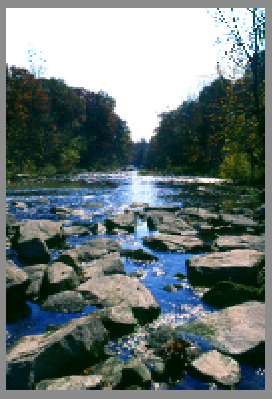
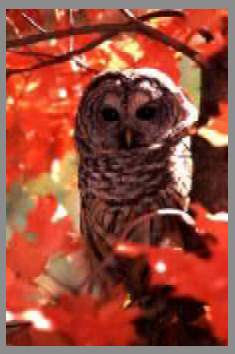
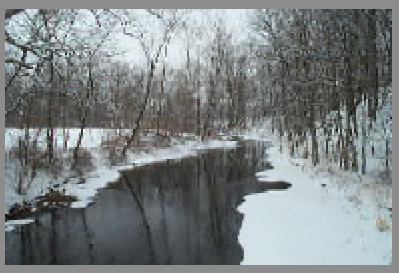
Kokosing Scenic River Watershed Plan

Ohio Department of Natural Resources
Division of Natural Areas & Preserves







Ohio EPA
319 Nonpoint Source Pollution
Grant Program
April 2004

EXECUTIVE SUMMARY

This watershed plan consists of four major sections, Introduction, Natural Resource Inventory, Water Quality and Strategies.

The Introduction section describes project background, mission and previous planning studies. Watershed steering committee membership, the Scenic Rivers law and governmental programs geared towards assisting landowners with conservation projects are discussed. Justification and need for conservation and protection activities is desribed, particularly the economic benefits associated with "ecosystem services," tourism and outdoor recreation opportunity.

The Natural Resources Inventory consists of a compliation of known data concerning land use/cover, geology/soils, minerals, surface/ground water, terrestial habitats, streams, lakes, floodplains, wetlands, faunal and floral diversity and rare species.

The Water Quality section includes aquatic habitat and water quality, water chemistry stormwater, Ohio Environmental Protection Agency use designations and impacts encountered during field sampling in 2003. Approximately 30% of streams in the watershed exhibited some degree of impact, with the majority of impacts caused by riparian vegetation removal, range grazing, land development and stream channelization activities. Historical information and socio-economic and transportation data is also included in this section, in an effort to analyize trends and predict future states.

Perhaps the most important section of the watershed plan deals with strategies, which, if employed, would restore or maintain ecosystem functions, quality of life and recreational opportunity. The goal of the Clean Water Act is:

> *"...To restore and maintain the chemical, physical, and biological integrity of the nation's waters."*

If one studies the chemical, physical and biological integrity of the Kokosing watershed, a prescription of restoration and preservation managerial responses appears appropriate.

Strategy topics include livestock exclusion fencing in two subwatersheds and protection of high quality riparian areas through acquisition or conservation easements from willing landowners. Wetland and floodplain protection, wetland restoration and headwater stream identification are also noted strategy topics. Management of storm water and improving landowner and local governmental decisionmaking, spill response planning, increasing outdoor recreation opportunity and environmental education and awareness round out the section.

If you have any questions or comments regarding this watershed plan, please contact:

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ACKNOWLEDGEMENTS

Having served with the Ohio Department of Natural Resources (ODNR) for nearly fifteen years, I have been exposed to, and have engaged in, many planning initiatives and processes on the local, regional, state and national level. My experience taught me that, for a planning process or natural resources initiative to be successful, one must sell the concept to the affected interests (or community) to achieve "buy-in." So, I commenced with the development of the watershed plan with the idea that I needed to obtain "buy-in" from the Knox County community and Kokosing watershed landowners to succeed in protecting the Kokosing State Scenic River and high quality habitats in its watershed. But, and unexpectedly, the exact opposite occurred. I soon found that I didn't need to obtain "buy-in" for the watershed plan or protection of the Kokosing; the community's buy-in was already in place. Instead of the community buying into ODNR's vision, I found myself buying into the Knox County community and their vision of resource protection and quality of life.

My task was an easy one. Section Manager Bob Gable and Scenic River Assistant Manager Tim Peterkoski of the Scenic Rivers Program laid considerable groundwork in Knox County for my task. Earlier work by former Scenic Rivers Program employee Yetty Alley during the scenic river designation process assisted as well. In fact, some text found in the watershed plan is taken verbatim (or nearly so) from the 1996 Kokosing State Scenic River Designation Study report. Morrow County Wildlife Officer Dirk Cochran served as my "eyes and ears" in the Morrow County portion of the watershed. ODNR retirees John Marshall, Bill Moody, Harold Bower, Howard Gratz, Jerry Scott and Cindy Bishop offered their advice and support as well.

Watershed steering committee members Rob Clendening, Siobhan Fennessey, Doug Givens, David Greer, Don Hawk, Eric Helt, Jim Henry, Steve Kauffman, Dick Mavis, Randy Pore, Richard Stallard, Brian Bennick and Mark Ramser, Scenic River Advisory Council members Doug McLarnan, Ray Heithaus and Gary Moore and Knox County Park District board members Susan Ramser and Mark Bennett offered to assist with tasks (without my asking), opened doors and established connections to local groups and provided their most in-demand resource—their time. I can't recall working with a group of individuals who wear so many hats, and donate so much time for the good of the community.

The Knox County Board of Commissioners, Alan Stockberger, Tom McLarnan and Bob Wise, deserve reconition for the donation of office space and furniture and for their collective leadership and vision for Knox County.

A wise individual once told me that the most effective form of government is two neighbors talking; the second most effective form of government is the township level, the third most effective form of government is the county level, and so on. With this concept in mind, I feel quite confident with the Knox County community moving forward with implementation of their Kokosing Watershed Plan and quite comfortable knowing the Kokosing River, its watershed and its future are in such able and competent hands.

April 2004
Kim Baker
Kokosing Watershed Planner

Contents

Figures

Tables

INTRODUCTION

Thousands of years ago, the ancient mound builders settled in the Kokosing River valley. The ancient people found, as do present-day citizens, that the valley and its watershed harbor fertile soils, abundant wildlife and a rich quality of life. Due to the presence of a healthy wooded corridor that landowners have maintained and erosion control measures used by farmers, the Kokosing River retains exceptional water quality and species diversity. However, the Kokosing watershed is changing quickly. As Columbus suburbs continue to burgeon, threats to the Kokosing River watershed have increased. Productive farmland is being subdivided for residential development, as more people flock to share excellent quality of life in the Kokosing River watershed (See Figure 1).

The Ohio Department of Natural Resources (ODNR), working with local government officials, organizations and citizens, embarked on a proactive initiative to draft a watershed plan for the Kokosing. In general, a watershed plan lists problems, priorities and activities that need to be addressed. The plan will serve to bring state dollars into the watershed to assist landowners with efforts to protect and maintain it.

Purpose of this Management Plan

The purpose of the plan is to identify and reduce non point sources of pollution and to identify and protect high quality habitat areas. The plan will help guide the Division of Natural Areas and Preserves (DNAP) and other local governmental and non-profit entities regarding decisions and actions that affect the Kokosing River and its tributaries. The decisions and actions include policy and procedure development and projects undertaken that will facilitate the accomplishment of strategies found in the plan. The plan represents an analysis of environmental, recreational, socio-economical, and historical factors related to activities in the watershed and outlines strategies to restore, enhance and protect resources.

Endorsement of the plan by local partners is indicated in the task matrices located under the Strategies Section. After the plan has been endorsed by the Ohio EPA and ODNR, the plan will be presented to local officials in the watershed for adoption.

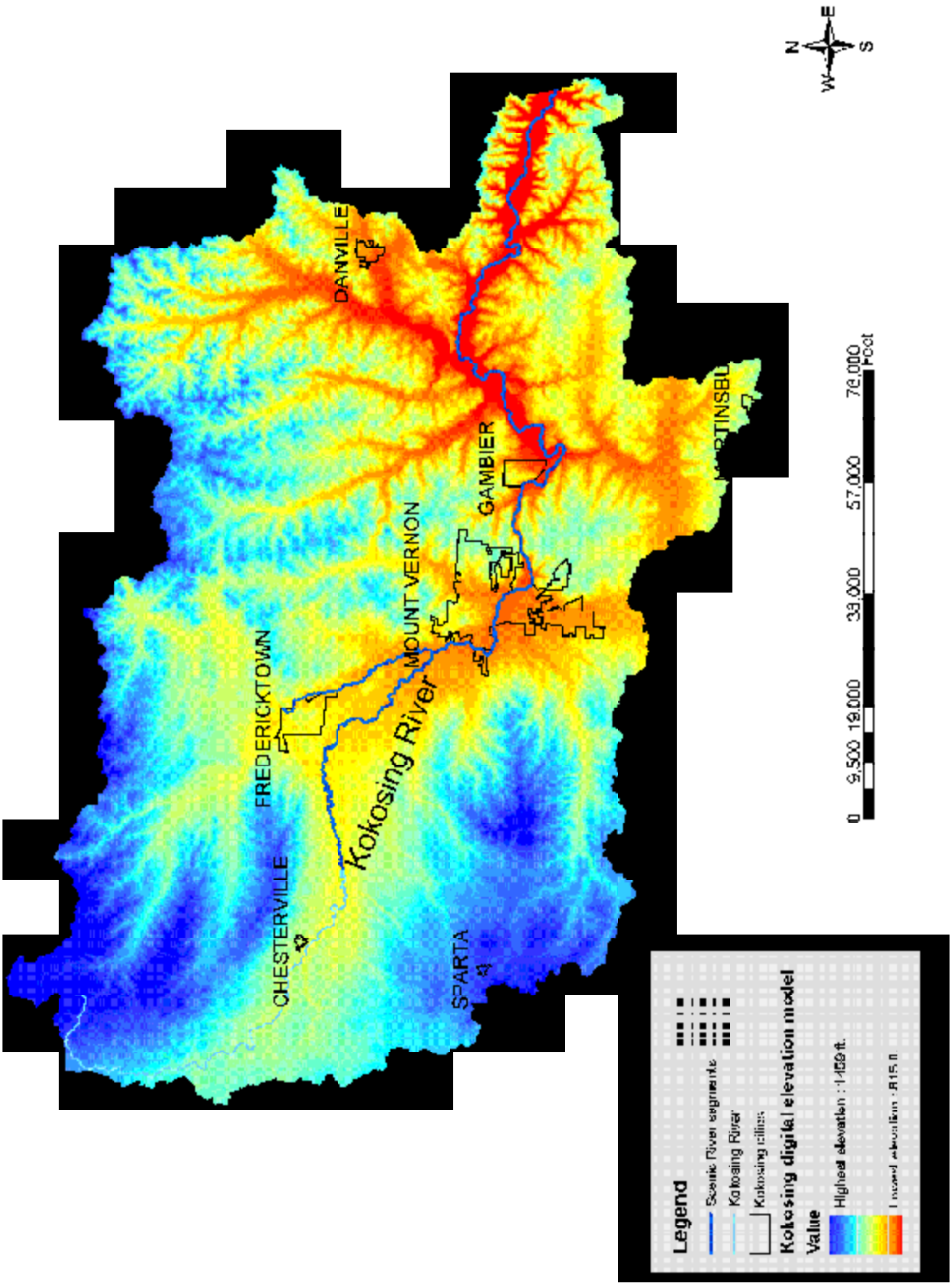
Project Background

The ODNR Division of Natural Areas and Preserves, with support from local legislators, local government officials, Knox Regional Planning Commission (RPC), Kenyon College, Soil and Water Conservation District (SWCD) staff and grassroots organizations, developed a grant proposal for submittal to the Ohio Environmental Protection Agency in 2002 to develop a watershed plan for the Kokosing River. The Kokosing Watershed Plan is unique since it occurs on a state designated scenic river.

The Division of Natural Areas and Preserves uses three approaches in scenic river protection:

- Public project review plays a major role in river preservation. The possible environmental impact of the construction of dams, bridges, roads or other publicly funded projects is carefully considered. ODNR has the authority to approve or disapprove all publicly funded projects on designated scenic rivers outside municipal corporation limits.
- Landowner assistance and education are vitally important components of river protection. Scenic river staff advises landowners about streamside protection techniques and provide technical assistance in river corridor restoration. Scenic river designation does not affect private property rights.
- Water resource protection balances the relationship between the streamside forest buffer, aquatic habitat and water quality. While the maintenance and improvement of the state's water resources are the

Figure 1: Kokosing River Watershed



responsibility of the Ohio Environmental Protection Agency (Ohio EPA), the most effective watershed protection involves cooperation among Ohio EPA, ODNR and local governments. To supplement this effort, The Division of Natural Areas and Preserves developed a stream quality monitoring and biological survey project using volunteers. Division staff also works with federal, state and local agencies to reduce non point source pollution, which causes serious environmental damage to rivers and streams.

Since the Ohio EPA has the responsibility to manage and protect water resources, including the regulation of non point sources of pollution, Ohio EPA agreed to offer a grant to the Division of Natural Areas and Preserves to pursue development of a watershed plan for the Kokosing River.

Mission of the Kokosing River Watershed Planning Project

As adopted through consensus by the Kokosing River Watershed Steering Committee members in February 2003, the mission statement of the Kokosing River Watershed Plan is "**To assist landowners in conserving and managing Kokosing River resources**."

Since most of the watershed is privately owned, the protection, restoration and enhancement of the Kokosing is fundamentally tied to those who own the land in the watershed. The committee decided against the use of specific adjectives to describe the term "resources," since the committee felt that to sustain quality of life in the watershed, a holistic approach was needed to manage several types of resources. The elements important to the committee include: farmland/agricultural resources, greenspace resources, historic and archaeological resources, recreational resources, ground water/surface water resources and biodiversity.

An information/education component used to enhance public understanding of the project included:

- Development of a web site dedicated to the watershed plan;
- Development of various power point presentations for talks to interest groups (Farm Bureau, conservation clubs, gardens clubs, Lions, Rotary, Kiwanis, etc.);
- Development of a brochure insert for distribution;
- One article/month in a local newspaper or newsletter;
- Radio spots on WMVO
- Canoe floats (fish sampling and river clean-up) and other "special events "for public (government officials, Farm Bureau, Owl Creek Conservancy, citizens);
- Networking with the community by participation in events or groups such as community breakfasts, county fairs, U.S. Department of Agriculture (USDA) local working group, Knox RPC

These types of activities will be on-going during the implementation phase of the project as well, to further community awareness of the plan/project. This watershed plan will also be distributed to the Watershed Steering Committee, Scenic Rivers Advisory Council, local elected officials and directors/presidents of non-profit groups operating in the watershed. The watershed plan is posted on the Kokosing watershed plan web site.

Watershed Steering Committee

Members of the steering committee represented a diverse group of local governmental officials and advocacy members. All identified stakeholders in the community agreed to serve on the committee and were active during the planning process. Steering members included:

- Dan Barker, Administrator, Morrow County SWCD
- Brian Bennick, Environmental Director, Knox Department of Health

- Rob Clendening, Administrator, Knox County SWCD
- Siobhan Fennessey, Professor, Kenyon College
- Doug Givens, Managing Director, The Philander Chase Corporation
- David Greer, Board Member, 4-H Extension Advisory & Knox SWCD and Farmer
- Donald Hawk, President, Knox Farm Bureau and Farmer
- Eric Helt, President, Knox Citizens for Smart Growth and Famer
- Jim Henry, Engineer, Knox County
- Steve Kauffman, Dairy Farmer
- The Honorable Dick Mavis, Mayor, City of Mount Vernon
- Randy Pore, Secretary, Knox RPC
- Mark Ramser, President, Ohio Cumberland Gas Development and Real Estate Developer
- Richard Stallard, President, Owl Creek Conservancy

Kim Baker served as chair and facilitator of the steering committee.

Scenic River Advisory Council

The protection and preservation of a designated scenic river depends heavily upon local input and community involvement. The Scenic Rivers Act requires a citizens' advisory council, representing local officials, landowners and conservation organizations, be appointed for each designated river. The council provides advice about local river protection and preservation concerns. Kokosing Scenic River Advisory Council members include:

- Rich Cunningham, Educator
- Frank DiMarco, Professional Forester
- David Greer, Farmer
- Donald Hawk, Knox Farm Bureau
- Ray Heithaus, Director, Brown Family Environmental Education Center
- Jim Henry, Knox County Engineer
- Doug McLarnan, College Township Trustee
- Gary Moore, Tree Farmer
- Roger Yarman, Conservation Club Member

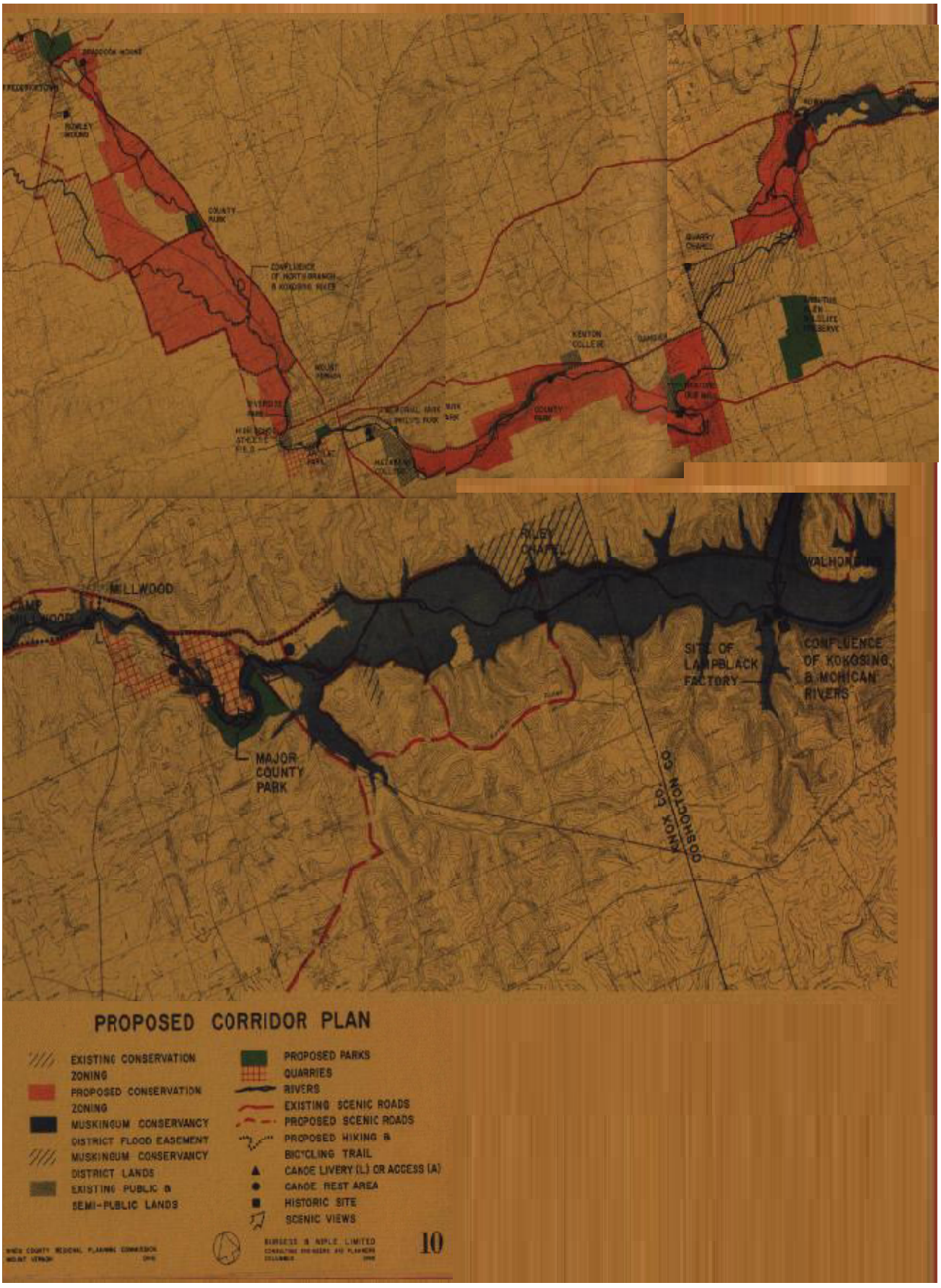
Previous Watershed Studies and Planning Documents

While no previous watershed study has been performed on the Kokosing, the Knox County Regional Planning Commission performed a study of the Kokosing and Mohican River Corridors in 1974 and 1975 (See Figure 2). The study made several recommendations, including purchasing scenic easements or properties within the rivers' corridors, improving local zoning to protect the rivers and providing increased recreational opportunity.

Additionally, *The Kokosing River Study* was prepared in September 1997 by ODNR Division of Natural Areas and Preserves staff. The study included a criteria-based river assessment to ascertain whether the Kokosing River met one of three categories for designation under Ohio's Scenic Rivers Law.

Ohio's Scenic Rivers Law provides for three categories of designation. Wild Rivers serve as rivers that are generally inaccessible, the flood plain is undeveloped, the river is free flowing and 75% of the adjacent corridor is forested to a depth of at least 300 feet. Scenic River designation is representative of a waterway that still retains much of its natural character for the majority of its length. Shorelines are for the most part undeveloped, but the river may exhibit signs of disturbances by human activities. The adjacent river corridor must be forested to a minimum depth of 300 feet for 25% of the stream's length. Recreational Rivers are those rivers that do not possess the same degree of natural quality found in Wild or Scenic Rivers; yet warrant protection due to unique cultural and/or important

Figure 2: 1975 Kokosing River Corridor Study



historical attributes. The influence of human activity is much more apparent on rivers with this classification.

Ohio pioneered the river preservation movement with the enactment of Senate Bill 345 by the 107th General Assembly on February 28, 1968. The Ohio Wild, Scenic, and Recreational Rivers Law, the first of its kind, predated the National Wild and Scenic River Act. The purpose of establishing scenic rivers is to assist in the protection and preservation of the few remaining natural rivers in the state. The focus of Ohio's Scenic Rivers Program is the maintenance of streamside forested corridors wide enough to protect the aquatic resources and suitable for the terrestrial communities dependent on forested riparian habitats.

Designation of the Kokosing River under the "scenic" classification was recommended beginning at the mouth of the river in Coshocton County (RM 0.0) upstream to the Knox/Morrow County line (RM 41.1). Designation was also recommended for the North Branch of the Kokosing River beginning at the confluence with the Kokosing (RM 0.0) upstream to the confluence of North Branch and East North Branch (RM 6.5). Together, these two segments total 47.6 miles. The recommendations were based on the public support received through local government resolutions, the degree to which the scenic river criteria were met, and through qualitative judgment and other subjective interpretations of data and information.

On November 4, 1997 the Director of Natural Resources declared 41 miles of the main stem of the Kokosing River as Scenic from its southern terminus upstream 41 miles. In addition, the North Fork of the Kokosing is also designated from its confluence with the Kokosing upstream 6.5 miles.

The Kokosing River lies within five counties in Ohio: Ashland, Coshocton, Knox, Morrow and Richland. All five counties have made some level of effort regarding regional planning initiatives. Knox County developed its first county-based comprehensive plan in 1974. In 1996, the Knox County/Mount Vernon Chamber of Commerce sponsored an initiative known as "Focus 2100." This initiative included a one-day conference open to all Knox County residents to discuss identification of community strengths and areas of concern. As an outgrowth of this Initiative, Knox County finished its most current comprehensive plan, *Focus 2100*, in 1998. Currently, the Knox RPC is undertaking an update and revision of *Focus 2100*. Several of the goals defined in Focus 2100 are germane to the development of a watershed plan, as listed below:

- To increase outdoor recreation space by 1,000 acres by the year 2005 to satisfy current needs, and by 2,000 acres by the year 2020 to meet projected demand.
- To protect the natural resources and environmental assets of Knox County.

- To protect Knox County's farms and rural character.
- To establish areas for residential growth in a manner consistent with desires to preserve farmland and rural character.
- To establish an effective and adequately staffed and funded planning organization in Knox County.
- To have organized, relevant, and up-to-date information on Knox County land resources readily available to local officials and the public.

- To effectively guide overall development in accordance with a plan for future land use and basic principles of wise land use.
- To develop and redevelop attractive, accessible, and viable commercial areas to serve the needs of Knox County residents.
- To identify (and reserve) areas especially suitable for industrial development and provide adequate industrial sites for future employment needs.
- To identify and recognize historic resources.
- To protect and enhance historic resources.
- Promote historic resources.

Morrow County has yet to develop a comprehensive land use plan. However, a steering committee, formed in 2003, nears competion of a draft plan. The City of Mansfield and Richland County jointly created the Richland County Regional Planning Commission (RCRPC) in 1959 to undertake regional planning. The organization carries on today still true to its original purpose — most notably in the ongoing focus on issues that "affect the development of the Region as a whole" (RCRPC, 2003).

The RCRPC has undertaken several special projects such as the development of stormwater management and erosion control regulations for Richland County and the preparation of a Farmland Preservation Plan. Both Ashland and Coshocton Counties have completed comprehensive land use plans. Ashland County updated its Comprehensive Plan in 2000, which covers many topics including future development patterns, quality of life and transportation issues. Coshocton County began updating its plan, originally drafted in the early 1970s, to reflect changing land use patterns and demographics, in 2003. Some of the strategies drafted in the Coshocton plan include encouraging conservation of environmentally sensitive areas, promoting preservation of natural resources, developing, maintaining and improving the quality of surface water resources and utilizing surface waters for recreational sites, where appropriate. All townships in the watershed, with the exception of five (three in Knox; two in Morrow), possess zoning regulations at the county or township level.

In 1998 and 1999, Knox County's Farmland Preservation Taskforce met to evaluate the state of agricultural production in Knox County, explore alternatives to unplanned development and develop recommendations for the preservation of farmlands in Knox County. Their eight recommendations are as follows:

- Direct funding sources for a county-wide voluntary Purchase of Development Rights Program.
- Knox County Planning Commission staff member be given the duties of administrative support for farmland protection programs and the Farmland Preservation Board.
- Creation of a private countywide land trust.
- Townships create comprehensive land use plans that not only identify and address residential and commercial areas, but also critical masses of productive agricultural lands.
- All townships be educated on a program for calculating the true Cost of Community Services before making any major land use decision.
- Educate and encourage townships to create their own farmland protection programs through special agricultural zoning or Purchase of Development Rights (PDR)/ Transfer of Development Rights (TDR) programs.
- Knox County Regional Planning Commission and the Knox County Cooperative Extension Office initiate a series of continuing education seminars for local attorneys and tax accountants on the tax benefits of PDR programs.
- Joint committee be formed to look at incentives to revitalize and develop existing urban areas that are already serviced by public infrastructure and services. Incentives would not only be considered for industrial and commercial development but also for the revitalization of residential neighborhoods.

Several governmental programs geared toward assisting farmers, improving wildlife habitat and water quality and conserving soil resources are employed in the Kokosing watershed. Most notable programs (with descriptions taken verbatim from agency web sites) are:

- The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to eligible landowners to address wetland, wildlife habitat, soil, water, and related natural resource concerns on private lands in an environmentally beneficial and cost-effective manner. The program provides an opportunity for landowners to receive financial incentives to enhance wetlands in exchange for retiring marginal land from agriculture.
- The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides assistance to farmers and ranchers who face threats to soil, water, air, and related natural resources on their land. Through EQIP, the Natural Resources Conservation Service (NRCS) provides assistance to agricultural producers in a manner that will promote agricultural production and environmental quality as compatible goals, optimize environmental benefits, and help farmers meet environmental requirements. In Farm Bill 2002, additional points are awarded to farmers who participate in the North Branch of the Kokosing and the Kokosing above the confluence the North Branch.
- The Wildlife Habitat Incentives Program (WHIP) is a voluntary program that encourages creation of high quality wildlife habitats that support wildlife populations. Through WHIP, the Natural Resources Conservation Service (NRCS) provides technical and financial assistance to landowners and others to develop upland, wetland, riparian, and aquatic habitat areas on their property. Division of Wildlife also provides technical assistance.
- Conservation Reserve Program (CRP) enables eligible owners or operators to place highly erodible or other environmentally sensitive land into a 10-15 year contract. The participant, in return for annual payments, agrees to implement a conservation plan approved by the local conservation district for converting highly erodible cropland or other environmentally sensitive land to a long-term resource conserving cover (i.e., eligible land must be planted with a vegetative cover, such as, perennial grasses, legumes, fobs, shrubs, or trees).
- Land and Water Conservation Fund (National Park Service pass-through to ODNR Division of Real Estate and Land Management) provides grants up to a 50 percent reimbursement level for outdoor recreation projects.
- NatureWorks (ODNR Division of Real Estate and Land Management) provides up to 75% reimbursement grants (state funding) for acquisition, development or rehabilitation of public park and recreation areas. The agency must have proper control (title or at least a 15-year non-revocable lease) to be eligible for development or rehabilitation grant.
- Greenspace Preservation Grants (Clean Ohio Fund, administered by Public Works Commission) are awarded to local governmental or nonprofit entities for greenspace protection. Special emphasis will be given to projects that: protect habitat for rare, threatened or endangered species; preserve high quality wetlands and other scarce natural resources; preserve streamside forests, natural stream channels, functioning floodplains, and other natural features of Ohio's waterways; support comprehensive open space planning; secure easements to protect stream corridors, which may be planted with trees or

vegetation to help reduce erosion and fertilizer/ pesticide runoff;

- Ohio Department of Agriculture's Agricultural Easement Donation Program (Clean Ohio Fund) allows landowners to donate an agricultural easement on their farm to the state, as well as to a county, municipality, township, or a charitable organization such as a land trust, thereby restricting development on farmland. Landowners may undertake any agricultural activity permitted under Ohio law, and they can sell their farm or pass it along as a gift to others. A restriction prohibiting non-farm development travels with the land, and a new owner would never be able to develop the land for non-farm uses.
- Forest Legacy Grants (ODNR Division of Forestry) is a new program in development in Ohio that will identify and help protect environmentally important forests from conversion to nonforest uses. The main tool used for protecting these important forests is conservation easements. The Federal government may fund up to 75% of program costs, with at least 25% coming from private, state or local sources.
- The Knox SWCD and ODNR, DNAP have collaborated to provide livestock exclusion fencing to local farmers. Funds are provided to the farmer for fencing materials. In exchange for fencing, the farmers protect streambanks from livestock encroachment. Access areas to the stream are planned with technical assistance from the SWCD. This win-win program results in increased water quality, restoration of riparian habitat and allows farmers to continue using streams for livestock watering. Table 1 shows details of the program.

Other programs, such as Ohio EPA's Water Resource Restoration Sponsorship Program (WRRSP) could be deployed in the watershed to protect high quality habitats. The goal of the WRRSP is to abate the loss of ecological function and biological diversity that jeopardizes the health of Ohio's water resources.

Justification and Need

Economic Benefits of Conservation/Protection

Streams and wetlands provide natural flood control, trap sediments, maintain water supplies, recycle nutrients, maintain biological diversity, recharge groundwater, provide wildlife habitat and corridors and afford people places to recreate. These "ecosystem services" help local governments reduce the costs of providing clean water and recreational areas to the public. For instance, reservoirs and water treatment plants located in

Table 1: 2003 Kokosing Watershed Livestock Exclusion Fencing Projects

	Drainage		Buffer	Fence			Total
Stream	Area	Buf Width	Ac.	(ft)	Fence Type	Other Practices	Est. Cost
un-named	> 1sq.mi	15 ft/side	0.2	640	woven wire	crossing	1,960
Indianfield Run trib.	> 1sq.mi	15 ft/side	0.6	1,760	barbed wire		2,640
Dowd Cr.	> 1sq.mi	15 ft/side**	0.5	1,480	4 strand barbed		4,440
Dowd Cr.	> 1sq.mi	15 ft/side	0.7	2,000	4 strand barbed		3,000
North Branch	97 sq.mi	25 ft/side	2.3	4,000	varies	planned crossings	10,000
Headwater trib. To Jelloway Cr.	> 1sq.mi	15 ft/side	0.8	2,160	high tensile	off stream water source	7,524
Headwater trib. To Jelloway Cr.	> 1sq.mi	15 ft/side	0.4	1,120	high tensile	crossing	3,328
** one side constructed at this time. 2nd part of project pending.			**Total:**	**11,680**			

watersheds with healthy streams and wetlands require less dredging of marinas and reduced treatment and filtration for water intake pipes than in watersheds with degraded streams and wetlands. Streams and wetlands absorb significant amounts of rainwater and runoff before flooding, and slow water down (which helps control erosion and sedimentation).

Economic Benefits of Local Tourism

The Kokosing watershed contains many historical and pre-historic sites that serve as assets to local tourism. Preserving the scenic beauty and historic assets in the watershed will ensure that tourism dollars continue flowing into the local economy. One of the more important local tourism opportunities is the emergence of interest in the Amish Culture, which provides enhanced opportunities for tourist travel with Amish settlements located in Holmes, Knox, Coshocton and Tuscarawas Counties. Also, since families are tending to take shorter (yet more frequent day or weekend) trips to avoid traffic and high-risk destinations, local and regional tourism is increasing. Families undertaking day trips seek areas that provide pastoral scenes and striking viewsheds, such as those found in the Kokosing watershed.

As indicated in the U.S. Fish and Wildlife Service's *2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*, wildlife watching is one of the most popular outdoor activities, with approximately $724 million generated annually in trip-related expenditures for Ohio's economy. Likewise, hunting and fishing expenditures generate $645 million and $904 million, respectively. Leisure research points to trends that wildlife watching and bicycling will continue to grow in popularity, due to changing demographics. As more "baby boomers" retire, these individuals will enjoy more discretionary time to recreate, possess disposable income to spend on recreation and, as a group, tend to focus on maintaining a healthier/more fitness-based lifestyle. Thus, outdoor recreation areas will experience greater visitation and pressure to provide quality recreational experiences.

Recreation services can provide significant positive local economic impacts. In 1996, the Wayne National Forest contracted a study to explore the impact of recreation opportunity on the local economy. The authors of the study concluded that this recreational demand led to a $45,768,000 total economic impact, with $24,971,000 total income impact and 1,024 jobs either directly or indirectly associated with recreation services.

A 1994 study, "Travel and Tourism Economic Impacts," conducted in 1996 by MarketVision Research Inc., shows a breakdown of economic outputs from tourism, business travel, and conventions (including outdoor and cultural tourism figures and expenditures such as travel, entertainment, lodging, and sightseeing). The economic impact of local tourism was estimated at $21.51 million for 1996, according to the study.

Outdoor Recreation

Ohio's water resources provide opportunities for a diversity of recreational activities. Ohio has approximately 44,000 miles of rivers and streams and 133,000 acres of inland lakes and reservoirs. In 1990, the Ohio Outdoor Recreational Participation Study verified the importance of water-based recreation by finding that fishing, boating, swimming and beach activities were in the top 10 of the most frequently participated in activities.

Quality recreational experiences in activities such as fishing, boating and/or swimming are directly related to the water quality. Because the Kokosing River and its tributaries are a high quality resource in a generally rural setting, it makes sense that Knox and Morrow Counties have an abundance of recreational opportunities to pursue.

In addition to the Kokosing River serving as a recreational resource, 1 to 2 percent of Knox County and Morrow County is devoted to other recreational endeavors. Of Knox County's 338,672 total acres, 5,940 acres are comprised of parks and open space. Morrow County contains a total of

260,280 acres with 1,643 acres used for parks and open space. While the citizens of Knox and Morrow Counties may perceive that their respective counties contain large amounts of greenspace, both counties actually rank low in terms of percentage of outdoor recreation acreage given county land size and population.

This public perception is based on the amount of undeveloped, privately held land in the watershed that the public perceives as greenspace. However, with increasing residential and commercial development, more citizens in the watershed are growing aware of the need to preserve and protect greenspace. The Knox Citizens for Smart Growth was formed to advocate the need to protect greenspace, farmland and quality of life. Additionally, The Owl Creek Conservancy, a private nonprofit organization, is "dedicated to preserving natural and agricultural lands in the Knox County area through widespread private action, and works with landowners for the public good to maintain and to improve the quality of life by preserving woodland, wetlands, farmland, waterways, scenic vistas and wildlife habitats of environmental, historic, and community importance." The Owl Creek Conservancy has secured conservation easements on wooded and riparian areas adjacent to the Kokosing.

No outdoor recreation areas occur in the Kokosing River watershed within Richland County. Coshocton County contains a small amount of outdoor recreation area, due to the presence of lands owned and managed by the Muskingum Watershed Conservancy District. Ashland County contains a small portion (255 acres) of the Mohican Memorial State Forest that occurs in the watershed. One park district and one recreation district own land in the watershed (Knox County Park District and Fredricktown Recreation District). Park Districts in Ashland, Morrow, Coshocton and Richland Counties do not own any land in the watershed.

The Kokosing River watershed contains several recreational facilities. Table 2 lists all outdoor recreation sites reported in the 2002 Statewide Comprehensive Outdoor Recreation Plan (SCORP). Several additional sites not found in the SCORP are included as well. Table 3 shows existing and planned trails that occur, either partially or wholly, within the Kokosing River watershed.

Major recreational areas include the Kokosing Lake Wildlife Area, making up 1,323 acres and the Knox Lake Wildlife Area, containing 761 acres. A small portion of the Mohican State Forest lies within the northeastern corner of the watershed, and the Muskingum Watershed Conservancy owns 1,495 acres in the lower portion of the Kokosing, managing these lands for hunting and hiking opportunities. More privately owned facilities than public facilities exist, and the largest of these is Apple Valley, covering 3,700 acres.

The Kokosing Gap Trail is a popular recreational resource stretching more than 14 miles from Mount Vernon to Danville along the Kokosing River. The City of Mount Vernon recently expanded the Kokosing Gap Trail and has plans to link the trail with other Mount Vernon managed park sites. Also in the conceptual planning stages is a trail linking the Kokosing Gap Trail that will trend through and outside the watershed to Centerburg, Ohio. Approximately 1.0 mile of the 4.54 mile Mohican Valley Trail lies within the Kokosing watershed. The Mohican Valley Trail links with the Kokosing Gap Trail in Danville, and consists of a multi-use trail for mountain bikes, horses and Amish buggies. About seven percent of available recreational area is water, with a large portion located at Knox Lake Wildlife Area and the Kokosing Lake Wildlife Area, suitable for canoeing and boating, fishing and other water-oriented activities. A 29 acre wooded area, Knox Woods, is designated as a state Nature Preserve by the Ohio Department of Natural Resources. Adjacent to Knox Woods is the Knox Park District area, known

Table 2: Outdoor Recreation Sites in the Kokosing Watershed

RECREATION SITE	LAND (Acres)	WATER (Acres)	HIKE TRAILS (Miles)	BIKE TRAILS (Miles)	HUNT (Acres)	BOAT (Acres)	CANOES (for rent)	BACKPACK TRAILS (Miles)
FREDERICKTOWN COMMUNITY PARK	35	1	0	0	0	0	0	0
ARCH AVE.PARK	21	0	0	0	0	0	0	0
DAN EMMETT PARK	5	0	0	0	0	0	0	0
CAMP MCPHERSON	160	1	3	0	0	0	0	0
LAKE MARANATHA CAMP	79	2	3	0	52	2	6	0
APPLE VALLEY GOLF COURSE	203	2	0	0	0	0	0	0
CAMP ANDERSON	200	5	2	0	0	0	0	0
MOHICAN MEMORIAL STATE FOREST	5,109	0	25	0	4,800	0	0	25
DEERFIELD LANES	17	0	0	0	0	0	0	0
KOKOSING VALLEY CAMP & CANOE	100		2				40	
KOKOSING WILDLIFE AREA	1,110	1	0	0	1,114	0	0	0
SUGARTREE FARMS	80	0	0	0	0	0	0	0
RUSTIC KNOLLS	98	2	3	0	0	0	0	0
RIVERSIDE PARK	18	0	0	0	0	0	0	0
PHILLIPS PARK	5	0	0	0	0	0	0	0
MOUNT VERNON COUNTRY CLUB	50	0	0	0	0	0	0	0
MERRIN MEMORIAL PARK	3	0	0	0	0	0	0	0
THE CAVES	25	0	0	0	0	0	0	0
MEMORIAL PARK	43	0	0	0	0	0	0	0
TOMAHAWK GOLF COURSE	50	2	0	0	0	0	0	0
KNOX WOODS	30	0	2	0	0	0	0	0
KNOX LAKE WILDLIFE AREA	266	495	0	0	0	495	2	0
KNOX CO.FISH & GAME ASSOC.	40	0	0	0	40	0	0	0
KNOX CO FAIRGROUNDS	66	1	0	0	0	0	0	0
IRISH HILLS GOLF COURSE	135	0	0	0	0	0	0	0
HIDDEN HILLS GOLF COURSE	30	1	0	0	0	0	0	0
HICKORY GROVE CAMPING	6	1	0	0	0	0	0	0
HIAWATHA GOLF COURSE	128	2	0	0	0	0	0	0
HIAWATHA COMMUNITY PARK	20	0	0	0	0	0	0	0
BROAD ACRES PRESBYTERIAN CAMP	86	0	2	0	0	0	0	0
WARNER PARK	1	0	0	0	0	0	0	0
FOUNDATION PARK	90	175	0	0	0	0	0	0
McDONALD PROPERTY	2	0	0	0	0	0	0	0
WOLF RUN REGIONAL PARK	267	1	0	0	0	0	0	0
MUSKINGUM WATERSHED CONSERVANCY DISTRICT	1,495	0	0	0	1,495	0	0	0
KNOX LANDFILL					68			
VIADUCT PARK	0.5							
McILVAINE PARK	0.5							
RAMSER ARBORETUM	630		25					
CAMP CORNISH	14		1					

Table 3: Existing and Proposed Trails in the Kokosing Watershed

Trail Name	Status	Length in Miles
Ohio to Erie Trail	Existing, Planned Segments	13.90
3C Trail	Planned	31.04
Ohio to Erie Trail	Existing, Planned Segments	48.20
Kokosing Gap Trail	Existing	14.74
Mohican Valley Trail	Existing	4.54
Owl Creek Trail	Planned	10.25

as Wolf Run Regional Park. Mount Vernon Nazarene University protects a 69-acre parcel as a nature preserve.

In 2003, the Knox Park District was awarded a Clean Ohio Fund Greenspace Preservation Grant to acquire a 2.0-acre parcel adjacent to the Kokosing River. The ODNR Scenic Rivers Program obtained a conservation easement over this parcel and is assisting the Knox Park District with restoration of riparian buffer on this parcel. The City of Mount Vernon was also awarded several Clean Ohio Fund grants to protect Kokosing River corridor parcels (at Foundation Park) and a 53-acre high quality (category three) wetland and Delano Run floodplain area, now known as the Blackjack Wetlands Preserve. The Owl Creek Conservancy will hold a conservation easement over the wetland preserve.

Facilities such as the bike trail and parks use the river to visually/aesthetically enhance the recreational experience for their users. The canoe livery and wildlife areas provide for more direct use of the river. Conversely, the bike trail, parks and canoe access sites provide users the chance to experience the river, which in turn, leads to greater appreciation and support for the protection of the Kokosing State Scenic River. Thus, recreational access and opportunity, if planned appropriately, can enhance support for the Kokosing River, while protecting unique habitats.

The Kokosing River has an adequate flow for canoeing throughout the year on the lower portion and fishing and hunting opportunities are well known. Part of the Kokosing River lies in the Mohawk Dry Reservoir flood area. Rapids, riffles, rock outcroppings and an isolated appearance give the Kokosing River its wilderness quality, particularly below Hazel Dell Road and Millwood Road Bridge at the gorge. A fair portion of the Kokosing River is canoeable on a yearly basis, weather permitting.

Nearly all Ohio rivers and streams are dependant upon rainfall and tend to have low flows late in the season that are not conducive to canoeing and/or recreational boating. Canoeing on the upper stretches of the Kokosing River, from the confluence with the North Branch until it reaches Howard, is somewhat restricted by such seasonal variations in river flow. According to ODNR, Division of Watercraft, the upper stretches of the Kokosing River above the confluence with North Branch are considered non-paddleable and may possess considerable logjams and portages. Examples of hazards in the upper stretches include three dams that are northwest of Mount Vernon. One is located on North Branch, another one lies on the East Branch of the Kokosing.

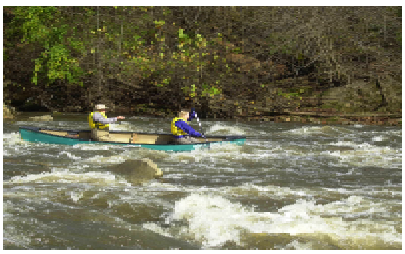
Table 4 lists Kokosing River canoe access sites, as provided by ODNR Division of Watercraft. It is important to note that most sites are undeveloped for canoe launching, so canoeists should exercise caution and obtain permission prior to accessing the river via private property.

The general feeling of isolation experienced on most sections of the Kokosing River is greatly diminished while canoeing through Mount Vernon

Table 4: Kokosing River Canoe Access Sites

Description	Nearest Town	County	Park-ing	Canoe Rental	Rest Room	Water	Picnic
Riverside Park off SR36/229. Access Left.	Mount Vernon	Knox	Yes	No	Yes	Yes	Yes
Memorial Park off Mount Vernon Ave. Access River Right.	Mount Vernon	Knox	Yes	No	Yes	Yes	Yes
Laymon Road Bridge. Canoe access River Right.	Gambier	Knox	Yes	No	No	No	Yes
Big Run Road. Canoe access River Right.	Gambier	Knox	Yes	No	No	No	Yes
Zion R. Bridge. Roadside Access River Right.	Gambier	Knox	Yes	No	No	No	No
Pipesville Road Canoe access River Right.	East of Howard	Knox	Yes	No	No	No	No
SR 715 to Riley Chapel Road.	East of Millwood	Knox	Yes	No	No	No	No
SR715 to Twp. Rd. 366/423 Bridge (W. of Walhonding at Mohican confluence) Access River Right & Left.	North of New-castle	Coshoc-ton	Yes	Yes Koko. Valley Camp & Canoe	No	No	No

because of the many bridge crossings, and urban activity; however, this is only temporary and the river quickly returns to its wilderness atmosphere once Mount Vernon is passed. The main stem of the Kokosing River from the Gambier area until it combines with the Mohican and Walhonding Rivers is generally canoeable year-round and relatively free of hazards. It is on this stretch below Hazel Dell Road and the Millwood Bridge that the scenic and challenging gorge begins where, depending on the water level, a section known as "Factory Rapids" may be considered a class 1 or 2 rapid. Caution should be taken when canoeing through the gorge.



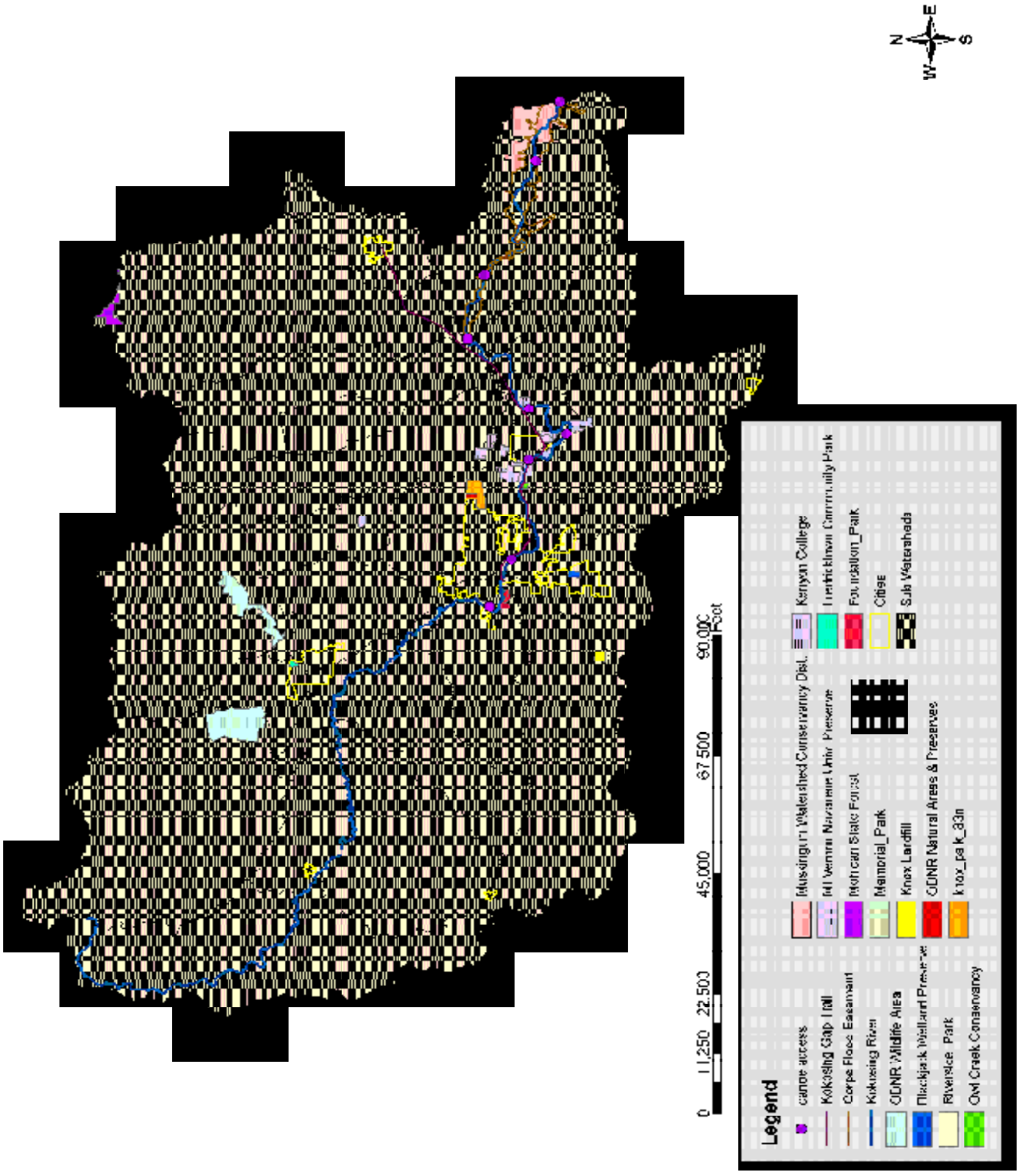
One canoe livery currently operates on the Kokosing River, the Kokosing Valley Camp and Canoe Livery. Their operating area includes the stretch through Millwood to the confluence with the Mohican River. The Kokosing Valley Camp and Canoe Livery operates from April through October 15th every year averaging about 300 people each month who use the livery services to experience the Kokosing River.

Knox County's comprehensive plan, Focus 2100, lists several initiatives relating to tourism and outdoor recreation including:

- Define the Kokosing and Mohican River Corridors as a "Greenway" and centerpiece of an extensive county-wide multi-purpose open space system;
- Aggressively seek additional parkland acquisition funds through available public grant programs, private foundation grants and private donations;
- Pursue a dedicated source of local tax revenue for the Knox County Park District;
- Extend the Kokosing Gap Trail where possible;
- Create a community land trust for open space preservation.

Several of the initiatives have been undertaken, with varying degrees of success. Owl Creek Conservancy, a non-profit land trust, serves as a community land trust for Knox County, and the Knox County Park District has been successful in obtaining state funds for greenspace preservation. The Kokosing Gap Trail has been extended into Mount Vernon and plans are underway for additional trail connections. In a difficult economic climate, voters in Fredricktown renewed a 1.5 mill-operating levy (maintenance and operations) for the Fredricktown Recreation District in November 2003. Figure 3 shows Kokosing watershed open spaces, protected areas and canoe access sites.

Figure 3: Kokosing Watershed Open Spaces, Protected Areas and Canoe Access Sites



NATURAL RESOURCE INVENTORY

Defining the Watershed

The Kokosing River watershed is situated between the two urban centers of Mansfield and Columbus in the northeast central Ohio rural countryside. This area has undergone significant changes in the past 100,000 years as a result of glacial activity. Most of the watershed lies within Knox County, which was on the outer edge of an area covered by continental glaciers. Two main glacial events left their mark on the landscape. The first was the Illinoian glacier that moved across the watershed and covered most of the eastern part of Knox County. The ice flowed around and between the hills leaving glacial deposits of varying thickness. The second glacial event only covered the western part of Knox County. It also left thick deposits of gravel, sand and silt. These events, together with nature's erosive forces, molded the present landscape.

The Kokosing River underwent many changes to become the river it is today. Draining an area of 482 square miles from a total of five counties, the Kokosing River watershed somewhat resembles the shape of the United States. The headwaters begin in Morrow and Richland counties. The majority of the river runs through the central part of Knox County almost splitting it in half. However, some tributaries do reach to the north just into Ashland County. An average fall of 8.5 feet per mile takes the Kokosing River from an elevation of 1,308 mean sea level (MSL) at the source in Morrow County just east of Mount Gilead to 819 MSL at the mouth in Coshocton County. The Kokosing River's main tributaries are the North Branch, draining 96.6 square miles, and Jelloway Creek, draining 74.2 square miles. Traveling some 57 miles from its headwaters, the Kokosing enters Coshocton County and joins the Mohican River to form the Walhonding River. Typically 12 hours pass between rainfall events in the upper Kokosing and Mohican River watersheds to when the Walhonding River level rises at the U.S. Army Corps of Engineers' Mohawk Dam. These rivers and several others eventually flow into the Muskingum River and finally into the Ohio River. The Muskingum River watershed is the largest basin in the state draining 8,051 square miles of eastern Ohio. Annual precipitation in the Kokosing watershed near Mount Vernon is 38.0 inches and near Millwood is 38.3 inches. As indicated by the National Climatic Center in Asheville, North Carolina, and reported in the Knox County Soil Survey, the Kokosing watershed is cold in winter and fairly warm in summer. Winter precipitation, in the form of snow, results in a good accumulation of soil moisture by spring and minimizes drought conditions during summer on most soils.

The Kokosing River name itself has an interesting history. The name "Kokosing" in the Delaware Indian language is said to mean "River of Many Delaware Villages." Other sources say that the word "Kokoshing" was used by the Algonquin Indians and meant "River of Little Owls." In addition, many early historians referred to the river as "Owl Creek." Use of this name prior to 1866 is corroborated by the names used for the Owl Creek Bank of Mount Vernon, Owl Creek Baptist Church and the Owl Creek Bookstore among others. There is also record of the name "Vernon River" being promoted by Bishop Philander Chase, founder of Kenyon College.

Land Use Characterization

The 1994 land use/land cover for the watershed suggests that a large percentage of the watershed consisted of agricultural/open lands and forested habitat. The 1994 land use coverage was used, since it was the most up-to-date coverage available for the entire watershed. During the course of plan document preparation, ODNR developed new land use/land cover coverages for Knox County. Land cover types, acreages and percentages are found in Table 5, based on the 2003 Knox data and 1994 data from the other 4 counties.

A comparison between the Knox 2003 and the Knox 1994 land use/land cover was not made, due to differences in the processing of the two data sets. The 1994 land use/land cover was determined using Landsat (satellite) imagery, whereas the Knox 2003 land use/land cover was determined using digital orthophotography (which is much more site-specific and offer greater detail for interpretation). Approximately 25,595 acres of grazing lands, 96,385 of cropped lands and 46 acres of confined feeding operations are found in the Knox County portion of the watershed. One berry farmer irrigates crops in Knox County. Livestock totals for the entire watershed were unavailable, however 1998 adjusted data for the Knox County portion of the watershed are as follows: beef cattle (11,711 head), dairy cattle (12,887 head), hogs (17,918 head), sheep (10,063 head), poultry (18,563 head) and horses (527 head). The Knox County data was based on a livestock inventory undertaken in the Kokosing watershed by the Knox SWCD. Figure 4 shows watershed land use cover types. Table 6 provides a breakdown of land use cover by subwatershed.

Geology & Soils

Please note that stream names in quotes are ancient streams that no longer exist.

The Kokosing River as it exists today dates back to the time of the Illinoian glaciation some 150,000 years ago. Prior to this time, most of the area now drained by the Kokosing drained to the south through the ''Utica'' River, a south-flowing tributary of the "Newark" River. The "Newark" River flowed south from Newark to join the "Cincinnati" River, which roughly followed the course of the present Ohio River.

The Illinoian glacier directly or indirectly blocked the pre-existing drainage courses, forcing the water to create new routes of escape. The routes that were created as the result of the Illinoian glaciation were modified only slightly by the Wisconsinan glaciation some 100,000 years later.

The present Kokosing valley is a combination of valley segments differing in age. Each of these segments has its history and distinct characteristics. For this reason, the geology and soils can best be described by segments. If the present valley were thought of as a pipeline, the segments from Mount Vernon to Gambier and Millwood to Zuck would be "new" couplings used to connect lengths of much older pipe.

Segment I: From Mount Vernon upstream- the headwaters

This part of the Kokosing watershed was once the headwaters of the "Utica" River. The West and North branches of the Kokosing, as well as Dry Creek follow routes essentially unchanged from preglacial times. The East Branch of the Kokosing may have flowed to the northeast toward Butler. No references to this effect were found, but the major tributaries, Toby, Markley and Isaacs Runs all flow to the east and make sharp turns into the East Branch.

From Mount Vernon, the "Utica" River flowed south through the valley now occupied by the north-flowing Delano Run and that occupied by the south--flowing part of Sycamore Creek. Gla-

Table 5: Land Cover in the Kokosing Watershed

Land Cover	Acres	Percent of Watershed
Agricultural/Open Land	181,984	59.0
Barren	772	0.3
Shrub Areas	10,838	3.5
Urban (impervious surface)	23,779	8.0
Open Water	2,783	1.0
Wetlands	2,127	0.7
Wooded	88,480	28.0

Figure 4: Land Use Cover in the Kokosing Watershed

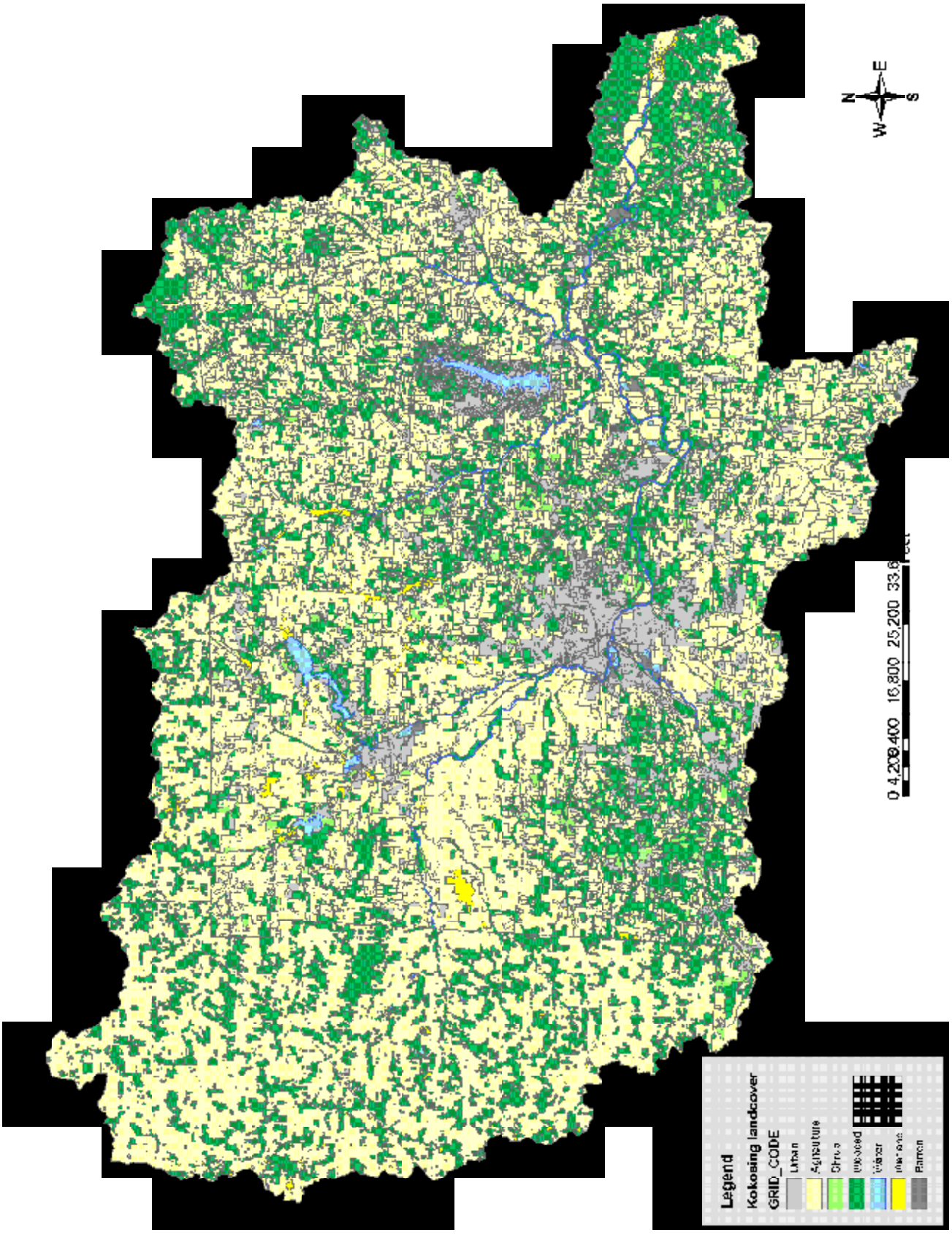


Table 6: Land Cover in the Kokosing Watershed

NARRATIVE	Land Cover Type	Acres
Kokosing River headwaters to below S. Branch Kokosing R.	**Land Cover Type**	**Acres**
	Urban	128
	Agriculture	16,769
	Shrub	85
	Wooded	6,077
	Water	28
	Wetland	211
	Barren	0
		23,298
Kokosing River below S. Branch to below Mile Run	**Land Cover Type**	**Acres**
	Urban	187
	Agriculture	16,595
	Shrub	171
	Wooded	7,323
	Water	85
	Wetland	378
	Barren	19
		24,758
Kokosing River below Mile Run to above N. Branch	**Land Cover Type**	**Acres**
	Urban	1,850
	Agriculture	207,304
	Shrub	283
	Wooded	26,127
	Water	117
	Wetland	80
	Barren	7
		235,768
North Branch Kokosing River headwaters to near St. Rt. 13	**Land Cover Type**	**Acres**
	Urban	388
	Agriculture	334,267
	Shrub	479
	Wooded	12,868
	Water	169
	Wetland	153
	Barren	0
		348,323
East Branch Kokosing River	**Land Cover Type**	**Acres**
	Urban	1,274
	Agriculture	12,812
	Shrub	490
	Wooded	5,035
	Water	514
	Wetland	279
	Barren	2
		20,406

Table 6: Land Cover in the Kokosing Watershed (continued)

North Branch Kokosing River near St. Rt. 13 to Kokosing R.	**Land Cover Type**	**Acres**
[except East Branch]	Urban	1,624
	Agriculture	8,604
	Shrub	263
	Wooded	2,021
	Water	236
	Wetland	378
	Barren	118
		13,244
Kokosing River below N. Branch to above Dry Run	**Land Cover Type**	**Acres**
	Urban	2,065
	Agriculture	5,158
	Shrub	496
	Wooded	2,999
	Water	150
	Wetland	0
	Barren	78
		10,947
Dry Creek	**Land Cover Type**	**Acres**
	Urban	2,436
	Agriculture	10,157
	Shrub	1,263
	Wooded	7,756
	Water	150
	Wetland	33
	Barren	106
		21,901
Kokosing River below Dry Creek to above Big Run	**Land Cover Type**	**Acres**
	Urban	6,013
	Agriculture	7,877
	Shrub	1,247
	Wooded	5,584
	Water	140
	Wetland	19
	Barren	125
		21,003
Big Run	**Land Cover Type**	**Acres**
	Urban	1,433
	Agriculture	13,197
	Shrub	877
	Wooded	4,297
	Water	72
	Wetland	9
	Barren	3
		19,887

Table 6: Land Cover in the Kokosing Watershed (continued)

Indianfield Run	**Land Cover Type**	**Acres**
	Urban	255
	Agriculture	5,236
	Shrub	307
	Wooded	1,630
	Water	21
	Wetland	2
	Barren	1
		7,452
Little Schenck Creek	**Land Cover Type**	**Acres**
	Urban	476
	Agriculture	6,573
	Shrub	357
	Wooded	2,750
	Water	43
	Wetland	210
	Barren	3
		10,411
Schenck Creek [except Little Schenck Cr.]	**Land Cover Type**	**Acres**
	Urban	1,209
	Agriculture	8,856
	Shrub	979
	Wooded	4,674
	Water	65
	Wetland	192
	Barren	10
		15,986
Kokosing River below Big Run to above Jelloway Cr.	**Land Cover Type**	**Acres**
[except Indianfield Run & Schenck Cr.]	Urban	1,776
	Agriculture	9,458
	Shrub	459
	Wooded	10,576
	Water	421
	Wetland	7
	Barren	128
		22,825
Jelloway Creek [except E. Branch & L. Jelloway Cr.]	**Land Cover Type**	**Acres**
	Urban	883
	Agriculture	16,931
	Shrub	1,238
	Wooded	9,182
	Water	92
	Wetland	9
	Barren	17
		28,352

Table 6: Land Cover in the Kokosing Watershed (continued)

East Branch Jelloway Creek	**Land Cover Type**	**Acres**
	Urban	704
	Agriculture	5,224
	Shrub	333
	Wooded	4,782
	Water	708
	Wetland	0
	Barren	1
		11,753
Little Jelloway Creek	**Land Cover Type**	**Acres**
	Urban	2,291
	Agriculture	5,579
	Shrub	393
	Wooded	3,675
	Water	556
	Wetland	9
	Barren	32
		12,535
Kokosing River below Jelloway Cr. to above Mohican R.	**Land Cover Type**	**Acres**
	Urban	983
	Agriculture	7,539
	Shrub	1,272
	Wooded	10,454
	Water	182
	Wetland	161
	Barren	123
		20,714

cial deposits near Sycamore Road blocked this route. Water backed up to the north of the blockage until a new escape route was cut to the east.

This part of the Kokosing watershed is extensively glaciated. The underlying Mississippian age sandstone is exposed in only a few places. The area was covered not only by the Illinoian glaciation, but also by the Wisconsinan glaciation some 100,000 years later. Most surface deposits in the area are of Wisconsinan age or younger. Glacial deposits believed to be of Illinoian age are at the surface north of Ankenytown and in the watershed of Toby Run. Illinoian deposits are present below the Wisconsinan in a deep cut along Granny Creek in Wayne Township.

Glacial deposits in the area include glacial till, deposited by the ice itself and glacial meltwater deposits laid down by water from the melting glaciers. Meltwater deposits are of two general types; outwash, deposited by flowing water and lacustrine of slackwater deposits that settled out of still or slowly moving water. Alluvial deposits along the major streams were deposited in relatively recent times.

At the east end of this segment, Center Run enters the Kokosing from the north. This stream once had a larger watershed that included the upper reaches of the present Schenk Creek watershed. The valley was blocked by glacial debris in the vicinity of Wells Road. Water ponded north of the blockage until cutting a new valley to the east to join that of Little Schenk Creek near the intersection of Gilchrist and O'Brien Roads.

The upper reaches of Schenk Creek connect through a sediment filled valley with the up-

per end of the Wannegan valley drainage into Knox Lake. There is no clear documentation that water ever flowed south through this connector, but soil mapping shows an area of water lain gravel near the present drainage divide. This may have been a temporary escape route for water from the melting Wisconsinan glacier.

This part of the watershed contains soils formed in all of the materials listed above. Of greatest extent are soils formed in glacial till deposits. These are the dominant soils on upland positions. In general, they have steeper slopes than the water-laid soils and thus have a higher potential for runoff and sediment production. The increasing use of these soils for row crops, especially corn and soybeans, is increasing the amount of sediment produced.

There are four major groups of till-derived soils in the area. The oldest are the Homewood (Hanover in Richland County) and Titusville soils formed in Illinoian age till. Wooster and Canfield soils formed in the oldest Wisconsinan age till deposits. Slightly younger are the Rittman and Wadsworth soils, with the Amanda, Centerburg and Bennington soils formed in the youngest till deposits. Of these, Homewood, Wooster and Amanda are well drained; Titusville, Canfield, Rittman and Centerburg are moderately well drained; and Wadsworth and Bennington are somewhat poorly drained.

Homewood, Titusville, Wooster, Canfield, Rittman and Wadsworth soils all contain a dense subsoil layer called a fragipan. This layer, believed caused by silica cementation, restricts water movement and to some extent, root development. It increases the potential for runoff by preventing water from moving into the lower part of the soil. Once the pores above the fragipan are full of water, any additional rainfall will run off. The fragipan also restricts root penetration in dry periods, reducing the volume of soil from which plants can extract water. Controlling erosion is the main management concern on the till derived soils. Wetness is also a problem on Bennington and Wadsworth soils, and in the more concave areas of the other soils.

No till planting is used as an erosion control practice in corn and soybeans. This is helping to compensate for the decreasing acreage of hay and pasture. Soils formed in outwash deposits laid down by water from the melting glaciers are extensive in the major valleys. These soils generally have lower slopes and higher infiltration rates than the till derived soils and are less likely to be a source of sediment. They have porous substrata, which can contribute to groundwater pollution. Ockley is the dominant soil formed in outwash in the upper Kokosing valley. It is a deep, well-drained soil with a loamy upper part to hold nutrients and water and a gravelly lower part to provide drainage. Ockley soils with slopes less than 6 percent dominate the "Green Valley" area of Knox County, an excellent farming area.

Other soils formed in outwash include Chili, which is more acid than Ockley, Fox, which has gravel within 40 inches, and Bogart, which is moderately well drained. Limestone is an important component of the gravel underlying Ockley and Fox soils, while the gravel underlying Chili and Bogart soils is dominantly sandstone and igneous pebbles.

The outwash filled valleys are excellent ground water reservoirs. They are also sources of commercially useable sand and gravel. The soils are well suited to housing and other non-farm land uses, and conversion of farmland to other uses can be expected to continue.

The dominant soil formed in lacustrine or lakebed deposits is Luray silty clay loam. This is a deep, dark colored, very poorly drained soil with silty textures. It has a high organic matter content and is very productive when adequately drained. Lakebed deposits are not extensive in this part of the Kokosing watershed. The largest areas are along Blackjack Road south of Mt. Vernon--in an old valley connecting the west and north branches of the Kokosing west of Fredricktown and in Wannegan

Valley at the head of Knox Lake. The Luray soil dominates all these areas.

Soils formed in recent stream deposits, or alluvium, are present on flood plains. Most flood plains in this part of the watershed are no wider than a few hundred feet and are not much lower than the adjacent outwash terraces. Soils on the flood plains are much younger than those on other parts of the landscape and do not have well defined subsoil layers. The dominant soil along the larger streams is Tioga fine sandy loam. This deep, well-drained soil is loam and sandy loam in the upper part and commonly is underlain by sand and gravel. Moisture shortages are common in extended dry periods. All areas are subject to flooding, but frequency and duration of flooding vary considerable from area to area.

Shoals in silt loam is the dominant soil in the narrower valleys. It is a deep, somewhat poorly drained soil that is loamy in the upper part and has sand and gravel below three feet. Other common soils formed in alluvium are Lobdell, Sloan and Medway. Sloan soils are dark colored and very poorly drained. Lobdell and Medway soils are moderately well drained. Medway soils have a dark surface layer high in organic matter and area very productive.

Segment II: Mount Vernon to Gambier - the Kokosing Gap

This is one of the younger segments of the present Kokosing valley. It formed when water ponded by the blockage of the "Utica" River backed up the valley of a west flowing tributary at the southeast corner of what is now Mount Vernon. The water broke over a divide into an east flowing stream, a tributary of the stream to be discussed in Segment III. The water cut downward through the weakly consolidated sedimentary rocks to form the present, steep-sided valley. Rocks exposed in the valley sides are the medium and coarse grained Black Hand and fine grained Logan sandstones, both of which are Mississippian age. This portion of the Kokosing has little watershed. Areas to th north and south drain to the east through tributaries of the older valley mentioned previously.

The dominate soils of the steep and very steep sided slopes are Schaffenaker loamy sand and Brownsville channery silt loam. The Schaffenaker soil is moderately deep and well drained. It formed in residuum and colluvium from medium and coarse-grained sandstone. These materials are mostly quartz with little feldspar or mica to weather into clay. As a result, Schaffenaker soils have weakly expressed subsoil. They are very acid and infertile. Tree growth is slow. Brownsville soils formed in residuum and colluvium from fine-grained sandstone and siltstone. They are deep and well drained with many rock fragments throughout. They are not quite as droughty as Schaffenaker soils but tree growth is still slow, especially on south facing slopes.

Above the Schaffenaker and Brownsville soils on shoulder slopes are the Loudonville soils. These soils consist of 20 to 40 inches of glacial till over residuum from sandstone. Rock at this depth limits rooting depth and moisture supplying capacity. Some roots, especially those of trees, penetrate cracks in the rock. The well-drained, porous Tioga soils are dominant on the narrow flood plain.

Segment III: Gambier to Howard- stream reversal

This segment of the Kokosing has a complex geologic history; some of which is difficult to visualize today. This discussion is based primarily on the work of Dr. Jane L. Forsythe, as recorded in Chapter 6 of "*The Geology of Knox County.*" The "Utica" River, mentioned in Segment I had a major tributary which entered from the east near the present railroad crossing on Route 13 about 3 miles north of Utica. This stream started south of Loudonville in what is now the Mohican River valley. At Greer, it turned southwestwardly through a valley paralleling Chapel road to Dowds Creek. Remnants of this valley are still very evident. The stream then flowed south using the present valleys of Dowds and Jelloway Creeks to Howard. From Howard, it continued southwest toward Gambier in the present Kokosing valley but flowing in the

opposite direction from the present stream. Just east of Gambier, the stream turned south up the present valley of Big Run, then west to join the "Utica" River. Indianfield Run and the upper Wakatomica Creek were tributaries to this stream.

Glacial deposits blocked this valley in the vicinity of Devore Road. This backed water to Gambier and Howard and up a west flowing tributary that passed through Millwood. The water broke over a divide and began flowing east into a tributary of the "Newark" River that flowed south from Coshocton.

Meanwhile, Indianfield Run was blocked between Burtnett and Horn roads and cut Arbutis Glen to the north. Its old valley is very evident on Horn and Grove Church roads. Wakatomica Creek was blocked west of U.S. 62 creating a sizeable lake north of Bladensburg until a new valley was cut to the south. A plug formed in the valley between Greer and Dowds Creek causing the upper part of the stream to flow east. The same happened in the valley between Brinkhaven and Danville and in the valley of Flat Run. Thus the eastern tributaries were cut off and are now part of the Mohican River and Wakatomica Creek drainage. It should be mentioned that at this time the Mohican was not the stream it is today since everything upstream from Loudonville drained to the northeast toward Shreve.

The valleys of the upper Jelloway Creek and Little Schenck Creek have undergone minor drainage changes in both the Illinoian and Wisconsinan time.

Most of the area drained by this segment of the Kokosing was glaciated in Illinoian time. The Illinoian glaciation was not vigorous and glacial deposits are thin or absent in many areas. The landscape is largely bedrock controlled. The Logan sandstone, a fine-grained formation of late Mississippian age, underlies the glacial deposits in most areas. Surficial deposits to the west of Big Run are of Wisconsinan age as are most of the glacial meltwater deposits in the valleys. In an area near North Liberty, Illinoian age glacial till is underlain by outwash deposits. The upper reaches of Jelloway Creek extend into an unglaciated area in southern Ashland County.

Soil conditions in this segment of the watershed are very diverse. Of 86 soil map units correlated in Knox County, 81 are present in this part of the Kokosing watershed. Slopes range from nearly level to very steep and drainage ranges from well drained to poorly drained. Soils formed in glacial till, glacial outwash, lacustrine deposits, alluvial deposits, weathered rock and combinations of the above.

Dominant soils of the glaciated uplands are Homewood, Titusville and Loudonville. Homewood and Titusville soils are deep and formed in Illinoian age glacial till deposits. They have loamy textures and a dense fragipan layer in the lower subsoil. The fragipan layer restricts water movement and root development. Erosion is a serious problem on these soils since it reduces the depth to the

fragipan. Seasonal wetness and seeps are also problems and the use of tile is increasing. Some areas are tiled systematically. Loudonville soils formed in glacial till deposits 20 to 40 inches thick over sandstone bedrock. These soils are well drained and have generally good tilth. They tend to be droughty because of the limited depth of soil over rock. Erosion lowers productivity by reducing the depth to rock.

Homewood, Titusville and Loudonville soils traditionally have been farmed with a rotation that included a substantial proportion of forage

crops. As livestock numbers decline, so does the acreage used for forage. The acreage of row crops, especially soybeans, is increasing--increasing the potential for erosion and the production of sediment. Fortunately, these soils are well adapted to conservation tillage and contour strip cropping, both of which are effective in reducing erosion losses.

The dominant soils on outwash plains and terraces are Chili and Bogart. Chili soils formed in loamy glacial outwash deposits that contain some gravel. They are well drained and acidic. Moisture shortages can be expected in most years on Chili gravelly loam and in dry years on Chili silt loam. In places, the Chili soils are present in a complex pattern with Homewood soils. Bogart soils are similar to Chili but are moderately well drained.

The moderately well drained Glenford, somewhat poorly drained Fitchville and very poorly drained Luray soils are dominant in local lakebeds and on slackwater terraces. These soils have a high silt content. They are potentially very productive but Fitchville and Luray soils need artificial drainage to reach this potential. These soils are very erosive but because of their gentle slopes, they are not a major source of sediment.

Some of the highest hills lack a covering of glacial deposits. Some were never covered by ice while others had a thin covering of glacial deposits removed by geologic erosion. Dominant soils on these hills are the moderately deep Gilpin and deep Westmoreland soils. Both are well drained and formed in residuum and colluvium from siltstone and fine-grained sandstone. They have good tilth and are very acidic. These soils are erosive. In addition, the Gilpin soils tend to be droughty. These soils are well suited to conservation tillage and strip cropping.

Dominant soils on the flood plains are the well-drained Tioga, moderately well drained Lobdell and somewhat poorly drained Orville. These soils are subject to occasional flooding. Streambank erosion is a problem in localized areas. The wider areas are generally productive cropland but many of the narrower flood plains are so divided by old channels that it is not practical to farm them. Such areas commonly serve as pasture.

Most dark colored soils in this part of Ohio are very poorly drained. Organic matter is not oxidized rapidly under wet conditions and accumulates to give the soil a dark color. The Crane soils in the Big Run valley south of Gambier have a dark surface but are somewhat poorly drained. This would suggest that the soils formed under native vegetation in which grasses rather than trees were dominant. Grasses are more effective in returning organic matter to the soil than trees. An area of grassland or savannah vegetation similar to that in the oak openings of western Ohio likely existed in the Big Run valley.

Segment IV: Howard to Walhonding

The origin of this part of the Kokosing valley is not well documented. The most logical explanation is that blockage of the stream flowing southwest from Howard caused water to back up in the valley of a west flowing tributary that passed through Millwood. The water broke over a divide into an east flowing tributary to the "Newark" River that flowed south from Coshocton. In doing so, it cut a narrow, steep sided valley into the Black Hand sandstone. The narrow section extends from just west of Millwood to Zuck. East of Zuck, the valley is much wider.

Stout and Lamb indicate that the Teays age "Cambridge" River, a stream of considerable size, flowed west through the present Kokosing valley west of Walhonding. Later, however, Stout, Ver Steeg and Lamb projected the "Cambridge" River flowing south from Coshocton along the course of the later "Newark" and present Muskingum Rivers.

A tributary called "Roscoe" Creek flowed east from the Knox County line. The valley of this stream forms the east end of the present Kokosing valley.

This segment of the Kokosing valley has relatively little watershed. The largest tributary is Brush Run which flows west parallel to the east flowing Kokosing and seems to be a remnant of the drainage pattern that once flowed west. Two smaller streams, Singer Run and Laurel Run, enter the Kokosing just upstream from its confluence with the Muskingum. These streams have very narrow, steep sided valleys. One branch of Laurel Run drops about 40 feet in a waterfall east of McIlvaine Park in Newcastle.

The dominant soils on the steep slopes bordering this part of the Kokosing valley are Brownsville and Westmoreland. These deep, well-drained soils formed in residuum and colluvium from fine-grained sandstone and siltstone primarily of the Logan formation. They are used primarily for forestry. Shortages of moisture, especially on south facing slopes, limit tree growth. Erosion in logging trails and access roads for oil wells can be a severe problem. Tree cover has minimized erosion losses in most areas.

The dominant soils on the ridgetops to the north and south of the valley are Coshocton, Gilpin and Loudonville. Coshocton soils are deep and moderately well drained. They formed in material weathered from shale and siltstone of the Pottsville formation, the lowest member of the Pennsylvanian system. These soils have high clay content in the subsoil and are very acid. They are also very erosive. Eroded areas do not have good tilth. Gilpin and Loudonville soils are moderately deep and well drained. Both have sandstone at 20 to 40 inches and tend to be droughty. The upper part of the Loudonville soils formed in glacial till while the Gilpin soils formed entirely in material weathered from sandstone and siltstone. Gilpin and Loudonville soils have loamy textures and generally good tilth. Controlling erosion and conserving moisture are the main concerns of management. The Homewood and Titusville soils are present in scattered areas of deep glacial till in the Brush Run drainage area.

The dominant soils on the flood plain of the Kokosing are Tioga and Landes. The Tioga soils have properties similar to Tioga soils described previously. Landes soils are unique. They are deep, well drained sandy soils with a dark surface layer up to 2 feet thick. The very large organic matter content would suggest the soils formed under vegetation dominated by grasses. The reason for these soils being present in the valley from Zuck to Walhonding was not clear to those mapping soils in the area.

Soils in this section of the flood plain are subject to controlled flooding from the Mohawk dam. This limits their use to late planted row crops. Moisture shortages are common and stream bank erosion occurs in localized areas. Detailed soil information is available in USDA-NRCS published soil surveys for the five counties in the watershed.

Highly erodible lands in the watershed was determined by using the NRCS list of highly erodible soils to query thematic mapper data in the watershed geographic information system. Approximately 94,739 acres of highly erodible soils were indicated in the watershed. The amount of potential soil loss in the watershed is relational to land use type, slope, presence of highly erodible soils, vegetation cover and type and cropland conservation measures. An estimate of the amount of potential soil loss in the watershed was not calculated, because of the inherent variability associated with estimating an accurate figure, given the attributes listed in the preceeding sentence.

Minerals of Economic Interest

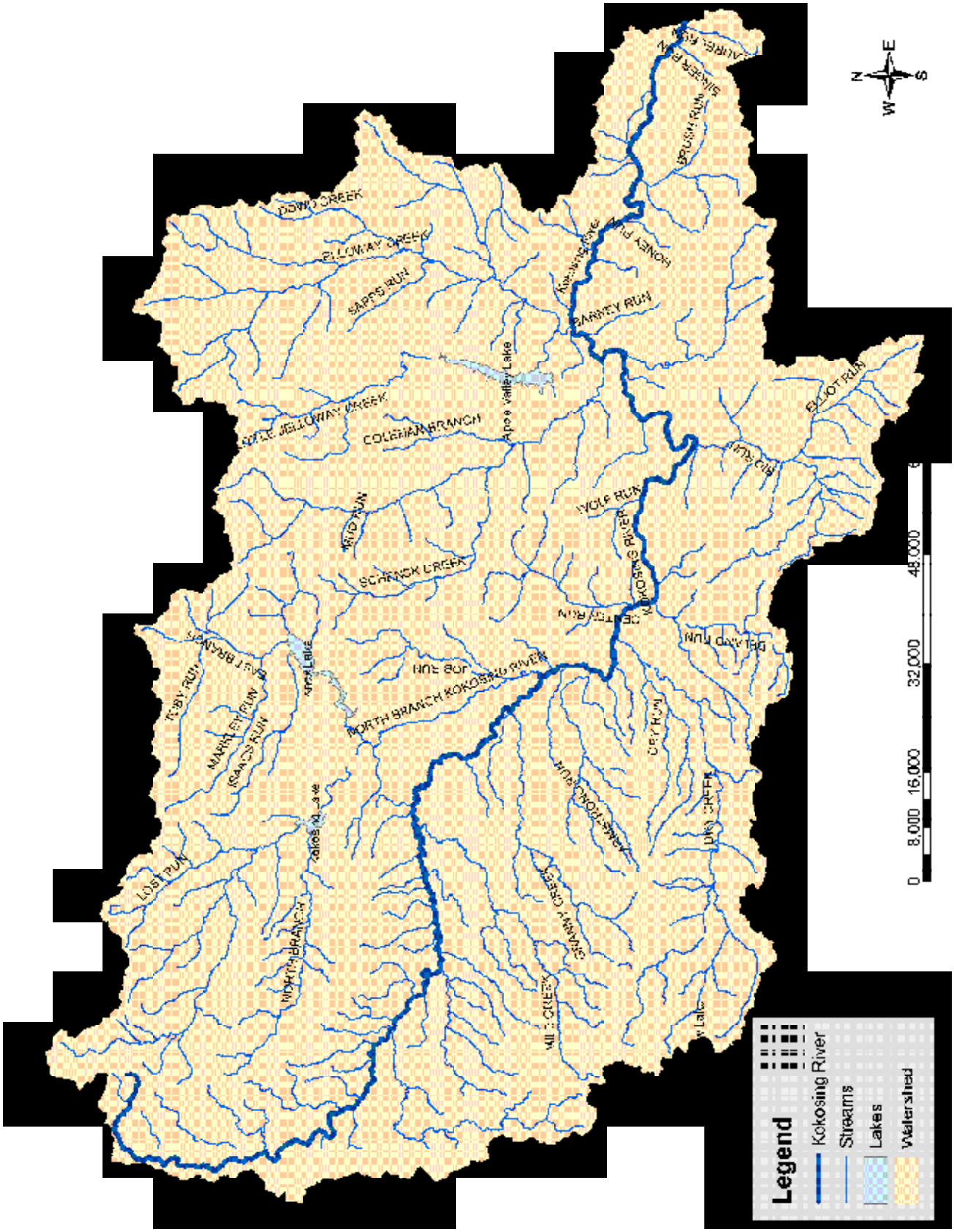
Glacial activity during the Illinoian and Wisconsinan glaciation shaped and manipulated

Table 7: Streams of the Kokosing Watershed

Stream Name	Ave. Fall in Feet per Mile	Drains Sq. Mi.	Flows Into
Kokosing River	8.5	482	Walhonding River
Laurel Run	130.7	2.13	Kokosing River
Singer Run*	20.5	1.16	Kokosing River
Brush Run	43	9.59	Kokosing River
Honey Run	103	2.05	Kokosing River
Jelloway Creek	17.6	74.2	Kokosing River
Little Jelloway Creek	32.2	19.5	Jelloway Creek
East Branch	23.5	10.46	Jelloway Creek
Sapps Run	55.4	3.93	Jelloway Creek
Dowd Creek	38.6	5.48	Jelloway Creek
Shadley Valley Creek	41.1	6.26	Jelloway Creek
Ireland Creek	45.3	3.41	Jelloway Creek
Barney Run	54.6	2.96	Kokosing River
Schenck Creek	21.8	41.8	Kokosing River
Coleman Branch	36.7	6	Schenck Creek
Little Schenck Creek	33.6	16.23	Schenck Creek
Mud Run	113.3	0.95	Little Schenck Creek
Indianfield Run	27.4	11.1	Kokosing River
Big Run	19	31.92	Kokosing River
Elliott Run	27.6	4.34	Big Run
Wolf Run	72.8	3.33	Kokosing River
Center Run	27.1	11.23	Kokosing River
Dry Creek	25.2	34.1	Kokosing River
Dry Run	51.4	6.16	Dry Creek
Armstrong Run	43.1	10.52	Kokosing River
North Branch	15.8	96.7	Kokosing River
Job Run	23.2	8.52	N. Br. Kokosing River
East Branch	13.8	30.6	N. Br. Kokosing River
Isaacs Run	24.9	4.59	E. Br. of N. Br. Kokosing R.
Markley Run	34.6	6.56	E. Br. of N. Br. Kokosing R.
Toby Run	39.2	4.49	E. Br. of N. Br. Kokosing R.
Lost Run	32.1	6.16	N. Br. Kokosing River
Granny Creek	30.9	12.68	Kokosing River
Mile Creek	24.3	13.54	Kokosing River
South Branch	16.2	10.94	Kokosing River
Sylvester Run	46.4	2.07	Kokosing River

* Intermittent stream

Figure 5: Streams and Lakes of the Kokosing Watershed



over half of the Kokosing watershed. The scouring impact of the glaciers, the erosive action of the meltwater and the deposition of glacial materials resulted in several beneficial features for the watershed. One commercially beneficial feature in particular is the outwash filled valleys that provide a source of sand and gravel.

Sand and Gravel Deposits

Eight sand and gravel mines have been permitted in the watershed since 1976 through the ODNR Division of Mineral Resource Management (formerly the Division of Mines and Reclamation). The permits are valid for ten years and must be updated annually with a map showing the past year's effected boundaries and where the company intends to mine over the coming year. There currently are five active sand and gravel operations in the watershed. All five are mining sand and gravel with the exception of one site near Millwood that is mining silica sand (used in glass making). One inactive operation is located just north of Fredericktown. In addition, two other operations, one north of Fredericktown and one east of Gambier, have been permitted but have not been started at this time.

Oil & Gas Deposits

Oil and gas drilling in Ohio is concentrated, for the most part, in the eastern half of the state. Knox County contains the majority of oil and gas wells in the Kokosing River watershed. The well depths range from 2600-4600 feet into the Clinton sandstone that formed in the Silurian period. Clinton sandstone serves as the most actively drilled zone in Ohio since 1965.

Surface Water

Perennial, intermittent and headwater streams, combined with lakes, ponds and wetlands, form the surface water features of the Kokosing watershed. Table 7 shows major streams in the watershed with approximate fall and drainage area. Streams and large lakes in the watershed are shown in Figure 5. Additional information on wetlands, streams and impoundments are found in later discussions. Estimated 10-year low flows (in cubic feet per second) for the Kokosing River and its major tributaries are as follows:

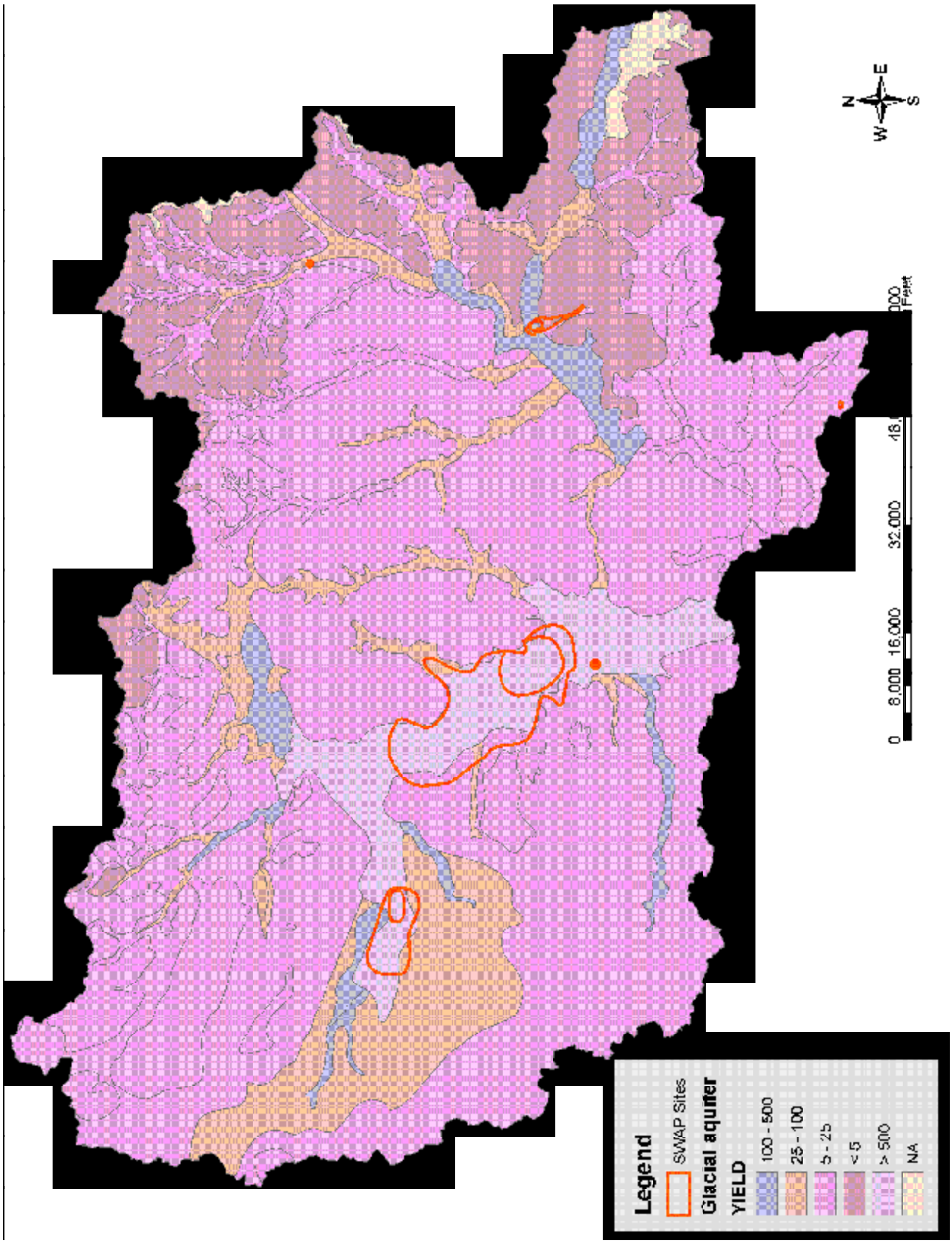
- Kokosing River upstream of North Branch (6)
- Kokosing River at Mount Vernon (19)
- Kokosing River at Millwood (48)
- North Branch (3)
- Jelloway Creek (3)
- Dry Creek (2)
- East Branch (2)
- Big Run (1.9)

GroundWater

Glacial activity in the Kokosing watershed has resulted in its being covered by varying thicknesses of glacial till and outwash sand and gravel. Layers ranging from 25 feet to more than 300 feet are found west of the Kokosing river valley while the layer over the eastern two-thirds is generally less than 25 feet thick. A network of buried valleys cross Knox County and make up the major ground-water resource. Public and private water supplies throughout the watershed are dependent on ground water. Yields of 100 to 500 gallons per minute can be expected in the major valley that lies beneath the present day Kokosing River particularly from Fredericktown down past Mount Vernon to Utica. A larger part of the watershed relies on ground water supplies developed from sandstone and shale formations where yields of 10 to 20 or more gallons per minute are available at depths ranging from 60 to 290 feet. Ground water recharge rates range from 8-10 inches per year, with ground water discharge rates of 8 inches per year. Figure 6 shows ground water resources.

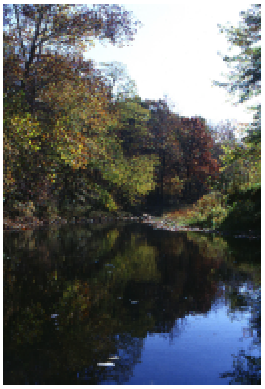
The invaluable, high-yield aquifers in the Kokosing watershed are principally recharged from direct infiltration of precipitation. Permeability of the streambed varies from location to location, and, at times, the Kokosing River's flow is augmented by ground water (depending on the season and other factors). Pollution potential (DRASTIC) mapping

Figure 6: Ground Water and Source Water Assessment and Protection Sites in the Watershed



available for the watershed indicates higher levels of pollution potential, particularly in the buried valley located under the Kokosing River and its major tributaries. Therefore, it is imperative that land use decisions regarding ground water recharge areas be made carefully to consider the pollution potential to the aquifers. Likewise, land use decisions should also be made based on the impact to surface waters given the sometimes direct connection that overlying stream waters have to ground water.

In an effort to protect their precious ground water resources, several well field protection plans have been drafted in the watershed. Well field protection plans contain an inventory of potential sources of groundwater contamination and protective strategies that, if implemented, help protect a drinking water source from becoming contaminated. The implementation of well field protection plans in the Kokosing watershed can assist protection of the Kokosing River and its tributaries. Among protective strategies noted in the Del-Co Water Company and City of Mount Vernon Wellfield Protection Plans are educational outreach, floodplain management and zoning ordinances. Ohio EPA has conducted and/or approved Source Water Assessment and Protection plans for public water systems in the watershed, including City of Mount Vernon, Village of Martinburg, Del-Co Water Company, Herris Mobile Home Park, Morning View Care Center.



Several entities within the watershed have the capacity to withdrawal large quantities of ground water. Of the list below, Oglebay Norton Industrial Sand also withdraws surface water for its processes.

Ground Water Facilities:

Knox County Water & Sewer District
Oglebay Norton Industrial Sand-Millwood
Tomahawk Golf Course
Mount Vernon City Water System
Cuddy Farms, Inc.
Small's Sand & Gravel
Mount Vernon Foundation Park
Apple Valley Golf Course
Fredricktown Village Water System
Martinsburg Village Water System

One element cited as contributing to the outstanding water quality of the Kokosing over the ages is the contribution of ground water to stream flow. Thus, potential impacts from upper aquifer dewatering to the Kokosing base stream flow and seasonal high flows should be considered. While Ohio and the eastern United States have enjoyed relatively few "water rights" conflicts, water policy experts predict increasing conflicts over water rights nationwide. Recognizing the potential for water conflicts and the need to maintain optimal flows for fish and wildlife resources, the Instream Flow Council (IFC), a consortium of fish and wildlife agencies from the United States and Canada, developed principles for riverine resource stewardship. The IFC recommends the maintenance of optimum stream flow to maintain natural ecological and morphological functions of riverine resources. Rare species, such as the state threatened bluebreast darter (*Etheostoma camurum*), require seasonal flooding events to maintain viable populations.

The Kokosing River is part of the "public trust," waters that are held "in trust" as navigational and fisheries resources for all people to use reasonably. The Division of Natural Areas and Preserves, owing to their responsibility to protect the Kokosing River, has entered into a long-term monitoring project with the U.S. Geological Survey to study the effects of a well field development on Kokosing River base flow. The well field, developed by Del-Co Water Company in 1999, pumps water out of the aquifer underlying the Kokosing for use in Columbus suburbs and watersheds outside of the Kokosing River watershed. No definitive results as to whether the wellfield has an impact on Kokosing River baseflow are available at this time. Also, the Knox County Commissioners have passed

a resolution creating a regional water district, which gives them some authority to deal with ground water withdrawals that leave the Kokosing watershed.

Terrestrial Habitat

Deciduous trees comprise the bank vegetation along the Kokosing River. It should be noted, however, that conifers begin to mix in with the deciduous trees in the lower reaches of the river. The amount of forested bank vegetation is one of the primary criteria assessed when considering the Kokosing River for scenic designation. The area adjacent to at least 25 percent of the river's length, considering both banks, should be forested outward from the river to a depth of 300 feet or greater. This forested condition is paramount to the preservation of the native aquatic fauna and the protection of the water quality values of the river. Forested corridors not only provide habitat and travel corridors for terrestrial species such as migratory birds, deer and other wildlife, they also filter sediment and excess nutrients from surface water flow. Trees and their roots along the riverbank help stabilize the bank and protect property from spring ice flows and debris during bank-full flood events. The roots also provide in-stream cover for aquatic species such as smallmouth bass. Leaves and other detritus serve as the primary food source that drives the aquatic food chain. Shade from the trees also serves to keep river temperatures cooler and more consistent, helping to maintain higher oxygen levels in the river and provide suitable conditions for native species reproduction.

A total of 27.5 percent of the mainstem Kokosing River corridor from RM 0 to RM 41 is forested to a minimum depth of 300 feet. Where less forest cover exists, the banks generally remain in a natural wooded condition of varying depths. The amount of corridor forested to at least 100 feet along the mainstem of the Kokosing River is 56.1 percent. The most heavily wooded corridor occurs on the lower half of the river from RM 24 and below with at least 30 and up to 43 percent forested to a minimum of 300 feet. The section of river around Mount Vernon, from RM 25 to RM 29, contained the least amount of corridor with minimal to no corridor. The North Branch of the Kokosing River, for at least the first 3.4 miles, is 17.4 percent forested to a minimum depth of 300 feet.

Within the riparian corridor, human activity is apparent to varying degrees along the length of the river. A total of 35 bridges cross the Kokosing River from its headwaters to its mouth. While bridges disrupt the riparian corridor and detract from the river's visually scenic qualities, they do provide an opportunity to view the river and its wildlife inhabitants. In some cases, with the adjacent property owner's permission, access is possible for launching canoes or for passive recreation activities such as fishing or bird watching near the bridge. Roads paralleling the river also can detract from the scenic qualities of the river by subjecting river users to traffic noise and odors. Roads too close to the river disrupt the corridor and natural drainage reducing the natural buffering from nonpoint pollutants that the wooded corridor provides. They also increase the potential for hazardous materials entering the river as a result of accidents. Road miles paralleling the river within 300 feet total 12.8 along the Kokosing River. This represents 22 percent of the river's total length.

As for the tributaries to the Kokosing, Figure 7 and Table 8 describes the extent of the wooded corridor. Approximately 9,750,248 linear feet of stream in the watershed contains forested buffer of varying widths.

Floodplains

The Kokosing River and many of its tributaries contain floodplains that have been mapped by the Federal Emergency Management Agency (FEMA). Figure 8 shows the extent of 100-year floodplains in the watershed. FEMA identified 19,951 acres (5% of total acreage) at risk from "100-year floods" in the watershed. A 100-year flood has a one percent chance of occurring in any

Figure 7: Streams with Wooded Riparian Areas in the Kokosing Watershed

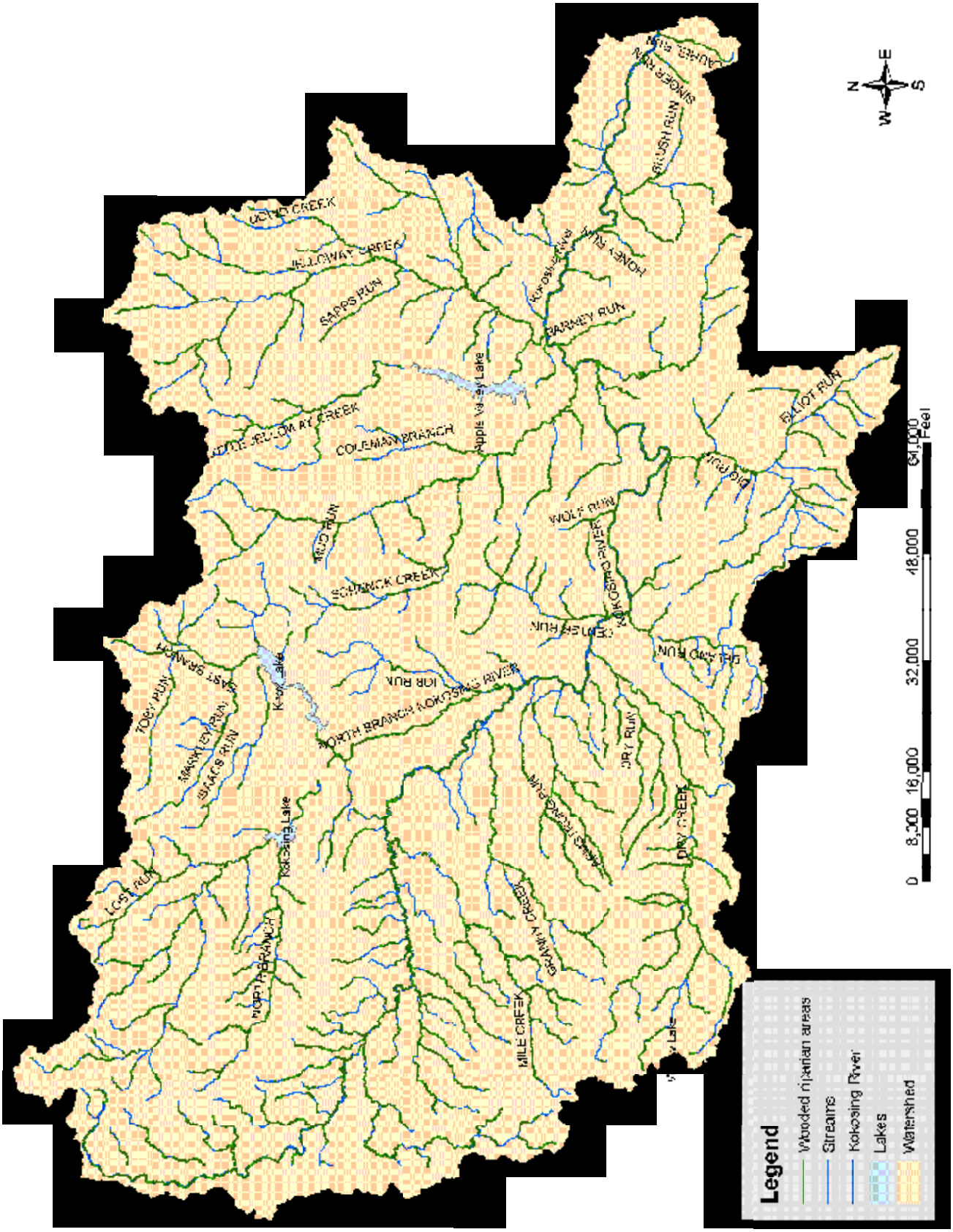
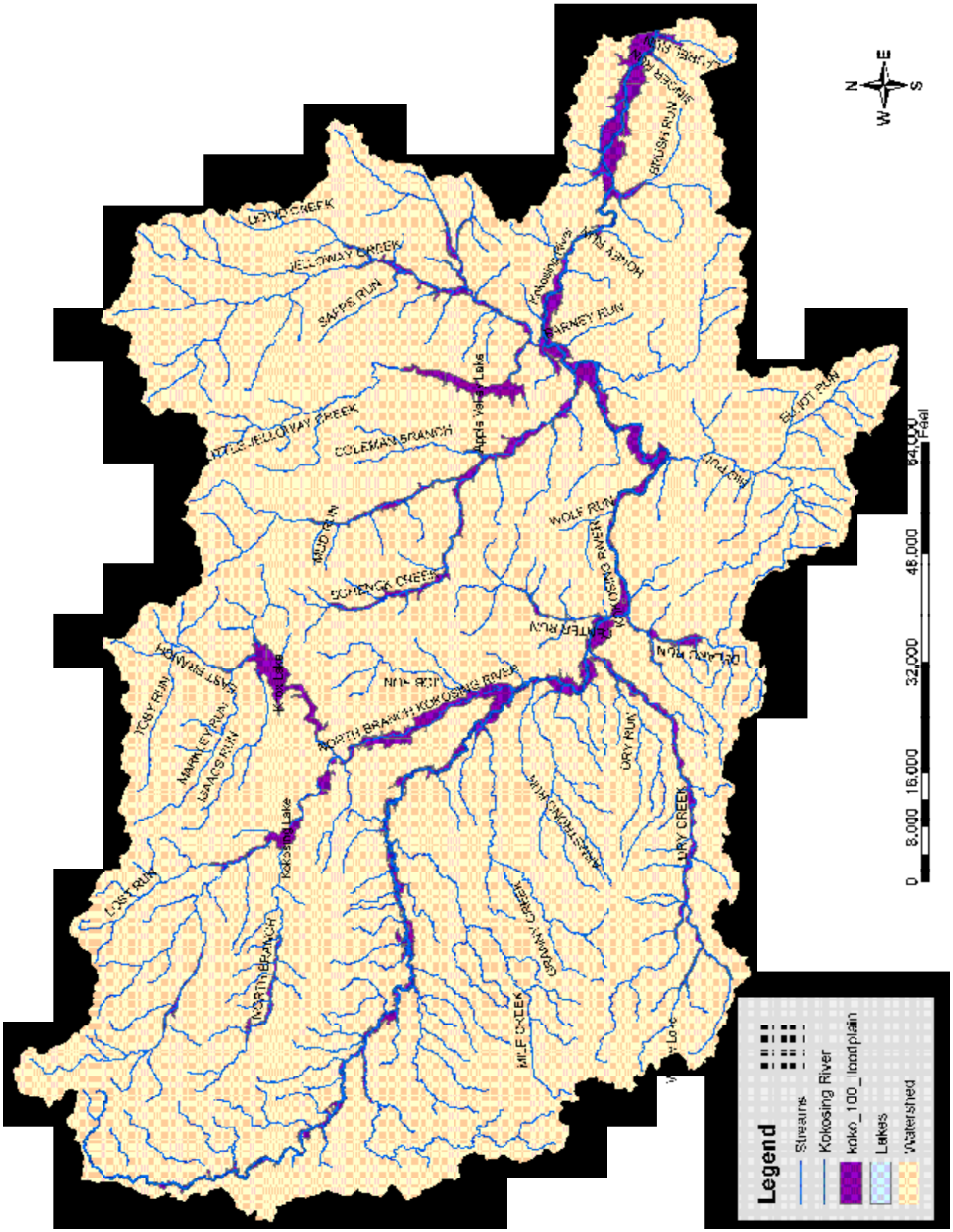


Table 8: Wooded Corridor Extent of Kokosing Tributaries

Stream Name			length	wooded corridor	wooded corridor
Kokosing River			(miles)	(miles)	(percentage)
Laurel Run			2.5	2.1	84.00%
Singer Run			1.3	0.9	69.23%
Brush Run			3.6	2.3	63.89%
Honey Run			1.6	1.1	68.75%
Jelloway Creek			13.2	7.9	59.85%
	Little Jelloway Creek		6.2	4	64.52%
	East Branch		5.5	3.5	63.64%
	Sapps Run		3.3	2.1	63.64%
	Dowd Creek		3.4	1.4	41.18%
	Shadley Valley Creek		4.7	2.6	55.32%
	Ireland Creek		2	1.4	70.00%
Barney Run			2.1	1.8	85.71%
Schenck Creek			12.2	9.5	77.87%
	Coleman Branch		4.2	2.1	50.00%
	Little Schenck Creek		7.9	4.5	56.96%
		Mud Run	0.7	0.53	75.71%
Indianfield Run			7.3	4.8	65.75%
Big Run			4.6	3	65.22%
	Elliott Run		3.9	1.3	33.33%
Wolf Run			1.7	1.2	70.59%
Center Run			3.4	1.7	50.00%
Dry Creek			18.9	14.3	75.66%
	Dry Run		4.7	3.9	82.98%
Armstrong Run			5.9	3.7	62.71%
North Branch			26.6	17.1	64.29%
	Job Run		3.8	1.1	28.95%
	East Branch		5	3.3	66.00%
		Isaacs Run	4.4	1	22.73%
		Markley Run	4.1	1.9	46.34%
		Toby Run	3.4	1.5	44.12%
	Lost Run		3.4	2.2	64.71%
Granny Creek			9	7.2	80.00%
Mile Creek			10	6.6	66.00%
South Branch			9.7	5.6	57.73%
Sylvester Run			3	1.3	43.33%

Figure 8: 100 Year Floodplain Areas in the Kokosing Watershed



given year. Ohio and Knox County have a long history of damaging floods, and the National Weather Services has identified flooding as the nation's leading weather-related killer. The last significant flood in the watershed occurred in June 1998, and the Governor declared a State of Emergency in Knox, Coshocton and Richland Counties (among others). Center Run homeowners and infrastructure were particularly hit hard by the flooding events in 1998.

Floodplains perform special "community" services, including filtering runoff, storing runoff, and providing wildlife habitat. The destruction of riparian zones along streams and indiscriminate filling of floodplains leads to increased flooding of homes and businesses, increased potential for production of disease-carrying insects, increased pollution of streams and increased potential of overload of combined storm water and sanitary treatment facilities. Thus, maintaining intact floodplains lessens human health risks and adverse impacts on wildlife habitat and community infrastructure. Given the importance of floodplains, the Knox Regional Planning Commission sponsored several floodplain management presentations for commission members in 2003 and continues to work towards possible adoption of more stringent floodplain regulations.

Plant Communities

The Kokosing River watershed lies within the Glaciated Appalachian Plateau. This region of the state encompasses a wide variety of natural habitats. Glacial activity many years ago heavily influenced the composition of the soil and the topography that makes this diversity of habitats possible.

Forest Communities

According to historical data from the earliest land surveys, Beech-Sugar Maple forests on the western end and Mixed Mesophytic forests on the eastern end dominated the watershed. The following descriptions outline the major forest community types found in the watershed. Approximately 103,827 acres (34%) contain forested habitat in the Kokosing watershed.

Beech-Sugar Maple Forests

The beech-sugar maple forest type is found predominantly in the western portion of the watershed. However, this community type grades into other community types such as oak-hickory, mixed mesophytic and maple-cottonwood-sycamore depending on the soils and topography and therefore can be found throughout the watershed. These forests are generally dominated by beech and/or sugar maple but they often contain associated species such as shagbark hickory (*Carya ovata*), black walnut (*Juglans nigra*), white oak (*Quercus alba*), red oak (*Quercus rubra*), American elm (*Ulmus americana*), slippery elm (*Ulmus rubra*), tuliptree (*Liriodendron tulipifera*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), American basswood (*Tilia americana*) and white ash (*Fraxinus americana*).

Maple-Cottonwood-Sycamore Flood Plain Forests

Species tolerant of seasonal flooding make up this forest community that is most notable along North Branch and the other tributaries in the western portion of the watershed. Dominant species include soft maple, cottonwood and sycamore primarily but also include sandbar willow (*Salix interior*), black willow (*Salix nigra*), hackberry (*Celtis occidentalis*), American elm (*Ulmus americana*), honeylocust (*Gleditsia triacanthos*), boxelder (*Acer negundo*), silver maple (*Acer saccharinum*), Ohio buckeye (*Aesculus glabra*), white ash (*Fraxinus americana*) and green ash (*Fraxinus pennsylvanica*).

Mixed Mesophytic Forests

Mixed mesophytic forests historically dominated the eastern portion of the watershed. This

forest type grades into other types of wet-mesic to dry-mesic forest communities but generally the stands are dominated by combinations of beech (*Fagus grandifolia*), tuliptree (*Liriodendron tulipifera*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), white oak (*Quercus alba*), red oak (*Quercus rubra*) and white ash (*Fraxinus americana*) with associated species of hickories (*Carya spp.),* black walnut (*Juglans nigra*), cucumbertree (*Magnolia acuminata*), black cherry (*Prunus serotina*), yellow buckeye (*Aesculus octandra*) and American basswood (*Tilia americana*).

Oak-Hickory Forests

Prevalent in the gorge area between Mount Vernon and Gambier, the oak-hickory forest type is characterized by upland oaks and hickories. Specifically, this forest type is dominated by shagbark hickory (*Carya ovata*), pignut hickory (*Carya glabra*), bitternut hickory (*Carya cordiformis*), mockernut hickory (*Carya tomentosa*), white oak (*Quercus alba*), red oak (*Quercus rubra*) and black oak (*Quercus velutina*). The oak-hickory community also grades into oak-pine communities on more exposed or more disturbed sites.

Hemlock-White Pine-Hardwood Forests

Hemlock-white pine-hardwood forests generally occur on valley slopes and bottoms. Examples of this type of community can be found around the Millwood area in the Kokosing watershed. Hemlock and/or white pine and hardwood species dominate this community over upland substrates. Dominant and associated species include white pine (*Pinus strobus*), hemlock (*Tsuga canadensis*), Beech (*Fagus grandifolia*), white oak (*Quercus alba*), red oak (*Quercus rubra*), tuliptree (*Liriodendron tulipifera*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*) and possibly yellow birch (*Betula alleghaniensis*) and sweet birch (*Betula lenta*).

Riverine Communities

The following riverine communities are found in the Kokosing watershed and throughout most of eastern United States east of the Mississippi.

Mixed Emergent Riverine Community

This community type includes immersed plants as well as herbaceous plants on adjacent wet mud, sand or rock banks or bars. If the stand has more than half its cover in water-willow, it is classified separately. Emergent riverine communities are found along the main channels of streams and in ponds and oxbows of flood plains that are usually flooded annually. The composition of the community varies depending on stream gradient, frequency and duration of floods, water and substrate chemistry, current and historical human impacts and other factors. Predominant flowering species that may be found in this community type include broad-leaved cattail (*Typha latifolia*), bur-reed (*Sparganium eurycarpum*), water-plantain (*Alisma subcordatum*), arrowheads (*Sagittaria spp.*), rice cutgrass (*Leersia oryzoides*), sedges (*Carex spp.*), umbrella-sedges (*Cyperus spp.*), spike-rushes (*Eleocharis spp.*), bulrush (*Scirpus atrovirens*), rushes (*Juncus spp.*), lizard's-tail (*Saururus cernuus*), smartweeds (*Polygonum spp.*), docks (*Rumex spp.*), swamp milkweed (*Asclepias incarnata*), fog-fruit (*Lippia lanceolata*), monkey-flower (*Mimulus ringens*), water-willow (*Justicia americana*) and beggar-ticks (*Bidens spp.*).

Water-willow Riverine Community

Water-willow riverine communities occur throughout Ohio in generally rocky riffles or in stream margins. Water-willow (*Justicia americana*) makes up well over half the cover of these stands and often is the only species in a given patch. A few species that may occur in limited association with water-willow are lizard's-tail (*Saururus cernuus*), sandbar willow (*Salix interior*), smartweeds (*Polygonum spp.*), docks (*Rumex spp.*), dodder (*Cuscuta gronovii*), monkey flower (*Mimulus ringens*) and beggar ticks (*Bidens spp.*).

Wetlands

When the first settlers came to Ohio, they found areas of shallow water or soggy soil filled

with lush vegetation and teeming with fish, waterfowl, furbearers and other kinds of wildlife. In general, wetlands are low-lying areas that are covered or saturated by water during part of each year. This results in specialized wet soil types and water dependent plants. Kokosing watershed wetlands include marshes, swamps, seeps, vernal pools and wet meadows. They vary by degree of wetness, soil characteristics and vegetation type. Figure 8 shows the extent of wetlands in the watershed, and Table 9 gives percentages for all counties in the watershed. Wetlands abate floodflows, provide wildlife habitat and nursery areas, filter sediment and improve water quality. According to the Ohio Wetland Inventory, Knox County contains approximately 7,286 acres of wetlands, comprising 2% of the county land base and Morrow County contains approximately 2,212 acres of wetland, comprising 0.8% of the county land base.

Approximately 5,958 acres of wetlands occur in the Kokosing watershed, and several high quality wetlands and vernal pools have been identified in Knox County (Delano Run watershed). A sixty acre wet meadow in the headwaters of Shadley Creek serves as nesting habitat for grassland birds, including bobolinks (*Dolichonyz oryzivorus*) and eastern meadowlarks (*Sturnella magna*). A vernal pool containing breeding eastern tiger salamanders (*Ambystoma tigrinum tigrinum*) is noted in the Morrow County portion of the watershed, and a very high quality (category three), 50+-acre wetland complex is noted adjacent to State Route 314 between Sparta and Chesterville in Morrow County. Kokosing wetlands, Kokosing forests and Kokosing streams GIS layers were used to spatially identify potential vernal pool sites in the watershed. Approximately 1,188 acres, representing 750 sites, may contain vernal pools. Vernal pools comprise one of the most threatened wetland types in Ohio. Vernal pools are forested wetlands, with no surficial connection to streams or lakes that have upland forest buffers.

Further, wetlands are one of the most archaeological sensitive areas in Ohio. Wetlands were exploited for their natural resources throughout Ohio's prehistory (14,000-450 years ago). Additionally, land adjacent to wetlands and streams, particularly in Ohio's glaciated region, was often used by prehistoric American Indians for hunting game, collecting plants, and establishing settlements.

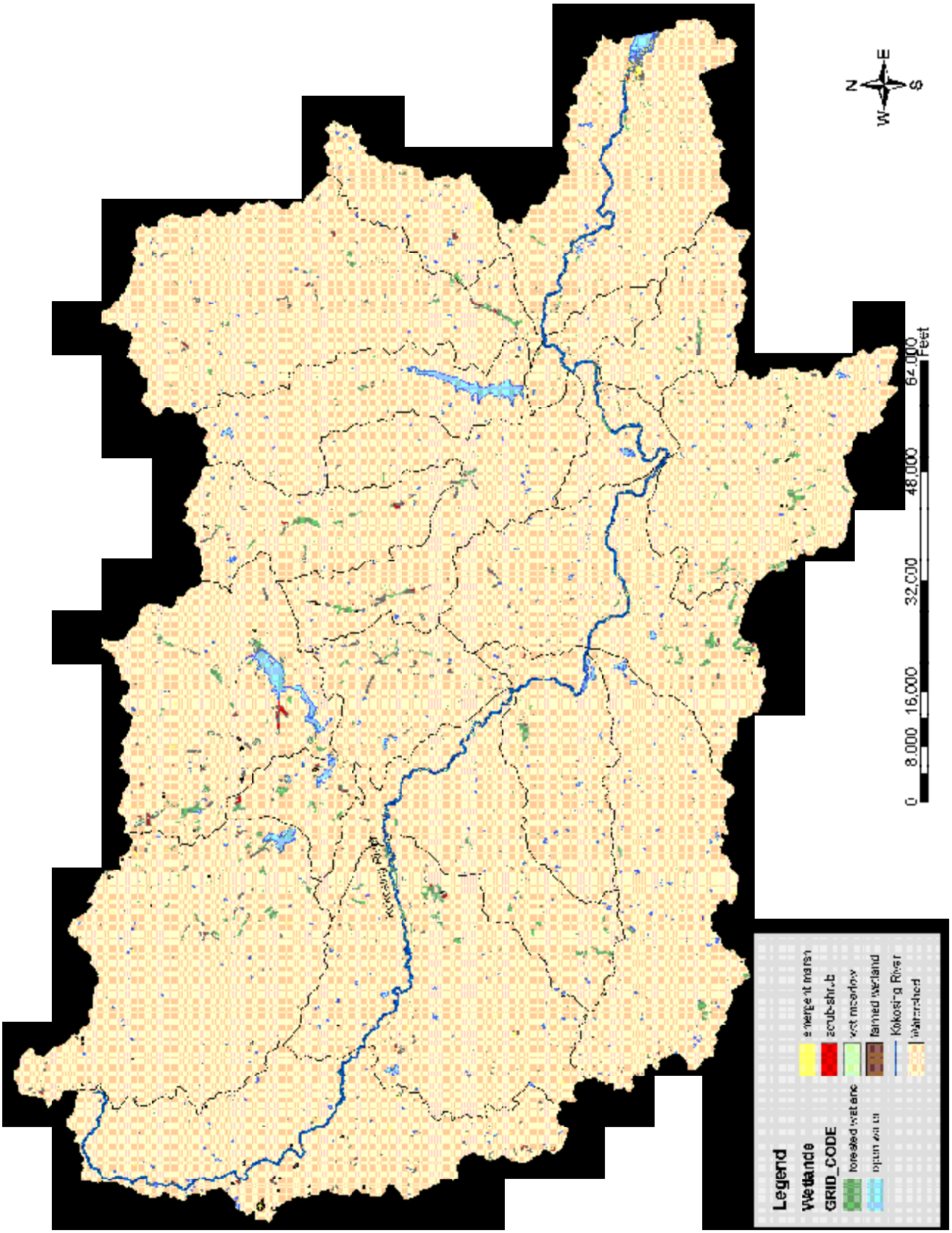
Wetlands also preserve the remains of Late Pleistocene and Early Holocene animals and plants exploited by Ohio's earliest inhabitants, the Paleoindians (14,000-9500 years ago). Mastodon (an extinct relative of the elephant) and human associations are the subject of great international interest, and lately sites in Ohio have been in the forefront of such research. Primary among these was the 1989 discovery of the Burning Tree mastodon in Licking County, and the 1993 recovery of remains from the Martins Creek mastodon in Holmes County.

The extremely well preserved and nearly complete skeletal remains of the Burning Tree mastodon were discovered while dredging a small wetland on a gently undulating late-Wisconsin end moraine during development of a golf course. This

Table 9: Wetlands of the Five Counties in the Kokosing Watershed

County	Woods Hydric	Open Water	Shallow Marsh	Shrub Scrub	Wet Meadow	Farmed Wetland	Total Wetland Acres	Non Wetland Acres	Total County Acres
Ashland	4817.96	1619.83	930.60	847.28	94.59	646.03	8956.29	264495.30	273451.59
Coshocton	1652.15	2779.05	3579.67	1345.64	1617.75	0.00	10974.25	351963.50	362937.75
Knox	3689.38	1797.54	427.00	781.84	459.42	131.26	7286.45	331384.76	338671.21
Morrow	4.05	1072.04	250.76	340.21	168.72	376.29	2212.09	258061.47	260273.56
Richland	7885.73	2450.79	1867.33	2630.29	713.54	1269.43	16817.10	303685.73	320502.83

Figure 9: Wetlands Areas in the Kokosing Watershed



significant find included the recovery of a portion of the mastodon's intestinal contents, including for the first time gut bacteria surviving in a dormant state for 11,000 years. Although no stone tools were recovered, some of the mastodon's skeletal remains showed evidence of cut marks indicating that prehistoric American Indians butchered the animal. Continued archaeological investigations at such sites are crucial to better understanding human interactions with these environments, past, present and future.

The destruction of wetlands and stream riparian areas is likely to destroy the archaeological sites that are inextricably associated with them. It is important to remember that where there are, or were, wetlands and riparian areas, there are archaeological sites that document over 10,000 years of American Indian prehistory in Ohio. Ohio's early settlers also exploited wetlands. Many water-related historic archaeological sites exist in wetland areas and riparian areas. As these areas disappear, so does the prehistory and history of these people and this State. Thus, protecting wetlands and riparian areas not only provides for water quality and fish and wildlife habitat, but also protects our history. Additionally, with 16,497 acres of hydric soils indicated in the watershed, a significant opportunity exists to restore wetland habitat on the landscape.

Headwater Streams

According to the Ohio EPA, "Headwater streams are the small swales, creeks and streams that are the origin of most rivers. These small streams join together to form larger streams and rivers or run directly into larger streams and lakes. Ohio EPA defines a headwater stream as a stream with a watershed less than or equal to 20 square miles. Many streams and drainageways have a watershed of less than one square mile. We refer to these as primary headwater streams." Headwater streams provide wildlife habitat, improve water quality and abate floodflows. The Kokosing River watershed has numerous headwater streams. Impacts to the headwater streams include channelization, road culverting and denuding of their riparian fringes.

Invasive, Nonnative Species

According to the ODNR DNAP, "About one-quarter of the plants growing in Ohio originated from other parts of the continent or world. These species, often called non-native, exotic or alien, were not known to occur in Ohio prior to European settlement in the mid 1700s. Some of Ohio's invasive plants arrived here by accident, while others were introduced for agricultural use, erosion control, horticulture, forage crops, medicinal use and food for wildlife." The most notorious invasive plants found in the Kokosing watershed, according to DNAP, include:

- Garlic mustard (aggressively out-competes native species in the understory of forests and woodlands);
- Common and cut-leaved teasel (produce massive amounts of seed that can remain viable in the soil for several years and have germination rates as high as 86%);
- Japanese knotweed (grows quickly and aggressively by extensive rhizomes and forms dense thickets that exclude native vegetation and reduce wildlife habitat, represents a significant threat to riparian areas where it can spread easily as small pieces of rhizome are washed downstream and deposited to create new colonies).
- Multiflora rose (thickets of this rose can successfully displace native plant species);
- Tree-of-heaven (sapling growth can reach 3-4 feet a year and can outgrow nearly any native tree, out competing natives for light, roots give off a toxin that acts as a herbicide that can kill or inhibit the growth of other plants);
- Canada thistle (extensive root system of Canada thistle allows it to out-compete and displace many native species)
- Amur, Morrow & Tartarian honeysuckles (these vigorous shrubs shade out native vegetation, particularly in the woodland understory and are able to out-compete native wildflowers for light and other resources).

Natural Areas and Features

Knox Woods State Nature Preserve

This mixed mesophytic forest is located less than one mile northeast of Mount Vernon on the south side of US Route 36. It is owned by the Knox County Commissioners and managed by the Ohio Division of Natural Areas and Preserves. Large specimens of sugar maple, black oak, red oak, black walnut and shagbark hickory dominate the forest. There are also large specimens of tuliptree, black gum, white oak, white ash and wild black cherry. Heavy grazing in the past has reduced the abundance and diversity of spring wildflowers.

Another unique geologic and community feature in the watershed is Arbutus Glen, a privately owned, gorge area characterized by towering hemlock on Indianfield Run. Likewise, the hemlock-dominated gorge named "Factory Rapids" in the lower reach of the Kokosing mainstem possesses unique geologic and community attributes.

Wildife

Mammals

No systematic inventories have been conducted to identify and categorize the mammal communities present within the watershed. Past reports have relied on a compilation of those species actually observed within the watershed coupled with those species that are likely to occur within the study area based upon their known distributions within the state. This type of data tends to be more accurate for the larger more visible species than for the smaller rodents and bats that may be spottier in their distributions. Species having statewide distributions or known distributions encompassing Knox County as identified in *The Mammals of Ohio* (Gottschang, 1981) are listed below.

Species most frequently observed along the riparian zones include muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor*), and deer (*Odocoileus virginianus*). Less frequently observed but also present along the stream are mink (*Mustela vison*) and beaver (*Castor canadensis*). The more common species of bats, which are most likely to be observed foraging for insects over the stream corridor, include the big brown bat (*Eptesicus fuscus*), little brown bat (*Myotis lucifugus*) and the eastern pipistrelle (*Pipistrellus subflavus*). The riparian forests along the stream provide suitable habitat for a variety of other mammals including masked shrews (*Sorex cinereus*), short-tailed shrews (*Blarina brevicauda*), gray squirrels (*Sciurus carolinensis*), fox squirrels (*Sciurus niger*), chipmunks (*Tamias striatus*) and deer mice (*Peromyscus leucopus*). Transitional forest communities and edge habitats provide habitats for species such as the opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridana*), red and gray fox (*Vulpes vulpes* and *Urocyon cinereoargenteus*), weasels (*Mustela nivalis* and *Mustela frenata*) and skunks (*Mephitis mephitis*). Pastures and other grasslands in the river valley provide suitable habitat for woodchuck (*Marmota monax*), thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*), meadow voles (*Microtus pennsylvanicus*) and meadow jumping mice (*Zapus hudsonius*).

Mammals Recorded for Knox or Adjacent Counties

1. Virginia opossum (*Didelphis virginiana*)**
2. Short-tailed shrew (*Blarina brevicauda*)*
3. Masked shrew (*Sorex cinereus*)**
4. Smoky shrew (*Sorex fumeus*)**
5. Least shrew (*Cryptotis parva*)**
6. Hairy-tailed mole (*Parascalops breweri*)*
7. Eastern mole (*Scalopus aquaticus*)**
8. Star-nosed mole (*Condylura cristata*)**

9. Little brown bat (*Myotis lucifugus*)*
10. Keen's bat (*Myotis keenii*)**
11. Indiana bat (*Myotis sodalis*)**
12. Silver-haired bat (*Lasionycteris noctivagans*)
13. Eastern pipistrelle (*Pipistrellus subflavus*)**
14. Big brown bat (*Eptesicus fuscus*)**
15. Red bat (*Lasiurus borealis*)
16. Evening bat (*Nycticeius humeralis*)**
17. Eastern cottontail (*Sylvilagus floridanus*)**
18. Eastern chipmunk (*Tamias striatus*)*
19. Woodchuck (*Marmota monax*)**
20. Thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*)*
21. Gray squirrel (*Sciurus carolinensis*)**
22. Fox Squirrel (*Sciurus niger*)*
23. Red squirrel (*Tamiasciurus hudsonicus*)*
24. Southern flying squirrel (*Glaucomys volans*)
25. Beaver (*Castor canadensis*)**
26. Eastern harvest mouse (*Reithrodontomys humulis*)*
27. Deer mouse (*Peromyscus maniculatus*)**
28. White-footed mouse (*Peromyscus l eucopus*)**
29. Meadow vole (*Microtus pennsylvanicus*)*
30. Prairie vole (*Microtis ochrogaster*)**
31. Pine vole (*Microtis pinetorum*)**
32. Muskrat (*Ondatra zibethicus*)**
32. Southern bog lemming (*Synaptomys cooperi*)**
33. Norway ray (*Rattus norvegicus*)**
34. House mouse (*Mus musculus*)**
35. Meadow jumping mouse (*Zapus hudsonius*)*
36. Coyote (*Canis latrans*)
36. Red fox (*Vulpes vulpes*)*
37. Gray fox (*Urocyon cinereoargenteus*)**
38. Raccoon (*Procyon lotor*)*
39. Least weasel (*Mustela nivalis*)*
40. Long-tailed weasel (*Mustela frenata*)**
41. Mink (*Mustela vison*)**
42. Badger (*Taxidea taxus*)*
43. Striped skunk (*Mephitus mephitus*)**
44. White-tailed deer (*Odocoileus virginianus*)*

**Museum record(s) for Knox County*
*** Museum record(s) for an adjacent county*

One unconfirmed report for a River Otter (*Lutra canadensis*) was made in 2002 in the City of Mount Vernon, with confirmed reports noted as close as Licking County (Licking River drainage) and Holmes County (Killbuck drainage). Since suitable habitat occurs in the Kokosing River, and river otters tend to move great distances, the Kokosing may, in the future, harbor a sustainable river otter population.

Birds:

The riparian corridor and adjacent uplands of the Kokosing River support a wide variety of nesting birds. A compilation of the results of different breeding bird surveys conducted between 1994 and 1996 are presented in Table 10. The cumulative list of probable nesting species in the watershed based on these surveys totals 89. In June of 1996, timed 5 minute point counts were conducted by the Ohio Division of Natural Areas and Preserves (DNAP) and Kenyon College personnel from a canoe at 1/4 mile intervals on the mainstem below Mount Vernon (26 miles) and on a five mile stretch of the North Fork between Fredericktown and Rt. 13. A total of 72 species were identified during these riparian counts. Some of the more common species as identified by these counts were the song sparrow, cardinal, robin, indigo bunting, warbling vireo, tufted titmouse, common grackle, rough-winged swallow and house wren. These are all edge-adapted species occurring statewide in Ohio. Species identified in these counts which are primarily dependent on riparian habitats in addition to the warbling vireo and rough-winged swallow included great blue heron, wood duck, spotted sandpiper, belted kingfisher, yellow-throated warbler, and Louisiana waterthrush. Some of the more common forest birds identified in the corridor included downy and red-

Table 10: Birds of the Kokosing Watershed

1. Great Blue Heron (*Ardea herodias*)	22. Belted Kingfisher (*Ceryle torquata*)	45. House Wren (*Troglodytes aedon*)	66. Yellow Warbler (*Dendroica petechia*)
2. Green Heron (*Butorides striatus*)	23. Common Flicker (*Colaptes aurotus*)	46. Carolina Wren (*Thrythorus ludovicianus*)	67. Kentucky Warbler (*Oporornis formosus*)
3. Canada Goose (*Branta canadensis*)	24.Red-bellied Woodpecker (*Melanerpes carolinus*)	47. Blue-gray Gnatcatcher (*Polioptila caerulea*)	68. Hooded Warbler (*Wilsonia citrina*)
4. Mallard (*Anas platyrhychos*)	25. Pileated Woodpecker (*Dryocopus pileatus*)	48. Eastern Bluebird (*Sialia sialis*)	69. Prairie Warbler (*Dendroica discolor*)
5. Wood Duck (*Aix sponsa*)	26.Red-headed Woodpecker (*Melanerpes erthrocephalus*)	49. Wood Thrush (*Hyocichla mustelina*)	70. Louisiana Waterthrush (*Seiurus motacilla*)
6. Turkey Vulture (*Cathartes aura*)	27. Downy Woodpecker (*Picoides pubescens*)	50. Veery (*Catharus fuscenscens*)	71. Common Yellow-throat (*Geothylpis trichas*)
7. Black Vulture (*Coragyps atratus*)	28. Hairy Woodpecker (*Dendrocopos villosus*)	51. American Robin (*Turdus migratorius*)	72.Rose-breasted Grosbeak (*Pheucticus ludovicianus*)
8. Cooper's Hawk (*Accipiter cooperii*)	29. Eastern Kingbird (*Tyannus verticalis*)	52. Gray Catbird (*Dumetella carolinensis*)	73. Northern Cardinal (*Cardinalis cardinalis*)
9. Red-tailed Hawk (*Buteo jamaicensis*)	30.GreatCrested Flycatcher (*Myiarchus crinitus*)	53. Northern Mockingbird (*Mimus polyglottos*)	74. Indigo Bunting (*Passerina cyanea*)
10. American Kestrel (*Falco sparverius*)	31. Eastern Phoebe (*Sayornis phoebe*)	54. Brown Thrasher (*Toxostoma rufum*)	75. Rufous-sided Towhee (*Pipilo erythrophthalmus*)
11. Spotted Sandpiper (*Actitis hypoleucous*)	32. Acadian Flycatcher (*Empidonax virescens*)	55. Cedar Waxwing (*Bombycilla cedrorum*)	76. Song Sparrow (*Melospiza meoldia*)
12. Killdeer (*Characdrius vociferus*)	33. Willow Flycatcher (*Empidonax difficilis*)	56. Starling (*Sturnus vulgaris*)	77. Field Sparrow (*Spizella pusila*)
13. Turkey (*Meleagris gallopavo*)	34. Eastern Wood Pewee (*Contopus virens*)	57. White-eyed Vireo (*Vireo griseus*)	78. Chipping Sparrow (*Spizella passerina*)
14. Rock Dove (*Columba livia*)	35. Horned Lark (*Eremophila alpestris*)	58. Yellow-throated Vireo (*Vireo flavifrons*)	79. Eastern Meadowlark (*Sturnella magna*)
15. Mourning Dove (*Zenaida macroura*)	36. Tree Swallow (*Tachycineta bicolor*)	59. Red-eyed Vireo (*Vireo olivaceus*)	80. Red-winged Blackbird (*Agelaius phoeniceus*)
16. Yellow-billed Cuckoo (*Coccyzus americanus*)	37. Rough-winged Swallow (*Stelgidopteryx serripennis*)	60. Warbling Vireo (*Vireo gilvus*)	81. Br.-headed Cowbird (*Molothrus ater*)
17. Barred Owl (*Strix varia*)	38. Bank Swallow (*Riparia riparia*)	61. Black & white Warbler (*Dendroica fusca*)	82. Common Grackle (*Quiscalus quiscula*)
18. Great Horned Owl (*Bub virginianus*)	39. Barn Swallow (*Hirundo rustica*)	62. Blue-winged Warbler (*Vermivora pinus*)	83. Northern Oriole (*Icterus galbula*)
19. Screech Owl (*Otus asio*)	40. Blue Jay (*Cyannocitta cristata*)	63. Northern Parula (*Parula americana*)	84. Orchard Oriole (*Icterus spurius*)
20. Chimney Swift (*Chaetura pelagica*)	41. Common Crow (*Corvus brachyrhynchos*)	64. Cerulean Warbler (*Dendroica cerulea*)	
21.Ruby-throated Hummingbird (*Archilochus colubris*)	42. Carolina Chickadee (*Parus carolinensis*)	65. Yellow-throated Warbler (*Vireo flavifrons*)	
	43. Tufted Titmouse (*Parus bicolor*)	66. Yellow Warbler (*Dendroica petechia*)	

bellied woodpeckers, Acadian flycatchers, pewees and red-eyed vireos. Other forest dependent species of interest included pileated woodpecker, wood thrush, parula warbler, cerulean warbler and scarlet tanager.

General census data was also collected along sections of a bike path that parallels the river in several areas near Gambier and Howard and from a county road that paralleled the river in an area marked by rock outcroppings and cliff formations east of Millwood. Species identified in these counts that were not recorded on the riparian counts included the hooded warbler from woodlands in the Gambier area and the white-eyed vireo, prairie warbler and rufous-sided towhee from successional uplands adjacent to the river east of Millwood. Other species of interest identified by local birders in the Gambier area between 1994 and 1996 include barred owl, veery, blue-winged warbler, black and white warbler, Kentucky warbler and summer tanager.

Reptiles and Amphibians

The watershed committee is unaware of any systematic herpetological surveys conducted on the Kokosing River and its adjacent riparian zones with the exception of a survey funded by the Division of Wildlife to determine the presence/status of hellbenders in the river. The hellbender population in the Kokosing represents the most noteworthy species currently known for the drainage. This is a state endangered species known from only a handful of streams in the state. The following list represents those amphibians known to have inhabited the watershed based on museum records, private collections and information contained in Salamanders *of Ohio* (Pfingsten and Downs, 1989) and the *Ohio Salamander Atlas* (Phingsten and Matson, 2003). Most of the species listed below are relatively common and widespread in their Ohio distributions. The red salamander (*Pseudotriton ruber*) is restricted to eastern Ohio and is somewhat local in occurrence, as is the spring salamander (*Gyrinophilus porphyriticus*) (which is restricted to unglaciated sections of Ohio). For most of the salamanders listed, the best habitats are found below Millwood where the river has eroded through the underlying rock strata forming cliffs with rocky crevices and talus slopes.

Amphibians Recorded for the Koksosing Watershed

1. American Toad (*Bufo americanus*)
2. Fowler's Toad (*Bufo woodhousei fowleri*)
3. Blanchard's Cricket Frog (*Acris crepitans blanchardi*)
4. Spring Peeper (*Pseudacris cruciferi*)
5. Western Chorus Frog (*Pseudacris triserata*)
6. Gray Treefrog (*Hyla versicolor*)
7. Bullfrog (*Rana catesbeiana*)
8. Green Frog (*Rana clamitans melanota*)
9. Pickerel Frog (*Rana palustris*)
10. Leopard Frog (*Rana pipiens*)
11. Wood Frog (*Rana sylvatica*)
12. Hellbender (*Cryptobranchus alleganiensis*)
13. Mudpuppy (*Necturus maculosus*)
14. Red-spotted Newt (*Notophthalmus viridescens*)
15. Spotted Salamander (*Ambystoma maculatum*)
16. Smallmouth Salamander (*Ambystoma texanum*)
17. Spring Salamander (*Gyrinophilus porphyriticus*)
18. Dusky Salamander (*Desmognathus fuscus*)
19. Two-lined Salamander (*Eurycea bislineata*)
20. Long-tailed Salamander (*Eurycea longicauda*)
21. Red-backed Salamander (*Plethodon cinereus*)
22. Slimy Salamander (*Plethodon glutinosus*)
23. Ravine Salamander (*Plethodon richmondi*)
24. Red Salamander (Pseudotriton ruber)
25. Eastern Tiger Salamander (*Ambystoma tigrinum tigrinum*)

Species of reptiles observed during other survey work by ODNR personnel include the northern water snake (*Nerodia sipedon*), common garter snake (*Thamnophis sirtalis*), Eastern milk snake (neonate) (*Lampropeltis triangulum triangulum*) and spiny softshell turtle (*Apalone spinifera*). Other common species which are doubtless present in or adjacent to the river include: snapping turtle (*Chelydra serpentina*), painted turtle (*Chrysemys picta*), box turtle (*Terrapene carolina*), black rat snake (*Elaphe obsoleta*) and DeKay's snake (*Storeria dekayi*). There are no

state or federally listed species of reptiles known for the Kokosing drainage. In 1995, a Blanding's turtle (*Emydoidea blandingi*) was encountered in a backwater of the Kokosing just upstream from the junction with the Mohican River. Whether this represents an escaped specimen or a member of a disjunct population is unknown at this time.

Fishes

The first recorded fisheries inventory in the Kokosing drainage was a survey of Big Jelloway Creek and its tributaries carried out by Parker, Williamson and Osburn of The Ohio State University in 1898. The authors listed 36 species for this drainage including the bigeye chub (*Notropis amblops*) and hornyhead chub (*Nocomis biguttatus*); species which are still present today. Table 11 contains fish species for the Kokosing watershed.

Milton B. Trautman and his contemporaries made a number of collections in the drainage prior to the 1951 publication of Trautman's "The Fishes of Ohio." Trautman and his students made additional collections in the Kokosing River during the 1960's as part of the Central Ohio Stream Survey. These records are included in Trautman's 1981 update of *The Fishes of Ohio*. Trautman recorded a total of 59 species for the drainage.

The fish populations of the Kokosing River and several of its tributaries were intensively surveyed between 1981 and 1987 by Daniel L. Rice and Mark Barnes (ODNR) and George J. Phinney (Otterbein College). A total of 62 species were recorded during these surveys including a previously undetected population of the state endangered mountain brook lamprey (*Ichthyomyzon greeleyi*).

In 1987 the Ohio Environmental Protection Agency's Biological Assessment Section conducted a basin-wide inventory using electrofishing equipment. A total of 61 species (not including hybrids) were identified during this survey. New species of interest added to the drainage by Ohio EPA include the river redhorse (*Moxostoma carinatum*), flathead catfish (*Pylodictis olivaris*) and spotted bass (*Micropterus punctulatus*).

Based on these surveys the number of species reported for the drainage now stands at 74 species. While this is less than the 85-86 species generally attributed to be resident in Big Darby Creek in central Ohio, the fish community of the Kokosing River appears to be intact. All of the species known to have been present in the drainage historically with a few exceptions like the muskellunge (*Esox masquinongy*) are still present today. Included in this list are a number of sensitive species such as the mountain and least brook lampreys, hornyhead, river, bigeye and streamline chubs, rosyface and silver shiners and the bluebreast and spotted darters.

Bivalve Molluscs

For reasons that are not entirely clear, the Kokosing River appears to support only a very limited bivalve fauna. While no intensive surveys have been conducted to date, the general lack of shell material would indicate a lack of extensive molluscs beds as are found downstream in the Walhonding River. Even in the Mohican River where past pollution has eliminated much of the bivalve fauna, there is ample dead shell material to testify to their historic abundance and distributions in this system. It is the presence of a large and diverse molluscan fauna in the Walhonding River coupled with the historic populations in the Mohican River which makes their apparent shortage in the Kokosing River so puzzling. The Kokosing certainly has the water quality and the fish populations to support healthy populations of bivalves.

At least six unionid bivalve species have been recorded for the Kokosing River. They include the spike (*Elliptio dilatata*), fluted-Shell (*Lasmigona costata*), fatmucket (*Lampsilis siliquoidea*), plain pocketbook (*Lampsilis cardium*) and the squawfoot (*Strophitus undulatus*). A new record for the Kokosing was found in 2003 for the sharp-ridged pocketbook (*Lampsilis obata*). All of these species are common throughout the state, with the exception of the fluted-shell and the state endangered sharp-ridged pocketbook. These species may be abundant in the proper habitat, appear to be intol-

Table 11: Fishes of the Kokosing Watershed

Scientific Name		Common Name	Ohio EPA 1987	ODNR 1987	Trautman 1957
1)	*Ichthyomyzon greeleyi*	Mount Brook Lamprey		X	
2)	*Lampetra aepyptera*	Least Brook Lamprey	X	X	X
3)	*Dorosoma cepedianum*	Gizzard Shad	X	X	X
4)	*Umbra limi*	Central Mudminnow	X	X	X
5)	*Esox americanus vermiculatus*	Grass Pickerel	X	X	X
6)	*Esox lucius*	Northern Pike	X		
7)	*Esox masquinongy*	Muskellunge			X
8)	*Carpiodes cyprinus*	Quillback Carpsucker	X	X	X
9)	*Carpiodes velifer*	Highfin Carpsucker	X		
10)	*Moxostoma anisurum*	Silver Redhorse	X	X	X
11)	*Moxostoma duquesnei*	Black Redhorse	X	X	X
12)	*Moxostoma erythrumum*	Golden Redhorse	X	X	X
13)	*Moxostoma macrolepidotum*	Shorthead Redhorse	X	X	X
14)	*Moxostoma carinatum*	River Redhorse	X		X
15)	*Hypentelium nigricans*	Northern Hog Sucker	X	X	X
16)	*Catostomus commersoni*	White Sucker	X	X	X
17)	*Cyprinus carpio*	Common Carp	X	X	X
18)	*Notemigonus crysoleucas*	Golden Shiner	X	X	X
19)	*Nocomis biguttatus*	Hornyhead Chub	X	X	X
20)	*Nocomis micropogon*	River Chub	X	X	X
21)	*Notropis amblops*	Bigeye Chub	X	X	X
22)	*Erimystax dissimilis*	Streamline Chub	X	X	X
23)	*Erimystax x-punctata*	Gravel Chub		X	X
24)	*Rhinichthys atratulus*	Blacknose Dace	X	X	X
25)	*Semotilus atromaculatus*	Creek Chub	X	X	X
26)	*Phoxinus erythrogaster*	Redbelly Dace		X	X
27)	*Clinostomus elongatus*	Redside Dace		X	X
28)	*Notropis atherinoides*	Emerald Shiner	X		
29)	*Notropis photogenis*	Silver Shiner	X	X	X
30)	*Notropis rubellus*	Rosyface Shiner	X	X	X
31)	*Luxilus chrysocephalus*	Striped Shiner	X	X	X
32)	*Luxilus cornutus*	Common Shiner		X	X
33)	*Cyprinella spiloptera*	Spotfin Shiner	X	X	X
34)	*Notropis stramineus*	Sand Shiner	X	X	X
35)	*Notropis volucellus*	Mimic Shiner	X	X	X
36)	*Notropis buccatus*	Silverjaw Minnow	X	X	X
37)	*Pimephales promelas*	Fathead Minnow	X		X
38)	*Pimephales notatus*	Bluntnose Minnow	X	X	X
39)	*Campostoma anomalum*	Central Stoneroller	X	X	X

Table 11: Fishes of the Kokosing Watershed (continued)

	Scientific Name	Common Name	Ohio EPA 1987	ODNR 1987	Trautman 1957
41)	*Ameiurus natalis*	Yellow Bullhead	X	X	X
42)	*Ameiurus melas*	Black Bullhead			X
43)	*Pylodictis olivaris*	Flathead Catfish	X		
44)	*Noturus flavus*	Stonecat Madtom	X	X	X
45)	*Fundulus notatus*	Blackstripe Topminnow	X	X	
46)	*Percopsis omiscomaycus*	Trout-Perch	X	X	X
47)	*Labidesthes sicculus*	Brook Silverside		X	
48)	*Morone chrysops*	White Bass	X		
49)	*Promoxis annularis*	White Crappie		X	
50)	*Poxomis nigromaculatus*	Black Crappie	X	X	X
51)	*Ambloplites rupestris*	Rock Bass	X	X	X
52)	*Micropterus dolomieu*	Smallmouth Bass	X	X	X
53)	*Micropterus punctulatus*	Spotted Bass	X		
54)	*Micropterus salmoides*	Largemouth Bass	X	X	X
55)	*Lepomis cyanellus*	Green Sunfish	X	X	X
56)	*Lepomis macrochirus*	Bluegill Sunfish	X	X	X
57)	*Lepomis megalotis*	Longear Sunfish		X	
58)	*Lepomis gibbosus*	Pumpkinseed Sunfish	X	X	
59)	HYBRID	Hybrid Sunfish	X	X	
60)	*Stizostedion vitreum*	Walleye	X		X
61)	*Perca flavescens*	Yellow Perch	X	X	
62)	*Percina maculata*	Blackside Darter	X	X	X
63)	*Percina caprodes*	Logperch	X	X	X
64)	*Ammocrypta pellucida*	Eastern Sand Darter		X	
65)	*Etheostoma nigrum*	Johnny Darter	X	X	X
66)	*Etheostoma blennioides*	Greenside Darter	X	X	X
67)	*Etheostoma zonale*	Banded Darter	X	X	X
68)	*Etheostoma variatum*	Variegate Darter	X	X	X
69)	*Etheostoma maculatum*	Spotted Darter		X	
70)	*Etheostoma camurum*	Bluebreast Darter	X	X	X
71)	*Etheostoma caeruleum*	Rainbow Darter	X	X	X
72)	*Etheostoma spectabile*	Orangethroat Darter	X		
73)	*Etheostoma flabellare*	Fantail Darter	X	X	X
74)	*Cottus bairdi*	Mottled Sculpin	X	X	X
75)	*Culaea inconstans*	Brook Stickleback		X	X

erant of pollutants and are becoming increasingly scarce in some river systems in Ohio.

Aquatic Macroinvertebrates

In general, exceptional macroinvertebrate communities were found during the *1987 Ohio EPA Kokosing River Water Quality Study*. The invertebrate community index (ICI) rating system was used to evaluate the invertebrate community of the Kokosing River. ICI values ranged from 48 to 56 and were within the levels necessary to meet exceptional warmwater habitat criteria. Table 12 lists macroinvertebrates recorded in the watershed. Table 13 lists Ohio EPA macroinvertebrate data.

Macroinvertebrate communities were evaluated at 17 stations from near the headwaters (RM 49.8) to near the mouth (RM 1.5) in 1987. The station with the highest total mayfly (Ephemeroptera), stonefly (Plecoptera) and caddisfly (Trichoptera) taxa richness (EPT), a measure of the diversity of pollution sensitive taxa, was upstream from Co. Rd. 35 (RM 11.6) with 27 taxa. There were two sites with an ICI of 38 (RMs 49.8 and 8.7), which is in the good (rather than exceptional) range, attributed to little or no water current and poor placement of the testing device. The lower scores were not attributed to lower water quality or degraded habitat.

Macroinvertebrate taxa collected in the Kokosing River that are indicative of high quality streams in Ohio included the mayfly *Serratella deficiens* at 17 sites between RMs 46.3 and 1.5, stoneflies of the genus *Pteronarcys* at RMs 11.6 and 6.2, the caddisflies *Psychomyia flavida* at RMs 24.2 and 6.2 and *Leucotrichia pictipes* at RM 28.6, the chironomid midges *Eukiefferiella devonica* group at RM 6.2 and the *Rheotanytarsus distinctissimus* group at 16 sites between RMs 49.8 and 1.5 and also *Sublettea coffmani* at RMs 45.2, 35.0 and 11.6.

Odonata Species Collected for Knox County:

As part of the Ohio Odonata Survey, the following 55 species (198 records) for Odonates (dragonflies and damselflies) are listed for Knox County:

- Ophiogomphus rupinsulensis (Walsh), 1862 - Rusty Snaketail - Family: Gomphidae
- Gomphus fraternus (Say), 1839 - Midland Clubtail - Family: Gomphidae
- Gomphus vastus Walsh, 1862 - Cobra Clubtail - Family: Gomphidae
- Gomphus lividus Selys, 1854 - Ashy Clubtail - Family: Gomphidae
- Gomphus quadricolor Walsh, 1862 - Rapids Clubtail - Family: Gomphidae
- Arigomphus villosipes Selys, 1854 - Unicorn Clubtail - Family: Gomphidae
- Stylogomphus albistylus (Hagen), 1878 - Least Clubtail - Family: Gomphidae
- Basiaeschna janata (Say), 1839 - Springtime Darner - Family: Aeshnidae
- Boyeria vinosa (Say), 1839 - Fawn Darner - Family: Aeshnidae
- Anax junius (Drury), 1770 - Common Green Darner - Family: Aeshnidae
- Epiaeschna heros (Fabricius), 1798 - Swamp Darner - Family: Aeshnidae
- Aeshna umbrosa Walker, 1908 - Shadow Darner - Family: Aeshnidae
- Macromia illinoiensis illinoiensis Walsh, 1862 - Illinois River Cruiser - Family: Macromiidae
- Neurocordulia yamaskanensis (Provancher), 1875 - Stygian Shadowdragon - Family: Corduliidae
- Epitheca princeps Hagen, 1861 - Prince Baskettail - Family: Corduliidae
- Epitheca cynosura (Say), 1839 - Common Baskettail - Family: Corduliidae
- Perithemis tenera (Say), 1839 - Eastern Amberwing - Family: Libellulidae
- Celithemis eponina (Drury), 1773 - Halloween Pennant - Family: Libellulidae
- Celithemis elisa (Hagen), 1861 - Calico Pennant - Family: Libellulidae
- Libellula luctuosa Burmeister, 1839 - Widow Skimmer - Family: Libellulidae

Table 12: Macroinvertebrates of the Kokosing Watershed

Phylum Annelida: Leeches & Aquatic Worms		
Helobdella stagnalis	Placobdella ornata	Mooreobdella microstoma
Helobdella triserialis	Mooreobdella fervida	Oligochaeta
Phylum Cnidaria: Hydrazoans		
Hydra sp		
Phylum Crustacea: Isopods: Aquatic Sowbugs		
Lirceus sp	Caecidotea sp	Hyalella azteca
Crangonyx sp		
Phylum Entoprocta: Bryozoans: Moss Animalcules		
Plumatella sp	Urnatella gracilis	Lophopodella carteri
Phylum Hydrachnida: Water mites		
Hydracarina		
Phylum Mollusca: Bivalvia: Clams and Freshwater mussels		
Corbicula fluminea (Aquatic Clam)	Pisidium sp (Fingernail Clam)	Sphaerium sp (Fingernail Clam)
Unionidae	Lasmigona costata (Fluted Shell)	Leptodea fragilis (Fragile Papershell)
Lasmigona complanata (White Heelsplitter)		
Phylum Mollusca: Gastropoda: Snails		
Cipangopaludina japonica	Hydrobiidae	Physella sp (Pouch Snail)
Elimia sp (River Snail)	Fossaria sp (Pond Snail)	Ferrissia sp (Limpets)
Gyraulus (Torquis) parvus (Orb Snail)	Helisoma anceps anceps (Orb Snail)	
Phylum Nemertea: Horsehair worms		
Nematomorpha		
Phylum Platyhelminthes: Flatworms		
Turbellaria		
Phylum Porifera: Freshwater Sponges		
Spongillidae	Eunapius fragilis	
Order Coleoptera: Beetles		
Ancyronyx variegata (Riffle Beetle)	Stenelmis sp (Riffle Beetle)	Optioservus trivittatus (Riffle Beetle)
Dubiraphia vittata group (Riffle Beetle)	Optioservus svalis (Riffle Beetle)	Dubiraphia sp (Riffle Beetle)
Dubiraphia bivittata (Riffle Beetle)	Optioservus fastiditus (Riffle Beetle)	Macronychus glabratus (Riffle Beetle)
Dubiraphia quadrinotata (Riffle beetle)	Helichus sp (Water Penny)	Psephenus herricki (Water Penny)
Laccophilus sp (Diving Beetle)	Ectopria sp (Water Penny)	Peltodytes sp (Crawling Water Beetle)
Hydroporus sp (Diving Beetle)	Dineutus sp (Whirligig Beetle)	Gyrinus sp (Whirligig Beetle)
Liodessus sp (Diving Beetle)	Enochrus sp (Water Scavanger)	Berosus sp (Water Scavanger)
Laccobius sp (Water Scavanger)	Paracymus sp (Water Scavanger)	Helophorus sp (Water Scavanger)
Tropisternus sp (Water Scavanger)	Sperchopsis tesselatus (Water Scavanger)	
Hydrobius sp (Water Scavanger)		

Table 12: Macroinvertebrates of the Kokosing Watershed (continued)

Order Decapoda: Crayfish and Amphipods		
Cambarus (Puncticambarus) robustus	Orconectes sp	Orconectes (Procericambarus) rusticus
Cambarus (Cambarus) bartonii cavatus (Scuds)		Cambarus sp (Scuds)
Orconectes (Crokerinus) sanbornii sanbornii		
Order Diptera: Mosquitoes and Flies		
Anopheles sp (Mosquito)	Simulium sp (Black Fly)	Hemerodromia sp (Dance Fly)
Chrysops sp (Horsefly)	Tabanus sp (Horsefly)	Atherix lantha (Snipefly)
Ephydridae (Shore Fly)	Empididae (Dance Fly)	Stratiomyidae (Soldier Fly)
Limnophora discreta (Anthomyiid)	Limonia sp (Cranefly)	Tipula sp (Cranefly)
Antocha sp (Cranefly)	Hexatoma sp (Cranefly)	Pilaria sp (Cranefly)
Erioptera sp (Cranefly)		
Order Odonata: Dragonflies and Damselflies		
Basiaeschna janata	Gomphus lividus	Stylurus spiniceps
Boyeria vinosa	Gomphus quadricolor	Macromia sp
Gomphidae	Ophiogomphus sp	Macromia illinoiensis
Neurocordulia obsoleta	Neurocordulia yamaskanensis	Somatochlora sp
Gomphus sp	Ophiogomphus mainensis	Epitheca (Epicordulia) princeps
Coenagrionidae (Damselfly)	Hetaerina sp (Damselfly)	Argia sp (Damsefly)
Calopteryx sp (Damselfly)		
Order Plecoptera: Stoneflies		
Pteronarcys sp	Acroneuria frisoni	Agnetina capitata complex
Paragnetina media	Acroneuria internata	Amphinemura delosa
Order Trichoptera: Caddisflies		
Chimarra aterrima	Neureclipsis sp	Ceratopsyche slossonae
Chimarra obscura	Polycentropus sp	Hydropsyche sp
Psychomyia flavida	Cheumatopsyche sp	Hydropsyche bidens
Polycentropodidae	Ceratopsyche morosa group	Hydropsyche depravata group
Hydropsyche valanis	Glossosoma sp	Hydropsyche dicantha
Hydropsyche venularis	Protoptila sp	Hydropsyche frisoni
Macrostemum zebratum	Hydroptila sp	Hydropsyche orris
Potamyia flava	Leucotrichia pictipes	Hydropsyche simulans
Rhyacophila sp	Neophylax sp	Nectopsyche sp
Pycnopsyche sp	Oecetis sp	Nectopsyche diarina
Helicopsyche borealis	Oecetis cinerascens	Mystacides sepulchralis
Ceraclea sp	Petrophila sp	

Table 12: Macroinvertebrates of the Kokosing Watershed (continued)

Order Diptera: Midges		
Ablabesmyia mallochi	Nanocladuis (N.) sp	Endochironomus sp
Ablabesmyia rhamphe group	Nanocladius (N.) crassicornus (old)	Endochironomus nigricans
Conchapelopia sp	Thienemanniella sp	Glyptotendipes (G.) sp
Labrundinia pilosella	Nanocladius (N.) minimus	Polypedilum (P.) aviceps
Natarsia species A (sensu Roback, 1978)	Nanocladius (N.) spiniplenus	Microtendipes pedellus group
Nilotanypus fimbriatus	Orthocladius (O.) sp	Thienemanniella n.sp 1
Polypedilum (Tripodura) halterale group	Parakiefferiella n.sp 1	Parachironomus frequens
Rheopelopia paramaculipennis	Parametriocnemus sp	Parachironomus pectinatellae
Paratendipes albimanus or P. duplicatus	Telopelopia okoboji	Zavrelimyia sp
Thienemannimyia group	Nanocladius (N.) distinctus	Phaenopsectra obediens group
Rheocricotopus (Psilocricotopus) robacki	Procladius sp	Rheotanytarsus distinctissimus group
Cricotopus (C.) tremulus group	Dicrotendipes sp	Stenochironomus sp
Polypedilum (Tripodura) scalaenum group Saetheria tylus		Stictochironomus sp
Cardiocladius obscurus	Thienemanniella similis	Polypedilum (P.) convictum
Corynoneura sp	Thienemanniella xena	Polypedilum (P.) fallax group
Tanytarsus sp	Tvetenia discoloripes group	Polypedilum (P.) illinoense
Corynoneura lobata	Chironomus (C.) decorus group	Polypedilum (P.) laetum group
Eukiefferiella gracei group	Chironomus (C.) riparius group	Dicrotendipes lucifer
Cricotopus (C.) bicinctus	Cryptochironomus sp	Dicrotendipes simpsoni
Paratanytarsus sp	Dircotendipes neomodestus	Tribelos jucundum
Eukiefferiella devonica group	Cricotopus (C.) trifascia group	Cricotopus (C.) sp
Ceratopogonidae (Biting Midge)	Atrichopogon sp (Biting Midge)	Dixella sp (Dixa Midge)
Sublettea coffmani	Tanytarsus Type 1	Tanytarsus guerlus group
Cladotanytarsus vanderwulpi group 1	Pseudochironomus sp	Rheotanytarsus exiguus group
Cladotanytarsus mancus group	Xenochironomus xenolabis	Stempellinella sp
Microtendipes "caelum" (sensu Simpson & Bode, 1980)	Cladotanytarsus sp	Tanytarsus glabrescens group
Nanocladuis (N.) crassicornus or N. (N.) rectinervus	Parachironomus "abortivus" (sensu Simpson & Bode, 1980)	Corynoneura "celeripes" (sensu Simpson & Bode, 1980)
Hayesomyia senata / Thienemannimyia norena	Glyptotendipes (Trichotendipes) amplus	

Table 13:Ohio EPA Macroinvertebrate Data for the Kokosing Watershed

River Mile	Total # Taxa	Total # Mayfly Taxa	Total # Caddisfly Taxa	Total # Dipteran Taxa	% of Mayflies	% of Caddisflies	% of Tanytarsini	% of Other Dipt / NI	% of Tolerant Taxa	ICI
Koko-sing River										
49.8	38	6	0	20	33.1	0	11.2	52.1	10.8	38
48.4	44	9	3	18	11.1	0.9	36.4	45.9	8.3	46
46.3	35	7	2	18	10.5	1.3	51	35.7	6.9	42
45.2	42	9	1	21	7.4	0.1	60.9	30.6	6.5	44
40.5	32	8	4	11	37.2	6	45.2	11	1.1	48
35	46	9	5	19	12.3	8.2	38.4	40.5	6.1	48
30.6	33	9	5	13	16	6.9	63.3	13.7	0.6	48
28.6	29	11	3	9	33.3	5.9	48.6	11.8	0.5	48
25.2	46	12	5	17	5.2	2.7	60.8	28.9	6.6	46
24.2	37	12	6	13	8.8	4	60.5	24.7	2.2	46
22.9	32	9	6	9	16.7	7.7	62.4	12.4	0.1	48
18	31	10	6	7	13.8	3.8	76.5	5.6	0	46
16.2	31	7	5	11	30.7	7.6	51	10.2	0	46
11.6	40	12	6	13	35	12.2	44.1	7.5	0.7	54
8.7	40	7	3	15	11.7	2.2	37.7	45.2	11.4	38
6.2	38	8	9	14	23.5	22	39.9	14.3	1.3	52
1.5	31	11	7	8	14.7	7.9	73.1	4.1	0.2	48

Table 13:Ohio EPA Macroinvertebrate Data for the Kokosing Watershed (continued)

River Mile	Total # Taxa	Total # Mayfly Taxa	Total # Caddisfly Taxa	Total # Dipteran Taxa	% of Mayflies	% of Caddisflies	% of Tanytarsini	% of Other Dipt/ NI	% of Tolerant Taxa	ICI
N. Br. Kokosing										
11.6	40	12	5	14	4.2	3.1	53.6	38.2	10.6	46
6.2	37	8	9	10	37.2	24.4	19	19.1	0	50
4.8	40	11	7	9	47.6	17.8	12.6	19.7	1.6	52
2.1	30	9	5	11	73.2	5.3	13.1	7.3	0.2	46

- Libellula cyanea Fabricius, 1775 - Eastern Spangled Skimmer - Family: Libellulidae
- Libellula semifasciata Burmeister, 1839 - Painted Skimmer - Family: Libellulidae
- Libellula pulchella Drury, 1770 - Twelve-spotted Skimmer - Family: Libellulidae
- Libellula quadrimaculata Linnaeus, 1758 - Four-spotted Skimmer - Family: Libellulidae
- Libellula lydia Drury, 1770 - Common Whitetail - Family: Libellulidae
- Sympetrum ambiguum (Rambur), 1842 - Blue-faced Meadowhawk - Family: Libellulidae
- Sympetrum rubicundulum (Say), 1839 - Ruby Meadowhawk - Family: Libellulidae
- Sympetrum vicinum (Hagen), 1861 - Yellow-legged Meadowhawk - Family: Libellulidae
- Sympetrum costiferum (Hagen), 1861 - Saffron-winged Meadowhawk - Family: Libellulidae
- Leucorrhinia intacta Hagen, 1961 - Dot-tailed Whiteface - Family: Libellulidae
- Pachydiplax longipennis (Burmeister), 1839 - Blue Dasher - Family: Libellulidae
- Erythemis simplicicollis Say, 1839 - Eastern Pondhawk - Family: Libellulidae
- Pantala flavescens (Fabricius), 1798 - Wandering Glider - Family: Libellulidae
- Tramea lacerata Hagen, 1861 - Black Saddlebags - Family: Libellulidae
- Calopteryx maculata (Beauvois), 1805 - Ebony Jewelwing - Family: Calopterygidae
- Hetaerina americana (Fabricius), 1798 - American Rubyspot - Family: Calopterygidae
- Lestes inaequalis Walsh, 1862 - Elegant Spreadwing - Family: Lestidae
- Lestes forcipatus Rambur, 1842 - Sweetflag Spreadwing - Family: Lestidae
- Lestes rectangularis Say, 1839 - Slender Spreadwing - Family: Lestidae
- Lestes vigilax Hagen, 1862 - Swamp Spreadwing - Family: Lestidae
- Argia apicalis (Say), 1839 - Blue-fronted Dancer - Family: Coenagrionidae
- Argia fumipennis violacea (Hagen), 1861 - Violet Dancer - Family: Coenagrionidae
- Argia moesta (Hagen), 1861 - Powdered Dancer - Family: Coenagrionidae
- Argia sedula (Hagen), 1861 - Blue-ringed Dancer - Family: Coenagrionidae
- Argia tibialis (Rambur), 1842 - Blue-tipped Dancer - Family: Coenagrionidae
- Amphiagrion saucium (Burmeister), 1839 - Eastern Red Damsel
- Nehalennia gracilis Morse, 1895 - Sphagnum Sprite - Family: Coenagrionidae
- Chromagrion conditum (Hagen), 1876 - Aurora Damsel - Family: Coenagrionidae
- Enallagma exsulans (Hagen), 1861 - Stream Bluet - Family: Coenagrionidae

- Enallagma antennatum (Say), 1839 - Rainbow Bluet - Family: Coenagrionidae
- Enallagma civile (Hagen), 1861 - Familiar Bluet - Family: Coenagrionidae
- Enallagma basidens Calvert, 1902 - Double-striped Bluet - Family: Coenagrionidae
- Enallagma aspersum (Hagen), 1861 - Azure Bluet - Family: Coenagrionidae
- Ischnura posita (Hagen), 1861 - Fragile Forktail - Family: Coenagrionidae

Ischnura verticalis (Say), 1839 - Eastern Forktail - Family: Coenagrionidae

Threatened, Rare, or Endangered Species

There are no known federally endangered species, either plant or animal, in the Kokosing River watershed. The watershed does support five state endangered and five state threatened species. The Ohio Division of Natural Areas and Preserves' Natural Heritage section not only tracks the occurrence of these state endangered and threatened species but also tracks potentially threatened, special interest species and other elements such as "Ohio's Big Trees" and Great Blue Heron Colonies. Natural Heritage elements for the Kokosing River watershed represent 27 different plants, fish, birds and amphibians. More specific information on these elements are presented in the discussions which follow each group. Table 14 shows the elements in list form.

Plants

No plant species of federal status or concern have been recorded in the Kokosing River watershed. State listed species include one endangered and four threatened species. The state endangered species, small purple fringed orchid (*Platanthera psycodes*), is found in wet, semi-shaded areas in neutral or subacidic substrates. The state threatened species are the false hop sedge (*Carex lupuliformis*), Philadelphia panic grass (*Panicum philadelphicum*), smooth rose (*Rosa blanda*), and woodland bulrush (*Scirpus expansus*). In addition, the watershed contains eight other Natural Heritage elements.

Mammals

There are no threatened or endangered mammalian species known to occur in the Kokosing River corridor at this time; however suitable habitat does occur in the corridor for the federally and state endangered Indiana Bat (*Myotis sodalis*). This species utilizes riparian corridors throughout Ohio during the summer months for feeding, resting and raising its young.

Birds

There are no federally listed species resident within the corridor at this time. However, two pairs of state endangered bald eagles (*Haliaeetus leucoephalus*) are nesting on the Kokosing River (below Millwood) and at Knox Lake. A third pair of bald eagles has been observed on the Kokosing at Foundation Park in Mount Vernon, but no nest was observed in 2003. The state endangered Northern harrier (*Circus cyaneus*) is a winter resident of the watershed. It is also possible that short-eared owls (*Asio flammeus*), a state listed breeding bird, could occur as a winter resident within the corridor. Their presence here is predicated on the existence of suitable pasturelands and fallow fields. One unconfirmed sighting of the Northern harrier was made in February 2003 on Muskingum Watershed Conservancy lands near the confluence of the Mohican and Kokosing Rivers.

Fish

There are no federally listed fish known for the Kokosing River drainage. State endangered species found in the Kokosing River include the mountain brook lamprey (*Ichthyomyzon greeleyi*) and the spotted darter (*Etheostoma maculatum*). The

Table 14:Natural Heritage Database Elements for the Kokosing Watershed

Common Name	Scientific Name
BALD EAGLE	HALIAEETUS LEUCOCEPHALUS
ROCK-HARLEQUIN	CORYDALIS SEMPERVIRENS
SMOOTH ROSE	ROSA BLANDA
DIFFUSE RUSH	JUNCUS DIFFUSISSIMUS
STREAMLINE CHUB	ERIMYSTAX DISSIMILIS
EASTERN SAND DARTER	AMMOCRYPTA PELLUCIDA
UMBRELLA MAGNOLIA	MAGNOLIA TRIPETALA
BLACK LOCUST	ROBINIA PSEUDOACACIA
HACKBERRY	CELTIS OCCIDENTALIS
AMERICAN CHESTNUT	CASTANEA DENTATA
SMALL PURPLE FRINGED ORCHID	PLATANTHERA PSYCODES
WOODLAND BULRUSH	SCIRPUS EXPANSUS
SPOTTED DARTER	ETHEOSTOMA MACULATUM
RAVEN-FOOT SEDGE	CAREX CRUS-CORVI
TIGER SALAMANDER	AMBYSTOMA TIGRINUM
CLIFF SWALLOW	PETROCHELIDON PYRRHONOTA
BIGEYE CHUB	HYBOPSIS AMBLOPS
	OAK-MAPLE FOREST
SORA	PORZANA CAROLINA
SOLITARY VIREO	VIREO SOLITARIUS
BLUEBREAST DARTER	ETHEOSTOMA CAMURUM
FALSE HOP SEDGE	CAREX LUPULIFORMIS
BLACK-THROATED GREEN WARBLER	DENDROICA VIRENS
MOUNTAIN BROOK LAMPREY	ICHTHYOMYZON GREELEYI

Kokosing also supports populations of the state threatened bluebreast darter (*Etheostoma camurum*). Species of special interest inhabiting the Kokosing include the river redhorse (*Moxostoma carinatum*), bigeye chub (*Hybopsis amblops*), streamline chub (*Erimystax dissimilis*) and eastern sand darter (*Ammocrypta pellucida*). A brief discussion of each of these species is presented below.

Mountain Brook Lamprey (*Ichthyomyzon greeleyi*), Endangered

This is one of the four species of small nonparasitic brook lampreys found in Ohio. Within Ohio this species was known to occur only in the Mahoning River drainage in Portage and Trumbull counties. Small populations were known to inhabit the West Branch Mahoning River and Eagle Creek. How the Kokosing population escaped detection for so long is unclear. Surveys by Rice and Phinney during the fall of 1985 identified a sizeable population with ammocoetes occupying suitable habitats in the mainstem from river mile 2.8 upstream as far as river mile 13.5 above Howard, Ohio. A total of 94 ammocoetes and transforming adults were collected during this survey. Surveys conducted intermittently by ODNR between 1981 and 1986 using both seines and electrofishing gear had failed to capture this species. Lampreys can be difficult to survey as the nonparasitic forms spend most of their lives buried in beds of sand and organic debris where they filter out nutrients and oxygen. As burrowers, the young are inaccessible to capture by seines and are insulated to a large degree from the electric currents used in electrofishing. The adults die shortly after spawning in the spring and offer a very limited time frame for survey work.

River Redhorse (*Moxostoma carinatum*), Special Concern

A species of larger rivers and streams, river redhorse are present in small numbers in the lower sections of the mainstem. The Kokosing population is a likely extension of the population found in the Walhonding River. Whether or not this species actually spawns in the Kokosing is unknown at this time. This species requires clean gravel and cobble substrates for feeding and spawning. They are most often found in runs, flowing pools and at the bases of riffles where they feed on a variety of macroinvertebrates. Spawning occurs over gravel riffles in the spring of the year.

Bigeye Chub (*Hybopsis amblops*), Special Concern

A pool species inhabiting small streams to large rivers, bigeye chubs are sight feeders requiring relatively clear waters. Bigeyes are sensitive to increasing water turbidity and have disappeared from many streams throughout Ohio due to siltation and increased turbidity levels. Once widespread throughout Ohio, bigeyes are now very local and greatly diminished in their distributions. The Kokosing River supports one of the largest remaining Ohio populations of this species. This population occupies the main channel from its junction with the Mohican River to upstream of Mount Vernon as far as river mile 31.7. The main population appears to be centered in the lower 20 miles below Mount Vernon.

Streamline Chub (*Erimystax dissimilis*), Special Concern

A species of medium-sized rivers and streams, the streamline chub is sparingly distributed in the Kokosing River as far upstream as Howard, Ohio at river mile 11.3. Usually no more than 1-4 individuals are captured on a given riffle at any one time. Streamline chubs feed on bottom-dwelling macroinvertebrates and are sensitive to siltation. They are most often collected over sand and gravel substrates at the bases of riffles and in chutes and runs. Elsewhere in the Muskingum basin this species is found in the lower Mohican, Walhonding and upper Muskingum rivers.

Eastern Sand Darter (*Ammocrypta pellucida*), Special Concern

A pool species requiring clean, stable sandy substrates, the sand darter is another of the once widely distributed and common species whose distribution and abundance has been greatly reduced by increasing turbidity levels and siltation of its habitat. Sand darters are rare residents of the lower Kokosing River. On several occasions single individuals have been collected from sandy substrates in the lower two miles of the river. These individuals likely represent the uppermost extensions of the populations found in the Walhonding River that provides better habitat conditions for this species. Sand darters are also found in the lower most reaches of the Mohican River and along the entire length of the Muskingum River.

Spotted darter (*Etheostoma maculatum*), Endangered

This species has one of the most restricted occurrences of all the fish collected in the Kokosing. The Kokosing population appears to be restricted to a single riffle (vicinity of Rt. 715 and Zuck Road). Spotted Darters require riffles having large boulders and swift currents. In these swift riffles, spotted darters are found under and around the larger rocks where the currents are deflected away from them. These habitats are difficult to sample because of current velocities and the size of the rocks present in them. Efforts to catch this species in several other boulder-strewn riffles (vicinity of Millwood, Ohio) that appear to provide suitable habitat conditions, have consistently met with failure.

Bluebreast Darter (*Etheostoma camurum*), Threatened

Like the spotted darter, the bluebreast darter also favors swift, rocky riffles but does not require the larger boulders favored by the spotted darter. This fact is reflected in the greater distribution of

the bluebreast darter in the Kokosing. Bluebreast darters have been taken in rocky riffles from the confluence with the Mohican to as far upstream as Big Run Rd. (river mile 13.5). Elsewhere in the Muskingum Basin Bluebreast darters have been collected in the lower Mohican River and the Walhonding River.

Reptiles and Amphibians

Hellbender (*Cryptobranchus alleganiensis*), Endangered

A large aquatic salamander restricted to the Ohio River drainage system in Ohio and adjacent states, this species inhabits medium to large sized streams having clean substrates and excellent water quality. It requires large flattened rocks in areas of moderate currents. Females lay and guard their eggs under these rock slabs, which also protect the young from potential predators. This species has disappeared from or declined in those streams that have been impacted by excessive siltation and increased water turbidity or where pollution has degraded the water quality. The Kokosing system supports a modest population of this state endangered animal, as does the Mohican and Walhonding rivers.

Unionid Molluscs

In the summer of 2003, the first record ever for a state endangered mussel was recorded on the Kokosing River mainstem, near Gambier. *Lampsilis ovata*, sharp-ridged pocketbook, was positively identified. The specimen consisted of a subfossil, meaning that historically, the Kokosing contained this species. No live specimens were encountered.

WATER QUALITY

Aquatic Habitat and Water Quality

The majority of the Kokosing River remains in a natural condition. Diverse substrate particle size created by past glacial activity has resulted in an exceptional habitat for the aquatic communities. The combinations of minimal alterations of the river channel, along with the diverse habitat, have enabled the native fish and invertebrate populations to survive intact.

The Ohio Environmental Protection Agency (OHIO EPA) uses several indices to evaluate the health and quality of Ohio's streams. One of these indices is the Qualitative Habitat Evaluation Index described as follows:

Qualitative Habitat Evaluation Index (QHEI)

QHEI is an objective method of measuring physical habitat conditions which examines and assigns numeric values to various attributes of the physical habitat including riparian corridor, substrate types, instream cover, geomorphology, pool and riffle development and others. Habitat quality untilizng the QHEI procedures is categorized as follows:

Excellent Habitat Quality:	QHEI = $\geq$ 75
Good Habitat Quality:	QHEI = $\geq$ 60
Fair Habitat Quality:	QHEI = $\geq$ 45
Poor Habitat Quality:	QHEI = < 45

The Ohio EPA conducted a QHEI assessment of the Kokosing River. The assessment produced index scores that ranged from 69 to 90.5 indicating the presence of excellent habitat. Three sites between RM 45.3 and RM 36.6 scored much lower however due to previous small-scale instream gravel mining and channel modifications. These alterations created habitats that are less diverse and that have a tendency to accumulate silt. Adjacent areas can buffer these localized interruptions in habitat quality, and segments of the river may still achieve mean scores that reflect adequate habitat to meet the designated aquatic life use. Table 15 shows segment scores for the Kokosing River:

Tributaries to the Kokosing River were measured to have QHEI scores ranging from 58.5 to 80.5 which demonstrates their ability to physically support good to exceptional aquatic communities.

The substrate throughout the Kokosing River from its headwaters to the mouth is predominantly cobbles, gravel and sand. The gradation in size of substrate from sand to the occasional boulders provides excellent habitat for fish and macroinvertebrates allowing for highly diverse populations. Good flow, low water temperatures (good ground water inflow) and typical stream riffle-pool-run sequences also contribute to the high quality habitat in the Kokosing River. In terms of stream morphology, approximately 98% of the Kokosing watershed streams are classified as C-type channels, meaning the streams typically consist of low gradient, meandering, point-bar, riffle/pool systems with broad, well defined floodplains. One percent of the streams (such as the upper portion of Laurel Run) in the watershed are considered A-type channels, characterized by a steep, entrenched, cascading, step/pool system. These streams are stable, since bedrock and or/boulders dominates the channel. One percent of the streams in the watershed are considered G-type channels, which consist of

Table 15: Segment Boundary QHEI Scores

Segment Boundaries	QHEI Score
Headwaters to upstream confluence with N.Br. Kokosing R.	66.4
Downstream confluence N.Br. Kokosing R. to upstream Mount Vernon WWTP	74.8
Downstream Mount Vernon WWTP to upstream Gambier WWTP	81.3
Downstream Gambier WWTP to upstream Millwood Quarries	84.3
Downstream Millwood Quarries to mouth	84.0

entrenched "gully" step/pool and low width/depth ratio on moderate gradients. Channelized (straightened) streams in the watershed comprise the G-type channels. G-type channels tend to be less stable than their C-type and A-type counterparts.

Ohio EPA recently developed methodologies for the evaluation for small primary headwater habitat streams (PHWH) with watershed areas less than 1 mi^2 where existing methodologies, such as QHEI, are inadequate to properly characterize the streams. For these small PHWH streams, a Headwater Habitat Evaluation Index (HHEI) has been developed for use in assessing the habitat quality to support aquatic life adapted to these systems (Ohio EPA, 2002). For purposes of determining weighting factors for habitat quality utilizing the HHEI, weighting factor scores are determined as follows:

Excellent Habitat Quality:	HHEI = $\geq$ 70
Good Habitat Quality:	HHEI = $\geq$ 50
Fair Habitat Quality:	HHEI = $\geq$ 30
Poor Habitat Quality:	HHEI = < 30

Note: Primary headwater stream impacts were not specifically identified or assessed during watershed plan fieldwork. Within the watershed in general, more primary headwater streams have been impacted by tiling/culverting practices and urbanization than intermittent and perennial streams. These smaller systems are easier to modify, are valued less by landowners and make up as much as 80 percent of the total stream habitat in the watershed.

Aquatic Habitat and Water Chemistry

Both the biological and chemical/physical sampling conducted by the Ohio EPA in 1987 revealed little impact resulting from point source discharges in the Kokosing River study area. However, they did observe some violations of chemical water quality standards (WQS). Violations of the iron WQS, noted throughout the mainstem and in the North Branch, varied in severity from slightly elevated to highly elevated concentrations. These violations were attributed to natural background conditions as well as runoff events but were not expected to cause instream biological impacts. Violations of the primary contact recreation WQS for fecal coliform occurred at 18 of the 25 sites sampled in 1987. Inputs from diffuse agricultural non-point source runoff were suggested as a potential cause. Additional sampling revealed fecal coliform WQS violations also occurred downstream from the Fredericktown wastewater treatment plant. The 1987 study also concluded that there was no significant impact to the Kokosing River water chemistry because of discharges from the Gambier wastewater treatment plant. However, after the 1987 study, this plant was found to be operating improperly which resulted in action being taken to bring the City of Gambier into compliance with their NPDES permit. The 1987 study also concluded that the Mount Vernon wastewater treatment plant appeared to be discharging a high quality effluent.

Mount Vernon, Gambier, Sparta, Danville and Fredericktown have upgraded their wastewater treatment plants since the 1987 study. Additionally, the Village of Martinsburg is investigating installation of a wastewater treatment system to deal with failing septic tank systems in the village. The Village of Chesterville has also switched from individual septic tanks to a wastewater collection system since Ohio EPA last conducted sampling. The wastewater treatment plants operated by Knox County that serve Apple Valley and Pleasant View Acres subdivisions have not experienced significant water quality discharge violations. Additionally, use of small wastewater treatment package plants at New Hope, County Engineer's compound and the Opportunity Center have been discountinued, with those areas tied into Mount Vernon's wastewater system. Combined with Knox County's plan to expend financial resources to make existing wasterwater instrastructure im-

provements, point source discharges in the Kokosing have been improving in quality and should continue to improve in the future.

The Morrow County Health Department responded to 27 complaints concerning failing septic systems in calendar year 2002, with 16 of the complaints resulting in verified failed systems. The Knox County Health Department received 8 verified complaints for failing septic systems in calendar year 2003. In general, areas adjacent to municipal corporation limits are serviced by public wastewater systems. All rural areas are serviced by individual property septic systems.

National Pollutant Discharge Elimination System permit holders within the watershed include the Villages of Chesterville, Sparta, Fredericktown and Gambier, City of Mount Vernon, Knox County Water Department, Camp McPherson, Highland Board of Education, Del-Co Water Company, the Olen Corporation, Oglebay Norton Industrial Sands, Columbia Gas system, and Cooper Energy Services. The watershed has been spared large spills and contamination problems from previous and current industrial and agricultural operations. No National Priority List (Superfund) sites occur in the watershed, and only one Comprehensive Environmental Response, Compensation and Liability Information System site exists in the watershed. Ohio EPA determined that no significant hazard existed at the site, American National Can, however.

The Ohio EPA Division of Emergency and Remedial Response (DERR) have investigated several hazardous or potentially hazardous incidents in the watershed (three of which occurred at the American National Can site). In 1996, Ohio EPA also detected petroleum hydrocarbons in the shallow aquifer underlying the BP Bulk Oil Facility (#69077) in Mount Vernon. This site was given a low priority by Ohio EPA, since the water supply for Mount Vernon and the Kokosing River were not affected by the contamination found at BP. In June of 2003, Ohio EPA-DERR investigated a potential spill at the East Knox School District bus garage, located near the Kokosing River. Bus maintenance has resulted in a small oil and grease release into a ditch and storm drain. The school district abated the problem the same day that Ohio EPA investigated the site. Scenic Rivers staff found no signs of slicks, sheens or contamination in the Kokosing River the next day.

According to the Ohio Department of Commerce, Bureau of Underground Storage Tanks, 120 registered underground storage tanks exist in the watershed, and 18 suspected or confirmed underground storage tank releases have occurred in the watershed and are under active investigation. Other potential sources for contamination include 12, class-five, shallow, underground injection wells and seven inactive/closed landfills. The largest closed landfill in the county, Knox County Landfill, appears to be meeting chemical limit parameters. Additionally, the Knox Soil and Water Conservation District is currently designing a small, passive, wetland treatment system to treat iron in the landfill leachate. Approximately 55 hazardous waste handlers regulated under the Resource Conservation and Recovery Act occur in the watershed.

Herbicide use by county is given in Table 16 by acres treated, pounds used and rate of use (based on 1991 estimates). No misapplication or misuse of herbicides was observed in the watershed during field visits.

Section 6111.12(A)(2) of the Ohio Revised Code specifically requires that the Ohio EPA establish provision "ensuring that waters of exceptional recreational and ecological value are maintained as high quality resources for future generations." As such, in 2002, the Ohio EPA designated the Kokosing and North Branch of the Kokosing as a state resource water under water quality standards. The Kokosing was designated because the system is among the very best within Ohio and supports very diverse aquatic life and rare species. A 70% set aside is implemented to preserve water quality near existing condition, more stringent pollution controls are placed for new sources, and social/economic justification is needed to lower water quality.

Table 16: Herbicide Use for Counties in the Kokosing Watershed

CNTYNAME	H1980_ACR	H1980_LBS	H1980_USE	H1863_ACR	H1863_LBS	H1863_USE	H1011_ACR	H1011_LBS	H1011_USE	H1414_ACR	H1414_LBS	H1414_USE
ASHLAND	34464.0	48953.0	120.504	17701.0	36359.0	68.317	18694.0	38715.0	38.570	1255.0	4636.0	11.184
RICHLAND	32654.0	47378.0	95.443	16379.0	36200.0	76.954	20222.0	39424.0	79.420	1022.0	3923.0	7.903
MORROW	31501.0	45676.0	110.945	22005.0	45577.0	110.704	25658.0	50316.0	122.263	881.0	3471.0	8.431
KNOX	40572.0	56827.0	108.672	20016.0	41642.0	78.920	21142.0	40021.0	75.779	1344.0	5050.0	9.329
COSHOCTON	24278.0	35200.0	60.997	9306.0	19445.0	33.596	8831.0	16907.0	29.258	937.0	3390.0	5.874

CNTYNAME	H1302_ACR	H1302_LBS	H1302_USE	H1361_ACR	H1361_LBS	H1361_USE	H1363_ACR	H1363_LBS	H1363_USE	H1639_ACR	H1639_LBS	H1639_USE
ASHLAND	7902.0	4087.0	9.859	2537.0	2710.0	6.537	10805.0	20547.0	49.567	3032.0	12479.0	30.104
RICHLAND	8791.0	4514.0	9.093	3254.0	3479.0	7.008	10196.0	19385.0	39.061	2859.0	11765.0	23.080
MORROW	7340.0	3782.0	9.186	5415.0	5794.0	14.073	9722.0	18482.0	44.887	2722.0	11161.0	27.109
KNOX	11382.0	5892.0	10.884	2604.0	2787.0	5.148	12545.0	23838.0	44.026	3514.0	14413.0	26.625
COSHOCTON	9038.0	4672.0	8.098	156.0	167.0	0.289	7516.0	14283.0	24.751	2106.0	8638.0	14.969

CNTYNAME	H1629_ACR	H1629_LBS	H1629_USE	H1099_ACR	H1099_LBS	H1099_USE	H1298_ACR	H1298_LBS	H1298_USE	H1287_ACR	H1287_LBS	H1287_USE
ASHLAND	2948.0	2512.0	6.060	6254.0	5260.0	12.589	12773.0	4127.0	9.956	2772.0	2191.0	5.285
RICHLAND	3649.0	3031.0	6.106	8508.0	6595.0	13.286	12032.0	4316.0	8.696	3554.0	2807.0	5.655
MORROW	5804.0	4659.0	11.376	10391.0	9166.0	22.264	11874.0	3895.0	9.461	5907.0	4667.0	11.336
KNOX	3105.0	2660.0	4.951	9229.0	6409.0	11.839	16280.0	5517.0	10.152	2843.0	2246.0	4.149
COSHOCTON	456.0	539.0	0.934	5887.0	2597.0	4.500	11045.0	3972.0	6.883	172.0	136.0	0.236

CNTYNAME	H1975_ACR	H1975_LBS	H1975_USE	H1305_ACR	H1305_LBS	H1305_USE	H1981_ACR	H1981_LBS	H1981_USE
ASHLAND	11705.0	4331.0	10.448	1462.0	587.0	1.416	2758.0	3904.0	9.418
RICHLAND	15066.0	5576.0	11.233	1336.0	535.0	1.078	2425.0	3458.0	6.966
MORROW	25107.0	9290.0	22.565	771.0	309.0	0.751	2114.0	3105.0	7.542
KNOX	12075.0	4468.0	8.254	1238.0	497.0	0.918	3082.0	4397.0	8.123
COSHOCTON	724.0	268.0	0.464	547.0	219.0	0.380	2022.0	2842.0	4.925

Data taken from 1994 coverage based on 1991 estimates
_ACR = acres treated; _LBS = pounds used; _USE = rate of use
Where:

The Total Maximum Daily Load (TMDL) program, established under Section 303(d) of the Clean Water Act, focuses on identifying and restoring polluted rivers, streams, lakes and other surface waterbodies. A TMDL is a written, quantitative assessment of water quality problems in a waterbody and contributing sources of pollution. No TMDLs exist for any subwatersheds in the Kokosing River. Ohio EPA's *2002 Integrated Report*, which includes a TMDL priority list, indicates that the Kokosing River, "downstream North Branch to upstream Jelloway Creek," contains 5.4 percent of large streams in nonattainment of aquatic life use. Improvements made to municipal wastewater treatment in this stretch have partially abated this nonattainment, which relates to organic enrichment and lower dissolved oxygen concentrations. Additional strategies, such as establishment of riparian wooded corridors would assist in abating this nonattainment. Ohio EPA's draft *2004 Integrated Water Quality Monitoring and Assessment Report* (1/9/04) removes the Kokosing River (headwaters to upstream North Branch) from the category five (priority impaired waters) list in the 303(d) list, due to errors in data reporting. No available data shows impairment at any site in that subwatershed.

The Kokosing River, "upstream Jelloway Creek to mouth" includes 37.5 percent of nonattainment of aquatic life use for large streams and 25 percent partial attainment of small streams in this subwatershed. Reasons given for the nonattainment include upstream impoundments (i.e. Mohawk Dry Dam on the Wahonding), pastured lands and other urban runoff. Obviously, the Mohawk Dry Dam performs a great service to downstream residents in Coshocton, thus, the flow alteration that occurs on the Kokosing will continue in the future. However, pastured lands and other urban runoff are sources of nonpoint source pollution that can be abated with implementation of strategies addressed later in this document.

The Integrated Report also indicates that the Kokosing River (headwaters to upstream North Branch) contains 75 percent of small streams that achieve partial attainment of their aquatic life use. The North Branch of the Kokosing exhibits full attainment of its aquatic life use. Ohio EPA's 1996 Ohio Water Resource Inventory 305(b) Report indicated that nutrient enrichment was the largest cause of impairment. The Kokosing River's 305(b) identification number is Group 18.

Ohio EPA's draft *2004 Integrated Water Quality Monitoring and Assessment Report* (1/9/04) lists the Kokosing River, upstream of Jelloway Creek to the mouth, as a category five, priority impaired water, in the 303(d) list.

Ohio EPA also regulates the discharge of fill material in isolated wetlands and "waters of the United States," through its isolated wetlands permit and 401 water quality certification. The U.S. Army Corps of Engineers also regulates the discharge of fill material through its Section 404 Clean Water Act permitting program. Within the last 10 years, the Corps of Engineers has performed 15 reviews and permits for the discharge of dredged material in the Kokosing watershed. 14 of the projects were minor in nature and were permitted under the Corps' Nationwide Permit authorization. In 2003, the Corp of Engineers and Ohio EPA have investigated three illegal channelizations and/ or fill projects in the watershed.

Storm Water

Storm water runoff can pollute streams, disrupt natural hydrogic regimes of streams and flood downstream neighbors. With an eye towards planning for future growth, and the resulting increase in storm water quantity, the Knox County Regional Planning Commission's Storm Water Advisory Committee (SWAC) surveyed residents regarding managing storm water. The mission statement of the committee, as accepted on May 16, 2002, is *to educate and to inform members of the SWAC and the general public on the topic of storm water management and about the authorization in H.B. 549 for a countywide storm water plan.* Survey results indicated that the public would more likely trust Ohio State University (OSU) extension agents, state agency

persons or other farmers regarding information about storm water. Respondents awareness that the Kokosing was designated scenic was extremely high, and more than 60% strongly agreed or agreed that regulations are needed now to reduce storm water pollution. Respondents showed majority support for paying a fee to maintain water quality and approximately 60% agreed that new developments should pay higher fees while charging less fees to existing lots for maintenance and resolution of existing storm water problems.

The SWAC also recommended to the Knox RPC to direct the drafting of regulations to include a comprehensive county storm water plan for new residential, commercial or industrial development and personnel to manage, administer and enforce the regulations. This was done coincidentally with passage of Article III of the Subdivision Regulations, which deal with sediment and erosion control and storm water management (as related to minor subdivisions). In December 2003, Knox County Commissioners proactively approved stormwater and sediment control regulations. The Knox County Engineer estimates that 70% of existing storm water management systems in the Kokosing watershed occur on private property. Thus, to manage storm water appropriately, private property owners will need to participate. The City of Mount Vernon is the only Phase II NPDES storm water community in the watershed.

Aquatic Habitat and Relative Water Quality

The Ohio EPA uses several indices, as previously mentioned, to evaluate the health and quality of Ohio's streams. Another one of these indices is the Index of Biological Integrity described as follows:

Index of Biological Integrity (IBI)

IBI is a means of objectively measuring and evaluating biological community performance based on the number of fish species found, the presence of certain indicator species, the numbers of individuals found and other characteristics of the fish community.

The Ohio EPA evaluated the Kokosing River using the IBI assessment method and has calculated scores ranging between 38 and 58 with an average of 48.8. Values typically range from 12 to 60 for streams in Ohio. In comparison, the IBI ratings for the Big and Little Darby Creeks range between 36 and 58 with and average of 47. The values for the Kokosing River indicate a stream water quality that rates among the top in Ohio.

Ohio's streams and rivers have seen significant changes since European settlement. Pre-settlement stream substrates consisted of cobbles and gravel that were free from clayey silts. This was due in large part to the fact that more than 95 percent of Ohio was wooded and the smaller streams had permanent flow most of the year. Springs were abundant and the water ran clear. Things began to change, however, as the European settlers moved into Ohio. About 24 million acres of forest existed in 1800 but was cut to 4 million by 1883. Population also increased rapidly from 3,000 in the 1700's to over 3 million by 1880. The abrupt changes in land use and increased use has left many Ohio streams still struggling to recover. Even as some of the more pronounced impacts from point sources of pollution are reduced, impacts from sources such as combined sewer overflows, urban storm water, siltation of substrates and habitat degradation are becoming more evident.

The Kokosing River has been less severely impacted than many other rivers in the state. It has essentially intact physical features that provide for some of the highest quality aquatic assemblages in Ohio. The Ohio EPA assigns each water body in the state one or more aquatic life habitat use designations. These designations are based on the attributes of species composition, diversity and functional organization that are measured using the IBI described previously, the modified index of well being (MIwb) and the

invertebrate community index (ICI) which are described as follows:

Modified Index of Well Being (MIwb)

MIwb is an objective method of measuring and evaluating fish community performance. This methodology is a measure of fish community abundance and diversity using numbers and weight information.

Invertebrate Community Index (ICI)

The ICI is a method of evaluation applied to macroinvertebrate community performance and characteristics.

Kokosing River segments have been assigned either the exceptional warmwater or the warmwater use designation by Ohio EPA.

The exceptional warmwater designation is for waters that can support and maintain an exceptional or unusual community of warmwater aquatic organisms having a species composition, diversity and functional organization comparable to the seventy-fifth percentile of the identified reference sites statewide. The Kokosing River mainstem from its confluence with the North Branch of the Kokosing at river mile 29.7 to the confluence with the Mohican River at river mile 0.0 is under the exceptional warmwater designation. In addition, Jelloway Creek, Little Jelloway Creek, East Branch of Jelloway Creek and Schenck Creek are also under the exceptional warmwater designation.

The warmwater designation is for waters that can support and maintain a balanced, integrated and adaptive community of warmwater aquatic organisms having a species composition, diversity and functional organization comparable to the twenty-fifth percentile of the identified reference sites within each of the following ecoregions: Erie Ontario Lake Plain, Western Allegheny Plateau, Eastern Corn Belt. The Kokosing River upstream of river mile 29.7 is designated warmwater habitat. Tributaries also under the warmwater designation include the following: Laurel Run, Singer Run, Brush Run, Honey Run, Sapps Run, Dowd Creek, Shadley Valley Creek, Ireland Creek, Barney Run, Coleman Branch, Little Schenck Creek, Mud Run, Indianfield Run, Big Run, Elliott Run, Wolf Run, Center Run, Dry Creek, Dry Run, Armstrong Run, North Branch, Job Run, East Branch of North Branch, Isaacs Run, Markley Run, Toby Run, Lost Run, Granny Creek, Mile Creek, South Branch, Sylvester Run. Kokosing stream designations are shown in Table 17.

Hydrologic unit codes, used to divide the Kokosing into subwatersheds include the following (18 total). Acre figures are given for each subwatershed as well:

05040003-010-010-Kokosing River headwaters to below S. Branch Kokosing R.
Subarea= 23,298 Acres
05040003-010-020-Kokosing River below S. Branch to below Mile Run
Subarea= 24,734 Acres
05040003-010-030-Kokosing River below Mile Run to above N. Branch
Subarea= 16,281 Acres
05040003-020-010-North Branch Kokosing River headwaters to near St. Rt. 13
Subarea= 29,100 Acres
05040003-020-020-East Branch Kokosing River
Subarea= 20,342 Acres
05040003-020-030-North Branch Kokosing River near St. Rt. 13 to Kokosing R. [except East Branch]
Subarea= 13,244 Acres
05040003-030-010-Kokosing River below N. Branch to above Dry Run
Subarea= 10,946 Acres
05040003-030-020-Dry Creek
Subarea= 21,810 Acres
05040003-030-030-Kokosing River below Dry Creek to above Big Run
Subarea= 21,000 Acres
05040003-030-040-Big Run
Subarea= 19,886 Acres

Table 17: Ohio EPA Use Designation

Stream Segment	Use Designations		
	SRW	**WWH**	**EWH**
Kokosing River: RM 29.7 to RM 20.5	*		*
RM 20.5 to Walhonding R.	*		*
All other segments	*	*	
Singer Run		*	
Brush Run		*	
Honey Run		*	
Jelloway Creek			*
Little Jelloway Creek			*
East Branch			*
Sapps Run		*	
Dowd Creek		*	
Shadley Valley Creek		*	
Ireland Creek		*	
Laurel Run		*	
Barney Run		*	
Schenck Creek			*
Coleman Branch		*	
Little Schenck Creek		*	
Mud Run		*	
Indianfield Run		*	
Big Run (and Elliott Run)		*	
Wolf Run		*	
Center Run		*	
Dry Creek (and Dry Run)		*	
Armstrong Run		*	
North Branch	*	*	
Job Run		*	
East Branch		*	
Isaacs Run		*	
Markley Run		*	
Toby Run		*	
Lost Run		*	
Granny Creek		*	
Mile Creek		*	
South Branch		*	
Sylvester Run		*	

SRW-State Resource Water, WWH-Warmwater Habitat, EWH-Exceptional Warmwater Habitat

05040003-030-050-Indianfield Run
Subarea= 7,452 Acres
05040003-030-060-Little Schenck Creek
Subarea= 10,411 Acres
05040003-030-070-Schenck Creek [except Little Schenck Cr.]
Subarea= 15,986 Acres
05040003-030-080-Kokosing River below Big Run to above Jelloway Cr. [except Indianfield Run & Schenck Cr.]
Subarea= 7,723 Acres
05040003-040-010-Jelloway Creek [except E. Branch & L. Jelloway Cr.]
Subarea= 28,259 Acres
05040003-040-020-East Branch Jelloway Creek
Subarea= 6,642 Acres
05040003-040-030-Little Jelloway Creek
Subarea= 12,524 Acres
05040003-040-040-Kokosing River below Jelloway Cr. to above Mohican R.
Subarea= 20,669 Acres

Dams

Three major reservoirs are located within the Kokosing watershed for flood control and recreation purposes. None of these, however, is on the mainstem of the river. Knox Lake, located on East Branch of North Branch near Fredericktown, is the oldest reservoir. This 500-acre lake was created solely as a fishing lake in the early 1950's. An earthfill dam measuring 51.5 feet high and 500 feet long impounds water to a depth of 17.5 feet. Kokosing Lake was built on North Branch just to the northwest of Fredericktown for flood control and recreation. It has a 154-acre permanent pool and a flood control basin area of more than 1,400 acres. The dam for this reservoir was completed in 1971 and is also an earthfill dam. It measures 71 feet high and 1400 feet long and impounds water over 10 feet deep. Apple Valley Lake is on Little Jelloway Creek north of Howard. The lake covers about 300 acres in a privately owned and controlled development.

The Muskingum Watershed Conservancy District (MWCD) owns about 1,495 acres from the confluence with the Mohican River to about two miles upstream on the Kokosing River. The MWCD is a political subdivision of the State of Ohio and was established in 1933. Its primary purposes were for flood control, conservation and recreation. The District transferred operation of ten dams with permanent reservoirs and four dry dams that only hold water during flooding events to the U.S. Army Corps of Engineers in 1939. None of the 14 dams are within the Kokosing watershed. However, the property owned by the MWCD at the mouth of the Kokosing River is part of the storage area for the Mohawk Dry Dam located along the Walhonding River in Coshocton County. This property is public land with the majority of the property along the river being under agricultural leases. The MWCD is responsible for all conservation and recreation throughout its 16,000 acres of water and 38,000 acres of land in the Muskingum River basin. Mohawk Dam has the potential to impound approximately 66,528 linear feet; Knox Lake impounds approximately 19,000 linear feet of the East Branch; Kokosing Reservoir impounds approximately 5,300 feet of the North Branch of the Kokosing; and Apple Valley Lake impounds approximately 18,000 of Little Jelloway Creek. One lowhead dam exists in the City of Mount Vernon, however water quality above and below the dam remain high. Of the approximately 870 privately owned ponds in the Knox County portion of the watershed, approximately 50 ponds impound small streams. Only a few ponds that lie adjacent to livestock feedlots/livestock pastures exhibit algal blooms.

Overall, the quality of the Kokosing River remains very high and results in use designations of exceptional warmwater and warmwater habitats by the Ohio EPA. These designations are based on the high diversity and abundance of fish and macroinvertebrate communities compared to similar sized streams in Ohio. Species such as darters (*Etheostoma sp.*) and mayflies (*Serratella sp.*), along with other pollution-intolerant aquatic fauna suggest little pollution of the river. There are no location-specific fish consumption advisories in the Kokosing watershed.

IMPACTS AND THREATS

Table 18 and Figure 10 summarize impacts (in linear feet) encountered in the Kokosing watershed. Table 19 lists the main threats on a subwatershed basis. Impacts were inventoried during field work and were initially rendered on aerial photography. Secondly, impacts were digitized as polylines into a geographic information system (GIS). Finally, for each line digitized, up to three sources and three causes of impacts were added as attributes in the GIS.

SOCIAL RESOURCE INVENTORY (HISTORICAL/ECONOMIC/SOCIAL/CULTURAL RESOURCES)

History of Human Development of the Area

Native Americans

Approximately 609 sites of historical value are present within the Kokosing watershed, with 49 sites listed on the National Register of Historic Places. The Ohio Historic Preservation Office, Ohio's official historic preservation agency, is

Table 18: Impacts Encountered in the Kokosing Watershed

Sources	Impacts	% Watershed Impacts
Agriculture	705	0.01%
Channelization Agriculture	402,352	5.75%
Channelization Development	68,253	0.98%
Construction	7,291	0.10%
Non-irrigated crop production	62,456	0.89%
Dredge mining	11,074	0.16%
Feedlot	7,952	0.11%
Filling	518	0.01%
Flow modification Development	43,819	0.63%
Hydromodification Agriculture	71,938	1.03%
Hydromodification Development	24,021	0.34%
Highway Bridge	302	0.00%
Land Development	2,215	0.03%
Natural	356	0.01%
On-site wastewater (septic)	6,808	0.10%
Other	9,114	0.13%
Range Grazing (encroachment)	245,974	3.52%
Riparian Vegetation Removal	916,419	13.10%
Streambank destabilization	162,841	2.33%
Upstream Impoundment	73,771	1.05%
Urban Runoff	13,011	0.19%
Total watershed in linear feet (approx.)	3,661,272	
Total Impacts in linear feet (approx.)	1,115,672	30.47%
County breakdown of impacts (acres)		
Ashland	2,348	0.76%
Coshocton	1,218	0.39%
Knox	228,598	73.92%
Morrow	67,084	21.69%
Richland	9,983	3.23%
Total acres (approx.)	309,231	100.00%

Figure 10: Impacts Encountered in the Kokosing Watershed

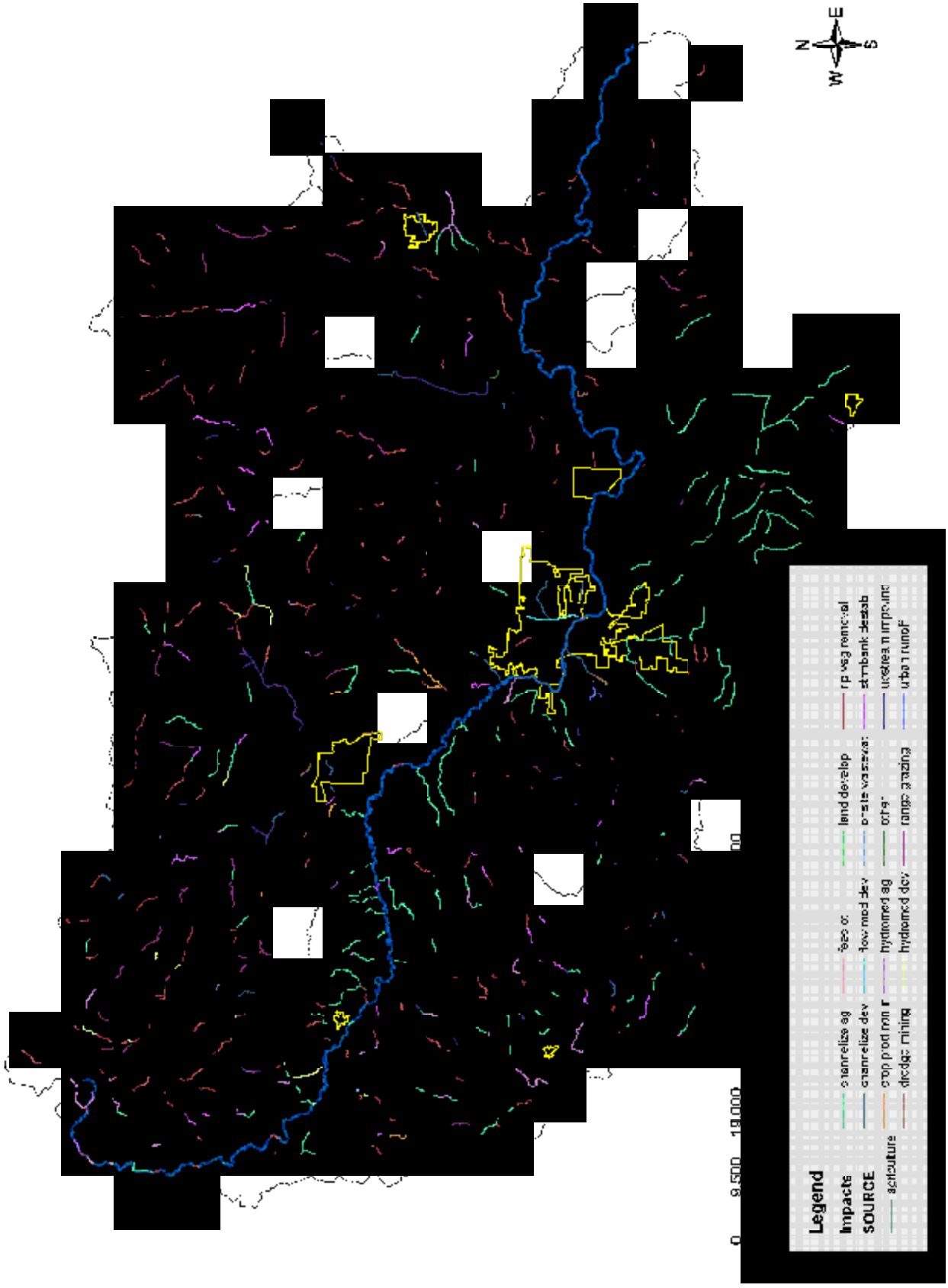


Table 19: Impacts by Subwatershed in the Kokosing Watershed

NARRATIVE	Impact Length (ft)	% Total Impact	Channel work (Ag)	Development (Urban)	Range Grazing	Riparian Veg. Removal	Streambank Destab.
Kokosing River headwaters to below S. Branch Kokosing R.	99,512	8.70%	21,815	6,215	12,110	71,390	10,405
Kokosing River below S. Branch to below Ville Run	119,666	10.47%	68,480	473	12,495	106,365	7,407
Kokosing River below Ville Run to above N. Branch	58,982	5.16%	35,632	0	8,628	54,869	8,361
North Branch Kokosing River headwaters to near St. Rt. 13	112,591	9.85%	8,877	12,998	36,610	99,675	27,794
East Branch Kokosing River	114,932	10.05%	9,398	3,705	10,822	37,716	257
North Branch Kokosing River near St. Rt. 13 to Kokosing R. (except East Branch)	18,813	1.27%	12,168	6,466	12,113	41,918	5,576
Kokosing River below N Branch to above Dry Run	63,508	5.56%	18,846	30,620	878	51,617	878
Dry Creek	55,110	4.82%	11,113	14,011	11,527	18,056	8,019
Kokosing River below Dry Creek to above Big Run	99,471	8.70%	42,911	29,494	2,674	51,521	1,539
Big Run	116,174	10.16%	111,747	0	22,771	81,820	10,064
Indianfield Run	16,226	1.42%	6,451	0	5,151	6,163	1,503
Little Schenck Creek	26,131	2.31%	0	0	11,228	23,022	9,601
Schenck Creek (except Little Schenck Cr.)	35,065	3.07%	1,889	0	9,878	30,910	9,878
Kokosing River below Big Run to above Jelloway Cr. (except Indianfield Run & Schenck Cr.)	5,716	0.50%	0	0	0	5,905	1,239
Jelloway Creek (except T. Branch & L. Jelloway Cr.)	76,919	6.73%	0	0	17,750	72,956	32,141
East Branch Jelloway Creek	13,387	3.80%	9,398	3,705	10,822	37,716	257
Little Jelloway Creek	43,911	3.84%	0	3,899	13,193	19,112	12,775
Kokosing River below Jelloway Cr. to above Mohican R.	26,652	2.33%	0	121	5,862	21,311	2,933
Total:	1,143,174	100.00 %					

Note: Figures under the impact types will not add up to the impact length total because due to multiple impacts occurring in some segments

Note: the column, "Development," groups impacts such as urban runoff, development flow alteration and development hydromodification

charged with identifying, evaluating and protecting important archeaological and historic sites in Ohio. The Kokosing watershed contains many relics from early cultures who lived in the area. Table 20 lists some of the more notable sites found in the Ohio's Historical Society's Ohio Archeological Inventory. No locations are given for the mounds, due to security concerns.

The earliest settlers of the area were the ancient mound builders. Of the two distinct mound cultures, the Adena Culture found Knox County to be desirable. The Adena inhabited Ohio from about 1,000 B.C. to 100 A.D. Indications that the Hopewell Culture existed are in the form of habitation sites, but these are rare. Nearly every area of Knox County shows the influence of the Adenas.

Table 20: Mounds of the Kokosing Watershed

SITE NAME
Gamble Mounds I & II
Hammond Mound
Staats Mound
Cemetery Mound
Hawn Mound
Shipley Mound
Higgins Fort
Higgins Mound
Liberty Township Works
Bonar Mound
Stackhouse Mound & Works
Fredericktown Works
Butler township Works
Campbell Mound
Loveridge Works
Kaser-Parrott Mound
Hammond Mound
Fredericktown Sand & Gravel Co. Mound
Rowley Mound
Osborn Kame
Clyde Black Earthworks
Overholt Mound
Kandel Works
Weller Mound

The majority of the Adena mounds and enclosures are located on points overlooking a river or stream, especially the Kokosing and its tributaries.

Most mounds and enclosures have been obliterated as a result of urbanization, agricultural practices and excavations. These include the Larimore Group, the Blane Roberts Mound, Fredericktown Sand & Gravel Co. Mound, the Hammond Mound, the Cemetery Mound, the Kandel Works, the Staats Mound, the Wobbecke Enclosure and the Greer Fort. Three mounds have remained unexcavated, and these are the Rowley Mound, the Braddock Mound and the Stackhouse Mound.

The next inhabitants of Knox County were the American Indians. The territory was mainly in possession of the Delaware Nation, though not used exclusively by this tribe. Several tribes of Ohio, including the Hurons, the Shawnees, the Mingos, and the Wyandots were generally on good terms and roamed freely across the boundaries of the Delawares. Several Delaware camps were located within Knox County prior to the War of 1812. One was along the Kokosing opposite the mouth of Center Run. Another was situated near Fredericktown.

The Kokosing River valley was utilized as a trade route for the Indians. This situation existed without much change until 1785 when the Greenville Treaty ceded a large portion of Northern Ohio to the Americans. The Delawares, however, were granted the right to live and hunt in the region. The Greenville Treaty marked the start of immigration into the area by early pioneers and the decline of the Indian dominance.

European Settlers

James Smith is thought to have been the first European to set foot in the area. In 1775 he was captured by the Indians and remained with them for about four years. He undoubtedly hunted in Knox County and is known to have traveled through the area on various occasions.

It is believed that Andrew Craig was the first European who located within the present boundaries of Knox County in 1805. He lived in a rough log hut near a little Indian field about a half mile east of where Mount Vernon now stands and at the point where Center Run empties into the Kokosing River. Craig felt uneasy when other settlers began to crowd around him and he moved further west.

The first permanent settler was Nathaniel Mitchell Young, "the Axemaker," who came in 1803. He settled on a branch of the Kokosing in what is now Wayne Township. This settlement was subsequently called the "Jersey Settlement." In 1804, Robert Thompson began another "improvement" on the rich bottomland of the river about one mile west of the present site of Mount Vernon. Shortly thereafter, George Dial settled near where Gambier is now located. In 1805-1806, the "Ten Mile Settlement" began a short distance south of the Kokosing River and became the largest settlement in the County. John Mills, Henry Hainer, Ebenezer and Abner Brown, Peter Baster and the Leonards were among the earliest settlers from Virginia, Maryland, New Jersey and Pennsylvania. In 1805, Benjamin Butler, Peter Coyles and Thomas Bell Patterson augmented the "Walker Settlement" where Mount Vernon was to be located.

By enactment of the Ohio legislature, Knox County organized in February 1808, from Fairfield County. The county, platted into four townships (Wayne, Clinton, Morgan, and Union), was named in honor of General Henry Knox who was President Washington's Secretary of War. Later the county was further divided into 22 townships.

Mills were of prime necessity to pioneers. The first gristmill was located at Ten Mile Settlement. In 1804, a flouring mill and sawmill were built in the area of what is now Morris Township. In 1807, a mill was built at Fredericktown and others were built rapidly throughout the county until Knox County was regarded as one of the most favored counties in the state, due to the number and excellence of these mills and durability of the streams. Flat boats loaded with pork, flour, whiskey and other goods were taken down the Mohican and Kokosing Rivers to the Walhonding and then on to the Muskingum and Ohio Rivers. One old mill still exists on the west bank of the Kokosing River just east of Gambier. A final, integral part of the pioneer life was chapels. Two chapels still exist today. The Quarry Chapel is just east of Gambier and the Riley Chapel is west of the Knox-Coshocton County line.

Transportation

Historical development in the Kokosing River watershed was tied to the railroad system. The importance of railroads to the Knox County history of development is clearly evident from noticing that the settlements of appreciable size existed only along railroad routes from the turn of the century until the 1960's. Before the railroads, the Ohio Canal system was an important transportation mode. The Walhonding Canal was opened in 1847. This canal brought commerce from Mount Vernon to Walhonding and Cavallo, but the importance of canal travel dwindled with the coming of the railroad.

The impact of the automobile is also evident, as those areas of development after the 1960s to the present shifted from railroad routes to highway routes. A classic pattern of development is evident in Mount Vernon as growth extends away from the central city along the roads and it forms a pattern similar to the spokes of a wheel as the growth stretches out. As Columbus sprawl encroaches closer to the watershed, increased traffic results on the watershed's main connector roads and arteries.

According to The Ohio State University Extension Data Center (OSUEDC), Knox County has experienced significant increases in the last decade regarding the number of commuters who live in

Knox County and work in Franklin County. Commercial and single resident development, important to the local economy, occurs along these heavily traveled roads and arteries. Knox County's Comprehensive Plan indicated that significant areas of traffic generation in Knox County included Coshocton Road and Harcourt Road (where commercial development is occurring), the industrial area south of Mount Vernon (industry) and Apple Valley (a resort with dense residential development near Howard). Because of their size and magnitude, regional developments at Easton (eastern Franklin County) and Polaris (southern Delaware County) will influence Knox County life as well. Single residential development in the western portion of the watershed reflects this. According to the Knox Regional Planning Commission, approximately 15.6 lot splits for single-family residences occur per month in Knox County (187 yearly total).

Resource Extraction

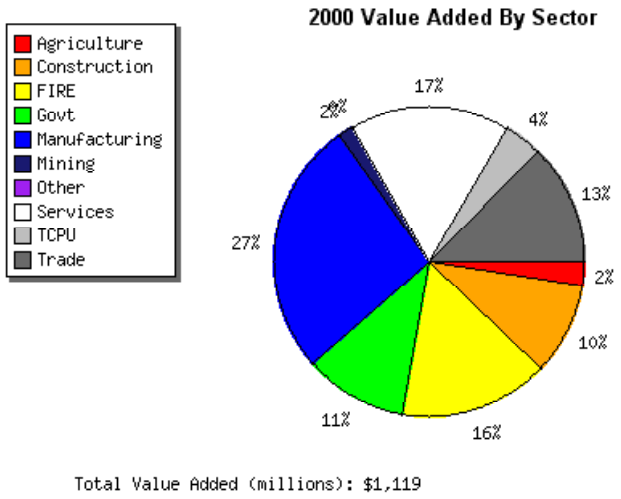
Sand and gravel mining in the Kokosing watershed continues to expand as demand for sand and gravel resources expands locally. Demand for gravel, in particular, has increased with commercial and residential development expansion associated with outlying areas of Columbus. Gravel resources are also used locally for transportation projects and concrete. Best available figures from ODNR's *2002 Ohio Mineral Industries Report* indicate that sand and gravel sales in Knox County totaled $1,005,896 and in Morrow County totaled $230,827. In 2002, approximately 67 individuals were employed in the sand and gravel business in Knox County and eight individuals were employed in Morrow County. Oil and gas drilling in Kokosing River watershed has seen declines since the boom times of the late 1970 and early 1980s, directly associated with oil and gas prices. In 2002, seven wells were drilled in Knox County, most of which occurred in the Kokosing watershed. No coal mining occurs within the watershed. Thus, mineral industries in the watershed are an important economic stimulus.

Timber harvesting in the Kokosing River watershed serves as a sustainable economic activity. Approximately 99% of the watershed's forests are privately owned. A small portion of Mohican State Forest is located in the extreme northeastern portion of the watershed, and the Muskingum Watershed Conservancy owns forested lands in the extreme lower portion of the watershed. While no data exists regarding the board feet of timber harvested annually or resulting dollars that flow into the local economy for the watershed, some indication of the economic value to the watershed can be extrapolated. Ohio timber products result in approximately $7 billion dollars generated annually, and Knox County ranks around 35 out of 88 counties in forested cover. Timber harvesting and forest product manufacturing is important, as evidenced by the more than 12 companies offering timber cruising, harvesting or manufacturing services in the watershed.

Economic Characteristics

According to The Ohio State University Extension Data Center (OSUEDC), the following chart (Figure 11) describes the economic value added (VA) by sector for Knox County. VA is a

Figure 11: Knox County Economic Value



broad measure of income that includes employee compensation (wages, salaries, benefits), proprietary

income (self-employment), other property income (interest, rent, royalties, dividends profits) and indirect business taxes (excise and sales taxes). For clarification of the chart:

FIRE = Finance, Insurance, RealEstate
TCPU = Transporation, Communications, Public Utilities
Trade = Wholesale and retail trade

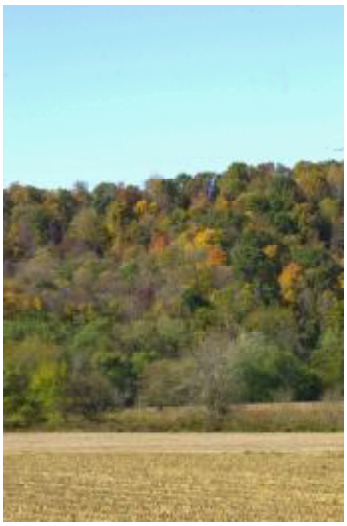
Social and Cultural Resources

While agricultural business does not appear as a large percentage in the value added sector, agriculture serves as a substantial and important part of the local community in the Kokosing watershed. As indicated in Kenyon College's *The Family Farm Project*:

> *"The agricultural character of Knox County instills certain values within the people which help to establish an even stronger sense of cohesiveness within the community…Agriculture and family living seem to be the common threads running through Knox County. They are responsible for its aesthetics, safety, sense of community and stable economy. Unlike life in the city, there still remains a strong system of values, work ethic, activity within the community and an overall sense of comfort. The rural character of Knox County does not stem solely from its natural state, but from one institution—the family farm."*

Farms comprise more than 60% of Knox and Morrow County lands, and Knox ranks first in Ohio in sheep farming (Morrow County ranks eighth, respectively). Annual cash receipts from marketing of farm commodities average nearly $60 million in Knox County. The eastern portion of Knox County does not contain as much cropland, due to the hilly terrain.

The Farmland Preservation Committee of the Knox RPC, with financial assistance from numerous local governmental and non-profit entities, commissioned a "cost of community services" study. The American Farmland Trust (AFT), a private, nonprofit conservation organization dedicated to protecting the nation's strategic agricultural resources, performed the study. The AFT notes that Ohio is 2nd only to Texas in the amount of prime farmland lost to development, and that the Eastern Ohio Till Plains (which includes the western portion of Knox and eastern portion of Morrow Counties) is the seventh most threatened farming region in the nation. The study showed that farms and greenspaces are more fiscally friendly than development. For every dollar in tax revenue generated by farmland and open space, 0.29 dollars was required back in services, whereas residential development requires $1.05 in services for every dollar generated. Thus, it is fiscally irresponsible for farmland and greenspace to be destroyed. Farmland and greenspace protection also protects property values and quality of life for local residents.



Additionally, in a recent survey performed by the Knox County Regional Planning Commission, 90% of respondents indicated agreement with protecting farms by managing growth. A majority of respondents also indicated that protective zoning and forming an advisory committee to advise local officials on planning and zoning were most needed to protect agricultural operations. Thus, the preservation of agricultural businesses is very important to the watershed community from a quality of life perspective. A survey by OSU Extension indicated that Ohio farmers strongly supported using financial incentives to encourage environmental benefits. However, only 22% participated in conservation programs in 2000. With an 80% increase in Farm Bill 2002 spending, it is likely that participation in conservation programs will increase. Participation in conservation programs increases the likelihood that farmers can continue to make a sus-

tainable living, while continuing to conserve and protect natural resources in the watershed and maintain quality of life for all community residents.

Demographics

Schools in the watershed include: Mount Vernon City, Danville, East Knox, Loudenville-Perrysville Exempted Village, Fredericktown, Centerburg, Highland, Clear Fork Riverview and North Fork. The largest city in the watershed is Mount Vernon (15,000 residents), and other villages (incorporated areas) in the watershed include: Gambier, Danville, Sparta, Chesterville, Millwood, Howard and Fredricktown. Townships (unincorporated areas) in the watershed are found in Table 21.

Table 21: Townships of the Kokosing Watershed

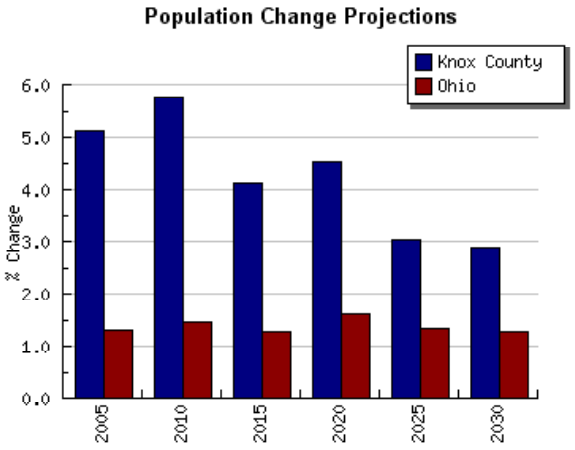
Townships	
HANOVER	MORGAN
NEW CASTLE	MORRIS
TIVERTON	PIKE
BERLIN	PLEASANT
BROWN	UNION
BUTLER	WAYNE
CLAY	BENNINGTON
CLINTON	CHESTER
COLLEGE	CONGRESS
HARRISON	FRANKLIN
HILLIAR	GILEAD
HOWARD	HARMONY
JEFFERSON	PERRY
LIBERTY	SOUTH BLOOMFIELD
MIDDLEBURY	JEFFERSON
MILFORD	PERRY
MILLER	WORTHINGTON
MONROE	

According to 2000 Census figures, both Knox and Morrow County have similar poverty levels (family income below poverty level), at 7.4% and 6.6%, respectively, which are slightly lower than the state average (7.8%). 42.1% and 47.3% of county citizens in Knox and Morrow Counties, respectively, possess a high school diploma. In terms of population by race, 97.4% of Knox County citizens and 98.8% of Morrow County citizens describe themselves as white, which is higher than the state average (84.9%). A very small portion of the watershed is located in Coshocton County (which is considered Appalachian in character). Amish families first migrated to Knox County around 1810, with an additional influx of Amish from Wayne and Holmes Counties into Knox County occurring in the past ten years (due to lower land prices). A typical Amish farm consists of approximately 80 acres of tillable ground with a few head of livestock.

From 1980 to 2001, Ohio's percent population change was +5.33%, according to U.S. Bureau of the Census data. However, percent population change in Knox and Morrow Counties were far above the state average. Morrow County's percent population change was +20-35%, while Knox County's percent population change was +10-20%. Figure 12 describes the percent change in Knox County's projected population in the future.

With this projected increased in population, additional taxing of infrastructure (such as roads, schools and water systems) will occur. Increased pressure on the conversion of undeveloped and agricultural lands is likely and thus, impacts on natural resources and quality of life in the community will undoubtedly increase. Managing for population growth and the protection of agricultural and high quality habitats now is crucial with these changes to come.

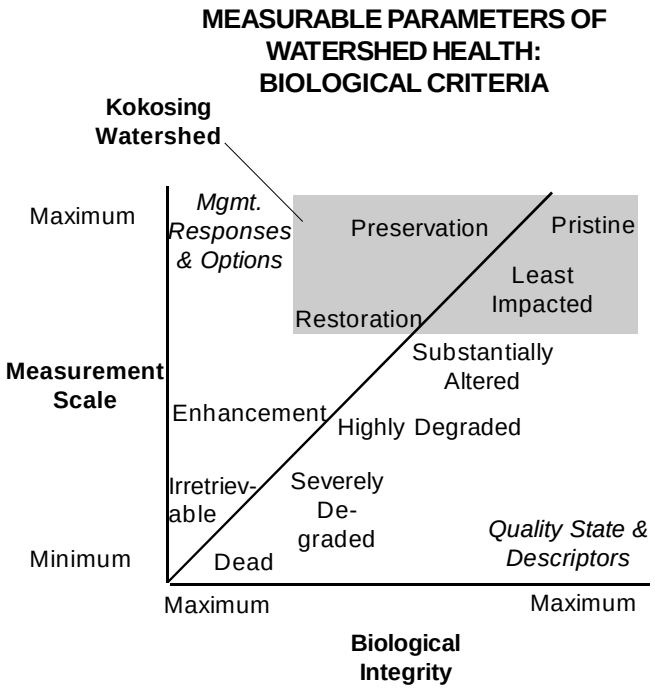
Figure 12: Projected Population Changes for Knox County



STRATEGIES

The preceeding sections in this watershed plan highlighted past and present conservation and protection activities, outdoor recreation trends, natural resources information, historical data, socio-economic and cultural aspects and water quality impacts. Given the information presented, where does the Kokosing River and its tributaries and wetlands fall in the grand scheme? Figure 13 encapsulates the status of biological integrity of the Kokosing River watershed and the management responses appropriate for deployment based on the biological status. This figure is based Ohio EPA's water quality standards framework of designated uses and attainment. Currently, the Kokosing River watershed lies within a continuum that dictates restoration and preservation as managerial responses.

Figure 13: Kokosing Watershed Integrity



OVERALL PROJECT GOAL:

To improve and protect water resource quality and quality of life in the Kokosing watershed by reducing nonpoint source pollution and protecting high quality areas and existing land uses.

OBJECTIVE SUMMARY:

Statement: Provide administrative leadership (one full time employee for three years) to support the implementation of the Kokosing Watershed Plan.

Specific Source(s) or Threat(s)

Loss of Riparian Vegetation and Habitat Problem Statement

Riparian vegetation serves as a critical component to the health of the Kokosing River and its tributaries. Riparian vegetation shades streams, thereby maintaining optimum temperatures for aquatic life. It traps sediment and pesticides from adjacent land uses and thus, maintains water quality. Stream-side vegetation serves as one of the forcing functions of the system, providing needed nutrients and substrate for organisms such as macroinvertebrate shredders, which form the base of the stream's food chain. Riparian vegetation also serves as habitat and migratory corridor for terrestrial species and provides an aesthetic view. Finally, it helps stabilize the stream and abates stormwater. Thus, the loss of a healthy riparian corridor destabilizes the stream system.

Riparian vegetation removal in the North Branch Kokosing River headwaters to near State Route 13 to the Kokosing River subwatershed was indicated on 99,675 linear feet of streams. This subwatershed showed one of the highest totals for linear feet impacts from riparian vegetation removal, livestock access and streambank destabilization. Ohio EPA's QHEI scores for the greater North Branch subwatershed were also slightly lower than other subwatersheds, which is indicative of impacts found during the 2003 field season. The Jelloway Creek subwatershed contained approximately 72,956 linear feet of riparian vegetation removal impacts, ranking it third highest for this impact category. Figures 14 and 15 show areas in red eligible for livestock exclusion fencing (which includes stream crossings or off-stream water supply). Fencing goals were based on the number of landowners

Figure 14: Identified Stream Segments Eligible for Livestock Exclusion Fencing, North Branch Headwaters Subwatershed

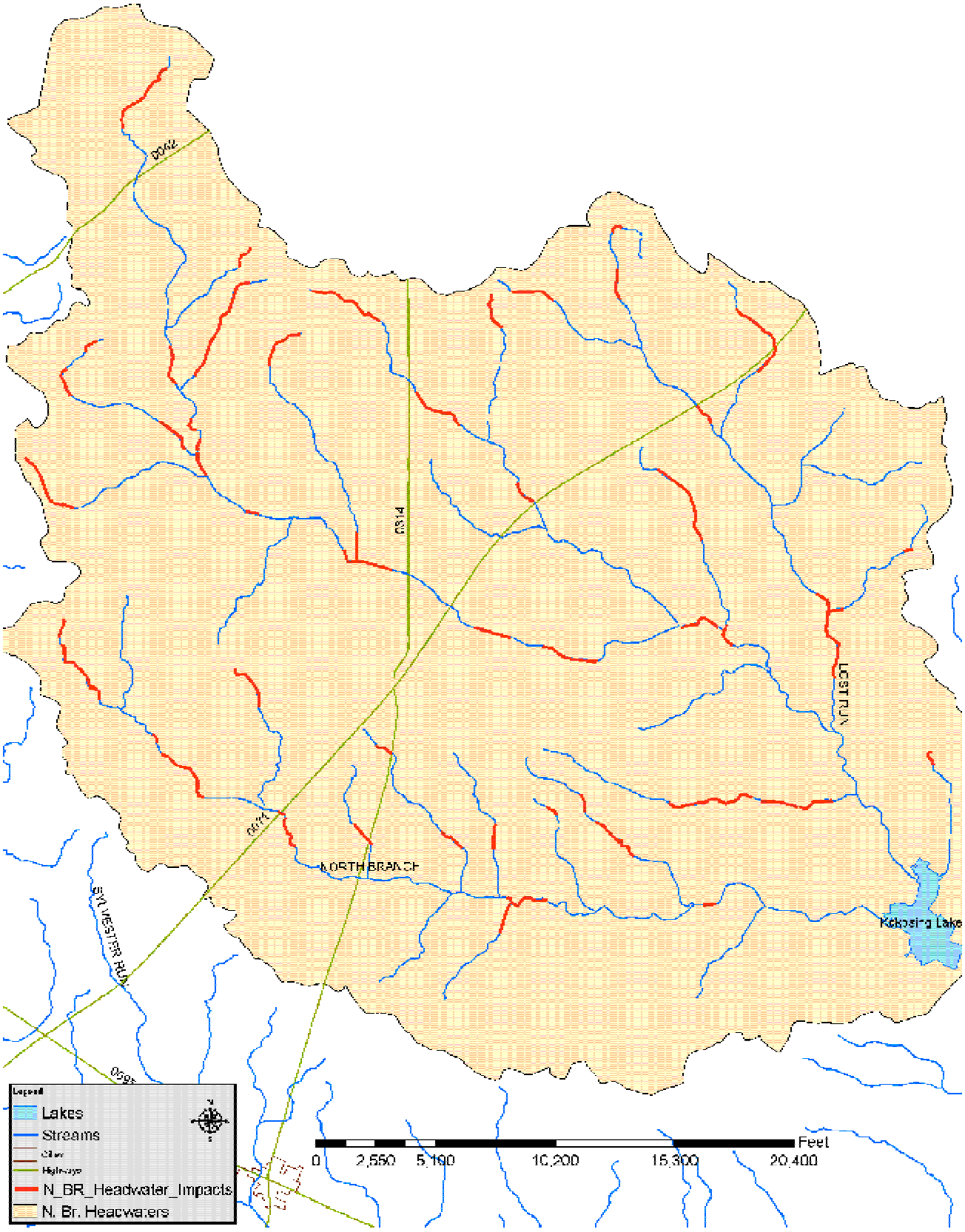
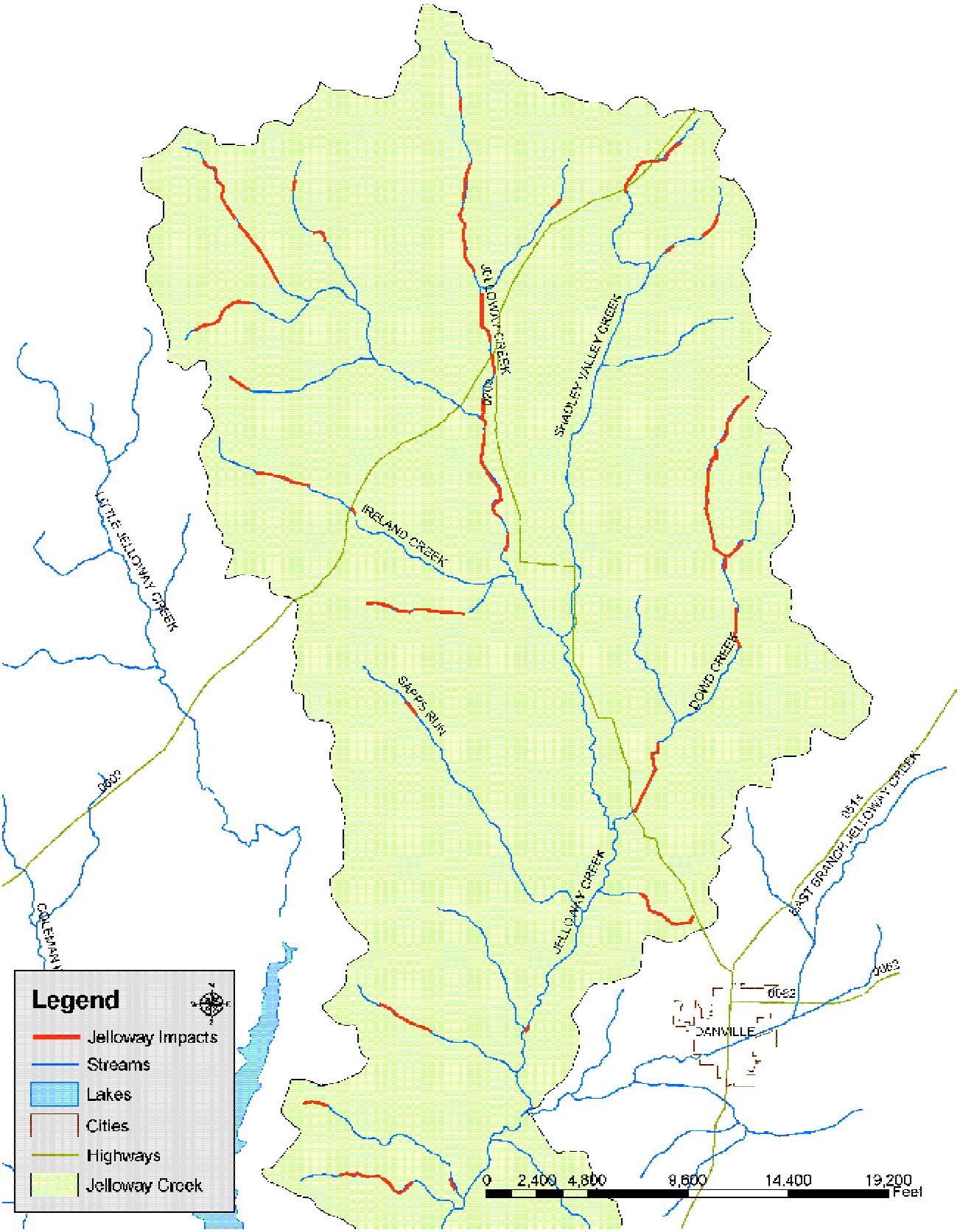


Figure 15: Identified Stream Segments Eligible for Livestock Exclusion Fencing, Jelloway Creek SubWatershed



Goal: Restore riparian vegetation in the North Branch Kokosing River headwaters to near State Route 13 subwatershed by approximately twenty percent (19,900 linear feet) and in the Jelloway Creek subwatershed by approximately twenty-six percent (19,100 linear feet) by September 2007.

Task Description (objective)	**Resources**	**How**	**Time Frame**	**Performance Indicators**
Livestock Exclusion Fencing	$30,000 Knox SWCD staff time DNAP staff time	DNAP will apply for 319 funds; Knox SWCD funds	November 2004-September 2007	10,000 linear feet of stream fenced. 386 tons of soil loss, 386 pounds of phosphorus and 774 pounds of nitrogen reduced. (North Br. Headwaters)
	$58,000 Knox SWCD staff time DNAP staff time	DNAP will apply for 319 funds; Knox SWCD funds	November 2004-September 2007	19,100 linear feet of stream fenced (Jelloway Cr.). 738 tons of soil loss, 738 pounds of phosphorus and 1,478 pounds of nitrogen reduced.
Riparian corridor protection. Woody vegetation will re-establish once area is not mowed or cut.	$50,000 for conservation easements	DNAP will apply for 319 funds; Partners will apply for Clean Ohio Funds, EQIP funds, Seek donations, Mitigation funds; 319 funds to serve as matching dollars	November 2004-September 2007	9,900 linear feet of stream protected.
Educate community on value of riparian areas	ODNR stream team fact sheet on riparian areas (already published)	Write articles for Knox, Richland and Morrow SWCD newsletters; Distribute riparian area fact sheet at SWCD offices; add fact sheet to Kokosing web site	November 2004-September 2007	Number of hits on Kokosing web site; Number of inquiries or comments from readers of newsletters; Number of fact sheets distributed.

the committee thought would participate. Within each subwatershed, those areas with severe impacts are prioritized highest, followed by participant willingness and position in the landscape. The problems statements found later in this section, streambank destabilization and range grazing, follow the same prioritization.

Protection of existing, high quality riparian habitats that provide ecosystem and societal functions is of paramount importance in the watershed. A spatial analysis was conducted to acertain those wooded riparian habitats that lie in designated 100 year floodplains in the watershed. A ranking of these areas was developed, based on the presence of attributes at the various sites. Attributes deemed important included: rare species located within 100 feet of riparian area, unique geological feature, presence of wetlands, overlays a SWAP area or contains archeaological resources. Societal floodplainfunctions and wooded habitat are inherent on all of the sites identified. Figure 16 (which is three pages) shows all of the site identified by rank. Those sites possessing two or more attributes are proposed for acquisition. A parcel layer in included in Figure 16, so that these priority sites are identified to the parcel level.

Destabilization of Streambanks
Problem Statement

Destabilization of streambanks cause numerous problems for streams, including increased sediment and nutrients and substrate siltation. In general, the destabilization of streambanks in the Kokosing is caused by riparian vegetation removal, stormwater and livestock access in streams. Destabilized streambanks in the North Branch Kokosing River headwaters to near State Route 13 subwatershed were found on approximately 27,794 linear feet of stream and were encountered on approximately 32,441 linear feet of stream in the Jelloway Creek subwatershed. Ohio EPA data supports the 2003 field season findings, particularly on Jelloway Creek. Please refer to Figures 14 and 15 for maps of the stream segments eligible for funding. During field work, stream segments were evaluated for up to three sources and three causes of impacts. Where livestock had access to streams, invariably the loss of riparian vegetation and destabilization of streambanks was also encountered.

Thus, the strategies involving riparian vegetation removal, destabilization of streambanks and livestock encroachment are clearly interwined in the two subwatersheds. The watershed steering committee wanted to ensure that all three of these threats were reasonably abated, thus the exclusion of livestock through fencing practices (and associated crossings or off-stream water supply) was deemed most effective. The strategy was deemed most effective, since the best management practice was sound technically; the practice was cost-effective and feasible; Knox SWCD and DNAP had previous experience with a livestock exclusion program offered in the watershed in 2003; and support from the agricultural community was present, based on cooperator success with the livestock exclusion program offered in 2003. In fact, requests for livestock exclusion assistance were more than double the amount of monies available in 2003. Note: Table 1 in the Introduction Section contains data on the 2003 fencing program.

While other best management practices exist to exclude livestock at certain times from streams, such as intensive pasture management, fencing places no further obligations of time or resources on the producer (other than routine maintenance) once the fencing is in place. The matrix of activity and monies allocated for riparian vegetation removal, streambank destabilization and livestock exclusion are the same. Thus, a relatively small amount of money, $30,000 and $58,000, will abate three causes and three sources of impairment in the two subwatersheds.

Range Grazing (livestock encroachment)
Problem Statement

Livestock, when given unrestricted access to streams, trample vegetation and damage soil on stream banks. Streams impacted by livestock encroachment exhibit wide shallow channels with

Figure 16: Identified Stream Segments with Two or More Priority Attributes Eligible for Riparian Protection

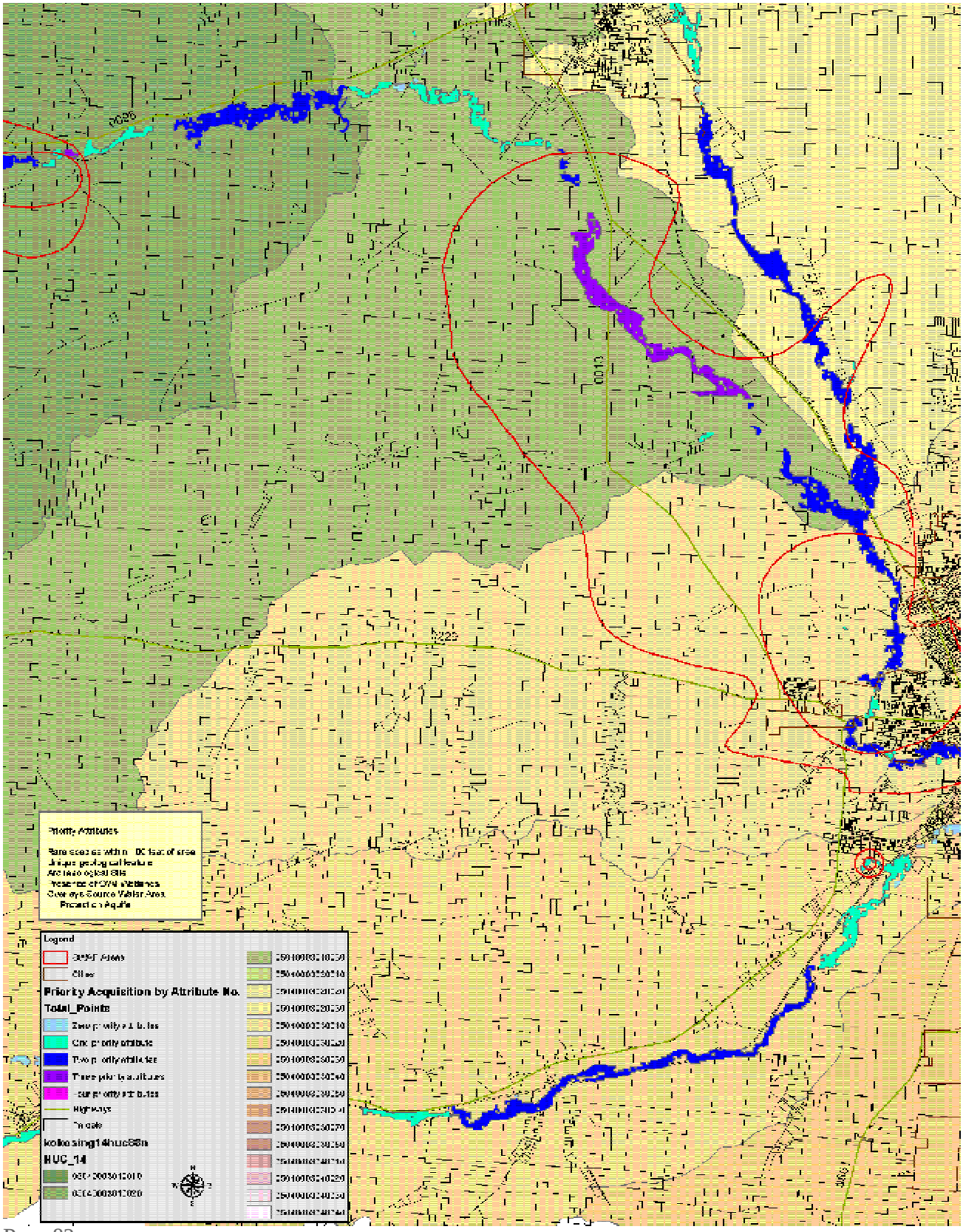


Figure 16: Identified Stream Segments with Two or More Priority Attributes Eligible for Riparian Protection (continued)

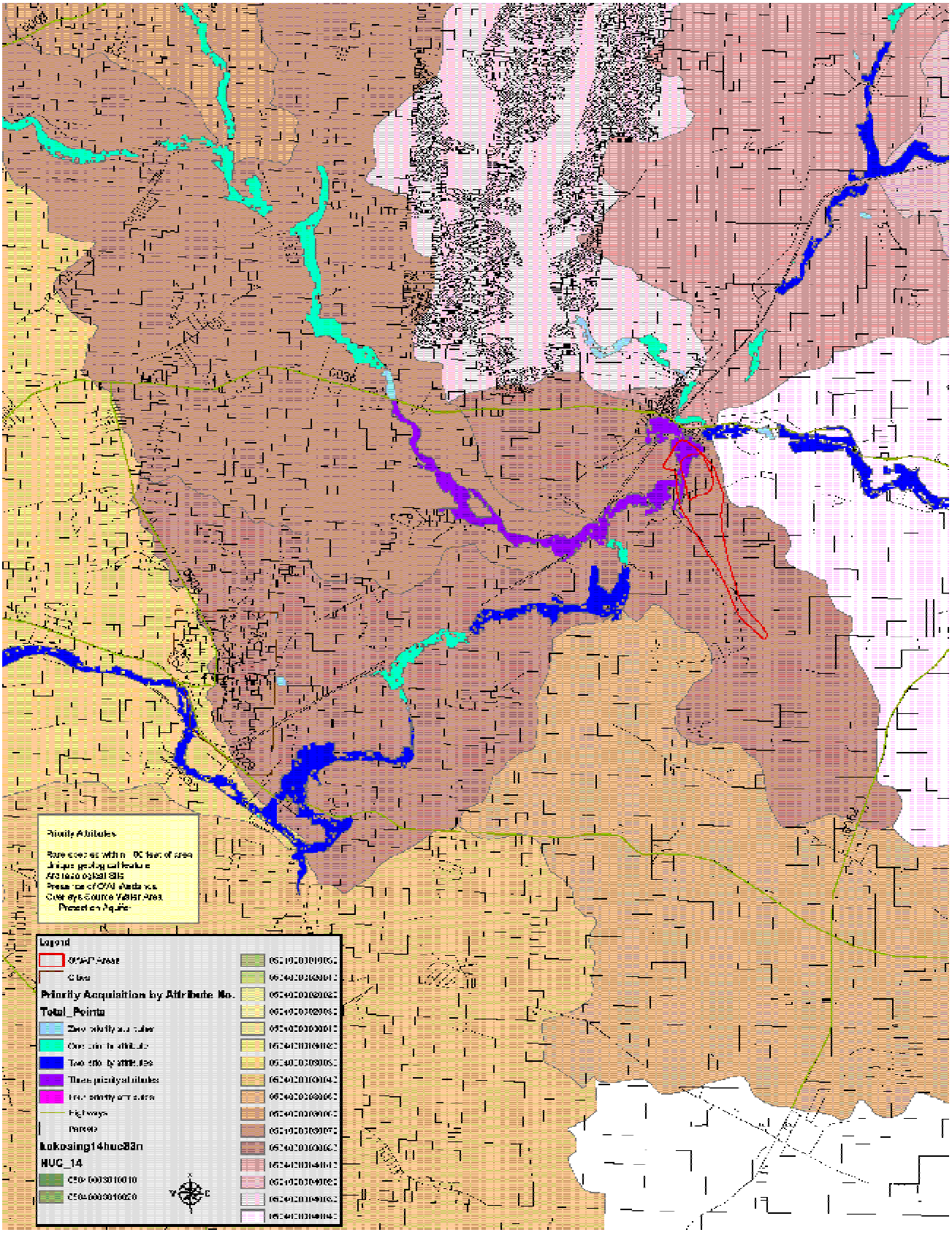
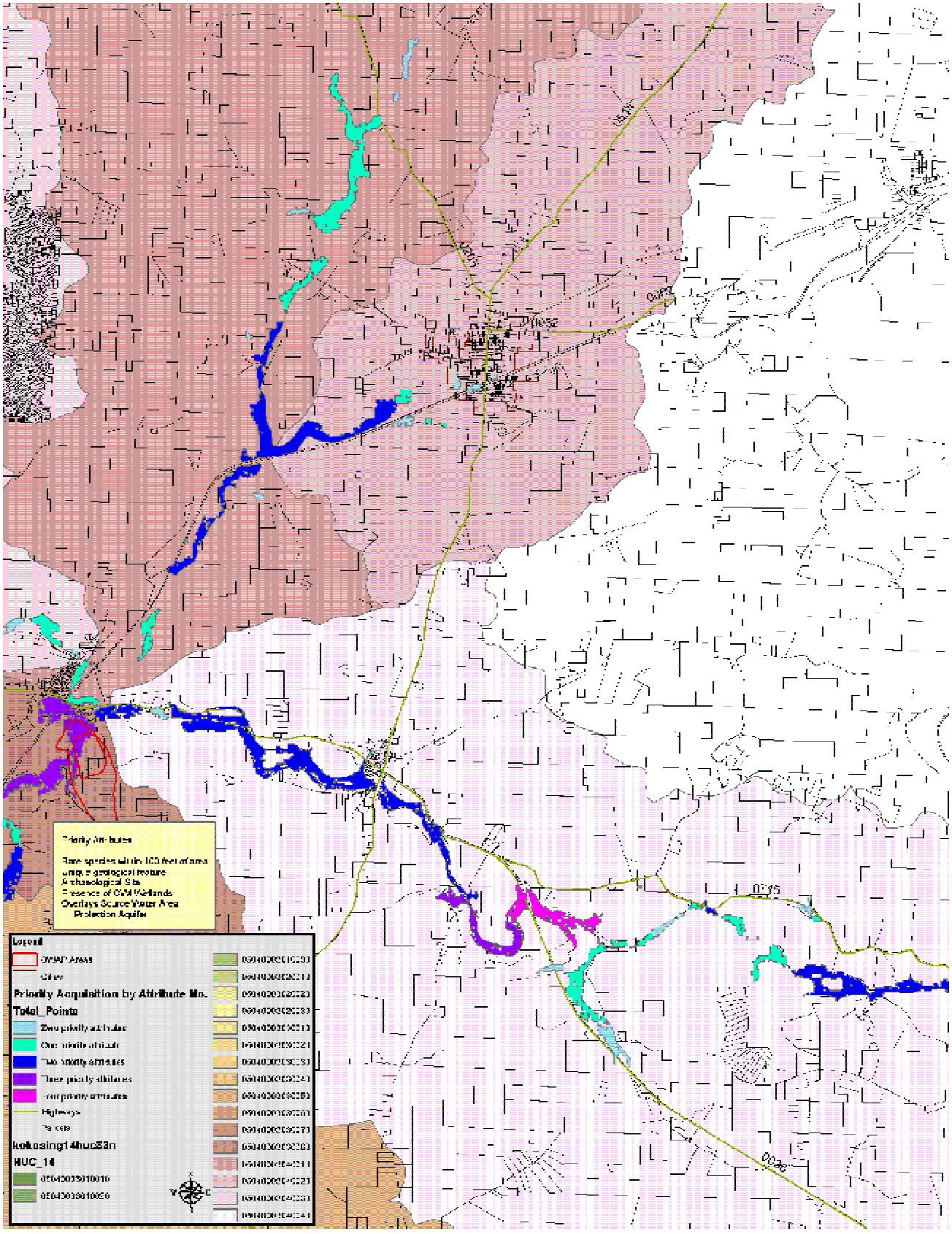


Figure 16: Identified Stream Segments with Two or More Priority Attributes Eligible for Riparian Protection (continued)



Goal: Protect approximately 500 acres of high value/high function riparian corridor habitat by October 2009.

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Riparian habitat protection	$860,000 for permanent conservation easements or fee-simple acquisition	DNAP will apply for 319 funds; Partners will apply for Clean Ohio Funds, WRRSP or WRP funds, Seek donations, mitigation funds; 319 funds to serve as matching dollars	November 2004-September 2009	500 acres of riparian corridor protected in the watershed
Extend scenic river designation into Morrow County	DNAP staff time Morrow County Commissioners Scenic River Advisory Council	DNAP will apply for 319 funds; DNAP Scenic Rivers License Plate fund	November 2004-September 2007	Director of ODNR makes journal entry of designation

minimal riparian vegetation, reduced shade, increased nitrates, increased turbidity, compacted soils and poor understory. Livestock encroachment in the North Branch Kokosing River headwaters to near State Route 13 subwatershed were found on approximately 36,610 linear feet of stream and were encountered on approximately 72,956 linear feet of stream in the Jelloway Creek subwatershed. Ohio EPA data supports the 2003 field season findings, particularly on Jelloway Creek. Please refer to Figures 14 and 15 for maps of the stream segments eligible for funding and narrative text under "Destabilization of Streambanks Problem Statement" for additional information.

Stormwater & Flooding
Problem Statement

Storm water runoff can pollute streams, disrupt natural hydrologic regimes of streams and flood downstream neighbors. As more homes and roads are constructed in the Kokosing watershed, stormwater and development-associated impacts will increase. Development related impacts, including runoff, flow alteration and hydromodification) detected in the watershed totaled more than 108,000 linear feet of impacts. Center Run, located north and within the City of Mount Vernon shows some of the greatest stormwater impacts in the watershed. Additionally, Knox County contains 113,176 acres of highly erodible soil, further heightening the the need for storm water management and soil erosion control. Figure 17 shows the distribution of the highly erodible soils.

In the document, *"Fish Community Response in a Rapidly Suburbanizing Landscape,"* Ohio EPA points to the importance of managing land use and storm water, particularly in high quality stream areas. Stream biotic integrity shows measurable declines when urban land cover exceeds 5.3% and declines below basic Clean Water Act attainment goals when urban land cover exceeds 25%. Of particular note is the fact that the Kokosing watershed is estimated to contain approximately 8% of urban land cover. However, the Ohio EPA research suggests that it might be possible to mitigate the negative effects of urbanization by protecting or enhancing near and instream habitat, including the riparian buffer zone and floodplain.

Goal: Restore destabilized streambanks in the North Branch Kokosing River headwaters to near State Route 13 subwatershed by approximately thirty-six percent (10,000 linear feet) and in the Jelloway Creek subwatershed by approximately fifty-nine percent (19,100 linear feet) by September 2007.

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Livestock Exclusion Fencing	$30,000 Knox SWCD staff time.	DNAP will apply for 319 funds; Knox SWCD funds	November 2004-September 2007	10,000 linear feet of stream fenced. 386 tons of soil loss, 386 pounds of phosphorus and 774 pounds of nitrogen reduced. (North Br. Headwaters)
	$58,000 Knox SWCD staff	DNAP will apply for 319 funds; Knox SWCD funds	November 2004-September 2007	19,100 linear feet of stream fenced (Jelloway Cr.). 738 tons of soil loss, 738 pounds of phosphorus and 1,478 pounds of nitrogen reduced.

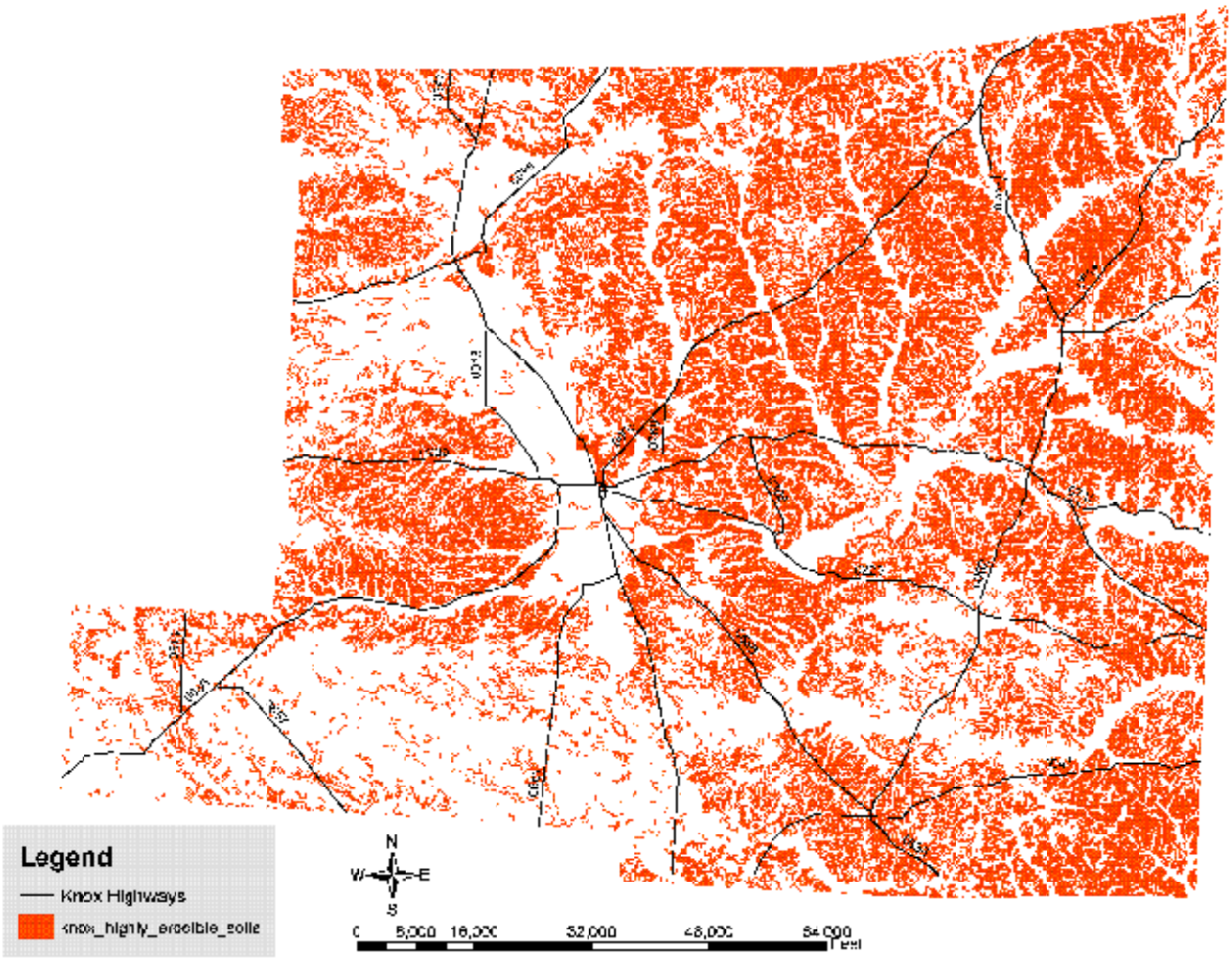
Goal: Restore streams in the North Branch Kokosing River headwaters to near State Route 13 subwatershed by approximately twenty percent (19,900 linear feet) and in the Jelloway Creek subwatershed by approximately forty percent (19,100 linear feet) by September 2007.

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Livestock Exclusion Fencing	$30,000 Knox SWCD staff time.	DNAP will apply for 319 funds; Knox SWCD funds DNAP GRF funds	November 2004-September 2007	10,000 linear feet of stream fenced. 386 tons of soil loss, 386 pounds of phosphorus and 774 pounds of nitrogen reduced. (North Br. Headwaters)
	$58,000 Knox SWCD staff	DNAP will apply for 319 funds; Knox SWCD DNAP GRF funds	November 2004-September 2007	19,100 linear feet of stream fenced (Jelloway Cr.). 738 tons of soil loss, 738 pounds of phosphorus and 1,478 pounds of nitrogen reduced.

Clearly, a critical juncture has been reached: protect the riparian cooridor and floodplain of the Kokosing now, or watch measurable declines to biotic integrity and quality of life occur in the near future. While the protection of 500 acres of high value/high functioning riparian corridor, as listed in a preceeding strategy, is laudable, the appropriate management of stormwater is an equally important and complimentary aspect of water quality protection.

With an eye towards planning for future growth, and the resulting increase in storm water quantity, the Knox County Regional Planning Commission (RPC) formed a subcommittee, known as the Storm Water Advisory Committee (SWAC), in late October 2001. The mission statement of the committee, as accepted on May 16, 2002, is *to educate and to inform members of the SWAC and the general public on the topic of storm water management and about the authorization in H.B. 549 for a countywide storm water plan.* The SWAC recommended to the Knox RPC to direct the drafting of regulations to include a comprehensive county storm water plan for new residential, commercial or industrial development and personnel to manage, administer and enforce the regulations. This was done coincidentally with passage of Article III of the Subdivision Regulations, which deal with sediment and erosion control and storm water management (as related to

Figure 17: Knox County Highly Erodible Soils



Goal: Manage stormwater and development to protect water quality and floodplain functions in the watershed.

Task Description (objective)	**Resources**	**How**	**Time Frame**	**Performance Indicators**
Implement Knox County stormwater and erosion control regulatory program	DNAP staff time Knox SWCD staff time Knox County Engineer staff time Knox Regional Planning Staff time	DNAP will apply for 319 funds; Knox SWCD, County Engineer and Regional Planning funds	November 2004-September 2007	Number of new construction sites complying with regulations
Host a regulatory workshop for landowners to increase awareness of environmental regulations	DNAP staff time Knox SWCD staff time Cooperative Extension Service staff time Knox Health Dept. staff time	DNAP will apply for 319 or OEEF funds DNAP GRF County funds	October 2004	Participants awareness increases by 50%, based comparison of pre-workshop test versus post-workshop text results
Conduct site monitoring of construction sites to ensure applicable regulations are being followed	DNAP staff time Knox SWCD and County Engineer staff time	DNAP will apply for 319 funds; Knox SWCD and County Engineer funds	November 2004-September 2007	Sites inspected and all deficiencies corrected by landowner.
Create brochure on Knox County stormwater regulations	DNAP staff time Knox Regional Planning Commission staff time	DNAP will apply for 319 or OEEF funds Knox Regional Planning Commission funds	November 2004	Brochure created; Number of brochures distributed
Create fact sheet for landowners with contact names of various regulatory permitting agencies	DNAP staff time	DNAP will apply for 319 or OEEF funds	November 2004	Fact sheet created; Number of fact sheets distributed
Conduct watershed monitoring for illegally constructed projects	DNAP staff time Knox SWCD and County Engineer staff time	DNAP will apply for 319 funds Knox SWCD funds Knox County Engineer funds DNAP GRF	November 2004-September 2007	Number of illegal projects identified; Number of illegal projects brought into compliance with regulatory programs.

Goal: Manage stormwater and development to protect water quality and floodplain functions in the watershed (continued).

Task Description (objective)	**Resources**	**How**	**Time Frame**	**Performance Indicators**
Educate City of Mount Vernon officials on importance of using good storm practices when permitting new subdivisions in city limits	DNAP staff time Knox SWCD and County Engineer staff time	DNAP will apply for 319 funds Knox SWCD funds Knox County Engineer funds	November 2004-October 2005	City of Mount Vernon officials awareness increased
Work with City of Mount Vernon to modify existing subdivision regulations to incorporate good storm practices	DNAP staff time Knox SWCD and County Engineer staff time	DNAP will apply for 319 funds Knox SWCD funds Knox County Engineer funds	October 2005-June 2006	Subdivision regulations changed to reflect stormwater practices
Perform low-level fly-over of North Branch to produce 2.0 foot contour mapping	Knox County Engineer staff time Village of Fredericktown staff time	Village of Fredericktown funds	January 2005-December 2006	Contour elevations delineated
Re-map 100 year floodplain areas in Knox County	Knox County Engineers staff time	Knox County Engineer funds Federal EMA funds ODNR Division of Water funds	January 2005-September 2006	New 100-year floodplain map adopted and approved by FEMA
Perform update to existing aerial photography of Knox County	Knox County Engineers staff time	Knox County Engineer funds Knox County Auditor Knox County Commissioners	January 2005-December 2006	New aerial photography available
Perform update of Knox County land use/land cover based on new aerial photography	DNAP staff time	DNAP will apply for 319 funds	June 2005-August 2006	Updated land use/land coverage available, including impervious surfaces
Compare 2003 created land use/land cover GIS data with 2006 created land use/land cover to ascertain trends in urbanization	DNAP staff time	DNAP will apply for 319 funds	August 2006-October 2006	Land use changes detected and information shared with local decisionmakers

Goal: Manage stormwater and development to protect water quality and floodplain functions in the watershed (continued).

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Work with Knox Regional Planning Commission Knox County to adopt floodplain regulations above the minimum NFIP standards	DNAP staff time Knox Regional Planning Staff time	DNAP will apply for 319 funds Knox Regional Planning funds	November 2004-October 2006	Knox County Commissioners adopt new floodplain management regulations. Track number of proposed projects that would have impacted floodplain resources if new regulations were not adopted.
Post floodplain management and stormwater management links and fact sheets on the Kokosing watershed web site	DNAP staff time	DNAP will apply for a 319 grant	January 2005	Tabulate the number of "hits" the site receives.
Educate township trustees on the importance of appropriate land use planning	DNAP staff time Knox Regional Planning staff time	DNAP will apply for a 319 grant; DNAP GRF	November 2004-October 2006	Number of meetings held with both zoned and unzoned townships in Knox and Morrow Counties
Initiate a detailed hydrological study of the Center Run subwatershed	DNAP staff time City of Mount Vernon staff time	City of Mount Vernon funds U.S. Army Corps of Engineers funds	June 2006	Complete the hydrological study of the Center Run subwatershed

minor subdivisions).

The Knox County Engineer estimates that 70% of existing storm water management systems in the Kokosing watershed occur on private property. Thus, to manage storm water appropriately, private property owners will need to participate. In December 2003, the Knox County Commissioners unanimously passed a resolution that creates the Knox County stormwater and erosion control regulatory program. The City of Mount Vernon is the only Phase II NPDES storm water community in the watershed.

Additionally, with increases in stormwater and runoff, the flooding of structures in the 100-year floodplain of the Kokosing has increased. The 100-year mapped floodplain for Knox County is quite inaccurate, due to the increase in stormwater and runoff from development. Thus, local officials cannot properly manage flood hazards due to this inaccuracy.

Loss of Wetland Habitat
Problem Statement:

At the time of settlement, the Kokosing watershed contained nearly 17,000 acres of wetlands (based on hydric soils). Nearly two-thirds of those original wetlands have been destroyed, and many of the remaining wetlands are threatened by development, due to their location in the watershed. Several high quality (category three) wetland complexes have been identified in the watershed and should be preserved. In particular, wetland complexes in the Kokosing River below Dry Creek to above Big Run subwatershed associated with Delano Run should be protected. Figure 18 shows the wetlands extant in the Delano Run drainage. Additionally, the Kokosing River below South Branch to below Mile Run subwatershed contains two large, category three wetlands with numerous wetland communities. Figure 19 shows these two sites.

Additionally, the loss of so many acres of wetlands in the watershed translates into wetland restoration potential. Wetlands restored or protected on the landscape perform many water quality benefits, including stormwater abatement, sediment filtration, wildlife habitat and greenspace. Approximately 2,000 acres of hydric soils exhibit good wetland restoration potential. Wetland restoration potential was determined using spatial analysis of mapped hydric soils, land use coverage and presence of OWI wetlands. The restoration goal for the watershed represents approximately 5% of areas with good potential. The Kokosing River headwaters to below South Branch and Kokosing River below South Branch to below Mile Run subwatersheds contains the largest amounts with of wetland restoration potential, with 432 and 376 acres, respectively. Figure 20 shows wetland restoration potential for these two subwatersheds.

While development will continue to occur in the watershed, it is important that any wetlands destroyed during development activities be mitigated within the watershed. One illegal wetland fill was encountered in Morrow County during the 2003 field season. Landowners need to understand their responsibilities in applying for appropriate permits before undertaking earthmoving activities

Figure 18: Wetlands Eligible for Protection Efforts, Delano Run Drainage

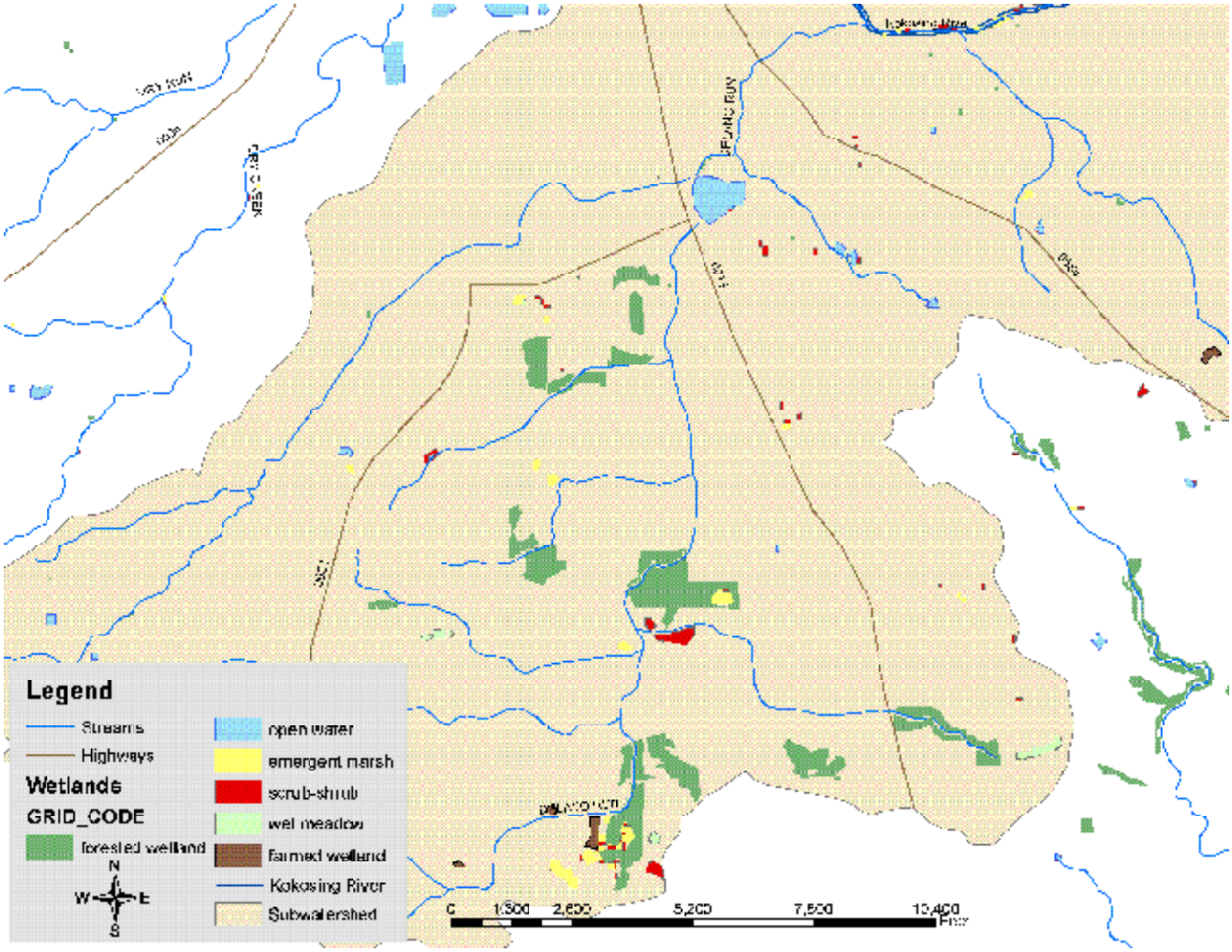


Figure 19: Wetlands Eligible for Protection Efforts, Kokosing River below South Branch to below Mile Run Subwatershed

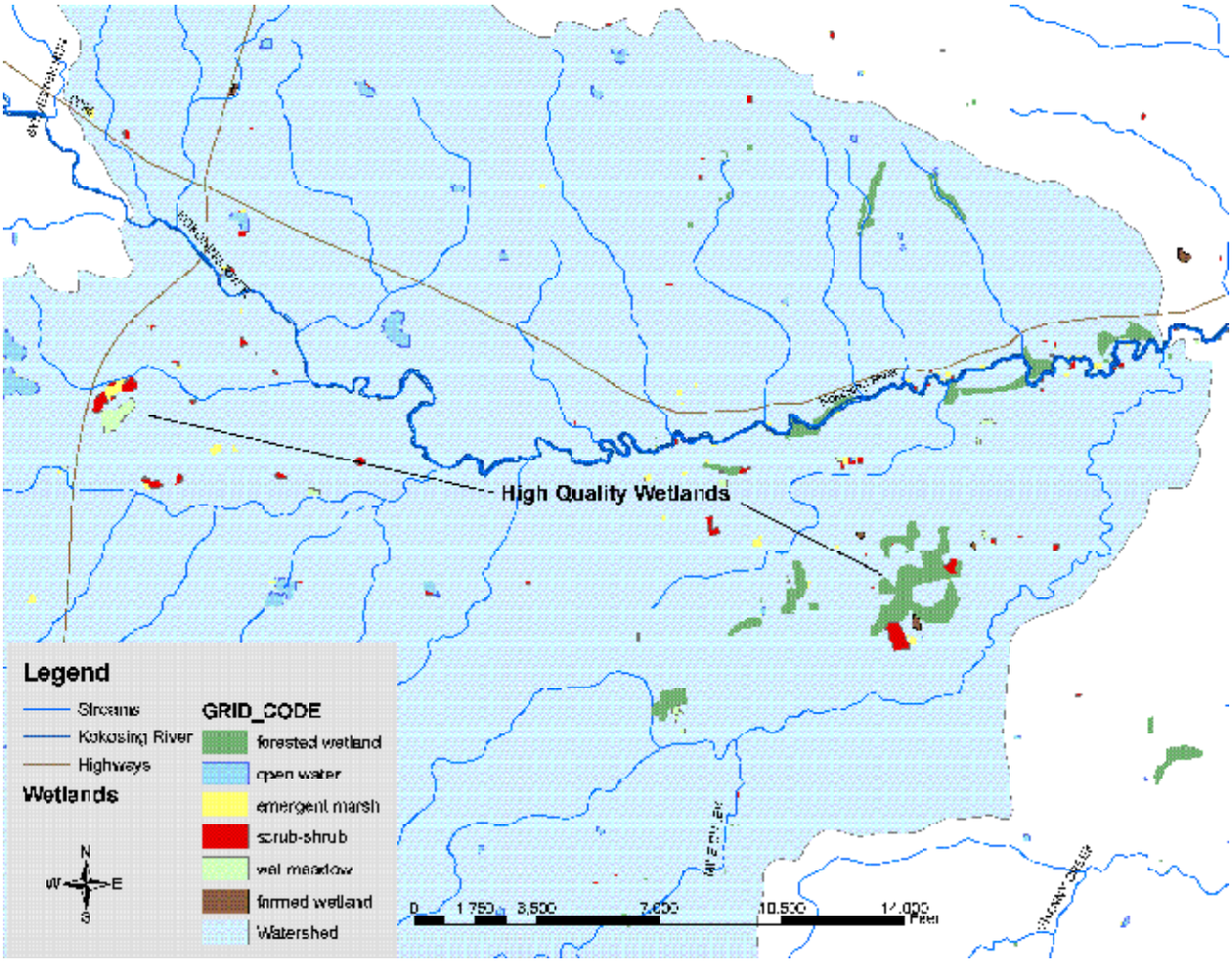
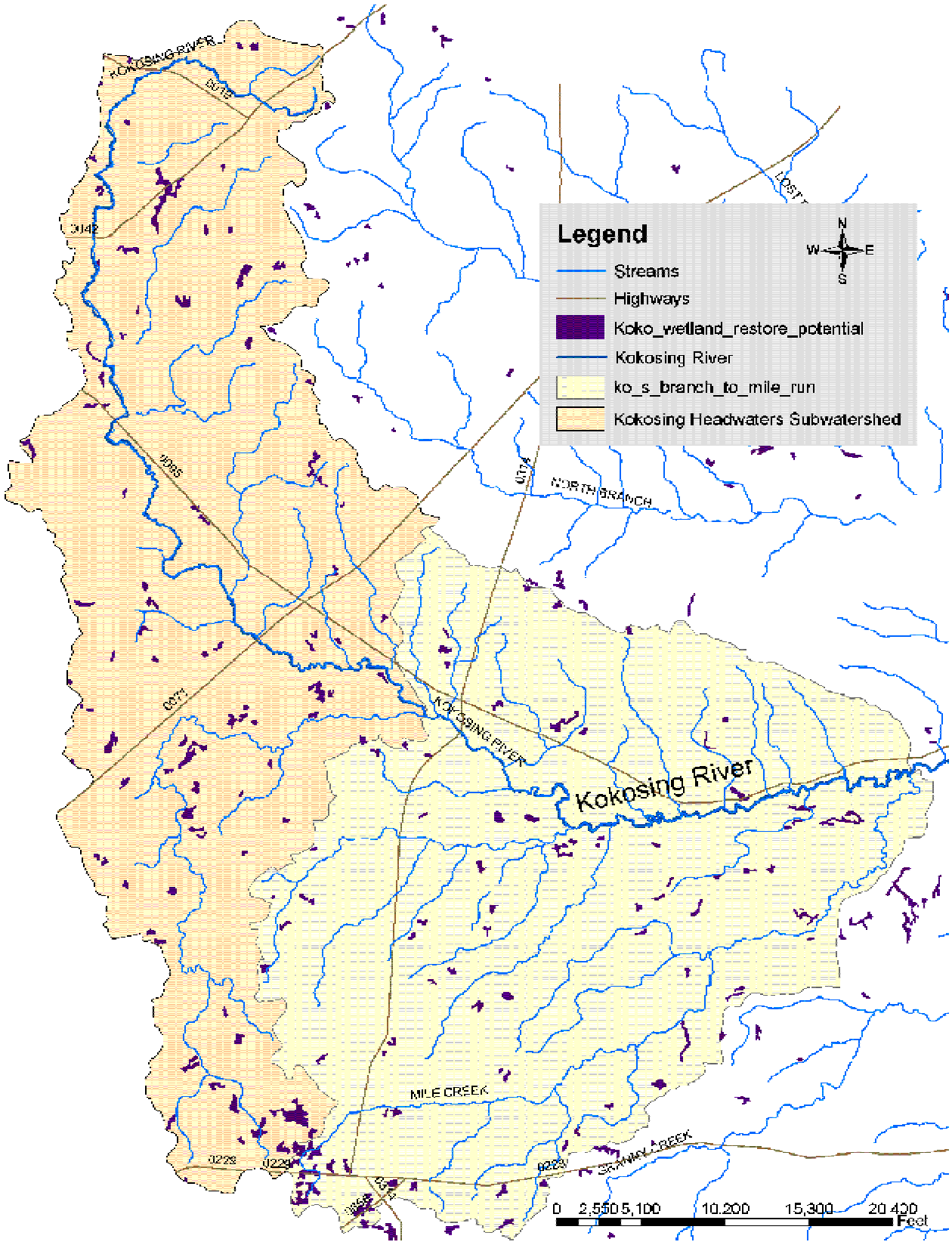


Figure 20: Wetland Restoration Potential, Kokosing River below South Branch to below Mile Run and Kokosing River Headwaters Subwatersheds



Goal: Protect approximately 100 acres of wetlands in the Kokosing River below Dry Creek to above Big Run subwatershed and restore approximately 100 acres of wetlands in the Kokosing River below South Branch to below Mile Run and Kokosing River Headwaters Subwatersheds by September 2009.

Task Description (objective)	**Resources**	**How**	**Time Frame**	**Performance Indicators**
Wetland habitat protection.	$500,000 for permanent conservation easements or fee-simple acquisition	DNAP will apply for 319 funds; Partners will apply for Clean Ohio Funds, WRRSP or WRP funds, Seek donations, mitigation funds; 319 funds to serve as matching dollars	November 2004-September 2009	100 acres of wetlands protected in the subwatershed.
Wetland restoration	$200,000 for restoration of hydrology in hydric soil areas.	DNAP will apply for 319 funds; Partners will apply for Clean Ohio Funds, WRRSP or WRP funds, Seek donations, mitigation funds; Division of Wildlife private lands restoration funds, 319 funds to serve as matching dollars	November 2004-September 2009	100 acres of wetlands restored in the Kokosing watershed.
Create wetland mitigation in-lieu fee system for the watershed	$6,000 in staff time to generate document for submittal to MBRT	DNAP will apply for 319 funds	February 2005-September 2006	MBRT signatures on in-lieu fee document
Monitoring for illegal wetland fill activities	$6,000 in staff time	DNAP (GRF)	November 2004-September 2007	Number of illegals found
Educate landowners, developers, real estate agents regarding environmental regulatory permitting requirements	$5,000 in staff time to develop and present workshop	Ohio EPA OEEF grant; DNAP (GRF)	2004 or 2005	Number of workshop participants.

Groundwater
Problem Statement

One element cited as contributing to the outstanding water quality of the Kokosing over the ages is the contribution of ground water to stream flow. Thus, potential impacts from upper aquifer dewatering to the Kokosing base stream flow and seasonal high flows should be considered. Maintaining optimum flows in the river for fish and wildlife and stream stability is important. If additional, large water withdrawals occur in the upper aquifer underlying the Kokosing, adverse impacts to the Kokosing's flow regime could result.

Additionally, the City of Mount Vernon's water supply taps a large aquifer that lies below the upper aquifer. Thus, the aquifers should be protected from not only a quantity standpoint, but also a quality standpoint. Figure 21 shows potential population growth based on current population size.

Building Local Governmental and Landowner Capacity to Make Better Resource-based Decisions
Problem Statement

Local government officials aspire to make the best decisions for their communities. A plethora of geographically-based data exists to aid a local decision maker in arriving at a reasoned decision that balances community needs, resource protection and quality of life. It is also important to acknowledge the local township ordinances in effect in Knox County, which afford some protection to the Kokosing River Appendix A contains an overview of township zoning in Knox County. Thus, educating local officials regarding the benefits of wetland, floodplain and stream protection, as it relates to local zoning, may prove beneficial.

Equally important is disseminating information to land owners so that they can make informed decisions regarding the use of their properties. Oil and gas well production and timber harvesting have a long history of activity in the watershed. Abandoned wells that are not capped properly can serve as conduits for contamination of drinking water supplies.

The ODNR Division of Mineral Resource Management offers plugging services on these orphaned wells, but most landowners are unaware of the free program. Additionally, many landowners may not understand their rights as property owners when negotiating with a company to harvest timber or drill wells on their property. Some landowners have been disappointed by the damage left after a resource extraction activity, and streams and wetlands on these properties have been adversely impacted due to lack of use of best management practices or avoidance measures.

Agricultural Pressures
Problem Statement

For many years, the Kokosing State Scenic River has maintained exceptional water quality and species diversity, due to a healthy riparian corridor and good conservation measures practiced by farmers. However, the Kokosing watershed is changing, and natural and agricultural resources threats have increased. These threats can degrade the substrate and habitat needed by the Kokosing's endangered species, decrease recreational fishing opportunity and degrade the quality of life its citizens enjoy.

Since agriculture serves as a substantial and important part of the local community in the Kokosing watershed and helps to maintain the Kokosing's high water quality, agricultural lands

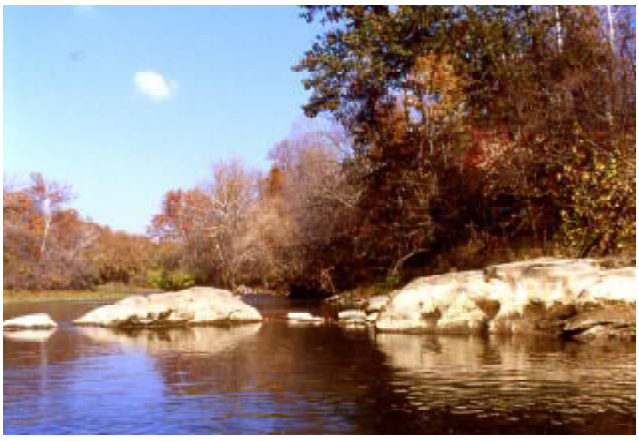
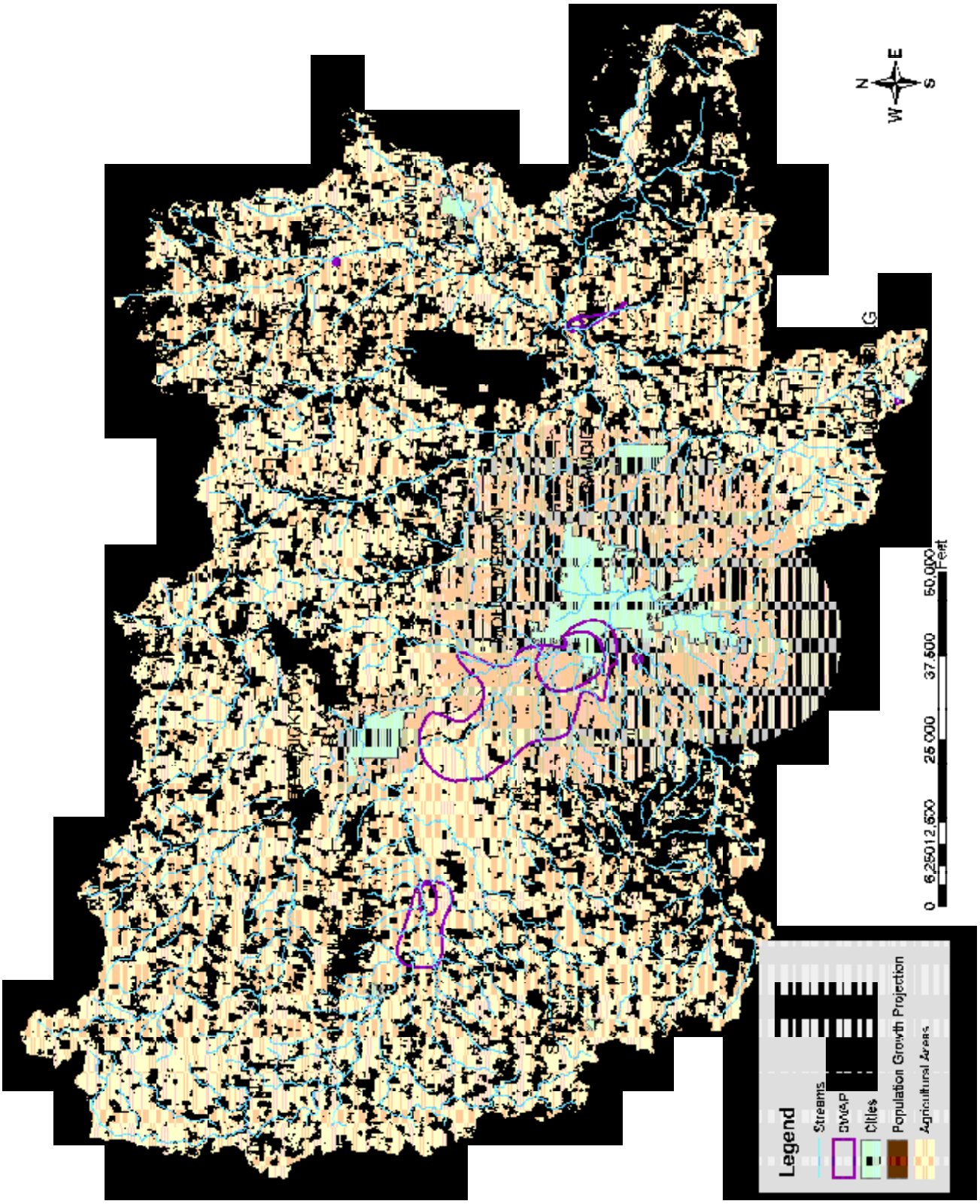


Figure 21: Potential Growth Area for Municipalities in the Watershed Based on Current Population Size



Goal: Protect groundwater quantity and quality of the aquifer underlying the Kokosing River by monitoring water withdrawals, increasing public awareness of the importance of ground water quality, protecting the City of Mount Vernon's well field and acquiring easements over 620 acres in the well field area by September 2009.

Task Description (objective)	**Resources**	**How**	**Time Frame**	**Performance Indicators**
Monitor the Del-Co well field withdrawal from the aquifer underlying the Kokosing River	$3,800 U.S.G.S. staff time DNAP staff time	DNAP Scenic Rivers License Plate Fund	November 2004-September 2007	Annual monitoring report completed and reviewed.
Assist the City of Mount Vernon will development of a Source Water Area Protection Plan	DNAP staff time City of Mount Vernon staff time	DNAP will apply for 319 funds; City of Mount Vernon funds	June 2004-July 2005	Source Water Area Protection Plan completed
Increase community understanding of the linkages between land use, individual landowner actions and ground water aquifer protection by creation of a brochure	DNAP staff time City of Mount Vernon staff time $5,000	DNAP will apply for OEEF or 319 funds	August 2004-August 2005	Brochure developed; Number of brochures distributed
Post brochure on City of Mount Vernon's and Kokosing watershed web sites	DNAP staff time City of Mount Vernon staff time	DNAP will apply for OEEF or 319 funds	August 2004-2005	Tabulate web hits on the ground water protection brochure on the web sites
Educate township trustees regarding the importance of protecting existing land uses in the City of Mount Vernon's well field protection area	DNAP staff time City of Mount Vernon staff time	DNAP will apply for OEEF or 319 funds City of Mount Vernon funds	August 2005-September 2006	Number of meetings held. Current zoning standards upheld or changed to increase protection.
Acquire agricultural preservation easements and/or conservation easements on 620 acres in the City of Mount Vernon's well field protection area	City of Mount Vernon time Owl Creek Conservancy time DNAP staff time	DNAP will apply for 319 funds City of Mount Vernon funds Owl Creek Conservancy funds Clean Ohio funds WRRSP funds Homeland Security Funds	November 2004-September 2009	620 acres of land protected in the three applicable subwatersheds: N. Branch Kokosing between N. Branch & Dry Run; Kokosing below Mile Run & N. Branch

Goal: To increase the capacities of local governmental entities and watershed landowners to make informed decisions concerning protection of resources in the Kokosing watershed.

Task Description (objective)	**Resources**	**How**	**Time Frame**	**Performance Indicators**
Create, support and maintain a geographic information system for the watershed	DNAP staff time	DNAP will apply for 319 funds;	November 2004-September 2007	Data layers are kept up-to-date; new data layers added as created or acquired.
Provide technical assistance in the form of field visits, consultations, permit reviews and provide GIS data to local officials	DNAP staff time	DNAP will apply for 319 funds;	November 2004-September 2007	Number of technical assistance activities performed
Provide GIS information either real time on a web site or by published cd or hard copy to officials, landowners and non-profit groups	DNAP staff time Kenyon College computer server space	DNAP will apply for 319 funds; Kenyon College will donate server space	November 2004-September 2007	Number of downloads on the web site or number of GIS products requested
Provide copies of sample timber sale leases and oil and gas leases for landowners to use to protect their properties	DNAP staff time $1,000 printing	DNAP will apply for 319 funds;	November 2004-September 2007	Number of sample contracts distributed
Place sample contracts on Kokosing web site for the public to access	DNAP staff time $1,000 for printing	DNAP will apply for 319 funds;	November 2004-September 2007	Number of downloads on the web site
Provide grant writing assistance to local governments and non-profit organizations to protect resources	DNAP staff time	DNAP will apply for 319 funds;	November 2004-September 2007	Number of assistance requests fulfilled Number/acreages protected or enhanced through grants
Make ODNR's orphan well program available to landowners	DNAP staff time ODNR Division of Mineral Resource Management staff time	DNAP will apply for 319 funds	November 2004-September 2007	Number of fact sheets or brochures distributed
Update the Kokosing plan as appropriate	DNAP staff time	DNAP will apply for 319 funds	November 2004-September 2007	Number of plan addendums

Goal: Protect 9,000 acres of agricultural lands from inappropriate development by 2009 in the Kokosing watershed.

Task Description (objective)	**Resources**	**How**	**Time Frame**	**Performance Indicators**
Create a Knox County Agricultural Easement Purchase Program Supplement Fund (KCAEPPSF)	Knox SWCD staff time Knox County Commissioners Knox County RPC	Knox County Commissioners adopt resolution	November 2004-September 2007	Fund created; Acres of farmland protected from development.
Obtain agricultural easements on 2,000 acres of farmland	Knox County Commissioners Philander Chase Corporation Knox SWCD DNAP Knox County RPC	KCAEPPSF funds Clean Ohio funds Philander Chase funds NRCS funds DNAP will apply for 319 funds	November 2004-September 2009	Number of farmland acres under easement
Revise and review protective zoning for agricultural land uses language to distribute to township trustees	Knox County RPC time DNAP staff time	Knox County RPC	November 2004-September 2007	Number of townships that incorporate zoning language Acres of farmland protected
Perform a cost of community services study in 2007 to generate trends data relating to development versus farmland and open space land uses	Knox County Commissioners Knox County RPC	County funds Knox County RPC funds	2007	Distribute results to township trustees and local government officials

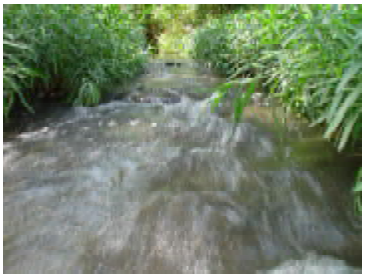
must be protected from development. The Knox County portion of the watershed contains acres of prime farmland soils and soils of local importance (See Figure 22). With conversion of farmland to residential development, the inevitable failing septic tank threat to water quality surfaces. Likewise, the City of Mount Vernon and Knox County aquifers are located in agricultural areas. Since the aquifers serving these entities has maintained a high level of drinking water quality, it's important to protect the agricultural land use that exists above the aquifers.

The American Farmland Trust (AFT), a private, nonprofit conservation organization dedicated to protecting the nation's strategic agricultural resources, notes that Ohio is 2nd only to Texas in the amount of prime farmland lost to development, and that the Eastern Ohio Till Plains (which includes the western portion of Knox and eastern portion of Morrow Counties) is the seventh most threatened farming region in the nation.

Headwater Streams
Problem Statement

Headwater streams provide wildlife habitat, improve water quality and abate floodflows. The Kokosing River watershed has numerous headwater streams. Impacts to the headwater streams include channelization, road culverting and denuding of riparian fringes. While geographically referenced data exists for intermittent and perennial streams in the watershed, no headwater stream data exists.

In the document, "*The Importance and Benefits of Primary Headwater Streams,*" Ohio EPA indicates, "Primary headwater streams are like the capillary system of a blood supply network – just as the health of the whole organism depends upon a functioning capillary system, the health of larger streams and rivers depend upon an intact primary headwater stream network." Sadly, headwater streams are subject to higher levels of destruction, because little value is placed on their importance, and their small size makes them easy to fill and channelize.



For local and state units of government to make informed decisions regarding the protection of these small streams, a watershed-wide identification of headwater streams needs to take place.

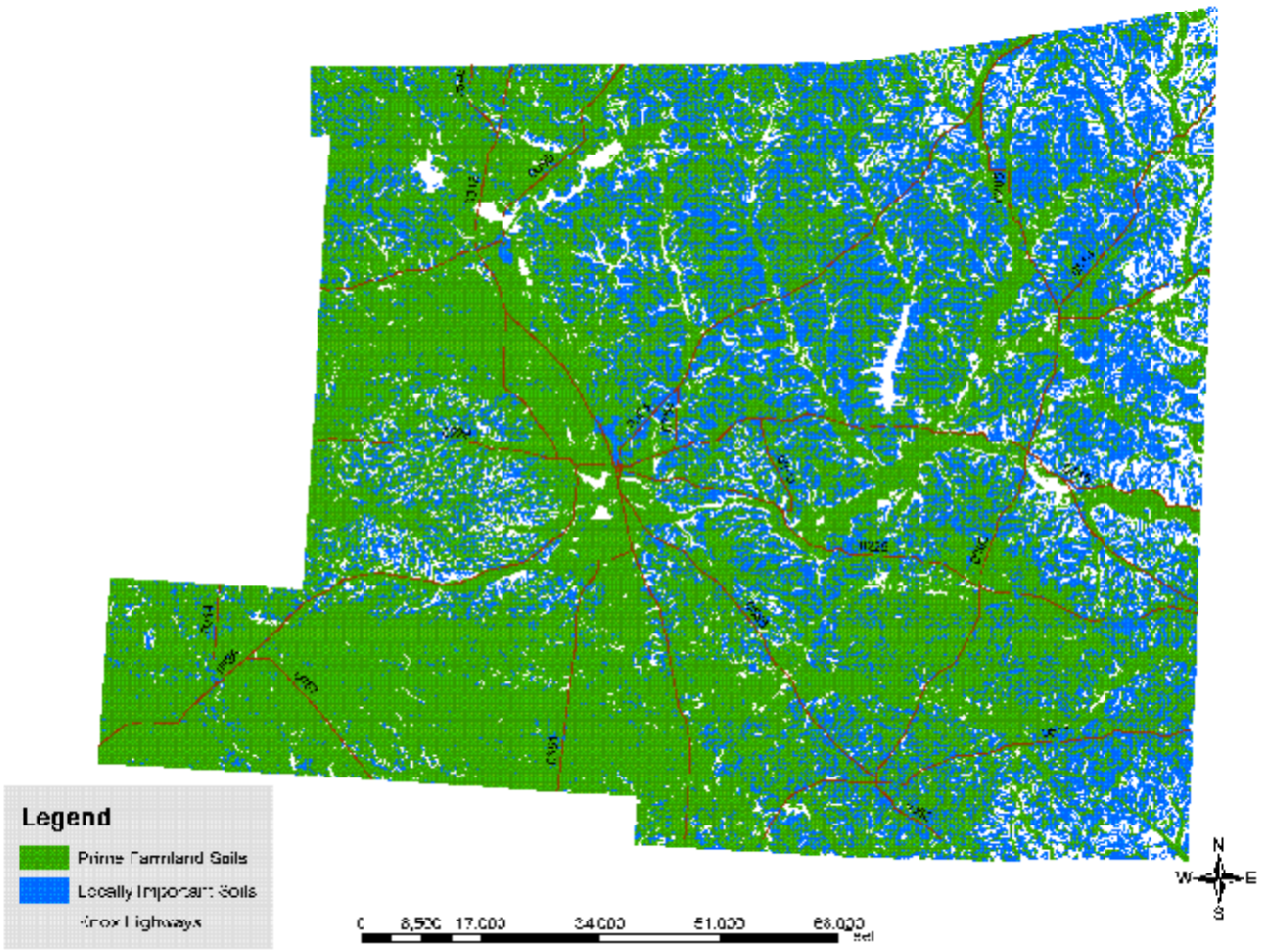
Pollution Containment
Problem Statement

As the Ben Franklin saying goes, "An ounce of prevention is worth a pound of cure." However, sometimes, accidents happen. While the Kokosing has been spared large pollutant spills,

Goal:
Using geographic information system technology, map headwater streams in the watershed.

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Use digital aerial photography and contour mapping data to identify and digitize headwater streams in the watershed	DNAP staff time	DNAP will apply for 319 funds;	November 2004-September 2007	Headwater streams are mapped; Mapping information is shared with ODNR divisions, Ohio EPA and local government units possessing regulatory authority over stormwater

Figure 22: Knox County Prime Farmland Soils and Soils of Local Importance



small spills that impact water quality have occurred. At present, no pollution containment plan has been developed for the Kokosing, and this is problematic. Critical components of spill containment include monitoring, response timeliness, access to areas conducive to barrier placement and notification of the right entities in the event of a spill. Appropriate pollution containment preparation, through the development of a spill plan, could protect or minimize damage to the Kokosing River in the future.

Lack of Open Space
Problem Statement

While the citizens of Knox and Morrow Counties may perceive that their respective counties contain large amounts of open space, both counties actually rank low in terms of percentage

Goal: To develop a spill containment plan for the Kokosing River by the end of 2005.

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Identify spill containment access sites, obtain landowner permission for access and map sites in the Kokosing GIS	DNAP staff time Knox EMA staff time Scenic River Advisory Council	Knox EMA funds	June 2005 October 2005	Access areas identified, landowner permission obtain, areas mapped
Create contact list of agencies involved in spill clean-ups	DNAP staff time Knox EMA staff time	Knox EMA funds;	June 2005 October 2005	Contact list distributed to county offices, townships and fire departments
Hold a spill drill/exercise	DNAP staff time Knox EMA staff time Scenic River Advisory Council Local Fire Departments	Knox EMA funds;	October 2005	Critique of the drill outcome by participants
Add links and information to the Kokosing web site and Knox County Health Department web site with contact information for citizens to report spills, malfunctioning septic tanks, etc.	DNAP staff time Knox County Health Department	Knox County Health Department funds	October 2005	Contact list created on web sites. Tabulate number of complaints received annually.

Goal: To increase outdoor recreation open space, opportunity and safety by 1,000 acres by September 2007 in the watershed.

Task Description (objective)	**Resources**	**How**	**Time Frame**	**Performance Indicators**
Acquire parcels or access easements for outdoor recreation activities	DNAP staff time Knox Park District staff time Fredericktown Recreation District	Clean Ohio funds NatureWorks funds LWCF funds Knox Park District Funds Private donations Fredericktown Recreation District	November 2004-September 2007	1,000 acres of outdoor recreation open space made available.
Build two additional canoe access sites on the Kokosing	DNAP staff time Knox Park District staff time	ODNR Division of Watercraft funds Division of Wildlife funds	November 2004-September 2007	Canoe access sites built at Foundation Park in Mount Vernon and at Knox Park District site.
Construct additional bikeways	DNAP staff time Knox Park District staff time	NatureWorks funds LWCF funds Private donations	November 2004-September 2007	Bikeways constructed
Increase boater safety by placing road name on each bridge crossing on the Kokosing River at canoeists' eye level	DNAP staff time Knox Park District staff time Knox County Engineer staff time	County Engineer funds Knox Park District funds	September 2004-September 2005	Bridges labeled

of outdoor recreation acreage given county land size and population. Of Knox County's 338,672 total acres, 5,871 acres are comprised of parks and open space. Morrow County contains a total of 260,280 acres with 1,643 acres used for parks and open space. As users gain opportunity to experience open space and explore natural areas, their appreciation and support for the protection of natural resources increase. Thus, recreational access and opportunity, if planned appropriately, can enhance support for the Kokosing River and its unique habitats.

Environmental Education, General Public Awareness of Kokosing Resources
Problem Statement

As development projects increase in number in the Kokosing watershed, threats to Kokosing resources will increase. One of the most effective means of protecting water quality, habitat and unique habitats is to inform and educate the community (i.e. general public) regarding ways that they can personally protect and conserve natural resources.

Goal: To raise awareness and appreciation for the protection of Kokosing watershed resources by engaging the public in environmental education and public participation processes.

Task Description (objective)	**Resources**	**How**	**Time Frame**	**Performance Indicators**
Host an annual "Kokosing River Day" for the public	DNAP staff time Scenic River Advisory Council Knox SWCD Brown Family Environmental Education Center; Knox Park District Owl Creek Conservancy	DNAP will apply for 319 funds; Brown Family Environmental Education Center funds Knox SWCD funds; Knox Park District funds	June or July each year	Number of participants; Number of new scenic river volunteers
Host an annual "Kokosing River Clean-up Day"	DNAP staff time Scenic River Advisory Council Brown Family Environmental Education Center Mount Vernon Nazarene University Student Development Office; Knox Litter Prevention Office	DNAP will apply for 319 funds; Brown Family Environmental Education Center funds Mount Vernon Nazarene funds; Solid Waste District funds	September each year	Number of participants; Number of new scenic river volunteers
Stream quality monitoring, biological survey and aquatic education project	DNAP staff time Scenic River Advisory Council	DNAP will apply for 319 funds; DNAP GRF; DNAP Scenic Rivers License Plate Fund	May 2004-September 2007	Number of participants; Number of new scenic river volunteers
Host annual fish shocking demonstrations, canoe floats, etc. for citizens, elected officials and non-profit organizations	DNAP staff time Scenic River Advisory Council	DNAP will apply for 319 funds; DNAP GRF; DNAP Scenic Rivers License Plate Fund	May 2004-September 2007	Number of participants; Number of new scenic river volunteers
Work with the Knox County Convention & Visitors Bureau (CVB) to create a natural and scenic treasures of Knox County map	DNAP staff time Knox CVB staff time	DNAP will apply for 319 funds; Knox County funds	February 2005-April 2005	Map printed and available for distribution; Map added to Conventions' web site

Goal: To raise awareness and appreciation for the protection of Kokosing watershed resources by engaging the public in environmental education and public participation processes.

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Seek Ohio Scenic Byway Status for U.S. Route 62 and State Route 514 in the watershed	Knox County Commissioners staff time Knox County RPC staff time DNAP staff time	Knox County funds	June 2004-January 2005	Roads designated scenic byways by ODOT; Scenic byway signs erected
Host presentations regarding various environmental/ natural resource issues	DNAP staff time Citizens for Smart Growth Knox SWCD staff time Cooperative Extension staff time	DNAP will apply for 319 funds; Citizens for Smart Growth funds	January 2005-October 2007	Number of presentations held; Number of participants at presentations
Provide home owners with information concerning the proper operation and maintenance of septic systems	DNAP staff time Knox Health Department staff time	DNAP will apply for 319 funds Knox Health Department funds	January 2005-October 2007	Number of fact sheets distributed
Present an "Owl Creek Minute" on WMVO radio every month	DNAP staff Owl Creek Conservancy Citizens for Smart Growth Brown Family Environmental Education Center	DNAP will apply for 319 funds	January 2005-October 2007	Number of radio presentations made

As quoted from the *Ohio Environmental Education Fund Program Guidelines*,

> *"Environmental education is the learning process whereby people acquire an awareness and scientific understanding of the natural and built environment; attitudes that value the environment; and skills for identifying and addressing environmental issues. When effective, it leads to participation in environmental decision making and actions that result in a sustainable environment, healthier people and livable communities."*

Additionally, nature-based tourism and local economic opportunities that help maintain compatible economic use of the Kokosing watershed will help protect the river and its tributaries.

PLAN EVALATION, UPDATE AND REVISION

Evaluation is a necessary step in a watershed planning process. DNAP will assume tracking of the Kokosing Watershed Plan implementation progress by capturing and documenting all activities undertaken in the plan. Close communication, through quarterly or bi-annual meetings (as needed) between DNAP and watershed partners (Scenic Rivers Advisory Council and Kokosing Watershed Steering Committee) will ensure that activities are documented appropriately. If other watershed stakeholders wish to participate in plan activities, they can (though not as formal members of the steering committee).

DNAP will communicate the annual results of plan activities to the general public by posting results on the Kokosing watershed plan web site and public service announcements in local papers. Likewise, the continued participation of DNAP staff on various regional planning committees will serve as an informal means of sharing results. Progress should be evident after the first quarter of the implementation grant, owing to the productive nature of the watershed partners. However, water quality improvements associated with some of the strategies will take time to monitor, and progress may not be fully shown in a 1-3 year timeframe. Surrogates of water quality progress and other activities undertaken by watershed partners (but not captured in the plan) will also be documented in the annual report to the community. Water quality goals are generally planned on a three year time frame in the action plan; a more in-depth evaluation will take place as water quality data are made available by further studies by the Ohio EPA (through their rotating basin approach or TMDL program). DNAP will seek general revenue funding for a full-time, permanent position in the watershed. DNAP tax check-off monies, Scenic Rivers license plate monies, various state and federal grants and assistance from local partners will be sought to fund the watershed plan long-term.

Formal revisions to the plan will be made when necessary. Additional interim plan amendments will be made if important opportunities exist, and new data becomes available. The amendments will be developed by DNAP, reviewed by the watershed steering committee and forwarded to Ohio EPA.

Lessons learned, such as techniques/activities found to be especially effective (or ineffective) will be shared as well. Owing to the overwhelming technical expertise and managerial experience possessed by DNAP and the watershed partners, substantive and methodological knowledge of county, state and non-profit processes and programs appears more than adequate. DNAP will also keep all records and documents involved in the plan, as prescribed by Ohio Public Records Law.

CONCLUSION:

With the completion of this document, citizens of the Kokosing watershed have the rare opportunity to prevent its degradation in the 21st century. The strategies presented here, if implemented, will prevent the Kokosing River from suffering the fate of other rivers such as the Olentangy River and Alum Creek.

It is the residents who live in harmony with and love their local water resources who are the only people who can truly implement those actions to avoid degradation and innappropriate development, leading to decreased biodiversity, lowered water quality and loss of open space.

This plan is not a blueprint for success, but merely a guidebook, providing direction from which important ideas, plans and further strategies will develop. The ultimate goal, embraced by all the friends of the river and its watershed, should not be to slow its degradation, but to incrementally and indefinitely improve upon the remarkable resource that is the Kokosing.

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GEOGRAPHIC INFORMATION SYSTEM VECTOR AND RASTER DATA

GIS layers acquired or created for the Kokosing watershed include: land use/land cover (urban, forest, agriculture, water features, wetlands, barren and shrub habitat), 14 digit watersheds, 11 digit watersheds, streams, 100 year floodplains, 500 year floodplains, floodways, biotics (natural heritage database list of endangered/rare species), Ohio wetland inventory, stream buffers, streams with wooded riparian habitat, Ohio historical inventory, national register of historic places, Ohio archeological inventory, Ohio historic districts, NPDES point source discharge points, water withdrawal facility registration program points (entities who withdrawal large amounts of water), Knox County parcel data, bedrock and glacial aquifer mapping, Knox County ortho-photography, soils, hydric soils, prime farmland soils, highly erodible soils, digital elevation model (elevations), counties, roads, highways, drinking water source protection areas, contour mapping, ecoregions, original vegetation of Ohio, underground storage tanks (UST), leaking USTs, oil and gas wells, sand and gravel mining operations, census data, dam points, townships, lakes, Knox County ponds, cities, canoe access points, bike trails, protected lands, scenic river designated stream segments, stream impacts (by cause, source and severity), floodplain/riparian areas with high quality attributes, potential vernal pool habitats, slope, herbicide use, Ohio EPA potential contaminants points and climate.

ACRONYMS REFERENCE LIST

ACSI—Appalachian Clean Streams Initiative
AFT—American Farmland Trust
AMD—Acid Mine Drainage
AMDAT—Acid Mine Drainage Abatement and Treatment Plan
BAT—Best Available Technology
BMP—Best Management Practices
C-1—Conservation District
CRP—Conservation Reserve Program
DERR—Division of Emergency and Remedial Response
EQIP—Environmental Quality Incentives Program
FEMA—Federal Emergency Management Agency
IBI—Index of Biotic Integrity
ICI—Invertebrate Community Index
IFC—Instream Flow Council
KRPC—Knox Regional Planning Commission
MCW—Monday Creek Watershed
MIwb—Modified Index of Well Being
MTC—Main Thoroughfare Cooridor Overlay District
MWCD—Muskingum Watershed Conservancy District
NPS—Non Point Source Pollution
NRCS—Natural Resource Conservation Service
ODNR—Ohio Department of Natural Resources
OEMA—Ohio Emergency Management Agency
Ohio EPA—Ohio Environmental Protection Agency
OSUEDU—The Ohio State University Extension Data Center
PHWH—Primary Headwater Habitat
PDR—Purchase of Development Rights
PND—Planned Neighborhood District
PUD— Planned Unit Development
PUCD—Planned Unit Conservation Development
QHEI—Quantitative Habitat Evaluation Index
RCRPC—Richland County Regional Planning Commission
SWCD—Soil and Water Conservation District
TMDL—Total Maximum Daily Load
TDR—Transfer of Development Rights
US EPA—United States Environmental Protection Agency
USDA—United States Department of Agriculture
WHIP—Wildlife Habitat Incentives Program
WQS—Water Quality Standards
WRP—Wetlands Reserve Program
WRRSP—Water Resource Restoration Sponsorship Program
WWH—Warm Water Habitat

APPENDIX A:
Zoning in Knox County

Berlin Township: Berlin Township currently has a Zoning Resolution adopted in 2001 but does not have a comprehensive plan. The Berlin Township Zoning Resolution contains some policies that indirectly protect the Kokosing State Scenic River. The plan also references Focus 2100. The plan does reference streams and watercourses but does not set specific standards for their protection. Cluster Residential Subdivisions are a very good example on how to conserve open space, natural features and farmland, all of which contribute to the protection of the Kokosing River. In cluster developments, 50% of the developable acreage is set aside as permanent open space or farmland. The township also has a restriction on the number of land subdivisions that can occur on a parcel of record after November 14, 2001 within the Agricultural District. This limits the amount of farmland that can be converted to residential development. The minimum lot sizes are two acres in the Agricultural District, one acre in R-1 and 14,000 square feet (sq. ft.) in R-2 (only when centralized sewer is available).

Brown Township: Brown Township currently has a Zoning Resolution, adopted 1961 and amended and revised in 1983, 1985, 1991, 1996 and 1999, but does not have a comprehensive plan. Natural resources are not referenced within the document and there is no reference to watercourses or streams. The minimum lot size within the township for residential development is three acres.

Butler Township: Butler Township is currently un-zoned.

ClintonTownship: Clinton Township currently has a Zoning resolution adopted in January 1998 but does not have a comprehensive plan. Natural resources are not referenced within the document and specifically there is no reference to watercourses or streams. Minimum lot size is two acres when sewers are unavailable and 10,000 sq. ft. when centralized sewer is available. Clinton Township does have a Planned Neighborhood District (PND) that could be used to protect natural resources but does not set out specific requirements. The zoning code also contains manufacturing districts, buisiness districts and a Main Thoroughfare Corridor Overlay District (MTC) that provides guidelines for development of a commercial district along the major thoroughfares of the township. The Clinton Township Zoning Resolution allows for relatively high densities of development to occur.

College Township: College Township currently has a Zoning resolution adopted June 1973 and amended October 2000. The College Township Zoning Resolution contains significant protections to natural resources and the Kokosing State Scenic River and references Focus 2100. Many of the items in the resolution could be used as a model for other township within Knox County that wish to enhance their capacity to protect natural resources. The zoning resolution prohibits buildings or structures from being erected on slopes greater than 20 percent. The resolution establishes a 120-foot buffer zone along perennial streams and a minimum lot size of one acre per dwelling unit. The Planned Unit Development (PUD) and Conservation Development classifications require that 50 percent of the total acreage of the development is set aside as open space in R-1 and R-2 districts and 80 percent within Ag districts.

Harrison Township: Harrison Township currently has a Zoning Resolution, adopted July 1973 and amended in 1984, 1990, 1996 and 2002 but does not have a comprehensive plan. They are in the process of drafting a plan currently. The Harrison Township Zoning Resolution does mention the Kokosing River, but there is no reference to watercourses or streams in general. Harrison Township has a Conservation District (C-1) that protects the floodplain along the main stem of the Kokosing River. The minimum lot size per dwelling unit is five acres for lots created after November 22, 1996 and one acre for lots created before November 22, 1996.

Howard Township: Howard Township currently has a Zoning Resolution adopted November 4, 1980 but does not have a comprehensive plan. Natural resources are not mentioned within the document and specifically there is no mention of the words “watercourse” or “stream.” Howard Township does have a Conservation District (C-1) classification to protect the public in regard to building in floodplains. The required lot area per dwelling unit is not less than one acre when water and sewer are unavailable and 12,000 square feet when sewer and water are available. In a PUD development 20 percent of the total acreage of the development is to be devoted to open space.

Liberty Township: Liberty Township currently has a Zoning Resolution adopted on December 18, 1996 but does not have a comprehensive plan. Natural resources are not mentioned within the document and there is no mention of the words “watercourse” or “stream.” Liberty Township does have a Conservation District (C-1) classification to protect the public in regard to building

in floodplains. The required lot area per dwelling unit is not less than two acres when water and sewer are unavailable and 12,000 square feet when sewer and water are available.

Monroe Township: Monroe Township currently has a Zoning Code Book issued in 1958 and revised in 1976, 1980, 1982, 1983, 1991, 1995 and 2002. The township does not have a comprehensive plan but references focus 2100. Natural resources are mentioned throughout the document with specific references to maintaining the natural beauty and natural flow of water through the township. Two zoning classifications, PUD and the Planned Unit Conservation Development (PUCD), contain significant protections for natural resources and streams. These classifications allow for flexibility in regard to lot size, lot setbacks and creative design to conserve the attributes that a property may contain. Within the PUCD, jurisdictional wetlands are protected with a 20-foot natural buffer and a building setback of 35 feet (measured from the edge of the designated wetland). Riparian buffers are provided for a width of not less than 120 feet, measured from the river or stream bank. Within the context of preserving natural resources the Monroe Township PUCD could be used as a model for all moderate to high-density development within Knox County.

Morgan Township: Morgan Township currently has a Zoning Resolution, adopted May 1971 and amended June 1989, but does not have a comprehensive plan. Natural resources are not referenced within the document and specifically there is no reference to watercourses or streams. Morgan Township does have a C-1 classification to protect the public in regard to building in floodplains. The required lot area per single-family dwelling unit is not less than two acres when water and sewer are unavailable and 12,000 sq. ft. when sewer and water are available. Morgan Township does not have a PUD zoning classification.

Morris Township: Morris Township Currently has a Zoning Resolution adopted in January 1999. The importance of natural resources and farmland to the township is referenced in the preamble of the resolution but there are no specific standards outlining their protection. There is no reference to watercourses or streams in the document. Morris Township does have a Flood Plain Overlay District that affords enhanced protection to floodplains. The minimum lot size within the township is 1 acre without centralized sewer and 10,000 sq. ft. when centralized sewer is available. The township has a PUD district which requires a minimum of 20 percent of the land to be reserved as common open space. In addition, every property developed should be designed to abut the common open space.

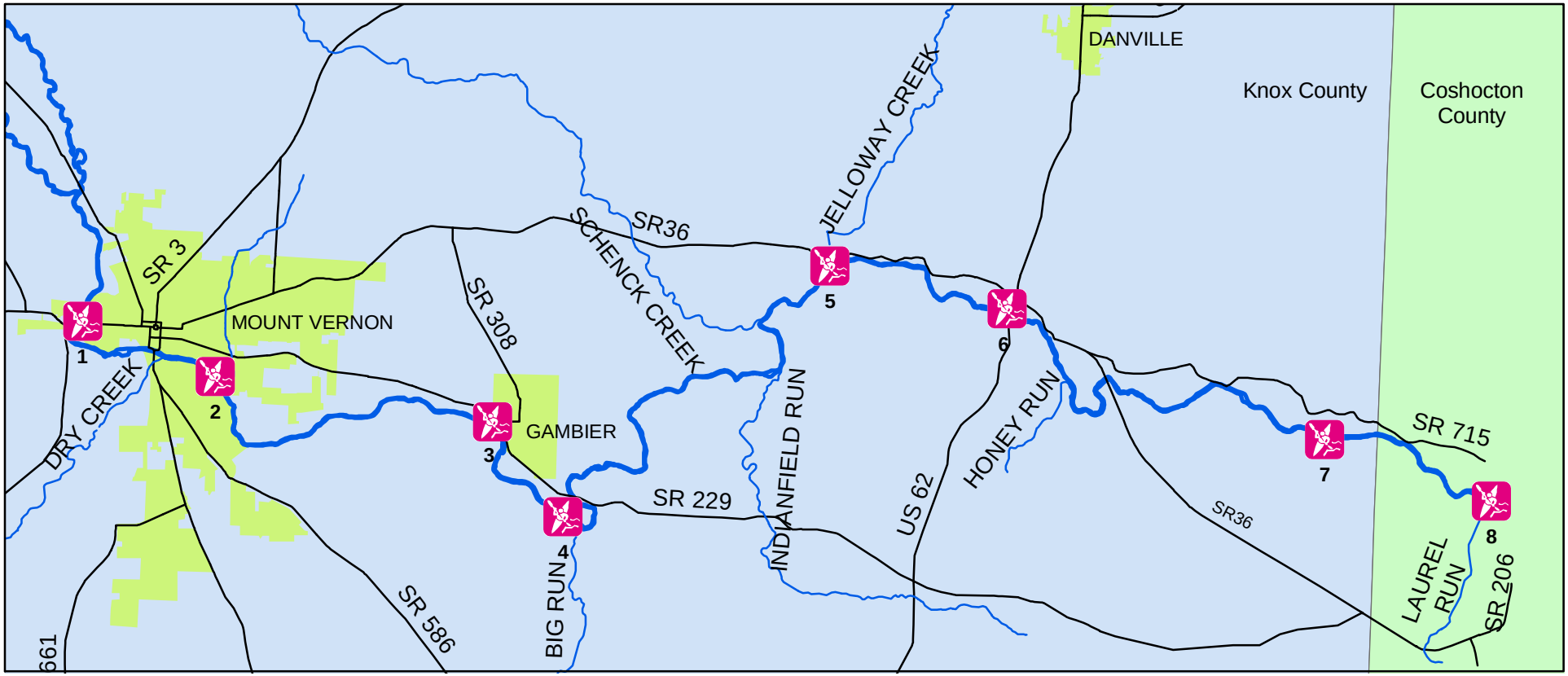
Pike Township: Pike Township currently has a Zoning Resolution adopted in 1995, revised in 1998, but does not have a comprehensive plan. There is no reference to watercourses or streams within the document. There is a floodplain district, which prohibits development inconsistent with the requirements for the conveyance of flood flows in order to minimize the expense and inconvenience to the public. The minimum lot size within the township is one acre.

Union Township Union Township is currently unzoned.

Wayne Township: Wayne Township currently has a Zoning Resolution adopted in 1986 but does not have a comprehensive plan. Natural resources are not referenced within the document and specifically there is no reference to watercourses or streams. The minimum lot size within the township is one acre.

City of Mount Vernon The City of Mount Vernon currently has a zoning code and subdivision regulations but does not have a comprehensive plan. There are no ordinances that contain specific standards for the protection of streams, riparian buffers, and/or natural resources. It is noted, however, that these are important community assets and due regard should be given to their protection within subdivisions. Within the subdivision regulations, there are some limited protections for watercourses and floodplains (but they relate more to the hazards of flooding rather than the health of the stream system). The City of Mount Vernon does have a Tree Preservation Ordinance that gives some protection to larger trees and woodlots within subdivision proposals. The City of Mount Vernon allows for high-density development with a minimum lot size of 8,000 sq. ft. in a traditional development. The Planned Neighborhood Development allows up to eight units per acre but has no minimum lot size to allow for creative design for the protection of open space or land for community facilities.

Canoe Access Sites, Kokosing River



ID	Description	Nearest Town	County	Park-ing	Canoe Rental	Rest Room	Water	Picnic
1	Riverside Park off SR36/229. Access Left.	Mount Vernon	Knox	Yes	No	Yes	Yes	Yes
2	Memorial Park off Mount Vernon Ave. Access River Right.	Mount Vernon	Knox	Yes	No	Yes	Yes	Yes
3	Laymon Road Bridge. Access River Right.	Gambier	Knox	Yes	No	No	No	Yes
4	Big Run Road. Access River Right.	Gambier	Knox	Yes	No	No	No	Yes
5	Pipesville Road. Access River Right.	East of Howard	Knox	Yes	No	No	No	No
6	Millwood Road. Access River Right.	Millwood	Knox	Yes	No	No	No	No
7	SR 715 to Riley Chapel Road. Access River Right.	East of Millwood	Knox	Yes	No	No	No	No
8	SR715 to Twp. Rd. 366/423 Bridge (W. of Walhonding at Mohican confluence) Access River Right & Left.	North of New-castle	Coshoc-ton	Yes	Yes Koko. Valley Camp & Canoe	No	No	No

0 1 2 4 6 8 Miles

Legend

- Canoe Access
- Streams
- Highways
- Kokosing River
- Cities/Towns

N W E S