1.5	nearly level
Taggart (TaA)	slow	poorly drained	medium	1.0 to 3.0	nearly level

Biological Features

With its rugged, wooded countryside decorated by a mosaic of farms, old fields, woodlots, pastures and open land, the Leading Creek Watershed is home to great numbers and varieties of wildlife.

Endangered Wildlife

The Leading Creek Watershed is habitat to 9 rare species of plants and animals (DNAP Heritage database). Table 3-2 lists the species and their distribution within the watershed. The River Redhorse (*Moxostoma carinatum*) is found in the mainstem of Leading Creek and is an aquatic species of "special interest".

Several endangered terrestrial species may also live within the Leading Creek Watershed boundaries (Carolyn Caldwell, personal communication). The area is considered home range for bobcats (*Felis rufus*), black bears (*Ursus americanus*), and the eastern spadefoot toad (*Scaphiopus holbrookii*). Two endangered species have received significant attention in southeast Ohio and may occur in the watershed. The Indiana bat (*Myotis sodalis*), a federally endangered species, is found in mature hardwood forests and has a small population to the north in the Wayne National Forest. The timber rattlesnake (*Crotalus horridus horridus*), an Ohio endangered species, may also inhabitat the watershed. The snakes prefer dry, wooded hill country and persist in widely scattered areas in southern unglaciated Ohio. The timber rattlesnake is a known inhabitant of Vinton County and has been spotted in the MeadWestvaco Experimental Forest.

TABLE 3-2. Location of state threatened and endangered species within the watershed

Common Name	Scientific Name	State Status	Subwatershed Location
Lance-leaved Violet	*Viola lanceolata*	Protected	05030202-090 070
Netted Chain Fern	*Woodwardia areolata*	Protected	05030202-090 070
Tennessee Bladder Fern	*Cystopteris tennesseen*	Protected	05030202-090 070
Angle-pod	*Matelea obliqua*	Threatened	05030202-090 070
Netted Chain Fern	*Woodwardia areolata*	Protected	05030202-090 050
Virginia-mallow	*Sida hermaphrodita*	Protected	05030202-090 040
Mollusk Bed			05030202-090 040
Tennessee Bladder Fern	*Cystopteris tennesseen*	Protected	05030202-090 040
River Redhorse	*Moxostoma carinatum*	Special Concern	05030202-090 040
Green Milkweed	*Asclepias viridiflora*	Protected	05030202-090 040
Netted Chain Fern	*Woodwardia areolata*	Protected	05030202-090 030
Slender Blazing-star	*Liatris cylindracea*	Threatened	05030202-090 030

Other Wildlife

The plaintive “bob white” calls of bobwhite quail are occasionally heard, particularly in the western portion of the watershed. Those southern birds are still recovering from loss of old-farm habitat coupled with the harsh winters of the late 1970’s and 1980’s, however coveys of wild birds can still be found in areas of “old farm” habitat. Grouse hunters have noted a decline in the number of ruffed grouse in the watershed; the Ohio Division of Wildlife attributes this decline to habitat change as the emergent forests preferred by grouse grow into more mature woodland.

There have been no bald eagle or river otter sightings in the watershed, although those species have been observed in the neighboring Shade River Watershed and in Mason County, West Virginia.

Mammals like whitetail deer, eastern wild turkey, beaver, rabbits and squirrels are found in abundance, while other mammals like mink and even bobcats or black bear may occasionally be spotted in the watershed. Meigs County routinely is one of Ohio’s top 10 counties in terms of whitetail deer and wild turkey harvest.

Invasive, Non-native Species

The introduction of non-native species into a region can have lasting, detrimental effects. Non-natives, also called exotic or alien species, usually have the following characteristics: fast growing, efficient seed dispersal and germination and rapid vegetative spread. Non-natives often have no natural systems present to keep their populations low. Without having natural predators or diseases, a non-native species can out-compete and displace native species leaving a monoculture of the exotic organism. This can have detrimental effects on the ecosystem by displacing natural foods and habitat and cause the area to be more vulnerable to catastrophic events. The following are examples of non-native species that are present in the watershed: Japanese Honey Suckle (*Lonicera japonica*), Multiflora Rose (*Rosa muliflora*), Privet (*Ligustrum valgare*), Autumn Olive (*Elaeagnus umbellate*), Garlic Mustard (*Alliaria petiolata*), Purple Loosestrife (*Lythrum salicaria*), Eurasian Water-Milfoil (*Myriophyllum spicatum*), Narrow-leaved and Hybrid Cattail (*Typha angustifolia*), Teasel (*Dipsacus spp.*), Tree-of-Heaven (*Ailanthus altissima*), Lesser Naiad (*Najas minor*) and Curly Pondweed (*Potamogeton crispus*).

Water Resources

Climate and Precipitation

The Leading Creek Watershed is characterized by temperate, humid conditions with well-defined winter and summer seasons. In winter, the average temperature is 32 degrees F and the average minimum daily temperature is 22 degrees F. The lowest temperature on record is – 24 degrees F (January 17, 1977). In summer, the average temperature is 71 degrees F and the average maximum daily temperature is 84 degrees F. The highest temperature on record is 102 degrees F (July 26, 1964) (Gilmore and Bottrell, 1991).

Average annual precipitation is 40.7 inches. About 57 percent of the precipitation usually falls in April through September. The heaviest 1-day rainfall during the period of record was 3.39 inches on September 21, 1966. Precipitation is well distributed over all calendar seasons with approximately 8 inches in winter, 11 inches in spring, 12 inches in summer, and 9 inches in fall.

Surface water

As mentioned in the Introduction, the Leading Creek Watershed drains 150 square miles in the un-glaciated hills of Southeastern Ohio. The watershed originates in the southern portion of Athens County, and flows into the Ohio River in Meigs County. According to the Gazetteer of Ohio Streams, there are a total of 10 named tributaries to Leading Creek (Table 3-3). The largest tributaries are Thomas Fork (drainage 32.4 square miles) and Little Leading Creek (drainage 25.6 square miles). (NOTE: Detailed descriptions of the sub-watersheds are presented in the Water Quality Inventory, Chapter 3).

TABLE 3-3. Summary of Leading Creek tributaries and their characteristics.

Water Body Segment	Length (mile)	Watershed Size (sq mile)	Estimated Mean Annual Flow* (GPM)	Floodplain Areas	Entrenchment Ratio
Leading Creek	29.5	150.1	68723.5	connected	ns
Thomas Fork	10.2	32.4	14834.4	connected	5.4
Hysell Run	4.8	4.5	2060.3	connected	ns
Bailey Run	2.3	1.8	824.1	connected	ns
East Branch of Thomas Fork	7.2	31.2	14285.0	connected	ns
Long Hollow	1.6	2.1	961.5	connected	ns
Little Leading Creek	10.6	25.6	11721.0	connected	48.1
Malloons Run	3.4	3.9	1785.6	connected	ns
Parker Run	4.8	7.5	3433.9	connected	ns
Dexter Run	5.3	7.8	3571.2	connected	ns
Mud Fork	7.9	13.2	6043.6	connected	35.5
Ogden Run	4.8	7.3	3342.3	connected	ns
Sisson Run	3.2	5.6	2564.0	connected	12.4
Fivemile Run	4.2	4.9	2243.5	connected	ns

ns= not sampled

* Flow represents the mean annual flow, which was estimated at the site based on drainage area (ILGARD, 2004)

Ohio EPA has classified all named stream segments in the watershed as “Warmwater Habitat” and “Primary Contact Recreation”. Table 3-4 summarizes the use designations for streams in the Leading Creek Watershed (Ohio Administrative Code, 2003).

TABLE 3-4. Designated uses and subcategories for surface water resource

Water Body Segment	Aquatic Life	Water Supply	Recreation
Leading Creek	WWH	AWS, IWS	PCR
Thomas Fork	WWH	AWS, IWS	PCR
Hysell Run	WWH	AWS, IWS	PCR
Bailey Run	WWH	AWS, IWS	PCR
East Branch of Thomas Fork	WWH	AWS, IWS	PCR
Long Hollow	WWH	AWS, IWS	PCR
Little Leading Creek	WWH	AWS, IWS	PCR
Malloons Run	WWH	AWS, IWS	PCR
Parker Run	WWH	AWS, IWS	PCR
Dexter Run	WWH	AWS, IWS	PCR
Mud Fork	WWH	AWS, IWS	PCR
Ogden Run	WWH	AWS, IWS	PCR
Sisson Run	WWH	AWS, IWS	PCR
Fivemile Run	WWH	AWS, IWS	PCR

WWH= Warmwater habitat

AWS= Agricultural water supply

IWS= Industrial water supply

PCR= Primary contact recreation

Although there are a number of small manmade ponds, there are no major lakes in the watershed. Most of the identified wetlands within the drainage area are small riparian marshes. The habitat conditions for two prominent wetlands have been evaluated using the Ohio Rapid Assessment Method (NOTE: Detailed descriptions of the wetlands are presented in the Water Quality Inventory, Chapter 3).

Ground water

“The Leading Creek Watershed contains Pennsylvanian aquifers in the Appalachian Plateaus Province mostly consisting of sandstone and limestone that are parts of repeating sequences of beds deposited during multiple sedimentary cycles. A complete, ideal cycle consists of the following sequence of beds, listed from bottom to top: underclay, coal, gray shale or black platy shale, freshwater limestone, and sandstone or silty shale. Not all the beds listed are present in each cycle. The coals, sandstones and limestones are the most productive aquifers. Upper Pennsylvanian aquifers are present in the Pennsylvanian Monongahela and Conemaugh. Strata that contain these aquifers are present in southeastern Ohio and a small part of northeastern Kentucky. In southeastern Ohio, Upper Pennsylvanian rocks are primarily interbedded sandstone, siltstone, and shale with minor coal; they grade to shale and siltstone in northeastern Kentucky. The dominant lithology is shale, although some limestone beds are present in the Monongahela Group. Together, the Monongehela and the Conemaugh Groups average about 1,000 feet in thickness. These rocks thicken slightly toward the southeast and exceed 1,500 feet in thickness along the Ohio River in Belmont, Monroe, and Washington Counties, Ohio.

Groundwater flow in Appalachian valleys occurs as vertical infiltration along valley walls via tensile stress-relief fractures, and lateral movement along bedding-plane fractures (Wyrich and Borchers, 1981). The primary permeability of sandstone in the region generally is low due to cementation and compaction, but secondary permeability due to fractures may cause an increase in hydraulic conductivity one to three orders of magnitude (Brown and Parizek, 1971). In fact, sandstone and coal are the most permeable of the Pennsylvanian rocks because they can support fractures.

The infiltration rate may be slowed by the rugged surface physiography, very low natural permeabilities of the rock, and the abundance of interbedded impermeable strata. The hydrologic regime is characterized by perched aquifers of limited lateral extent and typically limited groundwater yields.

The groundwater characteristics of the area have been mapped regionally by the ODNR, Division of Water, based on the interpretation of more than 2230 well records and the area's geology and hydrology. Most of the area encompassing Leading Creek typically yields less than one gallon per minute at depths of less than 125 feet. Deeper drilling is not recommended due to the presence of saline and poorer water quality and dry wells are common. Shallow wells in alluvial valleys will yield more water. Much of the population receives water supplies from Leading Creek private water supply. Springs are also a source of groundwater used to augment water for drinking and livestock, however, these sources are often subject to seasonal wetting and drying conditions." (Borch, 2004)

Oil and brine contamination has been found to contaminate drinking water wells in the watershed. During an investigation by Mineral Resources Management, two drinking waters wells were contaminated with brine along Swick Road (Lasher Run). The wells at two households on the same road were contaminated by acid mine drainage. Subsequently, the Abandoned Mine Land program extended the Leading Creek Conservancy District waterline to service the homes affected by mine drainage.

There are no public ground water supplies in the Leading Creek Watershed. The public is served by two rural water systems: Leading Creek Conservancy District and Tupper Plains-Chester Water District. The well fields for these systems are adjacent to the Ohio River near Kanahwa (Leading Creek) and well fields near Longbottom (Tupper Plains-Chester). There is no Source Water Assessment and Protection information for public drinking water supplies. DRASTIC maps are also not available for Meigs County.

Land use

Historic land clearing near Langsville

Land use descriptions

Current and historical land use is an important factor in determining the overall health of a watershed. Poor land management, particularly during mining and agricultural practices, has caused many water quality impacts in the watershed. Based on 1994 land use statistics from the National Land Use Database, the majority of the watershed (67.3%) is forested. Pastureland accounts for 25.6% while 4.8% is row crops. Land cover percentages are described in detail for each of the sub-watersheds in the Water Quality Inventory, Chapter 3 (Table 3-5; see also Map 3).

TABLE 3-5. Land cover percentages for each of the 14-digit subwatersheds

	Subwatershed						
Land Use Category	**010**	**020**	**030**	**040**	**050**	**060**	**070**
Other	0.1%	0.1%	0.1%	0.1%	0.0%	0.3%	0.1%
Open Water	0.1%	0.1%	0.3%	0.9%	0.1%	0.6%	0.3%
Low Inensity Residential	0.4%	0.0%	0.1%	0.2%	0.5%	0.5%	0.2%
High Intensity Residential	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Commerical/Industrial/Transportation	0.1%	0.1%	0.0%	0.2%	0.1%	0.0%	0.5%
Quarries	0.0%	1.5%	0.1%	0.2%	0.0%	0.0%	0.0%
Transitional	0.3%	0.8%	2.1%	1.0%	1.2%	1.5%	0.0%
Deciduous Forest	51.9%	55.4%	61.9%	64.4%	62.8%	59.2%	64.5%
Evergreen Forest	2.4%	1.4%	1.3%	4.6%	6.6%	9.3%	7.7%
Mixed Forest	0.5%	0.4%	0.3%	1.6%	2.1%	3.1%	1.8%
Pasture / Hay	33.9%	33.6%	26.0%	22.6%	22.9%	22.3%	22.3%
Row Crops	10.0%	6.7%	7.7%	4.2%	3.3%	3.0%	2.4%
Urban Recreational Grasses	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Woody Wetlands	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
Emergent Herbaceous Wetlands	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%

Urban

While impervious areas and urban growth threatens water quality in many watersheds in Ohio, it is not an issue of concern in the Leading Creek Watershed. The basin lies within the sparsely populated Appalachian region of Ohio. Based on 1994 land use data, residential areas comprise about 274 acres (0.3%) of the watershed. (Note: An inventory of the home sewage treatment systems within the watershed is presented in the Water Quality Inventory, Chapter 3).

Forest

About 67 percent of the Leading Creek Watershed is forestland, consisting of second, third, or fourth growth stands (Gilmore and Bottrell, 1991). Mixed mesophytic forests in this region of Ohio are noted for floristic richness due to the many microclimates, land surfaces, and soils. The forests consist of a diverse composition of tree species such as Red and White Oak (*Quercus spp.*), Hickory (*Carya spp.*), Red and Sugar Maple (*Acer spp.*), Tulip Popular (*Liriodendron tulipifera*), and Beech (*Fagus grandifolia*).

Woodlands are an important land use in the watershed. They help to prevent soil erosion by aiding water infiltration and reducing excess sediments from entering water bodies. In addition, forested riparian areas increase the stability of the stream channel and help maintain desirable water temperatures and dissolved oxygen levels.

Agriculture

Agriculture makes up about 30 percent of the Leading Creek Watershed. Of this, 25.6% (24,637 acres) is used for pasture/hay and 4.8% (4,644 acres) is used for row crops. Most agricultural activity is observed in the upper three sub-watersheds (*i.e.* Mud Fork and above).

According to 2003 Ohio Agricultural Statistics, the most common crops in Meigs County are hay (18,600 acres harvested) and corn for grain (2,200 acres harvested) (Ohio Department of Agriculture, 2003). Conventional tillage is the most common tillage method in the watershed. In 2002, conservation tillage was practiced on about 214 acres in the watershed (Meigs SWCD: Steve Jenkins, personal communication). Crop rotations, chemical use, and irrigation are not common in the watershed.

Table 3-6 summarizes the number and type of livestock within the watershed. Livestock with unrestricted access to streams can greatly compromise water quality and stream bank stabilization. The Sub-Watershed Impairments and Action Strategies section (Chapter 5) describes target areas within each sub-watershed where livestock have access to streams.

TABLE 3-6. Livestock inventory for the Leading Creek Watershed.

Subwatershed	Beef (Count)	Goat (Count)	Sheep (Count)
Leading Creek headwaters to below Fivemile Run (010)	580	7	0
Below Fivemile Run to above Mud Fork (020)	244	15	0
Mud Fork (030)	148	0	14
Below Mud Fork to above Little Leading Creek (040)	816	0	0
Little Leading Creek (050)	238	1	36
Below Little Leading Creek to the Ohio River (060)	64	0	0
Thomas Fork (070)	138	33	0

* Totals gathered from Farm Service Agency's Livestock Compensation Program (LCP), 2000

Pastureland is a land use that, if managed properly, offers many environmental benefits. Well-managed pastures have lower soil loss rates than most other crops. In addition, they can provide good wildlife habitat and have minimal affects on stream quality. Unfortunately, the majority (56%) of pastureland in Meigs County is poorly managed and requires some type of treatment for it to be adequately protected against erosion (National Resources Inventory, 1984). Overgrazing is the most widespread problem associated with pastures in the watershed (NRCS: Mike Duhl, personal communication). Overgrazing causes numerous problems such as increases in erosion, reduction in the productivity of forage species, greater runoff rates, and decreases in the habitat quality for wildlife. (NOTE: The Sub-Watershed Impairments and Action Strategies section (Chapter 5) describes target areas for overgrazing)


Pasture located in subwatershed 020

Water

According to 1994 land use statistics, open water comprises only 363 acres (0.4%) of the Leading Creek basin. There are no major lakes in the watershed and most of the “open water” (*i.e.* about 200 acres) consists of the Meigs Mine slurry impoundment.

Non-forested wetlands

There are only about 40 acres of herbaceous wetlands in the watershed. The habitat conditions for two prominent riparian marshes have been evaluated using the Ohio Rapid Assessment Method (NOTE: Detailed descriptions of the wetlands are presented in the Water Quality Inventory, Chapter 3).

Barren

Based on 1994 land use statistics from the Ohio Department of Natural Resources (ODNR), barren land comprises about 567 acres (0.6%) of the Leading Creek Watershed. Within the Leading Creek basin, 2,009 acres have been surface mined (US Department of Agriculture, 1985). The ODNR has restored several of the worst “pre-law” mines in the watershed, but a portion of land still lies un-reclaimed and barren. The presence of barren surface mines has resulted in high rates of erosion (as much as 200 tons/acre/year) and excessive sedimentation in many of the streams. (NOTE: The Sub-Watershed Impairments and Action Strategies section (Chapter 5) describes target areas for unreclaimed abandoned mine lands)

Protected Lands

Although there are no state or federal parks or forests in the watershed, the Meigs SWCD has acquired 174 acres along Little Leading Creek to be used to conduct educational activities, demonstrate conservation practices and provide trails for recreation.

In addition, the central portion of the watershed is known for the preservation and cultivation of medicinal herbs. United Plant Savers, the National Center for the Preservation of Medicinal Herbs and the Appalachian Forest Resource Center, are among the groups and organizations active in the watershed. These groups and many adjacent landowners manage about 800 acres of land to promote the protection and expansion of native medicinal herb habitat.

Status and Trends

Since 1900, the state population has nearly tripled (4.1 million to 11.4 million), while the population in Meigs County has actually decreased (28,620 to 23,072). With the abandonment of many farms and pastures, a reduction in active mineland, and very little urban development, much of the land in the watershed has begun to revert to forest. For example, an inventory of the corridor along Sisson Run from 1939 to 1983 showed the presence of riparian trees increased by 44% (Meigs SWCD: Cynthia Bauers, personal assessment). In contrast, a recent evaluation of Meigs County's farmland showed that there was a loss of 25,000 acres of farmland since 1980 (Meigs County Farmland Preservation Task Force, 2000).

Due to these trends, many of the current impacts to water quality cannot be linked to current land use, but must be connected to historical land uses such clearing the land for resource extraction (*i.e.* coal, brick/clay, salt, and oil) and agriculture.

Cultural Resources

Settlement and History

Settlement of the Leading Creek Watershed began shortly after the Indian Wars concluded with the Battle of Fallen Timbers (1794) and the Treaty of Greenville (1795).

In the spring of 1797, James Smith and his family left Marietta and on April 15th landed at the mouth of Leading Creek in Salisbury Township. They selected a location for settlement on the bank of the Ohio River about one mile above the mouth of Leading Creek, and within a few days, they built the first cabin in the western part of Meigs County.

One of the first settlers to the Leading Creek Watershed, David Thomas, came from Virginia in 1797 after the Indian Wars to settle a mile or so above the mouth of Leading Creek. Other settlers soon followed and many of the streams in the watershed bear the names of these early pioneers (The Daily Sentinel, 1994).

The community of Rutland, the largest community located wholly within the watershed, was founded in 1799.

The first water-powered gristmill was built at Rutland in 1805, immediately impacting the movement of fish traveling up the creek for spawning. Within 25 years, grist and sawmills were constructed at Carpenter, Langsville, Harrisonville, Pageville and Rutland, acting as further barriers to fish. Sawdust was dumped into the stream, choking many fish and covering their habitat.

In 1822, the first commercial salt well was bored on the banks of Leading Creek near Thomas Fork, followed by two more wells near Rutland the following year. Large-scale coal mining began in the 1830s with miners developing their tunnels so water would flow out of the mine entrance and into the creek (The Daily Sentinel, 1994).

By 1850, historians noted the declining uniformity of annual stream flows; new drainage patterns, droughts and floods that today are commonplace in southeastern Ohio and in the Leading Creek Watershed. Around 1890, historians reported fishless waters.

As the flow in the creek became less reliable, and the severity and frequency of flash flooding intensified (Leading Creek was reportedly completely dry on Aug. 3, 1930), the water powered grist and saw mills began to close down, but around the same time the amount of surface mining for coal began to increase dramatically. Sediment and acid mine drainage increased greatly (Trautman, 1977).

By the 1950s, dams on the Ohio River extended the river's influence further upstream into Leading Creek.

A large fish kill was recorded on July 3, 1971, and there were fish kills each year from 1972 to 1976, when they halted.

In July, 1993, the Southern Ohio Coal Company pumped a large amount of acidic mine water into the creek, killing practically all aquatic life downstream of the discharge point.

Sometimes the Ohio River and its tributaries struck back. The recent flash floods of Mothers' Day, 1995, and March 1, 1997, still stand out in the minds of many watershed residents, and the Ohio River floods of 1913 and 1937 backed up Little Leading Creek into the village, leaving many homes and businesses under water.

Sites of Cultural Significance

The only public school located in the watershed at this time is Meigs Elementary School, formed from the combined Salem Center, Rutland, Harrisonville, Salisbury, Bradbury, Pomeroy and Middleport elementary schools. Children in the northern portion of the watershed in Athens County and Meigs County's Columbia Township attend Alexander Local Schools located north of Albany.

The Ohio University Airport is located at the northern end of the watershed.

The Meigs Soil and Water Conservation Farm is located in the New Lima community. Fireman's Park and Jim Vennari Park are located in Rutland. The Skatopia skateboard park is also located near Rutland.

The area is served by two daily newspapers: The Pomeroy-Middleport Daily Sentinel and the Athens Messenger. Several radio and television stations also include the Leading Creek in their viewing areas.

Nearby colleges and universities include the University of Rio Grande in Rio Grande, the Rio Grande Meigs Center in Middleport, Ohio University in Athens and Hocking College in Nelsonville.

Healthcare facilities serving the watershed's residents include O'Bleness Memorial Hospital in Athens and Holzer Medical Center in Gallipolis. There are no hospitals located in the watershed. A variety of volunteer fire departments and ambulance services provide fire protection and emergency medical service to watershed residents.

The Rock Springs Fairgrounds, home to the annual Meigs County Fair, was purchased in 1870. The fairground boasts a half-mile racetrack with a unique grandstand built around the first turn of the track. The grandstand, still in use today, was built in the early 1880s and is listed in National Register of Historic Places.

Rutland holds an annual Fourth of July Ox Roast; this event dates to at least 1908.

Rutland had a railroad depot from 1886 to 1951, the village still boasts a "Depot" Street. In addition, a stage coach line, owned by A.E. Boone and discontinued in 1886, had stops in

Harrisonville and Albany. The coach ran from Charleston, West Virginia, to Athens and carried both mail and passengers.

The Holt Company produced weavers' reeds, used in commercial looms, for approximately 80 years beginning in 1823 near Rutland. The company's founder, Horace Holt, was also a noted abolitionist. A cannery was reportedly located in the New Lima area of the watershed on property now owned by the Meigs Soil and Water Conservation District.

The forest industry is also active in the Leading Creek Watershed and evidenced by the Facemyer Forest Products mill near Middleport and Ohio Pallet Company at Rock Springs.

Recreational pursuits in the watershed include hunting and fishing. The vast majority of land within the watershed is owned by private landowners.


Rutland Fire Station

Other historical items of interest:

- The first Meigs County Board of Commissioners meetings were held at the residence of Robert B. Harris, near the mouth of Leading Creek.
- Thomas Fork is most likely named for David Thomas, who settled in an area described as the "forks of Leading Creek" approximately one mile upstream from the Ohio River in 1797.
- Dexter Run and the community of Dexter were named after Timothy Dexter of Boston who gave a large tract of land to Captain James Merrill, who settled in the area in 1801.
- Parker Run was named for William Parker, an early settler of Salem Township.
- Ogden Run was named for the family of Alvin and Hannah Ogden, the first settlers of Columbia Township.
- Harrisonville, a small community along Little Leading Creek, was laid out in 1840. It was reported that the first hard surface road constructed in the county was a brick road leading into the village from Pomeroy.
- The community of Rock Springs is named for an old "Indian watering hole" that to this day provides a continuous stream of cool water.
- The Civil War came to the Leading Creek Watershed in July, 1863. Confederate General John Hunt Morgan and 2,000 cavalrymen entered the village of Rutland on July 18. To hinder the raiders, members of the Rutland militia on the day before burned the bridge over Leading Creek at Langsville, and felled trees across the road. Local militia hindered Morgan's raiders as they traveled along Thomas Fork behind Pomeroy and Rock Springs.

- Some residents of the Leading Creek Watershed, particularly in the communities of Rutland and Albany, were noted members of the Underground Railroad, and assisted slaves in their journey to freedom.
- The song "Home on the Range" was written by Rutland native Dr. Brewster Higley in the mid 1870's. The popular hymn "When the Roll is Called up Yonder" was penned in 1893 by James Minter Black of Rutland.

Previous and Complementary Efforts

Dr. Donald S. Cherry of Virginia Polytechnic Institute and State University and students from Virginia Tech conducted monitoring and developed an improvement plan for the watershed (*i.e*. *The Leading Creek Improvement Plan*- (LCIP)). This report characterized the conditions of the Leading Creek Watershed, identified sources of ecological impairment, and suggested actions necessary to remediate impacted sites. Jim Freeman, of the Meigs Soil and Water Conservation District, has led efforts to complete projects described in *The Leading Creek Improvement Plan*. Several projects have been accomplished that will protect and/or improve the ecological integrity of the watershed.

To date, under the Leading Creek Improvement Project, there have been 70.72 acres of land enrolled under the Conservation Reserve Program and/or the Leading Creek Improvement Program. This is land that was determined to be either cropland or marginal pasture under guidelines established by the United States Department of Agriculture (USDA).

In addition, 4.75 miles of streambank have been, or are under contract to be, protected by tree or grass buffer strips. The buffer strips range in width from 30 feet to 300 feet. The maximum allowable width of buffer strips is based on USDA regulations, which take into account the existing land practices, soil types and slopes.

To assist in planting the riparian buffer strips, the Meigs Soil and Water Conservation District used approximately $4,000 in Leading Creek funds to purchase a tree planting machine. So far approximately 15,000 trees have been planted in the watershed using the machine, and plans call for planting more trees next year.

Numerous farmers and landowners in the Leading Creek Watershed are utilizing the John Deere no-till drill, also purchased with Leading Creek funds, to encourage conservation-friendly agriculture. No-till agriculture greatly reduces the amount of topsoil erosion when compared to traditional plowing and planting practices.

A total of 326 acres were planted using the John Deere drill in 2000. For 2002, a total of 213.8 acres have been planted using the no-till drill as of Aug. 12, 2002. No figures are available for 2001, although it may be safe to assume it is similar to 2000.

The following pictures and descriptions highlight the practices sponsored by the Leading Creek Improvement Account.

Grass filter strips have been installed between Five Mile Run and adjacent crop fields, with additional riparian forest buffers installed further upstream in headwaters areas (LCIP Pages 15-1 and 15-7).

Section of Five Mile Run now excluded from livestock showing grass filter strip planted between the stream and crop field and pasture.

Roadbank erosion addressed along Dexter Road (County Road-10) by installation of limestone rip-rap (LCIP section 15.4, pages 15-18 and 15-19). While accomplishing one of the objectives of the Leading Creek Improvement Project, this was done independently by the Meigs County Highway Department.

Rip-rap installed on Leading Creek, just downstream of the confluence of Parker Run, along Dexter Road. This project was carried out by the Meigs County Highway Department to reduce stream roadbank erosion independently of the Leading Creek Improvement Project.

Crop field located along stream incorrectly identified as Plowed Run has been planted to Christmas trees and creeping red fescue and taken out of row crops. (LCIP 15-1, 15-9) Done independently of Leading Creek Improvement Program

Previously plowed field along Sharps Run at State Route 143 now planted to Christmas trees and creeping red fescue.

Corn field at confluence of Sisson Run and Leading Creek has been planted to orchard grass and taken out of row crop production.

Corn field located on Baker property along the east bank of Leading Creek along County Road 10 near the community of Dexter. This field will be planted to trees next spring under the Leading Creek Improvement Program and the Conservation Reserve Program.

Grass filter strip located across Leading Creek.

Traditional row crop agriculture halted at headwater of Mud Fork and Five Mile Run Planned reduction of 20 tons sediment/year in those streams through implementation of agricultural BMP's on hold (LCIP pages 15-1, 15-2, 15-7).

Cropland cultivation on Ogden Run continues, but riparian forest buffer planned for 2003 on Dickinson Property (LCIP pages 15-1, 15-10).

Many landowners have also been assisted under the Environmental Quality Incentives Program including Pauline Adkins on Little Leading Creek, Bill Dix on Mud Fork and Five Mile Run, and Tony Kopec, mainstem.

Jim Freeman, Leading Creek Watershed Coordinator, with newly purchased tree planter. Approximately 15,000 trees were planted in the Leading Creek Watershed with this planter during spring, 2002.

Another satisfied customer. Lois Jones with one of her pin oak trees in a newly planted riparian forest buffer.

Ogden Run at County Road 1. A riparian forest buffer will be planted here on property belonging to Dickinsons.

In addition to the efforts related to the *Leading Creek Improvement Plan,* the ODNR Mineral Resources Management, Abandoned Mine Land Program has sponsored activities to develop the *Leading Creek Acid Mine Drainage Abatement and Treatment (AMDAT) Plan*. The purpose of the Leading Creek AMDAT Plan is to detail the actions that are necessary to treat the sources of acid mine drainage (AMD) in order to restore stream segments and streams in the Leading Creek watershed to meet their designated aquatic life use. The objectives for the study are outlined below.

1. **Define current water quality conditions.** We wanted to adequately characterize current conditions in the watershed so that a comprehensive description is available for comparison in current and future monitoring.

2. **Describe the extent to which AMD affects each of the subwatersheds that were mined before the passage of the Surface Mining Control and Reclamation Act (SMCRA) in 1977.** We located and described all existing acidic, (mine) sediment, and metal- impacted waters and determined the locations of the sources of AMD in the watershed. The plan highlights each tributary impacted by mine drainage and describes sources of AMD found during the study.

3. **Determine the projects and measures necessary to remediate impacted sites.** Our final objective is to propose several actions that will abate and treat the acid mine drainage, providing conditions necessary for a healthy biological community. The treatment of particular sources was prioritized based on environmental benefits and cost-effectiveness.

To accomplish these objectives, an extensive watershed investigation was conducted from February 2003 to September 2004. The assessment included measurement of field and laboratory parameters in all the impacted subwatersheds and at all of the existing sources. Current monitoring was used along with historical sources of data to determine the existing impacted sites. A copy of the AMDAT plan along with a comprehensive description of the water chemistry and site characteristics was completed in September 2004 and as of April 2005 it is continuing to be reviewed by staff of ODNR Mineral Resources Management.

In addition to the Leading Creek AMDAT plan, the Abandoned Mine Land (AML) Program has provided support for many projects that have caused substantial improvements in the landscape. “Through the AML program, over 8 hundred acres of barren, eroding strip-mine land have been reclaimed, at a cost of over $6 million. Two project totaling approximately 35 acres are pending in the Thomas Fork watershed. The main goal of the projects was to stabilize the sediment sources to reduce sedimentation in the receiving streams. At the time, the federal funding agent, the Office of Surface Mining, did not allow funding for specific AMD control measures. In addition, over 150,000 tree seedlings have been planted on AML through this program.”(ODNR MRM: Barb Flowers, personal communication).

Physical attributes of Streams and Floodplains

While staff of the Meigs Soil and Water Conservation District and representatives of the Leading Creek Improvement Committee have compiled a significant amount of information and data on water quality, stream biology, and other watershed characteristics, more work is needed to adequately describe the physical attributes of the streams and floodplains.

It is also important to note that much of the information required in Appendix 8 (*i.e.* dams, channelization, levees, floodplain connectivity, *etc.)* is not adequate to describe the overall physical integrity of the sub-watersheds in this basin. The main cause of impairment in streams in the Leading Creek Watershed is sedimentation and poor substrate quality; therefore, these issues will be the focus of the following section.

Early Settlement Conditions

Leading Creek and its tributaries are remnants of the prehistoric Teays River Valley, which flowed northwest from the Carolinas towards Wisconsin. With the advent of glacial ice, the Teays River system was dammed by glacial deposits, forming an extensive lake system. Glacial meltwater and outwash produced Leading Creek and the existing gently sloping valley network seen today (Gilmore and Bottrell, 1991).

When the first settlers arrived, Leading Creek and its tributaries flowed clear and clean over sand, gravel and bedrock. The stream was cut deep into the valley floor, and trees and brush grew right up to the stream which, along with protruding brush and rootwads, provided a high degree of erosion protection.

The fallen and submerged trees provided habitat and cover for large fish and their food. The trees at the stream's edge formed a natural canopy that provided shading beneficial for aquatic life.

An abundance of springs in southeastern Ohio ensured a year-round flow in even the smallest of tributaries, which were used by the pioneers for drinking water. There was little impact from the Ohio River, which at that time was only navigable in spring and fall (Trautman 1977).

Channel and Floodplain Condition

Stream channel and substrate conditions are a major concern in the Leading Creek Watershed and may be the most important factor limiting aquatic life (Ohio EPA, 2000a). A large portion of the streambed has been inundated with residual sand from strip-mined land, upland erosion from agriculture, stream channel erosion, and/or natural geologic features. The excessive sediment not only impacts the substrate type and quality, but also alters pool and riffle depth and quality. The adverse impacts of sediment deposition are evident in many tributaries where sediment depths often exceed 2 feet and the average QHEI substrate score is well below 13. (NOTE: Descriptions of the streambed conditions in each sub-watershed are presented in the Water Quality Inventory, Chapter 3)

A comprehensive floodplain assessment has not been conducted in the Leading Creek Watershed, but information is available based on visual evaluations and anecdotal information from local residents (Table 3-7). System-wide, most of Leading Creek and its tributaries have access to their floodplains. Based on conversations with several older residents, many feel that there has been an increase in flooding for the equivalent storm conditions due to decreased channel capacities caused by sediment deposition in the streams. Due to development and road construction near streams, the floodplain has likely lost some of its ability to function properly. Since 1995, restrictions on floodplain development and relocation of several homes have occurred in Langsville and Rutland.

TABLE 3-7. Floodplain quality rating for three major tributaries of Leading Creek.

Little Leading Creek

Land Use Characteristics of Floodplain*

Left bank	Right bank**	
RM 11.9 to 7.3	RM 11.9 to 5.9	Forest, Swamp
RM 7.3 to 5.9		Shrub or old field
RM 5.8 to 0.0	RM 5.8 to 0.0	Residential, park, new field

Overall Floodplain Rating

Left bank	Right bank**	
		Low. Floodplain is not functioning as a landuse buffer and is not connected to the stream channel.
RM 11.9 to 10.9 RM 5.8 to 0.0	RM 5.8 to 0.0	Moderate. Floodplain supports some functions of stream protection and channel connectivity.
RM 10.9 to 5.9	RM 11.9 to 5.9	High. Floodplain is fully functioning and acts as a land use buffer and as a storage area for flood water.

Thomas Fork

Land Use Characteristics of Floodplain*

Left bank	Right bank**	
RM 11.0 to 6.9 RM 2.8 to 0.0	RM 4.4 to 2.8	Forest, Swamp
	RM 2.8 to 0.0	Shrub or old field
RM 6.9 to 2.8	RM 11.0 to 5.5	Residential, park, new field
	RM 5.5 to 4.4	Fenced Pasture

Overall Floodplain Rating

Left bank	Right bank**	
RM 6.9 to 5.5	RM 11.0 to 5.5	Low. Floodplain is not functioning as a landuse buffer and is not connected to the stream channel.
RM 11.0 to 8.7 RM 5.5 to 0.0	RM 5.5 to 0.0	Moderate. Floodplain supports some functions of stream protection and channel connectivity.
RM 8.7 to 6.9		High. Floodplain is fully functioning and acts as a land use buffer and as a storage area for flood water.

Mud Fork

Land Use Characteristics of Floodplain*

Left bank	Right bank**	
RM 3.4 to 1.1	RM 4.8 to 3.4 RM 2.3 to 1.1	Forest, Swamp
	RM 3.4 to 3.0 RM 2.6 to 2.3	Shrub or old field
	RM 3.0 to 2.6	Fenced Pasture
RM 4.8 to 3.4		Open pasture, row crop

Overall Floodplain Rating

Left bank	Right Bank**	
RM 4.8 to 3.4	RM 4.8 to 3.4	Low. Floodplain is not functioning as a landuse buffer and is not connected to the stream channel.
RM 3.4 to 2.3	RM 3.4 to 2.3	Moderate. Floodplain supports some functions of stream protection and channel connectivity.
RM 2.3 to 0.0	RM 2.3 to 0.0	High. Floodplain is fully functioning and acts as a land use buffer and as a storage area for flood water.

* This indicates the dominant land use in the floodplain (*i.e.* beyond the riparian area of 100 meters).

**River right looking upstream.

Forested Riparian Corridors

Forested riparian areas are vital for a healthy stream ecosystem. These corridors help to prevent soil erosion, provide wildlife habitat, and improve water quality. A healthy riparian habitat also regulates stream temperature and supplies organic matter that serves as the primary food source for many aquatic organisms.

As mentioned above, approximately 67 percent of the Leading Creek Watershed is forested; likewise, forestlands are prevalent in the riparian areas. Riparian corridors within the watershed commonly consist of Ash (*Fraxinus spp.*), Elm (*Ulmus spp.*), Maple (*Acer spp.*), River Birch (*Betula nigra*), and Sycamore (*Plantus occidentalis*). Approximately 75 percent (85 miles) of the assessed areas had a minimum of a 50- foot buffer on at least one-side of the stream. Table 3-8 details the location and number of miles of riparian buffer along Leading Creek and each of its major tributaries (NOTE: The Sub-Watershed Impairments and Action Strategies section (Chapter 5) describes target areas for riparian buffers.)

In recent years, watershed landowners have enrolled approximately 70 acres of riparian areas into the Conservation Reserve Program (CRP). In addition, the Meigs County SWCD has purchased a 174- acre riparian area adjacent to 0.7 stream miles of Little Leading Creek.

Functioning riparian area at Leading Creek RM 29.9

Stream Channel Modifications

Most of Leading Creek and its tributaries exhibit the features of natural channels. Channelization and stream modification has occurred in only a few areas and has mostly resulted from roadway construction. Table 3-8 summarizes locations of modified streams (*i.e.* channelized, dammed, and levied) and provides the miles affected.

Entrenchment is the degree to which a stream or river is cut into the valley floor, and is calculated as the width of the flood-prone area to the stream's width at bankfull stage (Rosgen, 1996). During the “natural” processes of a stream, waters that carry a heavier sediment load disperse out on a floodplain where sediment deposition occurs. Streams that no longer have access to their floodplain have increased sediment loads and often experience increased bank erosion.

Entrenchment is not a widespread problem in the Leading Creek Basin and may occur in only a few areas. The average entrenchment ratio for seven sites assessed throughout the watershed was 37.6. The very large ratios indicate that these streams have well-developed floodplains.

Streams with Unrestricted Livestock Access

Streamside forests are often severely degraded by livestock. The livestock not only damage vegetation and soil on the banks and upland areas, but they often trample and degrade the stream channel. Common impacts of livestock intrusion are excessive bank erosion, shallow channels with less cover, and increased nutrients and fecal coliform levels.

Livestock have access to several streams in the watershed (Table 3-8). Fivemile Run, Sisson Run, Sharps Run, Dexter Run, and Little Leading Creek are the streams with the greatest effects from livestock. (NOTE: The Sub-Watershed Impairments and Action Strategies section (Chapter 5) describes target areas for restricting livestock.)

TABLE 3-8. Summary of physical attributes of Leading Creek and its major tributaries.

Subwatershed*	River Mile	Mainstem Total Length (miles)	Channelized (miles)	Levied (miles)	Dammed (miles)	Rip. Buffer Present (miles)	Rip. Buffer Needed (miles)	Locations Rip. Buffer Needed RM	Unrestricted livestock access	Number of New Homes	Number Bridges/ Culverts	Notes
Leading Creek Headwaters to Fivemile Run	31.9 to 26.2	5.7	0.4	0.0	0.0	5.5	1.0	27.9 to 28.5 27.0 to 27.4	yes	2	7	most bridges/culverts and channelization is due to the Railroad
Fivemile Run	Confl. 26.2	4.5	0.0	0.0	0.0	3.5	0.9	See Appendix D	yes	0	11	
Leading Creek Below Fivemile Run to Mud Fork	26.2 to 18.9	7.3	0.6	0.0	0.0	4.0	3.1	26.0 to 25.0 25.8 to 25.2 24.7 to 23.6 22.3 to 21.9	yes	9	13	channelization is due to the Railroad and RR tunnels
Sharps Run	Confl. 25.7	4.4	0.0	0.0	0.0	4.0	0.2	See Appendix D	yes	3	9	
Sisson Run	Confl. 23.9	4.3	0.5	0.0	0.0	3.2	2.2	See Appendix D	yes	6	6	
Ogden Run	Confl. 21.9	5.7	2.3	0.0	0.0	4.7	1.3	See Appendix D	yes	0	6	Channelized for agricultural use
Dyesville Run	Confl. 20.8	3.1	0.0	0.0	0.0	2.7	0.4	See Appendix D	yes	0	5	
Mud Fork	Confl. 18.9	8.6	2.2	0.1	0.0	5.9	2.4	See Appendix D	yes	0	12	Channelized because of road flooding
Leading Creek Below Mud Fork to Little Leading	18.9 to 8.5	10.4	0.8	0.0	0.0	10.4	1.3	11.9 to 11.3 10.9 to 10.7 10.0 to 9.7 8.4 to 8.2	yes	1	12	Channelized because of roads
Dexter Run	Confl. 18.5	5.5	0.0	0.0	0.0	4.3	1.4	See Appendix D	yes	0	7	
Grass Run	Confl. 16.8	3.0	0.0	0.0	0.0	2.1	0.7	See Appendix D	no	0	5	
Parker Run	Confl. 15.6	5.4	0.9	0.0	0.0	4.1	1.2	See Appendix D	yes	0	12	
Malloons Run	Confl. 14.8	3.6	0.2	0.0	0.0	2.6	0.8	See Appendix D	yes	0	6	
Lasher Run	Confl. 8.9	3.6	0.5	0.0	0.0	2.6	0.9	See Appendix D	yes	1	6	
Little Leading Creek	Confl. 8.5	13.2	0.5	0.0	0.0	7.9	3.8	See Appendix D	yes	1	19	
Leading Creek Below Little Leading to the Ohio River	8.5 to 0.0	8.5	0.0	0.0	0.0	8.2	0.4	4.3 to 3.9	yes	0	6	
Titus Run	Confl. 7.4	3.8	0.0	0.0	0.0	3.0	0.2	See Appendix D	yes	1	9	
Paulins Run	Confl. 6.1	1.1	0.0	0.0	0.0	0.3	0.2	See Appendix D	no	0	5	
Thomas Fork	Confl. 1.5	11.9	0.4	0.0	0.0	6.2	5.4	See Appendix D	yes	1	30	

"Riparian Buffer Present" was determined by evaluating 2001 aerial photos to determine if at least a 50 foot buffer was present on at least one-side of the stream

"Riparian Buffer Needed" was determined by evaluating 2001 aerial photos and was only counted if a buffer could reasonably be established (*i.e.* roads and residential areas are not included).

The number of new homes is estimated for the entire subwatershed and not just along the stream.

Eroding Banks

Excessive bank erosion can contribute a significant amount of the sediment load to a stream. In addition, it can directly damage bridges, roads, and cause the loss of productive farmland. Table 3-9 summarizes areas where severe bank erosion is occurring within the watershed.

TABLE 3-9. Areas experiencing severe streambank erosion.

Stream Name	River mile	
	From	To
Leading Creek	31.5	31.1
Leading Creek	22.3	21.7
Leading Creek	23.9	23.6
Fivemile Run	2.5	2.0
Fivemile Run	1.5	0.9
Sharps Run	0.7	0.5
Sisson Run	1.2	0.5
Little Leading Creek	10.1	9.0
Little Leading Creek	8.9	8.9
Little Leading Creek	8.6	7.8
Little Leading Creek	7.4	6.9
Little Leading Creek	5.8	5.3
Tributary #14 to Little Leading	1.1	0.8
Tributary #20 to Little Leading	0.9	0.0
Tributary #2 to Mud Fork	0.6	0.1
Tributary #1 to Mud Fork	0.3	0.0

*Areas are based on visual assessments from Meigs SWCD staff and Cherry et al.

*Severe bank erosion was defined as having over 50%-75% of streambank being broken down or eroding.

*Thomas Fork has not been assessed

Status and Trends

In general, very little residential and/or commercial development is being constructed in the watershed, but housing development and land conversion should be considered a potential threat to stream quality in the northern part of the drainage area. According to the 2000 US Census, 25% to 27% of the housing units in this area were built between 1995 to March 2000. (NOTE: The Sub-Watershed Impairments and Action Strategies section (Chapter 5) describes target areas for habitat preservation.)

Within the next five years, the Meigs County Highway Department anticipates replacing 3 bridges in the watershed and completing regular maintenance (*e.g.* paving, patching, stablilizing) on existing roads (Table 3-10).

Table 3-10. Planned bridge replacements in the Leading Creek Watershed.

Location	Stream	Year
Depot Street (County Road 3)	Tributary #2 of Little Leading Creek	2005
Dexter Bridge (County Road 10)	Leading Creek at RM 17.4	2009
Laurel Cliff (County Road 22)	East Branch of Thomas Fork	2009

Chapter 4
Water Resource Quality

Designated Uses and Subcategories for Surface Water Resources

The Ohio Water Quality Standards used for managing water resources consist of designated uses and physical, chemical, and biological criteria. The Ohio Environmental Protection Agency created standards that exist in the form of “aquatic life uses” and “non-aquatic life uses”.

Ohio Water Quality Standards: Aquatic Life Uses

- ***Exceptional Warm Water Habitat (EWH)***
  Designation is reserved for waters which support “unusual and exceptional” assemblages of aquatic organisms. Water bodies are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (declining species). This use designation represents a protection goal for water resource management efforts in Ohio’s best rivers and streams.

- ***Warm Water Habitat (WWH)***
  Designation defines the “typical” warm water assemblages of aquatic organisms for Ohio rivers and streams. This use is the principal restoration target for the majority of water resource management efforts in Ohio, including those of the Leading Creek Watershed. Biological criteria are stratified across five ecoregions for the WWH use designation.

- ***Modified Warm Water Habitat (MWH)***
  Designation applies to streams and rivers which have been subjected to extensive and irretrievable modifications of the physical habitat such that the biocriteria for the WWH use are not attainable. The activities causing the “irretrievable modifications” have been sanctioned and permitted by state or federal law. The representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat. Biological criteria for MWH have three major modification types: channelization, run-of-river impoundments, and extensive sedimentation due to non-acidic mine drainage. Biological criteria for MWH are stratified across five ecoregions

- ***Limited Resource Water (LRW)***
  Designation applies to small streams (usually <3 square mile drainage area) and other waterbodies which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported. Waters designated LRW are affected by one or more factors: acid mine drainage, small drainageway maintenance, or other specified conditions. No formal biological criteria have been established for the LRW use designation.

- ***Coldwater Habitat (CWH)***
  Designation applies to waters which support assemblages of native cold water fish and associated organisms and/or those which are stocked with salmonids sanctioned by the Ohio DNR, Division of Wildlife. No specific biological criteria have been developed for the CWH use.

Ohio Water Quality Standards: Non- Aquatic Life Uses

In addition to monitoring the health and status of aquatic life, each water quality survey also assesses non-aquatic life uses such as recreation, water supply, and human health concerns.

- ***Recreational Uses-*** attainment status is based on bacterial indicators (*i.e.* fecal coliform, *E. coli*) which are specified in the Ohio Water Quality Standards.

    - **Primary contact-** Waters that during the recreational season are suitable for full-body contact recreation such as swimming, canoeing and scuba diving. Waters must have a depth >1 meter and an area >100 square feet.
    - **Secondary contact-** Waters that during the recreational season are suitable for partial body contact recreation such as wading.
    - **Bathing waters-** Waters that during the recreational season are suitable for swimming where a lifeguard and/or bathhouse facilities are present.

- ***Water Supply Uses-*** attainment status is based on chemical criteria which are specified in the Ohio Water Quality Standards.

    - **Public Water Supply-** Waters that with conventional treatment will be suitable for human intake and meet federal regulations for drinking water. Waters are defined as segments within 500 yards of a potable water supply or food processing industry intake.
    - **Agricultural Water Supply-** Waters that are suitable for irrigation and livestock watering without treatment.
    - **Industrial Water Supply-** Waters that are suitable for commercial and industrial uses with or without treatment.

Biological Criteria

Ohio's Water Quality Standards are dependent on the biological integrity, rather than water chemistry criteria, to classify the health of a given stream segment. Several structural multi-metric indices are used to assess the health of the biological community and determine habitat quality. Biological surveys are conducted to determine the condition of both fish (IBI and MIwb) and macroinvertebrate (ICI) populations.

- ***Index of Biologic Integrity (IBI)*** is a multi-metric index that represents the structural and functional integrity of the fish community. The index assesses fish community attributes that correlate with biotic integrity. The IBI consists of the following 12 metrics in wading sites (note some metrics are modified for headwater sites):
    - Metric 1. Total number of native fish species
    - Metric 2. Number of darter species
    - Metric 3. Number of sunfish species
    - Metric 4. Number of sucker species
    - Metric 5. Number of intolerant species
    - Metric 6. Percent abundance of tolerant species
    - Metric 7. Proportion of omnivores
    - Metric 8. Proportion of insectivores
    - Metric 9. Top carnivores
    - Metric 10. Number of individuals in a sample
    - Metric 11. Proportion of individuals as simple lithophilic spawners
    - Metric 12. Proportion of individuals with disease, eroded fins, lesions and tumors

- ***Invertebrate Community Index (ICI)*** is a multi-metric index used to evaluate the overall condition of benthic macroinvertebrates in a stream segment. The ICI consists of the following 10 metrics:
    - Metric 1. Total number of taxa
    - Metric 2. Total number of mayfly taxa
    - Metric 3. Total number of caddisfly taxa
    - Metric 4. Total number of dipteran taxa
    - Metric 5. Percent mayflies
    - Metric 6. Percent caddisflies
    - Metric 7. Percent tribe *Tanytarsini* midges
    - Metric 8. Percent other dipterans
    - Metric 9. Percent tolerant organisms
    - Metric 10. Total number of *Ephemeroptera*, *Plecoptera*, and *Trichoptera* (EPT) taxa

- ***Modified Index of Well Being (MIwb)*** is an index that incorporates the number of individuals, biomass, and the Shannon diversity index, in order to evaluate the relationship between fish abundance and development.

- ***Qualitative Habitat Evaluation (QHEI).*** QHEI scores are not adopted into the Ohio Water Quality Standards mandate as are the other indices described above. Physical features, such as type of substrate, amount and type of in-stream cover, channel width, sinuosity, and erosion, that affect fish communities are evaluated.

TABLE 4-1. Narrative ranges and biocriteria for the Western Allegheny Plateau wading sites

IBI	MIwb	ICI	Narrative Evaluation
50 -60	≥ 9.4	46 - 60	Exceptional
46 - 49	8.9 - 9.3	42 - 44	Very Good
44 - 45	**8.4** - 8.8	**36** - 40	Good
40 - 43	7.9 - 8.3	32 - 34	Marginally Good
28 - 39	5.9 - 7.8	14 - 30	Fair
18 - 27	4.5 - 5.8	8 - 12	Poor
12 -17	0 - 4.4	≤ 6	Very Poor

WWH criteria in bold

Leading Creek Watershed Group Targets and Benchmarks

In addition to the biological criteria, staff of the Meigs Soil and Water Conservation District have used the standards and targets summarized in Table 4-2 to determine water quality impairments in the watershed. Specific targets for the Leading Creek Watershed were determined by reviewing water quality data in reference reaches, the mainstem, the most heavily impacted sites, parameters in the Western Allegheny Plateau (WAP) which are attaining WWH, and other watershed group’s targets. The following target values for water quality parameters were choosen: pH 6.5 – 7.5 s.u., Alkalinity 70 mg/L, TDS 500 mg/L, Sulfates 150 mg/L, Iron 1.0 mg/L, Aluminum 0.75 mg/L, and Manganese 0.60 mg/L.

TABLE 4-2. Ohio EPA standards and benchmarks organized by the Leading Creek Watershed Group

Parameter	Ohio EPA standard	Ohio EPA benchmark	Watershed Group target
Ammonia	2.2 mg/L ‡		
Nitrate	0.34 mg/L, 0.47 mg/L *		
Total Phosphorus	0.05 mg/L, 0.06 mg/L *		
Fecal Coliform	2000 counts/100mL £		
pH	6.5 - 7.5 ‡		
Alkalinity	135 mg/L, 141 mg/L*		
Total dissolved solids	1500 mg/L ‡		
Total Iron	1.10 mg/L, 0.80 mg/L *		
Total Manganese	0.60 mg/L, 0.20 mg/L*		
Total Aluminum			0.50 mg/L §
Sulfate	204 mg/L, 191 mg/L *		
IBI		44-49 Ω	
ICI		36-44 Ω	
MIwb		8.4-9.3 Ω	

‡ Ohio EPA water quality standard for Ohio River Basin, outside mixing zone

* Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion. 1st number is for headwater sites and 2nd number is for wading sites (>20 square miles)

£ Ohio EPA water quality standard to meet the recreational use for primary contact

§ Target set by the Leading Creek Watershed based on the median water quality concentration at WAP reference sites meeting partial and full attainment of WWH.

Ω Ohio EPA benchmarks set for multimetric indices to meet Warmwater Habitat aquatic life use designation.

Causes and Sources of Water Quality Impairment

Section 305(b) of the Clean Water Act requires each state to conduct water quality surveys to determine if a waterbody's overall health is being met. The *Ohio Water Resources Inventory* (Ohio EPA, 2000a) summarizes the progress that Ohio is making toward achieving the goals of the Clean Water Act. In the 2000 report, Ohio EPA described the attainment status of Leading Creek and four of its tributaries, Parker Run, Malloons Run, Little Leading Creek, and Thomas Fork (Table 4-3 and see Map 4).

TABLE 4-3. Waterbody segment (305b) summaries for streams in the Leading Creek watershed.

Waterbody (RM) Upper/Lower	Stream Reach Length	Attainment Miles Status FULL	Partial	NON	Threatened	Causes, Sources, and Comments
Leading Creek mainstem - WWH						
33.00/18.50	14.50	10.00		4.50		*Causes:* Siltation, habitat alterations *Sources:* Surface mining, pasture land, nonirrigated crop production
18.50/8.49	10.01		10.01			*Causes:* Salinity, siltation *Sources:* Subsurface mining, pasture land, nonirrigated crop production, surface mining
8.49/0.00	8.49			8.49		*Causes:* Siltation, pH, habitat alterations *Sources:* Subsurface mining, surface mining, speciality crop production
Tributary to Leading Creek (confl. RM 20.45) - WWH						
3.35/0.00	3.35	2.00				*Comments:* Small headwater stream easily achieved the WWH Index of Biotic Integrity (IBI=46)
Parker Run (confl. RM 15.58) - WWH						
4.80/0.00	4.80	1.40	3.40			*Causes:* Salinity/TDS/chlorides, unknown *Sources:* Subsurface mining, channelization-development
Malloons Run (confl. RM 14.68) - WWH						
3.40/0.00	3.40	2.00				*Comments:* A good reference stream that easily attains WWH
Little Leading Creek (confl. RM 8.49) - WWH						
10.60/0.00	10.60			2.00		*Causes:* Siltation, other habitat modifications *Sources:* Surface mining, pasture land,
Thomas Fork (confl. RM 1.49) - WWH						
7.200/0.00	7.20			5.00		*Causes:* Siltation, pH *Sources:* Surface mining

In 2004, the Ohio EPA published the *Integrated Water Quality Monitoring and Assessment Report*, which integrated the water quality assessments previously presented in the Water Resources Inventory (Section 305(b)) reports and lists the impaired water bodies (Ohio EPA, 2004a). According to the 2004 Integrated Report, 33.3% of small streams sampled in the watershed (sites with < 50 square miles drainage) are in full attainment of warm water habitat, with 0% in partial attainment, and 66.7% in non- attainment. None of the large streams (sites with >50 square miles drainage) achieve full attainment, 66.7% are in partial attainment and 33.3% are in non- attainment (Table 4-4). The Ohio EPA cites the following high magnitude sources to explain why the sampled streams do not achieve their aquatic life use: cause unknown, pH, siltation, salinity/TDS/Chlorides, and other habitat alterations.

TABLE 4-4. Attainment assessment from the 303(d) report

	Percentage attainment		
	Full attainment	Partial attainment	Non attainment
Small streams (sites with < 50 square mile drainage)			
	33.3	0.0	66.7
Large streams (sites with > 50 square mile drainage)			
	0.0	66.7	33.3

Overview of Water Quality Impairments

The Ohio EPA outlines several sources of water quality impairments to the Leading Creek Watershed. They list known sources of impairment as follows: surface mining, subsurface mining, specialty crop production, pastureland, non-irrigated crop production, and channelization. Surface mining was listed as the source of water quality impairment in over half (5/9) of the assessed stream segments.

The sources of water quality impairment proposed by the Ohio EPA cause many problems for stream quality. Some of the causes of water quality impairment include siltation, pH, habitat alteration, and salinity/TDS/chlorides. Siltation is the main cause of impairment in the sampled areas, affecting 6 of the 9 stream segments.

These water quality impairments have obvious affects on the aquatic life in the streams. According to the attainment information, few streams and stream segments are achieving their aquatic life use designation (WWH). As outlined above, only 33.3% of small streams attain WWH and none of the large streams that were assessed attain WWH.

Point Source and Non Point Source Pollution

Point sources

There are currently 4 National Pollution Discharge Elimination System (NPDES) permits issued in the watershed (Table 4-5). The Rutland Sewage Treatment Plant and Leading Creek Conservancy District Water Treatment Plan are not expected to provide significant loadings of nutrients or metals, given the small populations they serve and assuming that reasonable performances are being attained. In contrast, elevated levels of TDS are contributed by the CONSOL mine operations. The Meigs Mine #31 treatment plant has a NPDES permit which allows it to discharge to a tributary of Parker Run. The TDS salts are primarily composed of sulfate and sodium, which are by-products of treatment of acid mine drainage by pH neutralization with sodium hydroxide. This effect of the Meigs #31 treatment plant was considered a high magnitude cause of impairment according to Ohio EPA’s 2000 Water Resource Inventory (Ohio EPA, 2000a).

TABLE 4-5. NPDES point source summary

Facility	Tributary/Subwatershed	NPDES ID	Description
CONSOL Energy Meigs Mine No. 2	Ogden Run/ 05030202-090 020	OH0022837	Mining
CONSOL Energy Meigs Mine No. 31	Parker Run/ 05030202-090 040	OH0022829	Mining
Leading Creek Conservancy District	Leading Creek/ 05030202-090 040	OH0099279	Water Supply
Rutland Sewage Treatment Plant	Little Leading Creek/ 05030202-090 050	OH0050130	Sewage System

Spills and illicit discharges in the watershed include: livestock waste, human waste, and crude oil. From 1993 to 2004, there have been no fish kills related to spills within the Leading Creek Watershed (ODNR DOW: Keith Wood, personal communication). Rutland's treatment plant does have periodic "overflows" due to excess flow. In general, "overflows" are rare and are usually associated with extremely wet weather.

Nonpoint sources

Nonpoint source pollution is the primary path through which contaminants enter Leading Creek and its tributaries. In general, the watershed is mainly affected by three causes of pollution: sedimentation/siltation, acid mine drainage, and nutrient enrichment/pathogens.

<u>Sedimentation/Siltation</u>

Siltation is ranked as a leading cause of water quality impairment in the nation's rivers and streams (United States EPA, 2000). Excessive sedimentation has been estimated to occur in almost half of all rivers and streams in the United States and is considered the most important factor limiting fish habitat (Judy *et al.* 1984). Sedimentation and siltation is also a leading cause of aquatic life impairment in Ohio's rivers and streams (Ohio EPA, 2000a).

The adverse impacts of sediment deposition are evident in Leading Creek and several of its tributaries (Cherry *et al.* 1999). Many of the streambeds are inundated with residual sand from strip-mined land, upland erosion from agriculture, stream channel erosion, and/or natural geologic features. In a 1985 survey of 30 Ohio counties impacted by mining, the Leading Creek Watershed ranked highest for sediment damage, acreage of sediment deposition, total erosion and erosion rate (US Department of Agriculture, 1985). Sediment depths exceeding 18 inches have been reported in Little Leading Creek, Thomas Fork, Sisson Run, and Mud Fork (Bauers field measurement; Cherry *et al.*, 1999). The QHEI substrate scores for the sediment-impacted streams range from 6 to 8, reflecting the poor substrate quality and the extensive embeddedness of the streambeds (Bauers, field measurement).

Acres of highly erodible land and potential upland soil erosion is of special concern in the Leading Creek Watershed because of chronic flooding and because sedimentation is considered a high magnitude cause of impairment in the basin (Ohio EPA, 2000a). Approximately 70% to 80% of the basin is considered "Highly Erodible Land" (Table 4-6); therefore, proper land management is very important to prevent and/or reduce soil loss (NRCS: Mike Duhl, personal communication).

Mud Fork's streambed covered with several feet of sand

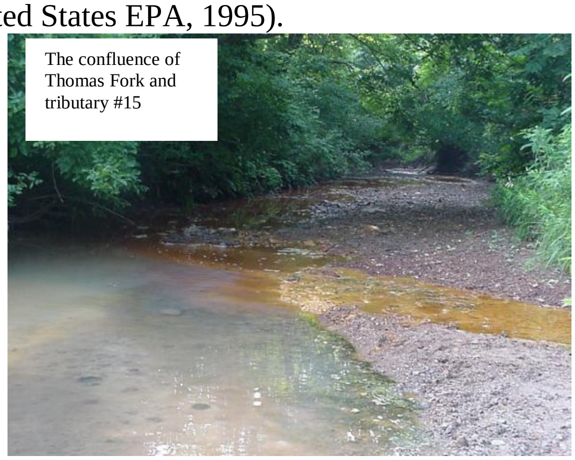
TABLE 4-6. Estimation of highly erodible land by subwatershed

Subwatershed	Percentage of Highly Erodible Soil*	Acres of Highly Erodible Soil
Leading Creek headwaters to below Fivemile Run 05030202-090 010	55% to 65%	4,744 acres to 5,607 acres
Leading Creek below Fivemile Run to above Mud Fork 05030202-090 020	65% to 75%	9,886 acres to 11,407 acres
Mud Fork 05030202-090 030	60% to 70%	5,096 acres to 5,945 acres
Leading Creek below Mud Fork to above Little Leading Creek 05030202-090 040	70% to 80%	15,182 acres to 17,351 acres
Little Leading Creek 05030202-090 050	80% to 90%	13,097 acres to 14,734 acres
Leading Creek below Little Leading Creek to the Ohio River 05030202-090 060	80% to 90%	4,595 acres to 5,169 acres
Thomas Fork 05030202-090 070	85% to 95%	16,968 acres to 18,965 acres

* Because digitized soil information was not available, percentages were roughly estimated based on the Meigs Soil Survey

Acid Mine Drainage (AMD)

Acid mine drainage is a complex environmental stressor that impacts aquatic ecosystems with high levels of acidity, elevated concentrations of dissolved metals and/or the deposition of metal precipitants. Within the last twenty years the devastating environmental stress of acid mine drainage has developed into a prominent ecological issue. The United States EPA has determined that AMD is the largest source of water pollution in the Appalachian Region affecting more than 6,400 km of streams (United States EPA, 1995).



The confluence of Thomas Fork and tributary #15

The Leading Creek basin is not affected by the severe and widespread AMD impacts that are common in many watersheds in Southeast Ohio. Based on extensive field reconnaissance, only two tributaries, Paulins Run and Thomas Fork, have widespread impacts that reduce the diversity and abundance of fish and macroinvertebrate communities. Localized impacts are also present in Little Leading Creek and Titus Run.

<u>Nutrient Enrichment/Pathogens</u>

Another major impact in the watershed is organic enrichment from excessive nutrients and untreated or poorly treated sewage delivered via runoff from household sewage treatment systems (HSTS), improper application of fertilizer, and organic wastes from livestock operations. High levels of nutrients encourage the growth of bacteria and algae in the water. Rapid increases of algae colonies (*i.e.* “blooms”) can severely depress dissolved oxygen levels in the water, making the stream inhospitable to sensitive fish and macroinvertebrates. Excess plant growth may also obstruct light and water movement in open waters.

While fecal coliform does not seem to be a widespread and severe impact in the watershed, there is evidence (*e.g.* direct pipes to stream, black organic sludge from houses, and odor) that contamination is likely in certain tributaries and stream segments.

The Rutland Sewage Treatment Plant serves about 200 housing units and is the only wastewater treatment system in the watershed; therefore, the majority of the homes within the watershed have HSTS. Although a comprehensive inventory of home septic systems (*i.e.* determinations of age, type, locations) has not been completed within the watershed, the Meigs SWCD and Meigs Health Department have worked together to identify target areas where improperly functioning septic systems are located and have estimated the number of failing systems (Table 4-7).

TABLE 4-7. Sewage statistics by subwatershed

Subwatershed	Total # Homes	Population	# Homes with Public Sewage	# Home Sewage Treatment Systems	Number of Failing Systems	% of Total Systems Failing
Leading Creek headwaters to below Fivemile Run 05030202-090 010	213	543	0	213	107	50%
Leading Creek below Fivemile Run to above Mud Fork 05030202-090 020	359	915	0	359	180	50%
Mud Fork 05030202-090 030	166	437	0	166	83	50%
Leading Creek below Mud Fork to above Little Leading Creek 05030202-090 040	562	1495	0	562	337	60%
Little Leading Creek 05030202-090 050	672	1767	175	497	298	60%
Leading Creek below Little Leading Creek to the Ohio River 05030202-090 060	126	321	0	126	63	50%
Thomas Fork 05030202-090 070	785	1923	0	785	471	60%

Total number of homes was estimated from 1995 topographic maps and 2000 U.S. Census Bureau data about housing units

Percentage of Failing systems was estimated by staff of the Meigs County Health Department

Additional Non point sources

Table 4-8 summarizes other potential non- point sources. Because none of these issues significantly impact the water quality of Leading Creek and its tributaries, assessments were completed for the entire basin and not for each sub-watershed. More detailed evaluations of the physical attributes (*i.e.* channelization, levies, dams, and livestock intrusion) are presented in Table 3-8.

TABLE 4-8. Summary of potential non point sources of pollution in the Leading Creek Watershed

Watershed *	Number of New Homes ‡	Number of Animal Feeding Operations §	Average Size of Animal Feeding Operations §	Number of Bridges/ Culverts£	Channelized River Miles£	Impounded River MilesΩ	Petition Ditches
Leading Creek Watershed 05030202-090	~25	198	33 A.U.	~450	~9.0	0	0

*Calculations were determined from evaluations along the mainstem of Leading Creek, along each of the major tributaries, and all streams entering the tributaries

‡ Number of new homes were estimated by surveying the watershed and talking with local landowners

§ Number and size of animal feeding operations was estimated from (Ohio Department of Agriculture, 2003)

£ Number of bridges/culverts and miles channelized were determined by evaluating 2001 aerial photos along the mainstem of Leading Creek, along each of the major tributaries, and all streams entering the "major" tributaries. Streams were considered "channelized" if they were still functionally impaired by previous modifications.

Ω The ODNR Division of Water does not include any structures within the watershed in their "Dam Safety Inventory"

Water Quality and Biological Information

Monitoring history

In July 1993, an emergency dewatering event at the Meigs #31 Mine resulted in the release of a large (billion gallon) volume of partially treated and untreated mine water into several streams in the Raccoon and Leading Creek Watersheds. The discharge essentially eliminated the entire fish, macroinvertebrate, unionid mussel, and amphibian assemblages from Parker Run and the lower ~ 16.0 miles of Leading Creek. Subsequently, extensive water quality and biological sampling has been conducted to assess the recovery of streams affected by the removal of water from Meigs Mine #31. Since 1993, the Ohio EPA has conducted extensive biological monitoring in the portions of the watershed affected by the mine release and in several tributaries that were sampled as reference sites.

Following the release of water from Meigs Mine 31, the U.S. Justice Department and Southern Ohio Coal Company (SOCCO) entered into a Consent Decree and Settlement Agreement that required SOCCO to complete biological monitoring to demonstrate that the stream had attained (or maintained) many of the ecological endpoints specified in the Ohio EPA Endpoints Document (1994). Monitoring of the ecological recovery was conducted by EA Engineering, Science, and Technology, an environmental consulting firm contracted by SOCCO, and by American Electric Power (AEP), who owned SOCCO. For simplicity, the following sections, which summarize the biological surveys conducted by EA Engineering, Science, and Technology and AEP will be credited to AEP.

In addition, the Federal Court Consent Degree required the development of the *Leading Creek Improvement Plan*. Dr. Donald S. Cherry of Virginia Polytechnic Institute and State University and students from Virginia Tech conducted monitoring and developed an improvement plan for the watershed, excluding Thomas Fork. This report characterized the conditions of the watershed, identified sources of impairment, and suggested actions to remediate the impacted sites. The monitoring conducted by Dr. Cherry and students from Virginia Polytechnic Institute and State University will hereafter be referred to as the Virginia Tech team.

Because of the extraordinary conditions at the time when most of this information was gathered, much of the historical information is not representative of current watershed conditions (*i.e.* during and after the release, the streams were severely contaminated and had highly degraded biological communities). Because of these limitations, the Leading Creek Watershed Coordinator, staff of the Meigs SWCD, and summer interns have completed additional water quality monitoring (see Map 5 for monitoring locations).

The current and previous watershed assessments, including biological surveys, water chemistry, and habitat evaluations, will be summarized in the following sections. The water chemistry database and fish and macroinvertebrate species lists are available upon request to the Leading Creek Watershed Coordinator. Table 4-9 summarizes Ohio EPA, AEP, and the Virginia Tech team's sampling locations and types of surveys conducted.

TABLE 4-9. Summary of historical biological surveys conducted by Ohio EPA, AEP, and the Virginia Tech researchers

Ohio Environmental Protection Agency			American Electric Power			Virginia Tech Team		
Location (RM)	Survey Type	Survey Year	Location (RM)	Survey Type	Survey Year *	Location (RM)	Survey Type	Survey Year
Subwatershed 010								
29.9	Fish	1993	30.4	Macroinvertebrate	1996	E. Branch Headwaters, RM 31.6	Macroinvertebrate	1996, 1997
29.7	Fish	1994, 1995	26.3	Macroinvertebrate	1996	29.9	Macroinvertebrate	1996, 1997
						W. Branch Headwaters, RM 0.2	Macroinvertebrate	1996, 1997
						Fivemile Run, RM 0.9	Macroinvertebrate	1996, 1997
						26.3	Macroinvertebrate	1996, 1997
Subwatershed 020								
26.0	Macroinvertebrate	1988 - 1991	24.1	Macroinvertebrate	1996	Sharps Run, RM 0.7	Macroinvertebrate	1996, 1997
24.3	Macroinvertebrate	1987	21.3	Macroinvertebrate	1996	24.3	Macroinvertebrate	1996, 1997
Trib. to Ogden Run, RM 1.0	Macroinvertebrate	1988 - 1990				Sisson Run, RM 0.1	Macroinvertebrate	1996, 1997
Trib. at RM 20.5, RM 0.5	Fish	1994				Ogden Run, RM 0.2	Macroinvertebrate	1996, 1997
19.0	Fish	1993				20.8	Macroinvertebrate	1996, 1997
Subwatershed 030								
						Mud Fork, RM 0.2	Macroinvertebrate	1996, 1997
						Mud Fork, RM 0.8	Macroinvertebrate	1996, 1997
Subwatershed 040								
Dexter Run, RM 0.7	Macroinvertebrate	1987 - 1989	17.3	Macroinvertebrate/ Fish	1995 - 1997	Dexter Run, RM 0.8	Macroinvertebrate	1996, 1997
16.8	Macroinvertebrate/ Fish	1993 - 2002	16.9	Macroinvertebrate/ Fish	1995-1997, 2000	17.3	Macroinvertebrate	1996, 1997
16.0	Fish	1993	15.6	Macroinvertebrate/ Fish	1995-1997, 2000	Grass Run, RM 0.8	Macroinvertebrate	1996, 1997
15.6	Fish	1993, 1994, 2002	Parker Run, RM 2.9	Macroinvertebrate/ Fish	1995 - 1997	16.9	Macroinvertebrate	1996, 1997
Parker Run, RM 1.8	Fish	1999	Parker Run, RM 1.5	Macroinvertebrate/ Fish	1995 - 1997	15.6	Macroinvertebrate	1996, 1997
Parker Run, RM 1.6	Macroinvertebrate/ Fish	1993 - 2002	Parker Run, RM 0.1	Macroinvertebrate/ Fish	1995 - 1997	Parker Run, RM 1.5	Macroinvertebrate	1996, 1997
Parker Run, RM 1.5	Fish	1995	15.5	Macroinvertebrate/ Fish	1995-1997, 2000	15.5	Macroinvertebrate	1996, 1997
Parker Run, RM 0.2	Fish	1995	14.8	Macroinvertebrate/ Fish	1995-1997, 2000	14.8	Macroinvertebrate	1996, 1997
Parker Run, RM 0.1	Fish	1993 - 1996	12.9	Macroinvertebrate/ Fish	1995-1997, 2000	Malloons Run, RM 0.1	Macroinvertebrate	1996, 1997
Little Parker Run, RM 0.4	Fish	1993	10.3	Macroinvertebrate/ Fish	1995-1997, 2000	12.9	Macroinvertebrate	1996, 1997
Trib. to Parker Run, RM 2.7	Macroinvertebrate	1998				10.3	Macroinvertebrate	1996, 1997
15.5	Fish	1993-1997, 1999, 2002				Lasher Run, RM 0.5	Macroinvertebrate	1996, 1997
14.9	Fish	1994 - 1996, 2000						
14.8	Macroinvertebrate/ Fish	1993 - 1999, 2002						
Malloons Run, RM 0.2	Fish	1993, 1996						
13.9	Fish	1995						

* Additional years may have been sampled, but the information was not readily available

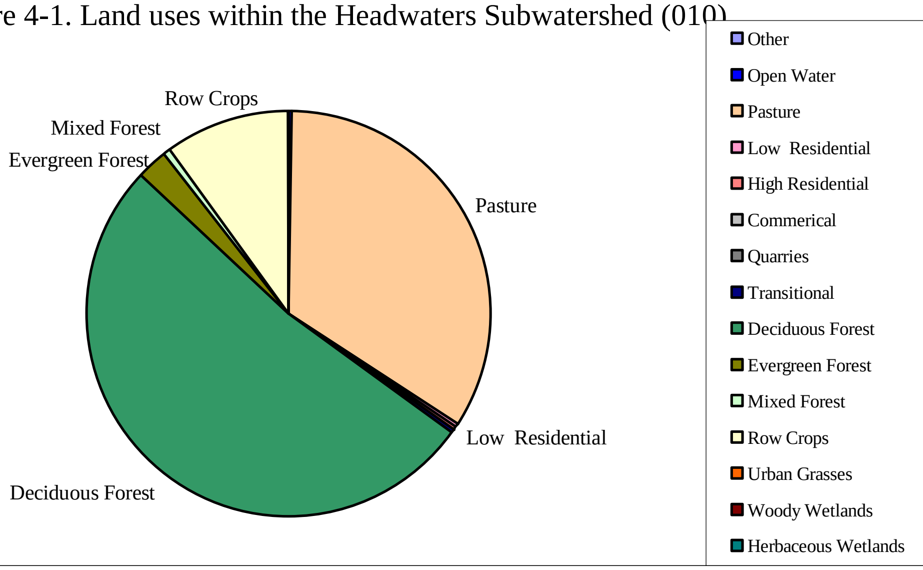
TABLE 4-9. Summary of historical biological monitoring continued.

Ohio Environmental Protection Agency			**American Electric Power**			**Virginia Tech Team**		
Location (RM)	Survey Type	Survey Year	Location (RM)	Survey Type	Survey Year	Location (RM)	Survey Type	Survey Year
Subwatershed 040 continued								
13.0	Fish	1993						
12.9	Fish	1993						
12.3	Fish	1999						
12.2	Fish	1994 - 1997						
10.3	Macroinvertebrate/ Fish	1987-1990, 1993-2002						
8.9	Fish	1995						
Subwatershed 050								
Little Leading Cr, RM 0.4	Fish	1993 - 1996	Little Leading, RM 0.1	Fish	1995, 1996	Little Leading Cr, RM 0.1	Macroinvertebrate	1996, 1997
Subwatershed 060								
7.1	Macroinvertebrate	1994.0	7.2	Macroinvertebrate/ Fish	1995 - 1997	Titus Run, RM 0.2	Macroinvertebrate	1996, 1997
6.0	Macroinvertebrate/ Fish	1993 - 2000, 2002	3.5	Macroinvertebrate/ Fish	1995 - 1997	7.2	Macroinvertebrate	1996, 1997
1.7	Fish	1993	1.8	Macroinvertebrate/ Fish	1995 - 1997	Paulins Hill Run, RM 0.3	Macroinvertebrate	1996, 1997
0.2	Fish	1993, 1994				3.5	Macroinvertebrate	1996, 1997
						1.8	Macroinvertebrate	1996, 1997
Subwatershed 070								
Thomas Fork, RM 4.4	Fish	1995				Thomas Fork, RM 1.2	Macroinvertebrate	1996, 1997
Thomas Fork, RM 2.8	Fish	1993						

Sub-watershed- 05030202-090 010
Leading Creek headwaters to below Fivemile Run
Background

This sub-watershed drains a 13.5 square-mile area (8,625 acres), with streams winding along the border of Athens and Meigs Counties in Alexander Township (Athens), Columbia Township (Meigs) and Scipio Township (Meigs). The sub-watershed begins in the rolling hills that form Leading Creek's headwaters (~RM 32.0) and meanders to below Fivemile Run (~RM 26.2). Although the prominent land use is deciduous forest, this sub-watershed has a higher percentage of pasture/hay and cropland than the other basins (Figure 4-1).

Figure 4-1. Land uses within the Headwaters Subwatershed (010)



The sub-watershed is mostly rural and has two small communities. Albany (in Athens County) is partially located within the watershed and Carpenter (in Meigs County) is entirely within the watershed. The entire village of Albany has a population of about 800 people (United States Census, 2000), but only about a third of the village is located within the watershed. Carpenter is a much smaller community with only 10 to 15 housing units. Housing development and land conversion is much more threatening to stream quality in this area than in the other locations in the Leading Creek Watershed. According to the 2000 US Census, 25% to 27% of the housing units in this area were built between 1995 to March 2000, far exceeding the 3% to 16% in the remaining areas of the watershed. The Ohio University Airport is also partially located within the headwaters sub-watershed. Recent expansion and construction activities at the airport terminal resulted in modification of an unnamed tributary of Leading Creek and wetlands. Consequently, 1.87 acres of the impacted wetlands were created on-site and 4.30-acres of wetlands were mitigated along Margaret Creek near Hebardville.

Stream Biology

The condition of the biological communities has been well defined for this sub-watershed. A total of seven different sites have been evaluated for various biological parameters (Table 4-9). The fish communities (IBI scores) were monitored at two sites by the Ohio EPA to represent reference sites after the Meigs Mine #31 dewatering. American Electric Power was also required to monitor Leading Creek after the dewatering, and they conducted assessments on the macroinvertebrate community (ICI scores) in the sub-watershed. The Virginia Tech team surveyed the macroinvertebrate communities and described the diversity and abundance of sensitive macroinvertebrates while developing the Leading Creek Improvement Plan.

Biological surveys conducted by the Ohio EPA and AEP show that the headwaters of Leading Creek supports a relatively healthy and diverse community of fish and macroinvertebrates (Table 4-10). Of the three fish surveys conducted in the sub-watershed, two of the survey scores fell within the range for warmwater habitat (WWH) criterion (IBI scores of 40 or greater). AEP assessed the condition of the macroinvertebrate community at two sampling locations (RM 30.4 and RM 26.3) and found that ICI scores at RM 26.3 achieved WWH (ICI scores of 32 or greater).

TABLE 4-10. Attainment table for sites in the Leading Creek headwaters to below Fivemile Run (Subwatershed- 05030202-090 010)

River Mile	Surveyor	Year	IBI	Narrative Evaluation	MIWb	Narrative Evaluation	ICI	Narrative Evaluation	Status
30.4	AEP	1996					23	Fair	(Non-attainment)
29.9	EPA	1993	38	Fair					(Non-attainment)
29.7	EPA	1994	46	Very Good					(Full)
29.7	EPA	1995	40	Marginally Good					(Full)
26.3	AEP	1996					43	Very Good	(Full)

The Virginia Tech team evaluated the diversity and abundance of sensitive macroinvertebrates at two mainstem sites (RM 29.9 and RM 26.3) and three tributaries: the west branch of the headwaters, east branch of the headwaters (RM 31.6), and Fivemile Run. The macroinvertebrate community at the mainstem sites appears to be in very good condition having a diverse assemblage of macroinvertebrates and a fairly high percentage of sensitive taxa. Likewise, the tributaries had a relatively diverse community of macroinvertebrates, but they had far fewer sensitive organisms than the mainstem sites (Table 4-11).

TABLE 4-11. Macroinvertebrate assessments for sites in the Leading Creek headwaters to below Fivemile Run (Subwatershed- 05030202-090 010)

Location	Taxa diversity *	Percentage EPT taxa
RM 29.9	26	68%
RM 26.3	27	59%
West branch of the headwaters	24	3%
East Branch of the headwaters (RM 31.6)	27	2%
Fivemile Run	24	11%

* total number of different macroinvertebrate taxa collected

Water Chemistry

Like the stream biology, the condition of the water chemistry has been well defined for this sub-watershed. In 2003, staff of the Meigs Soil and Water Conservation District monitored several nutrient parameters including ammonia, nitrate+nitrite, and total phosphorus and tested streams for fecal coliform impairments. In 1996 and 1997, the Virginia Tech biologists monitored nutrients extensively, collecting 15 to 20 samples at four locations in the sub-watershed. The more current information collected by Meigs SWCD was statistically compared to that collected previously by Virginia Tech to confirm that there were not any significant fluctuations over time. Upon determining that the data sets were not significantly different we used the integrated information in our analysis to determine potential problem areas.

Ammonia

Ammonia concentrations have been measured extensively in the sub-watershed (5 different sites were each measured at least 15 times) and only one sample exceeded Ohio EPA's aquatic life standard (Table 4-12). During the most recent sampling event, ammonia concentrations were extremely high in the west branch of the headwaters (5.80 mg/L) and greatly exceeded the concentrations from the 1996 and 1997 sampling. Overall, the ammonia concentration does not seem to be impairing waterways in this sub-watershed with less than 1% of the samples exceeding the Ohio EPA standard.

TABLE 4-12. Average ammonia concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
E. Branch of headwaters, RM 31.6	0.39 <0.05 to 1.52	295.79	1.38	16	0%
W. Branch of headwaters, RM 0.2	0.82 0.09 to 5.80	217.05	2.14	20	1%
Leading Creek, RM 29.9	0.06 <0.05 to 0.15	1746.64	1.17	15	0%
Five Mile Run, RM 0.9	0.36 0.06 to 1.84	1971.03	8.51	16	0%
Leading Creek, RM 26.3	0.07 <0.05 to 0.25	6033.21	4.78	29	0%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

** OEPA water quality standard for Ohio River Basin, outside mixing zone is 2.2 mg/L for ammonia concentrations

Nitrate-Nitrite

Nitrate-Nitrite concentrations have also been widely measured in the sub-watershed with over 75 samples taken at 5 locations. Unlike ammonia, the Ohio EPA has not established water quality criteria for nitrate-nitrite concentrations so we compared our concentrations to a possible benchmark published in an Ohio EPA technical report (*Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams*, Ohio EPA 1999). Nitrate-nitrite concentrations are a concern in the three sampled tributaries: the west branch of the headwaters, east branch of the headwaters, and Fivemile Run, but concentrations do not seem to be impacting the two mainstem sites. Nitrate-nitrite is a pollutant of concern at the five sampling sites with about 40% of the water samples exceeding the Ohio EPA benchmark of 0.34 mg/L (Table 4-13). (Note: the 0.34 mg/L benchmark is for headwater sites, which are defined as having a drainage area < 20 square miles).

TABLE 4-13. Average nitrate-nitrite concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
E. Branch of headwaters, RM 31.6	0.45 0.11 to 1.48	295.79	1.597	16	56%
W. Branch of headwaters, RM 0.2	0.42 0.17 to 0.73	217.05	1.094	20	50%
Leading Creek, RM 29.9	0.28 <0.05 to 0.54	1746.64	5.883	15	33%
Five Mile Run, RM 0.9	0.49 <0.05 to 1.03	1971.03	11.590	16	63%
Leading Creek, RM 26.3	0.22 <0.05 to 0.65	6033.21	15.628	29	14%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles)

Total Phosphorus

Total phosphorus was sampled at the same locations, times and frequencies as the other nutrient parameters described above. Like nitrate-nitrite concentrations, we compared our total phosphorus concentrations to a potential criterion published in *the Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams* (1999). Total phosphorus is the primary pollutant of concern in the three sampled tributaries with 73% of the samples collected exceeding the 0.05 mg/L benchmark. The west branch of the headwaters is of particular concern with 19 out of 20 samples exceeding the potential standard of 0.05 mg/L for headwater sites (drainage area < 20 square miles). On the contrary, concentrations at the mainstem sites do not seem to be important with less than 15% of the samples exceeding the potential criteria (Table 4-14).

TABLE 4-14. Average phosphorus concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
E. Branch of headwaters, RM 31.6	0.08 <0.01 to 0.28	295.79	0.284	16	44%
W. Branch of headwaters, RM 0.2	0.19 0.05 to 0.76	217.05	0.495	20	95%
Leading Creek, RM 29.9	0.04 <0.05 to 0.22	1746.64	0.824	15	13%
Five Mile Run, RM 0.9	0.15 0.02 to 0.31	1971.03	3.619	16	75%
Leading Creek, RM 26.3	0.04 <0.01 to 0.34	6033.21	3.171	29	10%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.05 mg/L for phosphorous at headwater sites (drainage area <20.0 sq miles)

Fecal coliform

Fecal coliform was sampled at three locations in the sub-watershed: one mainstem site (RM 26.3) and two sites along Fivemile Run. Fecal coliform counts were compared to Ohio EPA's water quality criteria for streams designated for "primary contact recreation use". Because of frequency of sampling (as required to directly compare results to the criteria), we cannot make definitive conclusions about bacterial contamination, but the data does support some concerns about levels of bacteria at Fivemile Run. During the July sampling, fecal coliform at Fivemile Run was more than 10 times higher than the primary contact standard of 2000 counts/100 mL (Table 4-15).

TABLE 4-15. Fecal coliform counts (#/100mL) for two sampling events in 2003

Site Location	July 29, 2003 (# /100 mL)	September 30, 2003 (# /100 mL)	Suspected Source
Five Mile Run, RM 1.8	21000	7000	Livestock
Five Mile Run, RM 2.4	Not sampled	220	Reference
Leading Creek, RM 26.3	1080	420	Unsewered community

Ohio EPA water quality standard to meet the recreational use for primary contact is 2000 counts/ 100 mL

Acidity and Metals

Historical and current land use does not indicate that acidity and metals would be pollutants of concern in this sub-watershed (*i.e.* there is no abandoned mine land). Likewise, pH and conductivity field measurements do not indicate that acidity or heavy metals would be affecting the water quality in the sub-watershed (pH ranges at the tributaries and mainstem sites: 8.05 to 7.67; conductivity ranges at the tributaries and mainstem sites: 968 to 523 µS/cm).

Habitat

The Ohio EPA, Virginia Tech crew, and the Meigs SWCD have conducted assessments of the habitat using Ohio EPA's Qualitative Habitat Evaluation Index (QHEI). The mainstem of Leading Creek (RM 30.0 to RM 26.2) in this sub-watershed has very good habitat features (substrate quality, channel development, riparian features, and instream cover), and QHEI scores indicate that the stream segment could support healthy and diverse aquatic communities. This reach has a higher gradient and higher quality substrates including cobble, gravel, and bedrock than in other sub-watersheds in the Leading Creek Watershed. The habitat in the tributaries (the west branch of the headwaters, east branch of the headwaters, and Fivemile Run) is much more degraded than the mainstem reaches and may be a primary variable limiting aquatic life (Table 4-16). The substrate type and quality and the pool and riffle depth and quality are the main habitat features that limit the overall physical condition of these streams.

TABLE 4-16. QHEI scores for sites sampled in the Headwaters subwatershed (05030202-090 010)

Site Location	Date Sampled	Surveyor	Individual metric scores: Substrate	Cover	Channel	Riparian	Pool/Flow	Riffle/Run	Gradient	Total Score
E. Branch of headwaters, RM 31.6	June 1996	Virginia Tech	2.0	10.0	12.0	6.0	5.0	0.0	10.0	45.0
E. Branch of headwaters, RM 31.6	August 2003	MSWCD	0.0	3.0	6.0	4.0	3.0	2.0	6.0	24.0
W. Branch of headwaters, RM 0.2	June 1996	Virginia Tech	0.0	10.0	11.0	6.0	5.0	0.0	8.0	40.0
W. Branch of headwaters, RM 0.2	August 2003	MSWCD	9.0	5.0	9.0	6.0	3.0	0.0	4.0	36.0
Leading Creek, RM 29.9	June 1996	Virginia Tech	12.0	6.0	14.0	7.5	7.0	6.0	10.0	62.5
Leading Creek, RM 29.9	July 1993	OEPA								70.0
Five Mile Run, RM 0.9	June 1996	Virginia Tech	9.0	8.0	12.0	6.5	4.0	0.0	10.0	49.5
Five Mile Run, RM 1.8	August 2003	MSWCD	13.0	8.0	16.0	2.0	7.0	4.0	8.0	58.0
Five Mile Run, RM 2.4	August 2003	MSWCD	10.0	10.0	15.0	8.5	4.0	4.0	8.0	59.5
Leading Creek, RM 26.3	June 1996	Virginia Tech	13.0	13.0	18.0	8.0	5.0	6.0	8.0	71.0
MAXIMUM METRIC SCORE			20.0	20.0	20.0	10.0	12.0	8.0	10.0	100.0

Note: A suggested benchmark for the total QHEI score is 60.0 to potentially attain the WWH designated use (SCWG 2002)

Overall conclusions for Sub-watershed- Leading Creek headwaters to below Fivemile Run

Stream biology

- The mainstem of Leading Creek in this sub-watershed supports a relatively healthy and diverse community of fish and macroinvertebrates.
- Mainstem sites attained the WWH criteria in 3 out of 5 biological surveys.
- The macroinvertebrate community has higher diversity and a higher percentage of sensitive taxa in the mainstem versus the tributaries.

Water Chemistry

- Ammonia concentrations do not seem to be impairing streams in this sub-watershed.
- Nitrate-nitrite is a concern in the west branch of the headwaters, the east branch of the headwaters and Fivemile Run, but the mainstem does not seem to be impacted.
- Total phosphorus concentrations are a primary concern in this sub-watershed. 73% of the samples at the tributaries exceeded the Ohio EPA’s potential criteria.
- Fecal coliform is a major concern in Fivemile Run, where counts are more than 10 times the Ohio EPA standard.
- Acidity and metals do not seem to be impairing streams in this sub-watershed.

Habitat

- The mainstem of Leading Creek has very good habitat features; whereas, the tributaries have poor substrate type and quality and poor pool and riffle depth and quality.
- Dominant substrate types include cobble, gravel, and bedrock and the substrate quality is much better than in other sub-watersheds.

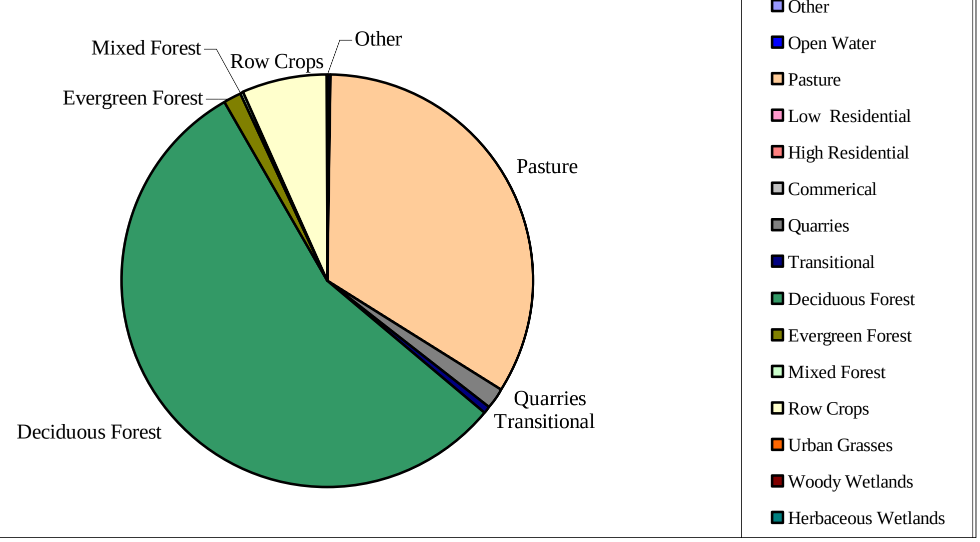
***Sub-watershed-* 05030202-090 020**
Below Fivemile Run to above Mud Fork
Background

This sub-watershed covers a 23.8 square-mile area (15,209 acres), with streams meandering through the Appalachian hills in Columbia Township in northwestern Meigs County. Similar to Leading Creek's other sub-watersheds, the topography of the land is characterized by steep slopes, but this sub-watershed also has many broad, flat valley floors. The sub-watershed is located from below Fivemile Run (~RM 26.2) to above Mud Fork (~RM 18.9) and has three major tributaries: Sharps Run, Sisson Run, and Ogden Run.

The area is sparsely populated with only one community, Dyesville. Dyesville is very small with only about 5 housing units. Fifty-seven percent of the watershed is forestland with the remaining land being used for pasture fields and row crops (Figure 4-2).

Despite the relatively undisturbed terrain, excessive sediment has accumulated in some streambeds and limits the biota (Ohio EPA, 2000b). Many of the streams are inundated with sands and silt that may have originated from upland erosion due to historic land use practices (*i.e.* deforestation and agriculture), current land use practices (*i.e.* pasture land management and grazing practices), and/or it could be a consequence of the natural geologic features (*e.g.* exposed sandstone outcroppings).

Figure 4-2. Land uses within Subwatershed (020)



Stream Biology

The Ohio EPA, AEP, and staff from Virginia Tech have evaluated the condition of the aquatic life in this sub-watershed. A total of eleven different sites, including four major tributaries, have been evaluated for various biological parameters (Table 4-9). The Ohio EPA conducted biological surveys at five sites to represent reference sites after the Meigs Mine #31 dewatering and as part of a USGS/Ohio EPA study of long wall mining (Coen, 1992). AEP assessed the macroinvertebrate community (ICI scores) at two mainstem sites in the sub-watershed. The Virginia Tech team evaluated the health of macroinvertebrate communities (diversity and abundance of sensitive taxa) at five sites.

Evaluations by the Ohio EPA indicate that the biological communities are somewhat impaired in this sub-watershed. Only two of the six mainstem surveys had scores within the range for the warmwater habitat (WWH) criterion (Table 4-17). On the other hand, the one tributary (confluence at RM 20.5) that was sampled had a fish community that easily attained WWH (IBI score= 46).

TABLE 4-17. Attainment table for sites below Fivemile Run to above Mud Fork (Subwatershed- 05030202-090 020)

Location	Surveyor	Year	IBI	Narrative Evaluation	MIWb	Narrative Evaluation	ICI	Narrative Evaluation	Status
Leading Creek, RM 26.0	OEPA	1988					26	Fair	(Non-attainment)
Leading Creek, RM 26.0	OEPA	1989					28	Fair	(Non-attainment)
Leading Creek, RM 26.0	OEPA	1990					40	Good	(Full)
Leading Creek, RM 26.0	OEPA	1991					30	Fair	(Non-attainment)
Leading Creek, RM 24.3	OEPA	1987					26	Fair	(Non-attainment)
Leading Creek, RM 24.1	AEP	1996					40	Good	(Full)
Leading Creek, RM 21.3	AEP	1996					38	Good	(Full)
Leading Creek, RM 19.0	OEPA	1993	32	Fair	8.0	Marginally Good			(Partial)
Trib. to Ogden Run, RM 1.0	OEPA	1988					30	Fair	(Non-attainment)
Trib. to Ogden Run, RM 1.0	OEPA	1989					40	Good	(Full)
Trib. to Ogden Run, RM 1.0	OEPA	1990					30	Fair	(Non-attainment)
Trib. at RM 20.5, RM 0.5	OEPA	1994	46	Very Good					(Full)

In more recent surveys (1996) of the mainstem, AEP found that macroinvertebrate communities easily achieved the ICI standard (ICI scores of 32 or greater), and sites were described as having a “good” assemblage of macroinvertebrates.

The Virginia Tech team determined the macroinvertebrate diversity and abundance at two mainstem sites (RM 24.3 and RM 20.8) and three tributaries: Sharps Run, Sisson Run, and Ogden Run. The macroinvertebrate community indicates that there is some degree of impairment in the sub-watershed. The taxa diversity and percentage of sensitive organisms vary considerably among the five sampled sites, but overall there is moderate taxa diversity and a fair percentage of sensitive taxa (Table 4-18).

TABLE 4-18. Macroinvertebrate assessments for sites below Fivemile Run to above Mud Fork (Subwatershed- 05030202-090 020)

Location	Taxa diversity *	Percentage EPT taxa
Sharps Run, RM 0.7	32	16%
Leading Creek, RM 24.3	24	20%
Sisson Run, RM 0.1	33	25%
Ogden Run, RM 0.2	29	30%
Leading Creek, RM 20.8	28	51%

* total number of different macroinvertebrate taxa collected

Water Chemistry

The overall condition of the water chemistry has also been evaluated for this sub-watershed. In 2003, staff of the Meigs Soil and Water Conservation District tested streams for fecal coliform impairments and measured the following nutrient parameters: ammonia, nitrate+nitrite, and total phosphorus. In 1996 and 1997, the Virginia Tech biologists completed intensive water chemistry sampling, collecting 15 to 20 samples at six locations in the sub-watershed. The more current information collected by Meigs SWCD was statistically compared to that collected previously by Virginia Tech to confirm that there were not any significant fluctuations over time. After determining that the data sets were not significantly different, we used the integrated information in our analysis to determine potential problem areas.

Ammonia

Ammonia has been measured extensively in the sub-watershed, 5 different sites were each measured at least 16 times. Ammonia concentrations were very low and none of the samples neared the Ohio EPA's aquatic life standard of 2.2 mg/L. The average concentrations ranged from <0.05 mg/L to 0.17 mg/L, which indicates that ammonia is not limiting the aquatic life in the sub-watershed (Table 4-19).

TABLE 4-19. Average ammonia concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
Sharps Run, RM 0.7	0.10 <0.05 to 0.16	1695.86	2.04	16	0%
Leading Creek, RM 24.3	0.05 <0.05 to 0.1	8452.12	5.48	18	0%
Sisson Run, RM 0.1	0.17 <0.05 to 0.35	2530.88	5.16	18	0%
Ogden Run, RM 0.2	0.14 <0.05 to 0.39	3315.12	5.57	16	0%
Leading Creek, RM 20.8	0.06 <0.05 to 0.13	15068.30	10.67	16	0%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** OEPA water quality standard for Ohio River Basin, outside mixing zone is 2.2 mg/L for ammonia concentrations

Nitrate-Nitrite

Nitrate-Nitrite concentrations have also been widely measured in the sub-watershed with over 75 samples taken at 5 locations. The Ohio EPA has not established water quality criteria for nitrate-nitrite concentrations so we compared our concentrations to a benchmark (0.34 mg/L) proposed in an Ohio EPA bulletin (*Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams*). Only one site, Sharps Run, had an average concentration that exceeded the OEPA benchmark, but concentrations were also high at RM 24.3 during several sampling events. Widespread impacts from nitrate-nitrite do not seem to be a problem in the sub-watershed, but samples taken from Sharps Run and Leading Creek (RM 24.3) do consistently exceed the potential criteria and are of concern (Table 4-20).

TABLE 4-20. Average nitrate-nitrite concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
Sharps Run, RM 0.7	0.41 <0.05 to 0.95	1695.86	8.34	16	50%
Leading Creek, RM 24.3	0.29 <0.05 to 0.49	8452.12	29.30	18	50%
Sisson Run, RM 0.1	0.26 <0.05 to 0.44	2530.88	7.90	18	11%
Ogden Run, RM 0.2	0.22 <0.05 to 0.37	3315.12	8.75	16	6%
Leading Creek, RM 20.8	0.26 <0.05 to 0.42	15068.30	46.56	16	31%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles)

Total Phosphorus

Like the other parameters, phosphorus was sampled at five locations in the sub-watershed in 1996, 1997, and 2003. Total phosphorus concentrations were evaluated using a proposed criterion (0.05 mg/L) listed in "the Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams" (Ohio EPA, 1999). Overall, total phosphorus does not seem to be impairing the streams in this sub-watershed and only 13 of the 84 samples taken (15%) exceeded the proposed standard. Leading Creek (RM 24.3) did have an average concentration of 0.05 mg/L and should be monitored to insure impairments do not exist (Table 4-21).

TABLE 4-21. Average phosphorus concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
Sharps Run, RM 0.7	0.03 <0.01 to 0.13	1695.86	0.61	16	13%
Leading Creek, RM 24.3	0.05 <0.01 to 0.17	8452.12	5.52	18	28%
Sisson Run, RM 0.1	0.03 <0.01 to 0.10	2530.88	0.91	18	17%
Ogden Run, RM 0.2	0.03 <0.01 to 0.05	3315.12	1.19	16	0%
Leading Creek, RM 20.8	0.04 <0.01 to 0.19	15068.30	7.23	16	13%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

* Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.05 mg/L for phosphorus at headwater sites (drainage area <20.0 sq miles)

Fecal coliform

Fecal coliform was sampled at four locations in the sub-watershed: one mainstem site (RM 20.8), two sites along Sisson Run, and Sharps Run. Fecal coliform counts were compared to Ohio EPA's water quality criteria for streams designated for "primary contact recreation use", but because of frequency of sampling (as required to directly compare results to the criteria), we cannot make definitive conclusions about bacterial contamination. Based on the data we can speculate that there may be bacterial contamination at Sisson Run. During the July sampling, fecal coliform at Sisson Run was more than 2100 (counts/100 mL) and land use activities would support the expectation for evaluated fecal counts (Table 4-22).

TABLE 4-22. Fecal coliform counts (#/100mL) for two sampling events in 2003

Site Location	July 29, 2003 (# /100 mL)	September 30, 2003 (# /100 mL)	Suspected Source
Sharps Run, RM 0.7	not sampled	150	Livestock
Sisson Run, RM 2.6	not sampled	70	Reference
Sisson Run, RM 0.1	2100	510	Livestock
Leading Creek, RM 20.8	1700	350	Unsewered community

Ohio EPA water quality standard to meet the recreational use for primary contact is 2000 counts/ 100 mL

Acidity and Metals

Historical and current land use does not indicate that acidity and metals would be pollutants of concern in this sub-watershed (*i.e.* there is no abandoned mine land). Likewise, pH and conductivity field measurements do not indicate that acidity or heavy metals would be affecting the water quality in the sub-watershed (pH ranges at the tributaries and mainstem sites: 7.90 to 7.62; conductivity ranges at the tributaries and mainstem sites: 1623* to 313 µS/cm). *Ogden Run receives TDS from Meigs Mine #1.

Habitat

The Ohio EPA, Virginia Tech crew, and the Meigs SWCD have conducted assessments of habitat condition using Ohio EPA's Qualitative Habitat Evaluation Index (QHEI). When compared to a QHEI benchmark of 60 used by other watershed groups in the Western Allegheny Plateau (Sunday Creek Watershed Group, 2002), most of the eight stream segments were near or just below the benchmark. Overall, the stream reaches had good channel morphology (sinuosity and natural channel characteristics), but many of the reaches, particularly Sisson Run near the mouth, Sharps Run, and Leading Creek at RM 24.3 had poor instream cover and riparian width and quality. The riffle/run depth and quality is also a habitat feature of concern with all the sites having very low scores for this metric (Table 4-23).

TABLE 4-23. QHEI scores for sites sampled in subwatershed (05030202-090 020)

Site Location	Date Sampled	Surveyor	Individual metric scores Substrate	Cover	Channel	Riparian	Pool/Flow	Riffle/Run	Gradient	Total Score*
Leading Creek, RM 26.0	August 2003	MSWCD	10.0	11.0	17.0	5.0	9.0	4.0	6.0	62.0
Sharps Run, RM 0.7	June 1996	Virginia Tech	9.0	6.0	15.0	6.0	6.0	0.0	8.0	50.0
Sharps Run, RM 0.7	August 2003	MSWCD	12.0	11.0	16.0	7.5	7.0	1.0	10.0	64.5
Leading Creek, RM 24.3	June 1996	Virginia Tech	8.0	6.0	10.0	4.0	9.0	0.0	8.0	45.0
Sisson Run, RM 0.1	June 1996	Virginia Tech	12.0	10.0	10.0	4.0	9.0	5.0	8.0	58.0
Sisson Run, RM 0.1	August 2003	MSWCD	9.0	2.0	11.0	4.5	0.0	0.0	8.0	34.5
Sisson Run, RM 2.6	August 2003	MSWCD	8.0	8.0	10.0	6.0	3.0	1.0	10.0	46.0
Ogden Run, RM 0.2	June 1996	Virginia Tech	9.0	10.0	13.0	8.0	4.0	1.0	8.0	53.0
Ogden Run, RM 0.2	August 2003	MSWCD	10.5	6.0	13.0	6.0	7.0	4.0	8.0	54.5
Leading Creek, RM 20.8	June 1996	Virginia Tech	12.0	11.0	15.0	5.0	5.0	2.0	10.0	60.0
Leading Creek, RM 19.0	August 1993	OEPA	11.0	12.0	14.0	7.0	8.0	4.0	8.0	64.0
MAXIMUM METRIC SCORE			20.0	20.0	20.0	10.0	12.0	8.0	10.0	100.0

*A suggested benchmark for the total QHEI score is 60.0 to potentially attain the WWH designated use (SCWG 2002)

Sediment

The Ohio EPA reports that sedimentation limits the biota and is a high magnitude cause of impairment in this sub-watershed (Ohio EPA, 2000b). Rankin (2002) suggests that subcomponents of the QHEI, particularly substrate score and embeddedness, are effective measures to assess the impacts of sedimentation. The QHEI substrate scores range from 8.0 to 12.0 in the sub-watershed reflecting the poor quality of the streambed (note: A score of 13.0 to 14.0 is a suggested benchmark for the QHEI substrate metric for WWH streams in the WAP ecoregion (Rankin, 2002).

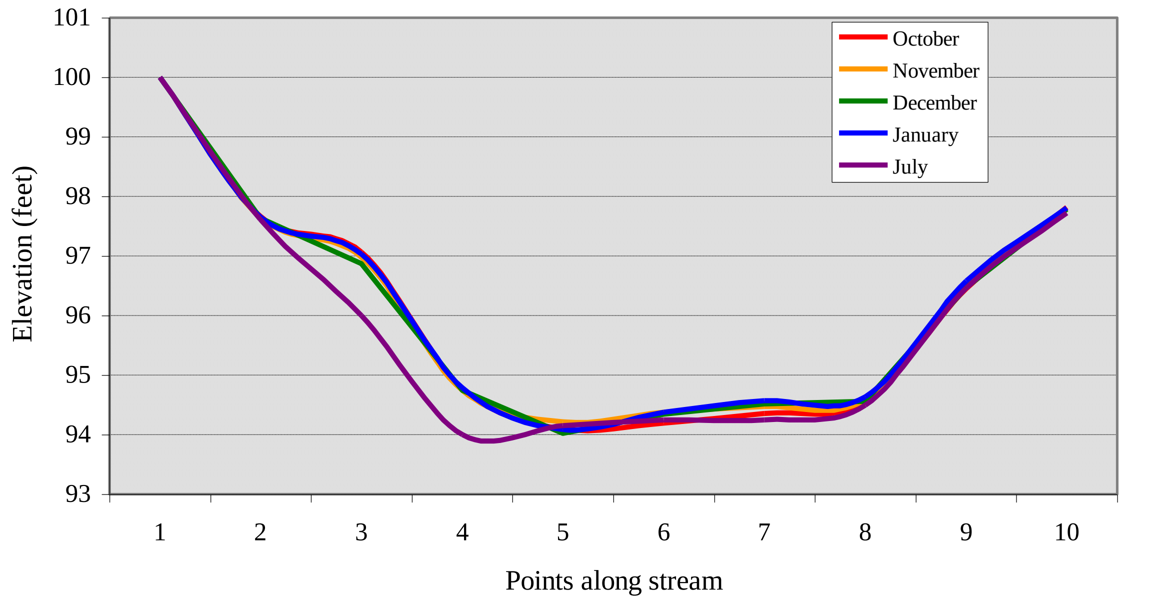
Two tributaries, Sisson Run and Ogden Run, are inundated with sand from historical and current agricultural practices, stream channel erosion, and/or natural geologic features. The Meigs SWCD staff has conducted extensive assessments of substrate condition and sediment deposition in Sisson Run (Table 4-24). Compared to other sites monitored in the Leading Creek Watershed, the streambed did not demonstrate extreme fluctuations (over the 9-month sampling period) and there was little or no evidence of significant bedload and suspended sediment movement during the sampling period (Figure 4-3). The results most likely indicate that transport of significant amounts of suspended sediment and bedload sediment is limited to high flow events and that Sisson Run may have a limited capability of transporting sediment.

TABLE 4-24. Summary of average and range sediment deposition and transport in Sisson Run

Site Location	Sediment depth feet	Bedload transport* lbs/day	Total Suspended Solids* lbs/day
Sisson Run, RM 2.6	1.9	2.49	40
	1.0 to 2.8	0.30 to 6.00	N/A

* Bedload transport and Total Suspended Solids transport were sampled during medium to high flow so sediment movement may be higher than average annual transport

Figure 4-3. Stream Cross-section of Sisson Run (RM 2.6) sampled in 2003-2004



Overall conclusions for Sub-watershed- Leading Creek below Fivemile Run to Mud Fork

<u>Stream biology</u>

- The streams in this sub-watershed seem to support a less healthy aquatic community than the headwaters of Leading Creek.
- Mainstem sites attained the WWH criteria in 3 out of 7 biological surveys.
- There was fair macroinvertebrate community diversity and percentage of sensitive taxa indicating some degree of impairment exists in the sub-watershed.

<u>Water Chemistry</u>

- Average ammonia concentrations were quite low and did not come close to the Ohio EPA standard.
- Widespread nitrate-nitrite impacts do not seem to exist, but it is a pollutant of concern at two sampling locations (Sharps Run and Leading Creek at RM 24.3).
- Total phosphorus does not seem to be impairing streams in this sub-watershed.
- Fecal coliform is potentially a problem in Sisson Run and Leading Creek at RM 20.8 (below Dyesville).
- Acidity and heavy metal concentrations do not seem to be limiting aquatic life in the sub-watershed.

<u>Habitat</u>

- There are some degraded habitat features that may be limiting aquatic life in the sub-watershed.
- Channel morphology appears to be unmodified and the surveyed stream segments have good sinuosity.
- The instream cover and riparian zone width and quality are a concern in Sisson Run near the mouth, Sharps Run and at Leading Creek (RM 24.3).

- The riffle/run habitat is very poor in the surveyed streams and may be an important factor limiting the aquatic life.
- Sisson Run and Ogden Run are inundated with sand, which most likely limits aquatic life.
- Sisson Run does not exhibit the dynamic fluctuations in suspended sediment and streambed movement that are common in many other streams in the watershed.

***Sub-watershed*- 05030202-090 030**
Mud Fork
Background

The Mud Fork sub-watershed drains a 13.3 square-mile area (8,493 acres) located primarily in Scipio and Columbia Townships in northwestern Meigs County. The sub-watershed consists of one tributary to Leading Creek, Mud Fork (confluence at ~RM 18.9).

The watershed is sparsely populated with no small communities or incorporated towns. Streams meander through rolling and steep hills and flat bottoms where the prevalent land uses are deciduous forest (62%) and pasture/hay fields (26%) (Figure 4-4).

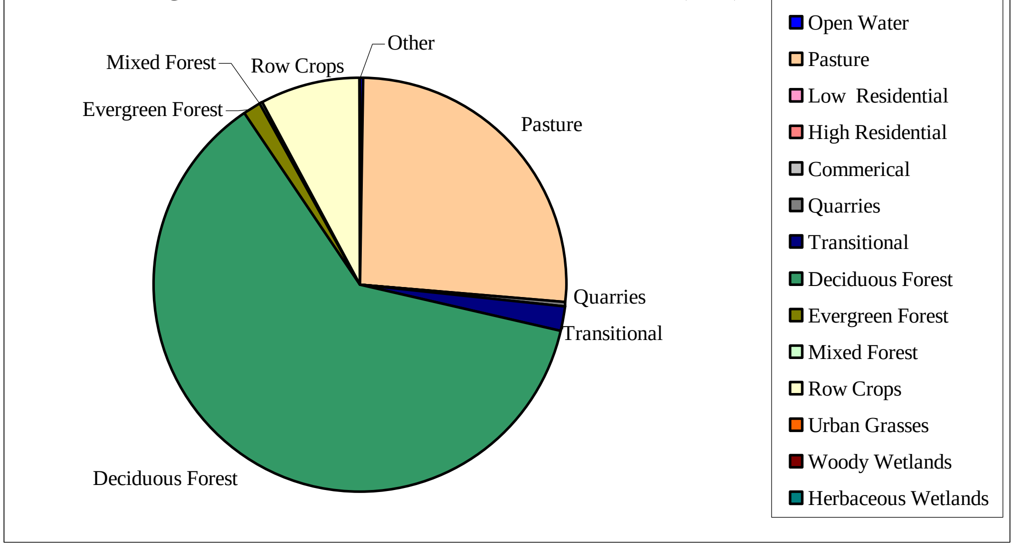


Figure 4-4. Land uses within Subwatershed (030)

Surface mining in the 1950s and 1960s exposed highly erodible mine spoil on many of the hillsides surrounding the headwaters. Erosion rates measured at surface mine spoils in the watershed exceeded ~200 tons/acre/year (US Department of Agriculture, 1985). Reclamation of abandoned mine lands took place in the watershed between 1984 and 1992 (Division of Mineral Resources Management: Barb Flowers, personal communication), but impacts from sedimentation (sand and other fines) still exist in Mud Fork and several of its tributaries. Many of the streambeds are inundated with several feet of residual sand from strip-mined land, upland erosion from agriculture, stream channel erosion, and/or natural geologic features. Habitat features, particularly substrate and riffle/run quality, may be the primary factor limiting aquatic life in the sub-watershed (see discussion below "Habitat").

A unique feature of the sub-watershed is a 70- acre emergent marsh. This wetland appears to be very productive and was given the highest quality ranking (*i.e.* category 3) when assessed by Ohio EPA wetland biologists (see discussion in "Wetlands Quality").

Stream Biology

Unlike the sub-watersheds described above, the condition of the aquatic life in Mud Fork is largely unknown. Although Ohio EPA has not monitored any sites in the sub-watershed, the Virginia Tech team evaluated the diversity and abundance of sensitive macroinvertebrates at two sites along Mud Fork (RM 0.8 and RM 0.2). The two sites varied considerably with the upstream site having lower diversity but a fairly high percentage of sensitive taxa, and the downstream site having greater taxa diversity but considerably lower percentage of EPT taxa (Table 4-25). Overall, the assemblages and abundances of macroinvertebrates indicate that there is some degree of impairment in the sub-watershed.

TABLE 4-25. Macroinvertebrate assessment for sites in the Mud Fork subwatershed (Subwatershed- 05030202-090 030)

Location	Taxa diversity *	Percentage EPT taxa
Mud Fork, RM 0.8	22	34%
Mud Fork, RM 0.2	25	10%

* total number of different macroinvertebrate taxa collected

Water Chemistry

In 2003, staff of the Meigs SWCD tested streams for fecal coliform impairments and measured the following nutrient parameters: ammonia, nitrate+nitrite, and total phosphorus. In 1996 and 1997, the Virginia Tech biologists measured the same nutrient parameters listed above at similar locations in the sub-watershed. The more current information collected by Meigs SWCD was statistically compared to that collected previously by Virginia Tech to confirm that there were not any significant fluctuations over time. After determining that the data sets were not significantly different, we used the integrated information in our analysis to determine potential problem areas.

In order to evaluate impacts from acid mine drainage, field measurements (pH, conductivity, and acidity) have been taken and water chemistry concentrations and loadings have been analyzed for Group I parameters (pH, conductivity, alkalinity, acidity, sulfate, total dissolved solids, total suspended solids, hardness, iron, aluminum, and manganese).

Ammonia

Ammonia was measured 16 times at both of the sample sites along Mud Fork. Ammonia concentrations for all 32 sampling events were below laboratory detection (<0.05 mg/L), indicating that ammonia is not limiting the aquatic life in the sub-watershed.

Nitrate-Nitrite

Nitrate-Nitrite concentrations have also been measured 32 times at the same two sites as ammonia. When compared to a benchmark (0.34 mg/L) proposed in an Ohio EPA bulletin (Ohio EPA, 1999), nitrate-nitrite does not seem to be impairing Mud Fork. Average concentrations are not near the proposed criteria and none of the samples taken exceeded the benchmark (Table 4-26).

TABLE 4-26. Average nitrate-nitrite concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
Mud Fork, RM 0.8	0.15 <0.05 to 0.28	1903.9	3.43	15	0%
Mud Fork, RM 0.2	0.13 <0.05 to 0.19	5983.8	9.33	17	0%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles)

Total Phosphorus

Like the other parameters, phosphorus was sampled at two locations in the sub-watershed. Total phosphorus concentrations were evaluated using a criterion (0.05 mg/L) proposed by Ohio EPA (1999). Total phosphorus does not seem to be impairing the streams in this sub-watershed. Most of the samples taken were below laboratory detection (63% were <0.01 mg/L) and less than 1% of the samples exceeded the potential criteria of 0.05 mg/L (Table 4-27).

TABLE 4-27. Average phosphorus concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
Mud Fork, RM 0.8	0.02 <0.01 to 0.14	1903.9	0.457	16	1%
Mud Fork, RM 0.2	0.02 <0.01 to 0.11	5983.8	1.436	16	1%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.05 mg/L for phosphorus at headwater sites (drainage area <20.0 sq miles)

Fecal coliform

Fecal coliform was sampled at one site in the sub-watershed. Because of frequency of sampling we could not definitively compare our results to Ohio EPA's water quality criteria, but we were able to make some general conclusions. During the July and September sampling, fecal coliform at Mud Fork was less than half of the Ohio EPA standard (2000 counts/100 mL), thus we do not expect fecal coliform to be a major concern in this sub-watershed (Table 4-28).

TABLE 4-28. Fecal coliform counts (#/100mL) for two sampling events in 2003

Site Location	July 29, 2003 (# /100 mL)	September 30, 2003 (# /100 mL)	Suspected Source
Mud Fork, RM 0.8	440	860	Livestock

Ohio EPA water quality standard to meet the recreational use for primary contact is 2000 counts/ 100 mL

Acidity and Metals

Impacts associated with acid mine drainage, particularly acidity and heavy metals, were also evaluated in the sub-watershed. The headwaters of Mud Fork were strip mined in the 1950s and 1960s, but much of the barren mine land has since been reclaimed. Field measurements did not indicate the presence of AMD impacts such as pH, conductivity, and acidity. During an initial screening to evaluate the extent of AMD impacts, pH measurements within the sub-watershed ranged from 6.08 to 6.75, while conductivity ranged from 278 to 460 (uS/cm). In addition, laboratory analyzed samples taken downstream from the AML showed the streams had a net alkalinity of 70.5 mg/L and total metals were 1.0 mg/L, far below concentrations indicative of impacted sites.

Habitat

The Ohio EPA, Virginia Tech crew, and the Meigs SWCD have conducted assessments of the habitat using Ohio EPA's Qualitative Habitat Evaluation Index (QHEI). The habitat conditions in Mud Fork are very poor and may be the primary factor limiting aquatic life (Table 4-29). The substrate type and quality is heavily impacted and the streambed is completely inundated with several feet of sediment (see discussion below). The pool and riffle characteristics (depth, substrate type, and embeddedness) are also severely impacted by the excessive sediment.

TABLE 4-29. QHEI scores for sites sampled in subwatershed (05030202-090 030)

Site Location	Date Sampled	Surveyor	Individual metric scores							Total
			Substrate	Cover	Channel	Riparian	Pool/Flow	Riffle/Run	Gradient	Score*
Mud Fork, RM 0.8	June 1996	Virginia Tech	9.0	7.0	11.0	4.5	0.0	0.0	8.0	39.5
Mud Fork, RM 0.8	August 2003	MSWCD	6.0	2.0	8.0	7.0	3.0	0.0	10.0	36.0
Mud Fork, RM 0.2	June 1996	Virginia Tech	8.0	8.0	12.0	7.5	0.0	0.0	8.0	43.5
MAXIMUM METRIC SCORE			20.0	20.0	20.0	10.0	12.0	8.0	10.0	100.0

*A suggested benchmark for the total QHEI score is 60.0 to potentially attain the WWH designated use (SCWG 2002)

Sediment

The Ohio EPA lists sedimentation as a high magnitude cause of impairment in the Leading Creek Watershed (Ohio EPA, 2004a). Rankin (2002) suggests that subcomponents of the QHEI, particularly substrate score and embeddedness, are effective measures to assess the impact of sediment deposition. The QHEI substrate scores range from 6.0 to 9.0 in this basin reflecting the poor quality of the streambed (note: A score of 13 to 14 is a suggested benchmark for the QHEI substrate metric for WWH streams in the WAP ecoregion, (Rankin, 2002).

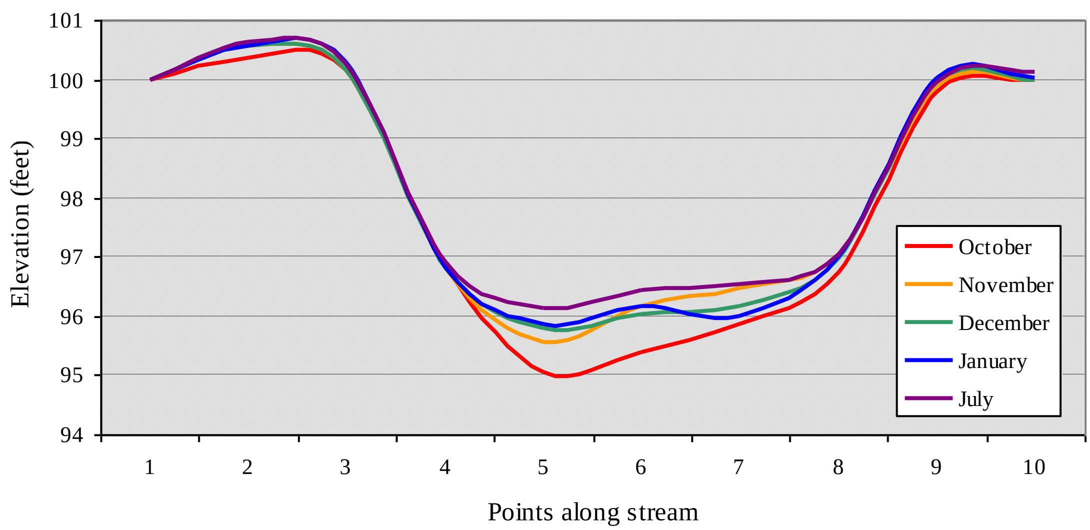
Almost the entire length of Mud Fork is inundated with several feet of residual sand from strip-mined land, stream channel erosion, and/or natural geologic features. The Meigs SWCD staff conducted extensive assessments of substrate condition and sediment deposition at Mud Fork (Table 4-30). Compared to other sites monitored in the Leading Creek Watershed, the streambed experienced extreme fluctuations (over the 9-month period) and seemed to have significant bedload and suspended sediment movement during the sampling period (Figure 4-5). The transport of sediment downstream may be influenced by beaver dams and stream channel modification (dredging and channelization) from river mile 0.3 to 0.7.

TABLE 4-30. Summary of average and range sediment deposition and transport in Mud Fork

Site Location	Sediment depth feet	Bedload transport* lbs/day	Total Suspended Solids* lbs/day
Mud Fork, RM 0.8	2.6	18.68	477
	2.2 to 3.5	7.38 to 30.19	N/A

* Bedload transport and Total Suspended Solids transport were sampled during medium to high flow so sediment movement may be higher than average annual transport

Figure 4-5. Stream Cross-section of Mud Fork (RM 0.8) sampled in 2003-2004



Overall conclusions for Sub-watershed- Mud Fork

Stream biology

- Ohio EPA biocriteria (IBI, MIwb, and ICI scores) have not been determined in the sub-watershed.
- There was limited macroinvertebrate community diversity and percentage of sensitive taxa indicating some degree of impairment exists in the sub-watershed.

Water Chemistry

- Ammonia concentrations were very low with all the samples below the level of laboratory detection.
- Nitrate-nitrite and total phosphorus concentrations were also very low with few if any samples exceeding the Ohio EPA benchmarks.
- Fecal coliform was not impairing Mud Fork during the 2003 sampling.
- Acidity and heavy metal concentrations suggest little or no impacts from acid mine drainage.

Habitat

- Habitat features may be the primary factor limiting aquatic life in the sub-watershed
- The substrate and pool/riffle conditions are severely degraded and are of major concern.
- Mud Fork is inundated with several feet of sand, which severely affects aquatic life.

- Mud Fork experiences considerable in-stream sediment and streambed movement and has dynamic fluctuations in the locations of the “streambed”.

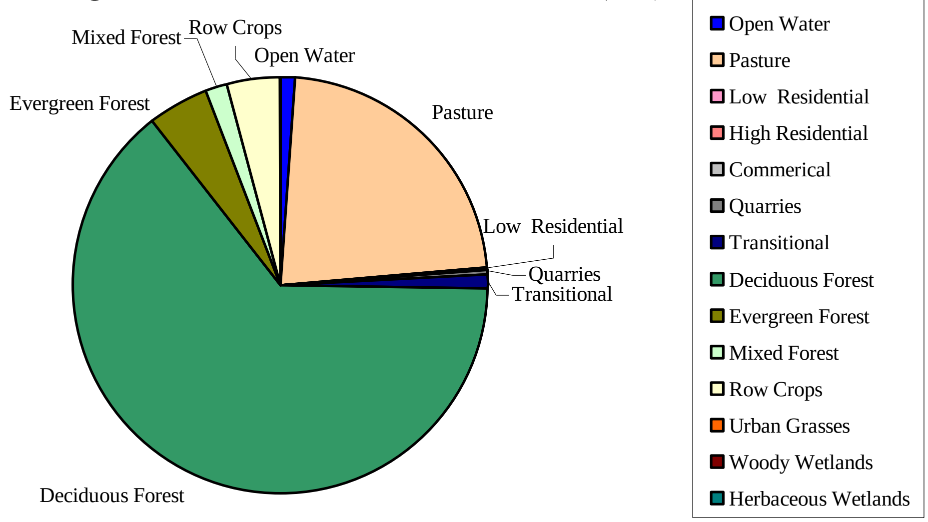
Sub-watershed- 05030202-090 040
Below Mud Fork to above Little Leading Creek
Background

The sub-watershed drains a 33.9 square-mile area (21,689 acres) primarily in Salem and Rutland Townships in western Meigs County. The sub-watershed is located from below Mud Fork (~RM 18.9) to above Little Leading Creek (~RM 8.5) and has five major tributaries: Dexter Run, Grass Run, Parker Run, Malloons Run, and Lasher Run. The land is primarily forested (71%) with rugged, steep terrain (Figure 4-6). The watershed population is very low and has two small communities, Dexter and Langsville, both located along Leading Creek.

In 1993, an emergency dewatering event at the Meigs #31 Mine resulted in the release of partially treated mine water into Parker Run and down 15.5 river miles of Leading Creek. Consequently, an extensive assessment of the water quality and biological condition has been completed for this sub-watershed.

Grass Run, Parker Run, and Malloons Run have higher quality substrate conditions than many streams in the Leading Creek Watershed. The streambeds are composed of large and coarse gravels rather than sand and fines common in other streams.

Figure 4-6. Land uses within Subwatershed (040)



Stream Biology

The condition of the biological communities has been very well defined for this sub-watershed. The Ohio EPA sampled 13 mainstem sites and 3 tributaries to monitor changes in stream conditions after the Meigs Mine #31 dewatering. Of the 13 mainstem sites, six sites were sampled regularly (some were sampled annually from 1993 to 2002) with the latest biological survey being performed in 2002. American Electric Power was also required to monitor Leading Creek after the dewatering, and they conducted assessments on the macroinvertebrate and fish communities at seven sites in the sub-watershed. The Virginia Tech team surveyed the macroinvertebrate communities and described the diversity and abundance of sensitive macroinvertebrates at 7 mainstem sites and 5 tributaries (Table 4-9). Because of the extraordinary circumstances that prompted the biological surveys, we have chosen to focus on the most recent evaluations (*i.e.* after the stream was believed to have "recovered" from the Meigs Mine discharge).

Biological surveys conducted by the Ohio EPA show that this reach of Leading Creek supports a relatively healthy and diverse community of fish and macroinvertebrates. Of the five sites surveyed in 2002, only one site (RM 14.8) did not attain warmwater habitat. Of the 32 biological surveys conducted in the sub-watershed since 1995, 19 (59%) of the survey scores fell within the range for warmwater habitat (WWH). While the surveys produced a "fair" to "very good" assemblage of fish, the MIwb scores were often rated as "fair" indicating the biomass of the fish was very small. Of the tributaries sampled, Malloons Run easily attained WWH both years it was sampled and was considered "a good reference condition for small streams in the Leading Creek Basin" (Ohio EPA, 2000b). Parker Run, on the other hand, only attained WWH in one of five surveys from 1998 to 2002 (Table 4-31).

TABLE 4-31. Attainment table for mainstem sites along Leading Creek from below Mud Fork to above Little Leading Creek (subwatershed 05030202-090 040) sampled by Ohio EPA.

River Mile	IBI	Narrative Evaluation	MIwb	Narrative Evaluation	ICI	Narrative Evaluation	Status
2002							
16.8/16.8	48	Very Good	7.5	Fair	30	Fair	Partial
15.6	46	Very Good	7.9	Marginally Good			(Full)
15.5	40	Marginally Good	7	Fair			(Partial)
14.8					26	Fair	(Non- attainment)
10.3/10.3	48	Very Good	9.2	Very Good	26	Fair	Partial
2001							
16.8	36	Fair	7.8	Fair			(Non- attainment)
10.3	46	Very Good	8.4	Good			(Full)
2000							
16.8					26	Fair	(Non- attainment)
14.9					18	Fair	(Non- attainment)
10.2					30	Fair	(Non- attainment)
1999							
16.8/16.8	32	Fair	6.1	Fair	32	Marginally Good	Partial
15.5	40	Marginally Good	6.2	Fair			(Partial)
14.8/14.8	42	Marginally Good	7.1	Fair	18	Fair	Partial
12.3	38	Fair	6.3	Fair			(Non- attainment)
10.3/10.3	38	Fair	7.1	Fair	22	Fair	Non- attainment
1998							
16.8/16.8	39	Fair	8	Marginally Good	32	Marginally Good	Partial
14.8					20	Fair	(Non- attainment)
10.3/10.3	36	Fair			32	Marginally Good	(Partial)
1997							
16.8/16.8	34	Fair	7.2	Fair	38	Good	Partial
15.5	36	Fair	7.8	Fair			(Non- attainment)
14.8/14.8	42	Marginally Good	7.8	Fair	30	Fair	Partial
12.2	38	Fair	7.2	Fair			(Non- attainment)
10.3/10.3	40	Marginally Good	7.9	Marginally Good	30	Fair	Partial
1996							
16.8/16.8	40	Marginally Good	6.4	Fair	44	Very Good	Partial
15.5	39	Fair	7	Fair			(Non- attainment)
14.8/14.8	44	Good	7.8	Fair	36	Good	Partial
12.2	41	Marginally Good	7.5	Fair			(Partial)
10.3/10.3	37	Fair	7.2	Fair	26	Fair	Non- attainment
1995							
16.8/16.8	37	Fair	6.9	Fair	44	Very Good	Partial
15.5	41	Marginally Good	5.8	Poor			(Non- attainment)
14.8/14.8	42	Marginally Good	6.7	Fair	38	Good	Partial
12.2	43	Marginally Good	7.2	Fair			(Partial)
10.3/10.3	42	Marginally Good	6.6	Fair	40	Good	Partial
Tributaries							
1996							
Malloons Run, RM 0.2	42	Marginally Good					(Full)
2002							
Parker Run, RM 1.6					18	Fair	(Non- attainment)
2001							
Parker Run, RM 1.6	40	Marginally Good					(Full)
2000							
Parker Run, RM 1.6					20	Fair	(Non- attainment)
1999							
Parker Run, RM 1.6					24	Fair	(Non- attainment)
1998							
Parker Run, RM 1.6					28	Fair	(Non- attainment)

AEP also assessed the condition of the aquatic life and had similar results as the Ohio EPA. Of the six sites surveyed in 2000, only one site (RM 15.6) did not attain warmwater habitat (Table 4-32).

TABLE 4-32. Attainment table for mainstem sites along Leading Creek from below Mud Fork to above Little Leading Creek (subwatershed 05030202-090 040) sampled by AEP.

River Mile	IBI	Narrative Evaluation	MIwb	Narrative Evaluation	ICI	Narrative Evaluation	Status
2000							
16.9/16.9	40	Marginally Good	8.42	Good	16	Fair	Partial
15.6	35	Fair	7.43	Fair			(Non- attainment)
15.5/15.5	42	Marginally Good	8.48	Good	30	Fair	Partial
14.8/14.8	43	Marginally Good	8.36	Good	26	Fair	Partial
12.9/12.9	45	Good	7.98	Marginally Good	32	Marginally Good	Full
10.3/10.3	39	Fair	8.49	Good	28	Fair	Partial
Tributaries							
2000							
Malloons Run, RM 0.1	46	Good					(Full)
Parker Run, RM 1.5	41	Marginally Good			28	Fair	Partial

The Virginia Tech team evaluated the diversity and abundance of sensitive macroinvertebrates at 7 mainstem sites and 5 tributaries: Dexter Run, Grass Run, Parker Run, Malloons Run, and Lasher Run. The macroinvertebrate community at the mainstem sites appears to be in very good condition having a diverse assemblage of macroinvertebrates and a fairly high percentage of sensitive taxa. The mainstem sites have some of the highest macroinvertebrate diversities found in the watershed. The tributaries, particularly Grass Run and Malloons Run, also seem to have healthy macroinvertebrate communities, with good taxa diversity and a considerable number of sensitive organisms (Table 4-33).

TABLE 4-33. Macroinvertebrate assessments for sites along Leading Creek from below Mud Fork to above Little Leading Creek (Subwatershed- 05030202-090 040)

Location	Taxa diversity *	Percentage EPT taxa
Dexter Run, RM 0.8	24	29%
Leading Creek, RM 17.3	34	33%
Grass Run, RM 0.8	18	38%
Leading Creek, RM 16.9	30	47%
Leading Creek, RM 15.6	16	35%
Parker Run, RM 1.5	28	19%
Leading Creek, RM 15.5	23	31%
Leading Creek, RM 14.8	21	32%
Malloons Run, RM 0.1	21	38%
Leading Creek, RM 12.9	33	36%
Leading Creek, RM 10.3	36	30%
Lasher Run, RM 0.5	24	22%

* total number of different macroinvertebrate taxa collected

Water Chemistry

In 2003, staff of the Meigs SWCD tested streams for fecal coliform impairments and measured the following nutrient parameters: ammonia, nitrate+nitrite, and total phosphorus. In 1996 and 1997, the Virginia Tech biologists measured the same nutrient parameters listed above at similar locations in the sub-watershed. The more current information collected by Meigs SWCD was statistically compared to that collected previously by Virginia Tech to confirm that there were not any significant fluctuations over time. After determining that the data sets were not significantly different, we used the integrated information in our analysis to determine potential problem areas.

In order to evaluate impacts from acid mine drainage, field measurements (pH, conductivity, and acidity) were taken and water chemistry concentrations and loadings were analyzed for Group I parameters (pH, conductivity, alkalinity, acidity, sulfate, total dissolved solids, total suspended solids, hardness, iron, aluminum, and manganese).

Ammonia

Ammonia has been measured extensively in the sub-watershed, 5 tributaries: Dexter Run, Grass Run, Parker Run, Malloons Run and Lasher Run were sampled in 1996, 1997 and 2003. In addition to the tributaries, 3 mainstem sites (RM 17.4, RM 14.8, and RM 10.3) were each sampled 15 times. Ammonia concentrations were very low and none of the samples neared the Ohio EPA's aquatic life standard of 2.2 mg/L (Table 4-34). Parker Run had the highest average ammonia concentration (1.07 mg/L) compared to the other tributaries, but none of the samples exceeded the ammonia criteria and there were no indications that ammonia is limiting the aquatic life in the sub-watershed.

TABLE 4-34. Average ammonia concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard *
Dexter Run, RM 0.8	<0.05 <0.05 to 0.06	3320.1	<0.004	15	0%
Leading Creek, RM 17.3	0.05 <0.05 to 0.08	28405.4	18.07	15	0%
Grass Run, RM 0.8	<0.05 <0.05	843.6	<0.001	15	0%
Parker Run, RM 1.5	1.07 0.16 to 1.59	2585.3	33.19	20	0%
Leading Creek, RM 14.8	0.27 <0.05 to 0.57	32297.6	103.09	15	0%
Malloons Run, RM 0.1	<0.05 <0.05	1876.3	<0.003	1	0%
Leading Creek, RM 10.3	0.15 <0.05 to 0.45	36611.8	64.54	16	0%
Lasher Run, RM 0.5	<0.05 <0.05	803.3	<0.001	2	0%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** OEPA water quality standard for Ohio River Basin, outside mixing zone is 2.2 mg/L for ammonia concentrations

Nitrate-Nitrite

Nitrate-Nitrite concentrations have been measured over 100 times at the same 8 sites as ammonia. When compared to benchmarks (0.34 mg/L= headwaters; 0.47 mg/L = wading sites) proposed in an Ohio EPA bulletin (Ohio EPA, 1999), nitrate-nitrite does not seem to be impairing most sites in the sub-watershed. The average concentrations are below the proposed criteria at all the sampling locations except Parker Run, where 45% of the samples exceeded the benchmark. Leading Creek at RMs 14.7 and 10.3 may also have periodic impairments from high nitrate concentrations (Table 4-35).

TABLE 4-35. Average nitrate-nitrite concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
Dexter Run, RM 0.8	0.19 <0.05 to 0.31	3320.10	7.65	16	0%
Leading Creek, RM 17.3	0.30 <0.05 to 0.71	28405.38	103.91	29	1%
Grass Run, RM 0.8	0.18 <0.01 to 0.27	843.63	1.84	16	0%
Parker Run, RM 1.5	0.35 0.23 to 0.60	2585.27	10.86	20	45%
Leading Creek, RM 14.8	0.36 0.08 to 0.76	32297.57	139.53	15	20%
Malloons Run, RM 0.1	<0.10 <0.10	1876.28	<0.005	1	0%
Leading Creek, RM 10.3	0.38 0.10 to 0.99	36611.80	165.30	16	25%
Lasher Run, RM 0.5	<0.10 <0.10	803.28	<0.002	2	0%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles) and 0.47 for nitrate at wading sites (drainage area >20.0 square miles).

Total Phosphorus

Like the other parameters, phosphorus was sampled at eight locations in the sub-watershed. Total phosphorus concentrations were evaluated using a proposed criterion (0.05 mg/L= headwaters; 0.06 mg/L= wading sites) listed in “the Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams” (Ohio EPA, 1999). Total phosphorus does not seem to be impairing the streams in this sub-watershed. Most of the samples taken were below laboratory detection (<0.01) and less than 10% of the samples exceeded the potential criteria (Table 4-36).

TABLE 4-36. Average phosphorus concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard *
Dexter Run, RM 0.8	0.03 <0.01 to 0.06	3320.10	1.20	16	6%
Leading Creek, RM 17.3	0.03 <0.01 to 0.10	28405.38	11.40	29	0%
Grass Run, RM 0.8	0.03 <0.01 to 0.05	843.63	0.26	16	0%
Parker Run, RM 1.5	0.04 <0.01 to 0.57	2585.27	1.24	20	5%
Leading Creek, RM 14.8	0.07 <0.01 to 0.65	32297.57	25.32	15	20%
Malloons Run, RM 0.1	0.20 N/A	1876.28	4.46	1	100%***
Leading Creek, RM 10.3	0.04 <0.01 to 0.23	36611.80	15.64	16	13%
Lasher Run, RM 0.5	0.04 0.03 to 0.04	803.28	0.41	2	0%

* Flow was estimated at each site based on drainage area (Koltun and Whitehead 2002)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.05 mg/L for phosphorus at headwater sites (drainage area <20.0 square miles) and 0.06 for phosphorous at wading sites (drainage area >20.0 square miles).

Fecal coliform

Fecal coliform was sampled at two mainstem sites (RM 17.3 and RM 11.9). Because of frequency of sampling we could not definitively compare our results to Ohio EPA's water quality criteria, but we were able to make some general conclusions. During the July and September sampling, fecal coliform was far less than the OEPA standard (2000 counts/100 mL), thus we do not expect fecal coliform to be a major concern in this sub-watershed (Table 4-37).

TABLE 4-37. Fecal coliform counts (#/100mL) for two sampling events in 2003

Site Location	July 29, 2003 (# /100 mL)	September 30, 2003 (# /100 mL)	Suspected Source
Leading Creek, RM 17.3	640	390	Unsewered community
Leading Creek, RM 11.9	410	330	Unsewered community
Lasher Run, RM 0.5	270	210	Unsewered houses

Ohio EPA water quality standard to meet the recreational use for primary contact is 2000 counts/ 100 mL

Acidity and Metals

Impacts associated with acid mine drainage, particularly acidity and heavy metals, were also evaluated in the sub-watershed. Pre-law mining occurred in Grass Run and Lasher Run, although neither seems to be impacted. Field measurements of pH, conductivity, and acidity did not indicate the presence of AMD. During an initial screening, pH measurements were taken at several tributaries and mainstem sites along Grass Run and ranged from 6.23 to 6.81, and conductivity ranged from 314 to 420 (uS/cm). Lasher Run was also "screened" at several locations, but pH readings ranged from 7.23 to 7.47 and conductivity varied from 294 to 374 (uS/cm) indicating that AMD is not impacting water quality.

In addition to the field screening, laboratory analyzed samples taken near the mouth of Lasher Run showed the stream had an average net alkalinity of 64.50 mg/L and total metals were 0.23 mg/L, far below concentrations indicative of impacted sites (Table 4-38). Although acid mine drainage is not a major concern in this sub-watershed, localized areas may be affected and were addressed in the Leading Creek AMDAT Plan.

TABLE 4-38. Summary of concentrations taken in the subwatershed below Mud Fork to Little Leading Creek (05030202-090 040)

Site Location	Average Concentration and Range				
	pH	Conductivity	Total Metals	Net Acidity	Number of samples
	units	µS/cm	mg/L	mg/L	(total count)
Leading Creek, RM 15.6	7.34 7.33 to 7.35	301 256 to 346	0.98 0.25* to 1.70	-82.28 -98.6 to -66.2	2
Leading Creek, RM 10.3	7.41 7.39 to 7.42	474 446 to 502	1.00 0.50* to 1.49	-81.20 -97.3 to -65.1	2
Lasher Run, RM 0.5	7.41 7.19 to 7.54	390 345 to 414	0.23 0.2 to 0.3	-64.50 -79.3 to -35.5	3

* Aluminum < 0.25 is not included in Total

Habitat

The Ohio EPA, Virginia Tech crew, and the Meigs SWCD have conducted habitat assessments using Ohio EPA's Qualitative Habitat Evaluation Index (QHEI). This sub-watershed had a higher average QHEI score (64.6) than the other Leading Creek sub-watersheds. Several tributaries (*i.e.* Grass Run, Parker Run, and Malloons Run) and mainstem segments (*i.e.* RM15.5, RM 14.8, RM 10.3) have high quality habitat features including substrates with large and coarse gravels rather than the sand and fines generally found in the watershed (Table 4-39). Stream morphology and channel development is also in good condition. The channel is primarily unmodified and sinuous having riffles and pools of moderate quality.

TABLE 4-39. QHEI score averages and ranges for sites in the subwatershed below Mud Fork to above Little Leading Creek (05030202-090 040)

Site Location	Survey Year	Surveyor (s)	Average QHEI score	Range	Number of Evaluations
Leading Creek, RM 17.3	1995, 2003	Virginia Tech, MSWCD	66.1	61.0-76.0	4
Leading Creek, RM 16.9	1995	Virginia Tech	63.8	62.5-66.5	3
Leading Creek, RM 16.8	1993, 1995-1998, 2001, 2002	OEPA	67.4	59.5-71.5	9
Leading Creek, RM 15.6	1993, 1995, 2002	Virginia Tech, OEPA	60.9	49.5-72.5	7
Leading Creek, RM 15.5	1995-1997, 2002	Virginia Tech, OEPA	72.1	65.5-75	9
Leading Creek, RM 14.9	1995	OEPA	73.0	73.0	2
Leading Creek, RM 14.8	1993	OEPA	72.0	72.0	3
Leading Creek, RM 14.7	1995	Virginia Tech	67.5	60.0-73	4
Leading Creek, RM 13.0	1993	OEPA	71.5	71.5	1
Leading Creek, RM 12.9	1995	Virginia Tech	66.5	63.5-70.5	3
Leading Creek, RM 11.9	2003	MSWCD	73.0	73.0	1
Leading Creek, RM 10.3	990, 1993, 1995, 1996, 1998, 2001- 200	Virginia Tech, OEPA, MSWCD	70.4	62.5-75.0	16
Dexter Run, RM 0.8	1996	Virginia Tech	56.8	56.8	1
Grass Run, RM 0.8	1996. 2003	Virginia Tech, MSWCD	54.1	49.5-56.0	2
Parker Run, RM 1.6	1994-1998, 2001	Virginia Tech, OEPA	65.5	57.0-73.0	9
Parker Run, RM 0.1	1993-1995, 2003	Virginia Tech, OEPA, MSWCD	57.0	32.5-70.0	11
Little Parker Run, RM 0.4	1993	OEPA	51.0	51.0	1
Malloons Run, RM 0.2	1993, 1995, 1996, 2003	Virginia Tech, OEPA, MSWCD	58.2	45.5-60.0	6
Lasher Run, RM 0.5	1996, 2003	Virginia Tech, OEPA	41.5	39.5-43.5	2

Note: A suggested benchmark for the total QHEI score is 60.0 to potentially attain the WWH designated use (SCWG 2002)

Sediment

The Ohio EPA reports that sedimentation is a high magnitude cause of impairment in this sub-watershed (Ohio EPA, 2000b). In general, this basin has very good substrate quality (see discussion above), but a few areas are affected by sediment deposition. Subcomponents of the QHEI (*i.e.* substrate score and embeddedness) provide effective standards to evaluate the impacts of sedimentation (Rankin, 2002). Lasher Run has the greatest impacts of sedimentation in the sub-watershed. The QHEI substrate scores range from 9.0 to 11.0 in the tributary reflecting the poor quality of the streambed (NOTE: A score of 13 to 14 is a suggested benchmark for the QHEI substrate metric for WWH streams in the WAP ecoregion, (Rankin, 2002).

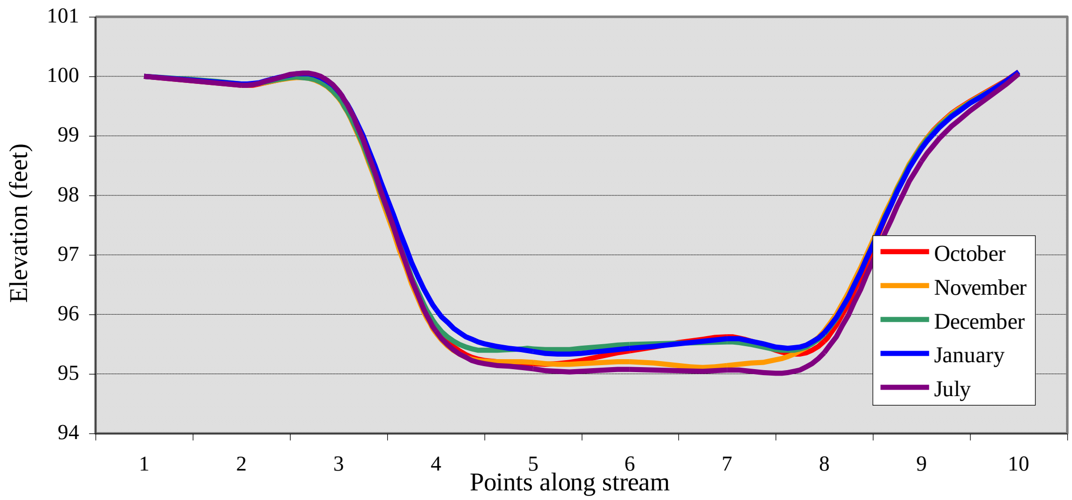
Lasher Run has widespread and severe impacts from sediment, which is mostly from extensive surface mining and/or natural geologic features. In 2004, the Meigs SWCD staff evaluated substrate condition and sediment deposition at Lasher Run. Bedload movement is clearly visible in this stream even during medium flow, but suspended sediment movement does not seem to be as significant (Table 4-40). The streambed did exhibit some fluctuations during the 9-month sampling period indicating that sediment transport is occurring in Lasher Run (Figure 4-7).

TABLE 4-40. Summary of average and range sediment deposition and transport in Lasher Run

Site Location	Sediment depth feet	Bedload transport* lbs/day	Total Suspended Solids lbs/day
Lasher Run, RM 0.5	2.2	24.0	86
	1.6 to 2.7	1.7 to 39.2	7 to 131

* Bedload transport was sampled during medium to high flow so sediment movement may be higher than average annual transport

Figure 4-7. Stream Cross-section of Lasher Run (RM 0.5) sampled in 2003-2004



Overall conclusions for Sub-watershed- Below Mud Fork to above Little Leading Creek

Stream biology

- Biological surveys conducted by the Ohio EPA show that this reach of Leading Creek supports a relatively healthy and diverse aquatic community
- Macroinvertebrates (ICI scores) and fish biomass (MIwb scores) commonly limit attainment of WWH in this reach.
- Tributaries in the sub-watershed (Malloons Run, headwaters of Parker Run, and Grass Run) seem to be of high quality and may be considered reference sites in the Leading Creek Watershed.

Water Chemistry

- Ammonia concentrations were below the Ohio EPA standard, but average concentrations at Parker Run were far higher than any other site in the watershed and should continue to be monitored.
- Nitrate-nitrite does not seem to be impairing most sites in the sub-watershed, but average concentrations at Parker Run are above the proposed criteria and 45% of the samples exceeded the benchmark
- Total phosphorus concentrations were very low with less than 10% of the samples exceeding the Ohio EPA benchmarks.

- Fecal coliform was not impairing this sub-watershed during the 2003 sampling.
- Acidity and heavy metal concentrations suggest little or no impacts from acid mine drainage.

Habitat

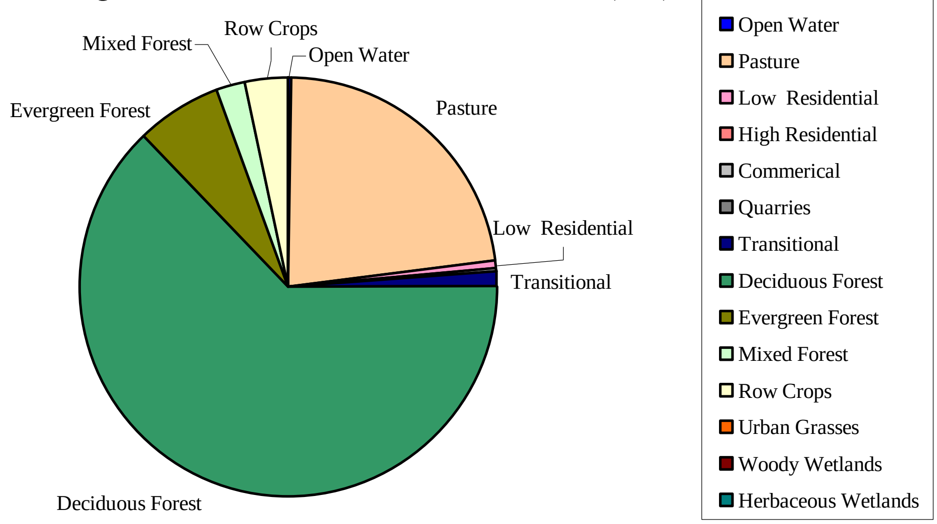
- Several tributaries (*i.e.* Grass Run, Parker Run, and Malloons Run) and mainstem segments (*i.e.* RM15.5, RM 14.8, RM 10.3) have the highest quality habitat conditions in the Leading Creek Watershed.
- The substrate and channel morphology are in good condition and have great potential to support a healthy and diverse aquatic community.
- Lasher Run has significant streambed movement that is clearly visible during field observations, and the streambed did experience some fluctuations.

***Sub-watershed-* 05030202-090 050**
Little Leading Creek
Background

The Little Leading Creek sub-watershed covers a 25.6 square-mile area (16,370 acres), with streams meandering through rolling and steep hills and flat bottoms in Scipio and Rutland Townships in western Meigs County. The sub-watershed consists of one tributary Little Leading Creek (Confluence at ~RM 8.5).

The watershed is sparsely populated with two small communities, Harrisonville and Rutland. Rutland is the only incorporated village within the Leading Creek Watershed and has a population of about 400 people (US Census 2000). Similar to the other sub-watersheds, more than 80 percent of the drainage area consists of deciduous forest (63%) and pasture/hay fields (23%) (Figure 4-8).

Figure 4-8. Land uses within Subwatershed (050)



The adverse impacts of sediment deposition are evident in Little Leading Creek and several of its tributaries (Cherry *et al.* 1999). A large portion of the streambed has been inundated with residual sand from hundreds of acres of abandoned strip-mined land, upland erosion from agriculture, stream channel erosion, and/or natural geologic features. Habitat features, particularly substrate and riffle/run quality, may be the primary factor limiting aquatic life in the sub-watershed (see discussion below "Habitat").

Stream Biology

The Ohio EPA, AEP, and staff from Virginia Tech have conducted several biological surveys in the Little Leading Creek Basin (Table 4-9) Ohio EPA and AEP surveyed the fish community for multiple years, and the Virginia Tech team assessed the health of macroinvertebrate communities.

Ohio EPA found that fish communities in this reach did not achieve the ecoregional biocriteria (IBI scores of 40 or greater, MIwb scores of 7.9 or greater) during any of the four surveys (Table 4-41). While the surveys produced a "fair" assemblage of fish, the MIwb scores were rated as "poor" to "very poor" indicating the biomass of the fish was very small. Likewise, AEP found that fish communities in the sub-watershed did not meet the warmwater habitat biocriteria. During two surveys, they found poor fish assemblages with a lack of darters and intolerant species.

TABLE 4-41. Attainment table for sites in the Little Leading Creek subwatershed.

River Mile	Surveyor	Year	IBI	Narrative Evaluation	MIWb	Narrative Evaluation	ICI	Narrative Evaluation	Status
0.4	EPA	1993	32	Fair	4.3	Very Poor			(Non-attainment)
0.4	EPA	1994	32	Fair	5.2	Poor			(Non-attainment)
0.4	EPA	1995	34	Fair	4.4	Very Poor			(Non-attainment)
0.4	EPA	1996	30	Fair	5.5	Poor			(Non-attainment)
0.1	AEP	1995	31	Fair					(Non-attainment)
0.1	AEP	1996	26	Poor					(Non-attainment)

The Virginia Tech biologists conducted macroinvertebrate surveys near the mouth of Little Leading Creek. The macroinvertebrate community indicates that there is some degree of impairment in the sub-watershed. There is relatively low taxa diversity (21 taxa) and only a fair percentage of sensitive organisms (32%).

Water Chemistry

In 2003, staff of the Meigs Soil and Water Conservation District measured fecal coliform and the following nutrient parameters: ammonia, nitrate+nitrite, and total phosphorus. In 1996 and 1997, the Virginia Tech biologists measured the same nutrient parameters listed above at similar locations in the sub-watershed (near the mouth). The more current information collected by Meigs SWCD was statistically compared to that collected previously by Virginia Tech to confirm that there were not any significant fluctuations over time. After determining that the data sets were not significantly different, we used the integrated information in our analysis to determine potential problem areas.

In order to evaluate impacts from acid mine drainage, field measurements (pH, conductivity, and acidity) have been taken and water chemistry concentrations and loadings have been analyzed for Group I parameters (pH, conductivity, alkalinity, acidity, sulfate, total dissolved solids, total suspended solids, hardness, iron, aluminum, and manganese).

Ammonia

Ammonia was measured 8 times in Little Leading Creek with no indication of impairment. Ammonia concentrations for 50% of the sampling events were below laboratory detection (<0.05 mg/L), and the maximum concentration (0.53 mg/L) was well below the Ohio EPA standard for ammonia (2.2 mg/L).

Nitrate-Nitrite

Nitrate-nitrite concentrations have also been measured 8 times near the mouth of Little Leading Creek. Nitrate exceeds a benchmark (0.47 mg/L) proposed in an Ohio EPA bulletin (Ohio EPA, 1999) two times indicating that nitrate may be a pollutant of concern and should be monitored to confirm there is no contamination (Table 4-42).

TABLE 4-42. Averages and ranges of nitrate-nitrite concentrations for samples collected in 1996, 1997, and 2003.

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
L.Leading Creek, RM 0.1	0.37 0.17 to 0.83	11318.9	50.26	8	25%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.47 mg/L for nitrate at wadeable sites (drainage area >20.0 square miles)

Total Phosphorus

Like the other parameters, phosphorus was sampled at the one location in the sub-watershed. Total phosphorus concentrations were evaluated using a proposed criterion (0.05 mg/L) listed by Ohio EPA (1999). Total phosphorus is not a pollutant of concern in Little Leading and does not seem to be impairing the sub-watershed. Overall, phosphorus concentrations were very low and none of the samples exceeded the potential criteria (Table 4-43).

TABLE 4-43. Averages and ranges of total phosphorus concentrations for samples collected in 1996, 1997, and 2003.

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
L. Leading Creek, RM 0.1	0.03 <0.01 to 0.05	11318.90	4.07	8	0%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.06 mg/L for phosphorus at wading sites (drainage area >20.0 square miles)

Fecal coliform

Fecal coliform was sampled at four sites where we suspected bacterial contamination was likely (because of land use practices or sewage treatment). Because of frequency of sampling, we could not definitively compare our results to Ohio EPA's water quality criteria, but we were able to make some general conclusions. Little Leading Creek below Harrisonville is a site of potential bacterial impairment, and Little Leading downstream of Rutland was very close to the Ohio EPA standard (2000 counts/100 mL) and is also an area of concern (Table 4-44).

TABLE 4-44. Fecal coliform counts (#/100mL) for two sampling events in 2003

Site Location	July 29, 2003 (# /100 mL)	September 30, 2003 (# /100 mL)	Suspected Source
Little Leading Creek, RM 9.4	2400	540	Unsewered community
Trib. of Little Leading Creek at RM 5.8, RM 0.1	Not sampled	<10	Livestock intrusion
Little Leading Creek, RM 1.7	1800	400	Sewered community

Ohio EPA water quality standard to meet the recreational use for primary contact is 2000 counts/ 100 mL

Acidity and Metals

Staff of the Meigs SWCD evaluated potential impacts associated with acid mine drainage, particularly the effects of acidity and heavy metals. Field measurements were taken at more than 50 locations in the sub-watershed to determine which tributaries and mainstem segments were impacted by mine drainage. Based on our results, the effects of AMD are isolated to three small tributaries (confluences at RM 2.7, RM 1.1, RM 0.1) with the remaining sites having pH scores ranging from 6.32 to 7.67 (Table 4-45).

In addition to the field screening, laboratory analyzed samples taken near the mouth of Little Leading showed the stream had an average net alkalinity of 63.8 mg/L and total metals were 0.53 mg/L, far below concentrations indicative of impacted sites. Although acid mine drainage is not a major concern in this sub-watershed, localized areas may be affected and were addressed in the Leading Creek AMDAT plan.

TABLE 4-45. Summary of field measurements taken in the Little Leading subwatershed

	pH range units	conductivity range μS/cm
Happy Hollow Road (confluence RM 2.7)	4.74 - 4.92	497 - 640
Brick Street (confluence RM 1.1)	4.00 - 4.65	526 - 710
Nichols Road (confluence RM 0.1)	4.08 - 5.25	623 - 880
Remaining Little Leading tributaries and mainstem sites	6.32 - 7.67	309 - 676

Habitat

The Ohio EPA, Virginia Tech crew, and the Meigs SWCD have conducted assessments of habitat condition using Ohio EPA's Qualitative Habitat Evaluation Index (QHEI). Habitat condition is likely the strongest variable preventing Little Leading Creek from attaining warmwater habitat (Table 4-46). A large portion of the streambed is severely impacted by sedimentation. The excessive sediment not only impacts the substrate type and quality, but also alters pool and riffle depth and quality.

TABLE 4-46. QHEI scores for sites sampled in the Little Leading Creek subwatershed

Site Location	Date Sampled	Surveyor	Individual metric scores: Substrate	Cover	Channel	Riparian	Pool/Flow	Riffle/Run	Gradient	Total Score
Little Leading Creek, RM 9.4	August 2003	MSWCD	8.0	3.0	8.0	4.0	4.0	0.0	6.0	33.0
Little Leading Creek, RM 2.4	August 2003	MSWCD	8.0	11.0	14.0	5.5	3.0	2.0	6.0	49.5
Little Leading Creek, RM 0.4	1993	OEPA								48.0
Little Leading Creek, RM 0.4	1994	OEPA								45.0
Little Leading Creek, RM 0.2	August 2003	MSWCD	8.0	13.0	13.0	5.5	7.0	3.0	10.0	59.5
MAXIMUM METRIC SCORE			20.0	20.0	20.0	10.0	12.0	8.0	10.0	100.0

Note: A suggested benchmark for the total QHEI score is 60.0 to potentially attain the WWH designated use (SCWG 2002)

Sediment

Siltation is listed as a high magnitude cause of impairment in the Little Leading Creek sub-watershed and Ohio EPA biologists note that "sediments and sand have filled in the pools and the channel bottom" (Ohio EPA, 2004a). The average QHEI substrate score is 8.0, reflecting the poor quality of the streambed (NOTE: A score of 13 to 14 is a suggested benchmark for the QHEI substrate metric for WWH streams in the WAP ecoregion, (Rankin, 2002).

Almost the entire length of Little Leading Creek is inundated with several feet of residual sand from strip-mined land, stream channel erosion, and/or natural geologic features. The Meigs SWCD staff has conducted extensive assessments of substrate condition and sediment deposition at two locations in the sub-watershed. Sediment (sand and coal fines) movement along the streambed is clearly visible even during medium flow. The stream cross-sections did not seem to fluctuate significantly over time (especially at RM 9.4), but there did seem to be significant bedload and suspended sediment movement during the sampling period (Table 4-47, Figure 4-9, Figure 4-10). These results suggest that while Little Leading is transporting sediment, additional sediment deposition is occurring.

TABLE 4-47. Summary of average and range sediment deposition and transport in Little Leading Creek.

Site Location	Sediment depth feet	Bedload transport lbs/day	Total Suspended Solids lbs/day
Little Leading Creek, RM 9.4	1.5 1.1 to 1.9	115.6* 51.3 to 196.8	99* N/A
Little Leading Creek, RM 0.4	1.2 1.0 to 1.4	50.2* 19.0 to 91.9	2164 92 to 5212

* Bedload transport and Total Suspended Solids transport were sampled during medium to high flow so sediment movement may be higher than average annual transport

Figure 4-9. Stream Cross-section of Little Leading Creek (RM 0.4) sampled in 2003-2004

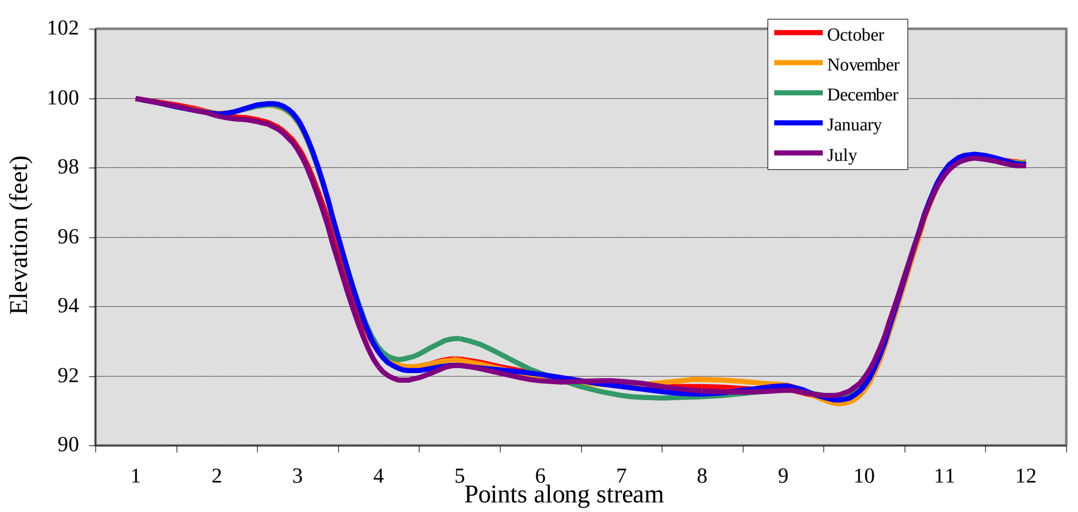
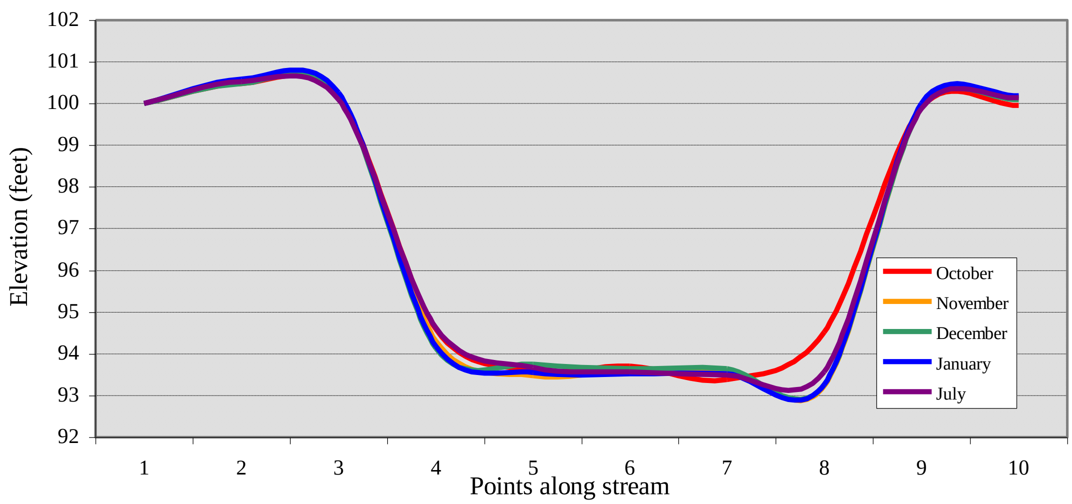


Figure 4-10. Stream Cross-section of Little Leading Creek (RM 9.4) sampled in 2003-2004



Overall conclusions for Sub-watershed- Little Leading Creek

Stream biology

- Biological surveys indicated that Little Leading Creek is impaired and has degraded aquatic life assemblages.
- Fish communities are not healthy and do not meet regional expectations for IBI or MIwb scores.
- There was limited macroinvertebrate community diversity and percentage of sensitive taxa indicating some degree of impairment exists in the sub-watershed.

Water Chemistry

- Ammonia concentrations were very low and none of the samples exceeded the Ohio EPA standard.
- Nitrate-nitrite is a pollutant of concern with 50% of the water samples exceeding the Ohio EPA benchmark
- Total phosphorus concentrations were very low with none of the samples exceeding the Ohio EPA benchmark.
- Fecal coliform is a concern along Little Leading Creek downstream of Harrisonville and downstream of Rutland.
- Acidity and heavy metal concentrations affect localized areas in the sub-watershed, but widespread impacts do not exist.

Habitat

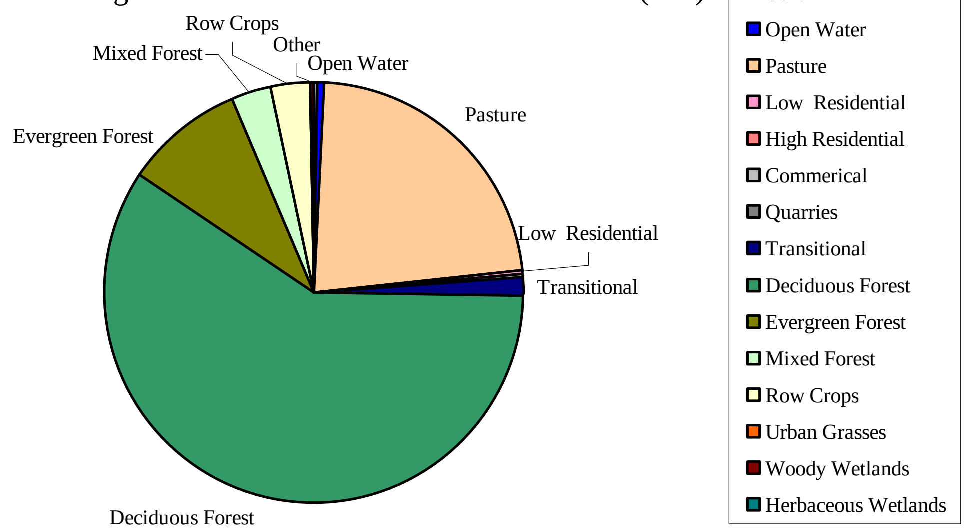
- Habitat is likely the strongest variable preventing Little Leading Creek from attaining warmwater habitat.
- Excessive sedimentation and the consequent impacts on pool and riffle characteristics are most likely the primary factor limiting aquatic life.
- Little Leading Creek has significant movement of sediment both in the water column and along the stream bottom, but it does not seem to have extreme fluctuations in the "streambed" elevations.

***Sub-watershed-* 05030202-090 060**
Leading Creek below Little Leading Creek to the Ohio River
Background

This sub-watershed covers a 9.0 square-mile area (5,743 acres), with streams meandering through the Appalachian hills along the border of Meigs and Gallia Counties in Rutland Township (Meigs), Cheshire Township (Gallia) and Salisbury Township (Meigs). The sub-watershed is located from below Little Leading Creek (~RM 8.5) to the Ohio River (excluding Thomas Fork) and has two tributaries: Titus Run and Paulins Hill Run.

The topography of the land is characterized by steep and rugged hillsides and narrow ridgetops. The watershed is sparsely populated with no small communities or incorporated towns. Sixty-eight percent of the watershed is forested, while the remaining land is used for pasture fields and row crops (Figure 4-11).

Figure 4-11. Land uses within Subwatershed (060)



Decades of unregulated coal mining left barren strip- mined land and many streams in the watershed contaminated by acid mine drainage. Only localized areas in Titus Run are impacted by mine drainage, whereas the impacts of AMD are widespread and devastating in Paulins Hill Run.

Stream Biology

The condition of the biological communities has been well defined for this sub-watershed. A total of nine different sites, including seven mainstem sites and two tributaries (Titus Run and Paulins Hill) have been evaluated for various biological parameters (Table 4-9). The Ohio EPA monitored fish and macroinvertebrate communities at four mainstem sites (RM 0.2, RM 1.7, RM 6.0, and RM 7.1) in order to evaluate recovery trends after the Meigs Mine discharge. American Electric Power was also required to monitor Leading Creek after the dewatering, and they conducted assessments at three mainstem sites (RM 1.8, RM 3.5, and RM 7.2). The Virginia Tech team surveyed the macroinvertebrate communities and described the diversity and abundance of sensitive macroinvertebrates at five sites in the sub-watershed.

The fish communities (IBI scores) have improved from the damage of the Meigs Mine discharge (*i.e.* they were rated as "very poor" in 1993 and "marginally good" in 2002), but aquatic life in this reach still appears to be impaired. Fish assemblages seem to have recovered with IBI scores often obtaining WWH, but fish biomass (MIwb scores) still remains much lower than regional expectations. Since 1995, biological communities have achieved warmwater habitat (WWH) in only 1 of 7 surveys (Table 4-48).

TABLE 4-48. Attainment table for sites in the subwatershed below Little Leading Creek to the Ohio River (except Thomas Fork) (*Subwatershed- 05030202-090 060*)

River Mile	Surveyor	Year	IBI	Narrative Evaluation	MIWb	Narrative Evaluation	ICI	Narrative Evaluation	Status
7.2	AEP	1995	33	Fair			28	Fair	(Non-attainment)
7.2	AEP	1996	35	Fair			34	Marginally Good	(Partial)
7.2	AEP	1997	38	Fair			30	Fair	(Non-attainment)
7.1	OEPA	1994					24	Fair	(Non-attainment)
6.0	OEPA	1993	20	Poor	3.1	Very Poor			(Non-attainment)
6.0	OEPA	1993	12	Very Poor	2.6	Very Poor			(Non-attainment)
6.0	OEPA	1993	20	Poor	3.6	Very Poor			(Non-attainment)
6.0	OEPA	1994	26	Poor	3.3	Very Poor			(Non-attainment)
6.0	OEPA	1994	34	Fair	3.9	Very Poor			(Non-attainment)
6.0	OEPA	1995	14	Very Poor	2.1	Very Poor			(Non-attainment)
6.0	OEPA	1995	24	Poor	3.4	Very Poor			(Non-attainment)
6.0	OEPA	1996	36	Fair	4.2	Very Poor			(Non-attainment)
6.0	OEPA	1996	42	Marginally Good	7.1	Fair	36	Good	Partial
6.0	OEPA	1997	42	Marginally Good	8.1	Marginally Good	32	Marginally Good	Full
6.0	OEPA	1998	30	Fair	5.7	Poor	22	Fair	Non-attainment
6.0	OEPA	1999	38	Fair	6.9	Fair	28	Fair	Non-attainment
6.0	OEPA	2000					26	Fair	(Non-attainment)
6.0	OEPA	2002	46	Very Good	7.9	Marginally Good	26	Fair	Partial
3.5	AEP	1995	33	Fair					(Non-attainment)
3.5	AEP	1996	29	Fair					(Non-attainment)
3.5	AEP	1997	37	Fair			28	Fair	(Non-attainment)
1.8	AEP	1995	25	Poor			32	Marginally Good	(Partial)
1.8	AEP	1996	31	Fair			18	Fair	(Non-attainment)
1.8	AEP	1997	33	Fair					(Non-attainment)
1.7	OEPA	1993	12	Very Poor					(Non-attainment)
0.2	OEPA	1993	12	Very Poor	2.4	Very Poor			(Non-attainment)
0.2	OEPA	1993	14	Very Poor	3.6	Very Poor			(Non-attainment)
0.2	OEPA	1993	20	Very Poor	6.9	Fair			(Non-attainment)
0.2	OEPA	1994	28	Fair	6.0	Fair			(Non-attainment)

From 1995 to 1997, AEP determined IBI and ICI scores for three sites in this sub-watershed. The biological communities did not meet Ohio EPA's WWH biocriteria in 8 of the 9 surveys indicating severe impairments in the sub-watershed. Fish communities were rated as "fair" in all the surveys, while the macroinvertebrates were described as "marginally good" to "fair".

The Virginia Tech team evaluated the diversity and abundance of sensitive macroinvertebrates at three mainstem sites (RM 1.8, RM 3.5, and RM 7.2), Titus Run and Paulins Hill. The macroinvertebrate community appears to be in poor condition having low taxa diversity and very few sensitive taxa (Table 4-49).

TABLE 4-49. Macroinvertebrate assessments for sites in the subwatershed below Little Leading Creek to the Ohio River (Subwatershed- 05030202-090 060)

Location	Taxa diversity *	Percentage EPT taxa
Titus Run, RM 0.1	9	21%
Leading Creek, RM 7.2	19	19%
Paulins Hill Run, RM 0.1	10	4%
Leading Creek, RM 3.5	22	18%
Leading Creek, RM 1.8	13	25%

* total number of different macroinvertebrate taxa collected

Water Chemistry

In 2003, staff of the Meigs Soil and Water Conservation District measured fecal coliform and the following nutrient parameters: ammonia, nitrate+nitrite, and total phosphorus. In 1996 and 1997, the Virginia Tech biologists measured the same nutrient parameters listed above at similar locations in the sub-watershed. The more current information collected by Meigs SWCD was statistically compared to that collected previously by Virginia Tech to confirm that there were not any significant fluctuations over time. After determining that the data sets were not significantly different, we used the integrated information in our analysis to determine potential problem areas.

In order to evaluate impacts from acid mine drainage, staff of the Meigs SWCD have extensively taken field measurements (pH, conductivity, and acidity) and collected water chemistry samples for Group I parameters (pH, conductivity, alkalinity, acidity, sulfate, total dissolved solids, total suspended solids, hardness, iron, aluminum, and manganese).

Ammonia

Ammonia concentrations have been measured extensively in the sub-watershed, 5 different sites were each measured at least 15 times. Average ammonia concentrations were very low, ranging from 0.06 mg/L to 0.12 mg/L. None of the samples were near the Ohio EPA's aquatic life standard of 2.2 mg/L, indicating ammonia is not impairing waterways in the sub-watershed (Table 4-50).

TABLE 4-50. Average ammonia concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
Titus Run, RM 0.2	0.06 <0.05 to 0.08	1213.1	0.87	61	0%
Leading Creek, RM 7.2	0.12 <0.05 to 0.44	51183.3	71.68	15	0%
Paulins Hill Run, RM 0.3	0.10 <0.05 to 0.23	362.7	0.44	19	0%
Leading Creek, RM 3.5	0.10 <0.05 to 0..36	53082.2	64.07	17	0%
Leading Creek, RM 1.8	0.11 <0.05 to 0.33	67910.7	88.01	15	0%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** OEPA water quality standard for Ohio River Basin, outside mixing zone is 2.2 mg/L for ammonia concentrations

Nitrate-Nitrite

Nitrate-Nitrite concentrations have also been widely measured in the sub-watershed with over 100 samples taken at 5 locations. Unlike ammonia, the Ohio EPA has not established water quality criteria for nitrate-nitrite concentrations so we compared our concentrations to a benchmark proposed in an Ohio EPA bulletin (Ohio EPA, 1999). Nitrate-nitrite concentrations are a concern at the three mainstem sites (RM 1.8, RM 3.5, and RM 7.2), but concentrations do not seem to be impacting the two tributaries, Titus Run and Paulins Hill (Table 4-51). Less than 10% of the samples collected at the tributaries exceeded Ohio EPA's potential standard; whereas, 41% of the samples taken at the mainstem sites exceeded the benchmark of 0.47 mg/L. The mainstem at RM 3.5 is of particular concern with 19 out of 31 samples exceeding 0.47 mg/L.

TABLE 4-51. Average nitrate-nitrite concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
Titus Run, RM 0.2	0.23 <0.05 to 0.83	1213.1	3.32	61	11%
Leading Creek, RM 7.2	0.42 0.12 to 0.97	51183.3	255.10	15	27%
Paulins Hill Run, RM 0.3	0.13 <0.05 to 0.32	362.7	0.58	19	0%
Leading Creek, RM 3.5	0.91 0.11 to 7.26	53082.2	580.87	17	61%
Leading Creek, RM 1.8	0.36 0.12 to 0.71	67910.7	291.74	15	13%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles) and 0.47 for nitrate at wading sites (drainage area >20.0 square miles).

Total Phosphorus

Total phosphorus was sampled at the same sites described above. Like nitrate-nitrite concentrations, we compared our total phosphorus concentrations to a potential criterion (Ohio EPA 1999). Total phosphorus is not a pollutant of concern at the five sites and does not seem to be impairing the sub-watershed. Overall, phosphorus concentrations were very low and only about 6% of the samples exceeded the potential criteria (Table 4-52).

TABLE 4-52. Average phosphorus concentrations and ranges sampled in 1996, 1997, and 2003

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
Titus Run, RM 0.2	0.04 <0.01 to 1.05	1213.1	0.58	61	8%
Leading Creek, RM 7.2	0.03 <0.01 to 0.16	51183.3	19.65	15	13%
Paulins Hill Run, RM 0.3	0.02 <0.01 to 0.03	362.7	0.10	19	0%
Leading Creek, RM 3.5	0.03 <0.01 to 0.15	53082.2	18.47	31	0%
Leading Creek, RM 1.8	0.05 <0.01 to 0.37	67910.7	38.06	15	6%

* Flow was estimated at each site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.05 mg/L for phosphorus at headwater sites (drainage area <20.0 square miles) and 0.06 for phosphorus at wading sites (drainage area >20.0 square miles).

Fecal coliform

Fecal coliform was only sampled at one site, the mainstem at RM 3.5. Fecal coliform counts were compared to Ohio EPA's water quality criteria for streams designated for "primary contact recreation use". Because of frequency of sampling we could not definitively compare our results to Ohio EPA's water quality criteria, but we were able to make some general conclusions. Fecal coliform counts were not near the 2000 counts/100 mL standard (our results were 300 counts/100 mL) so based on the sampling it does not appear bacterial contamination impairs this stream reach.

Acidity and Metals

Staff of the Meigs Soil and Water Conservation District measured field parameters (pH, conductivity, and acidity) at more than 30 sites to determine the which tributaries and mainstem segments are impacted by AMD. Based on our results, we determined that mine drainage has little, if any, affect on the mainstem of Leading Creek (RM 6.0), but it does impair three tributaries in this sub-watershed: Titus Run, Paulins Hill, and an unnamed tributary (Table 4-53).

TABLE 4-53. Summary of concentrations taken in the subwatershed below Little Leading Creek to the Ohio River (except Thomas Fork) (05030202-090 060)

Site Location	Average concentration and Range				Number of samples (total count)
	pH units	Conductivity µS/cm	Total Metals mg/L	Net Acidity mg/L	
Titus Run, RM 0.2	6.08 5.57 to 6.44	541 434 to 783	6.05 4.13 to 7.72	0.05 -19.17 to 5.00	5
Unnamed tributary, RM 0.3	4.71 N/A	535 N/A	9.26 N/A	47.49 N/A	1
Paulins Hill Run, RM 0.1	4.65 4.51 to 4.95	653 548 to 697	7.11 4.68 to 8.78	34.96 30.20 to 44.92	4
Leading Creek, RM 6.0	7.36 7.29 to 7.42	588 438 to 738	1.18 0.58 to 1.79	-72.54 -87.31 to -57.76	2

After the initial screening, water chemistry concentrations and loadings were determined for each tributary and for each source of AMD within Titus Run and Paulins Hill. Tributary one (PH01), tributary two (PH02), and "seep" (Seep Ditch) are the main sources of AMD within the Paulins Hill sub-watershed (Figure 4-12) and tributary One (TRH00) in the Titus Run sub-watershed contributes a significant loading (Figure 4-13). Additional information is provided in the Leading Creek AMDAT plan.

Figure 4-12. Acidity and Metal Loadings in the Paulins Hill Subwatershed

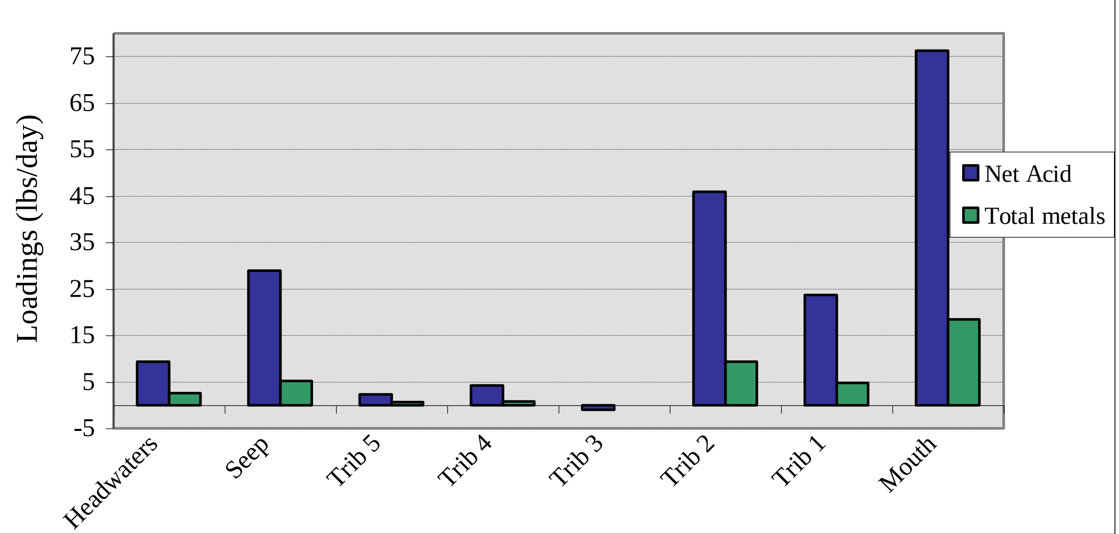
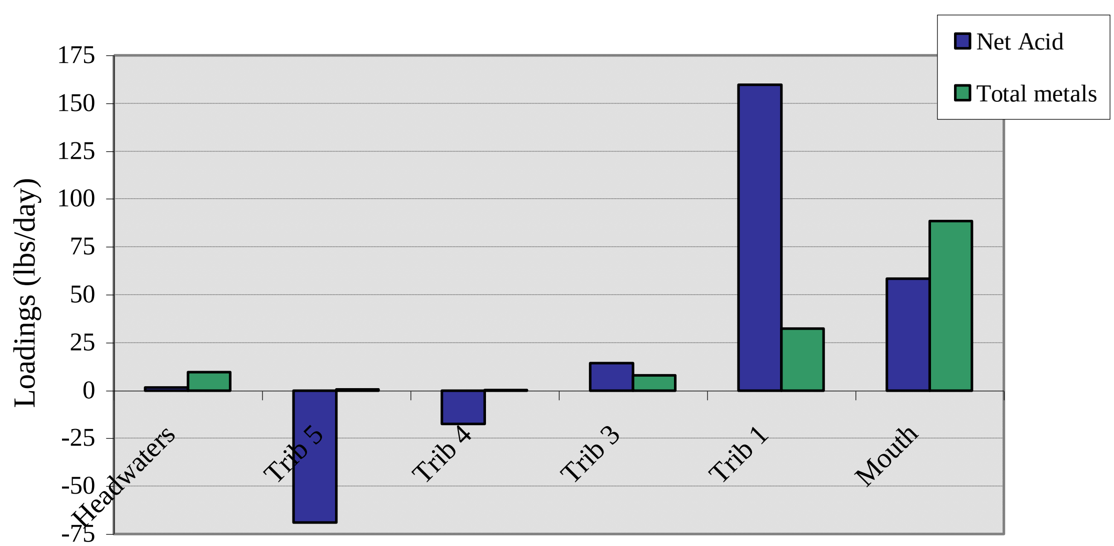


Figure 4-13. Acidity and Metal Loadings in the Titus Run Subwatershed



Habitat

The Ohio EPA, Virginia Tech crew, and the Meigs SWCD have conducted assessments of habitat condition using Ohio EPA's Qualitative Habitat Evaluation Index (QHEI) at nine stream segments in this sub-watershed (Table 4-54). Overall, the stream reaches had good channel morphology (sinuosity and natural channel characteristics) and riparian zones (width and quality), but they had very poor instream cover, substrate type and quality, and the riffle/run depth and quality was very impacted. The backwater of the Ohio River seems to greatly influence habitat conditions along the mainstem in this sub-watershed.

TABLE 4-54. QHEI score averages and ranges for sites in the subwatershed below Little Leading Creek to the Ohio River (except Thomas Fork) (05030202-090 060)

Site Location	Survey Year	Surveyor (s)	Average QHEI score	Range	Number of Evaluations
Titus Run, RM 0.2	1996, 2003	Virginia Tech, MSWCD	53.3	49.0-57.5	2
Leading Creek, RM 7.2	1995, 1996	Virginia Tech	49.8	42.5-55.0	4
Trib. at confluence RM 6.5, RM 0.1	6/25/1905	MSWCD	51.0	51.0	1
Paulins Hill Run, RM 0.3	1996, 2003	Virginia Tech, MSWCD	53.0	47.0-59.0	2
Leading Creek, RM 6.0	1993, 1995, 1997, 1998, 2002	OEPA	50.4	35.0-62.5	8
Leading Creek, RM 3.5	1995, 1996	Virginia Tech	49.1	38.0-55.0	4
Leading Creek, RM 1.8	1995, 1996	Virginia Tech	46.4	37.0-52.5	4
Leading Creek, RM 1.7	1993	OEPA	55.0	55.0	1
Leading Creek, RM 0.2	1993	OEPA	40.5	40.5	3

Note: A suggested benchmark for the total QHEI score is 60.0 to potentially attain the WWH designated use (SCWG 2002)

Sediment

In its 2000 Water Resource Report (Ohio EPA, 2000b), Ohio EPA reports that sedimentation is a high magnitude cause of impairment in this sub-watershed. The QHEI substrate score ranged from 6.0 to 11.0 in the sub-watershed, reflecting the poor quality of the streambed (NOTE: A score of 13.0 to 14.0 is a suggested benchmark for the QHEI substrate metric for WWH streams in the WAP ecoregion (Rankin, 2002).

The backwater of the Ohio River greatly influences sediment transport along the mainstem in this basin causing "extensive sedimentation" and "overwhelming sediment effects" (Ohio EPA, 2000b). The sources of sediment are "surface mining operations (mostly abandoned) and upstream forestry practices" (Ohio EPA, 2000b). An additional source of the sediment is unrestricted livestock causing excessive bank erosion at RM 4.1.

Most of the 8.5 miles of mainstem within this sub-watershed are impacted by sedimentation, and the lower 4.0 river miles are severely affected by sediment deposition. Titus Run and Paulins Hill Run also have substantial sedimentation.

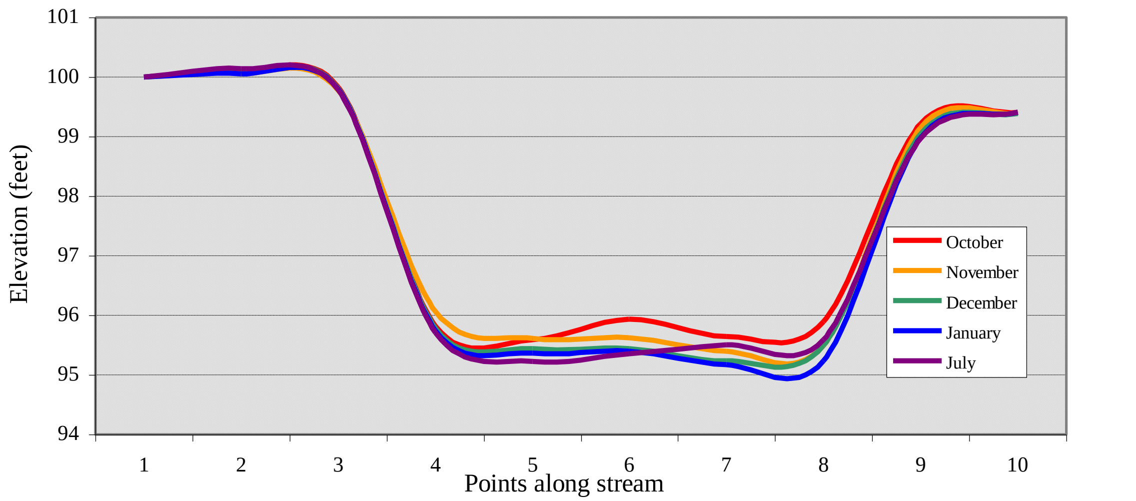
In 2004, the Meigs SWCD staff conducted extensive assessments of substrate condition and sediment deposition at Titus Run. Sediment (sand and coal fine) movement was not as obvious in Titus Run as in other tributaries (*i.e.* Lasher Run and Little Leading Creek) (Table 4-55), but the streambed clearly changed shape during the 9-month sampling period, indicating sediment was being transported through the system (Figure 4-14).

TABLE 4-55. Summary of average and range sediment deposition and transport in Titus Run

Site Location	Sediment depth feet	Bedload transport* lbs/day	Total Suspended Solids lbs/day
Titus Run, RM 0.6	2.3 1.8 to >4.0	11.0 2.8 to 22.5	279 104 to 538

* Bedload transport was sampled during medium to high flow so sediment movement may be higher than average annual transport

Figure 4-14. Stream Cross-section of Titus Run (RM 0.2) sampled in 2003-2004



Overall conclusions for Sub-watershed- Leading Creek below Little Leading Creek to the Ohio River

Stream biology

- Biological surveys indicated that this reach of Leading Creek is impaired and has degraded aquatic life assemblages.
- Fish communities are not healthy and do not meet regional expectations for IBI or MIwb scores.
- There was limited macroinvertebrate community diversity and percentage of sensitive taxa indicating impairment exists in the sub-watershed.

Water Chemistry

- Ammonia concentrations were very low and none of the samples exceeded the Ohio EPA standard.
- Nitrate-nitrite is a pollutant of concern at the mainstem sites and especially at RM 3.5 where 77% of the water samples taken exceeded the Ohio EPA benchmark
- Total phosphorus concentrations were very low and less than 10% of the samples exceeded the Ohio EPA benchmark.
- Based on *very* limited sampling, fecal coliform does not seem to be a concern in this reach of Leading Creek.

- Acid mine drainage impacts two major tributaries in this sub-watershed: Titus Run and Paulins Hill

Habitat

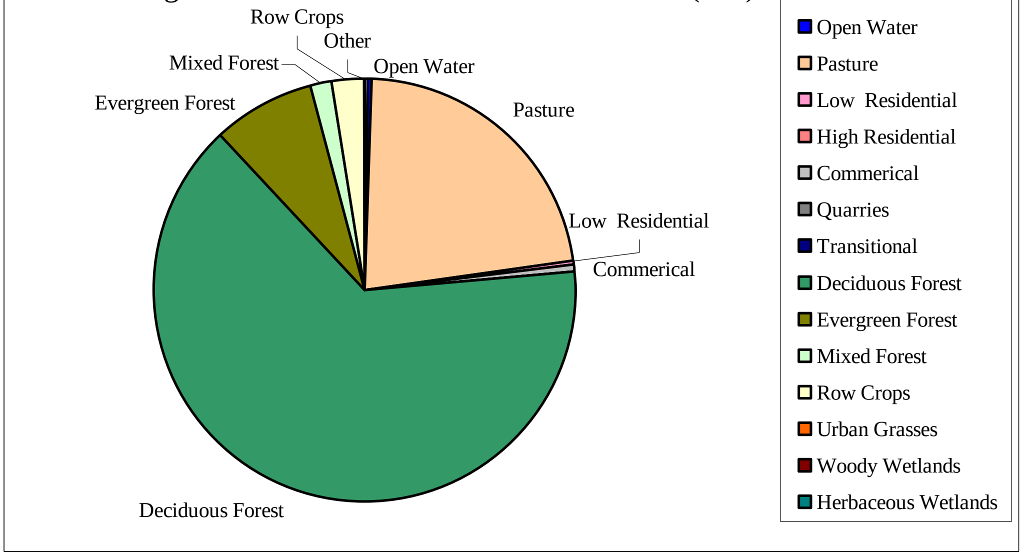
- Habitat is likely a primary variable preventing this reach of Leading Creek from attaining warmwater habitat.
- The (backwater from the) Ohio River seems to significantly impact habitat conditions along this stretch of mainstem.
- Excessive sedimentation, the condition of pools and riffles, and poor instream cover all likely limit aquatic life in this sub-watershed.
- Stream cross-sections in Titus Run indicate that sediment is being transported in that tributary.

***Sub-watershed*- 05030202-090 070**
Thomas Fork
Background

The Thomas Fork sub-watershed drains a 31.2 square-mile area (19,962.6 acres) located primarily in Rutland, Salisbury, and Chester Townships in south-central Meigs County. The sub-watershed consists of one tributary to Leading Creek, Thomas Fork (Confluence at RM 1.5).

The land is mostly forested (74%) and is characterized by steep and rugged hillsides and narrow ridgetops (Figure 4-15). The watershed has a very low population with no villages or communities located entirely within the drainage area. There are two incorporated villages, Pomeroy and Middleport, that border the Thomas Fork watershed and both have a small area located partially within the sub-watershed.

Figure 4-15. Land uses within Subwatershed (070)



Decades of unregulated coal mining has left much of this watershed covered by barren strip- mined lands, auger mined areas, abandoned deep mines, and some reclaimed lands. The watershed was extensively surface mined (8% of the watershed) and deep mined (12.5% to 15% of the watershed) leaving a severely disturbed landscape and widespread impacts of acid mine drainage (see Map 6). Contamination from acid mine drainage affects the health and survival of aquatic life in more than 10 miles of stream in the watershed.

Stream Biology

The Ohio EPA and staff from Virginia Tech have conducted biological surveys at three sites in the Thomas Fork watershed (Table 4-9). Based on the biological sampling, aquatic life seems to be severely impaired in this sub-watershed.

Ohio EPA found that fish communities were not close to achieving the ecoregional biocriteria (IBI scores of 40 or greater, MIwb scores of 7.9 or greater) during the two surveys. Ohio EPA found that the fish communities were severely degraded during both surveys, and biologists noted that “no fish were present” during the surveys.

The Virginia Tech biologists collected macroinvertebrates near the confluence of Thomas Fork and Leading Creek. They found extremely low abundances of macroinvertebrates (a total of

16 macros were collected during 2 sampling events) and low diversity of macroinvertebrate taxa with only 4 different taxa collected.

Water Chemistry

In 2003, staff of the Meigs Soil and Water Conservation District measured fecal coliform and the following nutrient parameters: ammonia, nitrate+nitrite, and total phosphorus. In 1996 and 1997, the Virginia Tech biologists measured the same nutrient parameters listed above at similar locations in the sub-watershed (near the mouth). The more current information collected by Meigs SWCD was statistically compared to that collected previously by Virginia Tech to confirm that there were not any significant fluctuations over time. After determining that the data sets were not significantly different, we used the integrated information in our analysis to determine potential problem areas.

In order to evaluate impacts from acid mine drainage, staff of the Meigs SWCD have done extensive field reconnaissance and have taken water chemistry concentrations and loadings for Group I parameters (pH, conductivity, alkalinity, acidity, sulfate, total dissolved solids, total suspended solids, hardness, iron, aluminum, and manganese).

Future consideration may also be necessary at a reclaimed landfill located within this sub-watershed. The landfill is located within the headwaters of an unnamed tributary that flows towards Lee Road (Township Road 168) before entering Thomas Fork. In 2004, Ohio EPA Division of Solid Waste formalized an agreement with the Meigs County Commissioners to install a leachate collection system in order to remediate approximately 8 to 10 seeps coming from the landfill. The Meigs County Highway Department anticipates installing structures to address the seeps in March 2005 (Ohio EPA- Division of Solid Waste: Joe Hollon, personal communication).

Ammonia

Ammonia concentrations have been measured extensively in the sub-watershed. In 1996 and 1997, 16 samples were collected near the mouth of Thomas Fork, and in 2003, 5 sites throughout the watershed were evaluated. Average ammonia concentrations were very low, ranging from 0.07 mg/L to 0.23 mg/L. None of the samples were near the Ohio EPA's aquatic life standard of 2.2 mg/L; therefore, ammonia is not a pollutant of concern in the sub-watershed.

Nitrate-Nitrite

In 1996 and 1997, nitrate-nitrite concentrations were measured 30 times near the mouth of Thomas Fork and 4 additional sites were evaluated in the sub-watershed in 2003. When compared to benchmarks (0.34 mg/L, 0.47 mg/L) proposed in an Ohio EPA bulletin (Ohio EPA, 1999), nitrate does not seem to be a pollutant of concern. The average concentration does not exceed the Ohio EPA benchmark and less than 10% of the water samples exceeded the standard (Table 4-56).

TABLE 4-56. Averages and ranges of nitrate-nitrite concentrations for samples collected in 1996, 1997, and 2003.

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
Thomas Fork, RM 10.1	<0.10 N/A	2039.9	<0.005	1	0%
Wolfpen Run, RM 0.1	<0.10 N/A	861.3	<0.002	1	0%
Thomas Fork, RM 5.0	0.15 N/A	4261.2	7.67	1	0%
East Branch, RM 0.1	0.33 N/A	4895.8	19.39	1	0%
Thomas Fork, RM 1.2	0.27 0.09 to 0.47	13937.3	0.10	30	7%

* Flow represents the mean annual flow, which was estimated at the site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles) and 0.47 for nitrate at wading sites (drainage area >20.0 square miles).

Total Phosphorus

Total phosphorus was sampled at the same sites described above. Like nitrate-nitrite concentrations, we compared our total phosphorus concentrations to a potential criterion (Ohio EPA, 1999). Total phosphorus is a minor concern in the sub-watershed because the average concentration exceeded the potential Ohio EPA benchmark (Table 4-57).

TABLE 4-57. Averages and ranges of total phosphorus concentrations for samples collected in 1996, 1997, and 2003.

Site Location	Average and Range concentration (mg/L)	Estimated Mean Annual Flow * (GPM)	Estimated Loading § (lbs/day)	Number of samples (total count)	Percentage of samples exceeding OEPA standard **
Thomas Fork, RM 10.1	0.02 N/A	2039.9	0.49	1	0%
Wolfpen Run, RM 0.1	0.01 N/A	861.3	0.14	1	0%
Thomas Fork, RM 5.0	0.01 N/A	4261.2	0.51	1	0%
East Branch, RM 0.1	0.05 N/A	4895.8	3.00	1	0%
Thomas Fork, RM 1.2	0.08 <0.01 to 1.49	13937.3	0.03	30	13%

* Flow represents the mean annual flow, which was estimated at the site based on drainage area (ILGARD, 2004)

§ Loading was estimated from mean annual flow and the average concentration.

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.05 mg/L for phosphorus at headwater sites (drainage area <20.0 square miles) and 0.06 for phosphorous at wading sites (drainage area >20.0 square miles).

Fecal coliform

Fecal coliform was sampled at three tributaries where bacterial contamination was suspected (because of land use practices or sewage treatment). Because of frequency of sampling we could not definitively compare our results to Ohio EPA's water quality criteria, but we were able to draw some general conclusions. Samples collected at Bailey Run and Hysell Run had low bacterial counts despite evidence that contamination is likely (direct pipes to creek, black organic sludge from houses, and distinctive odor). Likewise, the East Branch of Thomas Fork did not seem to be impaired based on the bacterial samples taken in July or September. Bacterial contamination is highly likely in these tributaries and should be sampled in the future to confirm these unexpected results (Table 4-58).

TABLE 4-58. Fecal coliform counts (#/100mL) for two sampling events in 2003

Site Location	July 29, 2003 (# /100 mL)	September 30, 2003 (# /100 mL)	Suspected Source
East Branch of Thomas Fork, RM 0.1	810	110	Unsewered community
Bailey Run, RM 0.1	10	Not sampled	Unsewered community
Hysell Run, RM 0.1	10	Not sampled	Unsewered community
Thomas Fork, RM 1.2	10	Not sampled	Unsewered community

Ohio EPA water quality standard to meet the recreational use for primary contact is 2000 counts/ 100 mL

Acidity and Metals

Staff of the Meigs Soil and Water Conservation District measured field parameters (pH, conductivity, and acidity) at more than 50 sites to determine which tributaries and mainstem segments were impacted by AMD. Based on our results, we determined that the impacts of mine drainage are widespread in Thomas Fork and that only the headwaters, Wolfpen Run, Ball Run, and the East Branch of Thomas Fork are un-impacted.

After the initial screening, water chemistry concentrations and loadings were determined for each tributary and for each source of AMD within the Thomas Fork sub-watershed (Table 4-59). Benchmarks to evaluate the Group I parameters (pH, conductivity, alkalinity, acidity, sulfate, total dissolved solids, total suspended solids, hardness, iron, aluminum, and manganese) were developed by summarizing water chemistry from WAP reference sites in partial and full attainment of WWH, from all WAP sites in attainment based on IBI scores, and water chemistry criteria limits developed during Sunday Creek and Monday Creek's TMDLs (Table 4-60).

TABLE 4-59. Summary of average pH, conductivity, and percentage loading for all Thomas Fork tributaries. (*Arranged from Highest Priority to Lowest Priority)*

LC ID#	Site Description	pH	Conductivity uS/cm	Net Acidity Percent Load*	Total metals Percent Load*	Flow Percent Load*	No. of Samples
TF1502	Unnamed Trib on Bailey Run Rd	2.99	2098	116.4%	35.5%	3.7%	6
TF0402	Bailey Run	4.41	1036	48.7%	12.4%	12.1%	6
TF1202	Seep from Kinzel's	2.79	2364	45.8%	12.7%	1.3%	5
TF1102	Seep from Casto's	3.07	1963	40.0%	9.3%	1.8%	6
TF0302	Hysell Run	5.75	741	14.6%	9.9%	31.1%	6
Venoy's	Underdrain at Venoy's	3.57	3857	14.4%	5.4%	0.1%	3
SR 124 Seep	Pipe located between Bailey Run and SR 7	2.98	4060	2.7%	6.2%	0.3%	1
TF0202	Unnamed tributary on McElhinney Hill	4.79	875	4.9%	1.6%	1.7%	3
Little's	Seep from Little's	4.10	2957	4.6%	1.8%	1.5%	3
Seep1 DS TF10	1st seep DS of the East Branch	3.23	1580	1.7%	0.4%	0.1%	1
Seep2 DS TF10	2nd seep DS of the East Branch	2.96	1690	6.8%	1.4%	0.2%	1
TF0105	Bone Hollow	6.72	697	-1.8%	0.3%	0.8%	2
TF1300	Unnamed tributary on Lee Rd	7.36	532	-2.0%	0.0%	0.3%	2
TF1001	East Branch of Thomas Fork	7.19	586	-179.1%	2.9%	42.3%	5

* Percent contribution based on % from site relative to all other sites in the subwatershed.

Mass balance determinations and extensive sampling at the sources allowed us to determine specific projects to remediate impacted streams. The Leading Creek AMDAT plan provides a detailed presentation of the water chemistry results and the specific recommendations for remediation. Table 4-61 summarizes the acidity and metal loadings at each of the tributaries.

TABLE 4-60. Summary of water quality standards and benchmarks used to evaluate AMD parameters.

Summary of the water quality for reference sites in partial and full attainment of WWH.

	Conductivity uS/cm	pH	Alkalinity mg/L	Acidity mg/L	TSS mg/L	TDS mg/L	Hardness mg/L	Sulfate mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L
Mean	508	7.80	111.22		25	453	225	199	0.91	0.20	0.97
Median	389	7.84	115.00		12	274	177	58	0.47	0.09	0.50
Range	3500 to 120	9.3 to 6.1	326 to 10		594 to 5	2750 to 5	1499 to 37	2360 to 11	29.00 to 0.04	2.17 to 0.01	24.00 to 0.11

Summary of the water chemistry for all WAP sites in attainment (just based on IBI)

	Conductivity uS/cm	pH	Alkalinity mg/L	Acidity mg/L	TSS mg/L	TDS mg/L	Hardness mg/L	Sulfate mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L
Headwaters											
Median	475	7.90	108		10	374		75	0.70	0.20	
75% percentile	600	7.60	135		18	1770		204	1.10	0.60	
Wadeable											
Median	500	9.00	111		6	408		108	0.50	0.10	
75% percentile	970	7.60	141		10	574		191	0.80	0.20	

Summary of the water chemistry criteria limits from FWPCA (1968)

Conductivity uS/cm	pH	Alkalinity mg/L	Acidity mg/L	TSS mg/L	TDS mg/L	Hardness mg/L	Sulfate mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L
> 800	< 6.0	< 20.0					>74	> 0.5	> 0.5	> 0.3

Summary of the water chemistry criteria limits from Sunday Creek and Monday Creek

	Conductivity uS/cm	pH	Alkalinity mg/L	Acidity mg/L	TSS mg/L	TDS mg/L	Hardness mg/L	Sulfate mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L
Sunday Creek	571	6.5- 7.5	20			1500		80	1.0	0.5	0.3
Monday Creek											
95% percentile		6.82	201	10.5		609			1.49		1.12
75% percentile		7.27		6.09		443			0.56		0.22

TABLE 4-61. Summary of Thomas Fork Water Chemistry Data (Averages and Ranges)

(Arranged Headwaters to Mouth)

LC ID#	Site Description	pH	Conductivity uS/cm	Net Acidity lbs/day	Total metals* lbs/day	Flow GPM	No. of Samples
TF0090	Mainstem on Smith Run Road (RM 10.1)	**7.51** 7.49 to 7.53	**324** 229 to 419	**-862.03** -1576.66 to -147.40	**13.50** 0.49 to 26.5	**981.6** 94.8 to 1868.4	**2**
Little's	Seep from Little's	**4.10** 3.60 to 4.87	**2957** 1910 to 4970	**33.4** 21.39 to 47.83	**11.34** 6.30 to 20.38	**64.7** 41.2 to 106.0	**3**
TF0071	Mainstem US of TF15 (RM 7.5)	**7.31** 7.10 to 7.44	**820** 698 to 1175	**-304.74** -496.06 to -26.80	**4.68** 0.49 to 6.24	**288.5** 33.4 to 451.2	**5**
TF1502	Unnamed Trib on Bailey Run Rd	**2.99** 2.88 to 3.14	**2098** 1640 to 2610	**843.77** 331.56 to 1249.16	**224.75** 45.41 to 384.32	**158.0** 76.8 to 426.6	**6**
TF0070	Mainstem DS of TF15 (RM 7.3)	**5.23** 2.95 to 6.45	**1074** 398 to 2165	**45.59** -717.25 to 828.04	**149.50** 24.14 to 259.09	**951.1** 153.0 to 2767.2	**6**
TF0064	Mainstem DS of TF14 (RM 6.2)	**6.60** 6.22 to 6.97	**681** 639 to 722	**-276.82** -397.45 to -156.19	**52.18** 17.27 to 87.09	**673.8** 608.2 to 739.3	**2**
TF1300	Unnamed tributary on Lee Rd	**7.36** 7.31 to 7.40	**532** 512 to 552	**-14.31** -14.94 to -13.68	**0.15** 0.11 to 2.00	**14.8** 14.8	**2**
Venoy's	Underdrain at Venoy's	**3.57** 3.35 to 3.68	**3857** 3650 to 4140	**104.36** 48.35 to 146.16	**34.41** 15.29 to 45.73	**5.0** 2.9 to 7.5	**3**
TF1202	Seep from Kinzel's	**2.79** 2.60 to 3.19	**2364** 1110 to 2660	**332.44** 267.14 to 419.12	**80.68** 59.94 to 89.63	**55.5** 22.2 to 136.7	**5**
TF1102	Seep from Casto's	**3.07** 2.82 to 3.50	**1963** 1030 to 2840	**290.21** 115.14 to 587.51	**59.15** 25.89 to 136.66	**78.1** 18.3 to 320.0	**6**
TF0050	Mainstem US of TF10 (RM 5.0)	**5.14** 3.18 to 6.55	**912** 499 to 1590	**180.69** -1262.32 to 1043.15	**151.41** 57.48 to 278.06	**1915.0** 306.6 to 5960.0	**7**
TF1001	East Branch of Thomas Fork	**7.19** 7.06 to 7.24	**586** 396 to 761	**-1298.43** -4516.80 to -226.10	**18.46** 5.19 to 44.83	**1816.1** 432.5 to 6320.7	**5**
TF0048	Mainstem DS of TF10 (RM 4.8)	**4.99** 4.41 to 5.57	**883** 726 to 1040	**537.62 **** 169.56 to 532.12	**219.77** 146.42 to 293.13	**1648.5** 1257.9 to 2039.0	**2**
Seep1 ds TF10	1st seep DS of the East Branch	**3.23** N/A	**1580** N/A	**12.59** N/A	**2.28** N/A	**4.6** N/A	**1**
Seep2 ds TF10	2nd seep DS of the East Branch	**2.96** N/A	**1690** N/A	**49.03** N/A	**8.78** N/A	**9.0** N/A	**1**
TF0030	Mainstem at bridge on SR 7 (RM 4.4)	**4.45** N/A	**1010** N/A	**387.87** N/A	**104.47** N/A	**762.3** N/A	**1**
SR 124 Seep	Pipe between Bailey Run and SR 7	**2.98** N/A	**4060** N/A	**19.34** N/A	**39.05** N/A	**14.8** N/A	**1**
TF0021	Mainstem US of TF04 (RM 3.1)	**5.63** 4.14 to 6.68	**828** 697 to 1050	**-70.99** 964.91 to 807.66	**244.04** 182.65 to 291.29	**2465.5** 1066.6 to 3792.9	**3**
TF0402	Bailey Run	**4.41** 4.00 to 4.67	**1036** 596 to 1490	**352.88** 121.05 to 776.18	**78.61** 23.18 to 180.50	**517.4** 92.7 to 1437.4	**6**
TF0020	Mainstem DS of TF04 (RM 3.0)	**5.63** 4.15 to 6.71	**849** 722 to 1090	**96.11** -649.69 to 977.12	**282.16** 239.85 to 305.22	**2557.8** 1230.0 to 3633.6	**3**
TF0302	Hysell Run	**5.75** 4.39 to 6.86	**741** 529 to 980	**106.15** -81.79 to 344.14	**62.77** 16.51 to 216.26	**1333.3** 227.3 to 4080.0	**6**
TF0202	Unnamed tributary on McElhinney Hill	**4.79** 4.63 to 4.99	**875** 824 to 935	**35.48** 31.61 to 38.76	**10.30** 9.37 to 12.11	**73.5** 61.6 to 89.3	**3**
TF0015	Bridge on Noble Summit (RM 2.8)	**4.24** N/A	**1060** N/A	**1104.24** N/A	**221.43** N/A	**1353.2** N/A	**1**
TF0105	Bone Hollow	**6.72** 6.66 to 6.78	**697** 669 to 724	**-13.06** -17.85 to -8.27	**2.15** 2.14 to 2.15	**35.1** 29.1 to 41.2	**2**
TF0010	Bridge on Leading Cr. Rd. (RM 1.2)	**6.35** 4.38 to 6.88	**697** 515 to 986	**-1292.80** -4530.56 to 1057.18	**245.50** 163.13 to 253.09	**6726.0** 1651.3 to 4093.4	**8**

* Total metals were determined by summing Aluminum, Iron, and Managanese loadings. Metals below laboratory detection were not included.

** The flow of East Branch was estimated for one of the sampling events.

Habitat

The Ohio EPA, Virginia Tech crew, and the Meigs SWCD have conducted assessments of habitat condition using Ohio EPA's Qualitative Habitat Evaluation Index (QHEI) on fourteen segments in the Thomas Fork sub-watershed. Habitat conditions along Thomas Fork are extremely variable with some high quality reaches and some heavily degraded segments. Many of the reaches (especially from RM 1.2 to RM 3.7) have moderate amounts of high quality instream cover (undercut banks, overhanging vegetation, deep pools) and have well developed channel morphology (sinuosity, deep pools, and higher quality riffles). Some of the best habitat conditions in the Leading Creek Watershed are found in the Thomas Fork sub-watershed. Other areas (especially from RM 0.0 to RM 1.2) are heavily impacted by mine sediment, have low channel stability and severe bank erosion. Overall, the habitat in most stream reaches in Thomas Fork does not appear to be limiting aquatic life and appears to have great potential to support a healthy and diverse fish community (Table 4-62).

TABLE 4-62. QHEI scores for sites sampled in the Thomas Fork watershed

Site Location	Date Sampled	Surveyor	Individual metric scores							Total Score
			Substrate	Cover	Channel	Riparian	Pool/Flow	Riffle/Run	Gradient	
Thomas Fork, RM 10.1	August 2003	MSWCD	10.0	10.0	13.0	5.0	10.0	2.0	8.0	58.0
Trib. at confluence RM 8.1, RM 0.1	August 2003	MSWCD	14.0	14.0	11.0	6.5	5.0	3.0	4.0	57.5
Trib. at confluence RM 7.4, RM 0.1	August 2003	MSWCD	9.0	5.0	7.0	5.5	5.0	1.0	4.0	36.5
Thomas Fork, RM 7.3	August 2003	MSWCD	8.0	9.0	15.0	6.0	8.0	3.0	8.0	57.0
Trib. at confluence RM 5.9, RM 0.1	August 2003	MSWCD	7.0	3.0	11.0	2.0	2.0	3.0	4.0	32.0
Trib. at confluence RM 6.2, RM 0.1	August 2003	MSWCD	11.0	5.0	13.0	5.0	2.0	2.0	4.0	42.0
Thomas Fork, RM 5.0	August 2003	MSWCD	8.0	4.0	12.0	4.0	5.0	2.0	8.0	43.0
East Branch, RM 0.1	August 2003	MSWCD	6.0	11.0	12.0	5.5	9.0	2.0	10.0	55.5
Bailey Run, RM .01	August 2003	MSWCD	9.0	8.0	12.0	7.0	4.0	2.0	4.0	46.0
Hysell Run, RM .01	August 2003	MSWCD	7.0	6.0	12.0	5.5	10.0	3.0	8.0	51.5
Trib. at confluence RM 2.8, RM 0.1	August 2003	MSWCD	7.0	5.0	11.0	4.0	3.0	1.0	4.0	35.0
Thomas Fork, RM 2.8	1993	OEPA								45.5
Thomas Fork, RM 1.2	June 1996	Virginia Tech	7.0	9.0	12.0	3.5	4.0	2.0	6.0	43.5
Thomas Fork, RM 1.2	August 2003	MSWCD	9.0	10.0	10.0	8.0	4.0	1.0	10.0	52.0
MAXIMUM METRIC SCORE			20.0	20.0	20.0	10.0	12.0	8.0	10.0	100.0

Note: A suggested benchmark for the total QHEI score is 60.0 to potentially attain the WWH designated use (SCWG 2002)

Sediment

In its 2000 Water Resource Report (Ohio EPA, 2000b), Ohio EPA reports that Thomas Fork "has a high sediment load from mining activities", and siltation is considered a moderate magnitude cause of impairment in the sub-watershed. The average QHEI substrate score was 9.0 in the sub-watershed, reflecting the poor quality of the streambed (NOTE: A score of 13.0 to 14.0 is a suggested benchmark for the QHEI substrate metric for WWH streams in the WAP ecoregion (Rankin, 2002).

Because the confluence of Thomas Fork is very close to the mouth of Leading Creek (RM 1.5), the backwater of the Ohio River greatly influences sediment transport in the basin. The source of sediment is mostly from abandoned surface mines, which were widespread in the sub-watershed (about 8% of the watershed area was strip mined).

In 2004, the Meigs SWCD staff conducted extensive assessments of substrate condition and sediment deposition at Thomas Fork. During field observations, the movement of sand along the streambed was not as clearly visible as in other tributaries (*i.e.* Lasher Run, Little Leading

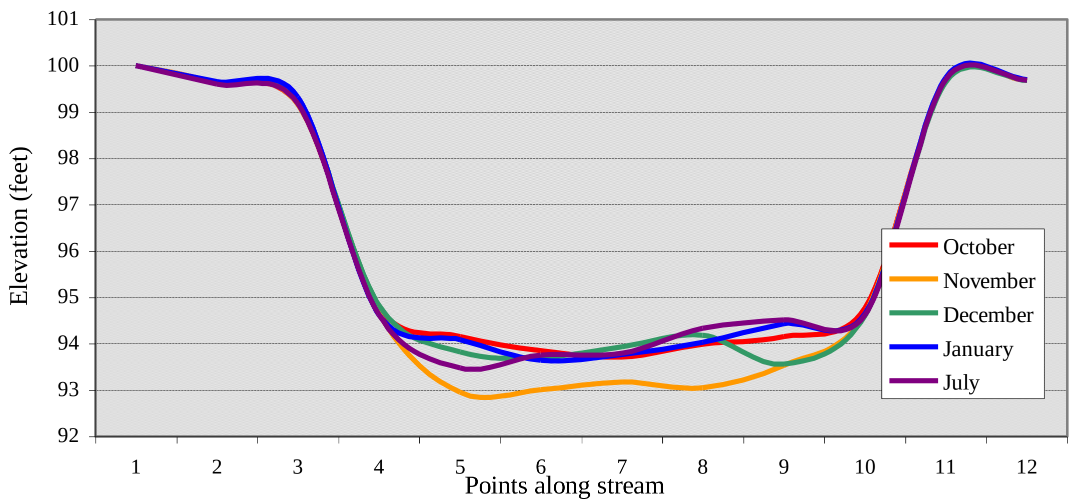
Creek) because the substrate in Thomas Fork is not entirely composed of sand and coal fines. There is evidence that the sediment is being transported based on the obvious fluctuations in the streambed during the 9-month sampling period and the high bedload and suspended sediment loadings (Table 4-63, Figure 4-16).

TABLE 4-63. Summary of average and range sediment deposition and transport in Thomas Fork

Site Location	Sediment depth feet	Bedload transport* lbs/day	Total Suspended Solids lbs/day
Thomas Fork, RM 1.2	3.0	6.2	2586
	2.1 to >4.0	0.8 to 17.8	198 to 7328

* Bedload transport was sampled during medium to high flow so sediment movement may be higher than average annual transport

Figure 4-16. Stream Cross-section of Thomas Fork (RM 1.2) sampled in 2003-2004



Overall conclusions for Sub-watershed- Thomas Fork

Stream biology

- Biological surveys indicated that Thomas Fork is severely impaired and has extremely degraded aquatic life assemblages.
- According to the 305(b) report, "no fish were present" during either of Ohio EPA's biological surveys.
- There was extremely low macroinvertebrate community diversity and very few sensitive taxa were collected.

Water Chemistry

- Ammonia concentrations were very low and none of the samples exceeded the Ohio EPA standard.
- Nitrate-nitrite does not seem to be impacting Thomas Fork. Average concentrations were less than the Ohio EPA benchmark

- Total phosphorus is somewhat a concern in the sub-watershed with the average concentration slightly exceeding the potential criteria and with 13% of the samples exceeding the benchmark
- Based on the results from sampling, fecal coliform does not seem to be a concern in Thomas Fork, but further investigation is necessary to confirm this.
- The impacts of acid mine drainage are widespread and severe in the Thomas Fork sub-watershed. The major tributaries of concern are: the unnamed tributary on Bailey Run Road (TF1500), Venoy's underdrain, Kinzel's seep (TF1200), Casto's seep (TF1100), Bailey Run (TF0400), and Hysell Run (TF0300).

<u>Habitat</u>

- Overall, habitat conditions in Thomas Fork do not appear to be limiting aquatic life and the stream appears to have great potential to support a healthy and diverse aquatic community.
- Habitat conditions in the sub-watershed are extremely variable with some high quality reaches and some heavily degraded segments.
- Stream cross-sections in Thomas Fork indicate that sediment is being transported in that tributary.

Wetland Quality

Wetlands are rich ecosystems that provide critical habitat for a diversity of plants, wildlife, insects, and fish. It is estimated that about two-thirds of Ohio's endangered animals and about half of the state's endangered plants inhabit wetlands (Columbus Zoo, 2004). In addition, wetlands provide many valuable services such as water quality improvement, floodwater storage, erosion control, aesthetics, and recreation.

The loss and degradation of wetlands in the U.S. has resulted in a decline in the important services that wetlands provide to society. Until recently, wetlands have been largely ignored in water quality assessments and watershed management, but the increasing awareness of their valuable functions has led to a movement to include wetlands in water quality management (Ohio EPA: Mick Miccachion, personal communication).

Although the well- drained soil in the watershed may have prevented large wetlands and bogs from forming, historic drainage tiles were used at several locations to dewater fields along Leading Creek providing evidence that historic riparian wetlands existed in the watershed (Trautman, 1977). Very few wetlands still exist within the drainage area, but assessments have been conducted on two prominent riparian marshes located along Mud Fork and Little Leading Creek (Table 4-64).

TABLE 4-64. ORAM scores for wetlands surveyed in the Leading Creek Watershed

Site Location	Date Sampled	Surveyor	Individual metric scores						Total Score	Category
			Area	Buffers	Hydrology	Development	Special	Cover		
Mud Fork, ~RM 0.6	July 2003	MSWCD	6.0	11.0	22.0	15.0	0.0	13.0	67.0	3
Little Leading Creek, ~RM 5.0	August 2004	MSWCD	2.0	9.0	11.0	8.0	0.0	2.0	32.0	1 or 2
MAXIMUM METRIC SCORE			6.0	14.0	30.0	20.0	10.0	20.0	100.0	

The marsh located along Mud Fork

Chapter 5
Sub-Watershed Impairments and Action Strategies

A principal goal of the Clean Water Act of 1972 is to maintain and restore the physical, chemical, and biological integrity of the waters of the United States; therefore, all recommended strategies for protecting and restoring streams in the Leading Creek Watershed will be directed by available data describing the integrity of the streams.

The previous chapter presented a detailed description of the major environmental stressors in each of the sub-watersheds. Overall, the main sources of impairment are surface mining and subsurface mining, pasture land, non-irrigated crop production, and channelization (Ohio EPA, 2000b). The sources of water quality impairment proposed by the Ohio EPA cause many problems for stream quality including sedimentation (siltation), low pH, habitat alteration, and elevated concentrations of salinity/TDS/chlorides. Excessive sediment deposition is the main cause of impairment in the Leading Creek Watershed, affecting 6 of the 9 surveyed stream segments (Ohio EPA, 2000b). In this chapter, a link between the causes of water quality impairment and pollutant sources will be presented, and then actions necessary to restore and protect streams in the watershed will be identified. The priority areas and restoration actions were selected based on extensive water quality monitoring and biological studies conducted by the Meigs SWCD, Ohio EPA, AEP, and the Virginia Tech research team. This information along with public input and technical assistance from the Leading Creek Improvement Committee has directed the context of this chapter of the management plan.

Table 5-1 summarizes the relationship between the causes (pollutants) and the potential sources (contributors) of water quality impairment in the Leading Creek Watershed.

TABLE 5-1. Watershed impairment summary for the Leading Creek Watershed

Leading Creek headwaters to below Fivemile Run		
Subwatershed- 05030202-090 010		
Causes of impairment	Sources of impairment	Target Areas
Litter and illegal trash dumping	Roadside littering	RM 30.0 to RM 26.1 and County Rd 10/13
Habitat modification	Residential development	Headwater tribs
Nutrient enrichment/ Pathogens	Livestock and HSTS	Headwater tribs, Fivemile Run, Carpenter
Leading Creek below Fivemile Run to above Mud Fork		
Subwatershed- 05030202-090 020		
Causes of impairment	Sources of impairment	Target Areas
Sedimentation	Agriculture, natural	Sisson Run and Ogden Run
Habitat modification	Agriculture	Sisson Run, Ogden Run, and Sharps Run
Nutrient enrichment/ Pathogens	Livestock and HSTS	Sisson Run and Dyesville
Mud Fork		
Subwatershed- 05030202-090 030		
Causes of impairment	Sources of impairment	Target Areas
Sedimentation	Historic surface mines and Agriculture	RM 5.5 to RM 0.0
Leading Creek below Mud Fork to above Little Leading Creek		
Subwatershed- 05030202-090 040		
Causes of impairment	Sources of impairment	Target Areas
Sedimentation	Historic surface mines	Lasher Run
Nutrient enrichment/ Pathogens	Livestock and HSTS	Dexter Run and Dexter
Salinity/TDS/Chlorides	Meigs Mine #31	Meigs Mine #31 treatment plant
Little Leading Creek		
Subwatershed- 05030202-090 050		
Causes of impairment	Sources of impairment	Target Areas
Sedimentation	Historic surface mines and Agriculture	Entire Little Leading mainstem
Pathogens	HSTS	Harrisonville
Litter and illegal trash dumping	littering, trash in floodplain	County Road 13, Harrisonville
Leading Creek below Little Leading Creek to the Ohio River		
Subwatershed- 05030202-090 060		
Causes of impairment	Sources of impairment	Target Areas
Sedimentation	Historic surface mines	Leading Creek RM 8.0 to RM 0.0
Acidity and metals	Surface and deep mines	Titus Run and Paulins Hill
Thomas Fork		
Subwatershed- 05030202-090 070		
Causes of impairment	Sources of impairment	Target Areas
Sedimentation	Historic surface mines	Casto's Seep, Bailey Run, and Hysell Run
Acidity and metals	Surface and deep mines	see text
Pathogens	HSTS	East Branch, Bailey Run, and Hysell Run

Sub-watershed- 05030202-090 010
Leading Creek headwaters to below Fivemile Run

Background

The chemical and biological integrity seem to be degraded in the three major tributaries in this sub-watershed; in contrast, the mainstem seems to support a relatively healthy and diverse biological community with no major impacts from water chemistry. Efforts should be made to minimize impacts from nutrient enrichment and organic enrichment to the mainstem and efforts should also be made to protect the current habitat conditions of the mainstem.

The mainstem of Leading Creek (RM 30.0 to RM 26.1) in this sub-watershed has very good habitat features (substrate quality, channel development, riparian features, and instream cover), and QHEI scores indicate that the stream segment could support a healthy and diverse aquatic community. This reach has higher gradient and higher quality substrates including cobble, gravel, and bedrock than other sub-watersheds in the Leading Creek Watershed. The habitat in the tributaries is much more degraded than the mainstem reaches and may be a primary variable limiting aquatic life.

Chemical Integrity

Summary of water chemistry for the Headwaters Subwatershed

	Percentage of Samples exceeding Ohio EPA Water Quality Standard		
Site Location	Ammonia*	Nitrate**	Phosphorus**
E. Branch of headwaters, RM 31.6	0%	56%	44%
W. Branch of headwaters, RM 0.2	1%	50%	95%
Leading Creek, RM 29.9	0%	33%	13%
Five Mile Run, RM 0.9	0%	63%	75%
Leading Creek, RM 26.3	0%	14%	10%

* Ohio EPA water quality standard for Ohio River Basin, outside mixing zone is 2.2 mg/L for ammonia concentrations

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles) and 0.47 for nitrate at wading sites (drainage area >20.0 square miles). The potential phosphorus standard for the WAP ecoregion is 0.05 mg/L at headwater sites (drainage area <20.0 square miles) and 0.06 for phosphorus at wading sites (drainage area >20.0 square miles).

Biological Integrity

Summary of biological performance for the Headwaters Subwatershed

Site Location	Attainment Status	Macroinvertebrate Taxa Diversity *	Percentage EPT taxa
E. Branch of headwaters, RM 31.6	N/A	27	2%
W. Branch of headwaters, RM 0.2	N/A	24	11%
Leading Creek, RM 30.4	(Non-attainment)	N/A	N/A
Leading Creek, RM 29.9	(Non-attainment)	26	68%
Leading Creek, RM 29.7	(Full)	N/A	N/A
Leading Creek, RM 29.7	(Full)	N/A	N/A
Leading Creek, RM 26.3	(Full)	27	59%
Five Mile Run, RM 0.9	N/A	24	11%

* total number of different macroinvertebrate taxa collected

N/A= Data was not taken and/or is not available

Physical Integrity

Summary of habitat conditions for the Headwaters Subwatershed

Site Location	Average QHEI score	Rip. Buffer Present (miles)	Rip. Buffer Needed (miles)	Livestock Access
E. Branch of headwaters	35	N/A	N/A	no
W. Branch of headwaters	38	N/A	N/A	no
Leading Creek mainstem	69	5.5	1.0	yes
Five Mile Run	55	3.5	0.9	yes

N/A= Data was not taken and/or is not available

Problem Statement 1 of 3
Litter and Illegal Trash Dumping

Many of the best habitat conditions in the Leading Creek Watershed are found in this sub-watershed (QHEI scores average 69.3 on the mainstem). Preservation and enhancement of these habitat features can, in part, be accomplished by removing litter from this stream reach (Leading Creek RM 30.0 to RM 26.1), and by educating local residents about the benefits of maintaining clean streams.

Goals

- Reduce the amount of trash in the sub-watershed by targeting pull-offs and bridges along Leading Creek, particularly along County Road 10-Meigs County and County Road 13-Athens County.
- Improve the communities' awareness of the benefits and functions of clean streams.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Plan community events and recruit volunteers to conduct clean-ups and haul trash to licensed landfills	Conduct a "Stream Walk"/ "Stream Sweep" at target areas along Leading Creek from RM 30.0 to 26.1	In-kind services provided by Meigs Recycling & Litter Prevention, US FWS, and Meigs SWCD (*i.e.* trash bags, gloves, dump trucks, and disposal costs)	Watershed coordinator, Meigs SWCD staff and volunteers will request funding for trash disposal from the Leading Creek Improvement Plan funds (*i.e.* US FWS).	Year 1	• Number of participants involved in clean-up events. • Amount of litter removed from the streams.
Educate public about the negative effects of illegal trash dumping and increase awareness of proper waste disposal and recycling practices.	Create a media campaign to increase awareness. Conduct presentations, workshops, and/or distribute informational flyers.	Potential funding sources: Ohio Environmental Education Fund, Ohio EPA Supplemental Environmental Programs grants, and WAWA grants. $200 in printing posters and fliers to advertise events and to produce educational handouts.	Watershed coordinator, Meigs SWCD staff and volunteers will write grants and request funding for educational materials.	Conduct 2 educational programs in Year 1 and 2 programs in Year 2.	• Monitor the amount of trash that accumulates at previously cleaned sites. • Creation of a survey to measure public awareness.

Action Statement 2 of 3
Habitat Preservation

Housing development and changing land uses are much more threatening to stream quality in this area than in the other locations in the Leading Creek Watershed. While development does not currently affect stream quality, future unrestricted land development may degrade habitat conditions.

This reach of Leading Creek has very good habitat features (average QHEI= 69.3), high quality substrates (average substrate score= 13), and 96% of the riparian area is present and functioning; therefore, it is a priority to establish proactive measures to preserve the current habitat conditions.

Goals

- Preserve current habitat and substrate conditions and maintain or improve current QHEI scores of 69.3 along the Leading Creek mainstem (RM 30.0 to RM 26.1).
- Improve public awareness of the functions of healthy riparian areas and the benefits of utilizing erosion and sediment best management practices.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Protect riparian corridor through land purchase or conservation easement	Work with Leading Creek partners and establish a work group to organize a permanent conservation easement program.	Time for watershed coordinator, representatives from Athens and Meigs SWCDs, ODNR, OEPA, and NRCS.	Watershed coordinator, staff from Athens and Meigs SWCDs, ODNR, OEPA, and NRCS to research process, procedures, legal and tax ramifications for easements.	Year 1	Creation of the "Leading Creek Conservation Easement Program" with an established set of guidelines.
	Work with Leading Creek partners and landowners to identify, assess, and map the most desirable areas for protection or acquisition.	Time for watershed coordinator, representatives from Athens and Meigs SWCDs, ODNR, OEPA, and NRCS to walk, canoe, and/or view aerial photos from this area.	Watershed coordinator, SWCD staff and volunteers will assess the quality of the riparian corridor along the mainstem between RM 30.0 and RM 26.1.	Years 1-2	The high quality riparian corridors between RM 30.0 and 26.1 are identified, assessed, and mapped. The addresses of landowners in the selected areas are generated.

Educate public about the functions of riparian corridors and ways to minimize upland erosion caused by construction, logging, and housing development.	Conduct an educational workshop to provide technical assistance about erosion and sediment best management practices.	Time for "presenters" such as the watershed coordinator, representatives from Athens and Meigs SWCDs, ODNR, OEPA, and NRCS. $200 in printing posters and fliers to advertise events and to produce educational handouts.	Facilitate a one-day workshop for developers, landowners, elected officials and other interested stakeholders to inform them of BMP’s, laws and regulations, and the water quality impacts associated with floodplain development.	Year 2	Increased use of best management practices by developers and loggers.
	Work with NRCS media campaign to promote incentive programs, targeting landowners who live adjacent to the stream.	Time for Watershed Coordinator, SWCD staff, and district conservationist to visit landowners.	Watershed Coordinator, SWCD staff, district conservationist and volunteers to visit landowners and inform them of financial and ecological benefits of riparian buffers. Sign up willing landowners for CRP, Clean Ohio Fund and EQIP cost share programs.	Years 2-4	Increased number of landowners enrolled in CRP, Clean Ohio Fund and EQIP cost share programs.

Problem Statement 3 of 3
Nutrient Enrichment/Pathogens

While the mainstem of Leading Creek does not seem to be impacted by nutrient enrichment, nitrate concentrations exceed Ohio EPA benchmarks in the west branch of the headwaters for 56% of the water samples collected, in the east branch of the headwaters (RM 31.6) for 50% of the samples, and in Fivemile Run for 63% of the water samples. Likewise, phosphorus concentrations are of concern with 44% of the samples exceeding targets in the west branch of the headwaters, 95% in the east branch of the headwaters (RM 31.6), and 75% in Fivemile Run.

Target areas within these tributaries are a dairy farm situated within the floodplain of Fivemile Run and a pasture field on Fivemile Run (RM 0.9) in which livestock have unrestricted access to the creek. These areas are obvious sources of nutrients, pathogens, and sedimentation.

Organic enrichment (*via* household sewage systems or livestock runoff) was ranked very high as a problem during public meetings. Based on recent sampling, fecal coliform counts were near or exceeded Ohio EPA standards at Leading Creek RM 26.2 (below Carpenter) and were more than 10 times the Ohio EPA standard at Fivemile Run (RM 1.8). The county health department estimates 50 percent of the on-site sewage treatment systems in this sub-watershed are failing. Based on an average of three bedrooms per household, the estimated 107 failing systems in this area cause an effluent of 38,520 gallons/day to enter the stream. Target areas for organic enrichment include residential areas in Albany Township, Athens County and Carpenter, Meigs County and organic wastes from livestock operations along Five Mile Run.

NOTE: Currently, landowners of the dairy facility located along Five Mile Run are implementing an Environmental Quality Incentive Program (EQUIP) plan, which should alleviate many of the sources and causes of water quality impairment in this tributary.

Goals

- Work with Meigs Health Department and Athens Health Department to increase the number of properly working home sewage systems by 20 percent within this sub-watershed.
- Work with Meigs Soil and Water Conservation District and Natural Resource Conservation Service to install practices at farming operations on Fivemile Run to reduce fecal coliform counts to meet Ohio EPA standards and to reduce nutrient (nitrogen and phosphorus) concentrations to meet Ohio EPA potential standards.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Decrease the number of failing home sewage treatment systems by 20% and reduce the level of fecal coliform to below Ohio EPA standards.	Work with Meigs and Athens County Health Departments to write the County Wide HSTS Plan.	Time for staff of Meigs SWCD and Meigs Health Department to write HSTS Plan.	Writing HSTS Plan will identify problem areas in the watershed and provide guidelines to those upgrading or repairing systems. In addition, the Health Department will establish operation and maintenance protocol for homeowners with HSTS.	Year 1	Completion of the HSTS inventory including the identification of households with straight pipes or failing systems.
	Work with Meigs and Athens County Health Departments to conduct fecal coliform sampling, which will help identify specific target areas and provide baseline data to compare to future results.	Time for staff of Meigs SWCD and Meigs Health Department to conduct water quality monitoring.	Watershed coordinator, Meigs SWCD staff, Meigs Health Department staff, and volunteers will conduct sampling throughout watershed targeting areas downstream of potential problem areas. Technical assistance provided by ODNR & OEPA.	Years 1	Database of water quality sampling results with report of potentially impacted areas.
	Work with Meigs and Athens County Health Departments to determine households with failing systems.	Health Department Inspectors time to inspect systems.	Health Department will inspect the approximately 107 failing systems in the subwatershed as time allows.	Years 3-6	Identification of the failing on-site systems with addresses generated.
	Work with Meigs County Health Departments to replace/upgrade 21 failing systems within the next 10 years.	Apply for approximately $168,000 in funds to repair 21 systems at $8,000 a system.	Seek funding from grants (see Appendix E for potential grants) and DEFA low interest loan program to cost share on-site HSTS repair, replacement or pumping.	Years 3-10	Improved operations of 21 septic systems within 10 years and decreased fecal coliform levels to below 2000counts/ 100mL in Leading Creek and its tributaries.

Educate public about the adverse human health and ecological effects of untreated sewage and provide information about how to maintain a properly functioning system	Conduct a HSTS operation and maintenance workshop for homeowners, real estate agents, and developers.	Time for "presenters" such as the watershed coordinator, representatives from Athens and Meigs SWCDs and HDs, ODNR, and OEPA. $100 in printing posters and fliers to advertise events and to produce educational handouts.	Facilitate a one-day workshop for developers, landowners, elected officials and other interested stakeholders to inform them of proper procedures for installation, operation, and maintenance of HSTS.	Year 2	Workshop held and evaluated by participants.
	Create a media campaign to provide information about treatment options, proper maintenance actions, and the adverse effects of untreated sewage.	Potential funding sources: Ohio Environmental Education Fund, Ohio EPA Supplemental Environmental Programs grants, and WAWA grants. $400 in printing and distributing educational handouts.	Watershed coordinator, Meigs SWCD staff, Meigs HD staff, and volunteers will write grants and request funding for educational materials.	Years 3-10	Educational information created and distributed.
Reduce fecal coliform counts to meet Ohio EPA standards and reduce nutrient (nitrogen and phosphorus) concentrations to meet Ohio EPA potential standards.	Work with Meigs SWCD and NRCS to complete EQUIP practices at dairy farm on Fivemile Run.	Time for Watershed Coordinator, SWCD staff, and district conservationist to work with landowners.	Watershed Coordinator, SWCD staff, and district conservationist to encourage and support completion	Years 1-2	Reduced nutrient concentrations with no samples exceeding Ohio EPA's potential standards.
	Work with Meigs SWCD to develop a long-term monitoring (LTM) plan downstream of the Fivemile Run project.	Time for Watershed Coordinator and SWCD staff to develop a monitoring strategy.	Writing LTM Plan will provide a systematic plan for conducting sampling.	Year 1	
	Conduct additional monitoring throughout the subwatershed to identify other impacted areas.	Time for staff of Meigs SWCD to conduct water quality monitoring.	Watershed coordinator, Meigs SWCD staff, and volunteers will conduct sampling throughout subwatershed targeting areas downstream of potential problem areas. Technical assistance provided by ODNR & OEPA.	Year 1	Database of water quality sampling results with report of potentially impacted areas.

	Provide information to landowners at other impacted areas about cost-share programs for livestock exclusion from waterways.	Time for Watershed Coordinator, SWCD staff, and district conservationist to visit landowners.	Watershed Coordinator, SWCD staff, district conservationist and volunteers to visit landowners and inform them of financial and ecological benefits of livestock exclusion. Sign up willing landowners for CRP, Clean Ohio Fund and EQIP costshare programs.	Years 2-4	Number of landowners at other impacted areas enrolled in cost-share programs for livestock exclusion from waterways.

Subwatershed 05030202-090 010

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Litter and Illegal Trash Dumping										
Community clean-up	■									
Educational programs	■	■								
Habitat Preservation										
Create easement program	■									
Define target areas	■	■								
Educational workshop		■								
Visit landowners		■	■	■						
Nutrient Enrichment/ Pathogens										
Write HSTS Plan	■									
Conduct fecal coliform sampling	■									
Identify failing systems			■	■	■	■				
Replace/ upgrade systems			■	■	■	■	■	■	■	■
Educational workshop		■								
Create media campaign			■	■	■	■	■	■	■	■
Complete EQUIP practices	■	■								
Develop monitoring plan	■									
Conduct nutrient sampling	■									
Visit landowners		■	■	■						

Sub-watershed- 05030202-090 020
Below Fivemile Run to above Mud Fork

Background

Evaluations by the Ohio EPA indicate that the biological communities are somewhat impaired in this sub-watershed. Only two of the six mainstem surveys had scores within the range for the warmwater habitat (WWH) criterion. In its 2000 Water Resource Report (305(b)), Ohio EPA reports that sedimentation and "other habitat alterations" limit the biota and are the major causes of impairment in this sub-watershed.

Overall, the stream reaches have good channel morphology (sinuosity and natural channel characteristics), but many of the reaches, particularly Sisson Run near the mouth, Sharps Run, and Leading Creek at RM 24.3 have poor instream cover (average metric score= 7 out of 20 possible) and riparian width and quality (average metric score= 5 out of 10 possible).

Chemical Integrity

Summary of water chemistry for the Subwatershed (05030202-090 020)

Site Location	Percentage of Samples exceeding Ohio EPA Water Quality Standard		
	Ammonia*	Nitrate**	Phosphorus**
Sharps Run, RM 0.7	0%	50%	13%
Leading Creek, RM 24.3	0%	50%	28%
Sisson Run, RM 0.1	0%	11%	17%
Ogden Run, RM 0.2	0%	6%	0%
Leading Creek, RM 20.8	0%	31%	13%

* Ohio EPA water quality standard for Ohio River Basin, outside mixing zone is 2.2 mg/L for ammonia concentrations

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles) and 0.47 for nitrate at wading sites (drainage area >20.0 square miles). The potential phosphorus standard for the WAP ecoregion is 0.05 mg/L at headwater sites (drainage area <20.0 square miles) and 0.06 for phosphorus at wading sites (drainage area >20.0 square miles).

Biological Integrity

Summary of biological performance for the Subwatershed (05030202-090 020)

Site Location	Attainment Status	Macroinvertebrate Taxa Diversity *	Percentage EPT taxa
Leading Creek, RM 26.0	(Non-attainment)	N/A	N/A
Leading Creek, RM 26.0	(Non-attainment)	N/A	N/A
Leading Creek, RM 26.0	(Full)	N/A	N/A
Leading Creek, RM 26.0	(Non-attainment)	N/A	N/A
Sharps Run, RM 0.7	N/A	32	16%
Leading Creek, RM 24.3	(Non-attainment)	24	20%
Leading Creek, RM 24.1	(Full)	N/A	N/A
Sisson Run, RM 0.1	N/A	33	25%
Leading Creek, RM 21.3	(Full)	N/A	N/A
Leading Creek, RM 20.8	N/A	28	51%
Leading Creek, RM 19.0	(Partial)	N/A	N/A
Trib. to Ogden Run, RM 1.0	(Non-attainment)	N/A	N/A
Trib. to Ogden Run, RM 1.0	(Full)	N/A	N/A
Trib. to Ogden Run, RM 1.0	(Non-attainment)	N/A	N/A
Ogden Run, RM 0.2	N/A	29	30%
Trib. at RM 20.5, RM 0.5	(Full)	N/A	N/A

* total number of different macroinvertebrate taxa collected

N/A= Data was not taken and/or is not available

Physical Integrity

Summary of habitat conditions for the Subwatershed (05030202-090 020)

Site Location	Average QHEI score	Rip. Buffer Present (miles)	Rip. Buffer Needed (miles)	Livestock Access
Leading Creek mainstem	58	4.0	3.1	yes
Sharps Run	58	4.0	0.2	yes
Sisson Run	46	3.2	2.2	yes
Ogden Run	54	4.7	1.3	yes

Problem Statement 1 of 3
Sedimentation

Two tributaries, Sisson Run and Ogden Run, have extremely poor substrate conditions as indicated by the low QHEI substrate scores (metric score= 10 out of 20 possible) and by the degree of sediment present, an average of 1.9 feet of sand (*i.e.* particles < 2 mm). Excessive sedimentation is due, in part, to upland erosion from poorly managed pasturelands and streambank erosion (Ohio EPA 305(b)). Pasturelands that are overgrazed and poorly managed contribute an estimated 26,312 tons/year of total sediment to the system. Erosion of the stream channel contributes an additional estimated 190 tons/year.

Goals

- Decrease sedimentation from known sources (*i.e.* excessive bank erosion and pastureland erosion) by 50%
- Increase average QHEI substrate score to 13 in Sisson Run and/or Ogden Run
- Monitor impaired stream segments to identify and quantify additional sources that contribute sediment to the creek.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Decrease sedimentation caused by upland and streambank erosion by 50 percent.	Reduce stream channel erosion by restricting livestock access and by stabilizing 3,960 feet of eroded stream bank along Sisson Run RM 0.5 to RM 1.3	Time for Watershed Coordinator, SWCD staff, and district conservationist to visit landowners. Total cost is approximately $8,712 for establishing 0.75 miles of fence @ $2.20/lineal feet of 4 strands of barbed wire.	Seek funding from grants (see Appendix E for potential grants) to install livestock exclusion fencing on 0.75 miles of streambank with unlimited access.	Years 1-2	Livestock excluded and eroding sites stablilized. Streambank delivering 50 percent less sediment to Sisson Run.
	• Provide technical and financial assistance to landowners interested in improving pastureland quality.	Time for Watershed Coordinator, SWCD staff, and district conservationist to visit landowners. Total cost is approximately $441,140 for applying lime and fertilizer to 3,836 acres @ $115/per acre ($75/acre for lime and $40/acre for fertilizer).	Seek funding from grants (see Appendix E for potential grants) to cost share practices that will increase pastureland cover and fertility.	Years 2-4	• Number of acres of pastureland being more properly managed. Pasturelands delivering 50 percent less sediment to Sisson Run.

Increase average QHEI substrate score to 13 in Sisson Run and Ogden Run.	Conduct a pilot study for sediment removal in Sisson Run and/or Ogden Run	Time for staff of Meigs SWCD, ODNR & OEPA to research appropriate methodology.	Seek funding from grants (see Appendix E for potential grants) to remove sediment and restore substrate conditions.	Years 3-5	Reduction of sediment depths and improvement in QHEI substrate scores to 13 in Sisson Run and Ogden Run.
Monitor impaired stream segments to identify and quantify additional sources that contribute sediment to the creek.	Gather appropriate field data in impaired stream segments and document potential sources of sediment	Time for staff of Meigs SWCD to conduct monitoring. $1,500 for monitoring equipment.	Watershed coordinator, Meigs SWCD staff, and volunteers will conduct sampling throughout subwatershed targeting areas downstream of potential sources. Technical assistance provided by ODNR & OEPA.	Years 3-4	Identification and prioritization of specific sites that seem to be contributing sediment

Problem Statement 2 of 3
Habitat Modification

Riparian encroachment and unrestricted livestock adversely affect Sharps Run and Sisson Run. QHEI scores for Sisson Run and Sharps Run are 46 and 57 respectively. Of the QHEI factors, instream cover and riparian zone width and quality have the greatest effects. Evaluation of 2001 aerial photos indicates that riparian buffer is needed on 3.1 miles of Leading Creek, 2.2 miles on Sisson Run, and 0.2 miles on Sharps Run.

Goals

- Improve overall QHEI scores to 60 by improving instream cover and riparian width and quality.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Improve overall habitat conditions by restoring 2.5 miles of riparian area along Sisson Run and Sharps Run.	• Restrict livestock access along high impact areas. • Establish a riparian corridor along 13,200 feet of Sisson Run and Sharps Run.	Use cost share funds to provide livestock exclusion. Total cost is approximately $29,040 for establishing 2.5 miles of fence @ $2.20/lineal feet of 4 strands of barbed wire.	Seek funding from grants (see Appendix E for potential grants) to install livestock exclusion fencing and establish a riparian area along 2.5 miles of Sisson Run and Sharps Run.	Years 1-2	Re-vegetate 2.5 miles of riparian area along Sisson Run and Sharps Run and measure improvement in QHEI scores.

Problem Statement 3 of 3
Nutrient Enrichment/Pathogens

Nitrate concentrations exceed Ohio EPA benchmarks in Sharps Run for 50% of the water samples collected and in Leading Creek (RM 24.3) for 50% of the water samples. Based on recent sampling, fecal coliform counts were near or exceeded Ohio EPA standards in Leading Creek at RM 20.8 (below Dyesville) and in Sisson Run.

Target areas within the sub-watershed include livestock operations along Sharps Run and Sisson Run where livestock have unrestricted access to the stream.

The county health department estimates 50 percent of the on-site sewage treatment systems in this sub-watershed are failing. Based on an average of three bedrooms per household, the estimated 180 failing systems in this area contribute 64,800 gallons/day to the stream. Target areas for organic enrichment include Dyesville and organic wastes from livestock operations along Sisson Run.

Goals

- Work with Meigs Health Department to increase the number of properly working home sewage systems 20 percent in this sub-watershed.
- Work with Meigs Soil and Water Conservation District and Natural Resource Conservation Service to install practices at farming operations on Sisson Run and Sharps Run to reduce fecal coliform counts to meet Ohio EPA standards and to reduce nutrient (nitrogen and phosphorus) concentrations to meet Ohio EPA potential standards.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Decrease the number of properly failing home sewage treatment systems by 20 % and reduce the level of fecal coliform to below Ohio EPA standards.	Work with Meigs County Health Departments to write the County Wide HSTS Plan.	Time for staff of Meigs SWCD and Meigs Health Department to write HSTS Plan.	Writing HSTS Plan will identify problem areas in the watershed and provide guidelines to those upgrading or repairing systems. In addition, the Health Department will establish operation and maintenance protocol for homeowners with HSTS.	Year 1	Completion of the HSTS inventory including the identification of households with straight pipes or failing systems.

	Work with Meigs County Health Departments to conduct fecal coliform sampling, which will help identify specific target areas and provide baseline data to compare to future results.	Time for staff of Meigs SWCD and Meigs Health Department to conduct water quality monitoring.	Watershed coordinator, Meigs SWCD staff, Meigs Health Department staff, and volunteers will conduct sampling throughout watershed targeting areas downstream of potential problem areas. Technical assistance provided by ODNR & OEPA.	Years 1	Database of water quality sampling results with report of potentially impacted areas.
	Work with Meigs County Health Departments to determine households with failing systems.	Health Department Inspectors time to inspect systems.	Health Department will inspect the approximately 180 failing systems in the subwatershed as time allows.	Years 3-6	Identification of the failing on-site systems with addresses generated.
	Work with Meigs County Health Departments to replace/upgrade 36 failing systems within the next 10 years.	Apply for approximately $288,000 in funds to repair 36 systems at $8000 a system.	Seek funding from grants (see Appendix E for potential grants) and DEFA low interest loan program to cost share on-site HSTS repair, replacement or pumping.	Years 3-10	Improved operations of 36 septic systems within 10 years and decreased fecal coliform levels to below 2000counts/ 100mL in Leading Creek and its tributaries.
Educate public about the adverse human health and ecological effects of untreated sewage and provide information about how to maintain a properly functioning system.	Conduct a HSTS operation and maintenance workshop for homeowners, real estate agents, and developers.	Time for "presenters" such as the watershed coordinator, representatives from Athens and Meigs SWCDs and HDs, ODNR, and OEPA. $100 in printing posters and fliers to advertise events and to produce educational handouts.	Facilitate a one-day workshop for developers, landowners, elected officials and other interested stakeholders to inform them of proper procedures for installation, operation, and maintenance of HSTS.	Year 2	Workshop held and evaluated by participants.
	Create a media campaign to provide information about treatment options, proper maintenance actions, and the adverse effects of untreated sewage.	Potential funding sources: Ohio Environmental Education Fund, Ohio EPA Supplemental Environmental Programs grants, and WAWA grants. $400 in printing and distributing educational handouts.	Watershed coordinator, Meigs SWCD staff, Meigs HD staff, and volunteers will write grants and request funding for educational materials.	Years 3-10	Educational information created and distributed.

Reduce fecal coliform counts to meet Ohio EPA standards and reduce nutrient (nitrogen and phosphorus) concentrations to meet Ohio EPA potential standards.	Work with Meigs SWCD and NRCS to provide information to landowners along Sharps Run and Sisson Run about cost-share programs for livestock exclusion from waterways.	Time for Watershed Coordinator, SWCD staff, and district conservationist to visit landowners.	Watershed Coordinator, SWCD staff, district conservationist and volunteers to visit landowners and inform them of financial and ecological benefits of livestock exclusion. Sign up willing landowners for CRP, Clean Ohio Fund and EQIP cost share programs.	Years 2-4	Reduced nutrient concentrations and fecal coliform levels with no samples exceeding Ohio EPA's standards.

Summary Timeframe for Proposed Activities

Subwatershed 05030202-090 020

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Sedimentation										
Livestock exclusion	■	■								
Pastureland improvement		■	■	■						
Pilot study			■	■	■					
Conduct sediment sampling			■	■						
Habitat Modification										
Livestock exclusion	■	■								
Nutrient Enrichment/ Pathogens										
Write HSTS Plan	■									
Conduct fecal coliform sampling	■									
Identify failing systems			■	■	■	■				
Replace/ upgrade systems			■	■	■	■	■	■	■	■
Educational workshop		■								
Create media campaign			■	■	■	■	■	■	■	■
Visit landowners		■	■	■						

Sub-watershed- 05030202-090 030
Mud Fork

Background

In its 2004 Integrated Report (Ohio EPA, 2004a), Ohio EPA reports that excessive sedimentation/siltation results in impaired use attainment in the Leading Creek Watershed. The adverse impacts of sediment deposition are evident in Mud Fork where sediment depths exceed 18 inches and QHEI substrate scores range from 6 to 9 (Bauers field measurement; Cherry *et al.* 1997).

The Mud Fork sub-watershed has a unique 70- acre freshwater emergent marsh. This wetland appears to be very productive and was given the highest quality ranking (*i.e.* category 3) when assessed by an Ohio EPA wetland ecologist.

Chemical Integrity

Summary of water chemistry for the Subwatershed (05030202-090 030)

Site Location	Percentage of Samples exceeding Ohio EPA Water Quality Standard		
	Ammonia*	Nitrate**	Phosphorus**
Mud Fork, RM 0.8	0%	0%	1%
Mud Fork, RM 0.2	0%	0%	1%

* Ohio EPA water quality standard for Ohio River Basin, outside mixing zone is 2.2 mg/L for ammonia concentrations

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles) and 0.47 for nitrate at wading sites (drainage area >20.0 square miles). The potential phosphorus standard for the WAP ecoregion is 0.05 mg/L at headwater sites (drainage area <20.0 square miles) and 0.06 for phosphorus at wading sites (drainage area >20.0 square miles).

Biological Integrity

Summary of biological performance for the Subwatershed (05030202-090 030)

Site Location	Attainment Status	Macroinvertebrate Taxa Diversity *	Percentage EPT taxa
Mud Fork, RM 0.8	N/A	32	16%
Mud Fork, RM 0.2	N/A	29	30%

* total number of different macroinvertebrate taxa collected

N/A= Data was not taken and/or is not available

Physical Integrity

Summary of habitat conditions for the Subwatershed (05030202-090 030)

Site Location	Average QHEI score	Rip. Buffer Present (miles)	Rip. Buffer Needed (miles)	Livestock Access
Mud Fork	40	5.9	2.4	yes

Problem Statement 1 of 2
Sedimentation

The adverse impacts of sediment deposition are evident in Mud Fork where QHEI scores range from 36.0 to 43.5. The primary cause of the sedimentation was surface mining, which exposed highly erodible mine spoil on many of the hillsides surrounding the headwaters of Mud Fork. Erosion rates in excess of 200 tons/acre/year were measured over a large area of strip mine spoil. Reclamation of abandoned mine lands has taken place in the watershed, but impacts from sedimentation (sand and other fines) still exist in Mud Fork and several of its tributaries.

Goals

- Increase average QHEI substrate scores to 13 in Mud Fork.
- Monitor impaired stream segments to identify and quantify additional sources that contribute sediment to the creek.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Increase average QHEI substrate scores to 13 in Mud Fork	Conduct a pilot study for sediment removal in Mud Fork	Time for staff of Meigs SWCD, ODNR & OEPA to research appropriate methodology.	Seek funding from grants (see Appendix E for potential grants) to remove sediment and restore substrate conditions.	Years 3-5	Reduction of sediment depths and improvement in QHEI substrate scores to 13 in Mud Fork.
Monitor impaired stream segments to identify and quantify additional sources that contribute sediment to the creek.	Gather appropriate field data in impaired stream segments and document potential sources of sediment	Time for staff of Meigs SWCD to conduct monitoring. $1,500 for monitoring equipment.	Watershed coordinator, Meigs SWCD staff, and volunteers will conduct sampling throughout subwatershed targeting areas downstream of potential sources. Technical assistance provided by ODNR & OEPA.	Years 3-4	Identification and prioritization of specific sites that seem to be contributing sediment

Action Statement 2 of 2
Wetland Preservation

There are very few wetlands remaining in the Leading Creek Watershed making the preservation of a unique 70- acre freshwater emergent marsh within the Mud Fork sub-watershed a priority. This wetland appears to be very productive and was classified as a category 3 (score= 67) wetland based on the Ohio Rapid Assessment Method.

Goals

- Preserve and enhance the wetland's features so that future ORAM scores will remain comparable to current scores.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Preserve and enhance the wetland's feature to maintain or improve ORAM current scores.	Work with Leading Creek partners and establish a work group to organize a permanent conservation easement program.	Time for watershed coordinator, representatives from Meigs SWCDs, ODNR, OEPA, and NRCS.	Watershed coordinator, staff from Meigs SWCDs, ODNR, OEPA, and NRCS to research process, procedures, legal and tax ramifications for easements.	Year 1	The wetland is permanently protected through land purchase or conservation easement.
	Research and utilize wetland restoration techniques to improve the hydrological conditions and vegetative communities where appropriate.	Time for watershed coordinator, representatives from Meigs SWCDs, ODNR, OEPA, and NRCS.	Watershed coordinator, staff from Meigs SWCDs, ODNR, OEPA, and NRCS to research techniques.	Years 3-4	Identification of specific methods to improve wetland quality.

Summary Timeframe for Proposed Activities
Subwatershed 05030202-090 030

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Sedimentation										
Pilot study			▬	▬	▬					
Conduct sediment sampling			▬	▬						
Wetland Preservation										
Create easement program	▬									
Research enhancement practices			▬	▬						

Sub-watershed- 05030202-090 040
Below Mud Fork to above Little Leading Creek

Background

Biological surveys conducted by the Ohio EPA show that this reach of Leading Creek supports a relatively healthy and diverse community of fish and macroinvertebrates. Of the five sites surveyed in 2002, only one site (RM 14.8) did not attain warmwater habitat. Of the 32 biological surveys conducted in the sub-watershed since 1995, 19 (59%) of the survey scores fell within the range for warmwater habitat (WWH). While the surveys produced a "fair" to "very good" assemblage of fish, the MIwb scores were often rated as "fair" indicating the biomass of the fish was very small. Of the tributaries sampled, Malloons Run easily attained WWH both years it was sampled and was considered "a good reference condition for small streams in the Leading Creek Basin" (Ohio EPA, 2000b). Parker Run, in contrast, only attained WWH in one of five surveys from 1998 to 2002.

This sub-watershed has a higher average QHEI score (64.6) than the other Leading Creek sub-watersheds. Several tributaries (*i.e.* Grass Run, Parker Run, and Malloons Run) and mainstem segments (*i.e.* RM15.5, RM 14.8, RM 10.3) have high quality habitat features including substrates with large and coarse gravels rather than sand and other fines generally found in watershed. Stream morphology and channel development is also in good condition (average metric score= 15 out of 20 possible). The channel is primarily unmodified and sinuous having riffles and pools of moderate quality.

Chemical Integrity

Summary of water chemistry for the Subwatershed (05030202-090 040)

	Percentage of Samples exceeding Water Quality Standard				
Site Location	Ammonia*	Nitrate**	Phosphorus**	pH*	Aluminum§
Dexter Run, RM 0.8	0%	0%	6%	0%	N/A
Leading Creek, RM 17.3	0%	1%	0%	0%	0%
Grass Run, RM 0.8	0%	0%	0%	0%	N/A
Parker Run, RM 1.5	0%	45%	5%	0%	N/A
Leading Creek, RM 14.8	0%	20%	20%	0%	N/A
Malloons Run, RM 0.1	0%	0%	100%***	0%	N/A
Leading Creek, RM 10.3	0%	25%	13%	0%	0%
Lasher Run, RM 0.5	0%	0%	0%	0%	0%

* Ohio EPA water quality standard for Ohio River Basin, outside mixing zone is 2.2 mg/L for ammonia concentrations and 6.5 to 7.5 for pH

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles) and 0.47 for nitrate at wading sites (drainage area >20.0 square miles). The potential phosphorus standard for the WAP ecoregion is 0.05 mg/L at headwater sites (drainage area <20.0 square miles) and 0.06 for phosphorus at wading sites (drainage area >20.0 square miles).

*** Note that only one sample has been taken at the site

§ Target of 0.50 mg/L was set by the Leading Creek Watershed based on the median water quality concentration at WAP reference sites meeting partial and full attainment of WWH.

N/A= Data was not taken and/or is not available

Biological Integrity

Summary of biological performance for the Subwatershed (05030202-090 040)

Site Location	Attainment Status based on OEPA's 2002 surveys	Macroinvertebrate Taxa Diversity*	Percentage EPT taxa
Dexter Run, RM 0.8	N/A	24	29%
Leading Creek, RM 16.8	Partial	30	47%
Grass Run, RM 0.8	N/A	18	38%
Leading Creek, RM 15.6	(Full)	16	35%
Parker Run, RM 1.5	N/A	28	19%
Leading Creek, RM 15.5	(Partial)	23	31%
Leading Creek, RM 14.8	(Non- attainment)	21	32%
Malloons Run, RM 0.1	N/A	21	38%
Leading Creek, RM 10.3	Partial	36	30%
Lasher Run, RM 0.5	N/A	24	22%

* total number of different macroinvertebrate taxa collected

N/A= Data was not taken and/or is not available

Physical Integrity

Summary of habitat conditions for the Subwatershed (05030202-090 040)

Site Location	Average QHEI score	Rip. Buffer Present (miles)	Rip. Buffer Needed (miles)	Livestock Access
Leading Creek mainstem	69	10.4	1.3	yes
Dexter Run	57	4.3	1.4	yes
Grass Run	54	2.1	0.7	yes
Parker Run	58	4.1	1.2	yes
Malloons Run	58	2.6	0.8	yes
Lasher Run	42	2.6	0.9	yes

Problem Statement 1 of 4
Sedimentation

In its 2000 Water Resource Report (305(b)), Ohio EPA reports that sedimentation limits the biota and is a high magnitude cause of impairment in this sub-watershed. The exact sources of the sedimentation are difficult to identify but likely sources include historical and current agricultural practices, stream channel erosion, natural geologic features, and unreclaimed surface mines. Approximately 40 acres of abandoned surface mines remain barren and contribute an estimated 4,880 tons of soil per year to the sub-watershed. The adverse impacts of sediment deposition are evident in Lasher Run where sediment depths exceed 24 inches and QHEI substrate scores range from 9 to 11 (Bauers field measurement; Cherry *et al.* 1997).

Goals

- Increase average QHEI substrate scores to 13 in Lasher Run.
- Monitor impaired stream segments to identify and quantify additional sources that contribute sediment to the creek.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Increase average QHEI substrate scores to 13 in Lasher Run.	Work with Meigs SWCD, NRCS, and MRM to reclaim 40 acres of abandoned surface mine land and reduce soil loss from the "Titus Run Reclamation Project" by 50 percent.	Time for watershed coordinator, SWCD staff, MRM, and NRCS.	Help with the timely progression of the project and with coordination as needed.	Years 1-2	Reduction of sediment depths and improvement in QHEI substrate scores to 13 in Lasher Run.
	Work with Meigs SWCD and MRM to develop a long-term monitoring (LTM) plan downstream of the "Titus Run Reclamation Project".	Time for Watershed Coordinator and SWCD staff to develop a monitoring strategy.	Writing LTM Plan will provide a systematic plan for conducting sampling.	Year 1	

Monitor impaired stream segments to identify and quantify additional sources that contribute sediment to the creek.	Gather appropriate field data in impaired stream segments to document potential sources of sediment	Time for staff of Meigs SWCD to conduct monitoring. $1,500 for monitoring equipment.	Watershed coordinator, Meigs SWCD staff, and volunteers will conduct sampling throughout subwatershed targeting areas downstream of potential sources. Technical assistance provided by ODNR & OEPA.	Years 3-4	Identification and prioritization of specific sites that seem to be contributing sediment

Problem Statement 2 of 4
Pathogens

Approximately 60 percent of the on-site sewage treatment systems in this sub-watershed are failing. Based on an average of three bedrooms per household, the estimated 337 failing systems in this area contribute an estimated 121,320 gallons/day. Target areas for organic enrichment include Dexter and organic wastes from livestock operations along Dexter Run.

There is some evidence that Parker Run is affected by nutrient enrichment. Ammonia concentrations at Parker Run were far higher than any other site in the watershed and 45% of the samples exceeded Ohio EPA's potential nitrate benchmark. Because the source of nutrient enrichment is not apparent in Parker Run, future monitoring of the site is required.

Goals

- Work with Meigs Health Department to increase the number of properly working home sewage systems by 20 percent in this sub-watershed.
- Work with Meigs Soil and Water Conservation District and Natural Resource Conservation Service to install practices at farming operations on Dexter Run to reduce fecal coliform counts to meet Ohio EPA standards and to reduce nutrient (nitrogen and phosphorus) concentrations to meet Ohio EPA potential standards.
- Monitor Parker Run to identify and quantify potential sources of nutrient enrichment.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Decrease the number of failing home sewage treatment systems by 20 % and reduce the level of fecal coliform to below Ohio EPA standards.	Work with Meigs County Health Departments to write the County Wide HSTS Plan.	Time for staff of Meigs SWCD and Meigs Health Department to write HSTS Plan.	Writing HSTS Plan will identify problem areas in the watershed and provide guidelines to those upgrading or repairing systems. In addition, the Health Department will establish operation and maintenance protocol for homeowners with HSTS.	Year 1	Completion of the HSTS inventory including the identification of households with straight pipes or failing systems.

	Work with Meigs County Health Departments to conduct fecal coliform sampling, which will help identify specific target areas and provide baseline data to compare to future results.	Time for staff of Meigs SWCD and Meigs Health Department to conduct water quality monitoring.	Watershed coordinator, Meigs SWCD staff, Meigs Health Department staff, and volunteers will conduct sampling throughout watershed targeting areas downstream of potential problem areas. Technical assistance provided by ODNR & OEPA.	Year 1	Database of water quality sampling results with report of potentially impacted areas.
	Work with Meigs County Health Departments to determine households with failing systems.	Health Department Inspectors time to inspect systems.	Health Department will inspect the approximately 337 failing systems in the subwatershed as time allows.	Years 3-6	Identification of the failing on-site systems with addresses generated.
	Work with Meigs County Health Departments to replace/upgrade 67 failing systems within the next 10 years.	Apply for approximately $536,000 in funds to repair 67 systems at $8,000 a system.	Seek funding from grants (see Appendix E for potential grants) and DEFA low interest loan program to cost share on-site HSTS repair, replacement or pumping.	Years 3-10	Improved operations of 67 septic systems within 10 years and decreased fecal coliform levels to below 2000counts/ 100mL in Leading Creek and its tributaries.
Educate public about the adverse human health and ecological effects of untreated sewage and provide information about how to maintain a properly functioning system	Conduct a HSTS operation and maintenance workshop for homeowners, real estate agents, and developers.	Time for "presenters" such as the watershed coordinator, representatives from Meigs SWCDs and HDs, ODNR, and OEPA. $100 in printing posters and fliers to advertise events and to produce educational handouts.	Facilitate a one-day workshop for developers, landowners, elected officials and other interested stakeholders to inform them of proper procedures for installation, operation, and maintenance of HSTS.	Year 2	Workshop held and evaluated by participants.
	Create a media campaign to provide information about treatment options, proper maintenance actions, and the adverse effects of untreated sewage.	Potential funding sources: Ohio Environmental Education Fund, Ohio EPA Supplemental Environmental Programs grants, and WAWA grants. $400 in printing and distributing educational handouts.	Watershed coordinator, Meigs SWCD staff, Meigs HD staff, and volunteers will write grants and request funding for educational materials.	Years 3-10	Educational information created and distributed.

Reduce fecal coliform counts to meet Ohio EPA standards and reduce nutrient (nitrogen and phosphorus) concentrations to meet Ohio EPA potential standards.	Work with Meigs SWCD and NRCS to provide information to landowners along Dexter Run about cost-share programs for livestock exclusion from waterways.	Time for Watershed Coordinator, SWCD staff, and district conservationist to visit landowners.	Watershed Coordinator, SWCD staff, district conservationist and volunteers to visit landowners and inform them of financial and ecological benefits of livestock exclusion. Sign up willing landowners for CRP, Clean Ohio Fund and EQIP costshare programs.	Years 2-4	Reduced nutrient concentrations and fecal coliform levels with no samples exceeding Ohio EPA's standards.
Monitor impaired stream segments to identify and quantify sources that may contribute nutrients to the creek.	Work with Meigs SWCD to develop a monitoring plan to determine sources of nutrients along Parker Run.	Time for staff of Meigs SWCD to conduct water quality monitoring.	Watershed coordinator, Meigs SWCD staff, and volunteers will conduct sampling throughout subwatershed targeting areas downstream of potential problem areas. Technical assistance provided by ODNR & OEPA.	Year 1	Identification and prioritization of specific sites that seem to be contributing nutrients

Problem Statement 3 of 4
Salinity/TDS/Chlorides

In its 2000 Water Resource Report (305(b)), Ohio EPA reports that salinity/ Total Dissolved Solids/chlorides limits the biota and is considered a high magnitude cause of impairment in this sub-watershed. Total Dissolved Solids are extremely elevated in this sub-watershed with concentrations ranging from 160 mg/L to 6,022 mg/L along the mainstem. These high concentrations are, in part, due to the Meigs Mine #31 treatment plant, which has a NPDES permit to discharge the by-products of AMD treatment to a tributary of Parker Run.

Goals

- Work with CONSOL and Ohio EPA to determine long-term plan for the Meigs Mine discharge.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Determine the long-term intentions for the discharge and how that may affect the biological communities in Leading Creek.	Work with Meigs SWCD, OEPA, and CONSOL to determine the specifics of the NPDES permit and the long term plan for the discharge	Time for watershed coordinator, Meigs SWCD staff, OEPA, and CONSOL to meet and discuss future plans.	Organize a discussion between all parties.	Year 1	Identification of potential impacts to the stream quality and determination of CONSOL's long-term intentions
	Research how elevated TDS concentrations may affect biological communities	Time for watershed coordinator, Meigs SWCD staff, volunteers, and students to organize and conduct research.	Work with local university and high school students to explore these issues.	Years 6-9	

Action Statement 4 of 4
Habitat Preservation

Several tributaries and mainstem segments have high quality habitat features including substrates with large and coarse gravels rather than sand and other fines generally found in the watershed (average substrate score= 13). Stream morphology and channel development is also in good condition. The channel is primarily unmodified and sinuous having riffles and pools of moderate quality (average riffle/run score= 5).

A number of threats could possibly degrade these habitat features (*e.g.* riparian encroachment, stream channel modification, sedimentation from unregulated development and/or forestry activities) so proactive strategies should be established to prevent significant damage from poor land use practices. Target areas to preserve the current habitat conditions should include Grass Run, Parker Run, Malloons Run, and Leading Creek (RM 15.5, RM 14.8, and RM 10.3).

Goals

- Preserve current habitat and substrate conditions and maintain or improve current QHEI scores at all of the target areas.
- Improve public awareness of the functions of healthy riparian areas and the benefits of utilizing erosion and sediment best management practices.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Protect riparian corridor through land purchase or conservation easement	Work with Leading Creek partners and establish a work group to organize a permanent conservation easement program.	Time for watershed coordinator, representatives from Meigs SWCDs, ODNR, OEPA, and NRCS.	Watershed coordinator, staff from Athens and Meigs SWCDs, ODNR, OEPA, and NRCS to research process, procedures, legal and tax ramifications for easements.	Year 1	Creation of the "Leading Creek Conservation Easement Program" with an established set of guidelines.
	Work with Leading Creek partners and landowners to identify, assess, and map the most desirable areas for protection or acquisition.	Time for watershed coordinator, representatives from Meigs SWCDs, ODNR, OEPA, and NRCS to assess. $1,000 to produce GIS maps of the target areas.	Watershed coordinator, SWCD staff and volunteers will assess the quality of the riparian corridor along the mainstem (RM 15.5 to 10.3), Grass Run, Parker Run, Malloons Run.	Years 1-2	The high quality riparian corridors along the mainstem and major tributaries are permanently protected through land purchase or conservation easement.

Educate public about the functions of riparian corridors and ways to minimize upland erosion caused by construction, logging, and housing development.	Conduct an educational workshop to provide technical assistance about erosion and sediment best management practices.	Time for "presenters" such as the watershed coordinator, representatives from Athens and Meigs SWCDs, ODNR, OEPA, and NRCS.	Facilitate a one-day workshop for developers, landowners, elected officials and other interested stakeholders to inform them of BMP's, laws and regulations, and the water quality impacts associated with floodplain development.	Year 2	Increased use of best management practices by developers and loggers.
	Work with NRCS media campaign to promote incentive programs, targeting landowners who live adjacent to the stream.	Time for Watershed Coordinator, SWCD staff, and district conservationist to visit landowners.	Watershed Coordinator, SWCD staff, district conservationist and volunteers to visit landowners and inform them of financial and ecological benefits of riparian buffers. Sign up willing landowners for CRP, Clean Ohio Fund and EQIP cost share programs.	Years 2-4	Increased number of landowners enrolled in CRP, Clean Ohio Fund and EQIP cost share programs.

Summary Timeframe for Proposed Activities

Subwatershed 05030202-090 040

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Sedimentation										
Help coordinate reclamation project	▬	▬								
Develop monitoring plan	▬									
Conduct sediment sampling			▬	▬						
Nutrient Enrichment/ Pathogens										
Write HSTS Plan	▬									
Conduct fecal coliform sampling	▬									
Identify failing systems			▬	▬	▬	▬				
Replace/ upgrade systems			▬	▬	▬	▬	▬	▬	▬	▬
Educational workshop		▬								
Create media campaign			▬	▬	▬	▬	▬	▬	▬	▬
Visit landowners		▬	▬	▬						
Conduct nutrient sampling	▬									
Salinity/TDS/Chlorides										
Determine intentions for the Mine discharge	▬									
Research the effects of TDS						▬	▬	▬	▬	
Habitat Preservation										
Create easement program	▬									
Define target areas	▬	▬								
Educational workshop		▬								
Visit landowners		▬	▬	▬						

Sub-watershed- 05030202-090 050
Little Leading Creek

Background

Evaluations by Ohio EPA found that fish communities in Little Leading Creek did not achieve the ecoregional biocriteria during any of their four surveys. While the surveys produced a "fair" assemblage of fish, the MIwb scores ranged from 4.3 to 5.5 and were rated as "poor" to "very poor" indicating the biomass of the fish was very small. The low fish biomass is most likely a result of altered trophic dynamics caused by the sedimentation (*i.e.* sedimentation eliminates certain food organisms, reduces primary production of aquatic plants, and secondary production of macroinvertebrates). In its 2000 Water Resource Report (305(b)), Ohio EPA reports that sedimentation and "other habitat alterations" limit the biota and are the major causes of impairment in this sub-watershed.

Chemical Integrity

Summary of water chemistry for the Subwatershed (05030202-090 050)

Site Location	Percentage of Samples exceeding Ohio EPA Water Quality Standard				
	Ammonia*	Nitrate**	Phosphorus**	pH*	Aluminum§
L. Leading Creek, RM 0.1	0%	25%	0%	0%	0%

* Ohio EPA water quality standard for Ohio River Basin, outside mixing zone is 2.2 mg/L for ammonia concentrations and 6.5 to 7.5 for pH

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles) and 0.47 for nitrate at wading sites (drainage area >20.0 square miles). The potential phosphorus standard for the WAP ecoregion is 0.05 mg/L at headwater sites (drainage area <20.0 square miles) and 0.06 for phosphorus at wading sites (drainage area >20.0 square miles).

*** Note that only one sample has been taken at the site

§ Target of 0.50 mg/L was set by the Leading Creek Watershed based on the median water quality concentration at WAP reference sites meeting partial and full attainment of WWH.

N/A= Data was not taken and/or is not available

Biological Integrity

Summary of biological performance for the Subwatershed (05030202-090 050)

Site Location	Attainment Status	Macroinvertebrate Taxa Diversity *	Percentage EPT taxa
L. Leading Creek, RM 0.4	(Non-attainment)	N/A	N/A
L. Leading Creek, RM 0.4	(Non-attainment)	N/A	N/A
L. Leading Creek, RM 0.4	(Non-attainment)	N/A	N/A
L. Leading Creek, RM 0.4	(Non-attainment)	N/A	N/A
L. Leading Creek, RM 0.1	(Non-attainment)	21	32%
L. Leading Creek, RM 0.1	(Non-attainment)	N/A	N/A

* total number of different macroinvertebrate taxa collected

N/A= Data was not taken and/or is not available

Physical Integrity

Summary of habitat conditions for the Subwatershed (05030202-090 050)

Site Location	Average QHEI score	Rip. Buffer Present (miles)	Rip. Buffer Needed (miles)	Livestock Access
L. Leading Creek	47	7.9	3.8	yes

Problem 1 of 4
Sedimentation

Little Leading Creek has extremely poor substrate conditions as indicated by the low QHEI substrate score, 8.0, and by the degree of sediment present, an average of 1.4 feet of sand (*i.e.* particles < 2 mm). Ohio EPA reports that the excessive sedimentation/siltation is due to abandoned coal mines and from “pasturing”. Pasturelands that are overgrazed and poorly managed contribute an estimated 19,273 tons/year of total sediment to the system. Reclamation of abandoned mine lands has taken place in the watershed, but a detailed study of the amount of sediment coming from the reclaimed lands and abandoned mine lands has not been conducted.

Goals

- Decrease sedimentation from known sources (*i.e.* pastureland erosion, gob piles, and barren mine lands) by 50%.
- Increase average QHEI substrate scores to 13 in Little Leading Creek.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Identify and prioritize the known sources (pasturelands, barren surface mines) of sediment.	Work with MRM and OU Department of Engineering to identify and quantify amount of sediment produced by abandoned minelands.	$54,000 from OEPA/SOCCO Meigs Mine #31 settlement	Help with the timely progression of the project and with coordination as needed.	Years 1-2	Identification and prioritization of specific sites that are contributing sediment
	Provide technical and financial assistance to landowners interested in improving pastureland quality.	Time for Watershed Coordinator, SWCD staff, and district conservationist to visit landowners. Total cost is approximately $309,100 for applying lime and fertilizer to 2,810 acres @ $115/per acre ($75/acre for lime and $40/acre for fertilizer).	Seek funding from grants (see Appendix E for potential grants) to cost share practices that will increase pastureland cover and fertility.	Years 3-5	Number of acres of pastureland being more properly managed. Pasturelands delivering 50 percent less sediment to Little Leading Creek.

Problem Statement 2 of 4

Nutrient Enrichment/Pathogens

Approximately 60 percent of the on-site sewage treatment systems in this sub-watershed are failing. Based on an average of three bedrooms per household, the estimated 298 failing systems in this area create an effluent of 107,280 gallons/day. Target areas for organic enrichment include Harrisonville and organic wastes from livestock operations along Little Leading Creek.

Goals

- Work with Meigs Health Department to increase the number of properly working home sewage systems by 20 percent in this sub-watershed.
- Work with Meigs Soil and Water Conservation District and Natural Resource Conservation Service to install practices at farming operations on Little Leading Creek and reduce fecal coliform counts to meet Ohio EPA.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Decrease the number of failing home sewage treatment systems by 20 % and reduce the level of fecal coliform to below Ohio EPA standards.	Work with Meigs County Health Departments to write the County Wide HSTS Plan.	Time for staff of Meigs SWCD and Meigs Health Department to write HSTS Plan.	Writing HSTS Plan will identify problem areas in the watershed and provide guidelines to those upgrading or repairing systems. In addition, the Health Department will establish operation and maintenance protocol for homeowners with HSTS.	Year 1	Completion of the HSTS inventory including the identification of households with straight pipes or failing systems.
	Work with Meigs County Health Departments to conduct fecal coliform sampling, which will help identify specific target areas and provide baseline data to compare to future results.	Time for staff of Meigs SWCD and Meigs Health Department to conduct water quality monitoring.	Watershed coordinator, Meigs SWCD staff, Meigs Health Department staff, and volunteers will conduct sampling throughout watershed targeting areas downstream of potential problem areas. Technical assistance provided by ODNR & OEPA.	Year 1	Database of water quality sampling results with report of potentially impacted areas.

	Work with Meigs County Health Departments to determine households with failing systems.	Health Department Inspectors time to inspect systems.	Health Department will inspect the approximately 298 failing systems in the subwatershed as time allows.	Years 3-6	Identification of the failing on-site systems with addresses generated.
	Work with Meigs County Health Departments to replace/upgrade 60 failing systems within the next 10 years.	Apply for approximately $480,000 in funds to repair 60 systems at $8,000 a system.	Seek funding from grants (see Appendix E for potential grants) and DEFA low interest loan program to cost share on-site HSTS repair, replacement or pumping.	Years 3-10	Improved operations of 60 septic systems within 10 years and decreased fecal coliform levels to below 2000counts/ 100mL in Leading Creek and its tributaries.
Educate public about the adverse human health and ecological effects of untreated sewage and provide information about how to maintain a properly functioning system	Conduct a HSTS operation and maintenance workshop for homeowners, real estate agents, and developers.	Time for "presenters" such as the watershed coordinator, representatives from Athens and Meigs SWCDs and HDs, ODNR, and OEPA. $100 in printing posters and fliers to advertise events and to produce educational handouts.	Facilitate a one-day workshop for developers, landowners, elected officials and other interested stakeholders to inform them of proper procedures for installation, operation, and maintenance of HSTS.	Year 2	Workshop held and evaluated by participants.
	Create a media campaign to provide information about treatment options, proper maintenance actions, and the adverse effects of untreated sewage.	Potential funding sources: Ohio Environmental Education Fund, Ohio EPA Supplemental Environmental Programs grants, and WAWA grants. $400 in printing and distributing educational handouts.	Watershed coordinator, Meigs SWCD staff, Meigs HD staff, and volunteers will write grants and request funding for educational materials.	Years 3-10	Educational information created and distributed.

Reduce fecal coliform counts to meet Ohio EPA standards and reduce nutrient (nitrogen and phosphorus) concentrations to meet Ohio EPA potential standards.	Work with Meigs SWCD and NRCS to provide information to landowners along Little Leading Creek about cost-share programs for livestock exclusion from waterways.	Time for Watershed Coordinator, SWCD staff, and district conservationist to visit landowners.	Watershed Coordinator, SWCD staff, district conservationist and volunteers to visit landowners and inform them of financial and ecological benefits of livestock exclusion. Sign up willing landowners for CRP, Clean Ohio Fund and EQIP cost share programs.	Years 2-4	Reduced nutrient concentrations with no samples exceeding Ohio EPA's potential standards.

Problem Statement 3 of 4
Litter and Illegal trash dumping

There are many unlicensed and unregulated trash dumps throughout the Leading Creek Watershed. In addition, litter is often thrown along roadsides, in ditches, or directly into creeks where it washes downstream during heavy rains. The primary source of trash in this sub-watershed is from individuals disposing of litter along roadsides and from landowners living near the creek having debris and other trash material in the floodplain where it washes into the water during heavy rains. Target areas include pull-offs and bridges over the creek particularly along County Road 3 and residents along the headwaters in Harrisonville.

Goals

- Reduce the amount of trash in the sub-watershed by targeting pull-offs and bridges along Little Leading Creek, particularly along County Road 3 and along the stream in Harrisonville.
- Improve the communities' awareness of the benefits and functions of clean streams.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Plan community events and recruit volunteers to conduct clean-ups and haul trash	Continue to conduct "Leading Creek Stream Sweep" and target areas along Little Leading Creek.	In-kind services provided by Meigs Recycling & Litter Prevention, US FWS, and Meigs SWCD (*i.e.* trash bags, gloves, dump trucks, and disposal costs)	Watershed coordinator, Meigs SWCD staff and volunteers will request funding for trash disposal from the Leading Creek Improvement Plan funds (i.e. US FWS).	Year 1	• Number of participants involved in clean-up events. • Amount of litter removed from the streams.
Educate public about the negative effects of illegal trash dumping and increase awareness on proper waste disposal and recycling practices.	• Continue to conduct "Leading Creek Stream Sweep" and target areas along Little Leading Creek. • Create a media campaign to increase awareness. Conduct presentations, workshops, and/or distribute informational flyers.	Potential funding sources: Ohio Environmental Education Fund, Ohio EPA Supplemental Environmental Programs grants, and WAWA grants. $200 in printing posters and fliers to advertise events and to produce educational handouts.	Watershed coordinator, Meigs SWCD staff and volunteers will write grants and request funding for educational materials.	Conduct 2 educational programs in Year 1and 2 programs in Year 2.	• Monitor the amount of trash that accumulates at previously cleaned sites. • Creation of a survey to measure public awareness.

Action Statement 4 of 4
Wetland Preservation

Having drained nearly 90 percent of its historic wetlands, Ohio claims the second highest percentage of wetland loss in the nation. Many of the riparian wetlands in the Leading Creek Watershed have also been altered allowing a valuable opportunity for ecosystem preservation at a riparian wetland along Little Leading Creek. There is a freshwater marsh located in the floodplain of Little Leading Creek near RM 4.9. This wetland provides many important functions and has great potential as an educational area because it is located on the Meigs Soil and Water Conservation Farm.

Using the Ohio Rapid Assessment Method (ORAM), the wetland is classified as a category 1 wetland (score= 32). Actions will be taken to preserve and/or enhance the wetland's features so that future ORAM scores will remain comparable to current scores.

Goals

- Preserve and enhance the wetland's features so that future ORAM scores will remain comparable to current scores.
- Provide educational opportunities about the important functions and benefits of wetland ecosystems.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Preserve and enhance the wetland's feature to maintain or improve ORAM current scores.	Research and utilize wetland restoration techniques to improve the hydrological conditions and vegetative communities where appropriate.	Time for watershed coordinator, representatives from Meigs SWCDs, ODNR, OEPA, and NRCS.	Watershed coordinator, staff from Meigs SWCDs, ODNR, OEPA, and NRCS to research techniques.	Year 1	Identification of specific methods to improve wetland quality.
Educate public about the functions and benefits that wetland ecosystems provide.	Create a land lab and/or demonstration area that highlights the importance of wetlands	Time for watershed coordinator and Meigs SWCD staff to organize educational programs. Potential funding sources: Ohio Environmental Education Fund, Ohio EPA Supplemental Environmental Programs grants, and WAWA grants.	Watershed coordinator, Meigs SWCD staff and volunteers will write grants and request funding for educational materials.	Years 1-3	Conduct educational programs to inform public of wetland's benefits.

Summary Timeframe for Proposed Activities

Subwatershed 05030202-090 050

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Sedimentation										
Help coordinate OU's study	■	■								
Pastureland improvement			■	■	■					
Nutrient Enrichment/ Pathogens										
Write HSTS Plan	■									
Conduct fecal coliform sampling	■									
Identify failing systems			■	■	■	■				
Replace/ upgrade systems			■	■	■	■	■	■	■	■
Educational workshop		■								
Create media campaign			■	■	■	■	■	■	■	■
Visit landowners		■	■	■						
Litter and Illegal Trash Dumping										
Community clean-up	■									
Educational programs	■	■								
Wetland Preservation										
Research enhancement practices	■									
Educational programs	■	■	■							

Sub-watershed- 05030202-090 060
Leading Creek below Little Leading Creek to the Ohio River

Background

The fish communities (IBI scores) in this sub-watershed have improved from the damage of the Meigs Mine discharge (*i.e.* they were rated as "very poor" in 1993 and "marginally good" in 2002), but aquatic life still appears to be impaired. Fish assemblages seem to have recovered with IBI scores often obtaining WWH, but fish biomass (MIwb scores) still remains much lower than regional expectations. Since 1995, biological communities have achieved warmwater habitat (WWH) in only 1 of 7 surveys.

Ohio EPA lists sedimentation and pH as high magnitude causes of impairment in this sub-watershed (Ohio EPA, 2000b). The backwater of the Ohio River greatly influences sediment transport along the mainstem in this basin causing "extensive sedimentation" and "overwhelming sediment effects". The sources of sediment are "surface mining operations (mostly abandoned) and upstream forestry practices" (Ohio EPA, 2000b). During low and medium flow, the effects of the Ohio River backwater cause pooling for about 4.0 river miles upstream; whereas, during high flow (*e.g.* the 1997 and 2004 floods) about 12.0 miles of the mainstem can experience backwater effects (Cherry *et al.* 1999).

Despite the poor substrate and riffle/run quality caused by the sedimentation, the stream reaches have good channel morphology (sinuosity and natural channel characteristics) and riparian zones (width and quality).

Chemical Integrity

Summary of water chemistry for the Subwatershed (05030202-090 060)

	Percentage of Samples exceeding Water Quality Standard				
Site Location	Ammonia*	Nitrate**	Phosphorus**	pH*	Aluminum[§]
Titus Run, RM 0.2	0%	11%	8%	50%	100%
Leading Creek, RM 7.2	0%	27%	13%	0%	N/A
Paulins Hill Run, RM 0.3	0%	0%	0%	100%	100%
Leading Creek, RM 3.5	0%	61%	0%	0%	N/A
Leading Creek, RM 1.8	0%	13%	6%	0%	N/A

* Ohio EPA water quality standard for Ohio River Basin, outside mixing zone is 2.2 mg/L for ammonia concentrations and 6.5 to 7.5 for pH

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles) and 0.47 for nitrate at wading sites (drainage area >20.0 square miles). The potential phosphorus standard for the WAP ecoregion is 0.05 mg/L at headwater sites (drainage area <20.0 square miles) and 0.06 for phosphorus at wading sites (drainage area >20.0 square miles).

*** Note that only one sample has been taken at the site

§ Target of 0.50 mg/L was set by the Leading Creek Watershed based on the median water quality concentration at WAP reference sites meeting partial and full attainment of WWH.

N/A= Data was not taken and/or is not available

Biological Integrity

Summary of biological performance for the Subwatershed (05030202-090 060)

Site Location	Attainment Status based on the most recent surveys	Macroinvertebrate Taxa Diversity*	Percentage EPT taxa
Titus Run, RM 0.1	N/A	9	21%
Leading Creek, RM 7.2	(Non-attainment)	19	19%
Paulins Hill Run, RM 0.1	N/A	10	4%
Leading Creek, RM 6.0	Partial	N/A	N/A
Leading Creek, RM 3.5	(Non-attainment)	22	18%
Leading Creek, RM 1.7	(Non-attainment)	13	25%
Leading Creek, RM 0.2	(Non-attainment)	N/A	N/A

N/A= Data was not taken and/or is not available

Physical Integrity

Summary of habitat conditions for the Subwatershed (05030202-090 060)

Site Location	Average QHEI score	Rip. Buffer Present (miles)	Rip. Buffer Needed (miles)	Livestock Access
Leading Creek mainstem	49	8.2	0.4	yes
Titus Run	53	3.0	0.2	yes
Paulins Hill Run	53	0.3	0.2	no

Problem Statement 1 of 2
Sedimentation

Within this sub-watershed, Leading Creek and several of its tributaries have very poor substrate conditions as indicated by the low average substrate score, 8.0. Ohio EPA reports that the excessive sedimentation/siltation is due to abandoned coal mines and from "upstream forestry practices", but a comprehensive evaluation of the sources of the sediment is critical to accurately characterize the sub-watershed. The identified sources of sediment include erosion of the stream channel (RM 4.1), which contributes an estimated 6 tons of sediment/year and erosion of unreclaimed surface mines along Titus Run, which contributes an additional 5,368 tons/year.

Goals

- Decrease sedimentation from known sources (*i.e.* unreclaimed mine lands in Titus Run and excessive bank erosion from unrestricted livestock (RM 4.1) by 50 percent.
- Develop a strategy for identifying and quantifying additional sources that contribute sediment to the creek.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Decrease sedimentation from known sources (pasturelands, barren surface mines) by 50 percent.	Work with MRM to reclaim abandoned minelands in the Titus Run subwatershed.	$267,000 to reclaim approximately 20 acres.	Watershed Coordinator to apply for 319- Non Point Source Pollution Grant, Appalachian Clean Streams Grant and/or Leading Creek Improvement Account to offset reclamation costs.	Years 2-4	• Identification and prioritization of specific sites that are contributing sediment
	Work with Technical Advisory Board to develop the methods needed to identify and prioritize sources of sediment.	Time for watershed coordinator, representatives from Meigs SWCDs, ODNR, OEPA, and NRCS.	Watershed coordinator, staff from Meigs SWCDs, ODNR, OEPA, and NRCS to research the best methods to measure and treat sediment load.	Years 3-4	• Monitoring strategy is developed and instituted.
	Restrict livestock access along high impact areas (RM 3.8).	Use cost share funds to provide livestock exclusion. Total cost is approximately $4,996 for establishing 2,271 feet of fence @ $2.20/lineal feet of 4 strands of barbed wire.	Seek funding from grants to install livestock exclusion fencing on 2,271 feet of streambank with unlimited access.	Years 2-3	• Livestock excluded and eroding sites stablilized. Streambank delivering 50 percent less sediment to Leading Creek.

Problem Statement 2 of 2
Acidity and Metals

The Ohio EPA lists pH as a high magnitude cause of impairment within the sub-watershed. According to the Water Resource Report (305 (b)), the mainstem of Leading Creek (RM 1.5 to the mouth) has limited aquatic life because of acid mine runoff from Thomas Fork.

Within this subwatershed, acid mine drainage affects two major tributaries: Paulins Hill Run and Titus Run. Paulins Run contributes an average of 76.3 lbs/day acid and 18.5 lbs/day total metals. Titus Run contributes an additional 58.3 lbs/day acid and 88.5 lbs/day total metals during low flow. The most common source of acid mine drainage in both Titus Run and Paulins Hill Run is diffuse seepage from strip mine pits and auger holes. In addition, Paulins Hill Run has acid mine drainage that is contributed via subsurface drains installed by Ohio DNR MRM during reclamation.

Goals

- Reduce acidity loading by 13.9 tons/year and the metal loading by 3.4 tons/year in Paulins Run and reduce the acidity loading by 10.6 tons/year and the metal loading by 16.2 tons/year in Titus Run.
- Create water quality conditions in the Leading Creek mainstem, downstream of Thomas Fork, that are suitable for aquatic life.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Construct treatment systems to lessen the effect of AMD in Titus Run and Paulins Hill Run (see AMDAT Plan for list of projects, remediation strategy, cost, and load reductions.)	Construct 4 projects in 8 years to reduce the acidity and metal loading.	$3,000,000 to complete 1 project in Titus Run and $2,000,000 to complete 3 projects in Paulins Hill. (Note costs are subject to change as MRM develops scope of work for AMDAT projects).	Watershed Coordinator to apply for 319- Non Point Source Pollution Grant and/or Appalachian Clean Streams Grant to offset remediation costs.	Years 2-10	Projects constructed and acidity and metal loadings reduced.

Summary Timeframe for Proposed Activities

Subwatershed 05030202-090 060

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Sedimentation										
Help coordinate reclamation project										
Conduct sediment sampling										
Livestock exclusion										
Acidity and Metals										
Construct AMD remedation projects										

Sub-watershed- 05030202-090 070
Thomas Fork

Background

During two biological surveys, Ohio EPA found that the fish communities were severely degraded in Thomas Fork. Virginia Tech biologists collected macroinvertebrates near the confluence of Thomas Fork and Leading Creek. They found extremely low abundances of macroinvertebrates (a total of 16 macros were collected during 2 sampling events) and low diversity of macroinvertebrate taxa with only 4 different taxa collected. In its 2000 Water Resource Report (305(b)), Ohio EPA reports that pH and sedimentation limit the biota and are major causes of impairment in this sub-watershed.

Chemical Integrity

Summary of water chemistry for the Subwatershed (05030202-090 070)

	Percentage of Samples exceeding Water Quality Standard				
Site Location	Ammonia*	Nitrate**	Phosphorus**	pH*	Aluminum§
Thomas Fork, RM 10.1	0%	0%	0%	0%	0%
Wolfpen Run, RM 0.1	0%	0%	0%	0%	N/A
Thomas Fork, RM 5.0	0%	0%	0%	100%	100%
East Branch, RM 0.1	0%	0%	0%	0%	20%
Thomas Fork, RM 1.2	0%	7%	13%	0%	100%

* Ohio EPA water quality standard for Ohio River Basin, outside mixing zone is 2.2 mg/L for ammonia concentrations and 6.5 to 7.5 for pH

** Ohio EPA ***potential*** standard published in *Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams (OEPA, 1999)* for the WAP ecoregion is 0.34 mg/L for nitrate at headwater sites (drainage area <20.0 square miles) and 0.47 for nitrate at wading sites (drainage area >20.0 square miles). The potential phosphorus standard for the WAP ecoregion is 0.05 mg/L at headwater sites (drainage area <20.0 square miles) and 0.06 for phosphorus at wading sites (drainage area >20.0 square miles).

§ Target of 0.50 mg/L was set by the Leading Creek Watershed based on the median water quality concentration at WAP reference sites meeting partial and full attainment of WWH.

N/A= Data was not taken and/or is not available

NOTE: Water sampling was primarily conducted during unusally wet conditions; therefore, the water chemistry concentrations may not be representative of typical conditions.

Biological Integrity

Summary of biological performance for the Subwatershed (05030202-090 070)

Site Location	Attainment Status based on the most recent surveys	Macroinvertebrate Taxa Diversity*	Percentage EPT taxa
Thomas Fork, RM 4.4	(Non-attainment)	N/A	N/A
Thomas Fork, RM 1.2	N/A	4	18%
Thomas Fork, RM 2.8	(Non-attainment)	N/A	N/A

N/A= Data was not taken and/or is not available

Physical Integrity

Summary of habitat conditions for the Subwatershed (05030202-090 070)

Site Location	Average QHEI score	Rip. Buffer Present (miles)	Rip. Buffer Needed (miles)	Livestock Access
Thomas Fork mainstem	50	6.2	5.4	yes
East Branch of Thomas Fork	56	3.4	3.4	yes
Hysell Run	46	1.9	1.5	no
Bailey Run	52	0.8	1.7	no

Problem Statement 1 of 3
Sedimentation

In its 2000 Water Resource Report (305(b)), Ohio EPA reports that Thomas Fork "has a high sediment load from mining activities", and siltation is considered a moderate magnitude cause of impairment in this sub-watershed. While many segments of Thomas Fork are not covered with sand and fine sediments, some reaches have lower substrate scores and embedded stream bottoms. The source of sediment is mostly from abandoned surface mines, which were widespread in the sub-watershed (about 8% of the watershed area was strip mined). Reclamation efforts will focus on Bailey Run, Hysell Run, and "Casto's seep". Barren surface mines in Bailey Run contribute an estimated 976 tons of sediment/ year, mine lands in Hysell Run add an estimated 3904 tons of sediment/ year, and the hillsides surrounding "Casto's seep" contribute an estimated 244 tons of sediment/ year.

Thomas Fork's stream quality is not only affected by sediment deposition, but it may also be affected by sediment toxicity and metal flocculent in the streambed. Because Thomas Fork has periods when it is net alkaline with near neutral pH levels (*i.e.* during medium to high flow), many of the toxic metals may precipitate out into the substrate. During the biological surveys of Thomas Fork, Ohio EPA biologists noted "yellow precipitates cover much of the substrates".

Goals

- Decrease sedimentation from known sources (*i.e.* unreclaimed mine lands in Casto's Seep, Bailey Run, and Hysell Run) by 50 percent.
- Research and monitor the effects of sediment toxicity on aquatic life in Thomas Fork.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Decrease sedimentation from known sources (barren surface mines in Bailey Run, Hysell Run, and Casto's seep) by 50 percent.	Work with MRM to reclaim abandoned minelands in Bailey Run, Hysell Run, and "Casto's seep" subwatershed.	$798,000 to reclaim 42 acres @ $19,000/acre	Watershed Coordinator to apply for 319- Non Point Source Pollution Grant and/or Appalachian Clean Streams Grant to offset reclamation costs.	Years 2-6	Identification and prioritization of specific sites that are contributing sediment
	Work with Technical Advisory Board to develop the methods needed to identify and prioritize sources of sediment.	Time for watershed coordinator, representatives from Meigs SWCDs, ODNR, OEPA, and NRCS.	Watershed coordinator, staff from Meigs SWCDs, ODNR, OEPA, and NRCS to research the best methods to measure and treat sediment load.	Years 3-4	Monitoring strategy is developed and instituted.

Work with OU, OEPA, and MRM to research the effects of sediment toxicity on the aquatic life.	Collect sediment samples and analyze metals present in sediments (target areas downstream of discharges)	Time for watershed coordinator, Meigs SWCD staff, volunteers, and students to organize and conduct research.	Work with local university and high school students to explore these issues.	Years 5-8	Identification of the potential effects of sediment toxicity on the biological communities.

Problem Statement 2 of 3
Acidity and Metals

Surface and subsurface mining has occurred throughout the Thomas Fork basin leaving a severely degraded landscape and widespread impacts of acid mine drainage. According to the Ohio EPA 305(b) report, "Thomas Fork is severely impaired by acid mine drainage", and pH is considered a high magnitude cause of impairment. The major tributaries of concern are the unnamed tributary on Bailey Run Road which contributes 843.8 lbs/day acid and 224.8 lbs/day total metals, Kinzel's seep contributing 332.4 lbs/day acid and 80.7 lbs/day total metals, Casto's seep adding 290.2 lbs/day acid and 59.2 lbs/day total metals, Bailey Run with 352.9 lbs/day acid and 78.6 lbs/day total metals, and Hysell Run contributing 106.2 lbs/day acid and 62.8 lbs/day total metals. (Note: A detailed description of each is presented in the Leading Creek AMDAT plan.)

Goals

- Reduce the acidity loading by 351.4 tons/year and the metal loading by 506.1 tons/year within the major tributaries of concern in the Thomas Fork basin.
- Reduce the effects of acid mine drainage in the following high priority areas: the unnamed tributary on Bailey Run Road, Kinzel's seep, Casto's seep, Bailey Run, and Hysell Run.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Construct treatment systems to lessen the effect of AMD in Thomas Fork (see AMDAT Plan for list of projects, remediation strategy, cost, and load reductions.)	Construct 5 projects in 10 years to reduce the acidity and metal loading.	$5,000,000 to complete 5 projects in Thomas Fork.	Watershed Coordinator to apply for 319- Non Point Source Pollution Grant and/or Appalachian Clean Streams Grant to offset remediation costs.	Years 1-10	Projects constructed and acidity and metal concentrations meeting targets.

Problem Statement 3 of 3
Nutrient Enrichment/Pathogens

The county health department estimates 60 percent of the on-site sewage treatment systems in this sub-watershed are failing. Based on an average of four persons per household, the estimated 471 systems in this area contribute a potential effluent of 169,560 gallons/day. Target areas for organic enrichment include Thomas Fork, Hysell Run, and Bailey Run.

Goals

- Monitor the level of fecal coliform in Thomas Fork and its tributaries.
- Work with Meigs Health Department to increase the number of properly working home sewage systems by 20 percent in this sub-watershed.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Decrease the number of failing home sewage treatment systems by 20 % and reduce the level of fecal coliform to below Ohio EPA standards.	Work with Meigs County Health Departments to write the County Wide HSTS Plan.	Time for staff of Meigs SWCD and Meigs Health Department to write HSTS Plan.	Writing HSTS Plan will identify problem areas in the watershed and provide guidelines to those upgrading or repairing systems. In addition, the Health Department will establish operation and maintenance protocol for homeowners with HSTS.	Year 1	Completion of the HSTS inventory including the identification of households with straight pipes or failing systems.
	Work with Meigs County Health Departments to conduct fecal coliform sampling, which will help identify specific target areas and provide baseline data to compare to future results.	Time for staff of Meigs SWCD and Meigs Health Department to conduct water quality monitoring.	Watershed coordinator, Meigs SWCD staff, Meigs Health Department staff, and volunteers will conduct sampling throughout watershed targeting areas downstream of potential problem areas. Technical assistance provided by ODNR & OEPA.	Year 1	Database of water quality sampling results with report of potentially impacted areas.
	Work with Meigs County Health Departments to determine households with failing systems.	Health Department Inspectors time to inspect systems.	Health Department will inspect the approximately 471 failing systems in the subwatershed as time allows.	Years 3-6	Identification of the failing on-site systems with addresses generated.

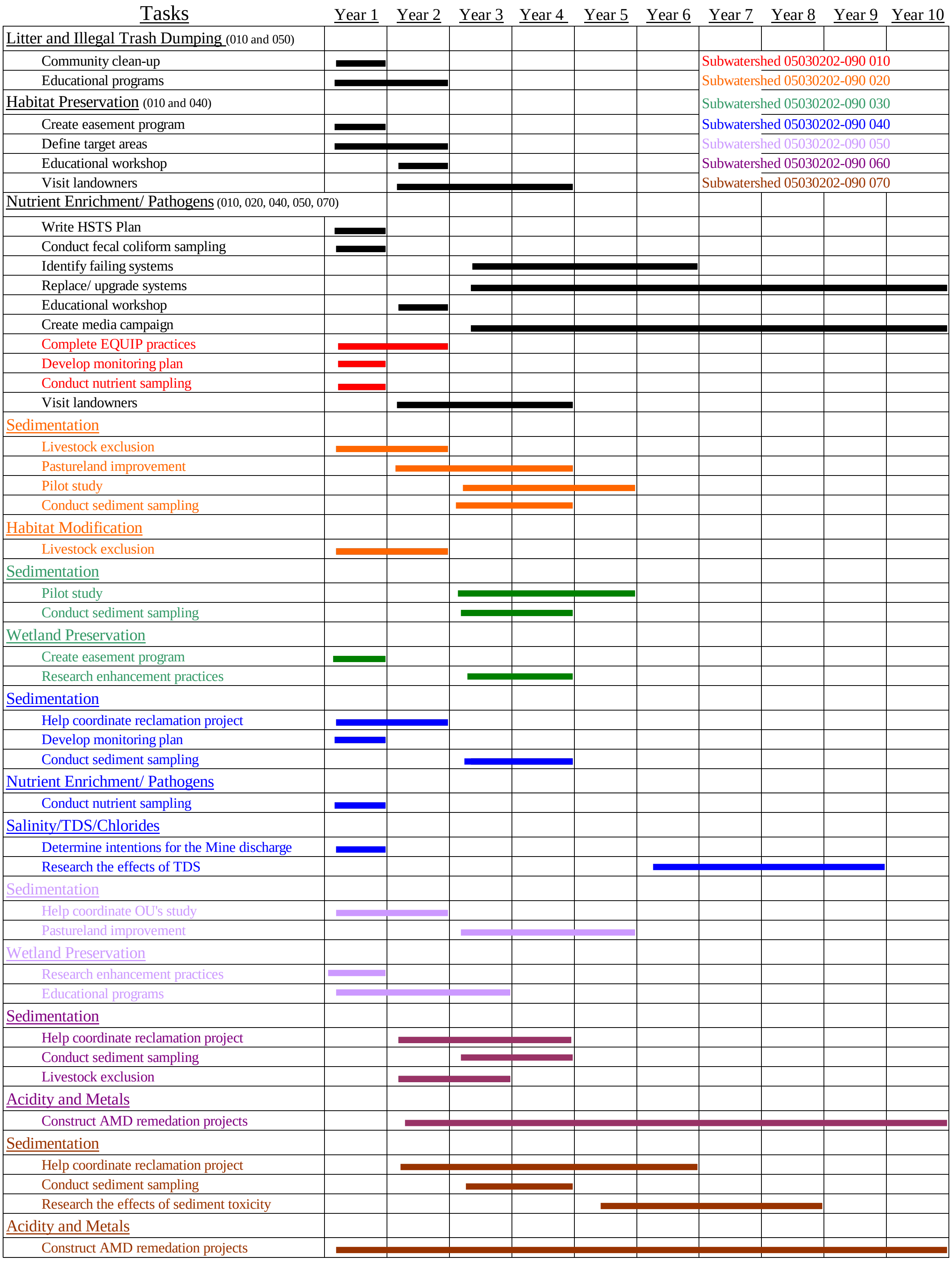
	Work with Meigs County Health Departments to replace/upgrade 94 failing systems within the next 10 years.	Apply for approximately $752,000 in funds to repair 94 systems at $8,000 a system.	Seek funding from grants (see Appendix E for potential grants) and DEFA low interest loan program to cost share on-site HSTS repair, replacement or pumping.	Years 3-10	Improved operations of 94 septic systems within 10 years and decreased fecal coliform levels to below 2000counts/ 100mL in Leading Creek and its tributaries.
Educate public about the adverse human health and ecological effects of untreated sewage and provide information about how to maintain a properly functioning system	Conduct a HSTS operation and maintenance workshop for homeowners, real estate agents, and developers.	Time for "presenters" such as the watershed coordinator, representatives from Athens and Meigs SWCDs and HDs, ODNR, and OEPA. $100 in printing posters and fliers to advertise events and to produce educational handouts.	Facilitate a one-day workshop for developers, landowners, elected officials and other interested stakeholders to inform them of proper procedures for installation, operation, and maintenance of HSTS.	Year 2	Workshop held and evaluated by participants.
	Create a media campaign to provide information about treatment options, proper maintenance actions, and the adverse effects of untreated sewage.	Potential funding sources: Ohio Environmental Education Fund, Ohio EPA Supplemental Environmental Programs grants, and WAWA grants. $400 in printing and distributing educational handouts.	Watershed coordinator, Meigs SWCD staff, Meigs HD staff, and volunteers will write grants and request funding for educational materials.	Years 3-10	Educational information created and distributed.
Reduce fecal coliform counts to meet Ohio EPA standards and reduce nutrient (nitrogen and phosphorus) concentrations to meet Ohio EPA potential standards.	Work with Meigs SWCD and NRCS to provide information to landowners along Thomas Fork about cost-share programs for livestock exclusion from waterways.	Time for Watershed Coordinator, SWCD staff, and district conservationist to visit landowners.	Watershed Coordinator, SWCD staff, district conservationist and volunteers to visit landowners and inform them of financial and ecological benefits of livestock exclusion. Sign up willing landowners for CRP, Clean Ohio Fund and EQIP cost share programs.	Years 2-4	Reduced nutrient concentrations with no samples exceeding Ohio EPA's potential standards.

Summary Timeframe for Proposed Activities

Subwatershed 05030202-090 070

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Sedimentation										
Help coordinate reclamation project										
Conduct sediment sampling										
Research the effects of sediment toxicity										
Acidity and Metals										
Construct AMD remedation projects										
Nutrient Enrichment/ Pathogens										
Write HSTS Plan										
Conduct fecal coliform sampling										
Identify failing systems										
Replace/ upgrade systems										
Educational workshop										
Create media campaign										
Visit landowners										

Summary Timeframe for All Proposed Activities



Chapter 6
Implementation, Evaluation, and Plan Revision

Implementation and Evaluation

The first step to implementing the activities detailed in this plan is to secure funding. Funds from the Leading Creek Improvement Account can be used when the activities listed in this plan correspond to projects described in the Leading Creek Improvement Plan (Cherry *et al.* 1999; Table 6-1). Additional sources of funding that can be used to assist in watershed restoration have been compiled by ILGARD staff and students and are listed in Appendix E.

TABLE 6-1. Projects suggested in the Leading Creek Management Plan (LCMP) and the Leading Creek Improvement Plan (LCIP) (Cherry *et al.* 1999)

Stream name	Cause of Impairment	LCMP page number	LCIP page number
The east branch of the headwaters	Nutrient enrichment/ Pathogens	130	15-15
The west branch of the headwaters	Nutrient enrichment/ Pathogens	130	15-15
Fivemile Run	Nutrient enrichment/ Pathogens	130	15-15
Sisson Run	Habitat modification/Nutrient enrichment	137-140	15-15
Sharps Run	Habitat modification/Nutrient enrichment	137-140	15-16
Mud Fork	Sedimentation	144-145	15-14
Lasher Run	Sedimentation	148	15-14
Little Leading Creek	Sedimentation/Nutrient enrichment	158-159	15-11 to 15-13
Titus Run	Sedimentation/Acid mine drainage	167-168	15-13
Paulins Hill Run	Sedimentation/Acid mine drainage	167-168	15-13

Evaluating the progress of the plan is an important component of the planning process. The Leading Creek Improvement Committee (LCIC) and the Meigs Soil and Water Conservation District (SWCD) Board of Supervisors should continually oversee the direction of implementation activities. The Leading Creek Improvement Committee should provide resources and technical advice about the best implementation strategies and should review whether the goals and priorities listed in the plan remain appropriate. The Meigs SWCD Board of Supervisors and Meigs SWCD Program Administrator have the administrative responsibility to insure that the watershed coordinator is fulfilling his/her duties. During the coordinator’s annual job performance evaluation, the Board and Program Administrator should evaluate the progress being made to accomplish the activities outlined in the plan. The Board of Supervisors should seek the advice of the LCIC if the expected performance and success of projects is not being met.

Citizens, stakeholders, and focus groups should review this document on an annual basis to suggest necessary revisions and evaluate the progress made toward the goals. The public’s suggestions should be discussed with the LCIC to determine if they are appropriate to include in the plan. In addition, these annual meetings will provide a way to publicize the progress of the plan to local officials and the public.

Project Prioritization (from planning to actions)

While all the proposed practices and projects described in this plan are considered important, some activities are thought to be of higher priority and should be given precedence. Many projects in this plan correspond to activities described in the Leading Creek Improvement Plan (see Table 6-1 above). Because funding for these projects is already established, proposals can be submitted to the Leading Creek Improvement Committee and US Fish and Wildlife Service as soon as possible.

Additional monitoring (water quality and sediment) is needed in several areas to better characterize stream conditions and should be conducted before projects are implemented in those areas. It should also be a priority to develop monitoring plans for current and pending projects so that improvements in water quality and biological condition will be recognized. The proposed timeframe listed in Chapter 5 should serve as an overall guide for the prioritization of remediation activities within each sub-watershed. Each of the sub-watersheds was categorized based on a number of factors and subsequently ranked by their overall potential for restoration (Table 6-2 and Appendix F). NOTE: The ranking should serve as a general guide and should be updated as additional information becomes available.

TABLE 6-2. Ranking of future restoration efforts in the watershed.

Priority	
1	Preserve riparian habitat in subwatersheds 010 and 040
2	Seek funding from the LCIA to implement practices in the following subwatersheds: 020 (Sharps Run and Sisson Run) 060 (Titus Run and Paulins Hill Run)
2	Implement projects in Thomas Fork (excluding those related to HSTS)
3	Develop a pilot study of the sediment and apply the results to the following tributaries: 020 (Sisson Run and Ogden Run) 030 (Mud Fork) 040 (Lasher Run)
4	Apply the results of Ohio University's Little Leading Creek sediment transport study and implement other suggested practices
5	Implement projects directed toward reducing pathogen impairments and improving non-aquatic use designations.

Future Monitoring

Monitoring the chemical, biological, and physical integrity of the streams is necessary in order to evaluate the overall success of implementation. Specific monitoring plans that are needed for current projects are detailed in the Sub-Watershed Impairments and Action Strategies section (Chapter 5). The following is a general strategy for evaluating the success of implementation.

Pre-construction monitoring

When funding has been secured for restoration of a priority site, the site will receive intensive, short-term sampling to assist in the modeling and design of a suitable treatment. Each site selected for treatment should receive monthly or bimonthly sampling for six months capturing high and low flows before entering a design phase.

Post-construction monitoring

The performance of the projects will be monitored monthly or bimonthly for one year following remediation. Parameters of interest (*i.e.* ODNR Group I parameters, ammonia, nitrate, nitrite, total phosphorus) will be monitored downstream of treatment sites in order to assess the effectiveness of the treatment system.

Long-term watershed monitoring

Long-term monitoring (LTM) data will be used to determine how water quality is changing over time (*i.e.* tracking trends in "baseline" conditions) and to evaluate the effectiveness of specific treatment and abatement projects. Long-term monitoring sites have been strategically located downstream of treatment sites and/or at the confluences with major tributaries where we anticipate improvements in biological condition and metal, acidity, and/or nutrient loadings.

Biological communities should be monitored every 3 to 5 years to evaluate the overall goal of attaining the aquatic life use designation, warmwater habitat. Water chemistry (Group I parameters and nutrient concentrations) and discharge will be sampled semi-annually at the LTM sites located throughout the restoration area.

Suggested locations of long-term monitoring sites

Site ID	River Mile	Sampling Justification	Target Parameters
LC0090	29.9	Monitor trends in reference conditions	Nutrients, AMD, QHEI
FR0040	1.8	Monitor improvements in Fivemile Run	Nutrients, Pathogens, QHEI
LC0080	26.0	Monitor improvements in the mainstem downstream of Carpenter	Nutrients, Pathogens, QHEI
SIR0005	0.1	Monitor improvements in Sisson Run	Nutrients, Pathogens, QHEI
LC0060	21.1	Monitor improvements in the mainstem downstream of Dyesville	Nutrients, Pathogens, QHEI
DR0005	0.8	Monitor improvements in Dexter Run	Nutrients, Pathogens, QHEI
LC0045	17.4	Monitor improvements in the mainstem downstream of Dexter	Nutrients, Pathogens, QHEI
MR0003	0.1	Monitor trends in reference conditions at Malloons Run	Nutrients, AMD, QHEI
LC0030	10.3	Monitor trends in reference conditions (upstream of AML)	Nutrients, AMD, Pathogens, QHEI
LL0060	9.4	Monitor improvements in Little Leading Creek downstream of Harrisonville	Nutrients, Pathogens, QHEI
LL0002	0.4	Monitor improvements near the mouth of Little Leading Creek	Nutrients, AMD, Pathogens, QHEI
PH0002	0.3	Monitor improvements near the mouth of Paulins Run	AMD, QHEI
TR0003	0.2	Monitor improvements near the mouth of Titus Run	AMD, QHEI
TF0010	1.2	Monitor improvements near the mouth of Thomas Fork	AMD, Pathogens, QHEI

Nutrients = Ammonia, Nitrate, Nitrite, and Total Phosphorus

Pathogens = Fecal coliform

AMD = ODNR Group I parameters

Additional monitoring and low priority sites

Some sites that exhibited mild characteristics of AMD and/or nutrient enrichment in the initial screening should be periodically sampled to ensure that the contamination is not more significant than originally estimated. The low priority sites should be monitored annually for field parameters including pH, acidity, conductivity, ammonia, total phosphorus, nitrate and nitrite. This data will serve to detect any changes in water chemistry that may undermine restoration efforts in the watershed.

In addition, more thorough investigations of certain sites may be helpful to accurately characterize the watershed. As mentioned in the text, fecal coliform levels in many streams were low despite evidence that contamination is likely (direct pipes to creek, black organic sludge from houses, and distinctive smell); therefore, future monitoring of these sites should be conducted.

Additional monitoring sites

Site Name	Target Parameters
The east branch of the headwaters	Nutrients, QHEI
The west branch of the headwaters	Nutrients, QHEI
Parker Run subwatershed	Nutrients, QHEI
Little Leading Creek subwatershed	Nutrients, AMD, Pathogens, QHEI
Lasher Run subwatershed	Nutrients, AMD, Pathogens, QHEI
Bailey Run	Pathogens
Hysell Run	Pathogens
East Branch of Thomas Fork	Pathogens

Plan Update and Revision

The Leading Creek Watershed Management Plan is a document that is intended to be updated and revised as new data is collected and practices are implemented. The plan will be reevaluated on an annual basis and all necessary revisions will be made by the watershed coordinator at the Meigs Soil and Water Conservation District. Additional information such as the biological monitoring conducted by Midwest Biodiversity Institute (scheduled for completion in Summer 2005) and the study of the sediment transport conducted by Ohio University Department of Engineering (scheduled for completion in Winter 2007) should be included in the plan as they become available. In addition, target areas should be reassessed as TMDL information becomes available in 2009.

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APPENDIX A.

MEMORANDUM OF UNDERSTANDING
between the
U.S. Fish and Wildlife Service
and the
Meigs Soil and Water Conservation District

For their cooperation in the restoration of the LCW

The Memorandum of Understanding (MOU) is entered into by and between the U.S. Fish and Wildlife Service (Service) and the Meigs Soil and Water Conservation District {District).

The Service enters into this agreement under provisions of the Fish and Wildlife Coordination Act (16 USC 661-666c).

The District authority to enter into this MOU is located in Chapter 1515 of the Ohio Revised Code.

STATEMENT OF PURPOSE
The purpose of the MOU is to guide the decision making process for selection and implementation of enhancement projects in the Leading Creek Watershed (LCW).

BACKGROUND
In July 1993, a catastrophic mine flooding event at a Southern Ohio Coal Company (hereafter, "SOCCO") mine resulted in the emergency release of a substantial volume of untreated, and partially treated, mine water into Parker Run and Leading Creek for 28 days. The environmental impact was substantial. Negotiations between SOCCO and the US Department of Justice resulted in the development of the Leading Creek Improvement Plan (LCIP) for the restoration and enhancement of water quality in the LCW. The LCIP was developed pursuant to a Federal court approved Consent Decree (Department of Justice file No. 90-5-1-1-5033, United States of America v. Southern Ohio Coal Company, U.S. District Court for the Southern District of Ohio, Eastern Division).

The Consent Decree, paragraph 51, includes the following language:

"The United States has determined that implementation of any enhancement projects identified in the LCIP would best be accomplished through a continued state/federal cooperative effort. The Service will endeavor to develop with the appropriate federal and state agencies a memorandum of understanding that will guide the decision-making process for selection and implementation of enhancement projects pursuant to this Section."

It is recognized that the Service and the District have unique skills and technical expertise which, when combined, would greatly facilitate the implementation of projects found in the LCIP. Therefore. the Service and the District have developed this MOU in order to inform and facilitate the decision making process

IT IS UNDERSTOOD THAT:
Both parties are independent, have their respective responsibilities, yet recognize the need to coordinate as a federal, state and local partnership for the successful restoration of the LCW.

The Service agrees to:

1. Work cooperatively with the District in the development and implementation of the restoration projects.
2. Agree to meet periodically with the District and other technical experts as appropriate to review and discuss projects necessary for the implementation of the LCIP.
3. Seek additional technical expertise as required as to the feasibility and appropriateness of enhancement projects.
4. Review proposed projects and provide approval/disapproval notification in writing with justification of decision within fifteen days of the periodic meeting.
5. Enter into agreements for support of the implementation projects.

The District agrees to:

1. Provide technical support on the feasibility and appropriateness of proposed projects.
2. Provide the Service with a description of proposed LCIP projects as described in the Cooperative Agreement 3018131012 at least seven days prior to the periodic meetings with the Service.
3. Provide leadership at the local level in developing projects appropriate for achieving the goals of the LCIP.
4. Provide leadership in developing good working relationships with local citizens, organizations and agencies.
5. Provide educational outreach in order to promote conservation of natural resources and enhance water quality in the LCW.
6. Maintain required records pertaining to projects that implement the LCIP .
7. 7. Provide support for the LCIP Watershed Coordinator to include office and meeting space.
8. Provide contracting services for LCIP projects.

We mutually agree to:

1. Give priority to projects found in Chapter 15 of the LCIP or other projects which can achieve significant improvement to water quality in the LCW.

2. To promote the sustainability of water quality improvement efforts in the LCW.

3. To promote sustainable relationships between the Service, the District and local Stakeholders for the purpose of achieving warm water habitat designation in the LCW.

This MOU in no way restricts the parties of this MOU from participating in similar activities with other public or private agencies, organizations, and individuals.

This MOU will become effective on the last date shown below. This instrument expires five years from the date of signing, at which time it can be renewed by mutual consent. This MOU may be terminated by one party by giving 60 days written notice to the other party.

The signatories will be in compliance with the nondiscrimination provisions contained in Titles VI and VII of the Civil Rights Act of 1964, as amended, the Civil Rights Restoration Act of 1987 (Public Law 100-259) and other nondiscrimination statues, namely Section 504 of the Rehabilitation Act of 1973, Title IX of the Education Amendments of 1972, the Age Discrimination Act of 1975, Americans with Disabilities Act of 1990, and in accordance with regulations of the Secretary of Agriculture (7CFR 15 Subparts A and B.) These provide that no person in the United State shall, on the grounds of race, color, national origin, age, gender, religion, marital status, or disability be excluded from participation in, be denied the benefits of, or be otherwise subject to discrimination under any program or activity receiving Federal financial assistance from the Department of Agriculture or any Agency thereof.

This MOU is neither a fiscal nor a funds obligation document. Any endeavor between the parties which is not expressly provided for by the terms of this MOU, will be outlined in a separate agreement that shall be made in writing by representatives of the parties, and shall be independently authorized by appropriate statutory authority.

APPENDIX B: Landowner contact information for priority tributaries

Landowners' contact information within each subwatershed

Site Name	Site ID	Name	Address	Phone
Unnamed tributary on	TF1502	Andy Grover	34150 Bailey Run Rd, Pomeroy, Ohio 45769	740-992-3010
Bailey Run Road		Ronald and Brenda Arms	34231 Bailey Run Rd, Pomeroy, Ohio 45769	740-992-5520
		Greg and Linda Grover	34215 Bailey Run Rd, Pomeroy, Ohio 45769	740-992-0632
		Robert and Esther Venoy	34284 Bailey Run Rd, Pomeroy, Ohio 45769	740-992-5422
		Lewis and Virginia Humphrey	39220 SR 143, Pomeroy, Ohio 45769	740-992-3508
Bailey Run	TF0402			
Hollow 4		Facemyer Lumnber Co.	31940 Bailey Run, Pomeroy, Ohio 45769	740-992-5965
		Virgil Parsons	37670 SR 124, Pomeroy, Ohio 45769	740-992-5626
Hollow 2		Facemyer & Salmons	Box 227, Midleport, Ohio 45760	not available
		Virgil Parsons	37670 SR 124, Pomeroy, Ohio 45769	740-992-5626
Tobin's		Robert and Sheri Tobin	32425 Bailey Run Rd, Pomeroy, Ohio 45769	740-992-3117
		Harold & Penny Brinker	32714 Bailey Run Rd, Pomeroy, Ohio 45769	740-992-6305
Kinzel's seep	TF1202	Boyd & Audry Kinzel	39483 SR 143, Pomeroy, Ohio 45769	not available
		Lydia & Thompson DeLong	39721 DeLong Rd, Pomeroy, Ohio 45769	740-992-5890
Casto's seep	TF1102	Marie Myra Wears	39649 SR 143, Pomeroy, Ohio 45769	not available
		Mildred Humphry	39711 SR143, Pomeroy, Ohio 45769	740-992-3859
		James & Melinda McClain	39641 SR 143, Pomeroy, Ohio 45769	740-992-7722 or
				740-992-2580
Hysell Run	TF0302			
Hollow 13		Brian & Jacqueline Justice	33841 Hysell Run Rd, Pomeroy, Ohio 45769	740-992-2927
		Alma Peterson	33845 Burney Hollow Rd, Rutland, Ohio 45775	740-742-2918
		James Fenton Taylor	34111 Hysell Run Rd, Pomeroy, Ohio 45769	not available
		Larry and Rita Ball	31491 Noble Summit, Middleport, Ohio 45760 (or)	740-992-0662
			29553 Sanford Davis Rd, Langsville, Ohio 45741	
Hollow 11		Alma Peterson	33845 Burney Hollow Rd, Rutland, Ohio 45775	740-742-2918
		Larry and Rita Ball	31491 Noble Summit, Middleport, Ohio 45760 (or)	740-992-0662
			29553 Sanford Davis Rd, Langsville, Ohio 45741	
		Betty Williams	33561 Hysell Run Rd, Pomeroy, Ohio 45769	740-992-7821
Hollow 8		Dwaine & Sonia Allen	33277 Hysell Run Rd, Pomeroy, Ohio 45769	740-992-5275
		John & Amanda Clonch	33425 Hysell Run Rd, Pomeroy, Ohio 45769	740-992-1009
		Thomas Myers	31471 SR 325, Langsville, Ohio 45741	740-742-2153
Hollow 6		Thomas Myers	31471 SR 325, Langsville, Ohio 45741	740-742-2153
		Timmy Hood	33011 Hysell Run Rd, Pomeroy, Ohio 45769	740-992-1176
		John Casto	33201 Hysell Run Rd, Pomeroy, Ohio 45769	not available

APPENDIX B: continued

Site Name	Site ID	Name	Address	Phone
		Landowners' contact information within the subwatershed		
Titus Run Hollow One	TRH0002	Samuel Wamsley	35737 Titus Rd, Middleport, Ohio 45760	740-742-2872
		Dale Ellis	35553 Titus Rd, Rutland, Ohio 45775	740-742-2686
		Ann Dater Trustee	Morton I. Rosenbaum 711 Graynne Bldg. 602 Main St, Cincinnati, Ohio 45202 (or)	
			J. Crain Norther Trust Bank 1100 E. Las Olas Blvd, Ft. Lauderdale, Florida 33301	not available
		David Carson & Dixie Sayer	9110 Patty Pllace, FT Wayne, Indiana 46804	not available
		Mary Carson	3895 Sierra Drive, Barnhart, Missouri 63012	not available
Dunst's Hollow	PH0100	Jimmy Griffith	30031 Twp.Rd 351, Middleport, Ohio 45760	740-742-0528
		George Wright	259 Union Ave, Pomeroy, Ohio 45769	740-992-2439
		Charles Gardener- Lisa Dunst	30054 Paulins Hill Rd, Cheshire Ohio 45620	
Long's Hollow	PH0200	Tom Long	1153 Paulins Hill Rd, Cheshire Ohio 45620	740-367-7191
		Bonnie Baird	not available	not available
		Susan Gormley	not available	not available
		J&M Land Ltd	not available	not available
		Frank Hearld Jr.	36394 Leading Cr Rd, Middleport Ohio 45760	740-742-2994
Fivemile Run	FR0040	Gene Jeffers	31976 Woodyard Road, Albany Ohio 45710	740-698-6823
		Ball Brother's Farm	PO Box 156, Albany Ohio 45710	not available
Sisson Run		Dolphus and Wanda Burke	40307 Salem School Lot Rd, Albany Ohio 45710	740-698-7244
		Everett Holcolm	30359 SR 143, Albany Ohio 45710	740-698-5025
Dexter Run	DR0005	Dwight Sprague	35503 Sheets Rd, Dexter, Ohio 45741	740-742-2883
Leading Creek RM 4.3		Micheal Harrison	37783 Leading Cr Rd, Middleport, Ohio 45760	742-0023

APPENDIX C. Contact information for residents who regularly attended watershed meetings and community events.

Leading Creek Watershed Group

People attending previous meetings and/or expressing interest in a local grassroots group:

Name	Address	Phone	e-mail
Brett Laverty	40080 Salem School Lot Rd, Albany, OH 45710	698-3733	brettlaverty@hotmail.com
Dave Enterline	33828 Parkinson Rd. Middleport, OH 45760	742-4204	DENTER@frognet.net
Dianne DonCarlos	33735 BeechGroove Rd., Rutland, OH 45775	742-1714	dianedoncarlos@aol.com
Doug Rogers	39617 SR 684 Pomeroy, OH 45769	742-4302	
Ginger Deason	10077 Sandridge Rd, Millfield, OH 45761	797-0257	ginger@appalachianforest.org
Jim Freeman	44425 Forest Run Rd, Racine, OH 45771	949-3403	jim-freeman@oh.nacdnet.org
Joe and Janet Bolin	New Lima Rd Rutland, OH 45775	742-2094	jub9@frognet.net
Leah Miller	39831 SR 684 Pomeroy, OH 45769	742-4302	
Mary Hobstetter	33222 Dexter Rd. Rutland, OH 45775	742-2681	MAREH@dragonbbs.com
Mike Duhl			mike-duhl@oh.nacdnet.org
Opal Dyer	33323 Jesse Creek Rd Bidwell, OH 45614	742-2805	opal-dyer@oh.nacdnet.org
Randall Hudson	430 College Ave Rutland, OH	742-2963	r_hudson11102@hotmail.com
Steve Jenkins	Box 247, 287 Weber St, Rutland, OH	742-2957	steve-jenkins@oh.nacdnet.org
Todd Alan	39811 SR 684 Pomeroy, OH 45769	742-8421	todd@toddalanstudios.com

APPENDIX D. Inventory of physical attributes of each tributary to Leading Creek

Stream Segment	River Mile	Length (feet)	Channelized (feet)	Levied (feet)	Dammed (feet)	Rip. Buffer Present (feet)	Rip. Buffer Needed (feet)	Unrestricted livestock access	Number of New Homes	Bridges/Culverts
Five Mile Run- Confluence Leading Creek at 26.16										
HW to Trib 05	HW to 2.83	7813	0	0	0	7300	500	n	0	1
Trib 05	2.83	2683	0	0	0	2650	0	n	0	1
Trib 05 to Trib 04	2.83 to 2.44	2454	0	0	0	2400	0	n	0	2
Trib 04	2.44	3075	0	0	0	1600	1000	y	0	1
Trib 04 to Trib 03	2.44 to 0.80	9341	0	0	0	5100	3200	y	0	2
Trib 03	0.83	8039	0	0	0	4900	2250	y	0	4
Trib 03 South Fork	0.83	4495	0	0	0	3995	500	y	0	0
Trib 03 to Leading Crk	0.83 to 0.0	4450	0	0	0	3400	980	y	0	0
Sharps Run- Confluence Leading Creek at RM 25.70										
HW to Trib 6	HW to 3.34	3980	0	0	0	3000	500	n	3	3
Trib 06	3.34	2000	0	0	0	1300	650	n	0	2
Trib 06 to Trib 05	3.34 to 2.62	4090	0	0	0	4000	0	y	0	1
Trib 05	2.62	5465	0	0	0	5465	0	n	0	0
Trib 05 to Trib 03	2.62 to 1.76	5745	0	0	0	5745	0	y	0	0
Trib 03	1.76	7600	0	0	0	7550	0	y	0	1
Trib03 to Leading Crk	1.76 to 0.0	9400	0	0	0	8750	600	y	0	2
Sisson Run- Confluence Leading Creek at RM 23.88										
HW to Trib 09	HW to 3.32	4250	0	0	0	3350	0	n	0	1
Trib 09	3.32	4496	0	0	0	4496	0	n	0	0
Trib 09 to Trib 08	3.32 to 2.77	2900	0	0	0	2900	0	n	0	0
Trib 08	2.77	3244	0	0	0	3184	0	n	0	2
Trib 08 to Trib 07	2.77 to 2.55	1177	0	0	0	1100	0	n	0	1
Trib 07	2.55	5469	0	0	0	5469	0	n	0	0
Trib 07 to Trib 06	2.55 to 1.83	4233	0	0	0	3200	1000	n	0	1
Trib 06	1.83	8330	556	0	0	7309	1020	y	5	1
Trib 06 to Trib 05	1.83 to 1.7	725	0	0	0	0	725	y	0	0
Trib 05	1.7	1866	546	0	0	1316	550	y	0	0
Trib 05 to Trib 04	1.7 to 1.39	1862	0	0	0	0	1850	y	0	1
Trib 04	1.39	4305	0	0	0	3200	1100	y	0	0
Trib 04 to Trib 03	1.39 to 1.30	237	0	0	0	237	0	y	0	0

Appendix D. continued

Stream Segment	River Mile	Length (feet)	Channelized (feet)	Levied (feet)	Dammed (feet)	Rip. Buffer Present (feet)	Rip. Buffer Needed (feet)	Unrestricted livestock access	Number of New Homes	Bridges/Culverts
Sisson Run continued										
Trib 03	1.3	3959	0	0	0	810	3000	y	1	1
Trib 03 to Trib 02	1.30 to 1.08	1356	773	0	0	0	1300	y	0	1
Trib 02	1.08	2671	0	0	0	1991	680	y	0	0
Trib 02 to Trib 01	1.08 to 0.70	2081	1651	0	0	0	2081	y	0	0
Trib 01	0.70	8735	0	0	0	7242	1410	y	0	2
Trib 01 to Leading Crk	0.70 to 0.0	4050	0	0	0	1100	2900	y	0	1
Ogden Run-Confluence Leading Creek at RM 21.90										
HW to Trib 07	HW to 3.87	7437	0	0	0	7437	0	y	0	1
Trib 07	3.87	6829	0	0	0	6830	0	n	0	1
Trib 07 to Trib 06	3.87 to 3.16	2879	0	0	0	2650	0	n	0	0
Trib 06	3.16	2403	0	0	0	0	2200	n	0	2
Trib 06 to Trib 05	3.16 to 3.40	1106	0	0	0	880	150	n	0	1
Trib 05	3.40	2714	0	0	0	2464	150	n	0	1
Triob 05 to Trib 04	3.40 to 2.90	1463	0	0	0	0	1463	n	0	0
Trib 04	2.90	5341	0	0	0	3950	1370	n	0	1
Trib 04 to Trib 03	2.90 to 2.45	2571	0	0	0	2550	0	n	0	1
Trib 03	2.45	3923	0	0	0	2796	950	n	0	1
Trib 03 to Trib 02	2.45 to 2.11	2029	2000	0	0	2000	2000	n	0	1
Trib 02	2.11	13015	5272	0	0	7735	5250	n	0	2
Trib 02A	2.11 to 1.00	3262	0	0	0	5037	2363	y	0	1
Trib 02B	2.11 to 1.95	3262	0	0	0	2650	600	y	0	0
Trib 02 to Trib 01	2.11 to 1.21	5316	3964	0	0	3154	2033	n	0	2
Trib 01	1.21	3709	515	0	0	600	2900	y	0	1
Trib 01 to Leading Crk	1.21 to 0.0	7373	5930	0	0	6370	1000	n	0	0
Dyesville Run-Confluence Leading Creek at RM 20.75										
HW to Trib 04	HW to 1.60	7452	0	0	0	6980	400	y	0	2
Trib 04 to Leading Crk	1.60 to 0.0	9103	0	0	0	7400	1650	n	0	3

Appendix D. continued

Stream Segment	River Mile	Length (feet)	Channelized (feet)	Levied (feet)	Dammed (feet)	Rip. Buffer Present (feet)	Rip. Buffer Needed (feet)	Unrestricted livestock access	Number of New Homes	Bridges/Culverts
Mud Fork- Confluence Leading Creek at RM 18.93										
HW to Trib 18	HW to 6.90	5600	0	0	0	5600	0	n	0	0
Trib 18 to Trib 16	6.90 to 5.59	7400	0	0	0	3450	3600	y	0	2
Trib 16	5.59	9107	0	0	0	9000	0	n	0	3
Trib 16 to Trib 14	5.59 to 4.74	4500	1340	0	0	1800	2200	n	0	2
Trib 14	4.74	8786	1300	0	0	7257	1300	n	0	2
Trib 14 to Trib 08	4.74 to 2.58	11645	6000	0	0	6800	4735	y	0	1
Trib 08	2.58	12079	5210	0	0	3150	8680	y	0	4
Trib 08 to Trib 06	2.58 to 2.25	2295	2295	0	0	2000	0	n	0	1
Trib 06	2.25	8180	2900	0	0	700	7150	y	1	5
Trib 06 to Trib 05	2.25 to 1.8	2767	2200	500	0	2700	0	n	0	1
Trib 05	1.8	6205	0	0	0	3900	4030	n	2	4
Trib 05 to Trib 03	1.80 to 1.15	3944	0	0	0	3944	0	n	0	2
Trib 03	1.15	5525	350	0	0	2500	1350	y	0	2
Trib 03 to Leading Crk	1.15 to 0.0	7130	0	0	0	4720	2100	n	0	3
Dexter Run- Confluence Leading Creek at RM 18.50										
HW to Trib 15	HW to 4.43	4209	0	0	0	3750	1400	y	0	1
Trib 15	4.43	3600	0	0	0	3100	0	n	0	1
Trib 15 to Trib 14	4.43 to 4.30	414	0	0	0	414	0	n	0	0
Trib 14	4.30	3346	0	0	0	3346	0	n	0	0
Trib 14 to Trib 13	4.30 to 3.55	4373	0	0	0	4333	0	n	0	1
Trib 13	3.55	4370	0	0	0	4330	0	n	0	1
Trib 13 to Trib 12	3.55 to 3.40	789	0	0	0	one side	789	y	0	0
Trib 12	3.40	3311	0	0	0	830	2481	y	0	0
Trib 12 to Trib 11	3.40 to 2.81	3187	0	0	0	2000	1050	y	0	1
Trib 11	2.81	9921	0	0	0	6871	3000	y	0	2
Trib 11 to Trib 10	2.81 to 2.74	377	0	0	0	0	377	y	0	0
Trib 10	2.74	7667	0	0	0	7637	300	n	0	1
Trib 10 to Trib 08	2.74 to 2.44	1676	0	0	0	0	1650	y	0	1
Trib 08	2.44	5100	0	0	0	3000	2000	y	0	4
Trib 08 to Trib 07	2.44 to 2.09	1971	0	0	0	1900	0	n	0	2

Appendix D. continued

Stream Segment	River Mile	Length (feet)	Channelized (feet)	Levied (feet)	Dammed (feet)	Rip. Buffer Present (feet)	Rip. Buffer Needed (feet)	Unrestricted livestock access	Number of New Homes	Bridges/Culverts
Dexter Run continued										
Trib 07	2.09	3682	457	0	0	2800	850	y	0	1
Trib 07 to Trib06	2.09 to 1.88	1205	0	0	0	1205	0	n	0	0
Trib 06	1.88	3538	0	0	0	3488	0	y	0	2
Trib 06 to Trib 04	1.88 to 1.13	4423	0	0	0	4423	0	n	0	0
Trib 04	1.13	6873	186	0	0	2697	4145	y	0	1
Trib 04 tdo Trib 03	1.13 to 0.96	871	0	0	0	0	871	n	0	0
Trib 03	0.96	4367	0	0	0	1800	2500	y	0	1
Trib 03 to Trib 01	0.96 to 0.76	1210	0	0	0	0	1180	y	0	1
Trib 01	0.76	3170	0	0	0	3120	0	n	0	1
Trib 01 to Leading Crk	0.76 to 0.0	4444	0	0	0	4444	0	y	0	0
Grass Run- Confluence Leading Creek at RM 16.82										
Hw to Trib 04	HW to 2.00	4022	0	0	0	2900	860	n	0	2
Trib 04 to Trib 01	2.00 to 1.27	4230	0	0	0	3500	450	n	0	3
Trib 01 to Leading Crk	1.27 to 0.0	7623	0	0	0	4423	2200	n	0	0
Parker Run- Confluence Leading Creek at RM 15.60										
HW to Trib 10	HW to 3.75	7300	0	0	0	5220	2020	y	0	4
Trib 10	3.75	3169	0	0	0	1150	2020	y	0	1
Trib 10 to Trib 09	3.75 to 3.30	2512	0	0	0	0	2450	y	0	1
Trib 09	3.30	6193	0	0	0	2315	3290	n	0	4
Trib 09 to Trib 08	3.30 to 2.95	1989	0	0	0	1989	0	n	0	0
Trib 08	2.95	6506	0	0	0	6000	160	n	0	3
Trib 08 to Trib 07	2.95 to 2.71	2155	2100	0	0	1070	1010	n	0	1
Trib 07	2.71	8182	1600	0	0	6010	1400	n	0	1
Trib 07 to Trib06	2.71 to 2.04	2623	2623	0	0	1600	1000	n	0	4
Trib 06	2.04	1130	0	0	0	0	1130	n	0	1
Trib 06 to Trib 05	2.04 to 1.58	2527	0	0	0	2527	0	n	0	0
Trib 05	1.58	8925	0	0	0	8243	0	n	0	4
Trib 05 to Trib 04	1.58 to 1.23	2105	0	0	0	2075	0	n	0	1
Trib 04	1.23	5075	0	0	0	5035	0	n	0	1
Trib 04 to Trib 01	1.23 to 0.70	3095	0	0	0	3095	0	n	0	0

Appendix D. continued

Stream Segment	River Mile	Length (feet)	Channelized (feet)	Levied (feet)	Dammed (feet)	Rip. Buffer Present (feet)	Rip. Buffer Needed (feet)	Unrestricted livestock access	Number of New Homes	Bridges/Culverts
Parker Run continued										
Trib 01	0.70	7531	0	0	0	7500	0	n	0	1
Trib 01 to Leading Crk	0.70 to 0.0	4196	0	0	0	4150	0	n	0	1
Malloon's Run- Confluence Leading Creek at RM 14.80										
HW to Trib 07	HW to 2.90	1710	0	0	0	1215	0	n	unk	1
Trib 07	2.90	2058	0	0	0	2058	0	n	0	0
Trib 07 to Trib 05	2.90 to 2.20	3425	0	0	0	2100	1100	n	unk	2
Trib 05	2.20	12214	0	0	0	8346	1300	y	unk	10
Trib 05 to Trib 04	2.20 to 2.19	134	0	0	0	0	134	y	0	0
Trib 04	2.19	8655	0	0	0	6125	0	y	0	3
Trib 04 to Trib 03	2.19 to 1.58	4024	1154			1446	2250	y	unk	1
Trib 03	1.58	2291	0	0	0	1300	900	y	unk	1
Trib 03 to Trib 02	1.58 to 1.49	620	0	0	0	0	620	y	0	0
Trib 02	1.49	3831	0	0	0	1990	1505	y	unk	3
Trib 02 to Trib 01	1.49 to 0.23	7266	0	0	0	7266	0	y	0	0
Trib 01	0.23	3665	0	0	0	3600	0	n	0	1
Trib 01 to Leading Crk	0.23 to 0.00	1541	0	0	0	1481	0	n	0	2
Lasher Run- Confluence Leading Creek at RM 8.90										
HW to Trib 04	HW to 2.65	3615	0	0	0	3615	0	n	0	0
Trib 04	2.65	1990	0	0	0	1990	0	n	0	0
Trib 04 to Trib 03	2.65 to 2.34	2016	0	0	0	1216	800	y	0	0
Trib 03	2.34	1609	0	0	0	1609	0	n	0	0
Trib 03 to Trib 02	2.34 to 2.04	1731	0	0	0	1731	0	n	unk	1
Trib 02	2.04	1436	0	0	0	1436	0	n	unk	0
Trib 02 to Trib 01	2.04 to 0.62	7782	1965	0	0	5181	1965	y	unk	4
Trib 01	0.62	2585	0	0	0	2585	0	n	0	0
Trib 01 to Leading Crk	0.62 to 0.0	3768	846	0	0	2000	1700	y	1	1

Appendix D. continued

Stream Segment	River Mile	Length (feet)	Channelized (feet)	Levied (feet)	Dammed (feet)	Rip. Buffer Present (feet)	Rip. Buffer Needed (feet)	Unrestricted livestock access	Number of New Homes	Bridges/Culverts
Little Leading- Confluence Leading Creek at RM 8.49										
West HW to Trib 23	HW to 10.81	5077	0	0	0	4284	782	n	0	3
Trib 23 to Trib 21	10.81 to 9.78	6126	1270	0	0	3587	2539	y	0	1
Trib 21	9.78	6047	3819	0	0	1130	4850	y	unk	3
Trib 21 to Trib 20	9.78 to 9.44	1770	0	0	0	460	1310	y	0	0
Trib 20	9.44	9351	0	0	0	1445	7900	y	0	6
Trib 20A		11181	2992	0	0	7187	3994	n	1	4
Trib 20 to Trib 17	9.44 to 8.61	5840	0	0	0	2840	3000	y	0	0
Trib 17	8.61	5686	0	0	0	2100	2200	y	0	3
Trib 17 to Trib 16	8.61 to 6.94	10200	0	0	0	2000	8200	y	0	1
Trib 16	6.94	12950	1760	0	0	5600	1815	y	unk	7
Trib 16A	6.94/0.83	4650	0	0	0	3250	250	y	unk	3
Trib 16 to Trib 12	6.94 to 5.77	6700	1470	0	0	1100	1470	y	0	2
Trib 12	5.77	31058	1084	0	0	0	3000	y	0	3
Trib 12 to Trib 11	5.77 to 5.25	3200	0	0	0	3000	0	n	0	2
Trib 11	5.25	6700	0	0	0	2400	1600	y	1	5
Trib 11 to Trib 09	5.25 to 3.79	8000	0	0	0	6500	1000	n	1	3
Trib09	3.79	17000	0	0	0	102000	4965	n	0	9
Trib 09 to Trib 07	3.79 to 2.45	7700	0	0	0	5430	2000	n	0	2
Trib 07	2.45	4619	0	0	0	2120	1560	n	0	4
Trib 07 to Trib 06	2.45 to 2.30	1100	0	0	0	1050	0	n	0	1
Trib 06	2.3	5972	0	0	0	2250	1600	n	1	10
Trib 06 to Trib 05	2.30 to 1.72	3500	100	0	0	2200	0	n	0	1
Trib 05	1.72	7320	0	0	0	2030	2700	n	unk	15
Trib 05 to 03	1.72 to 0.95	4430	0	0	0	3950	0	n	unk	1
Trib 03	0.95	9661	unk	0	0	2000	4200	n	New School/ sewer	15
Trib 03 to Leading Crk	0.95 to 0.0	5430	0	0	0	5400	0	y	unk	2
Titus Run- Confluence Leading Creek at RM 7.37										
HW to Trib 04	HW to 1.15	11077	0	0	0	10500	600	n	1	4
Trib 04	1.15	3695	0	0	0	3695	0	n	unk	0
Trib 04 to Trib 03	1.15 to 1.00	1132	0	0	0	475	630	y	unk	1

Appendix D. continued

Stream Segment	River Mile	Length (feet)	Channelized (feet)	Levied (feet)	Dammed (feet)	Rip. Buffer Present (feet)	Rip. Buffer Needed (feet)	Unrestricted livestock access	Number of New Homes	Bridges/Culverts
Titus Run continued										
Trib 03	1.00	2659	0	0	0	2500	625	y	unk	0
Trib 03 to Trib 02	1.00 to 0.30	4069	0	0	0	3500	0	n	unk	4
Trib 02	0.30	2790	0	0	0	2250	270	y	unk	1
Trib 02 to Trib 01	0.30 to 0.20	440	0	0	0	440	0	n	0	0
Trib 01	0.20	3293	0	0	0	2400	800	n	0	2
Trib 01 to Leading Crk	0.20 to 0.00	1099	0	0	0	1099	0	n	0	0
Paulins Hill Run- Confluence Leading Creek at RM 6.13										
HW to mouth	HW to 0.0	5900	0	0	0	1347	1156	n	0	5
Thomas Fork- Confluence Leading Creek at RM 1.49										
HW to Wolfpen(18)	HW to 8.69	12197	0	0	0	1590	10000	y	0	10
Trib at Smith Run RD	10.10	4612	0	0	0	2553	2065	n	0	3
Trib 18	8.69	10600	0	0	0	5686	2896	n	0	11
Trib 18 to Trib 15	8.69 to 7.4	7500	0	0	0	4539	2638	y	1	5
Trib 15	7.40	4272	0	0	0	3212	1060	n	0	6
Trib 15 to Trib 14	7.40 to 7.00	2507	0	0	0	2200	300	n	0	1
Trib 14	7.00	18807	207	0	0	13807	5000	y	0	10
Trib 14 to Trib 10	7.00 to 5.49	9730	250	0	0	6187	3543	n	0	10
Trib 10 to Trib 04	5.49 to 3.34	11543	1135	0	0	7433	3791	y	0	4
Trib 04	3.34	13187	1000	0	0	3970	8728	n	0	14
Trib 04 to Trib 03	3.34 to 3.00	1418	0	0	0	1400	0	n	0	1
Trib 03	3.00	28360	240	0	0	10054	7812	n	0	27
Trib 03 to Trib 02	3.00 to 2.84	1950	0	0	0	1010	940	n	0	0
Trib 02	2.84	7009	0	0	0	2240	0	n	0	7
Trib 02 to Leading Crk	2.84 to 0.00	16750	545	0	0	8231	7486	n	0	4
East Branch Thomas Fork- Confluence Leading Creek at RM 1.49/5.49										
HW to Trib 12	HW to 5.86	10085	0	0	0	4305	5780	y	0	3
Trib 12	5.86	7565	700	0	0	6865	680	n	0	1
Trib 12 to Trib 09	5.86 to 4.31	8623	0	0	0	965	7635	n	0	1
Trib 09	4.31	10355	2500	0	0	3695	6660	y	0	9
Trib 09 to Trib 08	4.31 to 3.91	1850	0	0	0	680	350	n	0	0

Appendix D. continued

Stream Segment	River Mile	Length (feet)	Channelized (feet)	Levied (feet)	Dammed (feet)	Rip. Buffer Present (feet)	Rip. Buffer Needed (feet)	Unrestricted livestock access	Number of New Homes	Bridges/Culverts
East Branch Thomas Fork continued										
Trib 08	3.91	7561	Modified Wetland	0	0	0	4725	y	0	1
Trib 08 to Leading Crk	3.91 to 0.00	20525	0	0	0	11967	3930	y	0	18

APPENDIX E. Potential Funding Opportunities

Various funding opportunities are available for watershed restoration activities. The following list was compiled by ILGARD (2002) and provides some of the existing funding sources.

“Ohio Department of Natural Resources, Division of Mineral Resources Management

1) Federally Funded Abandoned Mine Land Program: Federal excise taxes on coal are returned to the State of Ohio for reclamation of abandoned mine land sites that adversely affect the public's health and safety.
2) Acid Mine Drainage Set-Aside Program: Up to ten percent of Ohio's federal excise tax monies are set aside for acid mine drainage abatement. Priority is given to leveraging these funds with watershed restoration groups and other government agencies.
3) State Abandoned Mine Land Program: State excise taxes on coal and industrial minerals are dedicated to reclamation projects that improve water quality in impacted streams. Priority is given to leveraging these funds with other partners.

Office of Surface Mining (OSM). Reclamation and Enforcement

1) Appalachian Clean Streams Initiative: The mission of the ACSI is to facilitate and coordinate citizens groups, university researchers, the coal industry, corporations, the environmental community, and local, state, and federal government agencies that are involved in cleaning up streams polluted by acid mine drainage. OSM provides funds for ACSI projects on an annual basis.
2) Direct Grants to Watershed Groups: A grant process for directly funding citizen watershed groups efforts to restore acid mine drainage impacted streams on a project basis.

Natural Resource Conservation Services

1) Conservation Reserve Program (CRP): CRP is a voluntary land retirement program designed to reduce erosion and protect environmentally sensitive lands with grass, trees, and other long term cover. Landowners bid for annual rental payments during a sign-up period. If selected, landowners contract their land for a ten year period. Cost-sharing of 50 percent is available.
2) Conservation Reserve Enhancement Program is a voluntary program that encourages farmers to enroll in CRP in contracts of 10 to 15 years. The State provides approximately 20 percent of the total program costs and the Federal Government provides 80 percent.
3) Environmental Quality Incentive Program assists in the conservation of structural, vegetative, and land management practices on eligible land. Five to ten-year contracts are made with eligible producers. Cost-share payments may be made to implement one or more eligible structural or vegetative practices, filter strips, tree planting, and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices.
4) Forestry Incentives Program (FIP) aides in tree planting, timber stand improvement, site preparation for natural regeneration, and other related activities.
5) Wetland Reserve Program: This program is a voluntary program to restore wetlands. Participating landowners can establish conservation easements of either permanent or 30- year duration, or can enter into restoration cost-share agreements where no easement is involved. In exchange for establishing a permanent easement, the landowner receives payment up to the agricultural value of the land and 100 percent of the restoration costs for restoring the wetlands. The 30-year easement payment is 75 percent of what would be provided for a permanent easement on the same site and 75 percent of the restoration cost. The voluntary agreements are for a minimum ten year duration and provide for 75 percent of the cost of restoring the involved wetlands.

6) Rural Abandoned Mine Program (RAMP): This program provides technical and financial assistance to land users who voluntarily enter into five to ten year contracts for reclamation of up to 320 acres of eligible abandoned coal-mined lands and waters.

Environmental Protection Agency

1) EPA Section 319 Non-point Source Grant Program: Funding is available for planning, education and remediation of watershed pollution problems including acid mine drainage.
2) Office of Water -Watershed Protection and Flood Prevention/PL566 Program: This program provides technical and financial assistance to address resource and related economic problems on a watershed basis that address watershed protection, flood prevention, water supply, water quality, erosion and sediment control, wetland creation and restoration, fish and wildlife habitat enhancement, and public recreation. Technical assistance and cost sharing with varied amount are available for implementation of NRCS-authorized watershed plans.

United States Army Corps of Engineers

1) Section 905b-Water Resource Development Act (86): Recent additions to the Army Corps conventional mission include a habitat restoration grant program for the completion of feasibility studies and project construction where a Federal interest can be verified. A principal non-Federal sponsor must be identified for this cost-share program.
2) Flood Hazard Mitigation and Ecosystem Restoration Program/Challenge 21: This watershed based program assists in groups involved in mitigating flood hazards and restoration of riparian ecosystems. Assistance is provided to assist in identifying sustainable solutions to flooding problems by examining nonstructural solutions in flood- prone areas, while retaining traditional measures where appropriate. Cost-share between federal and local governments Federal share is 50 percent for studies and 65 percent for project implementation, up to a maximum federal allocation of $30 million.

United States Fish and Wildlife Service

1) Partners for Fish and Wildlife Program: This program assists private landowners by providing technical and financial assistance to establish self-sustaining native habitats.
2) Clean Water Action Plan Fund: The purpose of this fund is to restore streams, riparian areas and wetlands resulting in direct and measurable water quality improvements.
3) Five Star Challenge Restoration Grants: The purpose of this program is to provide modest financial assistance to support community-based wetland and riparian restoration projects that build diverse partnerships and foster local natural source stewardship

Ohio Division of Wildlife

1) Wildlife Diversity Fund: This fund financially assists with research, surveys (biological or sociological), management, preservation, law enforcement, education, and land acquisition.

Lindbergh Foundation

1) Lindbergh Grants: This program financially assists organizations that are making significant contributions toward the balance between technology and nature through the conservation of natural resources. The Lindbergh Grants provides a maximum grant of $10,580. The program is considered a provider of seed money and credibility for pilot projects that subsequently receive larger sums from other sources.

Turner Foundation

1) Water/Toxins Program: The program wants to protect rivers, lakes, wetlands, aquifers, oceans and other water systems from contamination, degradation, and other abuses; to stop the further degradation of water-dependent habitats from new dams, diversions and other large infrastructure projects; to reduce wasteful water use via conservation; to support efforts to improve public policies affecting water protection, including initiatives to secure pollution prevention and habitat protection.

The Acorn Foundation

1) The Acorn Foundation supports projects dedicated to building a sustainable future for the planet and to restoring a healthy global environment. The Acorn Foundation funds community-based projects which: preserve and restore habitats supporting biological diversity and wildlife; advocate for environmental justice, particularly in low-income and indigenous communities; and prevent or remedy toxic pollution."

The Leading Creek Improvement Account

1) The Leading Creek Improvement Account supports enhancement projects listed in the Leading Creek Improvement Plan (Cherry *et al.* 1999) and practices that improve the overall conditions of Leading Creek.

APPENDIX F. Index to rank restoration efforts for each of the subwatersheds and major tributaries

Subwatershed	Attainment Status (biological integrity)	Water Quality Status	Number of expected projects*	Degree of cooperation with landowners	Certainty of the required remediation methods	Ability to measure improvements	Overall benefits to community interests	Improvement to Leading Creek	Sum
010									
Leading Creek RM 30.0 to 26.1	1	1	1	1	1	1	2	1	**9**
Fivemile Run	3	1	2	1	1	1	3	2	**14**
020									
Sisson Run	3	1	2	1	2	2	3	2	**16**
Ogden Run	3	1	1	2	2	1	3	3	**16**
Sharps Run	3	1	1	1	1	1	3	2	**13**
030									
Mud Fork	3	1	1	1	2	2	3	2	**15**
040									
Lasher Run	3	1	1	1	2	2	3	2	**15**
050									
Little Leading Creek	1	1	5-10	1	2	2	1	1	**14-19**
060									
Titus Run	3	1	1	1	1	2	3	2	**14**
Paulins Hill Run	3	1	3	1	1	1	3	3	**16**
Leading Creek RM 8.0 to 0.0	1	2	5-10	1	2	2	1	1	**15-20**
070									
Thomas Fork	1	1	5-10	1	1	1	1	1	**12-17**
	1= Known 2= Some data 3= Unknown	1= Known 2= Some data 3= Unknown		1= Cooperative 1= Unknown 2= Somewhat cooperative 3= Uncooperative	1= Known 2= Some information 3= Unknown	1= Measurable 2= Somewhat measurable 3= Unmeasurable	1= Community uses more 2= Some recreation 3= Stream's use unchanged Recreation uses include wading, fishing, swimming, and canoeing	1= Improvement 2= Some improvement 3= No improvement	

NOTE: The lower the sum the better the overall restoration potential

NOTE: Tributaries impaired exclusively by pathogens are not included in this analysis because improvement of the non-aquatic use designation is a lower priority than improving the aquatic life use designation.

* Index is arranged so that a lower number required projects is better

Appendix G. Methodology and Calculations

The following is an overview of the methodology used during the water quality monitoring, habitat evaluations, and to complete the calculations presented in Chapter 5. The specific sampling procedures are described in more detail in the Leading Creek AMDAT Plan and the Leading Creek Quality Assurance Plan.

Monitoring Description

1) **Initial Screening.** This phase of the sampling allowed us to identify water quality problems and potential problem areas. The initial screening consisted of reviewing historical chemical and biological data, conducting field reconnaissance, and collecting field parameters. Attempts were made to take field measurements at the mouth of each of the major tributaries and upstream and downstream from sites that were potentially sources of pollution.

2) **Sub-watershed evaluations.** In this phase, a more detailed assessment was conducted within areas identified as potentially impaired during the initial screening. The purpose was to identify the specific sources and causes of pollution in each of the sub-watersheds. In order to characterize nutrient enrichment, we collected approximately 30 water samples and determined the discharge in 2003 and 2004. To quantify the AMD impacts, approximately 250 samples were collected and then we determined the relative loadings of each tributary and each source. Following each assessment, data was entered into a computer database and analyzed.

3) **Identification of specific sources and causes**. This final phase of the monitoring allowed us to identify specific impacted sites and develop problem statements to link causes and sources of impairments. As presented in the Leading Creek AMDAT, the pollutant sources and impacted tributaries were prioritized based on their relative contribution to the receiving stream.

Sampling Methods

Water Quality

Parameters measured in the field included pH, conductivity, dissolved oxygen, temperature, nitrate, ammonia, phosphorus, acidity, and discharge. In addition, water samples (*i.e.* “grab samples”) were collected for nitrate, ammonia, phosphorus, total suspended solids, and fecal coliform, and then analyzed at the Ohio EPA laboratory Murray Hall, Columbus, Ohio. Total acidity, total alkalinity, specific conductivity, total suspended solids, total dissolved solids, total manganese, total aluminum, total iron, hardness, and sulfates were analyzed at the Division of Mineral Resources Management laboratory in Cambridge, Ohio. (See the Leading Creek Quality Assurance Plan for a detailed description of sampling procedures).

Habitat Assessments

The Leading Creek Watershed Coordinator and staff of the Meigs Soil and Water Conservation District researched the sediment deposition using the following parameters: TSS loadings, bedload transport, QHEI scores, sediment depth, stream cross-section elevation surveys, soil/geological characteristics, anecdotal information, and stream gradients/power. These preliminary measurements allowed us to speculate about the potential sources of sediment delivery and enabled us to make tentative predictions about which streams may be best suited for restoration efforts.

Bedload transport was estimated by placing 3 to 4, $8^{1/2}$ inch x $8^{1/2}$ inch plastic containers flush with the streambed. The trays were placed in the substrate for a given time, and then removed. The collected material was then dried (to remove all moisture), weighed, and an average weight was determined. The amount of time each of the containers were placed in the stream was used to calculate the rate of bedload movement (*i.e.* weight/ time).

The depth measurement technique was based on a modified penetration test using a weight dropped on a stopping rest atop a steel diameter cylindrical rod. Typically, 5 to 7 points along each cross-section were measured, with only 3 points taken at smaller tributaries. The measurement was crude, but simple and effective.

Changes in the streambed elevation were determined by establishing benchmarks near the stream, control points at the top of each stream bank, and 3 to 5 points along a cross-section of the stream. The same points were surveyed over a 9-month period to determine the relative changes in the stream bank and the stream channel.

Calculations

Sub-watershed- 05030202-090 010

Number Septic Systems: 213 housing structures x 2.55 number of people/household (US Census 2000)

Septic System Loading: 107 failing systems x 360 gallons/day (effluent from a 3-bedroom house/day (Ohio Department of Health)= 38,520 gallons/day

Sub-watershed- 05030202-090 020

Number Septic Systems: 359 housing structures x 2.55 number of people/household (US Census 2000)

Septic System Loading: 180 failing systems x 360 gallons/day (effluent from a 3-bedroom house/day (Ohio Department of Health)= 64,800 gallons/day

Sediment Runoff:

- Estimated amount of sediment from overgrazed (poorly managed) pastures (tons/year)
  - Percentage of pasturefields that are overgrazed/ poorly managed
    - 75%
  - Acres of pasturefields in 020 subshed
    - 5,114 acres
  - Avg annual soil loss
    - 6.86 ton/acre/year
    - R= 135, K= 0.4, LS= 4.38, C= 0.029, P= 1
  - Soil loss from poorly managed pasturefields
    - .75 x 5114 acre x 6.86 ton/acre/year
    - 26,312 tons/year
- Estimated cost for lime and fertilizer (Mike Duhl (1-10-04))
  - Lime: $25.00/ton of lime x 3 tons of lime/acre= $75.00 /acre
  - Fertilizer: $40.00/acre
- Estimated amount of sediment from stream bank erosion (tons/year) entered into STEPL Program
  - Length of eroding bank

        - 3,960 feet
    - Height of eroding bank
        - 4 feet
    - Lateral Recession
        - .3

Sub-watershed- 05030202-090 030

Number Septic Systems: 166 housing structures x 2.63 number of people/household (US Census 2000)

Septic System Loading: 83 failing systems x 360 gallons/day (effluent from a 3-bedroom house/day (Ohio Department of Health))= 29,880 gallons/day

Sub-watershed- 05030202-090 040

Number Septic Systems: 562 housing structures x 2.66 number of people/household (US Census 2000)

Septic System Loading: 337 failing systems x 360 gallons/day (effluent from a 3-bedroom house/day Ohio Department of Health)= 121,320 gallons/day

Sediment Runoff:

- Estimated acres of barren abandoned surface mines
    - 40 acres
- Estimated soil loss from barren surface mines
    - 122 tons/acre/year
    - R= 135 , K= 0.15, LS= 6.04, C= 1, P= 1
- Total soil loss (tons/year)
    - 4,880 tons/year

Sub-watershed- 05030202-090 050

Number Septic Systems: 672 housing structures x 2.63 number of people/household (US Census 2000)

Septic System Loading: 298 failing systems x 360 galloons/day (effluent from a 3-bedroom house/day Ohio Department of Health)= 107280

Sediment Runoff:

- Estimated amount of sediment from overgrazed (poorly managed) pastures (tons/year)
    - Percentage of pasturefields that are overgrazed/ poorly managed
        - 75%
    - Acres of pasturefields in 050 subshed
        - 3746 acres
    - Avg annual soil loss
        - 6.86 ton/acre/year
        - R= 135, K= 0.4, LS= 4.38, C= 0.029, P= 1
    - Soil loss from poorly managed pasturefields
        - .75 x 3746 acre x 6.86 ton/acre/year
        - 19,273 tons/year
- Estimated cost for lime and fertilizer (Mike Duhl (1-10-04))
    - Lime: $25.00/ton of lime x 3 tons of lime/acre= $75.00 /acre
    - Fertilizer: $40.00/acre

Sub-watershed- 05030202-090 060

Number Septic Systems: 98 housing structures x 2.63 number of people/household (US Census 2000)

Septic System Loading: 63 failing systems x 360 gallons/day (effluent from a 3-bedroom house/day Ohio Department of Health)= 22,680 gallons/day

Sediment Runoff:

- Estimated amount of sediment from stream bank erosion (tons/year) entered into STEPL Program
  - Length of eroding bank
    - 2,271 feet
  - Height of eroding bank
    - 2 feet
  - Lateral recession
    - .03
  - Estimated acres of barren abandoned surface mines in Titus Run
    - 44
  - Estimated soil loss from barren surface mines
    - 122 tons/acre/year
    - R= 135, K= 0.15, LS= 6.04, C= 1, P= 1
  - Total soil loss (tons/year)
    - 5,368 tons/year
- Estimated cost of $19,000/acre was based on average costs from recent sites for the reclamation of surface mined sites (Barb Flowers personal communication)

Sub-watershed- 05030202-090 070

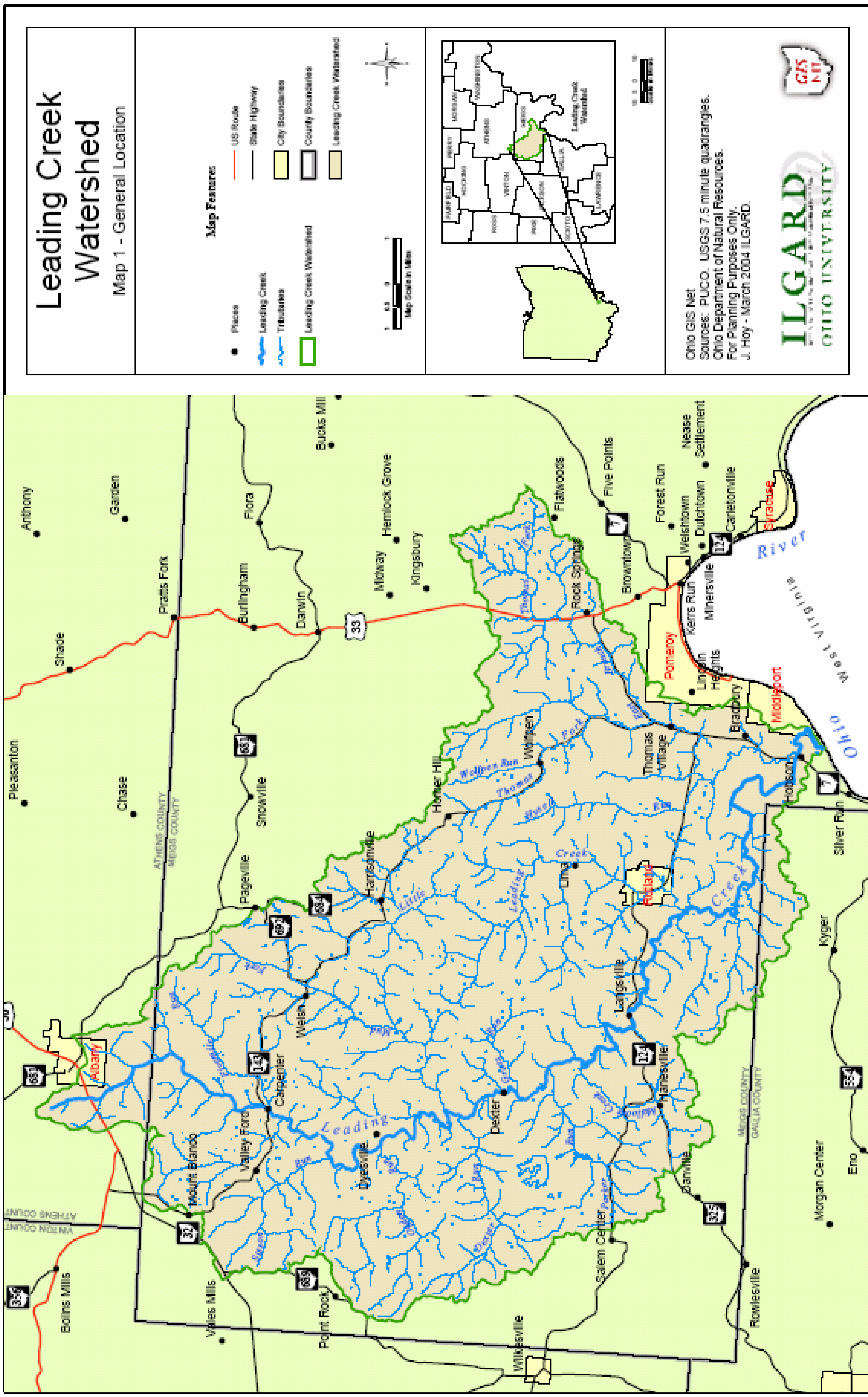
Number Septic Systems: 785 housing structures x 2.45 number of people/household (US Census 2000)

Septic System Loading: 471 failing systems x 360 gallons/day (effluent from a 3-bedroom house/day Ohio Department of Health)= 169,560 gallons/day

Sediment Runoff:

- Estimated amount of sediment from barren surface mines (tons/year)
  - Amount from Bailey Run
    - 8 acres
  - Amount from Hysell Run
    - 32 acres
  - Amount from Casto’s seep
    - 2 acres
  - Estimated soil loss from barren surface mines
    - 122 tons/acre/year
    - R= 135, K= 0.15, LS= 6.04, C= 1, P= 1
  - Total soil loss (tons/year)
    - 5,124 tons/year

Appendix H. Watershed Maps



Leading Creek Watershed
Map 1 - General Location
Map Features
Places
Leading Creek
Tributaries
Leading Creek Watershed
US Route
State Highway
City Boundaries
County Boundaries
Leading Creek Watershed
Ohio GIS Net
Sources: PUCO. USGS 7.5 minute quadrangles.
Ohio Department of Natural Resources.
For Planning Purposes Only.
J. Hoy - March 2004 ILGARD.
ILGARD
OHIO UNIVERSITY
Albany
Pomeroy
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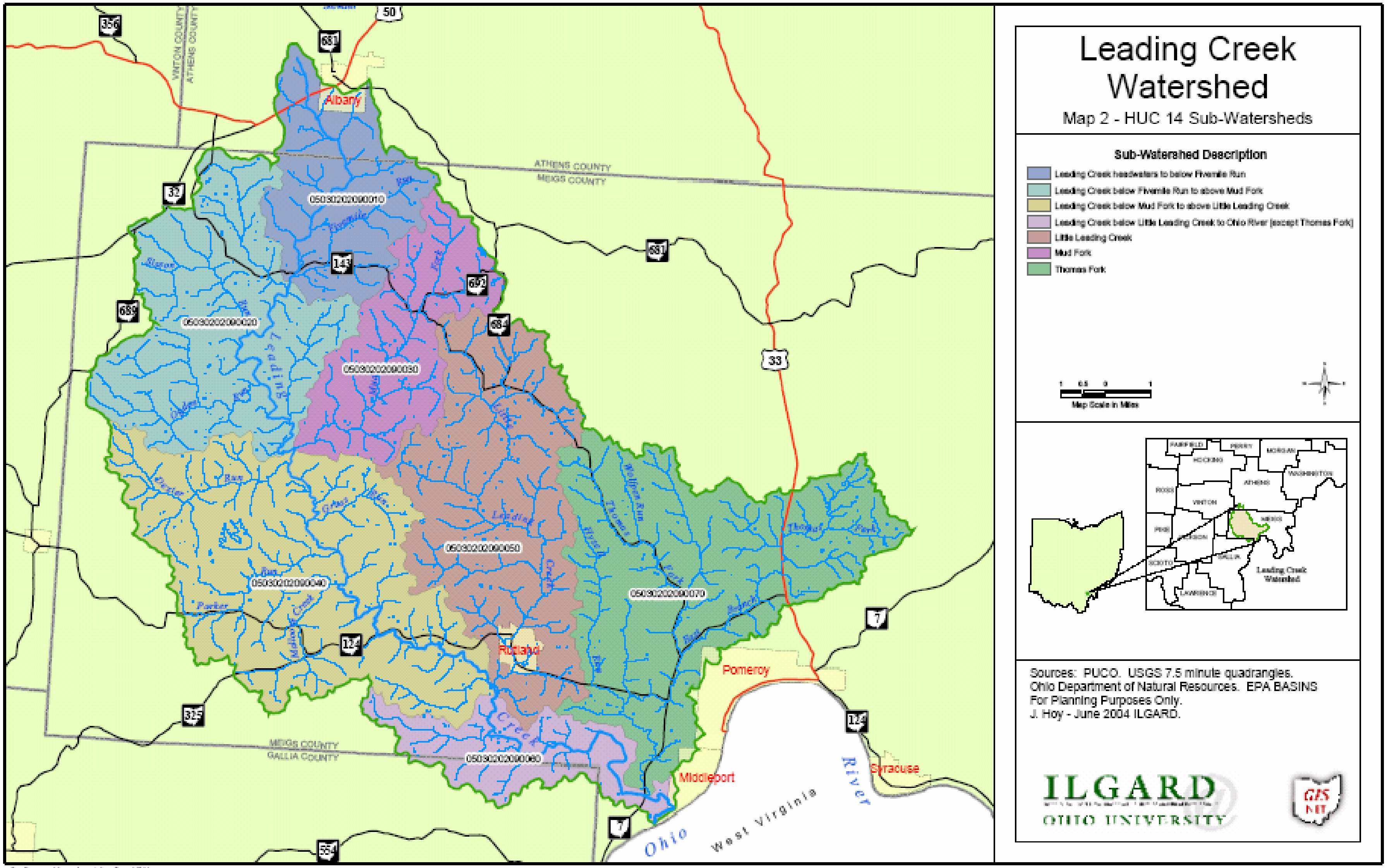
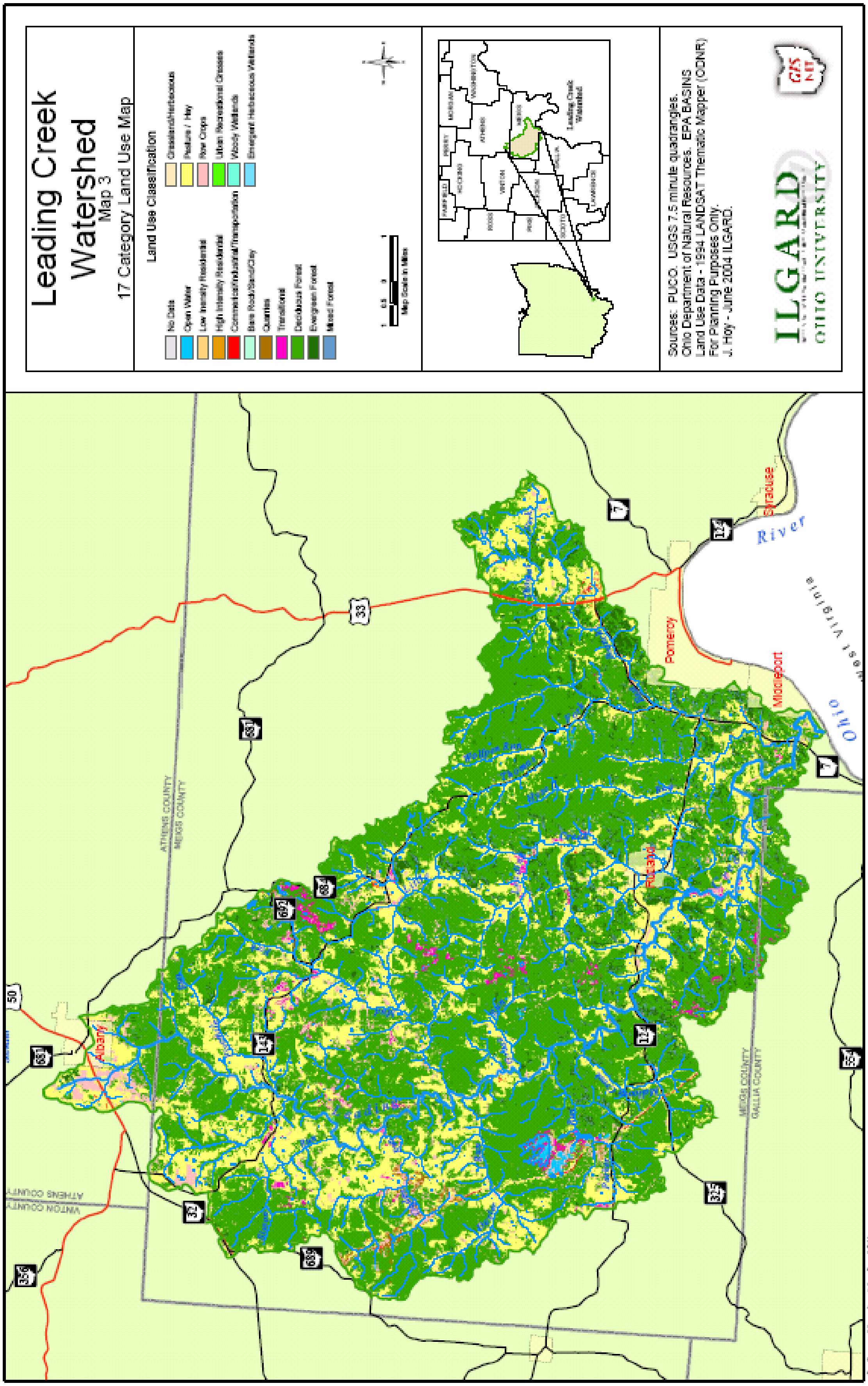
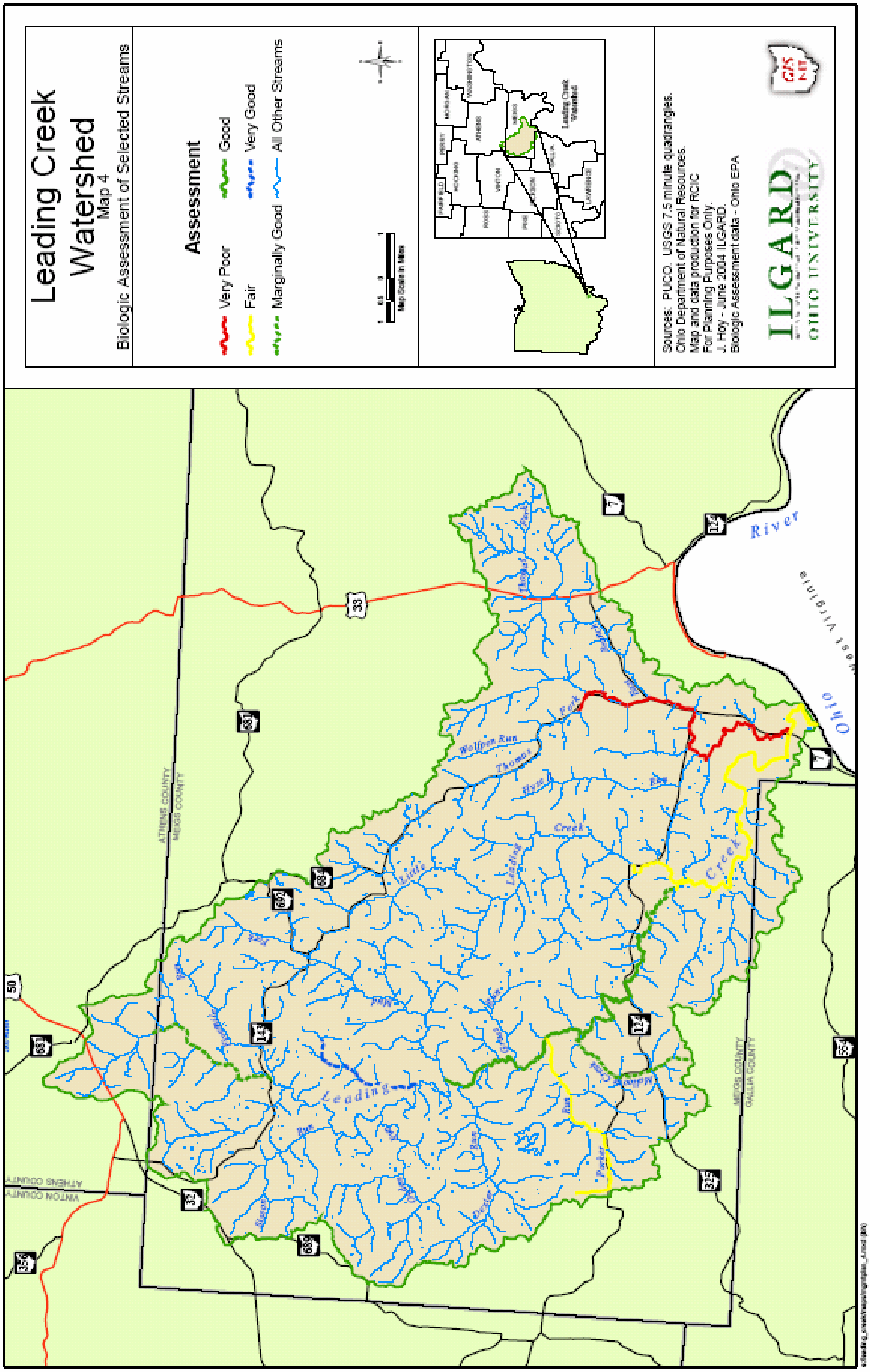
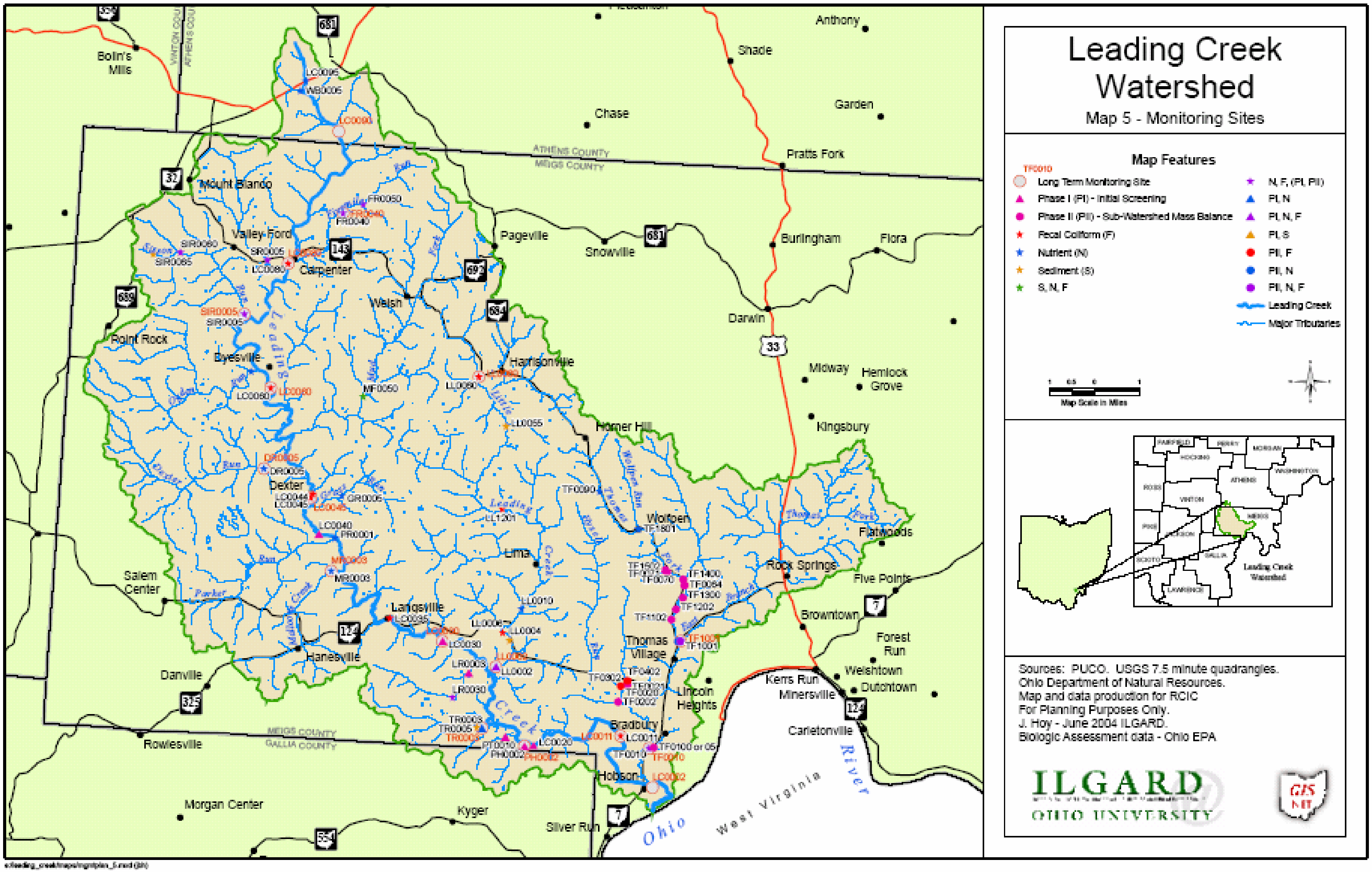
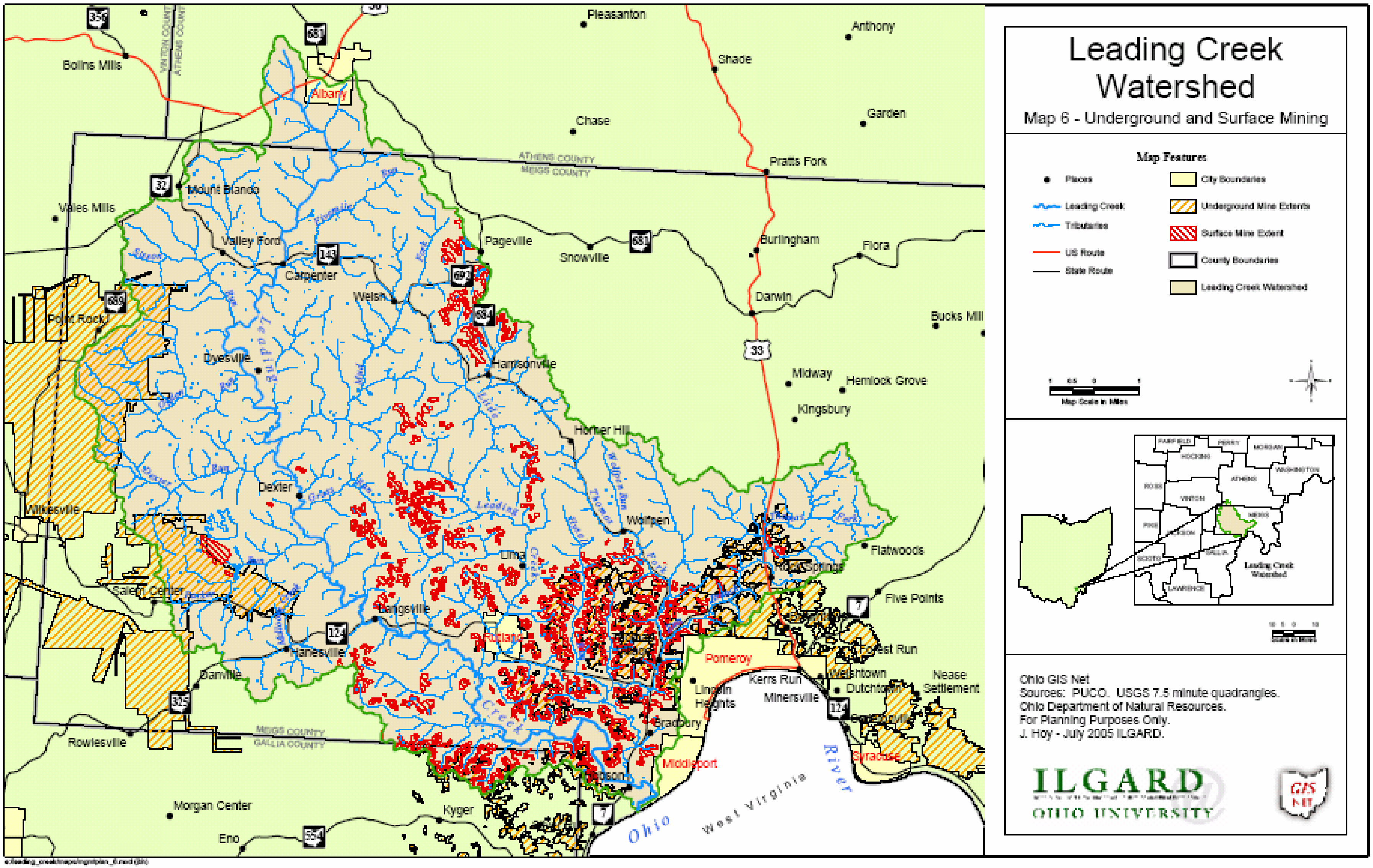
ATHENS COUNTY
MEIGS COUNTY
GALLIA COUNTY
VINTON COUNTY
Pleasanton
Anthony
Garden
Shade
Chase
Pratts Fork
Burlingham
Flora
Darwin
Snowville
Pageville
Bucks Mill
Hemlock Grove
Midway
Kingsbury
Flatwoods
Five Points
Forest Run
Nease Settlement
Welshtown
Dutchtown
Carletonville
Browntown
Rock Springs
Kerrs Run
Minersville
Lincoln Heights
Bradbury
Hobson
Silver Run
Thomas Village
Wolfpen
Harrisonville
Homer Hill
Langsville
Hamesville
Carpenter
Welsh
Valley Ford
Mount Blanco
Dyesville
Dexter
Salem Center
Danville
Kyger
Morgan Center
Eno
Rowlesville
Wilkesville
Point Rock
Vales Mills
Bolins Mills
Leading Creek
Little Leading Creek
Thomas Fork
Wolfpen Run


Leading Creek
Watershed
Map 2 - HUC 14 Sub-Watersheds
Sub-Watershed Description
Leading Creek headwaters to below Fivemile Run
Leading Creek below Fivemile Run to above Mud Fork
Leading Creek below Mud Fork to above Little Leading Creek
Leading Creek below Little Leading Creek to Ohio River (except Thomas Fork)
Little Leading Creek
Mud Fork
Thomas Fork
Map Scale in Miles
Leading Creek Watershed
Sources: PUCO. USGS 7.5 minute quadrangles.
Ohio Department of Natural Resources. EPA BASINS
For Planning Purposes Only.
J. Hoy - June 2004 ILGARD.
ILGARD
OHIO UNIVERSITY
Albany
Rutland
Pomeroy
Middleport
Syracuse
West Virginia
Ohio River
ATHENS COUNTY
MEIGS COUNTY
GALLIA COUNTY
VINTON COUNTY
05030202090010
05030202090020
05030202090030
05030202090040
05030202090050
05030202090060
05030202090070
Wolfpen Run
Thomas Fork
Leading Creek
Little Leading Creek
e:\leading_creek\maps\mgmtplan_2.mxd (jbh)


Leading Creek Watershed
Map 3
17 Category Land Use Map
Land Use Classification
No Data
Open Water
Low Intensity Residential
High Intensity Residential
Commercial/Industrial/Transportation
Bare Rock/Sand/Clay
Quarries
Transitional
Deciduous Forest
Evergreen Forest
Mixed Forest
Grassland/Herbaceous
Pasture / Hay
Row Crops
Urban Recreational Grasses
Woody Wetlands
Emergent Herbaceous Wetlands
Map Scale in Miles
Leading Creek Watershed
Sources: PUCO. USGS 7.5 minute quadrangles.
Ohio Department of Natural Resources. EPA BASINS
Land Use Data - 1994 LANDSAT Thematic Mapper (ODNR)
For Planning Purposes Only.
J. Hoy - June 2004 ILGARD.
ILGARD
OHIO UNIVERSITY
Albany
Rutland
Pomeroy
Middleport
Syracuse
Ohio River
West Virginia
ATHENS COUNTY
MEIGS COUNTY
VINTON COUNTY
GALLIA COUNTY
33
50
7
32
124
681
689
692
684
143
325
356


Leading Creek Watershed
Map 4
Biologic Assessment of Selected Streams
Assessment
Very Poor
Fair
Marginally Good
Good
Very Good
All Other Streams
Map Scale in Miles
Leading Creek Watershed
Sources: PUCO. USGS 7.5 minute quadrangles.
Ohio Department of Natural Resources.
Map and data production for RCIC
For Planning Purposes Only.
J. Hoy - June 2004 ILGARD.
Biologic Assessment data - Ohio EPA
ILGARD
OHIO UNIVERSITY
Ohio River
West Virginia
ATHENS COUNTY
MEIGS COUNTY
MEIGS COUNTY
GALLIA COUNTY
ATHENS COUNTY
VINTON COUNTY
Leading Creek
Little Leading Creek
Thomas Fork
Wolfpen Run


Leading Creek Watershed
Map 5 - Monitoring Sites
Map Features
TF0010
Long Term Monitoring Site
Phase I (PI) - Initial Screening
Phase II (PII) - Sub-Watershed Mass Balance
Fecal Coliform (F)
Nutrient (N)
Sediment (S)
S, N, F
N, F, (PI, PII)
PI, N
PI, N, F
PI, S
PII, F
PII, N
PII, N, F
Leading Creek
Major Tributaries
Map Scale in Miles
Sources: PUCO. USGS 7.5 minute quadrangles.
Ohio Department of Natural Resources.
Map and data production for RCIC
For Planning Purposes Only.
J. Hoy - June 2004 ILGARD.
Biologic Assessment data - Ohio EPA
ILGARD
OHIO UNIVERSITY
Leading Creek Watershed
Anthony
Shade
Chase
Garden
Pratts Fork
Bolin's Mills
Mount Blanco
Valley Ford
Carpenter
Pageville
Snowville
Burlingham
Flora
Welsh
Darwin
Point Rock
Byesville
Harrisonville
Midway
Hemlock Grove
Kingsbury
Homer Hill
Dexter
Wolfpen
Flatwoods
Lima
Salem Center
Rock Springs
Five Points
Langsville
Browntown
Thomas Village
Forest Run
Hanesville
Danville
Lincoln Heights
Kerrs Run
Minersville
Welshtown
Dutchtown
Carletonville
Rowlesville
Bradbury
Hobson
Morgan Center
Kyger
Silver Run
Ohio
West Virginia
River
ATHENS COUNTY
MEIGS COUNTY
GALLIA COUNTY


Leading Creek
Watershed
Map 6 - Underground and Surface Mining
Map Features
Places
Leading Creek
Tributaries
US Route
State Route
City Boundaries
Underground Mine Extents
Surface Mine Extent
County Boundaries
Leading Creek Watershed
Map Scale in Miles
Leading Creek Watershed
Ohio GIS Net
Sources: PUCO. USGS 7.5 minute quadrangles.
Ohio Department of Natural Resources.
For Planning Purposes Only.
J. Hoy - July 2005 ILGARD.
ILGARD
OHIO UNIVERSITY
Pleasanton
Anthony
Shade
Bolins Mills
Albany
Chase
Garden
Pratts Fork
ATHENS COUNTY
MEIGS COUNTY
Mount Blanco
Vales Mills
Valley Ford
Carpenter
Welsh
Pageville
Snowville
Burlingham
Flora
Darwin
Bucks Mill
Point Rock
Dyesville
Harrisonville
Midway
Hemlock Grove
Kingsbury
Horner Hill
Dexter
Wolfpen
Wilkesville
Flatwoods
Rock Springs
Five Points
Salem Center
Langsville
Rutland
Pomeroy
Forest Run
Welshtown
Nease Settlement
Kerrs Run
Dutchtown
Danville
Hanesville
Lincoln Heights
Minersville
Bradbury
Rowlesville
MEIGS COUNTY
GALLIA COUNTY
Middleport
Syracuse
Morgan Center
Kyger
Eno
Ohio
West Virginia
River
Leading
Creek