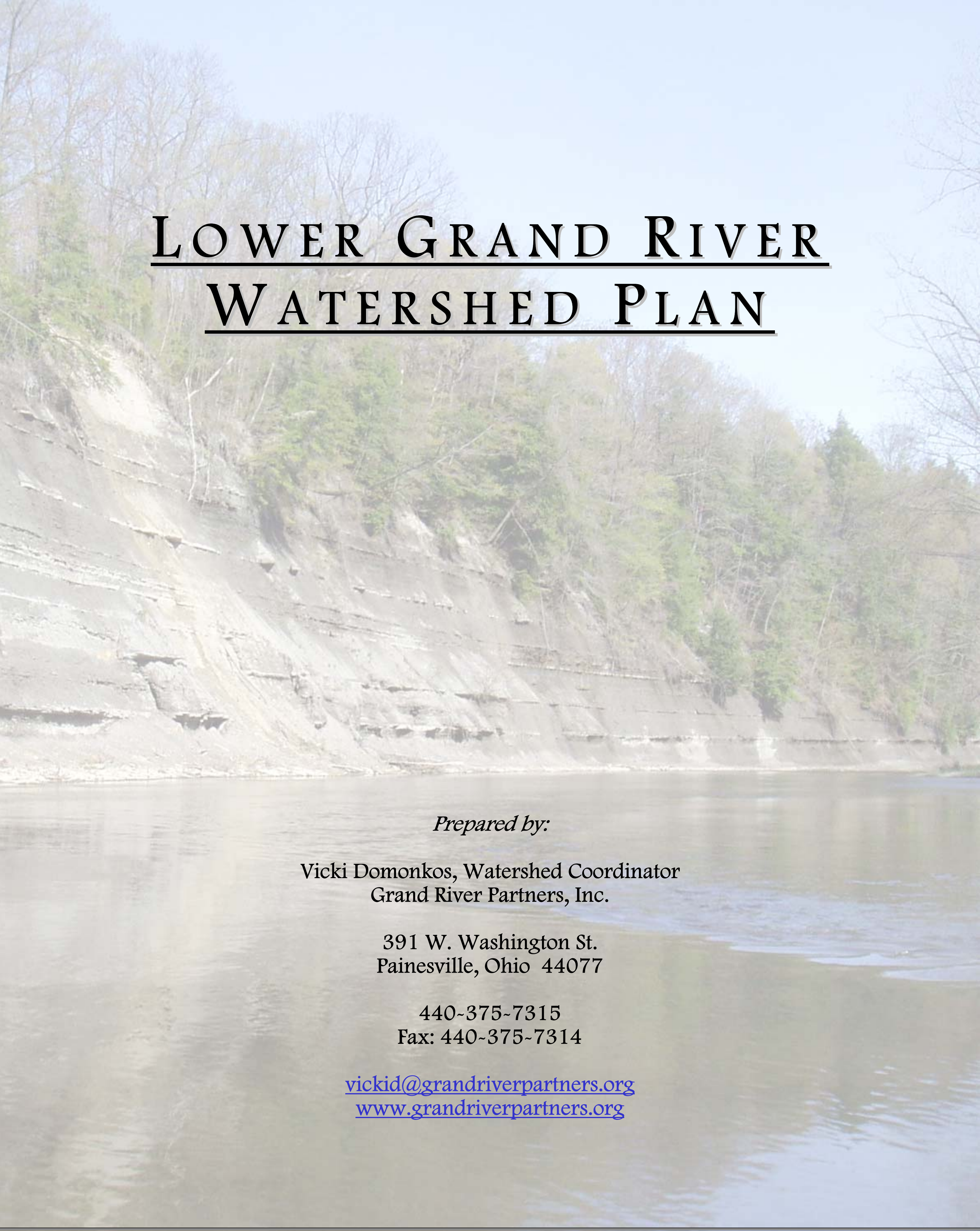

LOWER GRAND RIVER WATERSHED PLAN

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Special Note~

The Lower Grand River Watershed Plan is a living document and will be revised and changed based on the changes and status of the waters of the Grand River and its surrounding watershed. This version of the Lower Grand River Watershed Plan was completed and submitted prior to the completion of the Lower Grand River TMDL. Therefore, it is Grand River Partners, Inc.'s goal is to revise the Lower Grand River Watershed Plan upon the completion of the Lower Grand River TMDL, and include any additional information. It is anticipated that the Lower Grand River TMDL will be completed in summer of 2007.

LOWER GRAND RIVER WATERSHED PLAN
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SECTION IV

The Lower Grand River Watershed Plan was developed by Grand River Partners, Inc. with the support of the Grand River Partnership and other supporting agencies. For a copy of the Lower Grand River Watershed Plan contact Grand River Partners, Inc. at the information provided below.

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Supporting Agencies

- Ashtabula Soil and Water Conservation District
- Cleveland Museum of Natural History
- Ducks Unlimited
- Geauga County Planning Commission
- Geauga Park District
- Geauga Soil and Water Conservation District
- Lake County Planning Commission
- Lake County Soil and Water Conservation District
- Lake Metroparks
- The Nature Conservancy
- Ohio Department of Natural Resources
    - Division of Forestry
    - Division of Natural Areas and Preserves
    - Division of Wildlife
- OSU/ Seagrant
- The Trust for Public Land
- United States Department of Agriculture, Natural Resource Conservation Service
- Western Reserve Resource Conservation and Development

1. INTRODUCTION

1.1 The Grand River Watershed Action Plan Framework

This document presents the Watershed Plan developed for the Lower Grand River Watershed, an 11-digit Hydrolic Unit Code of the Grand River Watershed located in Northeast Ohio. The goal of the Lower Grand River Watershed Plan is to address causes and sources of water quality impairment and habitat degradation within the watershed, and to recommend restoration and protection goals. The final outcome of the Lower Grand River Watershed Plan is an itemization of problems, priorities, and action items identified and supported by local Grand River Watershed communities and stakeholders.

The purpose of this plan is to reduce water resource impairment in all waterbodies within the **Lower Grand River Watershed** that do not currently meet water quality standards. It is also to identify areas that are meeting standards, and protect these areas. However, the main goal of the **Lower Grand River Watershed Plan** is to restore and maintain the chemical, physical, and biological integrity of waterbodies within the watershed. Lakes, ponds, wetlands, are all covered under state and federal law.

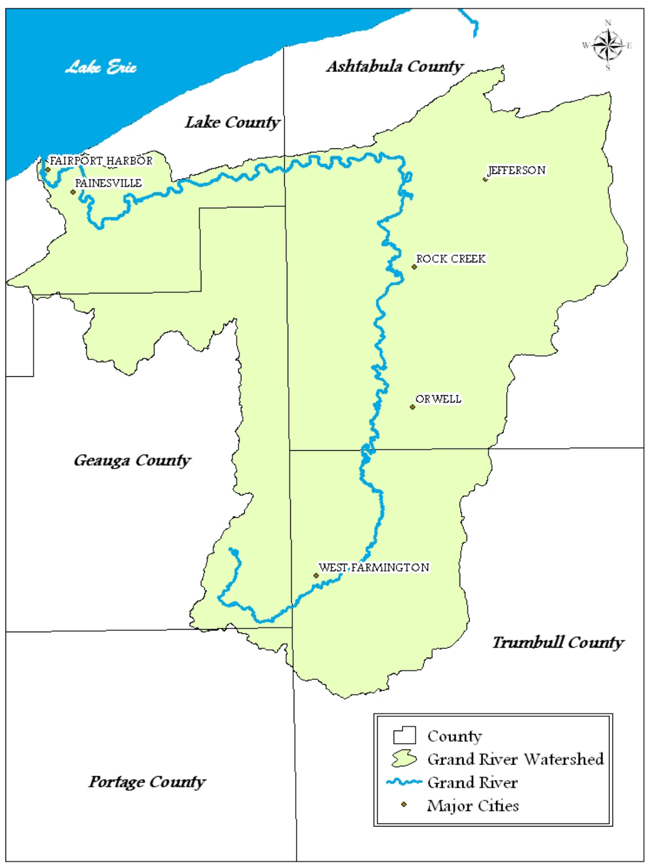
This Watershed Plan will cover a specific 11-Digit Hydrologic Unit Code of the Grand River Watershed. Both the Grand River Watershed and the focus area of this plan will be described to provide a background of the entire Grand River Watershed. To better understand the dynamics of the **Lower Grand River Watershed**, the entire Grand River Watershed must be described and taken into account.

1.2 Overview of the Grand River Watershed

The following describes the entire Grand River Watershed as a whole. Portions describing the project area will be referred to as the **LOWER GRAND RIVER WATERSHED.**

Arising from expansive wetlands in southeastern Geauga County, the Grand River runs generally northward into Trumbull County and Ashtabula County. It then turns sharply to the west into Lake County and continues on its path and empties into Lake Erie.

Map 1- Grand River Watershed/ Counties and Cities



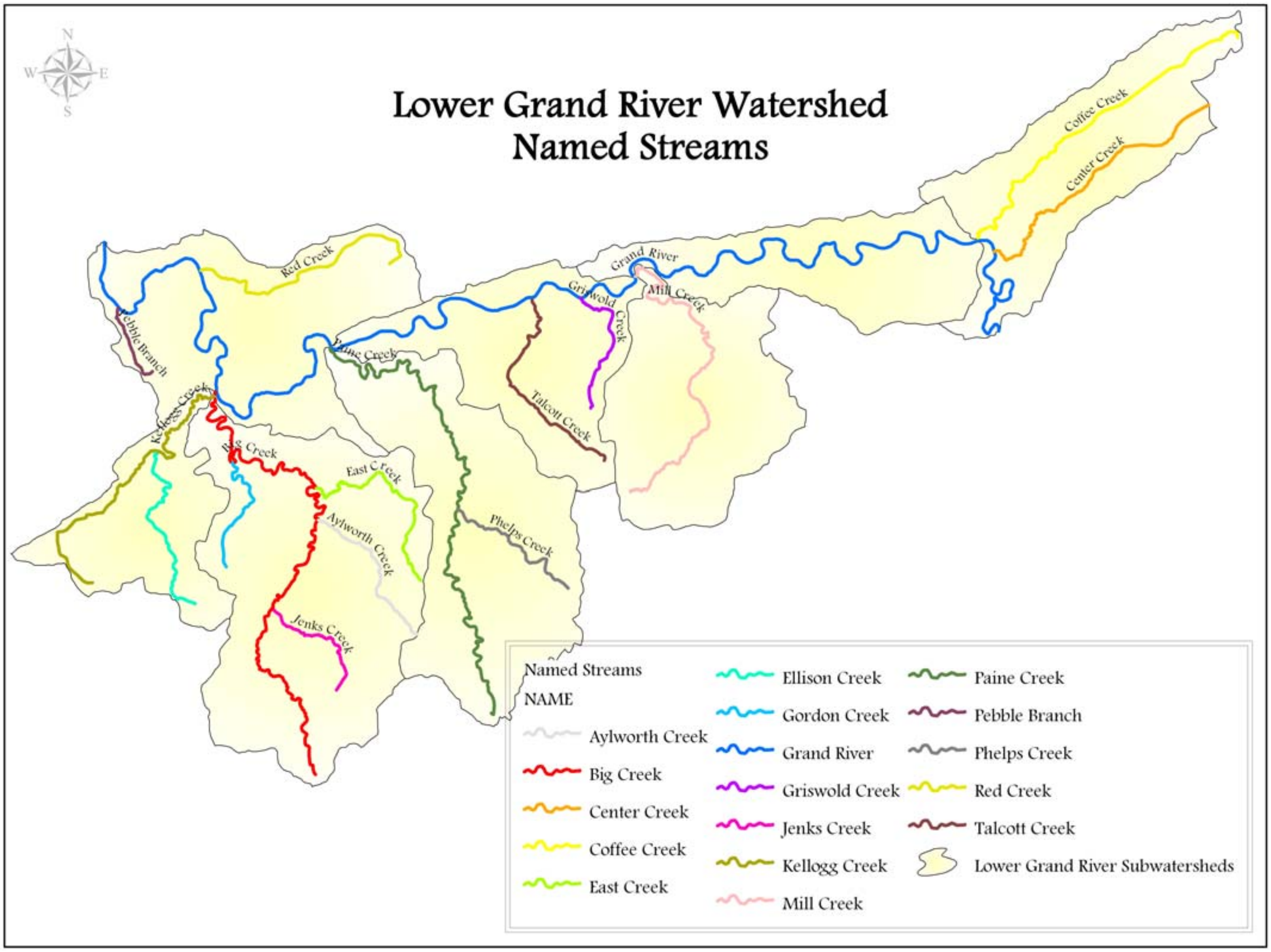
The Grand River- which was originally named the “Geauga” after the Native American word for “raccoon”- incorporates portions of Ashtabula, Geauga, Lake, Portage, and Trumbull Counties in Northeast Ohio.

The Grand River has two distinct reaches. The upper reach flows slowly through the broad valley of an ancient glacial lake, past some of the state's largest wetlands, floodplain forests, marshes, wet meadows, and swamps. The lower reach, west of Harpersfield, has cut a steep shale gorge notable for its cold, fast flow, spectacular sedge meadows, glacial slumps, and deep ravines. The lowest reaches of the river created sand dunes and palustrine sand plains; and aquatic beds and emergent marshes were once plentiful. Lake effect precipitation in Ohio's "snow belt" increases the biological diversity of the watershed. Hemlock/white-pine/northern hardwood forests in steep ravines and rare hemlock swamp forests provide habitats for plant and animal species usually found in colder, mountainous climates.

Rich in forested communities, the watershed supports beech-maple, oak-hickory, and hemlock-northern hardwood forests. Riparian and floodplain areas are often dominated by trees that tolerate frequent flooding, such as eastern cottonwood, sycamore, black willow, and black walnut. These streamside forests are critical to the health of the river. They minimize streambank erosion and filter out pollutants from agricultural and urban runoff. Forest canopies lower water temperature and allow the river to support a diversity of aquatic life such as river redhorse, rainbow trout, eastern sand darter, and northern brook lamprey. The Grand provides habitat for Ohio's smallest salamander, the rare four-toed salamander, and the elusive spotted turtle. Beavers frequent the riverbanks, and thanks to the Ohio Division of Wildlife's reintroduction program, river otters once again seen flourishing along the banks of the Grand.

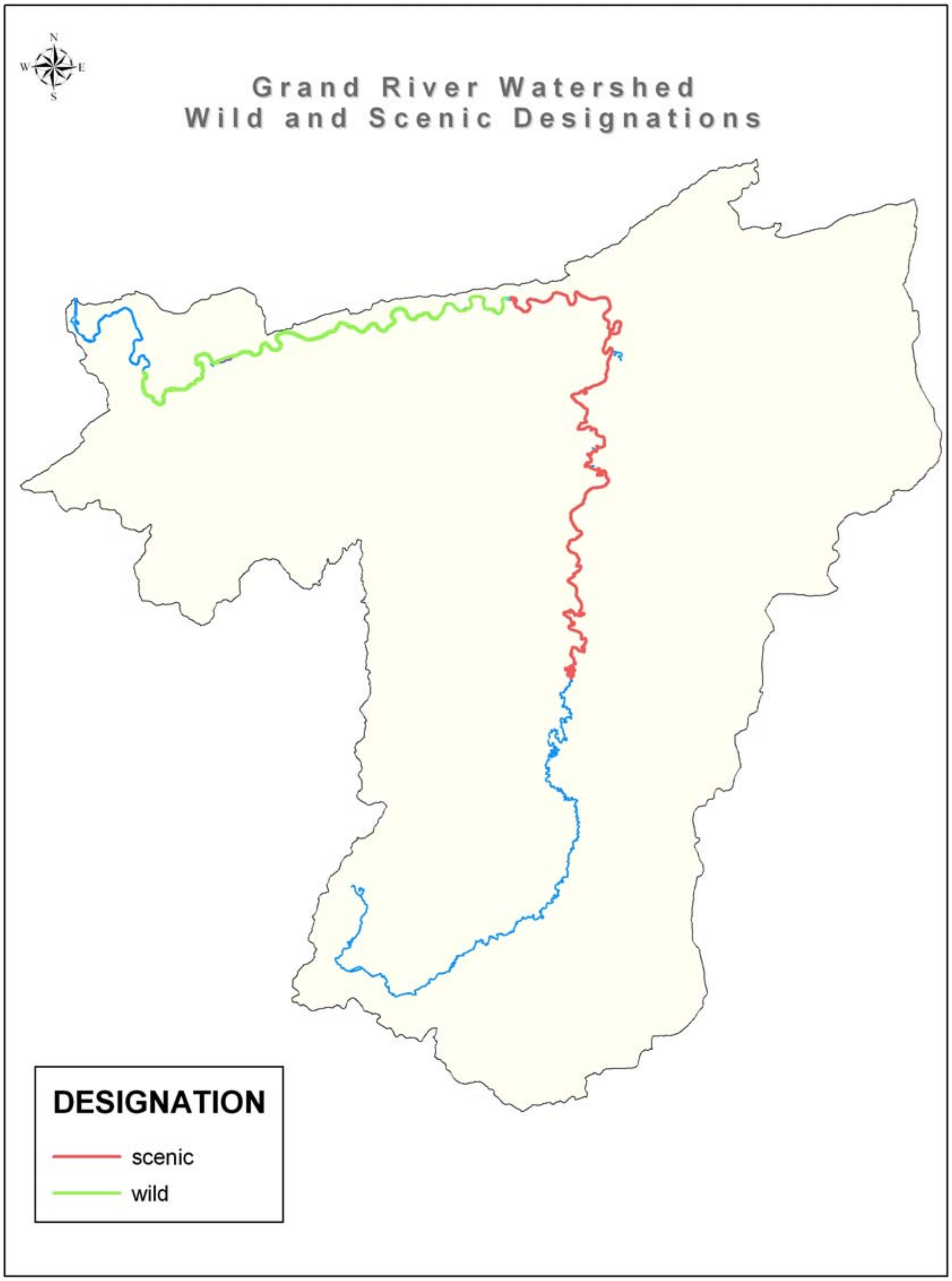
Diverse wetlands along the Grand River protect the quality of the stream's water from degradation. Many of these remaining wetlands support rare plant species, such as painted trillium and bunchberry. The forests along the river shelter nesting and migratory bird populations, including yellow-bellied sapsuckers and cerulean warblers. The Eastern massasauga rattlesnake, a very rare inhabitant of the watershed, has suffered dramatic population declines in recent years. The watershed may provide one of the best areas for recovery of this secretive reptile in coming years.

The Principal streams located within the watershed include: the Grand River (102.7 miles), Mill Creek (28.8 miles), Rock Creek (18.4 miles), and Big Creek (15.6 miles). In total, there are 53 named streams in the Grand River Watershed. 17 named tributaries are located within the **LOWER GRAND RIVER WATERSHED**.

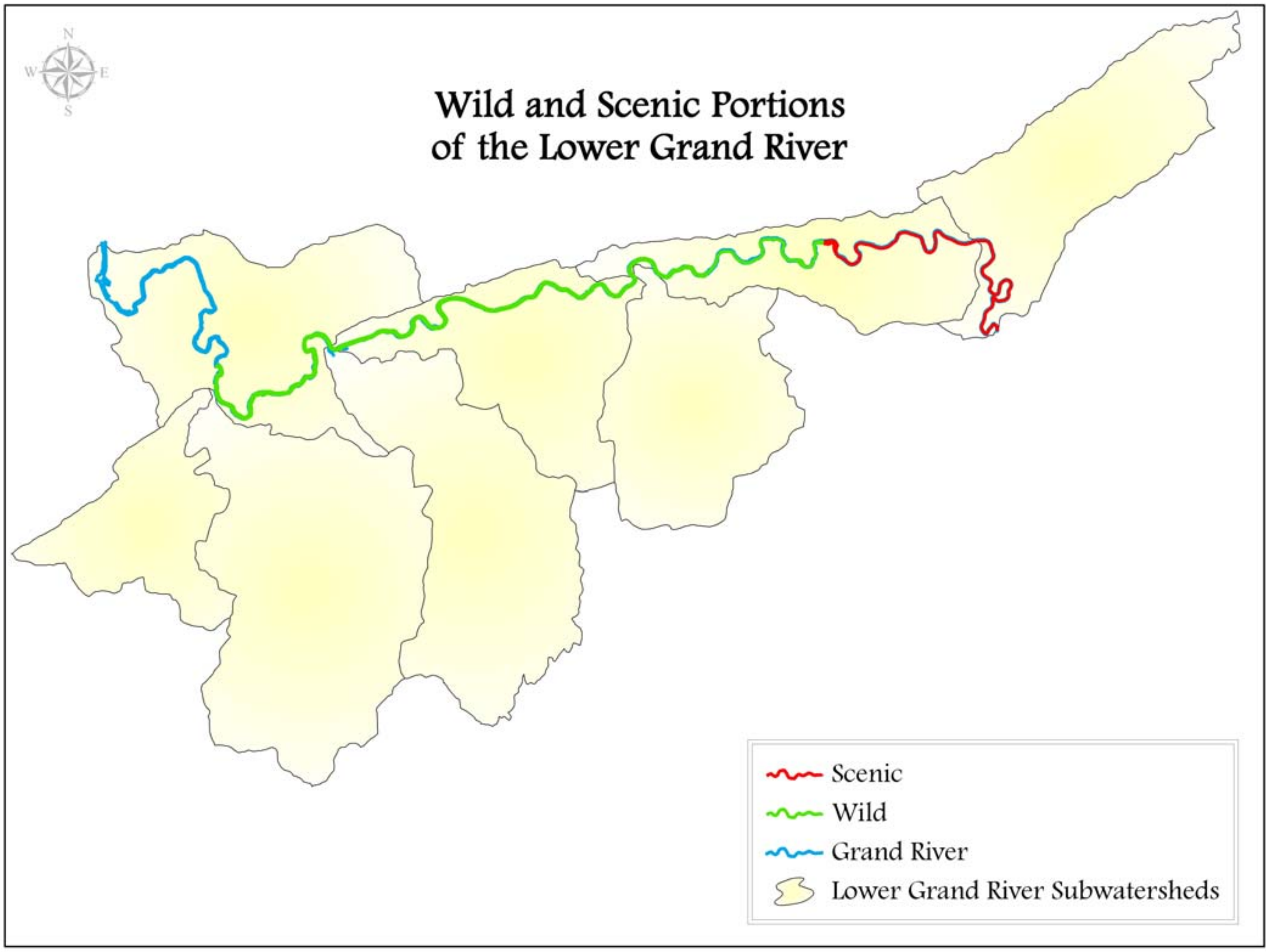


The majestic Grand was designated Ohio's second Wild and Scenic River in 1974. The Grand River is 98 miles long, of which 33 miles have a Scenic River Designation, and 23 miles have a Wild River Designation. All 23 miles of the Wild reach of the Grand is located within the **LOWER GRAND RIVER WATERSHED**, and 10.8 miles of the Scenic Designation are located within the area.

Map 3- Grand River Watershed Wild and Scenic Designations



Map 4- Lower Grand River Wild and Scenic Designations

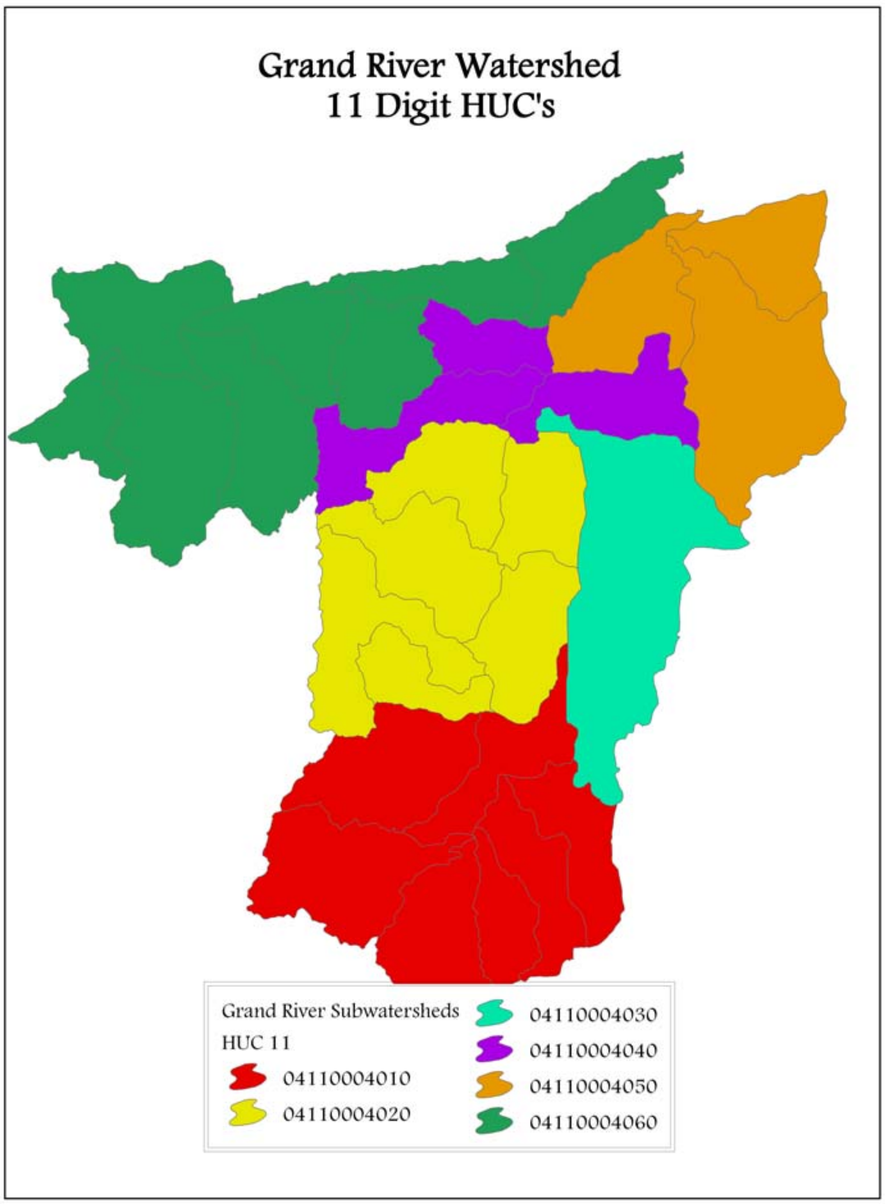


1.3 Incorporated/ Unincorporated Areas

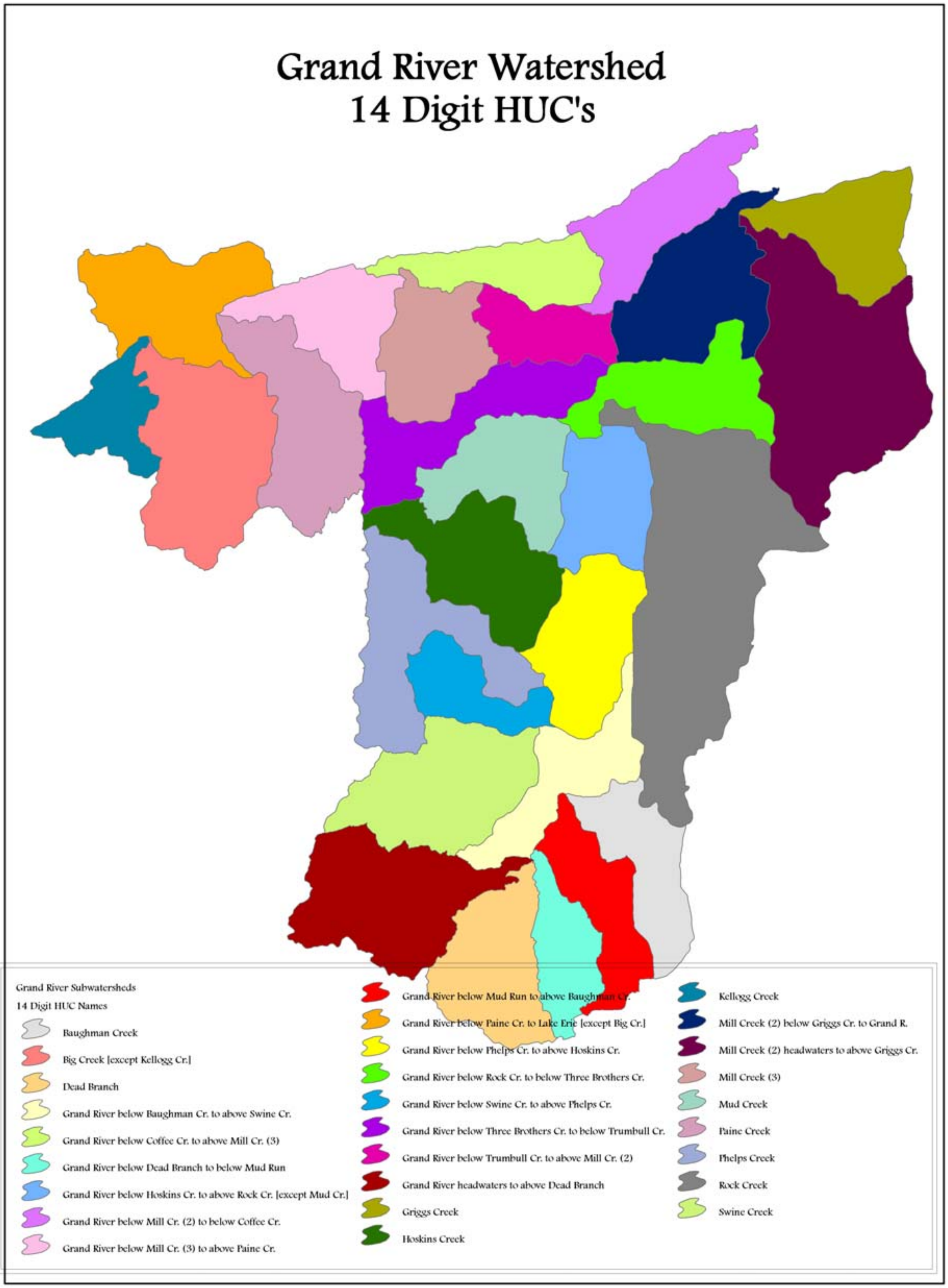
According to the United States Geological Survey (USGS), the Grand River Watershed's, eight digit hydrologic unit 04110004 has a total area of 712 square miles or 455,680 acres. There are twenty-eight (28), 14-digit watersheds located within the Grand River Watershed: 04110004020020- Phelps Creek- 18670.5 acres, 04110004050020- Griggs Creek- 13195.6 acres, 04110004050030- Mill Creek (2) below Griggs Creek to Grand River- 18022.4 acres, 04110004060020- Grand River below Coffee Creek to above Mill Creek (3)- 10654.4 acres, 04110004060080- Grand River below Paine Creek to Lake Erie [except Big Creek]-

16774.6, 04110004060040-Grand River below Mill Creek (3) to above Paine Creek- 12500.8, 04110004050010- Mill Creek (2_ headwaters to above Griggs Creek- 34919.4, 04110004060030- Mill Creek (3)- 13274.2, 04110004040030- Grand River below Trumbull Creek to above Mill Creek (2)- 8133.5, 04110004060070- Kellogg Creek- 8356.7, 04110004060060- Big Creek [except Kellogg Creek]- 23791.0. There are six, 11-digit watersheds within the Grand River Watershed.

Map 5- Grand River Watershed, 11 Digit HUC's



Map 6- Grand River Watershed, 14Digit HUC's



This Lower Grand River Watershed Plan encompasses the 11-digit HUC 04110004060, here in referred to as the **Lower Grand River Watershed.** Within this 11-digit HUC, are eight (8), 14-digit HUCs which include; 0411000401080 Grand River below Paine Creek To Lake Erie except Big Creek, 0411000404070 Kellogg Creek, 04110004060060 Big Creek except Kellogg Creek, 04110004060050 Paine Creek, 04110004060040 Grand River below Mill Creek (3) to above Paine Creek, 04110004060030 Mill Creek (3), 04110004060020 Grand River below Coffee Creek to above Mill Creek (3), and 04110004060010 Grand River below Mill Creek (2) to below Coffee Creek.

Map 7- Lower Grand River Watershed, 14 Digit HUC's

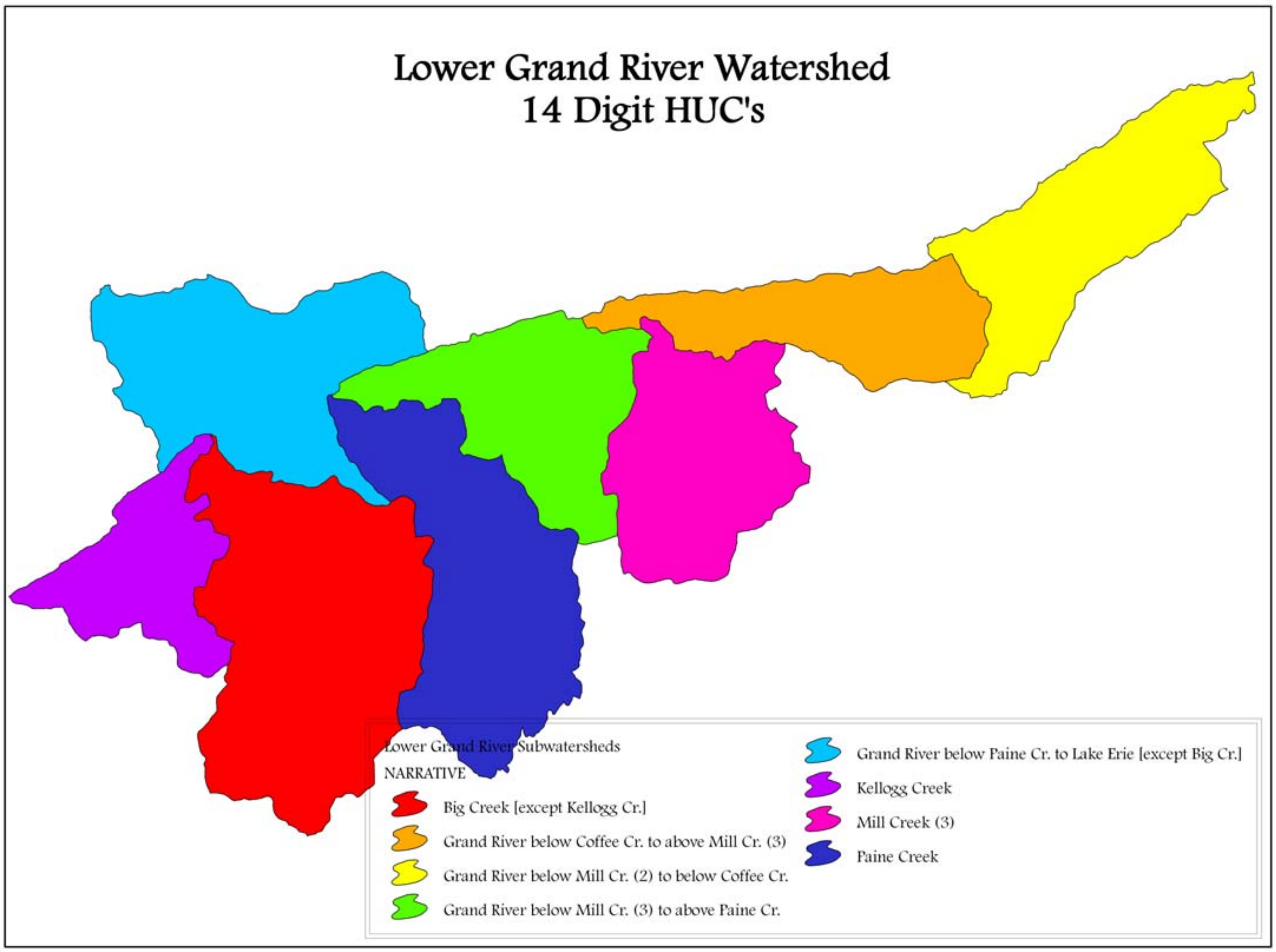


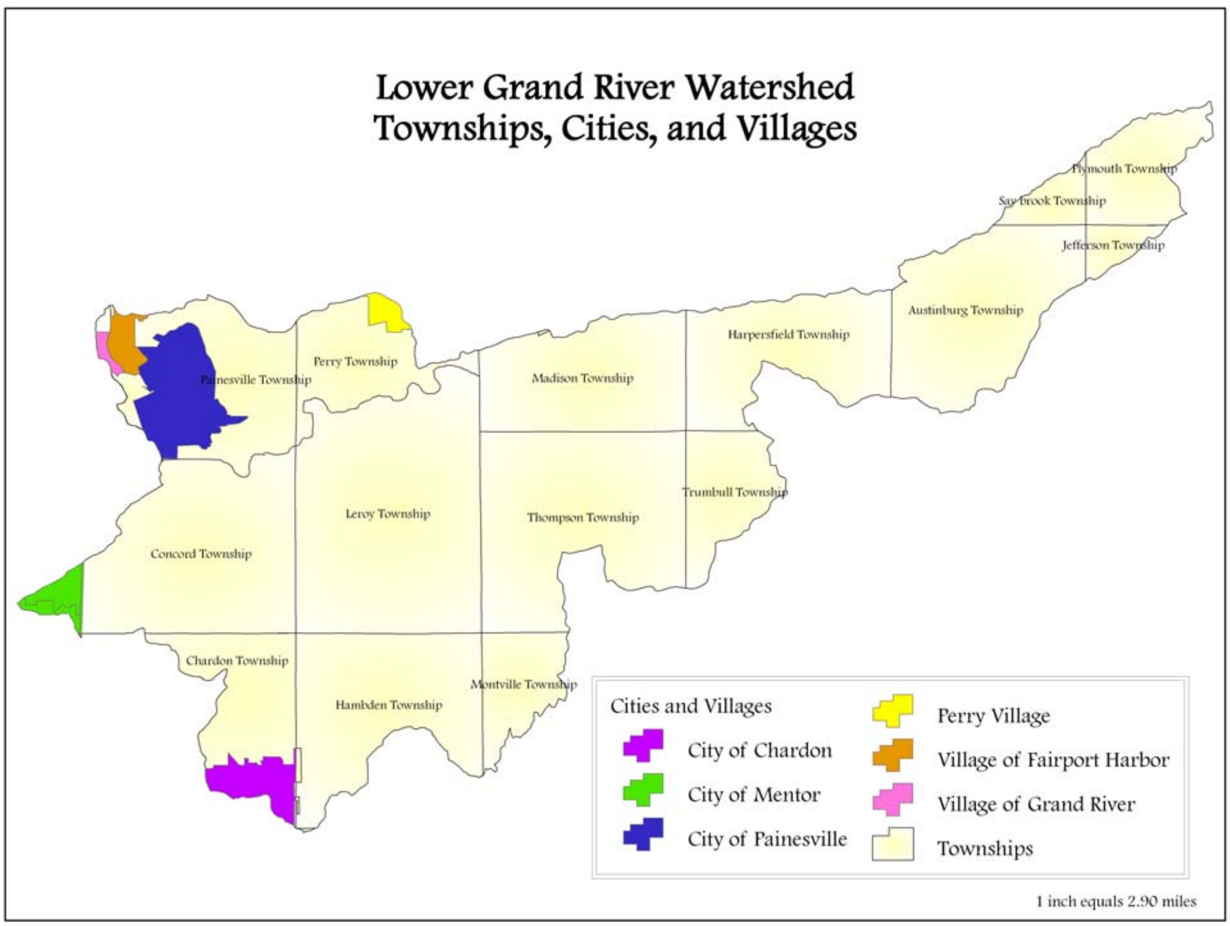
Table 1- Hydraulic Unit Code (HUC) information

HUC	Name	Size Acres	Size Square Miles	Population Density
04110004060	Lower Grand River Watershed	117836.18	184.122	-
04110004060010	Grand River downstream Mill Cr (3) to downstream Coffee Cr	14069.11	21.98	10.1
04110004060020	Grand River downstream Coffee Cr to upstream Mill Cr (3)	10654.31	16.65	8.3
04110004060030	Mill Creek (3)	13274.06	20.74	5.9
04110004060040	Grand River downstream Mill Cr (3) to upstream Paine Cr	12500.68	19.53	8.2
04110004060050	Paine Creek	18416.34	28.78	6.4
04110004060060	Big Creek	23790.66	37.17	11.2
04110004060070	Kellogg Creek	8356.61	13.06	22.9
04110004060080	Grand River downstream	16774.40	26.21	46.9

	Paine Cr to Lake Erie			

The Grand River Watershed includes portions of 39 townships in Ashtabula, Geauga, Lake, Portage, and Trumbull Counties. The **Lower Grand River Watershed** encompasses portions of 16 townships in Ashtabula, Geauga, and Lake Counties: Austinburg (Ashtabula), Chardon (Geauga), Concord (Lake), Hambden (Geauga), Harpersfield (Ashtabula), Jefferson (Ashtabula), Leroy (Lake), Madison (Lake), Mentor (Lake), Montville (Geauga), Painesville (Lake), Perry (Lake), Plymouth (Ashtabula), Saybrook (Ashtabula), Thompson (Geauga), and Trumbull (Ashtabula). The **Lower Grand River Watershed** is 117,836.18 acres in size, and 184.122 square miles.

Map 8- Lower Grand River Watershed Townships, Cities, and Villages



Populations for the Townships, Cities, and Villages located within the **Lower Grand River Watershed**, according to the 2000 census are as follows; Plymouth Township (2,081), Saybrook Township (10,057), Jefferson Township (5,559), Austinburg Township (2,234), Harpersfield Township (2,603), Trumbull Township (1,461), Madison Township (227,511), Perry Township (8,240), Leroy Township (3,122), Concord Township (15,282), Perry Village (1,195), Painesville Township (18,562), City of Mentor (50,278), City of Chardon (5,156), City of Painesville (17,503), Village of Fairport Harbor (3,180), Village of Grand River (345), Chardon Township (4,763), Hambden Township (4,024), Montville Township (1,984), Thompson Township (2,383). The projected population growth for these counties for the year 2015 is as follows: Ashtabula County~ 13.7%, Geauga County~ 23.3%, and Lake County~ 4.3%. The total population estimate for the Grand River Watershed is 96,437, with approximately 137 people per square mile.

1.3.1 Special Districts (park, school, conservancy, sewer, soil &water, agricultural, regional planning agencies)

Grand River Partners, Inc. (GRPI) works collaboratively with over 30 organizations and agencies within the Grand River Watershed. This partnership is known as the **Grand River Partnership**. Below are some of the members of the **Grand River Partnership** whose roles play an integral part in the preservation of the **Lower Grand River Watershed** and the implementation of the **Lower Grand River Watershed Plan.**

Geauga Soil and Water Conservation District: The Geauga Soil and Water Conservation District (SWCD) was established in 1944. It was the 29th SWCD established in Ohio. The Geauga SWCD is a legal entity of the state of Ohio and is administered by a five-member, elected Board of Supervisors. These Board members make important decisions regarding conservation within the county and set the direction for the District Staff. The district's mission is, "To conserve, protect, and enhance the soil and water resources of Geauga County by providing leadership, education, and assistance to all."

Geauga SWCD enforces the countywide Erosion and Sediment Control Regulations and the Subdivision Regulations. These documents are of major importance to maintaining the pristine water quality of the Lower Grand River Watershed.

Geauga County Health District: A five member Board oversees the Geauga County Health District. The Board members of the Health District are elected by a District Advisory Council comprised of Township Trustees and Mayors of participating municipalities. The Board adopts its own budget, hires and fires its own staff, and operates autonomously from the County. The County Auditor services as the district's Fiscal Agent. The Geauga County Health District is dedicated to providing public health services by detecting, educating, and preventing personal and environmental health problems in Geauga County.

The GCHD provides information and assistance to landowners on their septic systems, performs testing on systems to make certain they are functioning properly, and tests outfalls to determine any causes of impairments. All of these activities help maintain the water quality of the Lower Grand River Watershed.

Geauga County Planning Commission: The Geauga County Planning Commission has the responsibilities of reviewing subdivision plans, reviewing zoning amendments and giving zoning advise to local communities, providing census data, and preparing community land use plans.

The decisions made by the Geauga County Planning Commission can have direct influence on specific items such as riparian setback ordinances, amount of impervious surface, conservation development regulations, etc. Their role plays a vital impact on the quality of the Lower Grand River Watershed.

Geauga County Farmland Taskforce: In February of 1999 the Geauga County Board of Commissioners formed the County Farmland Preservation Task Force. The members of the Task Force represented a cross section of public and private sector interests. The primary objective of the Task Force was to prepare recommendations to be included in a county farmland preservation plan by the end of 1999 for presentation to the Board of County Commissioners.

Farming has provided Geauga County with its rural character. Unfortunately, many of these longtime farmsteads are becoming a financial burden on the farmer, and they are being sold to developers. This is decreasing both the rural character and the open space of the county. The Task Force helps to permanently preserve these farms and in turn preserve the open space and rural character of the county and Lower Grand River Watershed.

Geauga Park District: Geauga Park District has demonstrated its commitment to protecting the finest natural areas in Geauga County since the agency was established in 1961. Since its inception, Geauga Park District has maintained the mission "to preserve, conserve, and protect the natural features of Geauga County and to provide the opportunity for people to enjoy and appreciate those resources." Today, Geauga Park District manages more than 7,100 acres in 12 open parks and preserves and offers hundreds of programs and special events annually.

The Grand River Watershed is considered the most biologically diverse watershed in the entire Lake Erie Basin. Conservation and education has proved to be a beneficial tool in the preservation of high water quality and diversity, in which the Geauga Park District has been a very effective partner.

Geauga County OSU Extension: The Ohio State University, The United States Department of Agriculture, and Geauga County Commissioners work together to provide agricultural, educational, and horticultural information to the residents of Geauga County. This education offered to the local landowners is an integral part in the preservation of the high quality of the Lower Grand River Watershed.

Lake County Soil and Water Conservation District: Lake County SWCD will provide leadership and technical expertise to guide the protection and conservation of the unique soil and water resources of the county.

Lake SWCD enforces the countywide Erosion and Sediment Control Regulations and the Subdivision Regulations. Upon approval of the plans, inspections are carried out and any violations are turned over to the prosecutor. These documents and procedures are of major importance to maintaining the pristine water quality of the **Lower Grand River Watershed**.

Lake County General Health District: To ensure that residents of the community do not experience disease, adverse health effects or nuisances resulting from improperly or inadequately treated sewage, or other careless environmental actions. The agency's mission is to have "Healthy Lake County People Living in a Healthy Lake County Community."

The Lake County General Health District provides information and assistance to landowners on their septic systems, performs testing on systems to make certain they are functioning properly, and tests outfalls to determine any causes of impairments. All of these activities help maintain the water quality of the **Lower Grand River Watershed**.

Lake County Planning Commission: The following information is provided to the residents: topographic maps, census information, land use data, zoning information for the townships, comprehensive plan information for the townships, aerial photographs, subdivision and lot split activity in the townships, floodplain information, wetlands maps, soils information, house numbers for some townships, coastal erosion maps, and building permit data. The Lake County Costal Development Plan has been developed by the Lake County Planning Commission. This plan is of major importance to the Grand River. The plan outlines future development and recreational activities for the Grand River, its mouth, and the surrounding watershed.

Lake Metroparks: The mission of Lake Metroparks is "to conserve and preserve the natural resources of Lake County while providing a variety of safe, affordable, and enjoyable educational and recreational programs and activities that enhance the quality of life in Lake County now and for the generations to follow".

Lake Metroparks provides hundreds of educational programs throughout the year to Lake County residents. Also, they are the leading partner in Lake County for land preservation. These activities are of major importance in carrying out the implementation for the Lower Grand River Watershed Plan.

Lake County Farmland Conservation Taskforce: The mission of the Lake County Farmland Conservation Taskforce is to permanently conserve land of agricultural value in Lake County Ohio by means of advocacy, education and land protection for the benefit of present and future generations. Unfotunately, agriculture and prime farmland soils are swiftly being converted to primary residential and commercial land uses in Lake County.

Lake County Stormwater Management Department: The mission of the LCSMD is to enhance the quality of life in Lake County using education, science and technology to protect stormwater quality. Their mandate is to ensure that our member communities meet the federal National Pollutant Discharge Elimination System requirements.

Western Reserve Land Conservancy: The Western Reserve Land Conservancy is a private, nonprofit conservation organization of people who work with landowners and governmental entities to preserve the scenic beauty, rural character and natural resources of a 14-county area of the Lake Erie Basin in Northeast Ohio. The service area of the WRLC includes land in the counties of Ashtabula, Cuyahoga, Erie, Geauga, Huron, Lake, Lorain, Mahoning, Medina, Portage, Summit, Stark, Trumbull and Wayne. WRLC was formed in 2006 by the merger of eight local land trusts.

Grand River Partners, Inc. works closely with the WRLC on projects and other events and activities. WRLC currently has protected land within the Grand River Watershed, and has the potential to assist in the protection of additional acreage.

Western Reserve Resource, Conservation and Development (RC&D): Located in Northeast Ohio, the Western Reserve Resource Conservation and Development Council (RC&D) area includes Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, Summit, and Wayne Counties. The Western Reserve RC&D aims to plan, promote, and implement conservation and sustainable use of natural resources, in both rural and urban areas. Their vision is "A sustainable regional community with wild and open spaces, creeks and lakes, clean water and air, in balance with a viable mixed economy that includes agriculture, commerce, industry, and tourism."

United States Department of Agriculture, Natural Resource Conservation Service (USDA/NRCS): The Natural Resources Conservation Service is a Federal Agency that provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment. They work closely with agricultural producers to implement Best Managemtn Practices on farms, nurseries, vineyards, and orchards to help protect water quality.

Ashtabula Soil and Water Conservation District: The Ashtabula Soil and Water Conservation District is an independent body of state government responsible for the conservation of soil and water resources within its boundary. Formed under and subject to the Ohio Soil and Water Conservation District Law, the District was organized by local landowners January 28, 1949 and is administered by a board of five supervisors elected by owners and occupiers of land within the District. The major function of the District is to analyze landowners needs and to provide the assistance need to meet their needs while maintaining natural resource quality.

Ashtabula County Farmland Preservation Committee: On December 19, 2000 the Farmland Preservation was officially adopted by the County Commissioners by resolution. The goals of the Executive Committee are to seek out parties interested in the Ohio Department of Agriculture's Agricultural Easement Program, and to provide leadership for this effort. They work to maintain a viable agricultural presence in Ashtabula County that is mindful of individual private property rights and has community-wide support through positive relationship building and education among residents, farmers and public officials.

Ashtabula County Metroparks: The Ashtabula County Metroparks was established pursuant to the Ohio Revised Code in 1959. The aims of the original board were to create historical and recreational parks as well as conservation areas. These aims have not changed throughout the years. The board consists of three members, appointed by the court, to serve 3-year terms without compensation. Their mission is to preserve adequate green space, provide parks and recreational areas to meet our growing needs, maintain examples of the natural beauty and rural character of our county, enhance our natural resources, and promote a pleasant and health-giving environment for the people of Ashtabula County.

Ashtabula County Planning Commission: The Ashtabula Planning Commission provides Ashtabula County residents with assistance in local planning and development issues, information, and preparation of community land use plans.

Ashtabula County Health District: The Ashtabula County Health District is a local governmental entity that assists Ashtabula County residents with environmental and health related issues throughout the county.

Ashtabula County OSU Extension: The Ohio State University, The United States Department of Agriculture, and the Ashtabula County Commissioners work together to provide agricultural, educational, and horticultural information to the residents of Ashtabula County.

School Districts:

The following Schools provide service to the residents of the Grand River Watershed.

Table 2- School Districts within the Lower Grand River Watershed

County	*Public Schools*	*Private Schools*
Ashtabula County	• Geneva Area City Schools • Jefferson Area Local Schools • Ledgemont Local School District • Buckeye Local School District • Grand Valley Local School District	• Grand River Academy • Northeast Academy • Bethel Christian School • Christian Life Academy • Grace Christian Academy • Saints John and Paul School • St. Francis Cabrini Community School & Preschool
Geauga County	• Cardinal School District • Chardon local School District	• Hershey Montessori Farm School • St. Mary's School
Lake County	• Fairport Harbor Exempted Village School District • Painesville City Local School District	• Our Shepard Lutheran School • St. Mary School • Auburn Career Center • Hershey Montessori School

	• Painesville Township Local School District	• Phillips- Osborne School • Western Reserve SDA School • St. Anthony School • Lake Erie College

The following organizations, agencies, and interested parties will be given a copy of the **Lower Grand River Watershed Plan**.

- Ashtabula County Health District
- Ashtabula County Metropark District
- Ashtabula County Planning Commission
- Ashtabula Soil and Water Conservation District
- Center for Farmland Preservation
- Cleveland Museum of Natural History
- Ducks Unlimited
- Geauga County Park District
- Geauga County Planning Commission
- Geauga County Soil and Water Conservation District
- Grand River Advisory Council
- Kent State University
- Lake County Planning Commission
- Lake County Health District
- Lake County Soil and Water Conservation District
- Lake Metroparks
- The Nature Conservancy

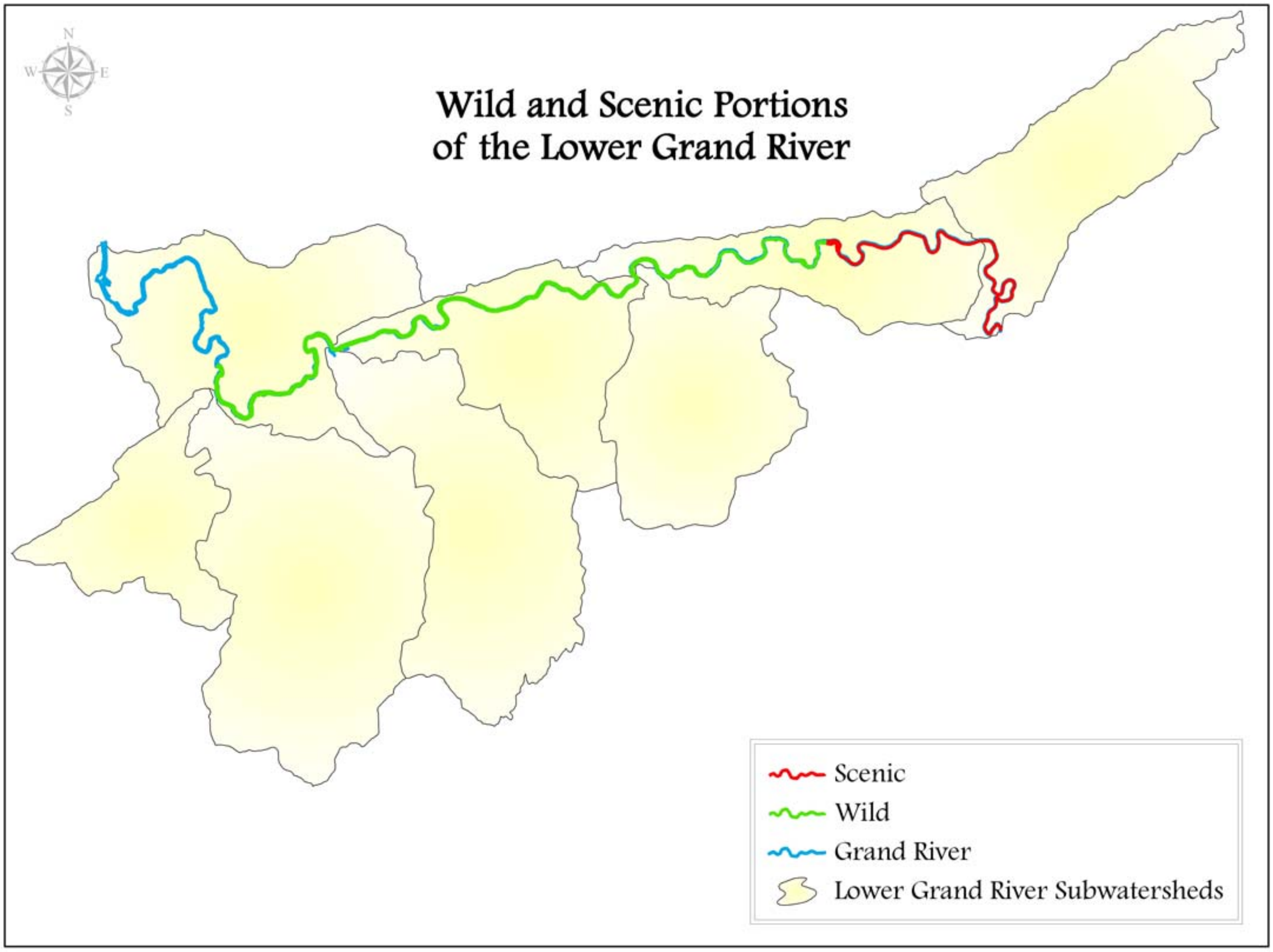
- Ohio EPA
- ODNR
    - Division of Forestry
    - Division of Natural Areas and Preserves
    - Scenic Rivers
    - Division of Soil and Water Conservation
    - Division of Wildlife
- OSU Cooperative Extension Service
- OSU Extension/ Sea Grant
- Trumbull County Health District
- Trumbull Soil and Water Conservation District
- Trust for Public Land
- U.S. Army Corps of Engineers
- USDA Natural Resources Conservation Service
- Western Reserve Resource Conservation & Development

Once the **Lower Grand River Watershed Plan** is considered fully endorsed, the above mentioned agencies including local units of government, will endorse the Lower Grand River Watershed Plan.

1.3.2 Special Designations

On January 17, 1974, the Grand River became Ohio's second wild and scenic river. Designated sections include: from Harpersfield covered bridge downstream to the Norfolk and Western Railroad trestle south of Painesville (wild, 23 miles) and from US 322 bridge in Ashtabula County downstream to Harpersfield covered bridge (scenic, 33 miles). The **Lower Grand River Watershed** encompasses all of the Wild Designation of the Grand River, and a portion of the Scenic Designation.

Map 9- Wild and Scenic Designations of the Lower Grand River Watershed



The upper portion of the Grand River in Ashtabula County is designated scenic. The river is bordered in many areas by extensive swamp forests of elm, ash, maple, pine, pin oak, and swamp white oak.

The slow flow of this section of the river, along with the adjoining wetlands, provides excellent habitat for a number of wildlife species, especially river otters, which have made a strong comeback after their reintroduction by the Division of Wildlife in 1986 and 1988.

The lower section of the Grand River in Lake County is designated wild. Here, the river is characterized by steeply-incised valley walls of Chagrin Shale.

Picture 1- Grand River, Gorge and floodplain

1.3.3 NPDES Phase II Communities

Water pollution degrades surface waters making them unsafe for drinking, fishing, swimming, and other activities. As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states. Since its introduction in 1972, the NPDES permit program is responsible for significant improvements to our Nation's water quality.

Another rule was developed in order to combat the nonpoint sources. The Phase II Final Rule requires NPDES permit coverage for storm water discharges from certain regulated small municipal separate storm sewer systems (MS4s); and Construction activity disturbing between 1 and 5 acres of land (i.e., small construction activities).

In addition to expanding the NPDES Storm Water Program, the Phase II Final Rule revises the no exposure exclusion and the temporary exemption for certain industrial facilities under Phase I of the NPDES Storm Water Program and certain exemptions relating to ISTEA. The Phase II Rule also established two potential waivers for small construction activities.

Table 3- NPDES Phase II Communities and populations

Community	Population
Concord Township	15,282
Fairport Harbor Village	3,180
Grand River Village	345
Madison Township UIA	15,494
Madison Village	2,110
City of Painesville	17,503
Painesville Township UIA	15,037
Perry Township	6,220
Perry Village	966

Most communities in Lake County met the urbanized area definition in the 2000 census and were therefore included under the new regulations. In response to these requirements, Lake County formed a Stormwater Management Department in August 2003. The Department has 16 member communities that receive services. The federal mandate requires that local governments bear all costs associated with the new regulations, so Lake County instituted a stormwater user fee program. The fees are charged on individual parcels of land based on the amount of impervious area on the property (hard surface). The amount of impervious land is used because it has been shown to be a good indicator of the amount of runoff that leads to pollution. All residential properties are charged a base rate. Nonresidential properties are charged based upon the square footage they contain divided by the equivalent residential unit (ERU) which is 3,050 sq. ft.

1.4 Demographics

The Demographics for the Townships, Villages, and Cities located wholly or partially within the Grand River Watershed are included within the individual HUC descriptions.

1.4.1 Population, ages, education levels, etc.

See the Demographic Sections of each of the individual HUCs- *Section II of the Lower Grand River Watershed Plan*

1.4.2 Income levels, locations of growth

See the Demographic Sections of each of the individual HUCs- *Section II of the Lower Grand River Watershed Plan*

1.4.3 Economic Patterns

See the Demographic Sections of each of the individual HUCs- *Section II of the Lower Grand River Watershed Plan*

1.4.4 Other Factors

See the Demographic Sections of each of the individual HUCs- *Section II of the Lower Grand River Watershed Plan*

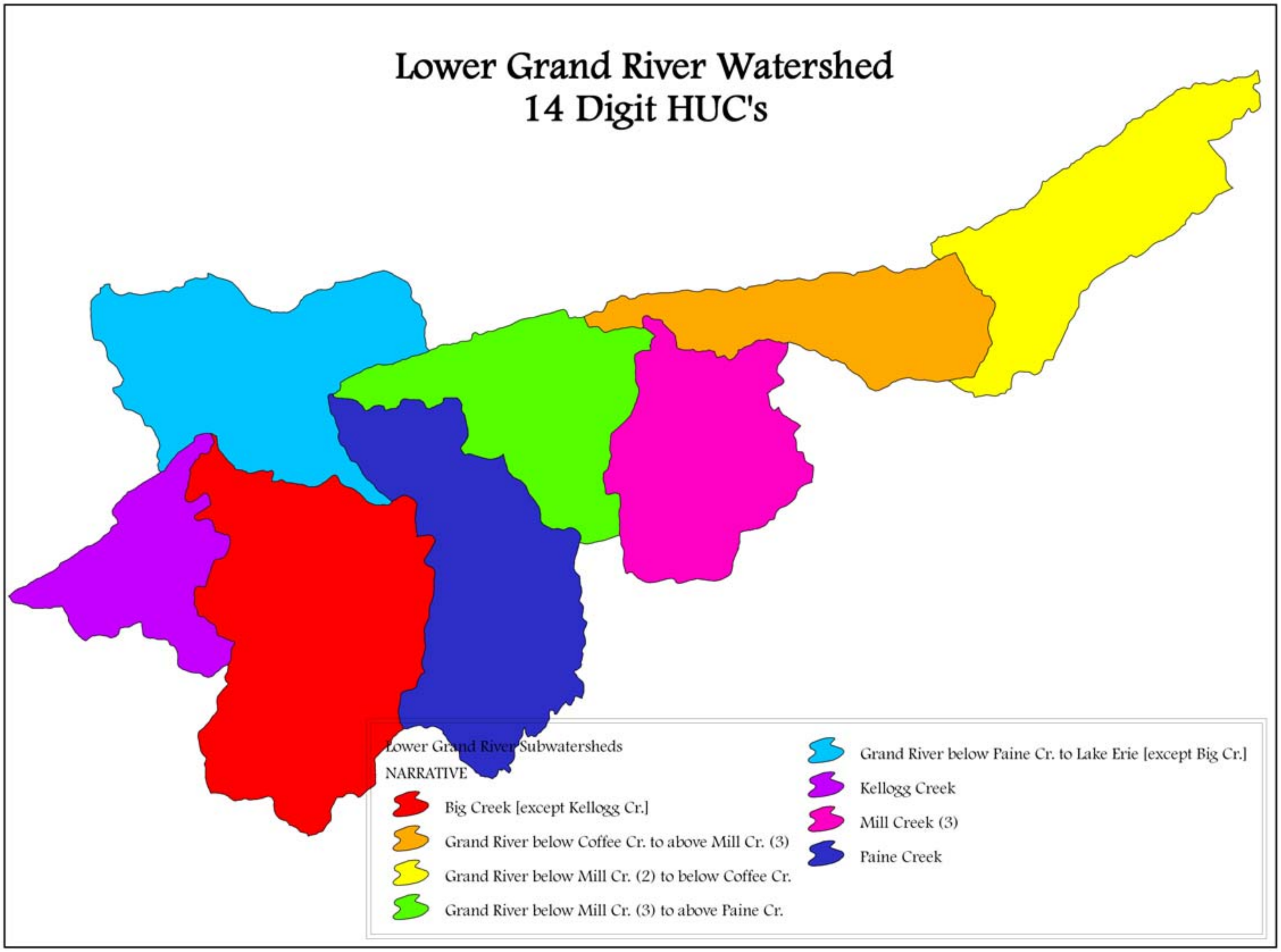
1.5 Geographic Locators

1.5.1 USGS HUC

According to the United States Geological Survey (USGS), the eight digit hydrologic unit 04110004 has a total area of 712 square miles or 455,680 acres. There are twenty-eight, 14-digit watersheds located within the Grand River Watershed, and six, 11- digit watersheds.

Due to the large size of the Grand River Watershed and its unique and drastically different characteristics, it was decided to develop a separate plan for the **Lower Grand River Watershed**. In the **Lower Grand River Watershed**, there is one, 11-digit watershed – 04110004060. There are eight, 14 digit watersheds located within this 11-digit watershed: 04110004060010- Grand River below Mill Creek (2) to below Coffee Creek, 04110004060020- Grand River below Coffee Creek to above Mill Creek (3), 04110004060030- Mill Creek (3), 04110004060040- Grand River below Mill Creek (3) to above Paine Creek, 04110004060050- Paine Creek, 04110004060060- Big Creek [except Kellogg Creek], 04110004060070- Kellogg Creek, 04110004060080- Grand River below Paine Creek to Lake Erie [except Big Creek].

Map 10- Lower Grand River Watershed 14 Digit HUC's



1.5.2 State 305(b) identification numbers

Table 4- State Identification Numbers

305(b) Identification Numbers	Segment Name
OH92 1	Grand River (Paine Creek to Lake Erie)
OH92 3	Pebble Branch (Tiber Creek)
OH92 4	Red Creek
OH92 5	Kellogg Creek

OH92 6	Ellison Creek
OH92 7	Big Creek
OH92 8	Gordon Creek
OH92 9	East Creek
OH92 10	Alyworth Creek
OH92 11	Jenks Creek
OH92 12	Cutts Creek
OH92 13	Paine Creek
OH92 14	Bates Creek
OH92 15	Phelps Creek
OH92 16	Grand River (Mill Creek to Paine Creek)
OH92 17	Talcott Creek
OH92 18	Griswold Creek
OH92 19	Mill Creek
OH92 20	Grand River (Mill Creek to Mill Creek)
OH92 21	Coffee Creek
OH92 22	Center Creek

1.5.3 Other (GIS, lat-long, etc.)

The table below lists the latitude and longitude of some geographic locators throughout the Grand River Watershed. The highlighted (in blue) areas are those that are located outside the Lower Grand River Watershed project area, but are of major significance to the Grand River Watershed.

Table 5- Geographic Locators

Feature	Latitude	Longitude	Elevation (ft)
Headwater	041° 24' 39.00" N	081° 04' 0.30" W	1180
Mouth	041° 45' 37.83" N	081° 16' 49.90" W	571
Scenic Section (Beginning)	041° 32' 4.72" N	080° 54' 5.24" W	786
Scenic Section (End)	041° 45' 22.42" N	080° 56' 28.47" W	728
Wild Section (Beginning)	041° 45' 22.42" N	080° 56' 28.47" W	728
Wild Section (End)	041° 42' 58.67" N	081° 13' 42.24" W	607
Gauging Station	041° 44' 26.51" N	081° 02' 47.91" W	677
Chardon WWTP	041° 35' 14.69" N	081° 11' 24.31" W	1119
Confluence of Red Creek and Grand River	041° 44' 57.87" N	081° 14' 9.95" W	580

Confluence of Big Creek and Grand River	041° 42’ 25.83” N	081° 13’ 47.01” W	611
Confluence of Paine Creek and Grand River	041° 43’ 19.49” N	081° 10’ 33.84” W	636
Confluence of Talcott Creek and Grand River	041° 44’ 15.34” N	081° 04” 52.27” W	664
Confluence of Griswold Creek and Grand River	041° 44’ 15.34” N	081° 03’ 33.17” W	677
Confluence of Mill Creek and Grand River	041° 44’ 42.15” N	081° 02’ 0.51” W	682
Confluence of Coffee Creek and Grand River	041° 45’ 20.87” N	080° 52’ 22.59” W	755
Confluence of Center Creek and	041° 45’ 6.98” N	080° 51’ 57.02” W	762

Grand River			

1.6 Background/historic info on previous or current watershed protection & management activities, including previous planning documents

1.6.1 Grand River Riparian Corridor Protection Plan

A consortium of public agencies and private organizations in Ashtabula, Geauga, Lake, and Trumbull Counties, know as the Grand River Partnership, initiated the Grand River Watershed Protection Project. Grand River Partners, Inc. is a land trust formed by the partnership.

An initial effort of the Grand River Watershed Protection Project has been to acquire conservation easements in the riparian corridor of the Grand and its major tributaries. To this end, three target areas—called "critical areas" by the Grand River Watershed Protection Project—along the mainstem of the Grand have been identified. Critical Area 1 is located in Trumbull and Ashtabula Counties and consists of about 38 square miles. Critical Area 2 lies along the middle stretch of the Grand in Ashtabula County and is the largest of the three, comprising of about 57 square miles. Critical Area 3 consists of about 33 square miles in Lake and Geauga Counties. Thus, a total land area of roughly 128 square miles (about 18%) of the watershed) is targeted for the acquisition of conservation easements.

The protection plan compiles all available natural resource maps of the watershed. These include soils, current land use, floodplains, groundwater resources, wetlands (as identified by the Ohio Wetlands Inventory), locations of NPDES discharges, critical areas, and rare, threatened, and endangered species.

Aerial photography was used to characterize the three critical areas for riparian corridors, large wetlands systems, and significant tracts of contiguous woodlands. Davey Resource Group biologists' field-checked portions of the critical areas as a quality control measure.

The Grand River Watershed Protection Project's goal is to protect the water quality and aquatic habitat, wetlands, and associated forest communities of the 705-sqaure-mile (approximately 455,680 acres) Grand River Watershed.

The first objective is to protect the riparian corridor of the Grand River and major tributaries through acquisition of conservation easements and land use controls. Criteria for prioritization of conservation easements have been created and land use controls that local jurisdictions can use have been identified based on public health and safety.

The second objective is to provide education for landowners on the ecological and economic benefits of riparian buffers, wetlands, floodplains, and steep slopes. The Grand River Riparian Corridor Protection Manual being developed in conjunction with this report will assist elected officials, public servants, decision makers, and concerned citizens in making the right choices for watershed protection.

The Grand River Riparian Corridor Protection Plan was adopted by the Grand River Partnership in March of 1998. To date, the Grand River Partnership has permanently protected approximately 50 miles of Streambank of the Grand River Proper.

1.6.2 Upper Grand River Watershed Plan; "A Watershed Management Plan for the Grand River Watershed"

This plan was written by a group of partnering agencies including: the Ashtabula Soil and Water Conservation District, Eastgate Regional Council of Governments, Geauga County Health Department, Geauga Soil and Water Conservation District, Grand River Partners, Inc., Kent State University, Lake Erie College, ODRN Division of Natural Areas and Preserves, ODNR Division of Soil and Water, ODNR Division of Wildlife, Ohio EPA Northeast District, Portage County Soil and Water Conservation District, Trumbull County Planning Commission, Trumbull County Soil and Water Conservation District, and the Trumbull Health Department.

The purpose of this plan is to reduce water resource impairment in all waterbodies within the Grand River Watershed that do not currently meet water quality standards. It is also to identify areas that are meeting standards, and protect these areas. The goal of the plan is to restore and maintain the chemical, physical, and biological integrity of waterbodies within the watershed. Lakes, ponds, wetlands are all covered under state and federal law.

1.6.3 Grand River Headwater Prioritization / Coldwater Stream Study

This project will initiate development of headwater stream conservation priorities for the western rim of the Grand River watershed which occurs in

Lake, Geauga and Ashtabula counties, Ohio. Conservation priorities for these streams will be developed through a combination of analyses using patterns of baseflow discharge to identify areas of high groundwater contribution, determining what landscape features these areas are associated with using a Geographic Information System (GIS), and field surveys to identify important local freshwater biodiversity features found within identified areas. It is hoped that results from initial analyses in select subwatersheds can be used to develop models to identify priority areas in adjacent subwatersheds, and possibly develop ordinances to help protect these important resources. This will be of major benefit to the Lower Grand River Watershed in maintaining its high water quality.

1.6.4 Lake Soil and Water Conservation District, Headwater Habitat Evaluation Study

Lake County Soil and Water Conservation District have been working on gathering data and information on all of the Headwater streams in the county. The ultimate goal of this study is to illustrate the importance and the direct impacts that Headwater Streams have on the overall health of the river system as a whole, and eventually generate regulations that protect these headwater streams. To date, all of the Headwater Streams in the Lower Grand River Watershed, located within Lake County, have been evaluated.

1.6.5 Landside Communities Master Plan- *Grand River Coastline Planning*

In April of 2006 the Lake County Planning Commissioners were presented a lakeshore redevelopment plan which entailed conceptual ideas and development strategies for communities in Lake County along the shoreline of Lake Erie. The plan was developed in part by the Lake County Planning Commission with contracted design assistance from Kent State University's Cleveland Urban Design Collaborative. This plan was titled the *Landside Communities Master Plan* and was developed to identify focus areas along the lakeshore and serve as a master conceptual plan for a countywide approach at lakeshore development/ redevelopment.

Among the focus areas identified through Lake County is the mouth of the Grand River as it discharges into Lake Erie between the Villages of Grand River and Fairport Harbor. Currently, the area along the banks of both sides of the river near the mouth are primarily used for maritime shipping of materials such as sand and gravel.

Picture 2- Sand and gravel shipping operations at mouth

Landside Communities Master Plan

As we move farther upstream away from the mouth, yacht and boating clubs line the banks along the Fairport Harbor Village side of the river while the Grand River Village side has mixed uses of both private dock space, charter fishing outfits, and commercial facilities like restaurants and bars. This continues on upstream until the Richmond Street Bridge where the last commercials dock spaces are located.

Picture 3- Federal navigation channel at Fairport Harbor showing mouth of the Grand River

Lake County Coastal Development Plan

The *Landside Communities Master Plan* details a conceptual plan for the development of this area which includes a variety of mixed uses that are largely on the east side (Fairport Harbor Village) of the Grand River. A new pedestrian bridge that extends from Olive Street in Grand River Village would cross the river just downstream of Ram Island and connect to Water Street in Fairport Harbor. New development areas between Water Street and the Grand River in Fairport Harbor Village would include mixed-use commercial and residential development and would extend along the east side of the river to its confluence with Lake Erie.

This area would be highlighted by the addition of over 325 new residential housing units consisting of apartments, townhouses, condos, and standalone units. Additionally, various restaurants, bars, and retail shopping opportunities would be mixed in with a boardwalk along the waters edge heading north towards the mouth of the river.

At the end of the boardwalk would be a public fishing pier that could be used by fisherman, walkers and bikers. This pier would also serve to protect a 400-500 slip deep water marina which would seasonally provide dockage for both fishing boats and deep keeled sails boats which would be adjacent to the existing Fairport Beach that is currently operated by Lake Metroparks.

Diagram 1- Landside Communities Master Plan's conceptual plan for the Grand River Mouth

Landside Communities Master Plan

Diagram 2- Conceptual plan for the new boardwalk and marina

Landside Communities Master Plan

Although this plan is still very much in the conceptual stage, it has gained both financial and political support over the last year. The Lake County Planning Commission is currently leading the charge to work with the private sector as well as public officials to get this project off of the ground. This project has the ability to generate vast amounts of revenue for local communities as well as for the county while still being able to provide public access and recreation opportunities to the general public along the Grand River.

1.6.6 Comprehensive Wildlife Conservation Strategy; Streams and Watersheds Tactical Plan 2005-2010

The Ohio Department of Natural Resources, Division of Wildlife developed a tactical plan to ensure that the quality and health of Ohio's most biologically diverse and pristine habitats remain in tact. The main goal of this plan is to use a watershed approach in protecting and managing riparian habitats to enhance aquatic wildlife abundance and diversity, and increase recreational opportunities in Ohio's Focus Watersheds.

Focus Watersheds were drawn from the ODNR Candidate Streams for Protection and Restoration. This rates Ohio watersheds by integrating measures of physical and biological integrity, biodiversity, and recreational opportunity. All watersheds received a prioritization score which ranks their relative importance for protection and restoration activities. The DOW has identified eleven Focus Watersheds to concentrate efforts related to aquatic portion of its CWCS. These include the highest scoring watersheds in Ohio. Watersheds in both the Lake Erie and Ohio River drainages representing all of Ohio's major ecoregions have been included. All have diverse habitat types with high use designations and excellent biodiversity, and most are Ohio Scenic Rivers. The Grand River was given a score of 11, the second highest score in the state of Ohio.

The key strategies outlined in the plan include; dam removal and fish passage, habitat protection and restoration on private lands, habitat restoration and protection on public lands, biological habitat assessment and monitoring, restoration and maintenance of hydrological functions, educating Ohio's citizens regarding the value of streams and watersheds, and to provide funding for stream and watershed programs.

2. WATERSHED PLAN DEVELOPMENT

2.1 Watershed Partners

2.1.1 Watershed residents and landowners

Grand River Partners, Inc. **(GRPI)** is a citizen-driven, non-profit land trust working to protect the Grand River and its tributaries. GRPI's goal is to unite residents, landowners, businesses and communities in the stewardship of the natural resources that make our region a productive, beautiful place to live.

In the early 1990s, several conservation agencies operating within the watershed recognized the existence of threats to the river's quality and moved to develop ways to maintain the pristine conditions of the Grand. This loose coalition of public and private agencies has come to be known as the **GRAND RIVER PARTNERSHIP**. It was through the **GRAND RIVER PARTNERSHIP** that **GRPI** was developed. The partnership consists of many people of many differing agencies. Chart 1 shows a list of the participating agencies in the **GRAND RIVER PARTNERSHIP** and how **GRPI** fits into this hierarchy.

Chart 1- Grand River Partnership and Grand River Partners, Inc.

Grand River Partnership

Ashtabula County Health District, Ashtabula County Metropark District, Ashtabula County Planning Commission, Ashtabula Soil and Water Conservation District, Center for Farmland Preservation, Cleveland Museum of Natural History, Ducks Unlimited, Geauga County Park District, Geauga County Planning Commission, Geauga County Soil and Water Conservation District, Grand River Advisory Council, Grand River Partners, Inc., Kent State University, Lake County Planning Commission, Lake County Health District, Lake County Soil and Water Conservation District, Lake Metroparks, The Nature Conservancy, Ohio EPA, ODNR Division of Forestry, Division of Natural Areas and Preserves, Division of Soil and Water Conservation, Division of Wildlife, OSU Cooperative Extension Service, OSU Extension/ Sea Grant, Trumbull County Health District, Trumbull Soil and Water Conservation District, Trust for Public Land, U.S. Army Corps of Engineers, USDA Natural Resources Conservation Service, Western Reserve Resource Conservation & Development

Grand River Watershed Committee

Lake Metroparks, Lake County Soil and Water Conservation District, ODNR Division of Wildlife, Lake Erie College, The Nature Conservancy, Lake County Health District, Land Owners, Grand River Partners Board of Trustees, Local Business Owners, Ohio EPA, Trumbull County Health District, ODNR Division of Natural Areas and Preserves, Ashtabula Soil and Water Conservation District, Grand River Advisory Council

Grand River Partners, Inc.

Eddie Dengg- Executive Director, Chad Knisely– Land Protection Coordinator, Vicki Domonkos– Watershed Coordinator, Brett Rodstrom- Land Protection Coordinator, Mary Jo Curtis– Administrative Assistant

Grand River Watershed Coordinator

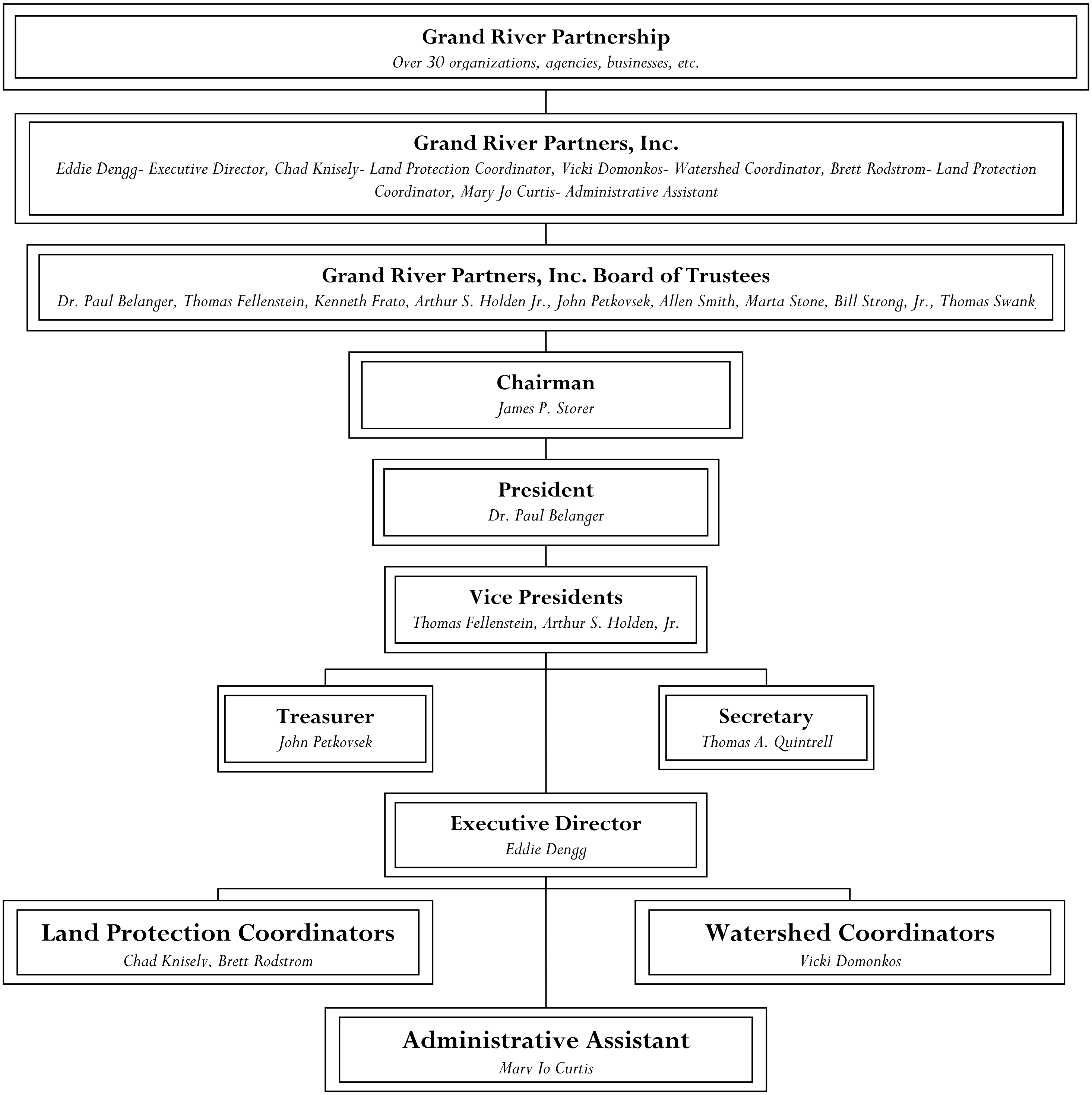
Vicki Domonkos– Grand River Partners, Inc.

A board of trustees is assembled to make financial and administrative decisions regarding **GRPI**. This board is made up of local citizens and currently includes five individuals representing farming, eco-business, education, and environmental interests.

GRPI is trying to help citizens withstand the pressure of development and secure the current balance of land uses within the watershed. **GRPI**, a not-for-profit land trust, hopes that this balance can be maintained by uniting residents, landowners, businesses, and communities in the stewardship of the natural resources that make the Grand River Valley worthy of its state "Wild" and "Scenic" designation.

GRPI has a membership of over 300 people, which includes landowners, government officials, concerned citizens, etc.

Chart 2- Grand River Partners, Inc.



2.1.2 Local businesses/ industries, regulated communities

The following local businesses are members of the **GRAND RIVER PARTNERSHIP**, from which **GRPI** was developed.

- Raccoon Run Canoe Livery
- Realty Net, Inc.
- Lubrizol Corporation

2.1.3 Local and State Government Agencies

The following local and state government agencies are members of the **GRAND RIVER PARTNERSHIP**, from which **GRPI** was developed.

- Ashtabula County Health District
- Ashtabula County Metropark District
- Ashtabula County Planning Commission
- Ashtabula County Soil and Water Conservation District
- Geauga County Park District
- Geauga County Planning Commission
- Geauga County Soil and Water Conservation District
- Lake County Planning Commission
- Lake County Health District, Lake County Soil and Water Conservation District
- Lake Metroparks
- Ohio Environmental Protection Agency
- Ohio Department of Natural Resources (ODNR)
  - Division of Forestry
  - Division of Natural Areas and Preserves

- Division of Soil and Water Conservation
- Division of Wildlife

- Rome Township Zoning Board
- Trumbull County Health District
- Trumbull County Soil and Water Conservation District
- U.S. Army Corp of Engineers
- USDA Natural Resources Conservation Service

2.1.4 Nongovernmental Organizations

The following nongovernmental organizations are members of the **GRAND RIVER PARTNERSHIP**, from which **GRPI** was developed.

- Center for Farmland Preservation
- Cleveland Museum of Natural History
- Ducks Unlimited
- Grand River Advisory Council
- Grand River Partners, Inc.
- The Nature Conservancy
- Trust for Public Land
- Western Reserve Resource Conservation & Development

2.1.5 Community Organizations

The following educational institutions are members of the **GRAND RIVER PARTNERSHIP**, from which **GRPI** was developed.

- Lake Erie Boy Scout Council

2.1.6 Educational Institutions or Educators

The following educational institutions are members of the **GRAND RIVER PARTNERSHIP**, from which **GRPI** was developed.

- Lake Erie College
- Cleveland Museum of Natural History
- Kent State University
- Ohio State University (OSU) Cooperative Extension Service
- OSU Extension/ Sea Grant

GRPI and the **GRAND RIVER PARTNERSHIP** provide a large number of educational programs and educational resources for the residents in both the **LOWER GRAND RIVER WATERSHED** and the Grand River Watershed itself. **GRPI** will continue to provide, and assist in the development of educational programs and resources. This includes both youth and adult education programs.

2.1.7 Other

There are no other Partners to list at this time, however the Partnership is continuously growing.

2.2 Mission Statement

The mission of **GRPI** is *"To preserve the water quality, open space, the natural, recreational, agricultural and scenic resources of the Grand River in Ashtabula, Geauga, Lake, Portage, and Trumbull Counties by uniting residents, landowners, businesses, and communities in the stewardship and permanent protection of the Grand River Watershed."*

The primary objective of **GRPI** is to serve as a land conservancy dedicated to protecting the Grand River, its tributaries and watershed. In this capacity, **GRPI** assists landowners in the planning, managing, and protection of their property through sound cost-effective conservation practices.

2.2.1 Structure, organization, administration

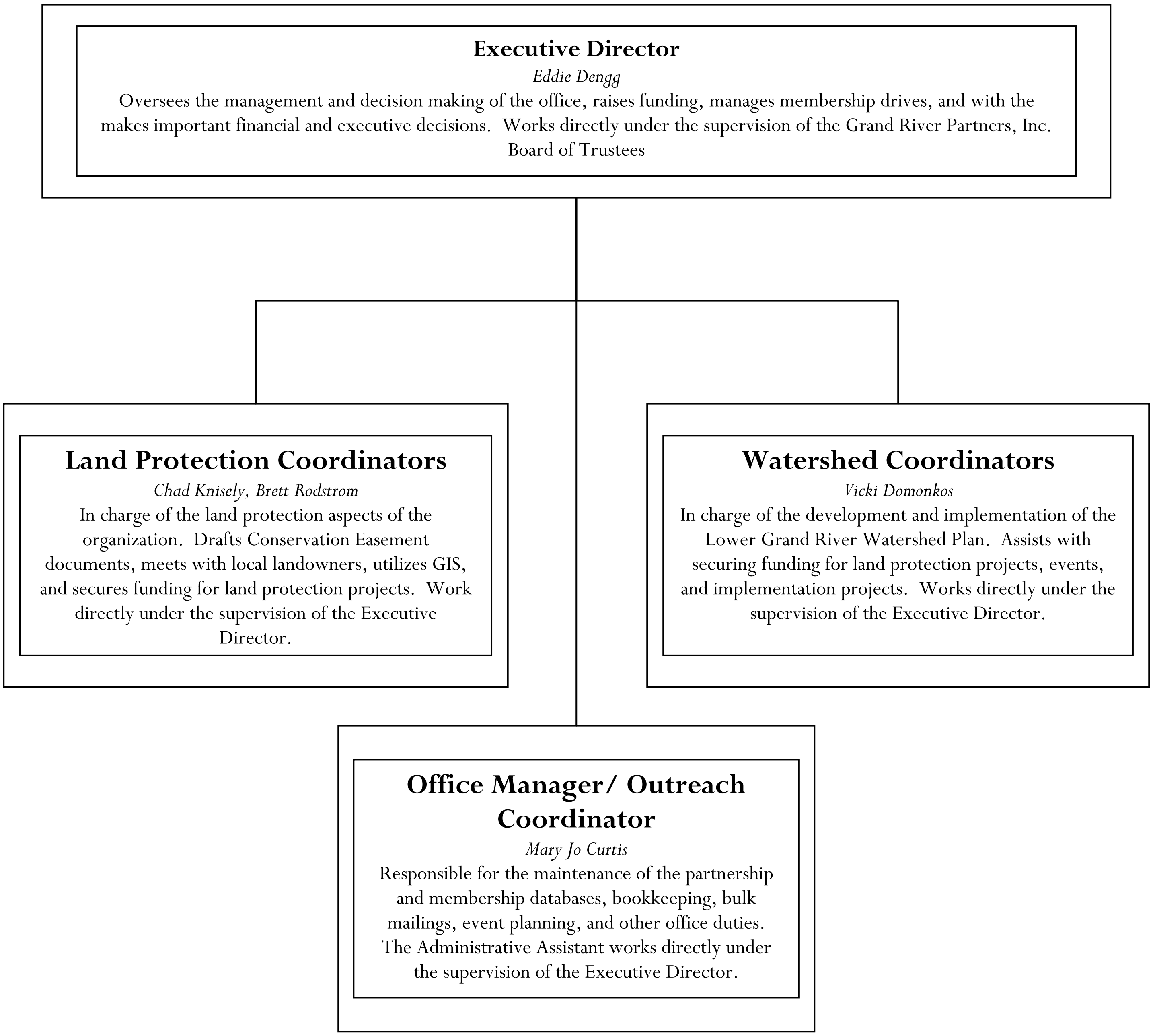
2.2.1.1 Legal status

GRPI is a non-profit, 501c3 organization.

2.2.2 Partner roles and responsibilities defined

See Chart 3 below to see how GRPI operates and the roles that each employee plays.

Chart 3- GRPI Organizational Hierarchy



2.2.3 Operational procedures and by-laws

Contact GRPI for a copy of the Operational By-Laws of Grand River Partners, Inc. at the below contact information.

2.2.4 Group decision-making process

Outlined by the Operational Procedures and By-laws. For a copy of the Operational By-Laws of Grand River Partners, Inc., contact GRPI at the information provided bleow.

2.2.4.1 Basic contact info

Grand River Partners, Inc.

C/o Lake Erie College

391 W Washington Street

Painesville, Ohio 44077

440-375-7311

440-375-7314 fax

e-mail: mail@grandriverpartners.org

Website: www.grandriverpartners.org

Staff Members:

Eddie Deng – *Executive Director*

440-375-7310

eddie@grandriverpartners.org

Chad Knisely – *Land Protection Coordinator*

440-375-7312

chadk@grandriverpartners.org

Vicki Domonkos – *Watershed Coordinator*

440-375-7315

vickid@grandriverpartners.org

Brett Rodstrom – *Land Protection Coordinator*

440-375-7313

brett@grandriverpartners.org

Mary Jo Curtis – *Office/ Outreach Coordinator*

440-375-7311

maryjo@grandriverpartners.org

2.3 Plan Development

The Lower Grand River Watershed Plan format follows the outline presented in Appendix 8 to the OEPA "Guide to Developing Local Watershed Action Plans" with one major modification: the Watershed Impairments and Restoration and Protection Goals sections have been placed at the end of each of the individual HUCs within SECTION II, the 14-Digit Subwatershed Analysis, to create a more user-friendly document that directly relates impairments, problem statements, goals and action items of each individual subwatershed. To further simplify the process (and to avoid redundancy) the watershed has been divided into the eight (8), 14-digit HUCs that are located within the 11-Digit HUC 04110040060, or the Lower Grand River Watershed. The plan presents separate problem statements and proposed actions for each 14-Digit HUC.

2.4 Commitment of Partners

The following members of the Grand River Partnership (see section 2.1.1) will receive a copy of the **Lower Grand River Watershed Plan.** Letters showing their support and commitment to the Lower Grand River Watershed Plan are available by contacting GRPI.

Table 6- Grand River Partnership

Ashtabula County Health District	*Ohio EPA*
Ashtabula County Metropark District	*ODNR Division of Forestry*
Ashtabula County Planning Commission	*ODNR Division of Natural Areas and Preserves*
Ashtabula Soil and Water Conservation District	*ODNR Division of Soil and Water Conservation*
The Farmland Center	*ODNR Division of Wildlife*
Cleveland Museum of Natural History	*OSU Cooperative Extension Service*
Ducks Unlimited	*OSU Extension/ Sea Grant*
Geauga County Park District	*Trumbull County Health District*
Geauga County Planning Commission	*Trumbull County Metroparks*
Geauga County Soil and Water Conservation District	*Trumbull Soil and Water Conservation District*
Grand River Advisory Council	*Trust for Public Land*
Grand River Partners, Inc.	*U.S. Army Corps of Engineers*
Kent State University	*U.S. Fish and Wildlife Service*
Lake County Planning Commission	*USDA Natural Resources Conservation Service*
Lake County Health District	*Western Reserve Land Conservancy*
Lake County Soil and Water Conservation District	*Western Reserve Resource Conservation & Development Council*
Lake Metroparks	
Lake County Stormwater Management Department	

2.5 Education and Outreach

The Lower Grand River Watershed Plan includes improving stewardship of local streams and watershed through public education as a separate goal which is incorporated in several of the tasks within the implementation plan to restore the watershed. For example, fact sheets, guidance, training programs and presentations to educate local decision makers, homeowners associations, and commercial property owners about stormwater quality, and best management practices (BMPs) are suggested activities to complement the task of preserving riparian areas. The goal of public education and outreach is supported by tasks such as demonstrating "on-lot" water quality BMPs, implementing Phase II sedimentation and erosion controls, preserving sensitive property and habitats, constructing wetlands, and working with local governments to develop conservation zoning and ordinances. Property owners will be educated by the distribution of educational materials (via newsletters, websites, municipal offices, libraries, permit offices, newspapers and public access television). The plan will be presented at public meetings to increase awareness among stakeholders, communities, residents, and property owners.

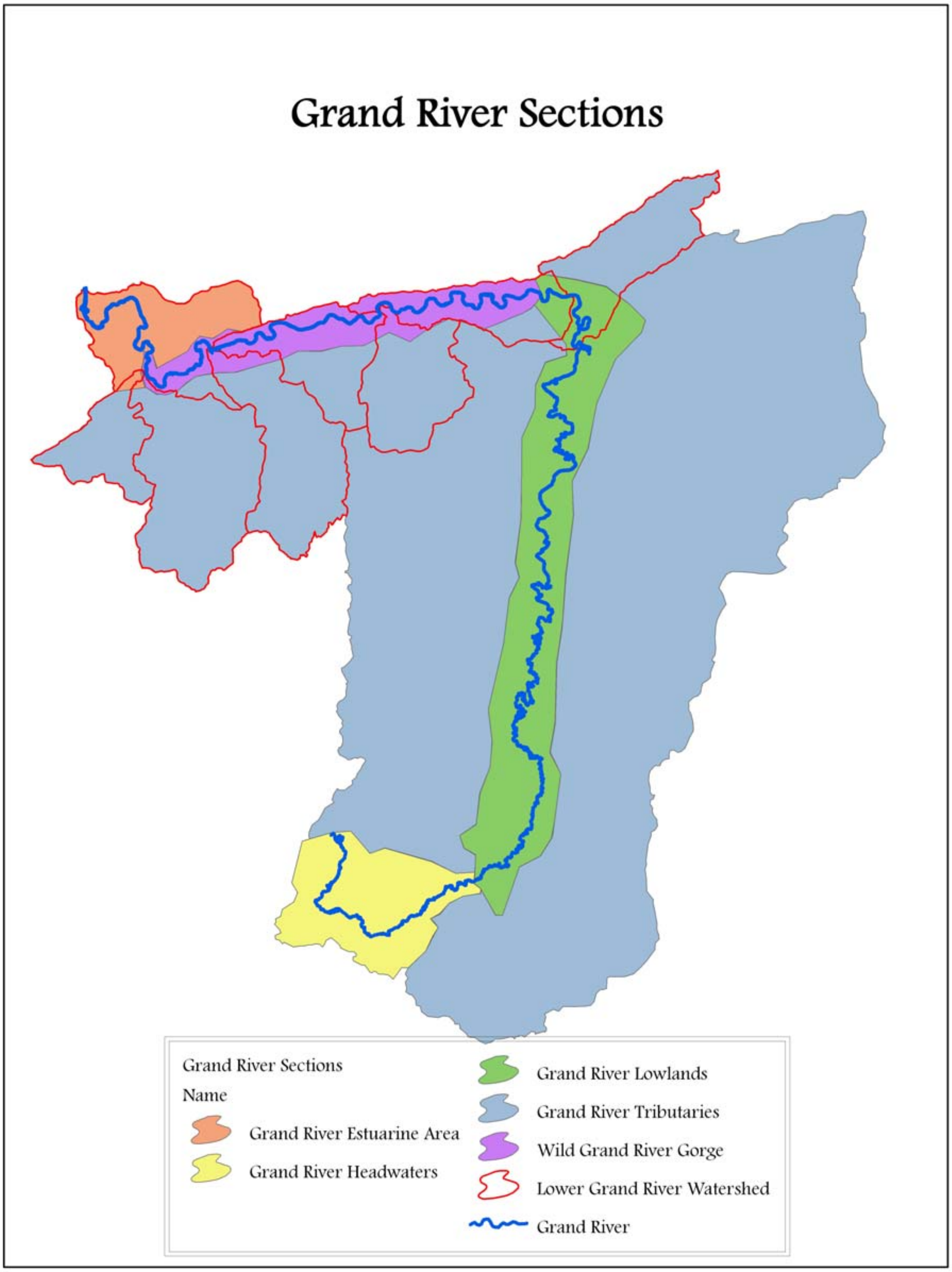
3. WATERSHED INVENTORY~ DESCRIPTION OF THE WATERSHED

3.1 Geology of the Grand River Watershed

3.1.1 Topography

The Grand River is very unique, and it varying topography has created a wide variety of habitats. The Grand River watershed can be broken into five very different topographical sections: the headwaters, the lowlands, the gorge area, tributaries, and the estuarine area. The sections of the Grand River that lie within the **LOWER GRAND RIVER WATERSHED** include the Gorge area, the Estuarine area, and portions of the Tributaries area and Lowlands area.

Map 11- Grand River Sections



The Headwaters Area:

This 15.5 mile reach of the Grand River begins in Parkman Township, Geauga County from the headwaters downstream to State Route 88. Channel substrates through this portion of the river have very little diversity. Here the Grand River is underlain predominately by sandstone bedrock, with very few riffle, run, pool complexes that are typically associated with streams.

Picture 4- Headwaters of the Grand River in Parkman Township, Geauga County

The Lowlands Section:

The Grand River lowlands is located between State Route 88 and Cork Cold Springs Road. The Grand River has cut a channel through what once was a lake bed. The lake bed is approximately 2 miles wide and has a profound influence on the rivers morphology. Here the Grand River flows through an entrenched channel that meanders wildly and has a very low gradient with a predominance of pool areas. Riffles in this reach of the Grand River are very few. Extensive terraces and wetlands can be found adjacent to the river. In this reach of the Grand River the floodplain is very narrow as a result of the entrenched channel. Soft sediments and woody debris dominate the substrate types in this reach of the river. The presence of fine sediments in combination with the narrow floodplain cause the fine material to remain suspended in the water column. The Grand River takes on a stained appearance that is simply the nature of the river. The water color only typically clears up each fall. The stained appearance of the water is for the most part natural, and not caused by land use practices.

Picture 5- Grand River Lowlands in Rome Township, Ashtabula County

The Gorge Area:

The Grand River Gorge is located between Cork Cold Springs Road and State Route 2 near Painesville. The Grand River Gorge area is comprised of extremely diverse habitat types. Here the Grand River has extremely well developed riffle, run, and pool complexes. Substrates range in size from fine clays up to large boulder slabs, and woody debris, cut banks, and overhanging vegetation can also be found in the rivers channel. Through the gorge area broad floodplains and steep bluffs are common features found adjacent to the river. These broad floodplains allow fine soil particles to settle out and the water to run clear. High quality wetlands can found in these floodplain areas and are home to many species of wildlife.

Picture 6- Grand River Harpersfield Township, Ashtabula County

The Estuarine Area:

The Estuarine Area begins approximately 1 mile downstream of the intersection of State Route 2 and the Grand River and ends at the confluence of the Grand River and Lake Erie between the communities of Fairport Harbor Village and Grand River Village. Here the Grand River is underlain with finer substrates such as silt, sand, and cobble. Through this reach of the Grand River there is a predominance of pool areas. Lake Erie can have a direct influence over the river. Predominate winds from the northeast can cause Lake Erie to seche, or temporarily raise the level of the lake by several feet. This raising of lake water can actually cause the Grand River to flow in the opposite direction. Unfortunately, the mouth of the Grand River has been channelized to accommodate shipping needs. Interestingly, the Mentor Marsh was once the location by which the Grand River entered Lake Erie. A storm event caused the river to abandon this channel and form the existing channel to Lake Erie.

Picture 7- Grand River City of Painesville, Lake County

The Tributaries Area:

The Tributaries Project Area is comprised of the high quality tributaries that help maintain the Grand River's pristine water quality. A number of these tributaries have been studied and monitored by the EPA and have been found to be some of the highest quality streams. Some of these tributaries to the Grand River have been found to be very rare, Cold Water Streams based on their biology.

3.2 Geological Features

3.2.1 Bedrock Geology

Most of the bedrock in the Grand River Watershed is Mississippian and Pennsylvanian in age. The Mississippian rocks are generally fine-grained siltstones and sandstones, while the Pennsylvanian rocks are mostly conglomerates, sandstones, shales, limestone, and coal. The strata dip gently to the south and southeast at about 30 feet per mile.

3.2.2 Surficial Geology

The glacial and immediate postglacial history of the region is mostly responsible for surficial deposits in the Grand River Watershed. The watershed is dominated by four major types of deposits:

- Silty tills dominate the uplands of the Glaciated Plateau;

- Sorted sands and gravels from glacial outwash are present mostly along the western boundary of the watershed;
- Fine silts and clays dominate the Grand River Lowland that had been occupied by proglacial lakes;
- Sorted pebbles dominate the Lake Plain where several beach ridges were formed by higher levels of Lake Erie.

3.2.3 Soils

Hydric soils are poorly and very poorly drained soils that have a high or perched water table and that formed in low-lying areas or areas with restricted drainage. Standing water and/or saturated soils over long time periods are required to form hydric soils. Many hydric soils are seasonally inundated in the early spring and have saturated soils for only a portion of the growing season. This is sufficient for the soils to develop hydric characteristics and support hydrophytic vegetation.

Hydric soils are generally more extensive than the wetlands associated with them. Drainage can be a result of artificial sources such as field tiling or stream dredging, or natural sources such as the natural down cutting of stream channels over long periods of time. Drained hydric soils are still classified as hydric based on their characteristics, even though they no longer are saturated for significant periods of time.

Somewhat poorly drained soils are classified as non-hydric soils, but many of these soil types can have hydric inclusions that are too small to be mapped on the county soil surveys. Non-hydric soils with hydric inclusions – generally somewhat poorly drained soil types – tend to collect surface water and support perched water tables during wet periods. Wetlands are common on these soil types where slight depressional areas occur or where drainage is restricted. Isolated vernal pools and lowland woods with standing water and/or saturated soils for short periods in the spring are common. Seasonal wetlands provide important habitats for a wide variety of plants, insects, amphibians, some of which are found nowhere else. Drainage in woodland areas is usually provided by very shallow, intermittent drainageways. This is most pronounced in flatlands (areas having 0-2 percent slopes).

Hydric soils and non-hydric soils with hydric inclusions are often not suitable for building because of stability concerns, permeability characteristics that preclude septic tank use, frequent association with wetlands, and septic system problems.

Alluvial soils are commonly found in the floodplain along the river, particularly in Lake County and western Ashtabula County. In these areas, the valley and floodplain are well defined. Chagrin, Euclid, Lobdell, Orrville, and Tioga soils commonly make up these areas. These soils range from somewhat poorly drained to moderately well drained. Hydric inclusions occur in depressional areas and in old oxbows.

Pierport and Platea soils are found on the areas surrounding the river valley in Lake and western Ashtabula Counties. These are somewhat poorly drained, non-hydric soils that can have hydric inclusions in depressions and along drainageways.

Further upstream, in Ashtabula and Trumbull Counties, the floodplain and valley become wider and less defined. Here large areas of hydric soils such as Canadice and Sheffield soils surround the river. These areas often support large expanses of wetlands. The large areas of Canadice-Caneadea soils mapped in these areas are a complex of wetlands and uplands areas.

3.2.4 Glacial History

The Grand River watershed is situated within the gently rolling dissected glacial plateau of the Erie-Ontario Lake Plain ecoregion. The majority of streams in this watershed are perennial. During the Pleistocene era, varying thicknesses of glacial drift were deposited over Pennsylvanian shales and Mississippian sandstones. The majority of this watershed exists in ground moraines and end moraines. Only the northern section of this watershed lies in beach ridge deposited sediments. The preglacial valleys within the underlying bedrock shale and sandstone were also buried by glacial clays, sands, and gravels. This watershed exhibits a mosaic of urban development, cropland, pasture, livestock, woodland, and forest. Some oil/gas extraction occurs within the watershed.

Ancient rocks line the Grand River in its lower reaches, but the river itself is a much more recent geologic phenomenon. During the Pleistocene, beginning two million years ago, a series of great continental ice sheets periodically covered much of Ohio. The Pleistocene was an eventful epoch, particularly the period fifteen to twelve thousand years ago. The last continental glacier (the Wisconsinan) ended about 12,500 years ago and the Grand River was born. The post-glacial Grand River drained the "Grand River Lake" in Ashtabula and Trumbull Counties and ran north to Lake Maumee, a precursor to Lake Erie that was much larger and much deeper. Today, the old "Grand River Lake" is the Grand River Lowland, a deep wide valley that extends for 28 miles and is up to three miles across. The depression lies as much as 300 feet below the surrounding uplands. The Grand River, brown with mud suspended from the silty bottom, glides northward in a meandering channel across the Allegheny Plateau. This is the 33 mile designated scenic river, extending from U.S. 322 to the Harpersfield Dam.

As the Grand River wanders northward, it flows against the Portage Escarpment and makes a sharp turn to the west. The river cuts through the 360 million-year-old bedrock on its wild run through Lake and Ashtabula Counties. Here the gorge is 250 feet deep, with hard, resistant sandstone near the rim. The lower gorge walls are much softer shale and siltstone – sedimentary rocks that were deposited during the Devonian Age when a shallow, salt-water sea covered this part of Ohio. The lower shale layers contain the fossil remains of clams, snails, crustaceans, and other animals. The most common fossils are brachiopods – marine invertebrates with shells that superficially resemble clams.

The Grand rolls along the escarpment, the 23-mile stretch designated wild by legislation. It finally cuts across a low moraine to enter the Lake Plain, and then Lake Erie. The Grand River channel originally continued west to the vicinity of Mentor, but severe lake erosion several thousand years ago cut into the Grand and created a new mouth between the present-day villages of Fairport Harbor and Grand River. The abandoned path of the river gradually silted in and is today's Mentor Marsh.

The Grand River Watershed flows through the Western Allegheny Plateau Ecoregion of the state. The Western Allegheny Plateau is a remnant of what the New World once looked like. It is 26.7 million acres in a region that encompasses most of eastern Ohio, western Pennsylvania, western West Virginia, and parts of western New York and northeastern Kentucky. Just 12,000 years ago, the retreat of Ice Age glaciers created an altered landscape, leaving rounded hills, ridges and broad valleys in the northern glaciated region. Natural lakes, fens, bogs and marshes abound in this landscape.

Table 7- Glacial Events of the Grand River Watershed

Sequence of Glacial Events of the Grand River Watershed			
Time (thousands of years)	Glacial Substage	Glacial Advances	Ice Activity and Deposits
40-28	Altonian		Furthest extent of ice down the Grand River Valley and onto the Glaciated Plateau depositing the Titusville Till
28-23	Farmdalian		
23-20	Woodfordian	Kent-Navarre advance	Ice re-advances to almost same extent as the Altonian and deposits the Kent Till. On the edges of the ice lobe significant deposition of outwash occurs
19		Lavery – Hayesville advance	Ice re-advances through the Grand River Lowland but fails to extend over the Glaciated Plateau and deposits the Laverly Till
Post 19		Hiram advance	Ice re-advances through the Grand River Valley and extends just beyond the position of the Defiance Moraine. Ice retreats and creates the Defiance Moraine
Post 19		Ashtabula advance	Ice re-advances but fails to advance up and over the Escarpment and onto the Plateau. The Painesville and Ashtabula Moraines are created.

Kent State University

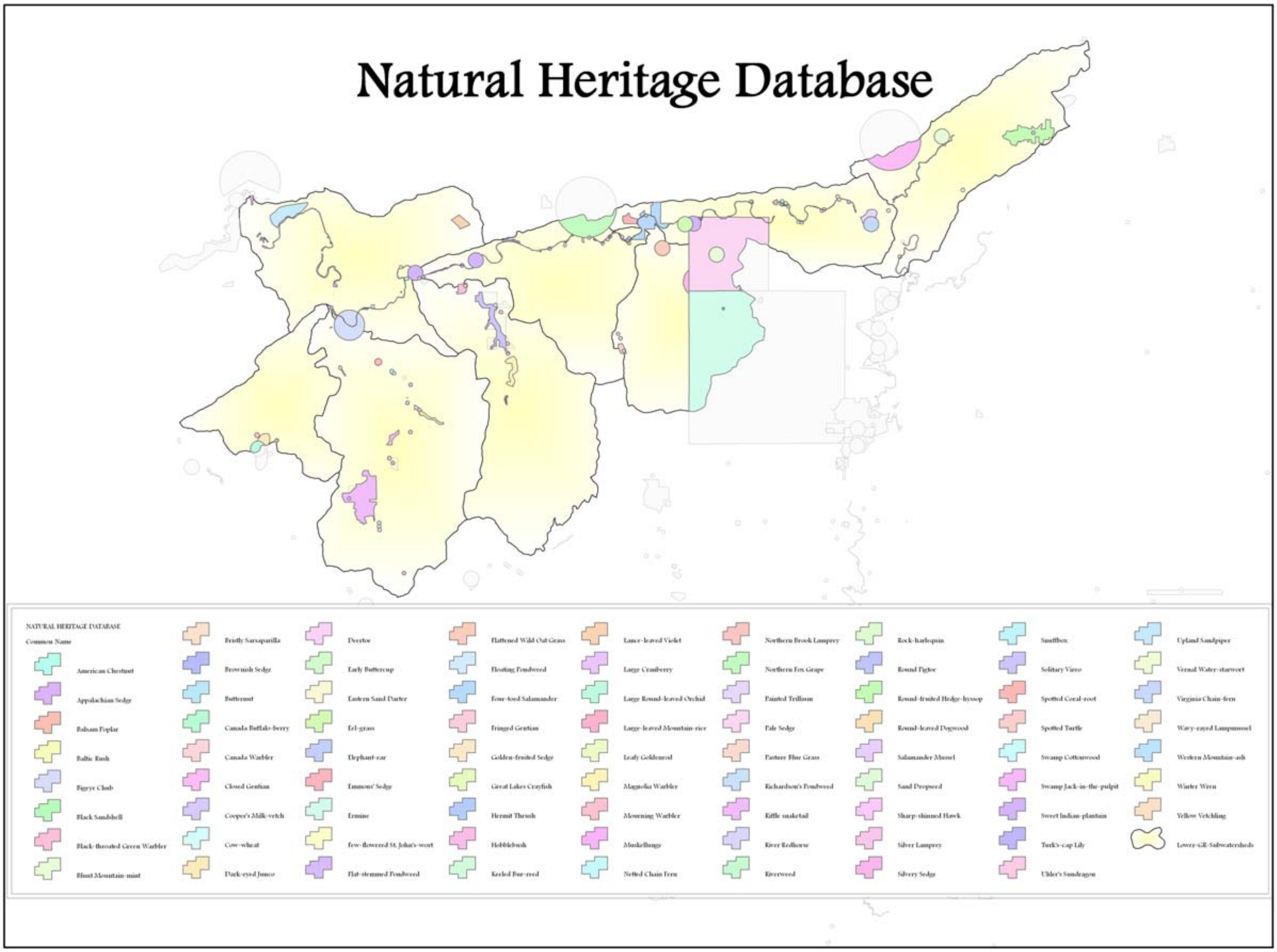
3.3 Biological Features

The relatively undisturbed and unique habitats found in the Grand River Watershed are home to many species of plants and animals. The numbers tell the story; over 400 species of macroinvertebrates, 33 mussel species, 77 fish species, 115 species of breeding birds, 45 mammal species, 18 reptile species, and 24 amphibian species which includes 9 frog species, 2 toad species, and 14 salamander species. The number of plant species is untallied, but it is likely close to 2,000.

3.3.1 Rare, Threatened, and Endangered Species

The 712 square mile Grand River Watershed serves as a refuge for more than 100 species on the state's rare, threatened, and endangered species list.

Map 12- Lower Grand River Watershed, Natural Heritage Database



Fringed gentian (state potentially threatened) and the closely related closed gentian (also state potentially threatened) are found in several sites within the critical areas of the Grand River Watershed. Species of wet meadows and streamsides, they have become scarce due to habitat destruction. The nearly intact riparian corridor along the Grand River is an ideal refuge for both species.

The eastern sand darter (state special interest) is recorded from several sites along the Grand River and its tributaries. This sensitive species was once classified as a candidate species for federal protection prior to the elimination of candidate species classifications. Formerly common throughout Ohio, the eastern sand darter has declined with degradation of habitat. Silt runoff from agriculture and development are commonly cited as the greatest threat to this rare fish.

The four-toed salamander (state special interest) is noted from a single location in Ashtabula County. This reclusive species is restricted to mature, wooded wetlands, bogs, and fens with well established areas of sphagnum moss and small vernal pools. Loss of habitat is most often cited as the primary reason for the decline of four-toed salamander populations, although it is also noted that the reclusive nature of this species makes monitoring difficult.

Picture 8- Four-toed salamander

Of particular interest, is the presence of the Eastern massasauga rattlesnake (state endangered). This species prefers expansive wetlands systems. Due to poaching, slow reproductive rates, and loss of habitat, this species had declined greatly in Ohio and the populations in Ashtabula County are of great ecological value.

Picture 9- Eastern Massasauga Rattlesnake

Yellow-bellied sapsucker (state endangered) is recorded from one nesting location in Ashtabula County by the Ohio Department of Natural Resources (ODNR). Recent additional sites confirm that this endangered species is still breeding in the Grand River Valley. This rare species has the unusual habit of boring holes into trees, then returning later to feed upon the insects trapped in the sap.

Although there are no confirmed collection records, the known range of the federally endangered Indiana bat covers the entire study area. Indiana bats require dead trees or trees with exfoliating bark, as maternity roosts. These trees need to be exposed to sufficient amounts of sunlight to provide warmth to growing young. Little is known about the true distribution of this species in Ohio, but most experts agree that where appropriate habitat is present, there is a good probability that the bat is also present. Given the undeveloped nature of the Grand River Watershed, and the nearly intact riparian zone, it is quite likely that the Indiana bat inhabits areas in the watershed.

3.3.2 Invasive Species

3.3.2.1 Plants

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 1700's.

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. Some plants, such as plants purple loostrife and teasel, may have been introduced by early settlers to remind themselves of "home".

Invasive plants are usually characterized by fast growth rates, high fruit production, rapid vegetable spread, efficient seed dispersal, and germination. Since these plants are not native to Ohio, they lack the natural predators and diseases that would naturally control them in their native habitats.

Not all non-native plants are invasive in natural areas, which include any area managed for natural habitats. Of the more than 700 non-native plants in Ohio, fewer than 100 are known to truly "invade" their natural settings.

Invasive plants, whether they are native or non-native, have the ability to take over native plant communities, forming monocultures and displacing native species.

In the Grand River watershed, there are 56 invasive, non-native plant species. Of these 56 species, 13 are being targeted for eradication; amur honeysuckle, morrow honeysuckle, tatarian honeysuckle, autumn olive, common reed grass, garlic mustard, glossy buckthorn, common buckthorn, Japanese honeysuckle, Japanese knotweed, multiflora rose, purple loostrife, and reed canary grass. The list below shows the invasive species found in the Grand River Watershed, and their level of concern.

Table 8- Grand River Watershed Invasive Plant Species List

Invasive Species- *plants*	
	Found in entire watershed
	Found in parts of watershed
Targeted Species	
Garlic mustard	*(Allaria petiolata)*
Autumn olive	*(Elaegnus umbellata)*
Japanese honeysuckle	*(Lonicera japonica)*
Amur honeysuckle	*(Lonicera maackii)*
Morrow honeysuckle	*(Lonicera morrowii)*
Tatarian honeysuckle	*(Lonicera tatarica)*
Purple loostrife	*(Lythrum salicaria)*

Reed canary grass	*(Phalaris arudinacea)*
Reed grass	*(Phragmites australis)*
Japanese knotweed	*(Polygonum cuspidatum)*
European buckthorn	*(Rhamnus cathartica)*
Glossy buckthorn	*(Rhamnus frangula)*
Multiflora rose	*(rosa multiflora)*
Well-established Species	
Quack grass	*(Agropyron repens)*
Tree-of-heaven	*(Ailanthus altissima)*
Japanese barberry	*(Berberis thunbergii)*
Smooth brome	*(Bromus inermis)*
Asian bittersweet	*(Celastrus orbiculatus)*
Canada thistle	*(Cirsium arvense)*
Poison hemlock	*(Conium maculatum)*
Field bindweed	*(Convolvulus arvensis)*
Crown-vetch	*(Coronilla varia)*
Queen Anne's lace	*(Daucus carota)*
Cut-leaved teasel	*(Dipsacus laciniatus)*
Common teasel	*(Dipsacus sylvestris)*
Hairy willow-herb	*(Epilobium hirsutum)*
Small-flowered hairy willow-herb	*(Epilobium parviflorum)*
Winged euonymus	*(Euonymus alatus)*
Meadow fescue	*(Festuca pratensis)*
Day-lilly	*(Hemerocallis fulva)*
Dame's rocket	*(Hesperis matronalis)*
Yellow flag	*(Iris pseudacorus)*
Common privet	*(Ligustrum vulgare)*
Moneywort	*(Lysimachia nummularia)*
White sweet-clover	*(Melilotus alba)*
Yellow sweet-clover	*(Melilotus officinalis)*
Eurasian watermilfoil	*(Myrioohyllum spicatum)*
Lesser naiad	*(Najas minor)*
Water-cress	*(Nasturtium officinale)*
Curly pondweed	*(Potamogeton crispus)*
Lesser celandine	*(Ranunculus ficaria)*
Bouncing Bet	*(Sapnaria officinalis)*
Johnson Grass	*(Sorghum halepense)*
Narrow-leaved cattail	*(Typha angustifolia)*
Hybrid cattail	*(Typha X glauca)*

European cranberry-bush	*(Viburnum opulus* var. *opulus)*
Periwinkle	*(Vinca minor)*
Watch List Species	
Porcelain-berry	*(Amohelopsis brevipedunculata)*
Nodding thistle	*(Carduus nutans)*
Spotted knapweed	*(Centaurea maculosa)*
Border privet	*(Ligustrum obtusifolium)*
Showy pink honeysuckle	*(Lonicera X bella)*
Chinese silvergrass	*(Miscanthus sinensis)*
Star-of-Bethlehem	*(Ornithogalum umbellatum)*
Dog rose	*(Rosa canina)*
Black swallow-wort	*(Vincetoxicum nigrum)*
	The Nature Conservancy

Picture 10- collection of Invasive Species

purple loostrife

tatarian honeysuckle

glossy buckthorn

autumn olive

DNAP

3.3.2.2 Animals

Invasive and exotic animals can be found all over the state. These animals were introduced intentionally for personal pleasure or as biological control agents, while others were accidentally introduced through shipping, mainly ballast water, and travel.

The European starling and house sparrow are found within the entire Grand River Watershed, including the Lower Grand River Watershed. Also, many different exotic species of fish can be found in the Grand River and its tributaries; common carp, sea lamprey, round goby, rainbow trout, rainbow smelt, alewhite, gizzard shad, and white perch.

Picture 11- Invasive Animal Species

common carp

Round goby

sea lamprey

3.4 Climate and Precipitation

3.4.1 Ashtabula County

Situated in the northeastern corner of Ohio, on the western slope of the Appalachian Mountains, Ashtabula County has a climate that may roughly be classified as continental, though adjacent Lake Erie has some effects. The Grand River flows northward, in a broad valley, to within 8 miles of lake shore, where it turns sharply westward and continues into adjoining Lake County. The terrain in the valley is gently rolling in most areas, but it ranges to nearly level or even level in some places. The valley rises gradually toward the east and west. The average elevation on the river bottom is almost 800 feet, but elevation on hilltops is between 1,000 and 1,100 feet.

Lake Erie, on the northern boundary of the county, has a moderating effect on climate throughout the county, but the effect lessens as distance from the lake shore increases. Because of the valley of the Grand River extends north and south, the effect of the lake is more pronounced than it would be if this valley extended east and west. The effect of the lake is most pronounced in a narrow belt between the lake shore and an escarpment that parallels the shore and is about 4 miles inland.

There are two distinct climates in Ashtabula County, but each climate gradually blends into the other as the distance from Lake Erie increases. The transition is most abrupt in a zone a few miles wide at the crest of the escarpment between Ashtabula and Jefferson. The effect of Lake Erie is most moderating during the cold periods, and because of this effect, the growing season is lengthened a few days on each end. The warming effect, however, is confined to times when winds blow from a northerly direction. Jefferson is too far from the lake for its temperature to be greatly affected by the lake. During the warm periods, one effect of the lake reverses because water is cooler than land. The combination of lake influence and topographic features produces a large variation in precipitation.

Lake Erie affects the weather primarily by moderating the temperatures. The high temperature during the day is lowered in the summer, and low temperature is raised in winter when winds are blowing across the warmer water. When winds are from a southerly direction, the lake has no effect on the weather. In the interior of the county, daytime temperatures are 2 to 5 degrees lower than those near the lake shore. This contrast is most noticeable when comparing climate records for Geneva and Dorset, where instruments are located on level farmland.

Annual precipitation ranges from about 35 inches on the shore line to more than 42 inches at higher elevations along the west-central part of the county. The average is about 37 inches on the costal strip and is 39 or 40 inches within the valley of the Grand River. This difference in precipitation is caused mostly by a difference in elevation. When moisture-bearing winds are forced to rise over hills, the amount of rainfall or snowfall increases in rough proportion of the distance the moisture rises.

3.4.2 Geauga County

Geauga County is cold and snowy in the winter and warm in the summer. Areas nearest Lake Erie are markedly cooler than the rest of the area in the summer. Precipitation is well distributed during the year and is adequate for most crops on most soils. From late in fall through winter, snow squalls are frequent. In some years, a single prolonged storm can leave more than 2 feet of snow on the ground, and strong winds can create deep drifts.

In winter, the average daily minimum temperature is 19 degrees. The lowest temperature on record which occurred at Chardon on January 24, 1963 is -20 degrees. In summer the average temperature is 69 degrees, and the average daily maximum temperature is 79 degrees. The highest recorded temperature, which occurred on September 12, 1953, is 98 degrees.

The total annual precipitation is about 46 inches. Of this, 23 inches, or 50% usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 20 inches. The heaviest 1-day rainfall during the period of record was 4 inches at Chardon on August 15th, 1952. Thunderstorms occur on about 40 days of each year, and most occur in summer.

Average seasonal snowfall is 113 inches. The greatest snow depth at any one time during the period of record was 34 inches. On an average of 43 days, at least one inch of snow was on the ground. The number of such days varies greatly from year to year.

The average relative humidity in mid afternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 30 percent in winter. The prevailing wind is from the south. Average wind speed is highest, 13 miles per hour, in January.

Crop development early in the growing season is slowed by frequent cool winds off of a cold lake. This slowing is important to fruit crops, which usually blossom only after most chance of spring freeze is past. Fall winds, which blow off of a relatively warm lake, delay the first fall freeze and prolong the growing season for all crops.

3.4.3 Lake County

Lake County has warm summers and cold winters. Precipitation is well distributed during the year and is adequate for most cultivated crops. From late fall through winter, snow squalls are frequent and total snowfall is normally heavy. In some years a single prolonged storm can even leave more than 2 feet of snow on the ground, and strong winds can cause deep drifts.

The climate of Painesville represents the climate of the parts of the county near Lake Erie. The climate of Chardon is more representative of the southern part of the county.

In Painesville the average temperature in winter is 30 degrees F, and the average daily low is 23 degrees. The lowest temperature on record at Painesville was 15 degrees below zero on January 24, 1963. In summer the average temperature is 70 degrees, and the average daily high is 79 degrees. The highest recorded temperature is 96 degrees recorded on June 20, 1963.

In Chardon, the average temperature in winter is 27 degrees F, and the average daily low is 19 degrees. The lowest temperature on record at Chardon was 20 degrees below zero on January 24, 1963. In summer, the average temperature is 69 degrees, and the average daily high is 79 degrees. The highest temperature on record was 98 degrees on September 2, 1953. The average temperature in summer is cooler in Chardon than in Painesville because of the higher elevation--- 1,130 feet.

Beginning in spring, growing-degree days accumulate by the amount that the average temperature each day exceeds a base temperature if 40 degrees F, which commonly is used to calculate growth of small grain and grass crops. Corn and soybeans require a higher base temperature for growth. The normal monthly accumulation is used to schedule single or successive plantings of a crop between last freeze in spring and first freeze in fall.

Of the total annual precipitation, about 55 percent generally falls between April and September; this period includes the growing season for most crops. Two years in ten, the April to September rainfall is less than 20 inches in Chardon and 16 inches in Painesville. The heaviest one-day rainfall during the period of record was 4 inches at Chardon on August 15, 1962, and at Painesville on July 17, 1968. There are about 36 thunderstorms each year, 18 of which are in summer.

Average seasonal snowfall is 40 inches in Painesville and 113 inches in Chardon. The greatest snow depth at any one time during the period of record was 15 inches in Painesville and 34 inches in Chardon. On the average, 18 days have at least 1 inch of snow on the ground in Painesville, and 43 days had at least 1 inch in Chardon. The number of days varies greatly from year to year.

The average relative humidity in mid-afternoon is about 60 percent. Humidity is higher at night in all seasons, and the average at dawn is about 80 percent. The percentage of possible sunshine is 70 percent in summer and 30 percent in winter. The prevailing wind direction is from the south. Average wind speed is highest, 13 miles per hour, in March.

Crop development early in the growing season is slowed by frequent cool winds off a cold lake. The slowing is important for fruit crops which generally do not blossom until after chance of a freeze in spring passes. Fall winds, which blow off a relatively warm lake, delay the first freeze in fall and prolong the growing season for all crops.

3.5 Surface water

3.5.1 Wetlands

The map below shows the wetlands for the Lower Grand River Watershed by the Ohio Wetlands Inventory. Lowland woods, or swamps, were mapped for areas of hydric soils that were forested. Marshes were determined by emergent vegetation in water less than three feet deep. Wet meadows were defined as grassy vegetation in water less than six inches deep. Scrub/shrub wetlands were designated by emergent woody vegetation in water less than three feet deep.

This classification was based on analysis of satellite data and existence of hydric soils. Many wetlands may have not been indicated, and the accuracy of these maps is dependent on the quality if the resource materials used to create them.

These maps should be used to show the general locations and concentrations of wetlands, not to identify individual wetlands on specific properties.

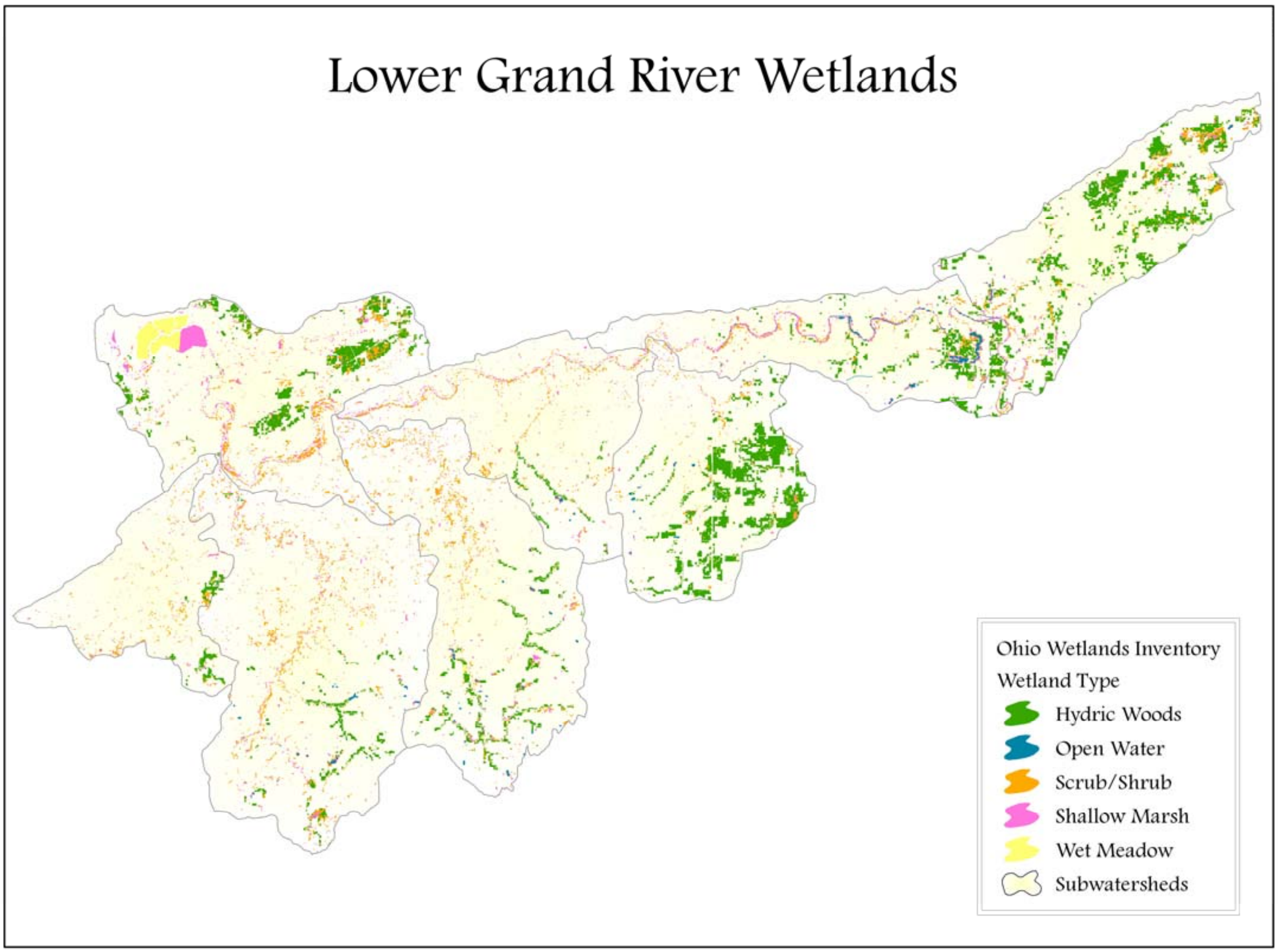
The forested wetlands include all wooded areas with hydric soils. In many instances, the actual wetlands within these areas are less extensive than the areas of hydric soils. Many areas of hydric soils have been drained over time by artificial and natural processes. In addition, the soil surveys were originally focused on agriculturally productive areas, thus the accuracy of the soil survey is sometimes not as reliable within forested lands.

Over the past 50 years, more than 50 percent of the wetlands in the continental United States have been destroyed as a result of conversion to agriculture, mining, forestry, and urban uses. The primary ecological values of wetlands are water quality improvement, hydrologic functions, and wildlife habitat. Wetlands act as sponges that absorb water, delaying its downstream release, and serve as biological filters by purifying water before it proceeds downstream. Wetlands are important in flood mitigation and storm water abatement. They are also important for aquifer recharge and for streambank stabilization during high flows. Wetlands provide diverse habitat to many species, including a significant number of rare, threatened, and endangered plants and animals.

Because wetlands hold exceptional environmental value and deserve maximal environmental protection, there are existing federal laws that regulate the discharge of dredged or fill material into waters of the United States, including wetlands. These regulations are found under Section 404 of the Clean Water Act. In Ohio, the U.S. Army Corp of Engineers is in charge of the wetlands regulatory program. The Buffalo District of the U.S. Army Corp of Engineers has jurisdiction of all aquatic areas in Ohio that drain into Lake Erie, including the Grand River Watershed.

There are approximately 12,942 acres of wetlands in the Lower Grand River Watershed; approximately 6,598 acres of Hydric Woods, approximately 282 acres of Open Water Wetlands, approximately 3,191 acres of Scrub/Shrub Wetlands, approximately 1,804 acres of Shallow Marsh Wetlands, and approximately 1,066 acres of Wet Meadow wetlands.

Map 13- Lower Grand River Watershed OWI



3.5.2 Streams

Table 9- Named Tributaries located within each 14 Digit HUC

14 Digit Hydraulic Unit Code (HUC)	Named Tributary
04110004060010	Center Creek
04110004060010	Coffee Creek
04110004060030	Mill Creek
04110004060040	Griswold Creek
04110004060040	Talcott Creek
04110004060050	Bates Creek
04110004060050	Phelps Creek
04110004060050	Paine Creek
04110004060060	Cutts Creek
04110004060060	Jenks Creek

04110004060060	Big Creek
04110004060060	Alyworth Creek
04110004060060	East Creek
04110004060060	Gordon Creek
04110004060070	Kellogg Creek
04110004060070	Ellison Creek
04110004060080	Red Creek
04110004060080	Pebble Branch

3.5.3 Tributary names, length, watershed size, floodplain areas, etc.

For information on each of the tributaries located within the Lower Grand River Watershed, see Section II- 14 Digit Subwatershed Analysis.

3.5.4 Tributary use designations

For information on each of the tributaries located within the Lower Grand River Watershed, see Section II- 14 Digit Subwatershed Analysis.

The following table shows the use designations for the named tributaries in the Lower Grand River Watershed.

Table 10- Use Designation Status

Tributary Name	Use Designation
Grand River (Paine Creek to Lake Erie)	EWH
Pebble Branch (Tiber Creek)	WWH
Red Creek	WWH
Kellogg Creek	WWH
Ellison Creek	WWH
Big Creek	WWH
Gordon Creek	WWH
East Creek	WWH

Alyworth Creek	WWH
Jenks Creek	WWH
Cutts Creek	WWH
Paine Creek	WWH
Bates Creek	WWH
Phelps Creek	WWH
Grand River (Mill Creek to Paine Creek)	EWH
Talcott Creek	WWH
Griswold Creek	WWH
Mill Creek (1)	WWH
Phelps Creek	WWH

3.6 Ground Water Resources

Groundwater resources in the Grand River Watershed areas are obtained from the consolidated Devonian shale and Lower Pennsylvanian and Mississippian sandstone and shale bedrock aquifer systems, and from the glacial deposits that cover the region. The most productive aquifers in the watershed are found in scattered valley fill sand and gravel deposits or lenses, and from sandstones of the Pennsylvanian Pottsville Group. Groundwater yields in the watershed range from areas in which yields of 25-100 gallon per minute may be developed, to areas where less than 3 gallon per minute may be developed. Yields are meager for most of the watershed, providing just enough water for domestic use.

Glacial till of varying thicknesses overlies the bedrock aquifers in the study area. A generalized map of glacial deposits of Northeast Ohio indicated that a clay-rich Hiram till is found at the surface in the majority of the watershed. The clay-rich nature of this till may provide some protection to the groundwater resources in the area, because its low permeability slows infiltration from the surface to the aquifer.

Flow in the Lower Grand River is fed pr imarily by rainfall and snow melt, with very little base flow sustained by ground water because of the river's glacial history and bedrock geology. Consequently, discharge becomes quite small in the summer relative to drainage area. The Lower Grand River and its adjoining tributaries have limited assimilative capacity, so they are quite fragile and can be expected to reach their quality threshold at comparatively modest amounts of suburban development. The minimum 7-day average stream flow with a 10-year recurrence interval (7Q10) for the USGS gauge at SR 84, where the drainage area is 685 mi^2, is 9.0 cfs. For comparison, the 7Q10 for the Chagrin River at Willoughby is 14 cfs at a drainage area of 246 mi^2. Discharge in the Grand River during the summer is strongly related to rainfall in the preceding month, and has shown a downward trend commensurate with average monthly precipitation between 1974 and 1997.

3.7 Land Use

Analysis of aerial photographs confirms that land use within the watershed is primarily residential, agricultural, and undeveloped land. Very little industrial development has occurred in the area. Most of the industrial land is concentrated between Painesville and Fairport.

Land use in Lake County is greatly influenced by topography. Steep slopes surround the river, making access very difficult. Most of the steep slopes and valleys are covered by mature forest with relatively little development. There are few road crossings over the river. Residential land use is predominant in Lake County where development has occurred. As land values and development pressures increase, the large amounts of remaining undeveloped land will become prime targets for residential developments. Historically, developers have avoided sensitive lands with environmental constraints because of the extra costs of developing those parcels. However, as open space becomes less available, environmentally sensitive lands tend to experience increased development pressures.

Land use upstream in Ashtabula County is a mixture of agricultural and residential. Scattered residences are found along established roads with very few new streets and subdivision development. Agriculture is widespread throughout the county. Hayfields are most common. Since no plowing is involved with this practice, the effect in the Grand River is minor. A few crop fields were noted, but all had good forested buffer zones along the river and its tributaries. The large wetlands surrounding the river through the county have made the land unsuitable for development; therefore, large tracts of natural areas remain.

The majority of the land in the watershed is zoned residential. Two trends are of concern; the loss of agricultural land and natural land to urban development, and the conversion of some natural lands such as riparian areas to agricultural use.

3.8 Cultural Resources

Below is a list of the Historical and Cultural resources located within the Lower Grand River Watershed.

Table 11- Cultural and Historical Resources

NAME	RESOURCE TYPE	AREA OF SIGNIFIGANCE	LISTING CRITERIA	CITY	COUNTY
Administration Building, Lake Erie College	Building	- Education - Architecture	- its association with the events that have made a significant contribution to the broad patterns of our history - its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Painesville	Lake
Casement House	Building	- Architecture	- its association with the events that have made a significant contribution to the broad patterns of our history	Painesville	Lake
Indian Point Fort	Site	- Prehistoric	- it has yielded, or may be likely to yield, information important in prehistory or history	Painesville	Lake
Lutz's Tavern	Building	- Architecture	- its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Painesville	Lake
Mathews House	Building	- Architecture	- its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose	Painesville	Lake

			components may lack individual distinction		
Mentor Avenue District	District	- Education - Politics/Government - Architecture - Social History - Religious - Property	- its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction - it represents a significant and distinguishable entity whose components may lack individual distinction - its association with the life of a person or people important in our past at the local, state, or nation level	Painesville	Lake
The Methodist Episcopal Church of Painesville	Building	- Religious Property - Architecture	- its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Painesville	Lake
Lewis Morley House	Building	- Architecture	- its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Painesville	Lake
Painesville City Hall	Building	- Politics/Government - Architecture	- its association with events that have made a significant contribution to the broad patterns of our history - its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Painesville	Lake
Uri Seeley House	Building	- Architecture	- its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Painesville	Lake
Sessions House	Building	- Architecture	- its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Painesville	Lake
Smead House	Building	Architecture	- its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Painesville	Lake
South Leroy	Building	- Religious Property	- its association with events that have	Painesville	Lake

Meeting House		- Social History	made a significant contribution to the broad patterns of our history		
St. James Episcopal Church	Building	- Religious Property - Architecture	- its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Painesville	Lake
Lucius Green House	Building	- Architecture	- its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Perry	Lake
Chardon District •Commerce •its association with events Chardon Geauga Courthouse Square District	District	- Commerce - Architecture - Social History	- its association with events that have made a significant contribution to the broad patterns of our history - its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Chardon	Geauga
Fowlers Mill Historic District	District	- Architecture - Industry - Commerce	- its association with events that have made a significant contribution to the broad patterns of our history - its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction	Chardon	Geauga
Ashtabula County Courthouse Grounds	District	- Community Planning and Development - Politics/ Government - Architecture - Social History	- its distinctive characteristics of a type, period, or method of construction, because it represents the work of a master, possesses high artistic values, or because it represents a significant and distinguishable entity whose components may lack individual distinction - its association with the life of a person or people important in our past at the local, state, or nation level	Jefferson	Ashtabula
Joshua Reed Giddings, Law Office	Building	- Politics/Government	- its association with the life of a person or people important in our past at the local, state, or nation level	Jefferson	Ashtabula

3.9 Previous and Complementary Watershed Planning Efforts

3.9.1 History of previous water quality efforts in the watershed

3.9.1.1 Grand River Riparian Corridor Protection Plan

A consortium of public agencies and private organizations in Ashtabula, Geauga, Lake, and Trumbull Counties, known as the Grand River Partnership, initiated the Grand River Watershed Protection Project. Grand River Partners, Inc. is a land trust formed by the partnership.

An initial effort of the Grand River Watershed Protection Project has been to acquire conservation easements in the riparian corridor of the Grand and its major tributaries. To this end, three target areas—called "critical areas" by the Grand River Watershed Protection Project—along the mainstem of the Grand have been identified. Critical Area 1 is located in Trumbull and Ashtabula Counties and consists of about 38 square miles. Critical Area 2 lies along the middle stretch of the Grand in Ashtabula County and is the largest of the three, comprising of about 57 square miles. Critical Area 3 consists of about 33 square miles in Lake and Geauga Counties. Thus, a total land area of roughly 128 square miles (about 18%) of the watershed) is targeted for the acquisition of conservation easements.

The protection plan compiles all available natural resource maps of the watershed. These include soils, current land use, floodplains, groundwater resources, wetlands (as identified by the Ohio Wetlands

Inventory), locations of NPDES discharges, rare, threatened, and endangered species, and critical areas.

Aerial photography was used to characterize the three critical areas for riparian corridors, large wetlands systems, and significant tracts of contiguous woodlands. Davey Resource Group biologists' field-checked portions of the critical areas as a quality control measure.

The Grand River Watershed Protection Project's goal is to protect the water quality and aquatic habitat, wetlands, and associated forest communities of the 705-sqaure-mile (approximately 455,680 acres) Grand River Watershed.

The first objective is to protect the riparian corridor of the Grand River and major tributaries through acquisition of conservation easements and land use controls. Criteria for prioritization of conservation easements have been created and land use controls that local jurisdictions can use have been identified based on public health and safety.

The second objective is to provide education for landowners on the ecological and economic benefits of riparian buffers, wetlands, floodplains, and steep slopes. The Grand River Riparian Corridor Protection Manual being developed in conjunction with this report will assist elected officials, public servants, decision makers, and concerned citizens in making the right choices for watershed protection.

The Grand River Riparian Corridor Protection Plan was adopted by the Grand River Partnership in March of 1998.

3.9.2 Listing of current efforts that will help to meet water quality standards that are occurring in the watershed

3.9.2.1 *Environmental Quality Incentives Program*

The Environmental Quality Incentives Program (EQIP) was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land.

EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practices and a maximum term of ten years. These contracts provide incentive payments and cost-shares to implement conservation practices. Persons who are engaged in livestock or agricultural production on eligible land may participate in the EQIP program. EQIP activities are carried out according to an environmental quality incentives program plan of operations, developed in conjunction with the producer that identifies the appropriate conservation practice or practices to address the resource concerns. The practices are subject to NRCS technical standards adapted for local conditions. The local conservation district approves the plan.

EQIP may cost-share up to 75 percent of the costs of certain conservation practices. Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the incentive. However, limited resource producers and beginning farmers and ranchers may be eligible for cost-shares up to 90 percent. Farmers and ranchers may elect to use a certified third-party provider for technical assistance. An individual or entity may not receive, directly or indirectly, cost-share or incentive payments that, in the aggregate, exceed $450,000 for all EQIP contracts entered during the term of the Farm Bill.

3.9.2.2 *Wildlife Habitat Incentives Program*

The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP USDA's Natural Resources Conservation Service provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed.

WHIP has proven to be a highly effective and widely accepted program across the country. By targeting wildlife habitat projects on all lands and aquatic areas, WHIP provides assistance to conservation minded landowners who are unable to meet the specific eligibility requirements of other USDA conservation programs.

The Farm Security and Rural Investment Act of 2002 reauthorized WHIP as a voluntary approach to improving wildlife habitat in our Nation. Program administration of WHIP is provided under the Natural Resources Conservation Service.

3.9.2.3 *Wetlands Reserve Program*

The Wetlands Reserve Program is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The USDA Natural Resources Conservation Service (NRCS) provides technical and financial support to help landowners with their wetland restoration efforts. The NRCS goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.

3.9.2.4 *WREP*

In the spring of 2006, Grand River Partners, Inc. through the efforts of the Western Reserve RC&D, was awarded federal dollars for the protection of riparian areas through a new sister program of the popular Wetland Reserve Enhancement Program (WRP), called the Wetland Reserve Enhancement Program (WREP). WREP was established to expand existing WRP easements to neighboring landowners. Recognized for its water quality and biological diversity, the Grand River is currently the only watershed in Ohio that these funds have been made available to.

3.9.2.5 *Lake Erie College*

Lake Erie College began testing on the Grand River and some of its tributaries in June 2003, and has been continuing the testing cycle. The goal of this water testing program is to establish baseline water quality data for the Grand River. This is intended to be accomplished by developing a sample routine (twice yearly) at selected sites along the Grand River and its tributaries using chemical and biological parameters to indicate the health is the Grand River.

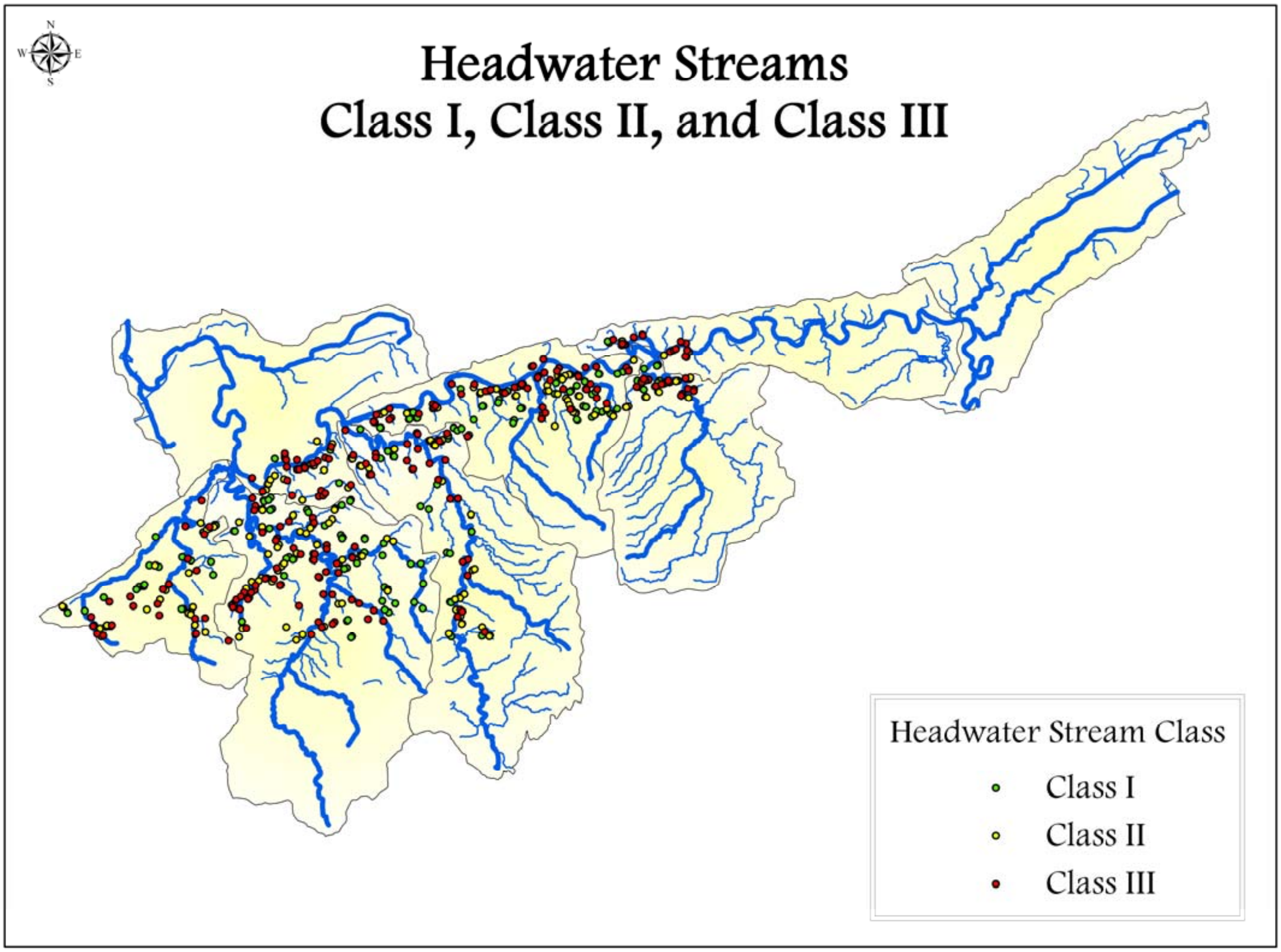
3.9.2.6 *Lake Soil and Water Conservation District*

The Lake County Soil and Water Conservation District has developed Erosion and Sediment Control Regulations that have been adopted by the Lake County Commissioners. These regulations are applied to construction activities that occur within Lake County.

3.9.2.7 *Headwaters Habitat Evaluation Index (HHEI)*

This project is a comprehensive survey of stream health and is an ongoing project of Lake SWCD. Since a river's conditions are dependent on the waters that flow into it, HHEI focuses on the upper reaches and sources of the larger watersheds. The information collected includes physical and chemical characteristics as well as a survey for biological activity. Physical characteristics include composition of the stream bed, and canopy cover, among other things. Some of the chemical measures are oxygen and pH or acidity. After a site visit, the data is entered into a computer database and can be used to create geographic information system (GIS) maps showing stream conditions.

Map 14- Lake SWCD HHEI data



3.9.2.8 *Geauga Soil and Water Conservation District*

The Geauga County Soil and Water Conservation District has developed Erosion and Sediment Control Regulations that have been adopted by the Geauga County Commissioners. These regulations are applied to construction activities that occur within Geauga County. Along with the ESC regulations, Geauga County has recently adopted a countywide riparian and wetland setback ordinance.

3.9.2.9 *Lake County Stormwater Management Department*

In 1999, the United States Environmental Protection Agency (USEPA) issued a mandate pursuant to the Clean Water Act requiring urban areas to improve water quality. Specifically, the National Pollutant Discharge Elimination System (NPDES) regulations have imposed six minimum control measures which are targeted at improving our Nations water resources. Most communities in Lake County met the urbanized area definition in the 2000 census and were therefore included under the new regulations. In response to these requirements, Lake County formed a Stormwater Management Department in August 2003. The Department has 16 member communities that receive services. The federal mandate requires that local governments bear all costs associated with the new regulations, so Lake County instituted a stormwater user fee program. The fees are charged on individual parcels of land based on the amount of impervious area on the property (hard surface). The amount of impervious land is used because it has been shown to be a good indicator of the amount of runoff that leads to pollution. All residential properties are charged a base rate. Nonresidential properties are charged based upon the square footage they contain divided by the equivalent residential unit (ERU) which is 3,050 sq. ft. For example, a commercial property with 30,500 sq. ft. of impervious surface would pay 10 times that of a residential property (30,500/3,050=10).

3.9.2.10 *Ohio EPA*- IBI, HHEI, TMDL, QHEI. ICI

The biological integrity of Lake Erie's near shore areas continues to be monitored by Ohio EPA using fish communities as an indicator of overall ecosystem health. A fish community's health integrates a wide range of environmental factors (water chemistry, habitat quality, food web structure, etc.) and can be easily measured using the Index of Biotic Integrity, or IBI.

The IBI uses 12 fish community characteristics based on species numbers, behavior and trophic guilds, and community health. Each community characteristic was ranked as a zero, one, three, or five based on how closely the measure approached natural, undisturbed conditions, with the best condition receiving a score of five. All 12 scores are summed resulting in a score ranging from 0 (dead) to 60 (undisturbed). The three areas that were scored include the near shore zones (right along the shore), river mouths, and freshwater estuaries.

Primary headwater habitat streams (PHWH) are identified by Ohio EPA as waterways that have a defined bed and bank with watershed area less than 1 square mile (256 ha; 633 ac; 2.59 km2), that also have deep pools less than 40 cm. Primary headwater streams are the precursors to larger streams and rivers in Ohio. They have important water quality, ecological, and economic functions, including sediment and nutrient retention, refuge for native wildlife, energy dynamics, water supply, and aesthetics.

As part of a primary headwater stream initiative, the Ohio EPA, Division of Surface Water, evaluated a total of 305 sites in 1999 and 2000 to document the physical, chemical, and biological characteristics of small streams in Ohio. The Ohio EPA has coined the term “Primary Headwater Habitat” (PHWH) to describe headwater streams that have a well defined bed-bank and channel with drainage areas less than 1.0 square mile, or maximum pool depth less than 40 cm. The goals and objectives of this study were generally to provide the statewide data necessary to support a rule-making to define appropriate aquatic life use designations for primary headwater habitat streams.

Sites included in a year 2000 study of 10 Ohio counties with potentially rapidly developing areas (PRDA study). Sites were randomly selected within target counties for the PRDA study to provide a statistical estimation of the distribution of PHWH stream types within different areas of the State. Sites were selected in the four major ecoregions of Ohio. A modification of the QHEI habitat assessment method, called the HHEI, was developed to help distinguish among the various classes of PHWH streams. The HHEI was deemed necessary because it was found that the QHEI was not able to statistically separate Class I from Class II PHWH streams. This is understandable because the QHEI was calibrated to fish communities found in much larger streams, where numerous fish species are present. However, the fish species richness in PHWH streams is low, often with only a single dominant species present such as the creek chub. In contrast to the QHEI which is calibrated to fish communities, the HHEI was initially calibrated to the presence/absence of headwater salamander populations, which replace fish as the top vertebrate predators in PHWH streams. As with the QHEI, the HHEI is a field assessment tool to be used to determine "potential" aquatic life uses. It was found that three physical habitat measures (1) bankfull width, (2) maximum depth of pools, and (3) substrate type & percent could be used to statistically separate Class III streams from Class II and Class I streams.

3.9.2.11 *GRPI- Land Protection/ Partnership*

Grand River Partners, Inc. is a non-profit land trust whose primary objective is to serve as a land conservancy dedicated to protecting the Grand River, its tributaries, and watershed. In this capacity, we assist landowners in the planning, managing, and protection of their property through sound, cost-effective conservation practices. The mission of this organization is "To preserve the water quality, open space, the natural, recreational, agricultural, and scenic resources of the Grand River in Ashtabula, Geauga, Lake, Portage, and Trumbull Counties by uniting residents, landowners, businesses, and communities in the stewardship and permanent protection of the Grand River Watershed."

Grand River Partners, Inc. has partnered with other agencies in the Grand River Partnership to hold easements, procure monies, and assist in the protection of properties. Thus far, GRPI holds 26 easements and owns 3 properties, for a total of 2444.6 acres of permanently protected natural land.

3.9.2.12 *The Nature Conservancy, Natural Condition Index of the Grand River Watershed*

The Nature Conservancy (TNC) has been utilizing Geographical Information System (GIS) to gather data and develop a hierarchy for 14 digit HUC's (hydraulic unit codes) in the Grand River Watershed. Population density, Land use, Core Forest, Riparian areas, and Protected Lands data layers were all used to determine the sensitive areas of the watershed. Each 14-digit HUC was assigned a score after examining each of these parameters. Core forest areas were identified as Forested areas of 100 acres or more with a forested buffer zone from pastures and agriculture, and no roads within at least 300 meters. This number was determined based on the needs of certain organisms. For example, a breading pair of pileated woodpeckers needs at least 100 acres to breed, and certain amphibians use forest up to 200 meters away from the wetland in which they live. TNC also examined the condition of the riparian areas of the watershed. By using the land cover, it was determined if there was sufficient riparian buffer. This parameter was also used to determine the final score of the watershed.

3.9.2.13 *Land Protection Priority List Project*

Grand River Partners, Inc.'s goal is to protect the natural resources of the Grand River and its watershed. Grand River Partners, Inc. utilizes the conservation easement as the primary tool to protect such resources. Conservation easements are a great tool to protect resources on private lands but still maintain them in private hands. The Grand River watershed is approximately 712 square miles. Obviously Grand River Partners, Inc. cannot protect all of the 712 square miles (455,000 acres) with conservation easements. Grand River Partners, Inc. believes that water quality can be protected by conserving the "right" 25% of a watershed. In the specific case of the Grand River, this represents roughly 114,000 acres. Protecting 114,000 acres is an achievable goal considering the number of partner organizations and the fact that approximately 25% of the 114,000 acres has already been protected.

The challenge remains to protect the remaining 86,000 acres of the "right" land. To fulfill this goal, Grand River Partners, Inc. developed a parcel based **Land Protection Priority List**. Before any prioritization process could begin, any parcel less then five acres was removed from the potential list of priorities. To make fair comparisons an analysis of the watershed was conducted to determine the unique areas within the watershed. From this analysis, the Grand River Watershed was divided into 5 distinct project areas based on the unique natural features of each. The parcel prioritization process involved a two tier analysis. The first, Tier 1, involved an analysis of natural resources. The second, Tier 2, involved a strategic analysis that took into account parcel size, proximity to other protected land, and partner priorities.

The Headwaters Project Area consists of the area drained by all the unnamed tributaries that together form the Grand River. The area begins more or less upstream of the crossing with SR 534 at the southern end of the watershed. In summary, important natural resources ranked for each parcel located in the Headwaters Project Area are intact riparian areas, the Grand River main stem, wetlands, unnamed tributaries, floodplains, core forest blocks and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Lowlands Project Area begins at the crossing of SR 534 with the mainstem in the southern portion of the watershed and extends between the 810' contour interval north to the crossing where the Grand River intersects Windsor-Mechanicsville Road. Important Natural

Resources identified in the Lowlands Project Area are swamp forests, wetlands, intact riparian areas, core forest blocks, mainstem, rare species, floodplains, TNC subwatershed ranking, and named tributaries. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Gorge Project Area begins at the crossing of the mainstem and Windsor-Mechanicsville Road bridge and extends upstream to the crossing with SR 84. The Gorge Project Area is bordered to the north by the watershed boundary and to the south by the 950' contour interval. The important natural characters of the Gorge are the mainstem, wetlands, floodplains, intact riparian areas, named tributaries, core forest blocks, steep slopes, TNC subwatershed rankings, and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Estuarine/Urban Project Area begins at the State Route 84 crossing with the Grand River and ends in Fairport Harbor Village and Grand River Village at its terminus with Lake Erie. The Estuarine/Urban Project Area includes the subwatershed of Red Creek which extends to the west just north of the City of Painesville. In this project area the mainstem, river access points, wetlands, intact riparian areas, floodplains and named tributaries were considered important natural features. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The last area is the Tributaries Project Area which consists of two areas; one is located east of the Grand River Lowlands Project Area, which and includes the subwatersheds of such named tributaries as Mill Creek, Rock Creek and Coffee Creek, and the second project area is located west of the Lowlands Project Area, north of the Headwaters Project Area and south of the Gorge Project Area. This portion of the Tributaries Project Area contains the subwatersheds of such high quality streams as Indian Creek, Phelps Creek, Hoskins Creek, and Paine Creek. Important natural resources considered include, cold water habitat, wetlands, floodplains, core forest blocks, and rare species. Again each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

Each parcel within the watershed was further evaluated based on additional strategic rankings. These rankings include parcel size, proximity to protected land and partner priorities. Each parcel meeting the acreage requirement, or within a certain distance of existing protected land or included as a priority by a partner organization or agency was weighted more heavily and therefore considered a high priority. A statistical analysis of the final scores was performed and each parcel was categorized as being priority, high priority or an urgent priority parcel.

4. USE ATTAINMENT STATUS

4.1 Aquatic Life Attainment

Aquatic life in the Grand River is fully attaining standards for Exceptional Warmwater Habitat (EWH) from Sweitzer Road (RM 42.2) to the SR 2 bridge in Painesville (RM 5.2), and is fully meeting standards for Warmwater Habitat (WWH) downstream from the SR 2 bridge. The Seasonal Salmonid use designation currently in place should be retained.

The Grand River is an economic asset to Northeast Ohio, but is especially sensitive to pollution and disturbance because of limited summer base flows. Therefore, regional planning, stream protection policies, comprehensive construction site management plans, construction site performance bonds, identification and preservation of sensitive areas, and above all, defined limits to growth are needed to maintain the biological integrity of the Grand River.

The Grand River is the only Ohio tributary to Lake Erie that harbors a self-sustaining population of Great Lakes Muskellunge, and therefore is a priority for conservation. The Grand River is also has a native population of walleye and Northern pike making it singularly unique among Ohio streams. The Grand River and its tributaries provide habitat for many species considered rare by Ohio EPA, or listed as threatened or endangered by the Ohio Department of Natural Resources including 34 macroinvertebrates and freshwater mussel species, and 11 fish species. The single greatest threat to the Grand River basin is suburbanization.

The tributaries to the Grand River that are not in full attainment are listed in the table below. These are discussed in more detail in Section II, 14-digit Subwatershed Analysis.

Table 12- tributary impairments

					Causes of Impairment							Sources/Notes	TMDL Method				
HUC	Stream name	River mile	Aquatic life use designation	Status	Sedimentation	Flow alteration	Organic enrichment	Toxicity	Unknown	Natural limitations	Habitat alteration		Load allocation	Permit enforcement	Habitat analysis	Flow modeling	No action
04110004 060	Red Cr.	0.5	WWH	NON		X		X				Urban runoff	F				
	Kellogg Cr.	5.7	WWH	NON				X				Urban runoff	F				
	Big Cr.	16.2	WWH	Partial							X	Urban runoff			X		
	Big Cr.	2.5	WWH	Partial						X						X	
	Jordan Cr.	1.1	WWH	Partial		X						Development; CWH proposed					X
	Paine Cr.	0.5	EWH	Partial						X						X	
	Bates Cr.	2.2/ 2.3	WWH	Partial						X		Wetlands					X
	Bates Cr.	0.6	WWH	NON					X			Data collected by ODNR					X
04110004 050	Mill Cr. (03-120)	25.6	WWH	NON	X							Ag channelization			X		
	Mill Cr. (03-120)	4.1	WWH	Partial						X		Featureless bedrock					X
	Griggs Cr.	2	WWH	Partial						X		Wetlands					X
	Cemetery Cr.	1.3	WWH	NON			X	X				Failing sewer pump station		X			
F = since toxicity is caused by an unknown compilation of chemicals from precipitation runoff, a surrogate consisting of a matrix of fish sample components was used to quantify the impairment.																	

OEPA- TMDL

4.2 Use Designations

Ohio Water Quality Standards list the current use designations for the Grand River system as: agricultural and Industrial Water Supply and Primary Contact Recreation. The mainstem in Geauga and Trumbull Counties, plus all tributaries to the Grand River have been designated Warmwater Habitat. The section of the mainstem identified as scenic has been designated Warmwater Habitat and State Resource Waters. The section of the mainstem identified as wild (located within the

Lower Grand River Watershed) has been designated Exceptional Warmwater Habitat, State Resource Water and Seasonal Salmonid Habitat.

4.3 Biological Indicators

Fish communities in the Grand River have an exceptionally high degree of biological integrity. Furthermore, the Grand River is one of the few rivers in Ohio that has a full suite of endemic, naturally reproducing and self-sustaining top carnivores including walleye, Northern pike, small mouth bass, and muskellunge. The later is the Great Lakes subspecies (*Esox masquinongy masquinongy*), and so represents a vitally important area for genetic and habitat conservation. Given the propensity for muskellunge to differentiate into unique strains, the population in the Grand River may well be a truly endemic strain. As it stands, it is the last naturally reproducing muskellunge population found in any of Ohio's Lake Erie tributaries.

The site sampled at Sweitzer Road did not meet the EWH biocriteria. However, that site is near the transition between WWH and EWH, and lacks a riffle within the sampling zone, so the results do not indicate a water quality or aquatic life use impairment. Similarly the MIWb scores that did not meet the EWH biocriterion were due to natural limitations (very deep, slow current, lacustrine habitat) or sampling inefficiency.

Waste containment ponds from the abandoned Diamond Alkali Chemical Plant are located adjacent to the Grand River. The Diamond Shamrock Works produced chromate compounds, chlorine, chlorinated paraffins, and coke. Diamond Shamrock also accepted and disposed of used spent pickle liquor from nearby steel industries. Eight pollution sources are associated with the Diamond Shamrock Works; 0.75 million tons of chromate waste materials, three waste lakes, a waste water retention basin, a hazardous waste landfill, chromate effluent treatment lagoons, and contaminated soils in the main production area. As part of a remedial effort, clay dikes and caps have been placed around and over the waste lagoons; however, chromium continues to leak into the Grand River, with at least two known discharges reported during the spring of 2004 that violated water quality standards for hexavalent chromium. Fish samples were collected at three locations along the area flanking the Diamond Shamrock waste lakes. IBI and MIWb scores for each of the locations sampled met applicable biocriteria; however, the percent of fish having anomalous deformities, eroded fins, lesions, or tumors (DELT) was elevated above background conditions at each location sampled, all compositional metrics were suppressed, and the relative abundance of all non-pollution tolerant fish was lower than expected. Collectively these findings demonstrate that recovery in the Lower Grand is transient and incomplete. The reach, therefore, remains impaired.

Macroinvertebrate communities were evaluated at 35 stations in the Lower Grand River Watershed during 2003 and 2004. The community performance was evaluated as exceptional at 19 stations, very good at two, good at four, marginally good at three, fair at two, low fair at one, poor at one, and three lacustuary stations that scored high on the Lacustuary ICI. The station with the highest total mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Trichoptera) taxa richness (EPT) was on the Grand River upstream from SR 84 (RM 8.7) with 39 taxa. The station with the highest number of total sensitive taxa was on the Grand River upstream from SR 528 (RM 22.6) with 59 taxa. Twenty-three sensitive taxa (excluding the freshwater mussels) found in the Lower Grand River Watershed are noteworthy because they are not commonly collected in state-wide collections. In addition to these, the state listed Species of Concern crayfish *Orconectes propinquus* (Great Lakes Crayfish) was collected at 19 of the 35 stations in the Lower Grand River Watershed. Seventeen species of freshwater mussels (Unionidae) were collected from the Lower Grand River. In total, two state endangered species, three state threatened species, and four state Species of Concern were found to be present in the Lower Grand River Watershed. This assessment unit had an unusually high number of uncommonly collected sensitive taxa and state listed species, which is an indication of the exceptional resource quality in the Lower Grand River Watershed.

The number of mussel species present in the Lower Grand River has remained constant over the last decade. A review of mussel collection data however shows that seven species of mussel have their distributions restricted to the Mainstem reach below Harpersfield Dam. Of those seven, three may be restricted by habitat requirements, one by a combination of host and habitat requirement, and three appear restricted by host requirement alone. The latter three all use freshwater drum as a host for dispersal of glochidia. Freshwater drum are absent above Harpersfield Dam in the Grand River.

4.4 Groundwater Resources

Groundwater yields in the Grand River can range from less than 5 gallons per minute to 100 gallons per minute, depending on depth, thickness of aquifer and proximity to the source of recharge. In general, the groundwater yields are less than 5 gallons per minute around most of the mainstem. The flood plain in the Lower Grand River Watershed has remained largely undeveloped due to steep walls of Chagrin shale. Population in the Grand River Watershed has increased nearly 7%

between 1980 and 1990, while the population in northeast Ohio as a whole has decreased. Changing land use patterns are altering the rate of flows in the Grand. These low flows are a direct result of glacial history and bedrock geology, therefore impervious surfaces which prohibit groundwater recharge should be held to a minimum in order to ensure groundwater recharge.

4.5 Nonpoint Sources

The quality of surface waters in Ohio has generally improved over the past 25 years. Credit must go to private industries and government entities that have improved point source discharges and upgraded sewage treatment facilities. Now Ohio's major water pollutants primarily come from nonpoint sources; storm water run-off which transports contaminants from broad areas of a landscape. Specific nonpoint source pollution concerns within the Lower Grand River Watershed include:

4.5.1 Construction Sites

Construction of individual houses, residential developments, commercial properties, and industrial sites are occurring throughout this watershed. Uncontrolled storm water runoff from construction sites can carry tons of soil into local streams, and devastate aquatic communities. If the excavated area is to exceed 5 acres an NPDES permit must be filed with the Ohio EPA and a storm water management plan developed. The new NPDES Phase II regulations require and construction that disturbs 1 acre or more must submit an erosion and sediment control plan. A large portion of the communities within the Lower Grand River Watershed fall under NPDES Phase II regulations.

4.5.2 Farms, Orchards and Nurseries

The Lower Grand River Watershed includes numerous farms, orchards and nurseries. Plowing fields to the edge of waterways can cause significant soil loss into local streams. Sudden sediment loads can totally change stream bottom habitat, which directly impacts the entire aquatic community. Over application or untimely application of herbicides and pesticides can stress or eliminate aquatic organisms. Fertilizer run-off can cause aquatic plants and algae to grow at high rates, creating an imbalance in the ecosystem.

Local Soil and Water Conservation Districts have been working with farms and nurseries on conservation practices. The districts have encouraged practices such as no-till farming, animal waste storage structures, minimal usage of chemicals, filter stripping, livestock exclusion fencing, etc. Many of these operators have discovered that new techniques may not only improve the environment, they often save time and money. Continuing education throughout the watershed is necessary.

4.5.3 Failing Septic Systems

A major portion of the Lower Grand River Watershed is not serviced by sanitary sewers. A high percentage of the septic systems in this watershed are well beyond 20 years in age (the expected life of a system). Additionally, high percentages of clay content in the local soils, and shallow bedrock contribute to the high failure rates of septic systems. Inadequately treated sewage can impact the water quality of roadside ditches, wetlands, streams, and lakes. This can cause health hazards in drinking and recreational waters, decreased oxygen levels, excessive aquatic plant growth and offensive odors. Areas identified with large concentrations of failing septic systems include:

- **Ashtabula County** - Austinburg (Coffee Creek subwatershed)

Data indicating the number of failing systems located within the Lower Grand River Watershed is currently not available.

4.5.4 Urban Runoff

Large and small communities have storm sewer systems which discharge to all of the watershed basins. Urbanized pollutants (*e.g.*, road salts, vehicle fluids, litter and debris, lawn chemicals, pet wastes) can be detrimental to local water quality. City ordinances and programs which help control these concerns are important. Educating the community at large about these effects is very important in establishing support for, and compliance with existing or proposed ordinances and programs.

4.5.5 Timber Harvesting Operation

Heavy timbering activities are occurring in the Grand River Watershed. Poor road layout and construction can contribute enormous volumes of sediment during active operations. If the timber has been over harvested, erosion will continue until a natural vegetative cover has been established. Professional foresters are available to monitor and educate timber harvesting operations.

4.5.6 Oil and Gas Extraction

Hundreds of oil and gas wells have been developed in the Grand River Watershed. Oil and brine spills from a well or tank can devastate a local waterway. The Ohio Department of Natural Resources, Division of Oil and Gas and the Ohio EPA Division of Emergency and Remedial Response have jurisdiction over spills.

4.5.7 Riparian Corridor Protection

Vegetation along the embankments of streams and lakes offers many benefits including stream bank stabilization, filtration of run-off waters, food source for fish and wildlife, cooler water temperatures, and habitat enhancement. Conservation easements, land trusts, education, and responsible legislation are valuable tools for riparian corridor protection.

14~DIGIT

SUBWATERSHED INVENTORY

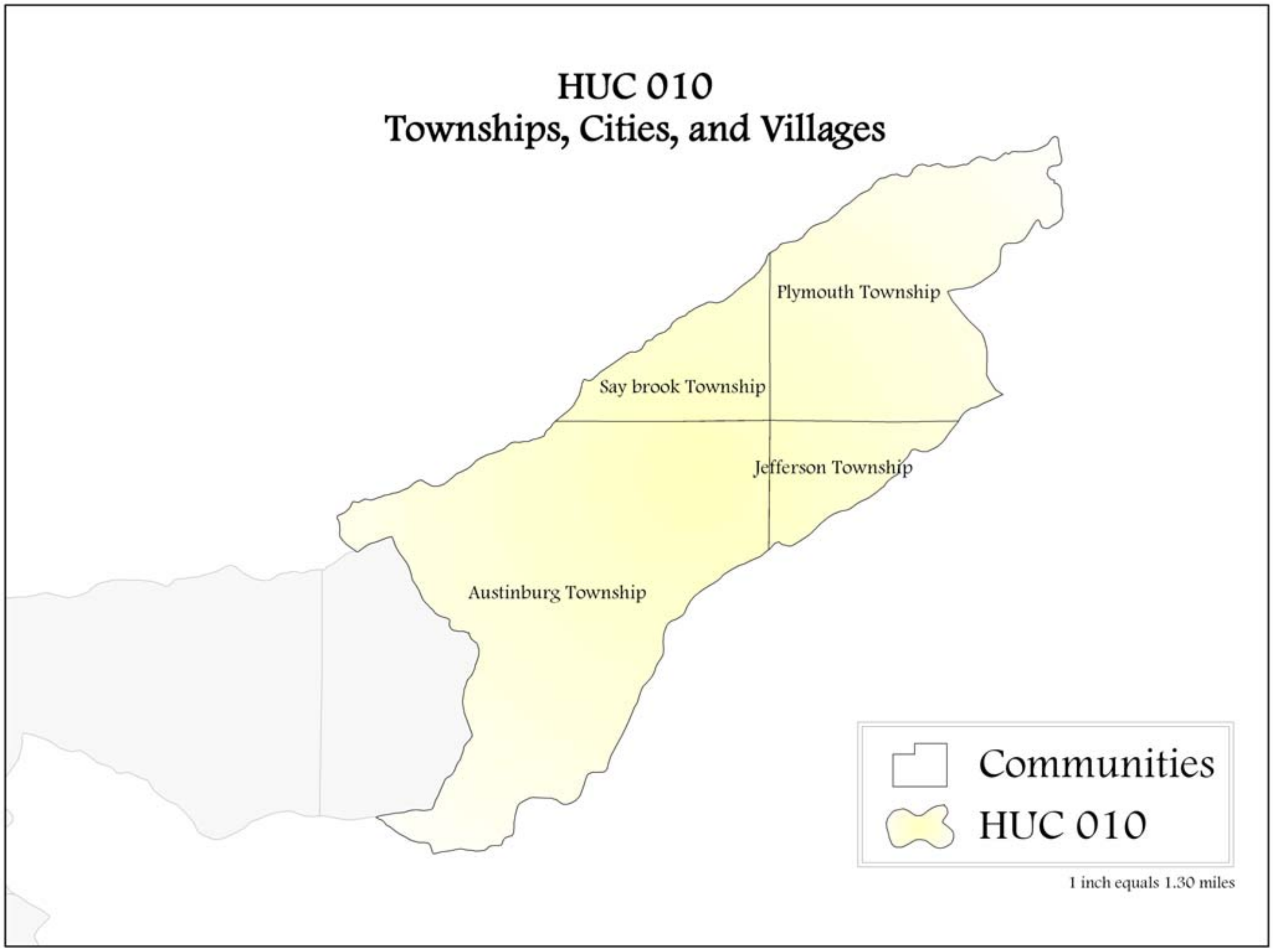
A Detailed Subwatershed Inventory of the HUCs

located within the Lower Grand River Watershed

04110004060010 ~ Grand River below Mill Creek (2) to below Coffee Creek

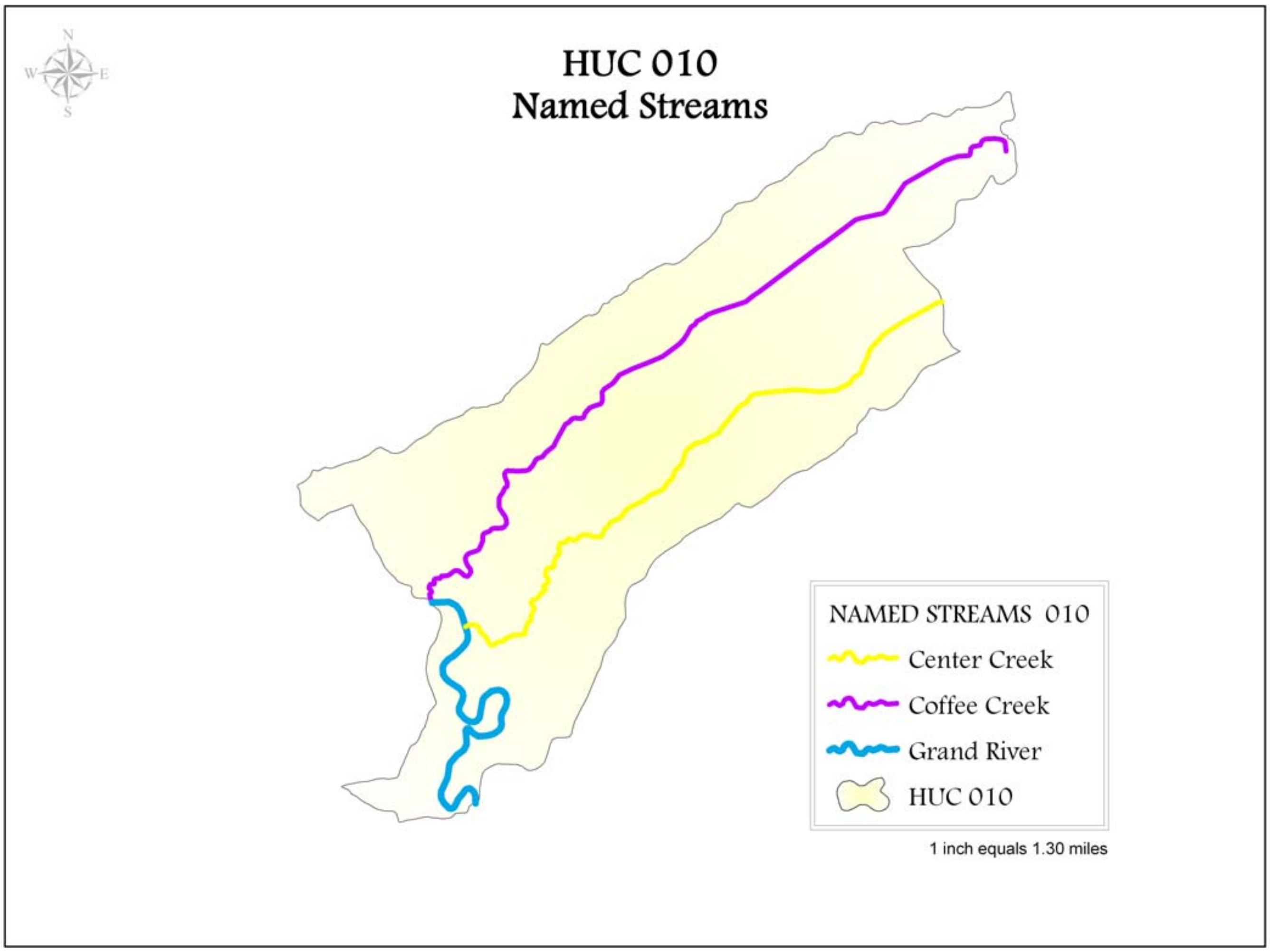
DESCRIPTION~ The 14-digit Hydraulic Unit Code 04110004060010 (HUC 010) is located within the 11-digit HUC 04110004060 know as the Lower Grand River Watershed. HUC 010 is approximately 14,069 acres and approximately 22 square miles. This watershed encompasses portions of Jefferson, Saybrook, Plymouth, and Austinburg Townships in Ashtabula County.

Map 1.010 – Townships, Cities, and Villages of HUC 04110004060010



Coffee Creek, Center Creek, and the Grand River Mainstem are the principal streams located within this subwatershed. Coffee and Center Creeks drain lacustrine deposits in a mostly rural area. Despite being rural, anthropogenic disturbance and stormwater from Austinburg has mobilized the fine sediments, resulting in a bedload of sand and silt.

Map 2.010 – Named Streams of HUC 04110004060010



DEMOGRAPHICS~ Unfortunately, demographic statistics are collected on a per township or per county basis, thus making it difficult to determine the exact numbers for each subwatershed. Therefore, the data for each township located within each subwatershed was examined, and the totals and averages were taken of each; outliers were taken into account. The statistics for the townships of Jefferson, Saybrook, Plymouth, and Austinburg in Ashtabula County were utilized to determine the information below.

Total Population~

The total population for HUC 010 is approximately 19,925 with a 48.51/ 51.49% male to female ratio. The largest age group represented is the 45 to 54 years groups (16.25% of the total population), followed by the 35 to 44 years group (15.73%), and the 25 to 34 years group (10.90%). 15,200 people represent the 18 and older groups, which accounts for 76.29% of the total population for the townships located within HUC 010. The median age for the townships located within HUC 010 is 40.4.

The male to female ratio for the state of Ohio is 48.60/ 51.40%. The largest age group represented is the 35 to 44 years groups (15.90% of the total population), followed by the 45 to 54 years group (13.80%), and the 25 to 34 years group (13.40%). The median age for the people who reside in Ohio is 36.2.

Educational Attainment~

Of the 13,926 people who are over the age of 25 in the townships within the HUC 010 subwatershed, the majority education level is high school graduate (45.13%), followed by some college with no degree (18.27%), and 9th grade to 12th grade with no diploma received (11.31%).

Employment Status~

Approximately 9,824 (62.23%) people over the age of 16, in the Townships of Jefferson, Saybrook, Plymouth, and Austinburg, are currently in the workforce. There are approximately 396 (2.51%) who are currently

Household by type~

There are approximately 3,661 households in the Townships located within the HUC 010, of which 2,778 (75.88%) are family households. The average family size is 2.98 people.

Income (1999)~

The average median household income in1999 for individual households in the Townships of Jefferson, Saybrook, Plymouth, and Austinburg was $42,519. The majority of the households had an income of $50,000 to $74,999 (21.56%), followed by $35,000 to $49,999 (20.77%), and $15,000 to $24,999 (14.07%).

The average median family income in1999 for families in the Townships of Jefferson, Saybrook, Plymouth, and Austinburg was $47,716. The majority of families had an income of $50,000 to $74,999 (26.54%), followed by $35,000 to $49,999 (22.31%), and $25,000 to $34,999 (13.08%).

The average median earnings for a male, full time, year round worker were 37,851 and 24,129 for a female, full time, year round worker.

Below Poverty Level (1999)~

There are 1,382 individuals within the HUC 010 subwatershed, for whom poverty status was determined. Of those, approximately 267 families are represented, and 122 are families with a female householder with no male present.

Occupation~

The residents of the Townships of Jefferson, Saybrook, Plymouth, and Austinburg represent the following occupations; 2,519 management professionals, 1,547 service occupations, 2,226 sales and office occupations, 36 farming, fishing, and forestry occupations, 1,049 construction, extraction and maintenance occupations, and 2,045 production, transportation, and material moving occupations.

Race~

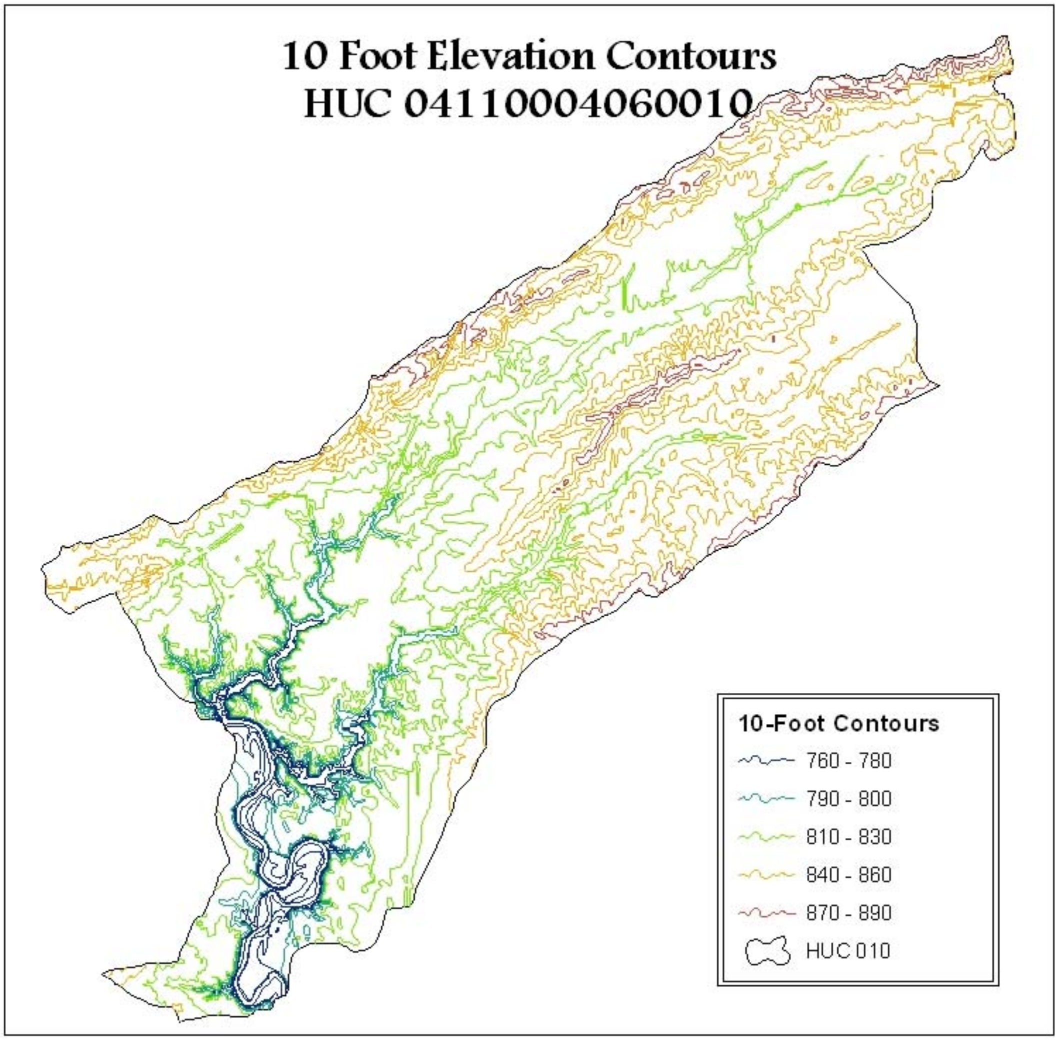
Approximately 87.73% of the population of the HUC 010 is white, 1.65% is African American, and .35% is Asian.

Other~

Within the HUC 010, approximately 35 residences are lacking complete plumbing facilities, 11 are lacking complete kitchen facilities, and 97 are without telephone service.

TOPOGRAPHY~ The majority of HUC 010 is located within the East Tributaries Project Area of the Grand River Watershed. This area is known for its high-quality tributaries and rural characteristics. Located near the Grand River Lowlands, HUC 010 has lower elevations and shows little to no drastic elevation changes. The highest point in HUC 010 is 890 feet and the lowest is 760 feet.

Map 3.010- 10 Foot Elevation Contours of HUC 04110004060010

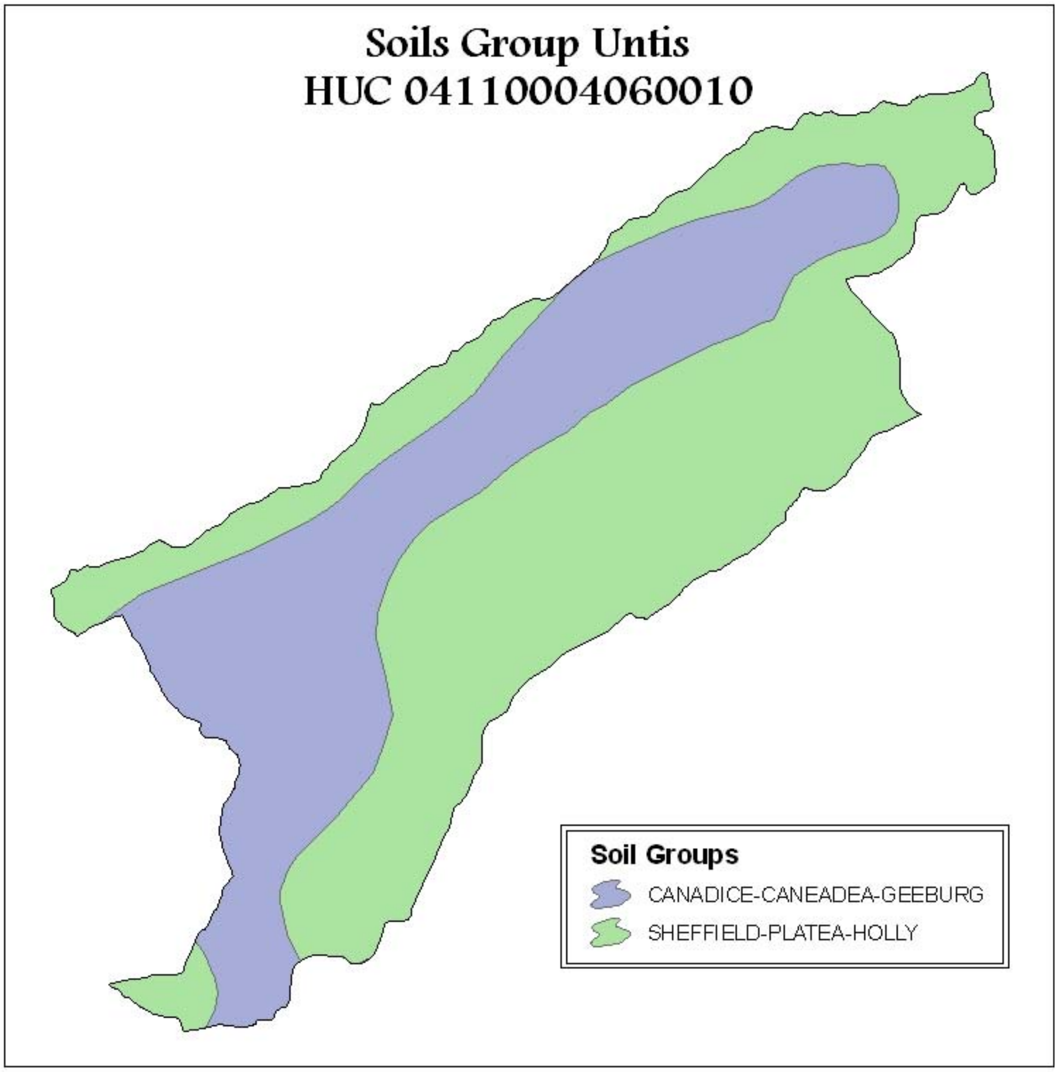


SOILS~ There are two soil groups represented within HUC 010; the Canadice – Caneadea – Geeburg (approximately 5,770 acres) and the Sheffield – Platea – Holly (approximately 8,300 acres) groups.

Canadice~ Caneadea~Geeburg Group: This association is a very deep, level and gently sloping, poorly and somewhat poorly drained soils that formed in moderately fine and fine textured sediments deposited from lakes and medium and moderately fine textured sediments from glacial till deposited from streams on valley floors. This soil association occupies areas that were lakebeds during the Wisconsin glacial period. These soils are mostly strongly acidic in the upper part of their root zone. The erosion hazard is severe on the valley sides along the Grand River. The steeper soils in these areas are unstable and subject to slippage. Limitations for farm and nonfarm uses of these soils are seasonal wetness, very slow permeability, and the moderately fine texture to fine texture.

Sheffield~ Platea~ Holly: This association is comprised of soils that are deep, nearly level, poorly drained to somewhat poorly drained silty soils on glaciated uplands. These soils have a root zone that is generally strongly acidic to extremely acidic and low in natural fertility. They have a dense compact layer in the lower part of the subsoil. This layer restricts the movement of water and the penetration of plant roots. Extensive ponding occurs in this association in spring and after thunderstorms. Artificial drainage is needed to remove excess water. Very slow permeability and seasonal wetness are limitations to many nonfarm uses.

Map 4.010- Soils Group Units of HUC 04110004060010



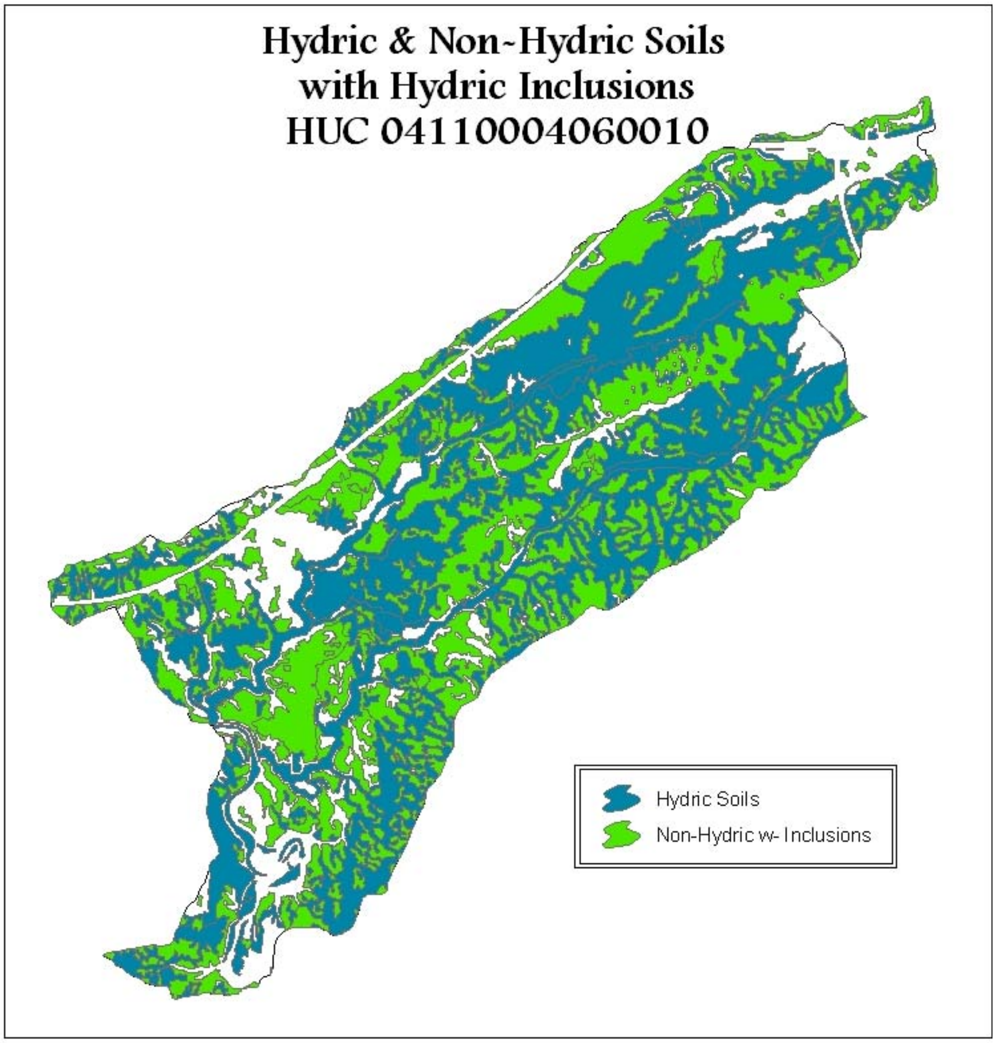
A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. This lack of oxygen in the soil can lead to the formation of certain observable characteristics in hydric soils, such as a thick layer of organic matter (non-decomposed plant materials) in the upper part of the soil column. Other observable features include oxidized root channels and redoximorphic features (concentrations and depletions of Iron and other elements, i.e., mottling, gleying). The following National Soil Information System (NASIS) criteria reflect those soils that may meet the definition of hydric soils.

- All Histels except Folistels and Histosols except Folists, or
- Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:
- Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or
- poorly drained or very poorly drained and have either:
    - water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils
    - water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or
    - water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or
- Soils that are frequently ponded for long duration or very long duration during the growing season, or
- Soils which are frequently flooded for long duration or very long duration during the growing season.

In HUC 010, there are approximately 6,200 acres of hydric soils.

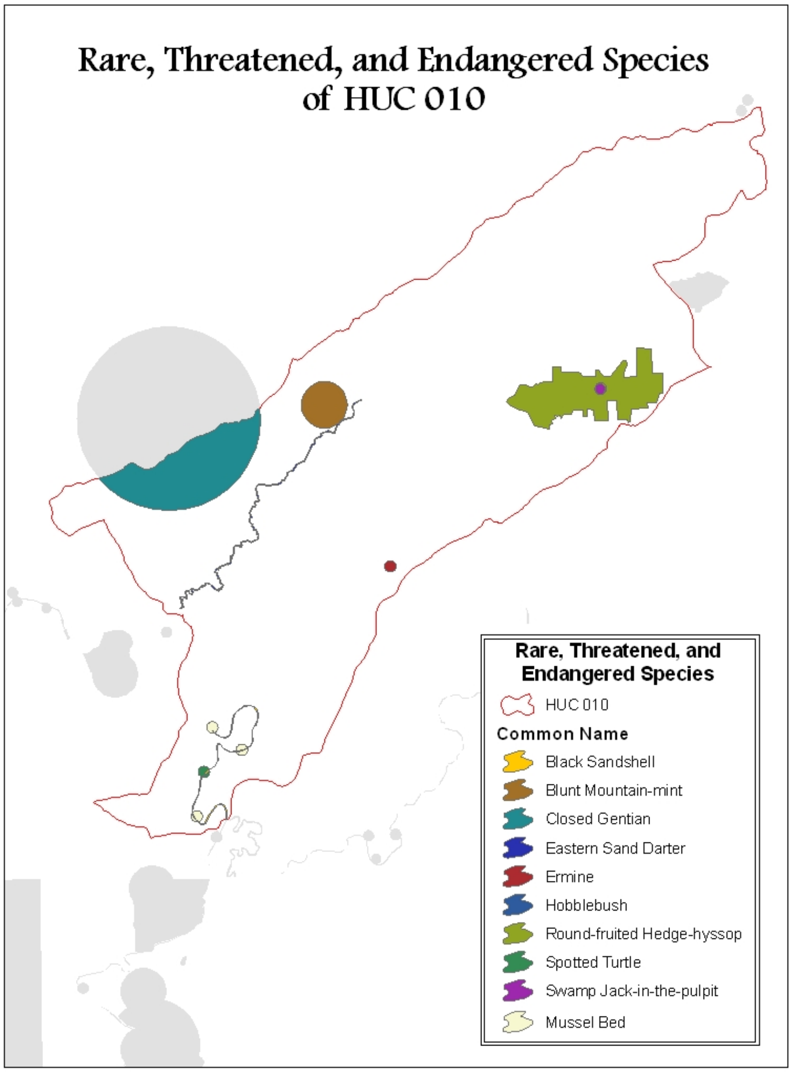
Non hydric soils can be of major importance to water quality as well. Many non-hydric soil types contain small areas of hydric soils, or hydric inclusions. These soils are generally not associated with having the properties of hydric soils, but the do have small pockets, which are too small to have been mapped by the soils surveys, to be considered hydric. Soil Survey books generally do not map "inclusions" of different soil types if the map units are less than 2 acres in size. These inclusions can be wetland soils within an upland soil series. Sometimes, the description will include the types of soils that are the most common inclusions in the series. HUC 010 contains roughly 5,445 acres of non hydric soils with hydric inclusions.

Map 5.010- Hydric and Non-hydric Soils with Hydric Inclusions of HUC 04110004060010



RARE, THREATENED, and ENDANGERED SPECIES~ The Grand River Watershed provides the perfect habitat for many rare, threatened, and endangered species. In fact, the Ohio Department of Natural Resources, Division of Wildlife recognized the unparalleled biodiversity and habitats of the Grand River Watershed, and chose this watershed to reintroduce the wild turkey, river otter, and snowshoe hare. The following species are found within HUC 010 in the Grand River Watershed; black sandshell mussel, blunt mountain-mint, closed gentian, eastern sand darter, ermine, hobblebush, round-fruited hedge-hyssop, spotted turtle, and swamp jack-in-the-pulpit.

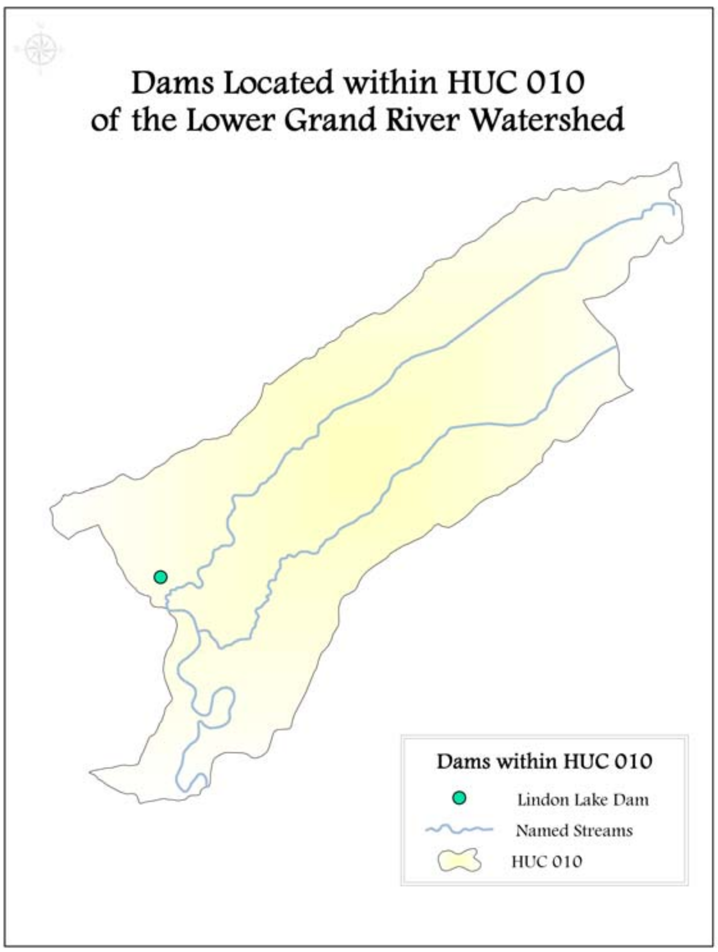
Map 6.010~ Rare, Threatened, and Endangered Species of HUC 04110004060010



DAMS- There are 18 dams located with in the Lower Grand River Watershed. In HUC 010 there is one dam, the *Lindon Lake Dam*.

- The *Lindon Lake Dam*, NID OH00404, is located in Austinburg Township, Ashtabula County. This is a privately owned, earthen dam, located on an unnamed tributary to the Grand River. The purpose for this dam is strictly recreational, and is 15 acres in size. The potential hazard to the downstream area resulting from failure or misoperation of the *Lindon Lake Dam* is low; meaning that no probable loss of human life and low economic and/or environmental losses would be expected.

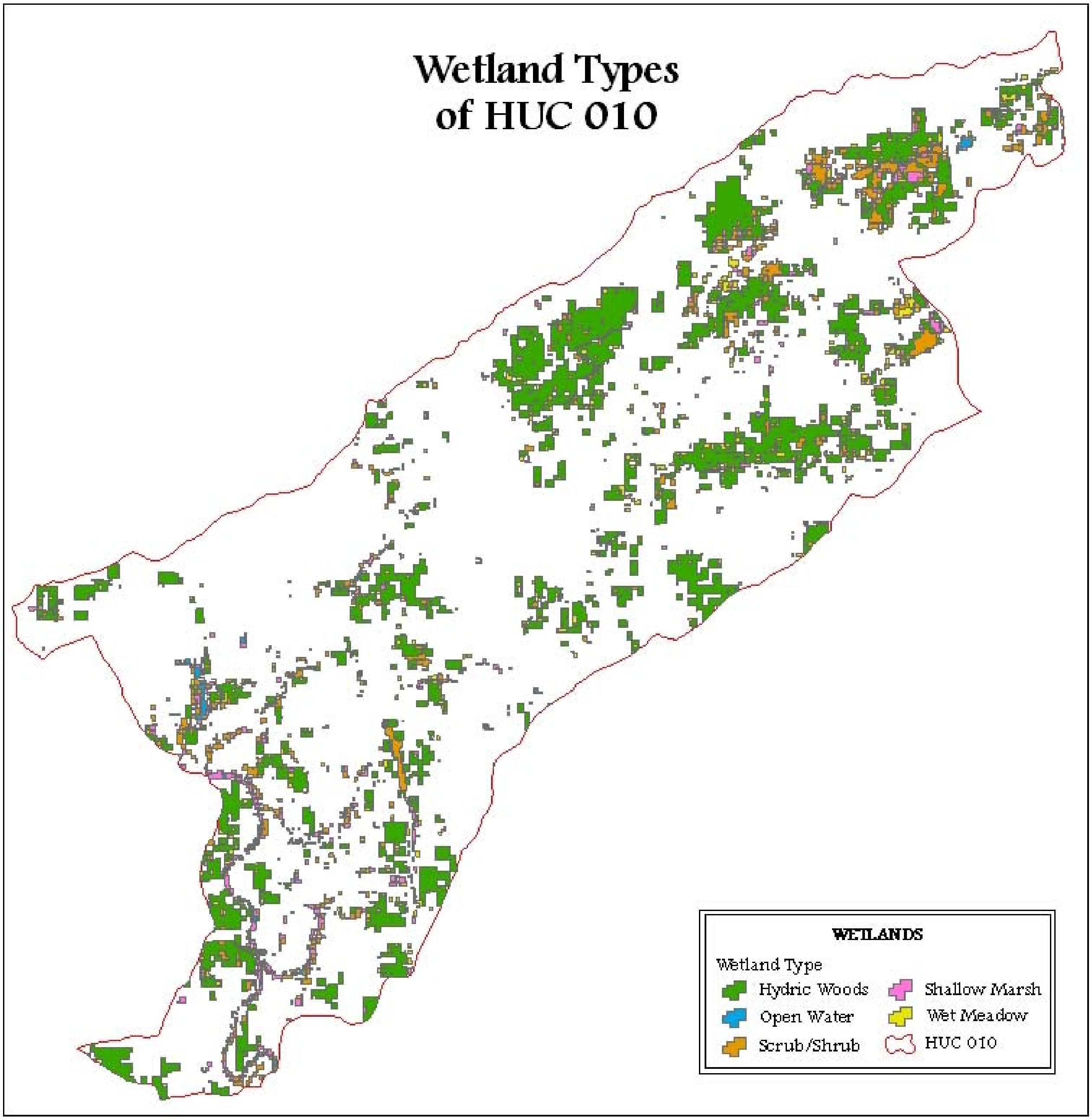
Map 7.010- Dams located within HUC 04110004060010



WETLANDS~ Wetlands are typically highly productive habitats, often hosting considerable biodiversity. The Army Corps of Engineers and the Environmental Protection Agency define wetlands as; "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions". Wetlands are found under a wide range of hydrological conditions, but at least some of the time water saturates the soil. The result is a hydric soil, one characterized by an absence of free oxygen some or all of the time, and therefore called a "reducing environment." Plants called hydrophytes specifically adapted to the reducing conditions presented by such soils can survive in wetlands, whereas species intolerant of the absence of soil oxygen (called "upland" plants) can not survive. Adaptations to low soil oxygen characterize many wetland species.

HUC 010 has approximately 2,894 acres of wetlands; 2,004 acres of Hydric Woods, 23 acres of open water, 450 acres of scrub/shrub, 206 acres of shallow marsh, and 210 acres of wet meadow.

Map 8.010- Wetland Types of HUC 04110004060010



DRASTIC- The DRASTIC maps, produced by the Ohio Department of Natural Resources, show the pollution potential for groundwater systems. The DRASTIC mapping system allows the pollution potential of any area to be evaluated systematically using the following existing information about an area:

D= Depth to Water

R= Net Recharge

A= Aquifer Media

S= Soil Media

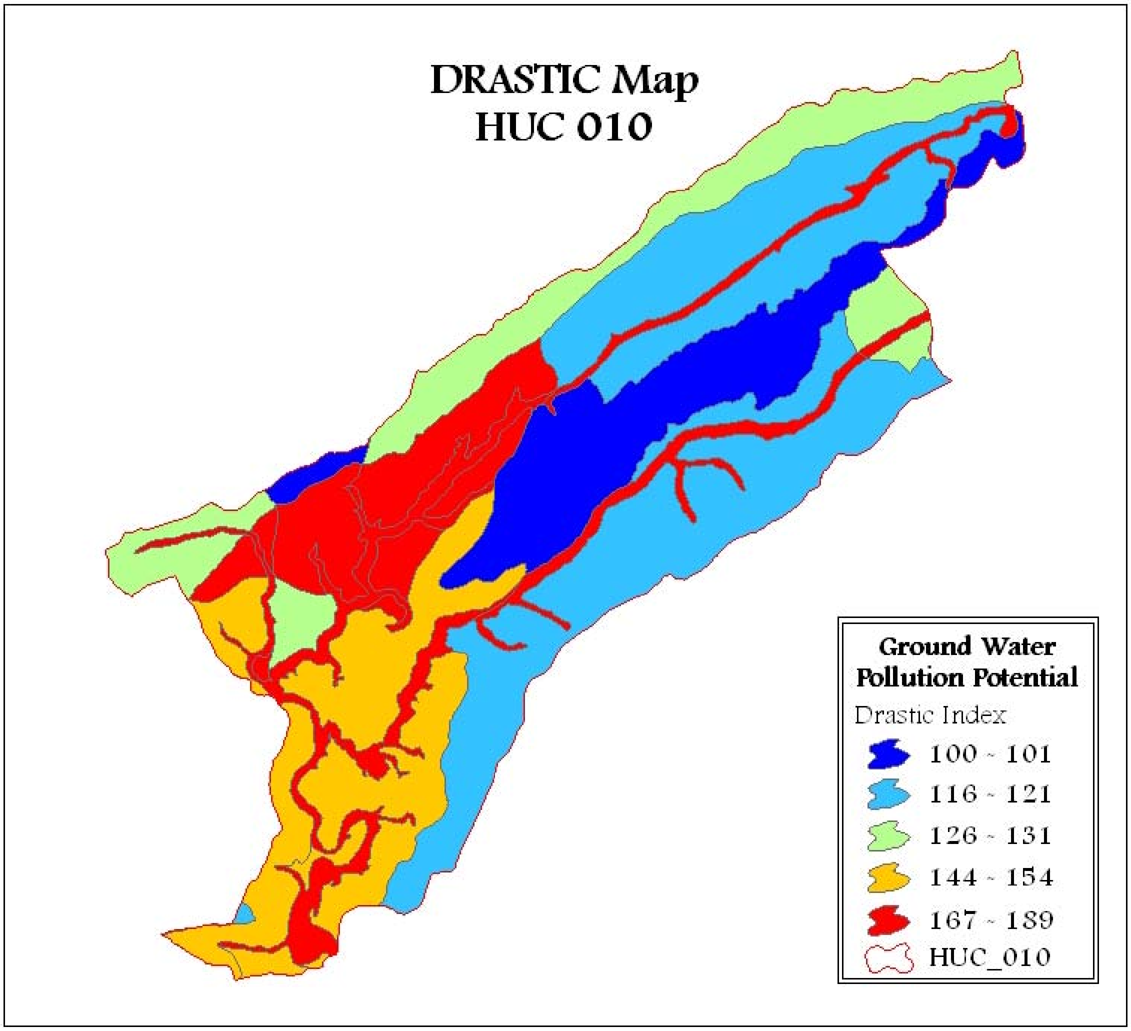
T= Topography

I= Impact of the Vadose Zone Media

C= Hydraulic Conductivity of the Aquifer

In evaluating an area's vulnerability to contamination, the DRASTIC mapping system assumes a contaminant with the mobility of water is introduced at the surface and flushed into the groundwater by precipitation. A pollution potential map can assist in developing ground water protection strategies. By identifying areas more vulnerable to contamination, officials can direct resources to areas where special attention or protection efforts might be warranted. This information can be utilized effectively at the local level for integration into land use decisions and as an educational tool to promote public awareness of ground water resources. Pollution potential maps may be used to prioritize ground water monitoring and/or contamination clean-up efforts. Areas that are identified as being vulnerable to contamination may benefit from increased ground water monitoring for pollutants or from additional efforts to clean up an aquifer. HUC 010 has a maximum DRASTIC index of 189. Approximately 21.12% of HUC 010 has a high DRASTIC index.

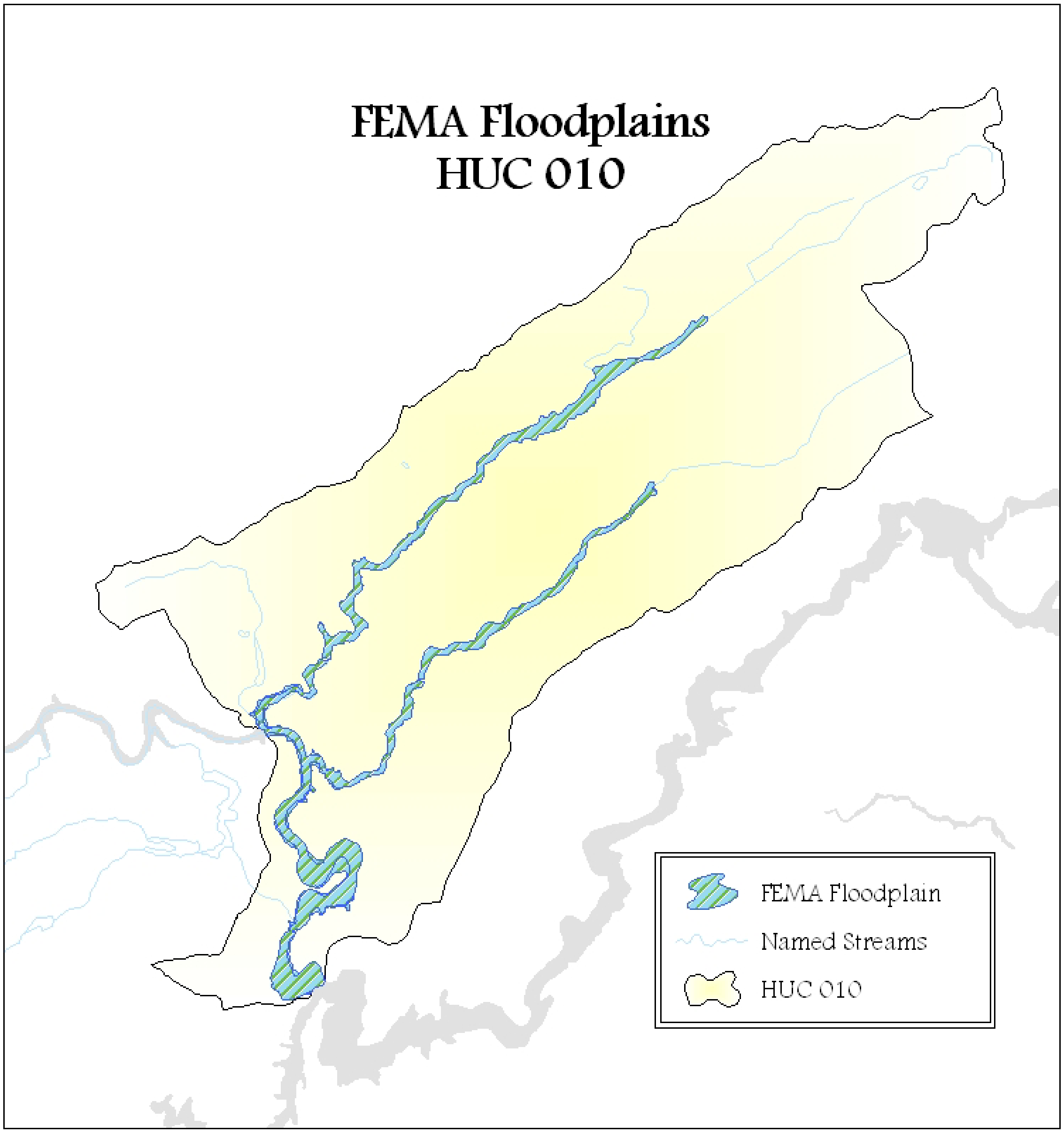
Map 9.010- DRASTIC of HUC 04110004060010



FLOODPLAINS- Floodplains are the low, flat, periodically flooded lands adjacent to rivers, lakes and oceans and subject to geomorphic (land-shaping) and hydrologic (water flow) processes. FEMA, the Federal Emergency Management Agency, has developed areas within watersheds that are designated as 100-year and 500- year floodplains. A "100-year flood" is defined as a flood event that has a 1 in 100 chance of occurring in any given year, and a 500-year flood has a 1 in 500 chance. HUC 010 has a total of 794 acres of floodplain; 733 acres of designated 100-year floodplain, which represents approximately 5.2% of the watershed, and 61 acres designated as 500-year floodplain, which represents approximately .43% of the watershed.

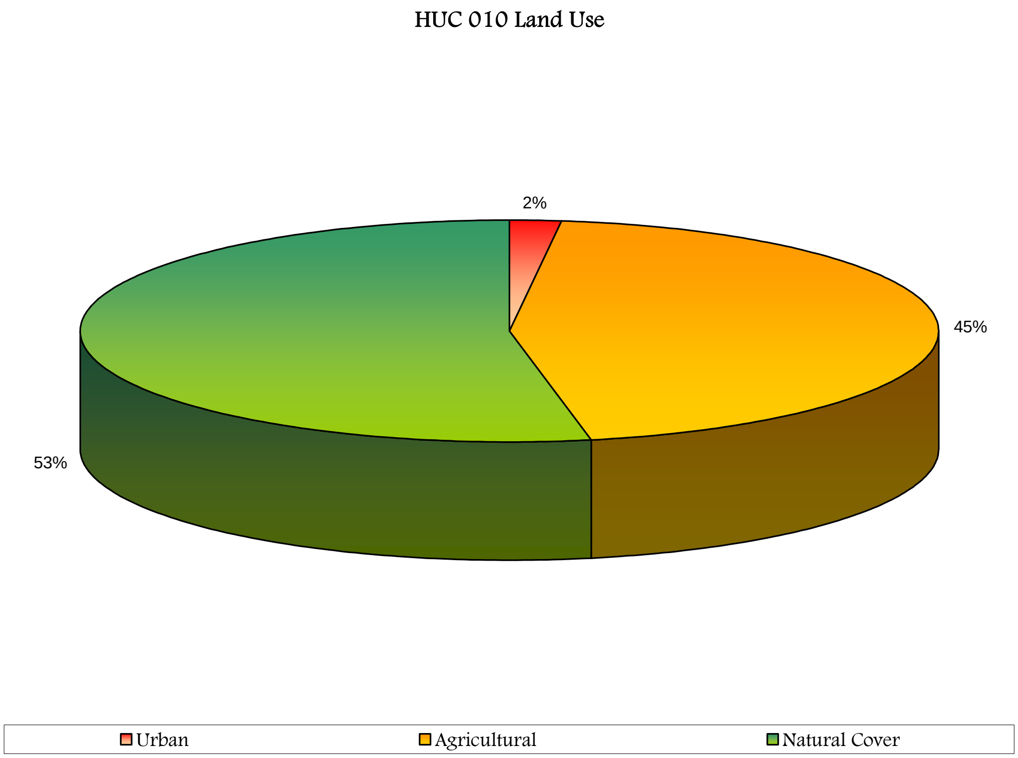
Current the only regulations that protect floodplains are established by the Federal Emergency Management Agency, and are enforced by the Ashtabula County Subdivision Regulations.

Map 10.010- FEMA Floodplains of HUC 04110004060010



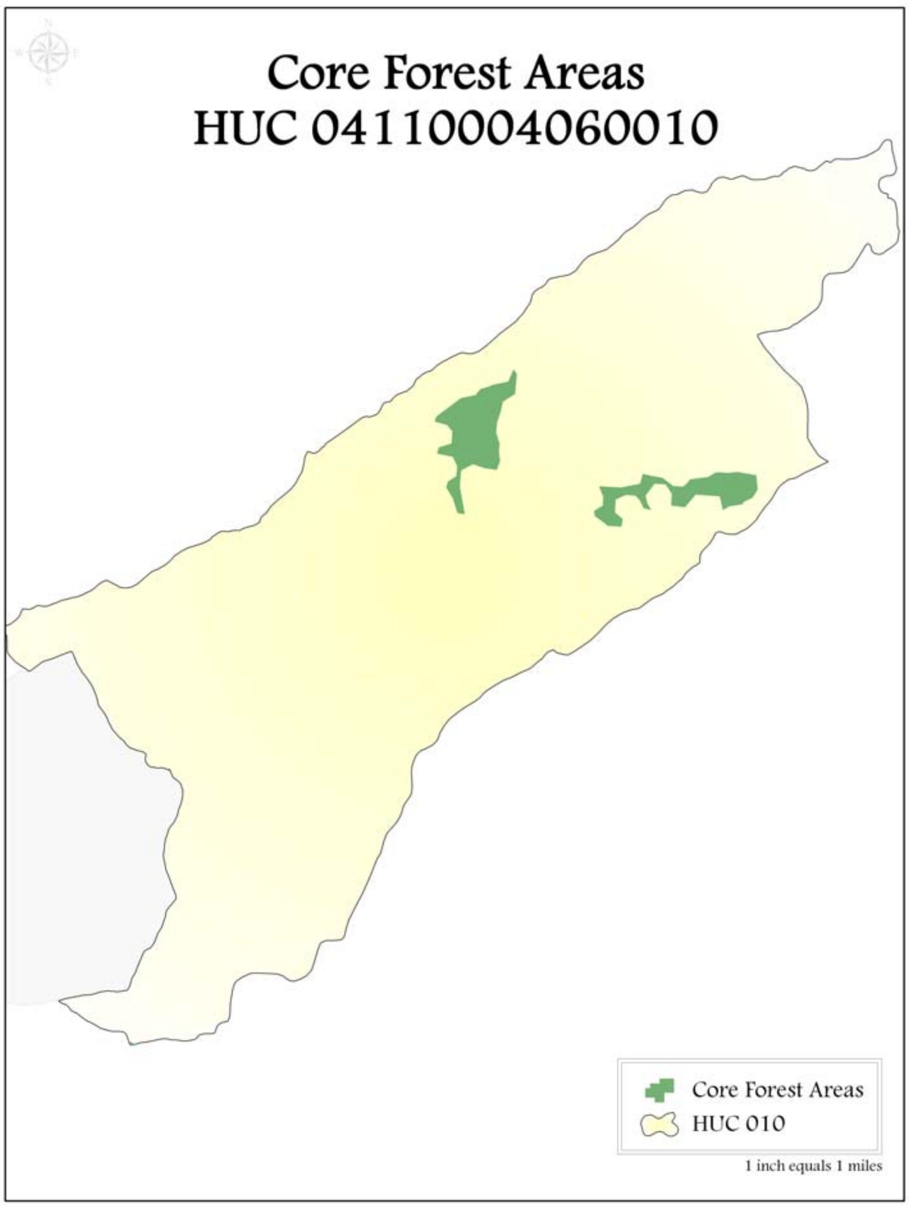
LAND USE- HUC 010 is a relatively rural subwatershed. Much of this watershed is agricultural, with little urban areas. However, suburbanization is a threat to this area of the Grand River Watershed. Here, land is plentiful and still remains at a very low cost. Population density is low (10.1), but is inspected to increase due to suburbanization.

Chart 1.010- Land Use of HUC 04110004060010



Since the majority of the watershed remaining in natural cover, there are many large tracts of undisturbed forest blocks. The Nature Conservancy realized the importance of these large tracts of forest, or "Core Forest Areas", for not only their natural resources value but their importance for breeding populations as well. Core Forest Areas are forested areas of 100 acres or more with a forested buffer zone from pastures and agriculture, and no roads within at least 300 meters. These numbers were determined by the habits and lifecycles of certain forest species; a pair of pileated woodpeckers will need at least 100 acres in order to breed, certain amphibian populations use forest areas up to 200 meters away from their wetland habitat for breeding purposes, and cowbirds will penetrate up to 150 meters of the core forest areas. HUC 010 contains two Core Forest Areas, which total 389.78 acres, or roughly 2.77% of the HUC 010 watershed. Currently, there are no Core Forest Areas that are under permanent protection in HUC 010.

Map 11.010- Core Forest of HUC 04110004060010



GRPI~ LAND PROTECTION PRIORITY LIST~ Grand River Partners, Inc.'s goal is to protect the natural resources of the Grand River and its watershed. Grand River Partners, Inc. utilizes the conservation easement as the primary tool to protect such resources. Conservation easements are a great tool to protect resources on private lands but still maintain them in private hands. The Grand River watershed is approximately 712 square miles. Obviously Grand River Partners, Inc. cannot protect all of the 712 square miles (455,000 acres) with conservation easements. Grand River Partners, Inc. believes that water quality can be protected by conserving the "right" 25% of a watershed. In the specific case of the Grand River, this represents roughly 114,000 acres. Protecting 114,000 acres is an achievable goal considering the number of partner organizations and the fact that approximately 25% of the 114,000 acres has already been protected.

The challenge remains to protect the remaining 86,000 acres of the "right" land. To fulfill this goal, Grand River Partners, Inc. developed a parcel based **Land Protection Priority List**. Before any prioritization process could begin, any parcel less then five acres was removed from the potential list of priorities. To make fair comparisons an analysis of the watershed was conducted to determine the unique areas within the watershed. From this analysis, the Grand River Watershed was divided into 5 distinct project areas based on the unique natural features of each. The parcel prioritization process involved a two tier analysis. The first, Tier 1, involved an analysis of natural resources. The second, Tier 2, involved a strategic analysis that took into account parcel size, proximity to other protected land, and partner priorities.

The Headwaters Project Area consists of the area drained by all the unnamed tributaries that together form the Grand River. The area begins more or less upstream of the crossing with SR 534 at the southern end of the watershed. In summary, important natural resources ranked for each parcel located in the Headwaters Project Area are intact riparian areas, the Grand River main stem, wetlands, unnamed tributaries, floodplains, core forest blocks and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Lowlands Project Area begins at the crossing of SR 534 with the mainstem in the southern portion of the watershed and extends between the 810' contour interval north to the crossing where the Grand River intersects Windsor-Mechanicsville Road. Important Natural Resources identified in the Lowlands Project Area are swamp forests, wetlands, intact riparian areas, core forest blocks, mainstem, rare species, floodplains, TNC subwatershed ranking, and named tributaries. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Gorge Project Area begins at the crossing of the mainstem and Windsor-Mechanicsville Road bridge and extends upstream to the crossing with SR 84. The Gorge Project Area is bordered to the north by the watershed boundary and to the south by the 950' contour interval. The important natural characters of the Gorge are the mainstem, wetlands, floodplains, intact riparian areas, named tributaries, core forest blocks, steep slopes, TNC subwatershed rankings, and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

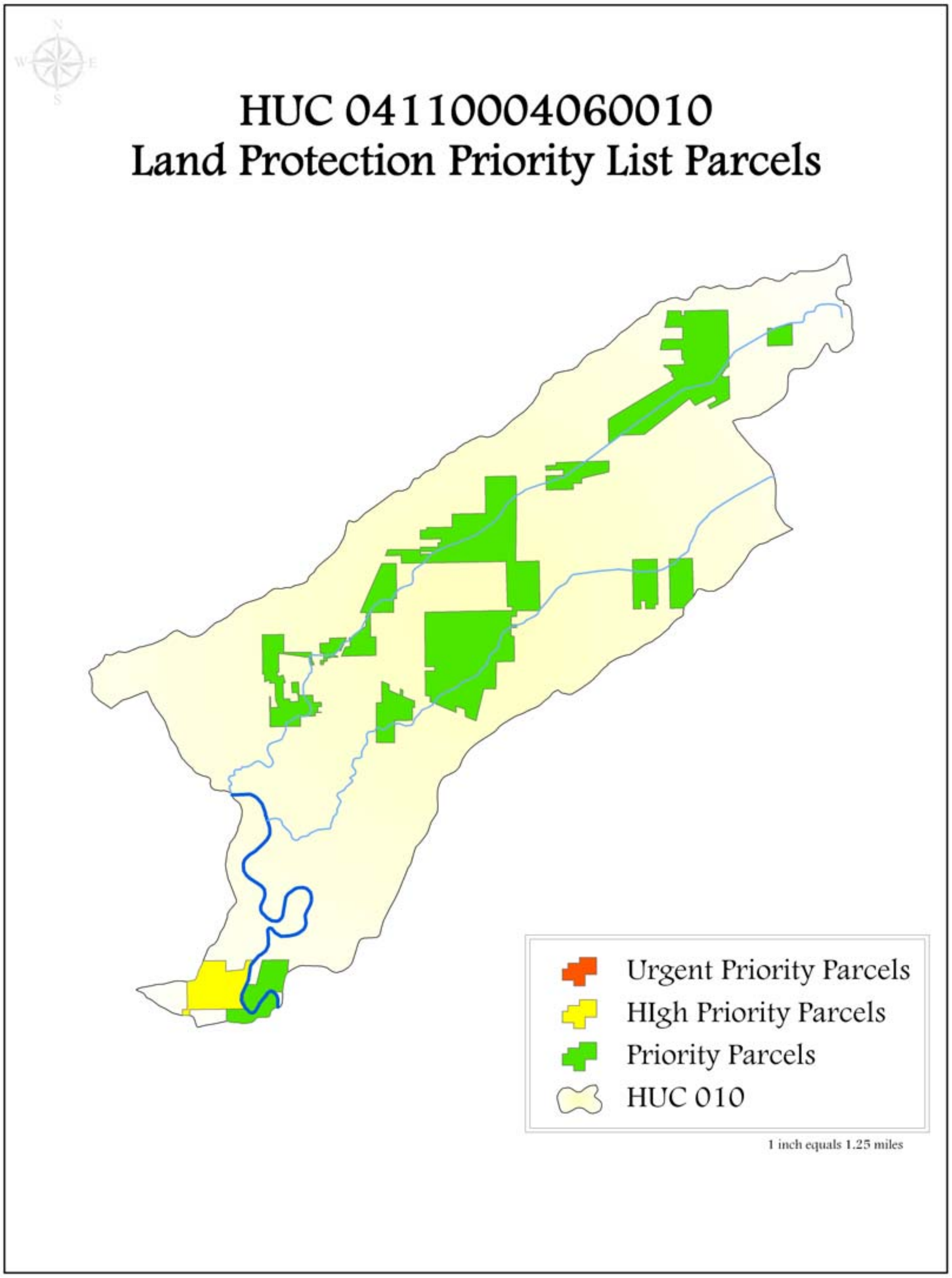
The Estuarine/Urban Project Area begins at the State Route 84 crossing with the Grand River and ends in Fairport Harbor Village and Grand River Village at its terminus with Lake Erie. The Estuarine/Urban Project Area includes the subwatershed of Red Creek which extends to the west just north of the City of Painesville. In this project area the mainstem, river access points, wetlands, intact riparian areas, floodplains and named tributaries were considered important natural features. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The last area is the Tributaries Project Area which consists of two areas; one is located east of the Grand River Lowlands Project Area, which and includes the subwatersheds of such named tributaries as Mill Creek, Rock Creek and Coffee Creek, and the second project area is located west of the Lowlands Project Area, north of the Headwaters Project Area and south of the Gorge Project Area. This portion of the Tributaries Project Area contains the subwatersheds of such high quality streams as Indian Creek, Phelps Creek, Hoskins Creek, and Paine Creek. Important natural resources considered include, cold water habitat, wetlands, floodplains, core forest blocks, and rare species. Again each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

Each parcel within the watershed was further evaluated based on additional strategic rankings. These rankings include parcel size, proximity to protected land and partner priorities. Each parcel meeting the acreage requirement, or within a certain distance of existing protected land or included as a priority by a partner organization or agency was weighted more heavily and therefore considered a high priority. A statistical analysis of the final scores was performed and each parcel was categorized as being priority, high priority or an urgent priority parcel.

In 010, there are a total of 2,246.91 acres of priority parcels and 165.39 acres of high priority parcels identified for protection. This subwatershed contains no urgent priority parcels. Currently there are no protected lands within HUC 010.

Map 12.010- LPPL of HUC 010



IMPERVIOUS SURFACE~ The Conversion of farmland, forests, wetlands, and meadows to rooftops, roads, and lawns creates a layer of impervious surface in the urban landscape. Impervious cover is a very useful indicator with which to measure impacts of land development on aquatic systems. The process of urbanization has a profound influence on the hydrology, morphology, water quality, and ecology of surface waters. Recent research has shown that streams in urban watersheds possess a fundamentally different character than streams in forested, rural, or even agricultural watersheds. The amount of impervious cover in the watershed can be used as an indicator to predict how severe these differences can be. In many regions of the country, as little as ten percent watershed impervious cover has been linked to stream degradation, with the degradation becoming more severe as impervious cover increases.

Impervious cover directly influences urban streams by dramatically increasing surface runoff during storm events. Depending on the degree of impervious cover, the annual volume of stormwater runoff can increase by two to 16 times its predevelopment rate, with proportional reductions in groundwater recharge. In natural settings, very little annual rainfall is converted to runoff and about half is infiltrated into the underlying soils and the water table. This water is filtered by the soils, supplies deep water aquifers, and helps support adjacent surface waters with clean water during dry periods. In urbanized areas, less and less annual rainfall is infiltrated and more and more volume is converted to runoff. Not only is this runoff volume greater, it also occurs more frequently and at higher magnitudes. As a result, less water is available to streams and waterways during dry periods and more flow occurs during storms.

The relationship between impervious cover and subwatershed quality can be predicted by a simple model that projects the current and future quality of streams and other water resources at the subwatershed level. Stream research generally indicates that certain zones of stream quality exist, most notably at about 10% impervious cover, where sensitive stream elements are lost from the system. A second threshold appears at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition; diminished aquatic diversity, water quality, and habitat scores.

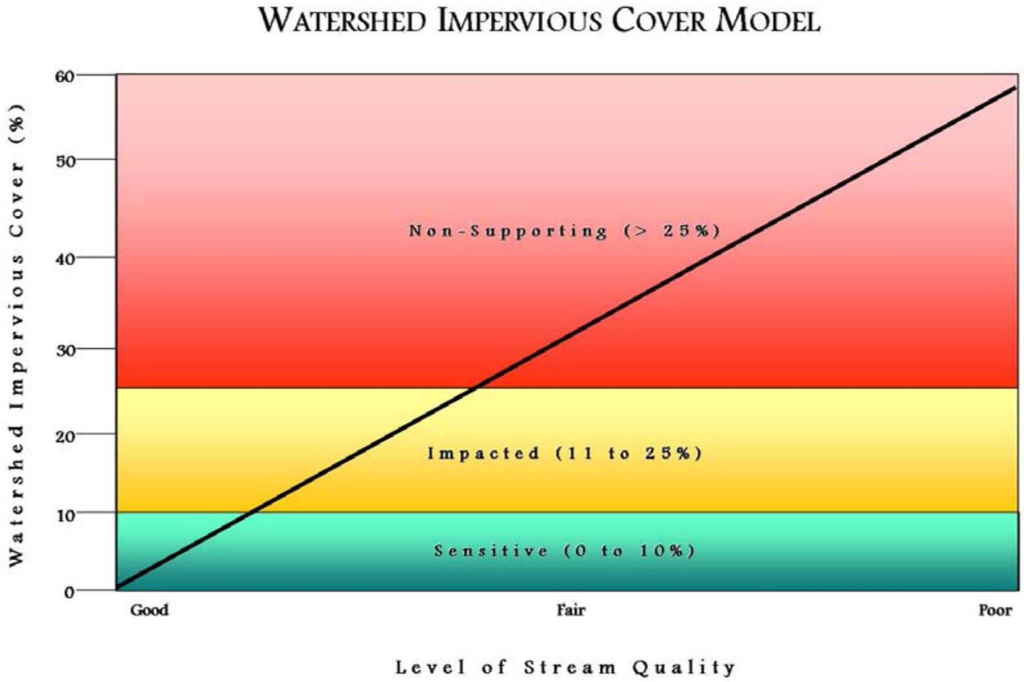
The model classifies streams into one of three categories; sensitive, impacted, and non-supporting. Each stream category can be expected to have unique characteristics as follows:

Sensitive Streams: These streams typically have a watershed impervious cover of zero to 10 percent. Consequently, sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Impacted Streams: Streams in this category possess a watershed impervious cover ranging from 11 to 25%, and show clear signs of degradation due to watershed urbanization. Greater storm flows begin to alter the stream geometry. Both erosion and channel widening are clearly evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with the most sensitive fish and aquatic insects disappearing from the stream.

Non- Supporting Streams: Once watershed impervious cover exceeds 25%, stream quality crosses a second threshold. Streams in this category essentially become a conduit for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, down-cutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated, and the stream substrate can no longer provide habitat for insects or spawning areas for fish. Water quality is consistently rated as fair to poor, and water contact recreation is no longer possible due to the presence of high bacterial levels. Subwatersheds in the non-supporting category will generally display increases in nutrient loads to downstream receiving waters, eve if effective urban BMPs are installed and maintained. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish.

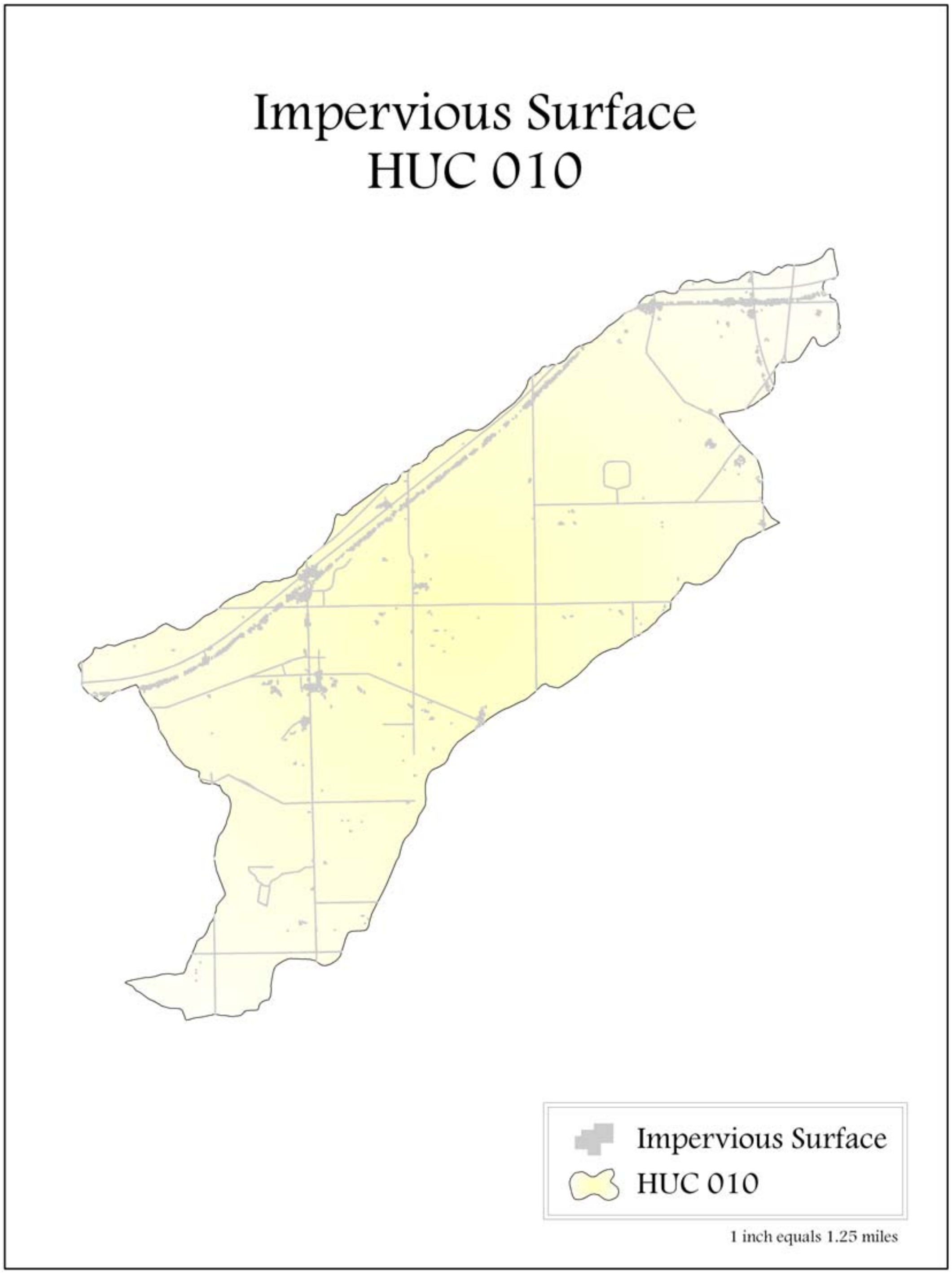
Graph 1.010- Impervious Cover Model



Center for Watershed Protection, Rapid Watershed Planning Handbook

HUC 010 has an impervious cover of approximately 4.75%. Therefore, the streams in this subwatershed are considered "sensitive streams" by the impervious surface model. Sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Map 13.010- Impervious Surface of HUC 04110004060010



ATTAINMENT STATUS- *Ohio Water Quality Standards: Designated Aquatic Life Use*

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*

2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*

3) *Cold-water Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie

tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) *Modified Warmwater Habitat (MWH)* ~ this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) *Limited Resource Water (LRW)* ~ this use applies to small streams (usually <3 mi.^{2} drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

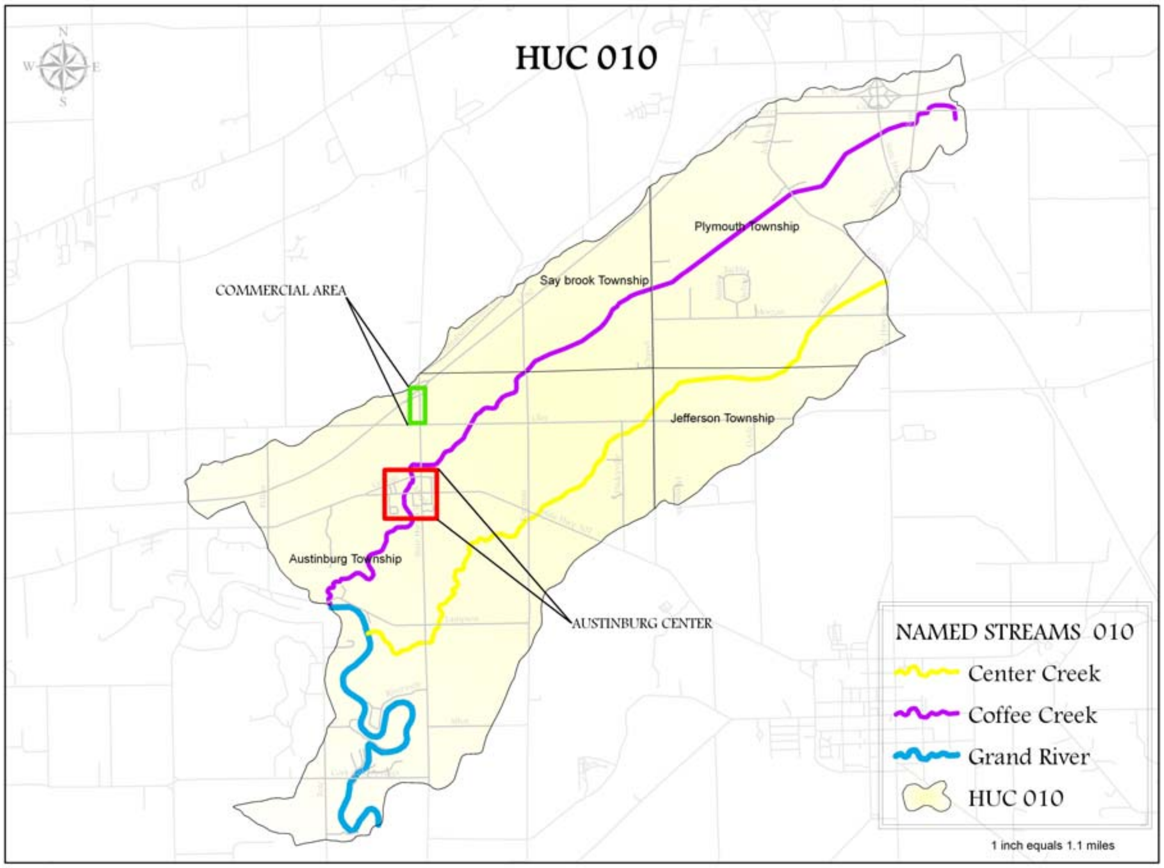
Coffee and Center Creeks~ Both Coffee and Center Creeks are in full attainment of their WWH aquatic like use designations. However, results from a water quality survey performed in 2000, found bacteria counts that exceeded both the geometric mean and 10 percent criteria. Coffee Creek drains a moderately sized commercial area surrounding State Route 45 interchange from Interstate 90 and through the Village of Austinburg which has a high density of failing onsite wastewater treatment systems in the town center. Although much of the Village is served by an Ashtabula County operated wastewater treatment plant, there are also several small "package" treatment facilities operated within the vicinity. There have been discussions between Ashtabula County and the Ohio EPA regarding expansion of this facility to service additional customers, but no formal plans for this expansion have yet been submitted. A thorough study of the sources of bacterial contamination to Coffee Creek in the Austinburg area should be conducted and plans developed to tie in failing systems to the Austinburg WWTP to alleviate this problem. The lower 1 mile of Coffee Creek flows through a large wooded area before entering the Grand River. This area should be preserved as a buffer against stormwater from the industrial park south of I-90 in Austinburg. Also, the existing riparian buffers along the length of the Creek should be protected.

Grand River Mainstem- Aquatic life in the Grand River is fully attaining standards for Exceptional Warmwater Habitat (EWH) from Sweitzer Road (RM 42.2) to the SR 2 bridge in Painesville (RM 5.2), and is fully meeting standards for Warmwater Habitat (WWH) downstream from the SR 2 bridge. The Seasonal Salmonid use designation currently in place should be retained.

The Grand River is an economic asset to Northeast Ohio, but is especially sensitive to pollution and disturbance because of limited summer base flows. Therefore, regional planning, stream protection policies, comprehensive construction site management plans, construction site performance bonds, identification and preservation of sensitive areas, and above all, defined limits to growth are needed to maintain the biological integrity of the Grand River.

The Grand River is the only Ohio tributary to Lake Erie that harbors a self-sustaining population of Great Lakes Muskellunge, and therefore is a priority for conservation. The Grand River is also has a native population of walleye and northern pike making it singularly unique among Ohio streams. The Grand River and its tributaries provide habitat for many species considered rare by Ohio EPA, or listed as threatened or endangered by the Ohio Department of Natural Resources including 32 macroinvertebrates and freshwater mussel species, and 11 fish species. The single greatest threat to the Grand River basin is suburbanization.

Map 14.010- Problem Areas of HUC 04110004060010



BIOLOGICAL INDICATORS- Fish communities in the Grand River have an exceptionally high degree of biological integrity. This is obvious in the consistently high IBI scores along the length of the mainstem and between sampling years, and is also evident in the unusually high percent composition of pollution intolerant species making up electrofishing samples (Figure 40). Furthermore, the Grand River is one of the few rivers in Ohio that has a full suite of endemic, naturally reproducing and self-sustaining top carnivores including walleye, northern pike and muskellunge. The later is the Great Lakes subspecies (*Esox masquinongy masquinongy*), and so represents a vitally important area for genetic and habitat conservation. Given the propensity for muskellunge to differentiate into unique strains, the population in the Grand River may well be a truly endemic strain. As it stands, it is the last naturally reproducing muskellunge population found in any of Ohio's Lake Erie tributaries.

Coffee Creek was sampled at three locations in 2000 to evaluate the Austinburg WWTP, and once in 2004 near the mouth. There was no discernable impact from the WWTP discharge. Diversity of sensitive taxa, for the most part, slightly improved downstream from the WWTP. However, the communities appeared to be mildly impacted by siltation and embedded substrates at all the stations.

PROBLEM STATEMENTS

PROBLEM 1

BACKGROUND: Based on the 2000 Census data, the population growth for Ashtabula County from 1990 to 2000 increased 2.9%. It is projected that the trend in population growth will continue over the next 25 years. Similar growth in adjacent Counties in the watershed has shown that an increase in development due to population increase has caused erosion and siltation of waterways.

PROBLEM STATEMENT: LACK OF COUNTYWIDE EROSION AND SEDIMENT CONTROL REGULATIONS IN ASHTABULA COUNTY

The projected population growth shows that there will be a significant increase in population and development in the Grand River Watershed. Ashtabula County, the county in which the majority of the Grand River Watershed lies (351 square miles or 224,640 acres (49.8%)), currently has subdivision regulations for the unincorporated areas, which include an Erosion and Sediment Control provision. However, these regulations do not cover any type of individual lot construction.

GOALS:

1. Develop ESC Regulations for individual lot construction

2. Have ESC Regulations for individual lot construction adopted by the Ashtabula County Commissioners

3. Hire an Erosion and Sediment Control Administrator

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Develop Erosion and Sediment Control (ESC) Regulations for Ashtabula County	$10,000 for staff salary, benefits, etc.	Ashtabula Soil and Water Conservation District	1/08-12/08	Completed ESC Regulation Manual
Have developed ESC Regulations adopted by the County Commissioners	Existing Ashtabula SWCD staff time for developing presentations and public education program for elected officials	Ashtabula SWCD & Grand River Partnership	1/09-6/09	ESC Regulations are adopted and in place through the Ashtabula County Commissioners
Hire full time Erosion and Sediment Control Administrator	$100,000 for first year, $60,000 each year after	Ashtabula Soil and Water Conservation District	12/07	Administrator hired

PROBLEM 2

BACKGROUND: Subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek) contains two major named tributaries, Coffee Creek and Center Creek. In subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek), 27,721.8 feet of the Coffee Creek are channelized and 21,064.6 feet of Center Creek are channelized.

PROBLEM STATEMENT: IMPACT OF NATURAL STREAM HABITAT DUE TO CHANNELIZATION.

The Ohio EPA stated channelization as one of the sources of known or suspected impacts to Coffee Creek. Center Creek is similarly impacted by channelization.

GOALS:

1. Develop stream restoration plan for the channelized portions of subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek)

2. Restore 50% of the channelized portions of subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek)

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Hire consultant to develop a Coffee/ Center Creek restoration plan to restore 50% of the channelized portion of 04110004060010	$15,000-30,000	Grand River Partners, Inc.	1/09-6/09	Completed stream restoration plan
Consultant will implement restoration plan	To be determined by restoration plan. Similar restoration efforts have cost between $150-300 per linear foot.	Grand River Partners, Inc. and Consultant	7/09-7/11	50% of channelized portions of subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek) restored

PROBLEM 3

BACKGROUND: In subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek), beginning at RM 1.89 and ending at RM 2.42 on Coffee Creek, there are septic systems in failure.

PROBLEM STATEMENT: FAILING SEPTIC SYSTEMS HAVE A NEGATIVE IMPACT ON THE OVERALL HEALTH OF COFFEE CREEK.

The Ashtabula County Health Department has estimated that 85% of all septic systems in the community of Austinburg at RM 1.89 and ending at RM 2.42, located in subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek) are failing.

GOALS:

1. Assist Ashtabula County Commissioners with obtaining a Water Pollution Control Loan for community of Austinburg sewer project.

2. Secure WRRSP funding for implementing components of Coffee/Center Creek stream restoration plan

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Assist Ashtabula County Commissioners with obtaining a Water Pollution Control Loan for community of Austinburg sewer project.	Staff time	Grand River Partners, Inc. & Ashtabula County Commissioners	8/07-8/08	Obtain Water Pollution Control Loan
Secure WRRSP funding for implementing components of Coffee/Center Creek stream restoration plan	Staff time	Grand River Partners, Inc. & Ashtabula County Commissioners	8/08- 8/09	Obtain WRRSP funding

PROBLEM 4

BACKGROUND: Subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek) contains two major named tributaries, Coffee Creek and Center Creek. In subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek), 10,060.3 feet of Coffee Creek and 5,700 feet of Center Creek have insufficient riparian buffer.

PROBLEM STATEMENT: INSUFFICIENT RIPARIAN BUFFER ON BOTH COFFEE AND CENTER CREEKS

In subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek), there is a lack of riparian habitat and buffer due to channelization, clearing for farming, and other agricultural activities

GOAL:

1. Develop stream restoration plan for the impaired riparian portions of subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek)

2. Restore 50% of the impaired riparian portions of subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek)

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Hire consultant to develop a Coffee/ Center Creek restoration plan to restore 50% of the impaired riparian portion of 010	$15,000-30,000	Grand River Partners, Inc.	1/10-6/10	Completed stream restoration plan
Consultant will implement restoration plan	To be determined by restoration plan. Similar restoration efforts have cost between $50-75 per linear foot.	Grand River Partners, Inc. and Consultant	7/10-7/12	50% of impaired riparian portions of subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek) restored
Work with Plymouth and Austinburg Township officials to adopt a riparian set-back ordinance	Staff time	Grand River Partners, Inc. & Ashtabula SWCD	7/08-7/10	Riparian set-back ordinance adopted
Educate local landowners on importance of riparian buffers	Staff time & $15,000/year for travel, and educational materials	Grand River Partners, Inc. & Ashtabula SWCD	7/08-7/10	% change in land use along streams in HUC 04110004060010

PROBLEM 5

BACKGROUND: Subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek) contains two major named tributaries, Coffee Creek and Center Creek. This HUC is approximately 41% agriculture, of which approximately 25% have working conservation management plans.

PROBLEM STATEMENT: LACK OF CONSERVATION MANAGEMENT PLANS IN HUC 04110004060010 OF THE LOWER GRAND RIVER WATERSHED

There is a lack of environmentally sound agricultural practices in subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek), which can contribute to declining water quality.

GOALS:

1. Establish Comprehensive Nutrient Management Plans (CNMP) with 75% of the agricultural producers in subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek)

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Establish CNMPs with 75% of the agricultural producers in subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek)	Staff time	USDA NRCS	ongoing	75% goal reached

PROBLEM 6

BACKGROUND: Based on the 2000 Census data, the projected population growth for Ashtabula County is 13.7%. Similar growth in adjacent Counties in the watershed has shown that an increase in development due to population increase has caused erosion and siltation of waterways. Permanent protection of critical areas will ensure that high water quality will remain.

PROBLEM STATEMENT: NEED FOR FUNDING FOR LAND PROTECTION EFFORTS

Currently there are no permanently protected acres in subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek). Grand River Partners, Inc. Land Protection Priority List has identified 2,412.3 acres of priority land for protection.

GOALS:

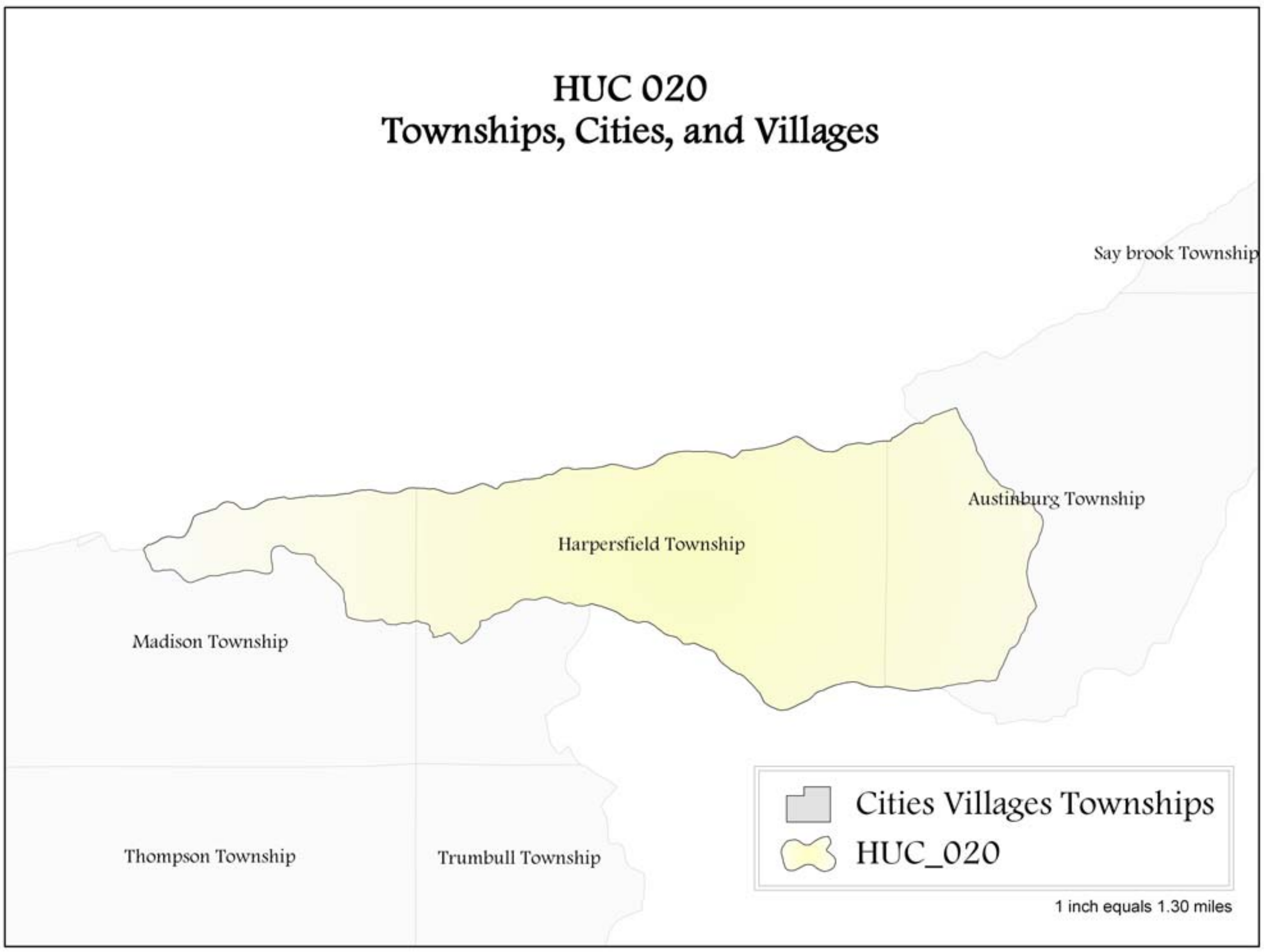
1. Work to secure funding to preserve pristine water quality by protecting 2,412.3 acres of pristine land within subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek).

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Permanent protection of 2,412.3 acres of subwatershed 04110004060010 (Grand River below Mill Creek (2) to below Coffee Creek)	≈ $2,412,300 (≈$1,000/ acre conservation easement value)	Ashtabula SWCD, Ashtabula Metroparks, Grand River Partners, Inc., The Nature Conservancy, etc.	1/08-ongoing	Number of acres put into conservation easement protection

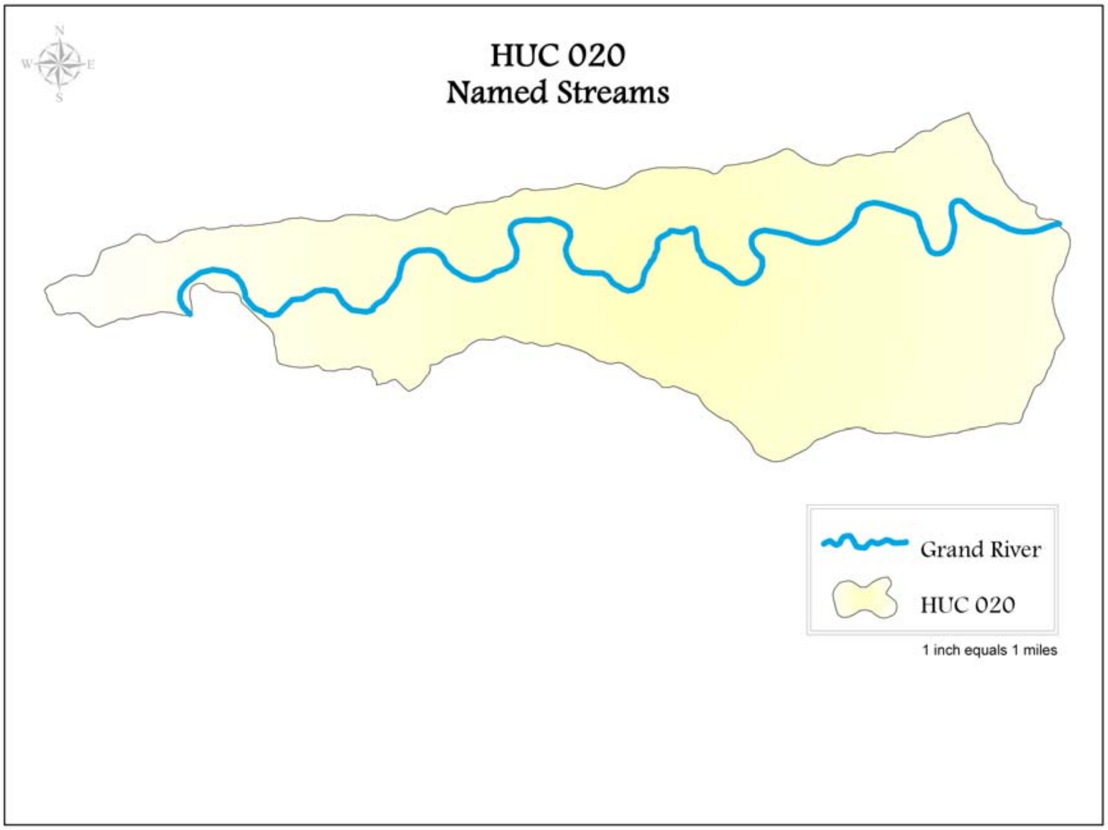
04110004060020 – Grand River below Coffee Creek to above Mill Creek (3)

DESCRIPTION- The 14-digit Hydraulic Unit Code 04110004060020 (HUC 020) is located within the 11-digit HUC 04110004060 know as the Lower Grand River Watershed. HUC 020 is approximately 10,654 acres and approximately 17 square miles. This watershed encompasses portions of Austinburg and Harpersfield Townships in Ashtabula County, and Madison Township in Lake County.

Map 1.020- Communities of HUC 04110004060020



Map 2.020 Named Streams of HUC 020



DEMOGRPAHICS~ Unfortunately, demographic statistics are collected on a per township or per county basis, thus making it difficult to determine the exact numbers for each subwatershed. Therefore, the data for each township located within each subwatershed was examined, and the totals and averages were taken of each; outliers were taken into account. The statistics for the townships of Austinburg and Harpersfield Townships in Ashtabula County, and Madison Township in Lake County were utilized to determine the information below.

Total Population~

The total population for HUC 020 is approximately 23,265 with a 49.59/ 50.41% male to female ratio. The largest age group represented is the 35 to 44 years group (17.42% of the total population), followed by the 45 to 54 years group (14.67%), and the 25 to 34 years group (13.38%). 15,200 people represent the 18 and older groups, which accounts for 73.77% of the total population for the townships located within HUC 020. The average median age represented is 38.3.

The male to female ratio for the state of Ohio is 48.60/ 51.40%. The largest age group represented is the 35 to 44 years groups (15.90% of the total population), followed by the 45 to 54 years group (13.80%), and the 25 to 34 years group (13.40%). The median age for the people who reside in Ohio is 36.2.

Educational Attainment~

Of the 15,606 people who are over the age of 25 in the townships within the HUC 020 subwatershed, the majority education level is high school graduate (41.77%), followed by some college with no degree (22.63%), and 9th grade to 12th grade with no diploma received (11.18%).

Employment Status~

Approximately 12,209 (68.57%) people over the age of 16, in the townships of Austinburg and Harpersfield Townships in Ashtabula County, and Madison Township in Lake County, are currently in the workforce. There are approximately 491 (2.76%) who are currently unemployed.

Household by type~

There are approximately 8,591 households in the Townships located within the HUC 020, of which 6,425 (74.79%) are family households. The average family size is 3.05 people.

Income (1999)~

The average median household income in1999 for individual households in the townships of Austinburg and Harpersfield Townships in Ashtabula County, and Madison Township in Lake County was $49,652. The majority of the households had an income of $50,000 to $74,999 (27.33%), followed by $35,000 to $49,999 (27.33%), and $25,000 to $34,999 (12.75%).

The average median family income in 1999 for families in the townships of Austinburg and Harpersfield Townships in Ashtabula County, and Madison Township in Lake County, was $53,491. The majority of families had an income of $50,000 to $74,999 (23.74%), followed by $35,000 to $49,999 (16.83%), and $75,000 to $94,999 (9.45%).

The average median earnings for a male, full time, year round worker were $38,936 and $24,147 for a female, full time, year round worker.

Below Poverty Level (1999)~

There are 1,147 individuals within the HUC 020 subwatershed, for whom poverty status was determined. Of those, approximately 195 families are represented, and 120 are families with a female householder with no male present.

Occupation~

The residents of the townships of Austinburg and Harpersfield Townships in Ashtabula County and Madison Township in Lake County, represent the following occupations; 2,902 management professionals, 1,539 service occupations, 2,978 sales and office occupations, 64 farming, fishing, and forestry occupations, 1,461 construction, extraction and maintenance occupations, and 2,755 production, transportation, and material moving occupations.

Race~

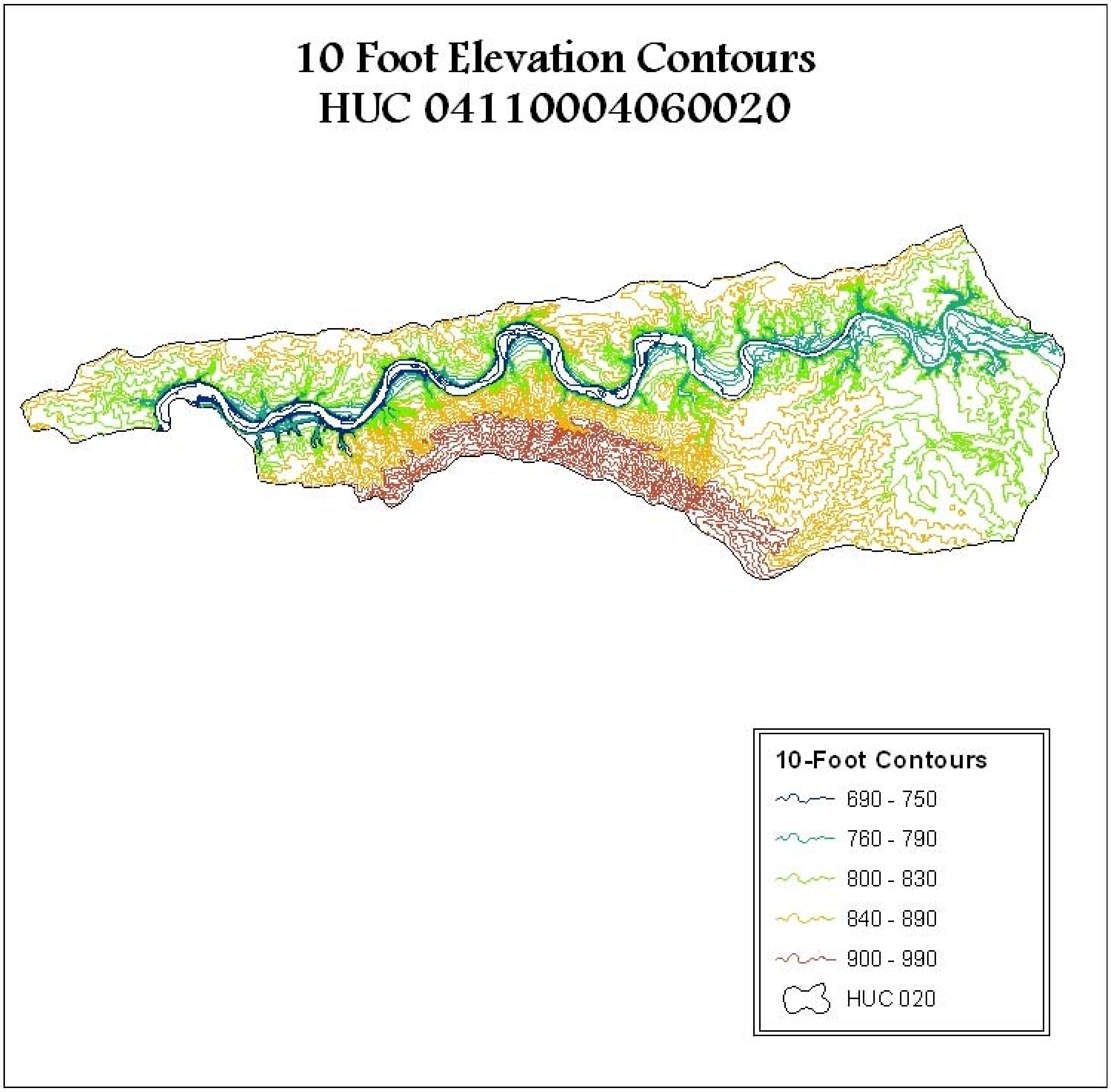
Approximately 98.82% of the population of the HUC 020 is white, 0.41% is African American, and 0.32% is Asian.

Other~

Within the HUC 020, approximately 11 residences are lacking complete plumbing facilities, 15 are lacking complete kitchen facilities, and 141 are without telephone service.

TOPOGRAPHY~ The majority of HUC 020 is located within the Gorge Project Area of the Grand River Watershed. This are is known for its high bluffs that overlook the Grand River. HUC 020 has drastic elevation changes at it approaches the river, which gives the Grand River its amazing gorge and shale bluffs. The highest point in HUC 020 is 990 feet and the lowest is 690 feet.

Map 3.020- 10 foot contours HUC 020

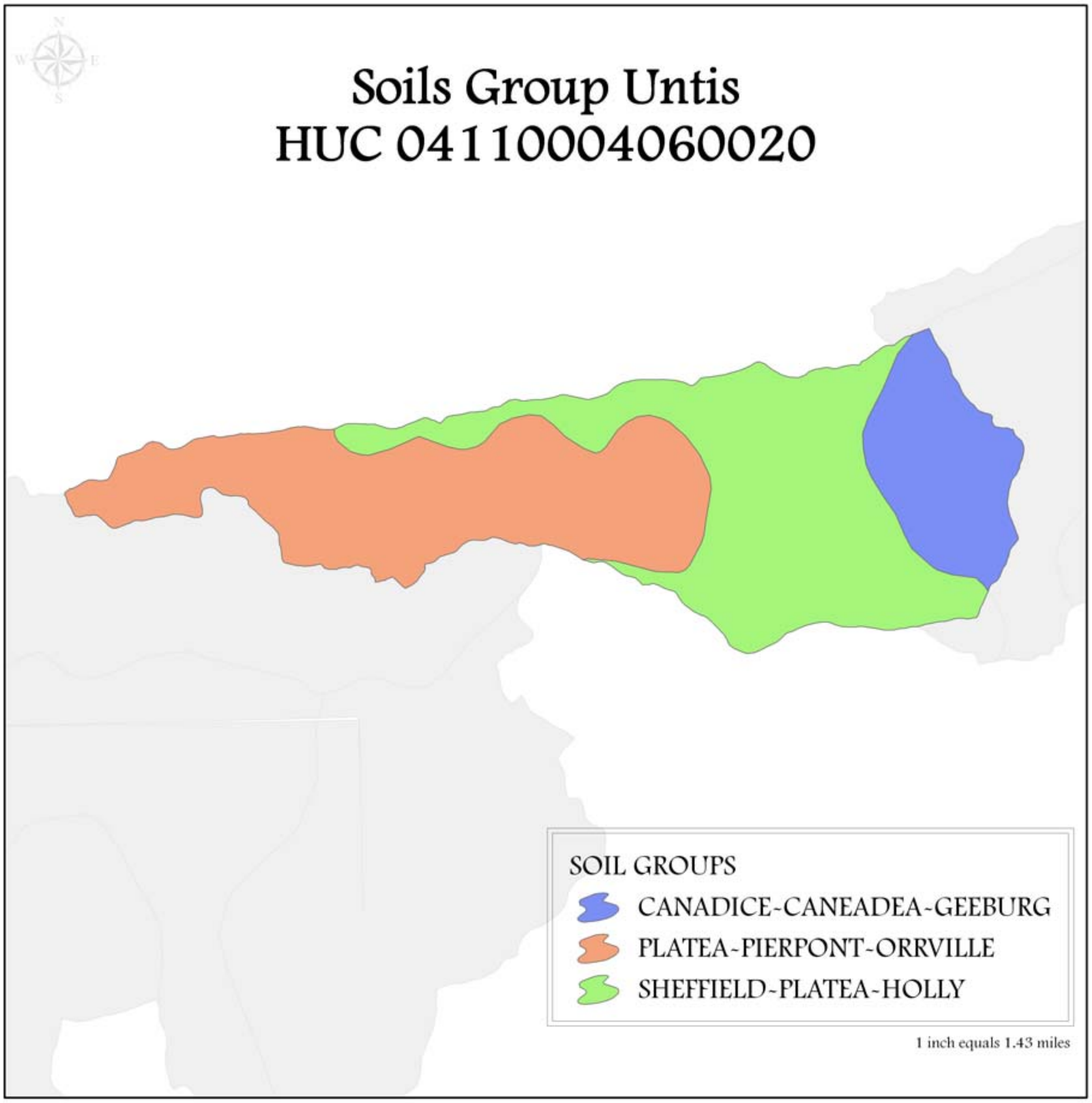


SOILS- There are three soil groups represented within HUC 020; the Canadice – Caneadea – Geeburg (approximately 1,690 acres), the Platea – Pierpont – Orrville (4,450), and the Sheffield – Platea – Holly (approximately 4,500 acres) groups.

Canadice- Caneadea-Geeburg Group: This association is a very deep, level and gently sloping, poorly and somewhat poorly drained soils that formed in moderately fine and fine textured sediments deposited from lakes and medium and moderately fine textured sediments from glacial till deposited from streams on valley floors. This soil association occupies areas that were lakebeds during the Wisconsin glacial period. These soils are mostly strongly acidic in the upper part of their root zone. The erosion hazard is severe on the valley sides along the Grand River. The steeper soils in these areas are unstable and subject to slippage. Limitations for farm and nonfarm uses of these soils are seasonal wetness, very slow permeability, and the moderately fine texture to fine texture.

Platea- Pierpont- Orrville Group: This association is deep, nearly level to moderately steep, somewhat poorly drained to moderately well drained silty soils on glaciated uplands. This soil is found in undulating and hilly areas, but steep soils occur along rivers and streams including the Grand River. Grapes and small fruits are grown where the climate is suitable, particularly where air drainage is good. Very slow permeability, slope, and seasonal wetness are limitations for many nonfarm uses in this association.

Map 4.020- Soil Groups of HUC 020



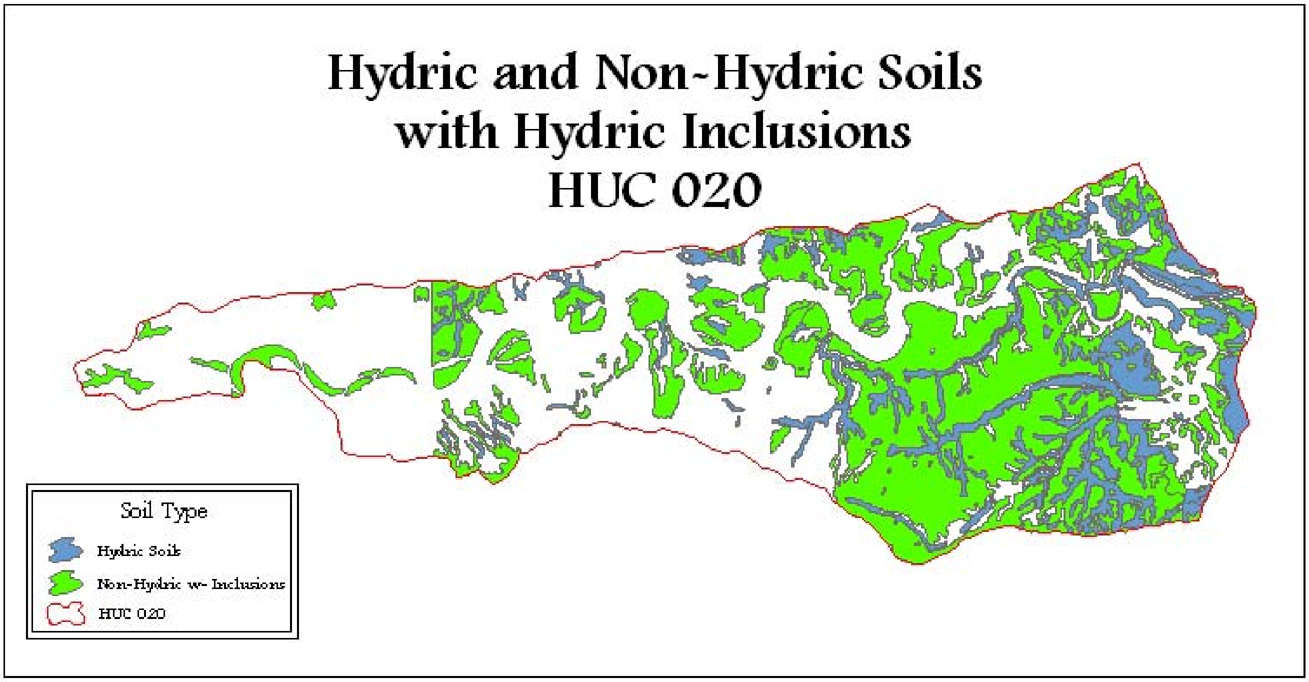
A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. This lack of oxygen in the soil can lead to the formation of certain observable characteristics in hydric soils, such as a thick layer of organic matter (non-decomposed plant materials) in the upper part of the soil column. Other observable features include oxidized root channels and redoximorphic features (concentrations and depletions of Iron and other elements, i.e., mottling, gleying). The following National Soil Information System (NASIS) criteria reflect those soils that may meet the definition of hydric soils.

- All Histels except Folistels and Histosols except Folists, or
- Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:
- Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or
- poorly drained or very poorly drained and have either:
    - o water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils
    - o water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or
    - o water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or
- Soils that are frequently ponded for long duration or very long duration during the growing season, or
- Soils that are frequently flooded for long duration or very long duration during the growing season.

In HUC 020, there are approximately 1,447 acres of hydric soils.

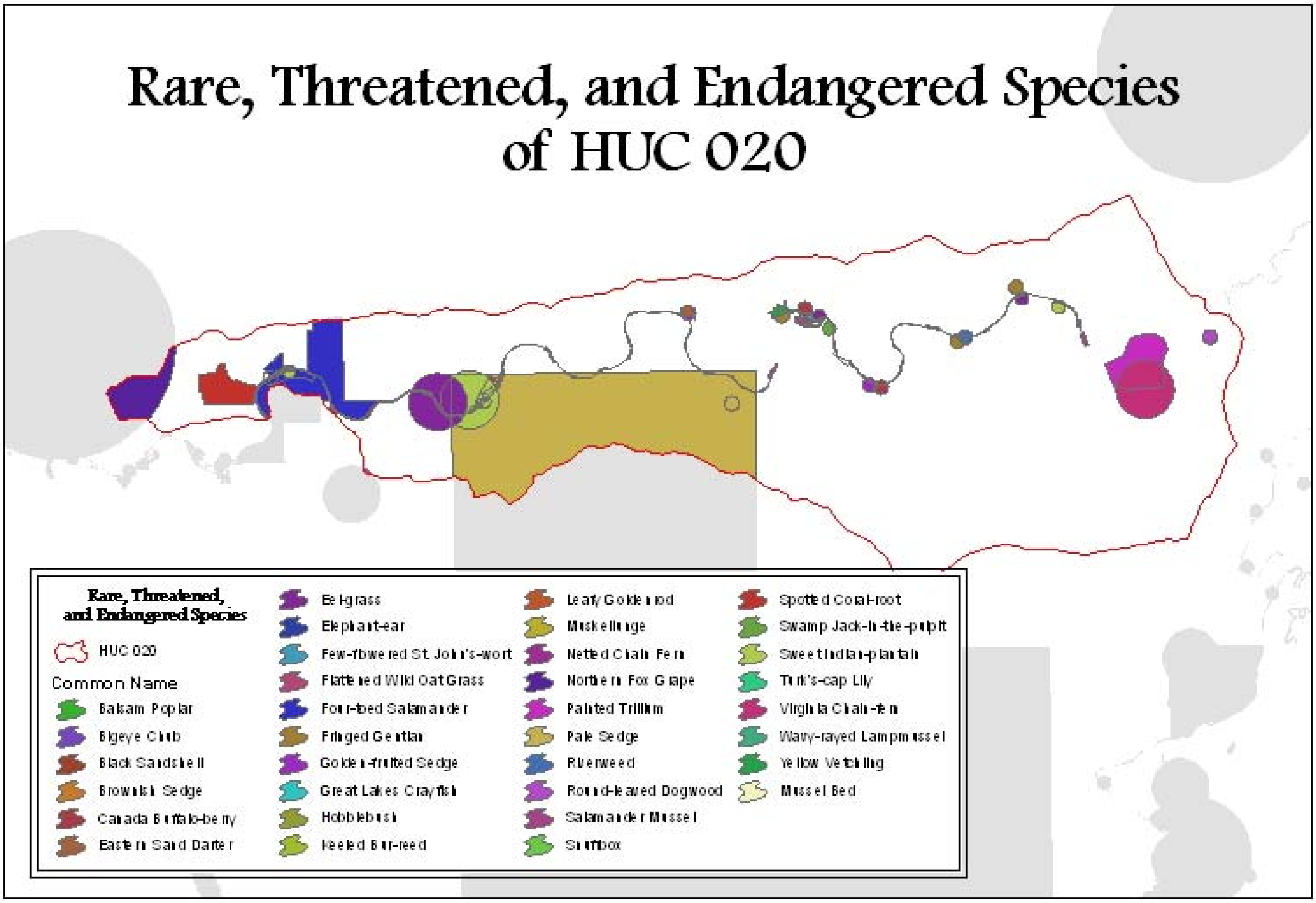
Non hydric soils can be of major importance to water quality as well. Many non-hydric soil types contain small areas of hydric soils, or hydric inclusions. These soils are generally not associated with having the properties of hydric soils, but the do have small pockets, which are too small to have been mapped by the soils surveys, to be considered hydric. Soil Survey books generally do not map "inclusions" of different soil types if the map units are less than 2 acres in size. These inclusions can be wetland soils within an upland soil series. Sometimes, the description will include the types of soils that are the most common inclusions in the series. HUC 020 contains roughly 4,064 acres of non hydric soils with hydric inclusions.

Map 5.020- Hydric and Non-Hydric Soils HUC 020



RARE, THREATENED, and ENDANGERED SPECIES- The Grand River Watershed provides the perfect habitat for many rare, threatened, and endangered species. In fact, the Ohio Department of Natural Resources, Division of Wildlife recognized the unparalleled biodiversity and habitats of the Grand River Watershed, and chose this watershed to reintroduce the wild turkey, river otter, and snowshoe hare. The following species are found within HUC 020 in the Grand River Watershed; balsam poplar, bigeye chub, black sandshell mussel, brownish sedge, Canada buffalo-berry, eastern sand darter, eel-grass, elephant-ear mussel, few-flowered St. John's-wort, four-toed salamander, fringed gentian, golden-fruited sedge, Great Lakes crayfish, hobblebush, keeled bur-reed, leafy goldenrod, muskellunge, netted chain fern, northern fox grape, painted trillium, pale sedge, riverweed, round-leaved dogwood, salamander mussel, snuffbox mussel, spotted coral-root, swamp jack-in-the-pulpit, sweet-Indian plantain, Turk's-cap-lily, Virginia chain-fern, wavy-rayed-lampmussel, and yellow vetching.

Map 6.020- Rare Species of HUC 020



DAMS- There are 18 dams located with in the Lower Grand River Watershed. In HUC 020 there are five dams; ***Lake Asegra Dam***, ***Lake George Dam***, ***Sili Lake Dam***, ***Harpersfield Low Head Dam***, and the ***Debevc Lake Dam***.

- The ***Lake Asegra Dam***, NID OH00405, is located in Austinburg Township, Ashtabula County. This is a privately owned, earthen dam, located on an unnamed tributary to the Grand River. The purpose for this dam is strictly recreational, and is 53.4 acres in size. The drainage area of this dam is 4.02

square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Lake Asegra Dam* is significant; meaning that no loss of human life is probable, however economic and/or environmental losses, disruption of lifeline facilities, and other impacts would be expected.

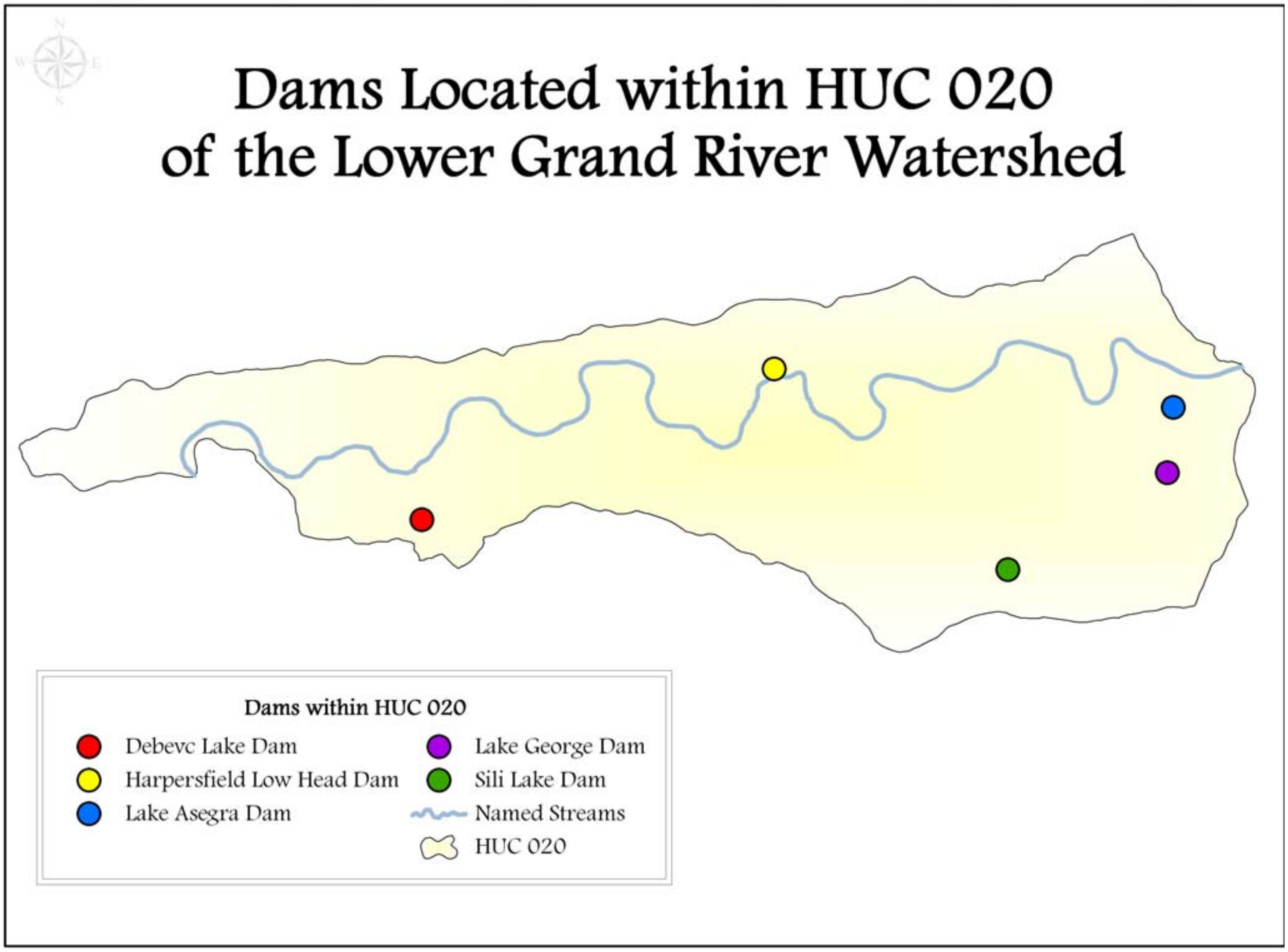
- The *Lake George Dam*, NID OH00402, is located in Austinburg Township, Ashtabula County. This is a privately owned, earthen dam, located on an unnamed tributary to the Grand River. This dam is 30.6 acres in size, and has a drainage area of 2.94 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Lake George Dam* is significant; meaning that no loss of human life is probable, but economic and/or environmental losses, disruption of lifeline facilities, and other impacts would be expected.

- The *Sili Lake Dam*, NID OH001195, is located in Harpersfield Township, Ashtabula County. This is a privately owned, earthen dam, located on an unnamed tributary to the Grand River. The purpose for this dam is strictly recreational, and is 8 acres in size. The drainage area of this dam is 0.51 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Sili Lake Dam* is low, meaning that no loss of human life is probable and economic and/or environmental losses, disruption of lifeline facilities, and other impacts would not be expected.

- The *Harpersfield Low Head Dam*, NID OH00810, is located in Harpersfield Township, Ashtabula County. This is a federally owned, concrete-gravity dam, located on the Grand River. The drainage area of this dam is 575 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Harpersfield Low Head Dam* is low, meaning that no loss of human life is probable and economic and/or environmental losses, disruption of lifeline facilities, and other impacts would not be expected. The *Harpersfield Low Head Dam* is accompanied by the Harpersfield Covered Bridge. Replacing an earlier bridge that was carried away in a spring flood, the Harpersfield Covered Bridge was built in 1868 and spans the Grand River. This bridge which currently carries County Road No. 154 (Harpersfield Road) is a two-span wooden Howe truss bridge, with center pier. The great flood of 1913 washed away the northern approach and it was at this time that the additional 140 foot steel truss was added. The 228-foot-long Harpersfield Bridge is the longest covered bridge in Ohio and is on the National Register of Historic Places.

- The *Debevc Lake Dam*, NID OH00403, is located in Harpersfield Township, Ashtabula County. This is a privately owned, earthen dam, located on an unnamed tributary to the Grand River. The purpose for this dam is strictly recreational, and is 2.7 acres in size. The drainage area of this dam is 0.13 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Debevc Lake Dam* is low, meaning that no loss of human life is probable and economic and/or environmental losses, disruption of lifeline facilities, and other impacts would not be expected.

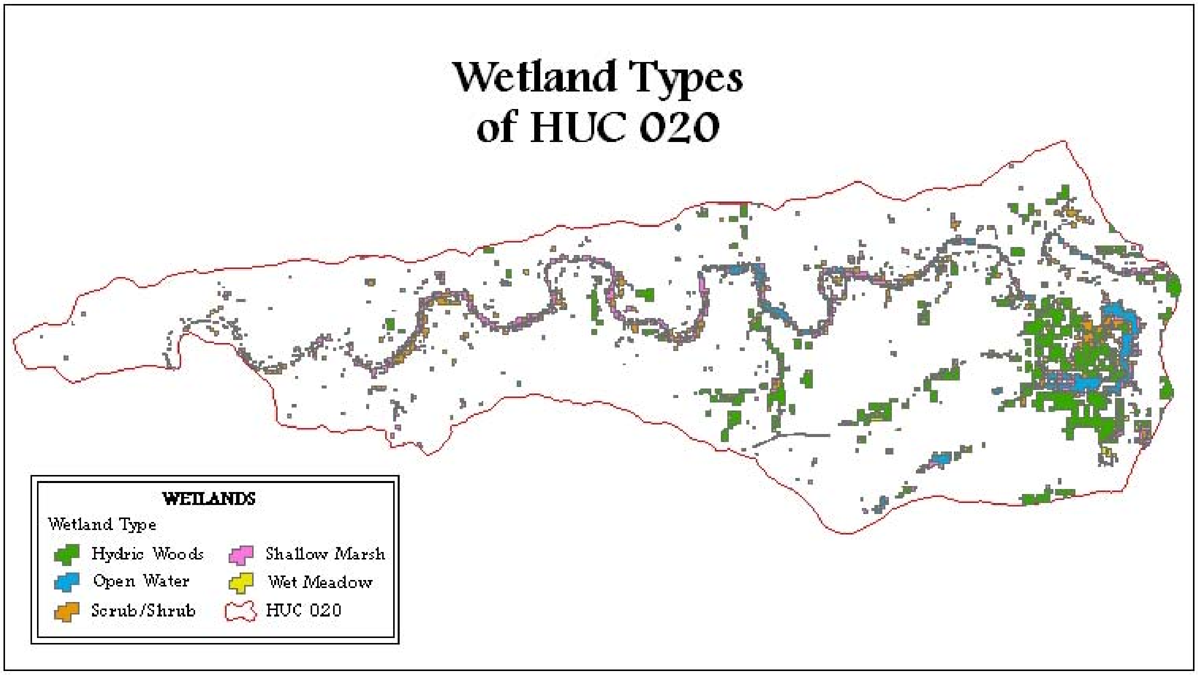
Map 7.020- Dams of HUC 020



WETLANDS- Wetlands are typically highly productive habitats, often hosting considerable biodiversity. The Army Corps of Engineers and the Environmental Protection Agency define wetlands as; "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions". Wetlands are found under a wide range of hydrological conditions, but at least some of the time water saturates the soil. The result is a hydric soil, one characterized by an absence of free oxygen some or all of the time, and therefore called a "reducing environment." Plants called hydrophytes specifically adapted to the reducing conditions presented by such soils can survive in wetlands, whereas species intolerant of the absence of soil oxygen (called "upland" plants) can not survive. Adaptations to low soil oxygen characterize many wetland species.

HUC 020 has approximately 1,272 acres of wetlands; 219 acres of Hydric Woods, 138 acres of open water, 283 acres of scrub/shrub, 284 acres of shallow marsh, and 47 acres of wet meadow.

Map 8.020- Wetlands of HUC 020



DRASTIC- The DRASTIC maps, produced by the Ohio Department of Natural Resources, show the pollution potential for groundwater systems. The DRASTIC mapping system allows the pollution potential of any area to be evaluated systematically using the following existing information about an area:

D= Depth to Water

R= Net Recharge

A= Aquifer Media

S= Soil Media

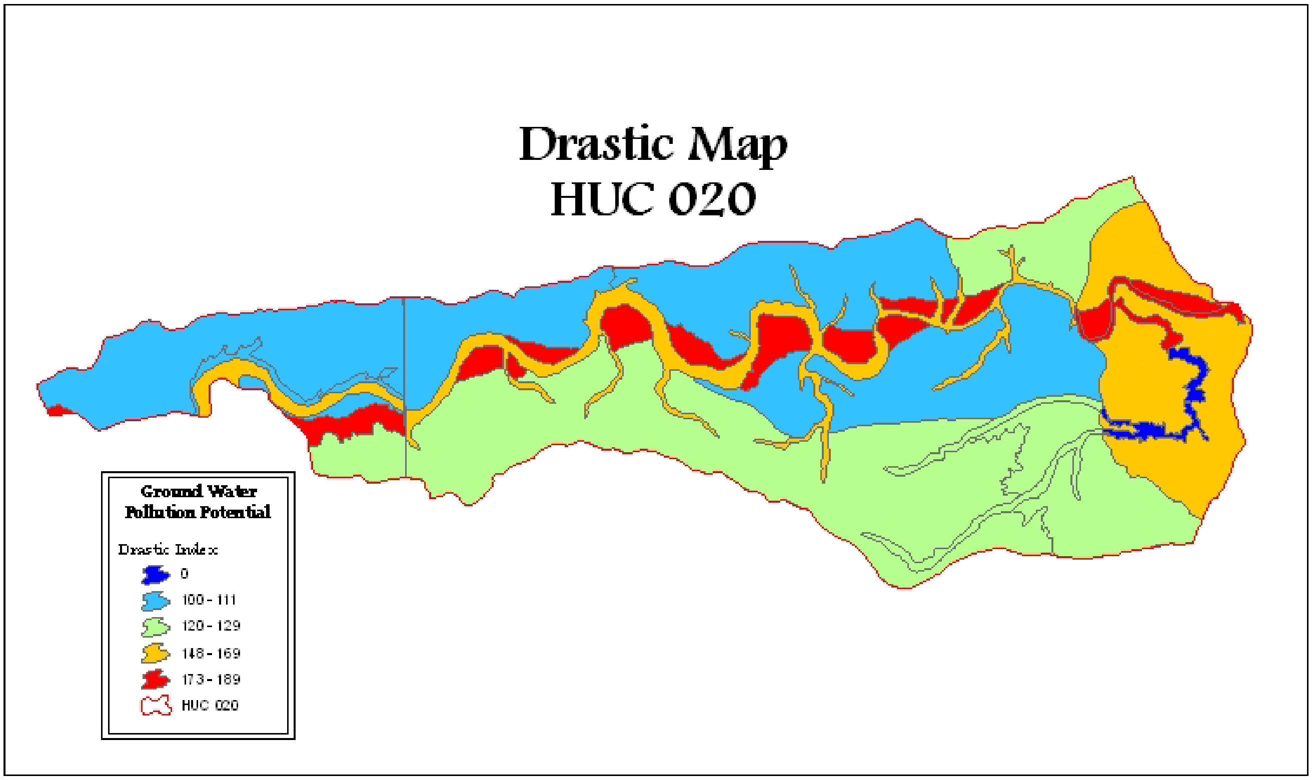
T= Topography

I= Impact of the Vadose Zone Media

C= Hydraulic Conductivity of the Aquifer

In evaluating an area's vulnerability to contamination, the DRASTIC mapping system assumes a contaminant with the mobility of water is introduced at the surface and flushed into the groundwater by precipitation. A pollution potential map can assist in developing ground water protection strategies. By identifying areas more vulnerable to contamination, officials can direct resources to areas where special attention or protection efforts might be warranted. This information can be utilized effectively at the local level for integration into land use decisions and as an educational tool to promote public awareness of ground water resources. Pollution potential maps may be used to prioritize ground water monitoring and/or contamination clean-up efforts. Areas that are identified as being vulnerable to contamination may benefit from increased ground water monitoring for pollutants or from additional efforts to clean up an aquifer. HUC 020 has a maximum DRASTIC index of 189. Approximately 7.33% of HUC 020 has a high DRASTIC index.

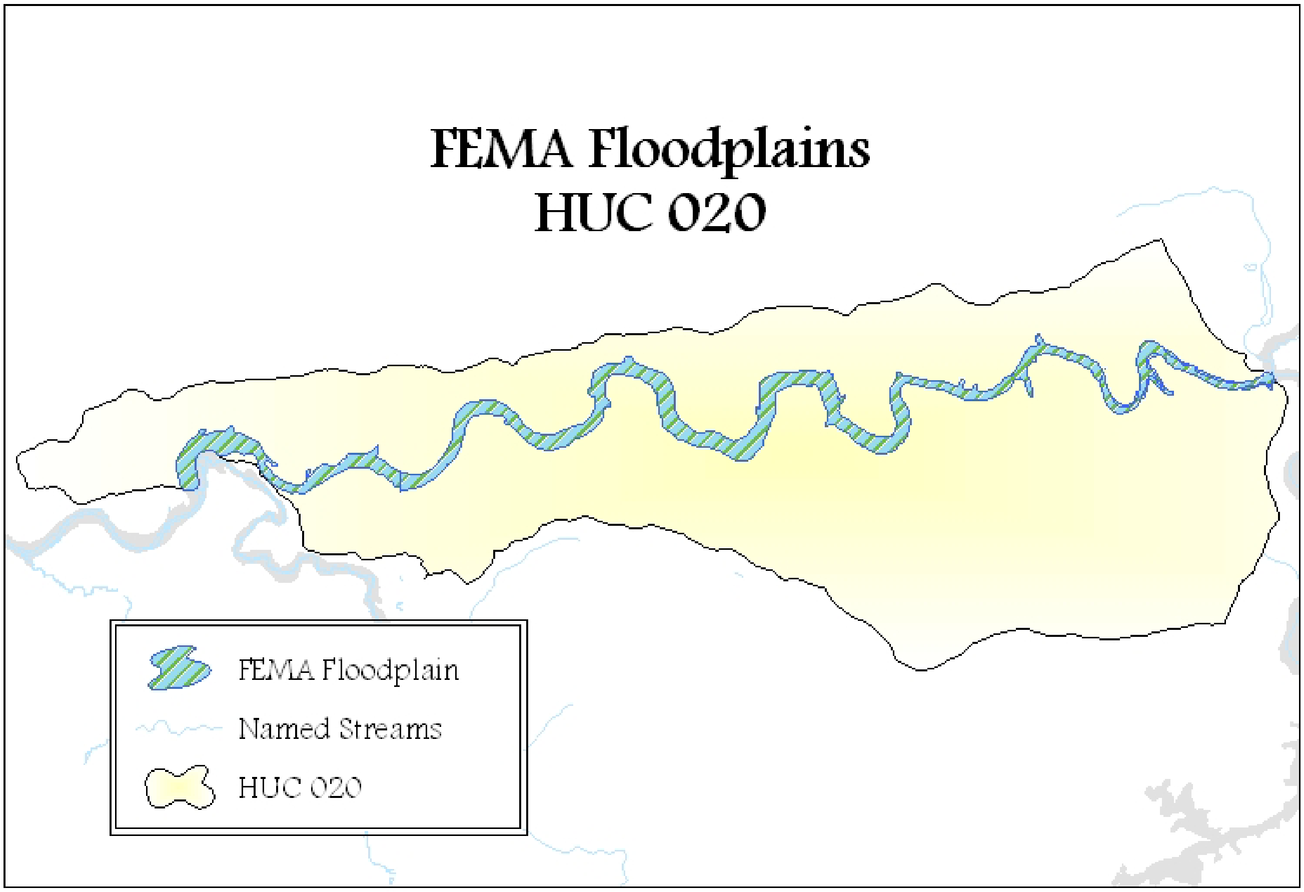
Map 9.020- DRASTIC of HUC 020



FLOODPLAINS- Floodplains are the low, flat, periodically flooded lands adjacent to rivers, lakes and oceans and subject to geomorphic (land-shaping) and hydrologic (water flow) processes. FEMA, the Federal Emergency Management Agency, has developed areas within watersheds that are designated as 100-year and 500- year floodplains. A "100-year flood" is defined as a flood event that has a 1 in 100 chance of occurring in any given year, and a 500-year flood has a 1 in 500 chance. HUC 020 has a total of 758 acres of floodplain; 739 acres of designated 100-year floodplain, which represents approximately 6.92% of the watershed, and 19 acres designated as 500-year floodplain, which represents approximately .18% of the watershed.

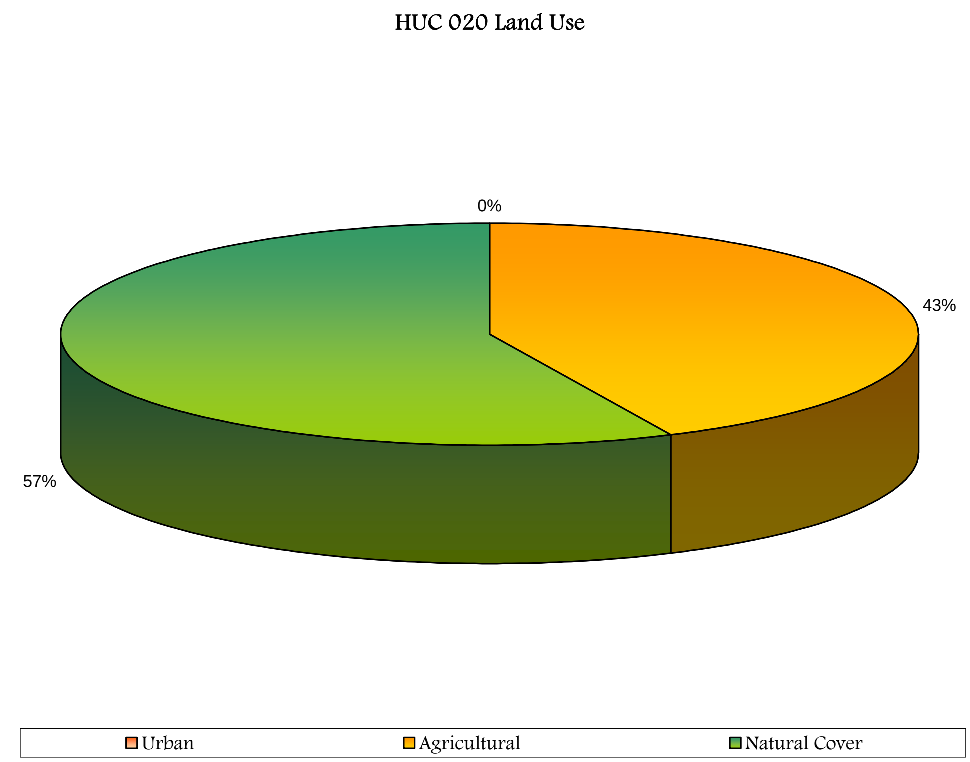
Current the only regulations that protect floodplains are established by the Federal Emergency Management Agency, and are enforced by the Ashtabula County Subdivision Regulations.

Map 10.020- FEMA Floodplains of HUC 020



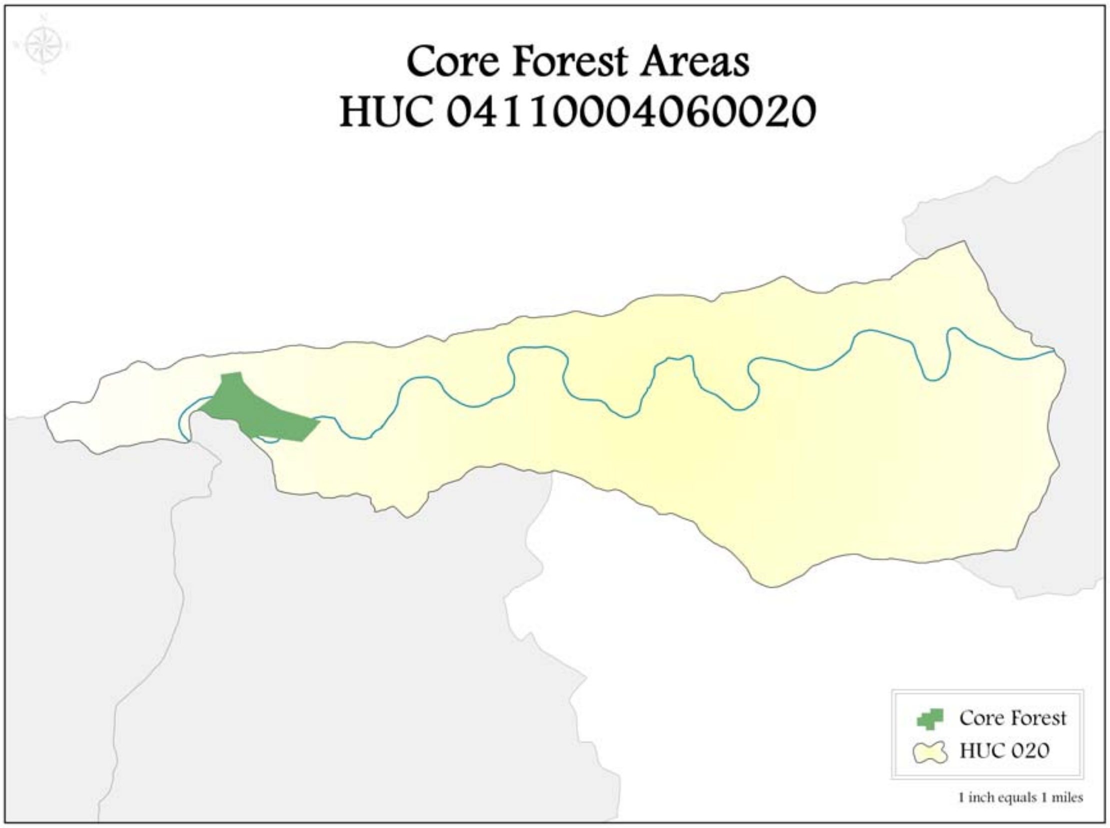
LAND USE- HUC 020 is a relatively rural subwatershed. Much of this watershed is agricultural, with little urban areas. However, suburbanization is a threat to this area of the Grand River Watershed. Here, land is plentiful and still remains at a very low cost. Population density is low (8.3), but is inspected to increase due to suburbanization.

Chart 1.020- Land Use in HUC 020



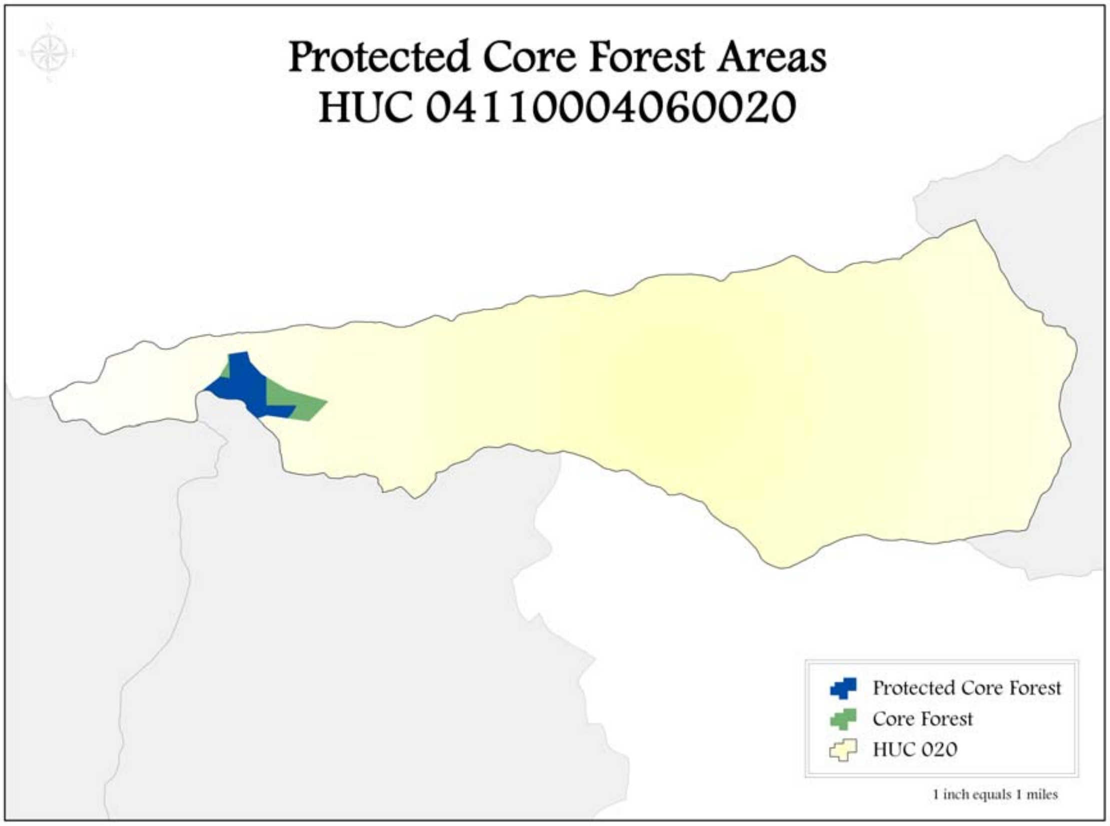
Since the majority of the watershed remaining in natural cover, there are still a few large tracts of undisturbed forest blocks. The Nature Conservancy realized the importance of these large tracts of forest, or "Core Forest Areas", for not only their natural resources value but their importance for breeding populations as well. Core Forest Areas are forested areas of 100 acres or more with a forested buffer zone from pastures and agriculture, and no roads within at least 300 meters. These numbers were determined by the habits and lifecycles of certain forest species; a pair of pileated woodpeckers will need at least 100 acres in order to breed, certain amphibian populations use forest areas up to 200 meters away from their wetland habitat for breeding purposes, and cowbirds will penetrate up to 150 meters of the core forest areas. HUC 020 contains one Core Forest Area, which totals 220.24 acres, or roughly 2.07% of the HUC 020 watershed.

Map 11.020- Core Forest of HUC 020



These Core Forest Areas are very important habitats that need to be preserved. There are currently 141.99 acres of the 220.24 acres of Core Forest in permanent protection, or approximately 64.47%.

Map 12.020- Protected Core Forest of HUC 020



GRPI- LAND PROTECTION PRIORITY LIST- Grand River Partners, Inc.'s goal is to protect the natural resources of the Grand River and its watershed. Grand River Partners, Inc. utilizes the conservation easement as the primary tool to protect such resources. Conservation easements are a great tool to protect resources on private lands but still maintain them in private hands. The Grand River watershed is approximately 712 square miles. Obviously Grand River Partners, Inc. cannot protect all of the 712 square miles (455,000 acres) with conservation easements. Grand River Partners, Inc. believes that water quality can be protected by conserving the "right" 25% of a watershed. In the specific case of the Grand River, this represents roughly 114,000 acres. Protecting 114,000 acres is an achievable goal considering the number of partner organizations and the fact that approximately 25% of the 114,000 acres has already been protected.

The challenge remains to protect the remaining 86,000 acres of the "right" land. To fulfill this goal, Grand River Partners, Inc. developed a parcel based **Land Protection Priority List**. Before any prioritization process could begin, any parcel less then five acres was removed from the potential list of priorities. To make fair comparisons an analysis of the watershed was conducted to determine the unique areas within the watershed. From this analysis, the Grand River Watershed was divided into 5 distinct project areas based on the unique natural features of each. The parcel prioritization process involved a two tier analysis. The first, Tier 1, involved an analysis of natural resources. The second, Tier 2, involved a strategic analysis that took into account parcel size, proximity to other protected land, and partner priorities.

The Headwaters Project Area consists of the area drained by all the unnamed tributaries that together form the Grand River. The area begins more or less upstream of the crossing with SR 534 at the southern end of the watershed. In summary, important natural resources ranked for each parcel located in the Headwaters Project Area are intact riparian areas, the Grand River main stem, wetlands, unnamed tributaries, floodplains, core forest blocks and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Lowlands Project Area begins at the crossing of SR 534 with the mainstem in the southern portion of the watershed and extends between the 810' contour interval north to the crossing where the Grand River intersects Windsor-Mechanicsville Road. Important Natural Resources identified in the Lowlands Project Area are swamp forests, wetlands, intact riparian areas, core forest blocks, mainstem, rare species, floodplains, TNC subwatershed ranking, and named tributaries. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Gorge Project Area begins at the crossing of the mainstem and Windsor-Mechanicsville Road bridge and extends upstream to the crossing with SR 84. The Gorge Project Area is bordered to the north by the watershed boundary and to the south by the 950' contour interval. The important natural characters of the Gorge are the mainstem, wetlands, floodplains, intact riparian areas, named tributaries, core forest blocks, steep slopes, TNC subwatershed rankings, and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Estuarine/Urban Project Area begins at the State Route 84 crossing with the Grand River and ends in Fairport Harbor Village and Grand River Village at its terminus with Lake Erie. The Estuarine/Urban Project Area includes the subwatershed of Red Creek which extends to the west just north of the City of Painesville. In this project area the mainstem, river access points, wetlands, intact riparian areas, floodplains and named tributaries were considered important natural features. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

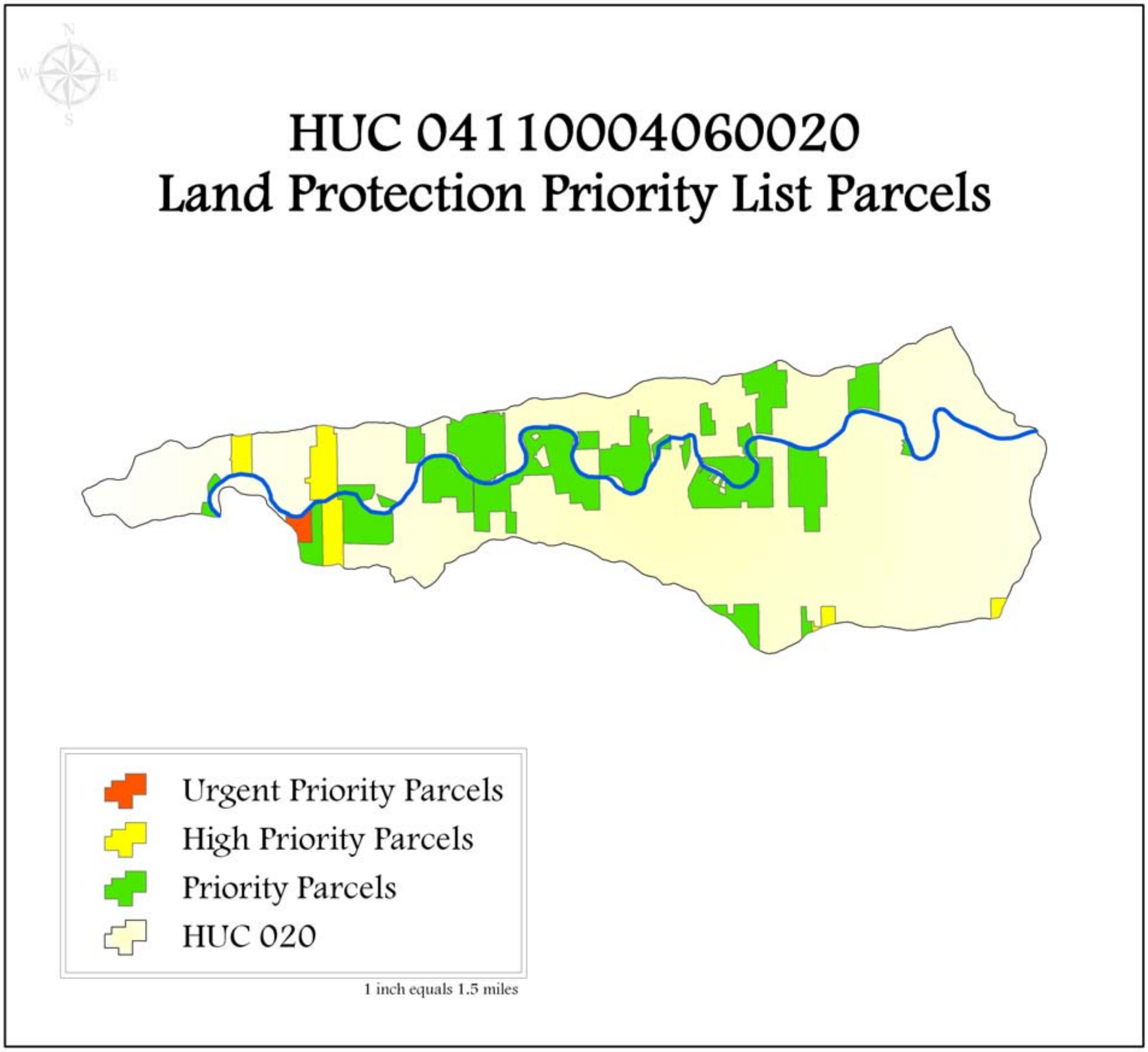
The last area is the Tributaries Project Area which consists of two areas; one is located east of the Grand River Lowlands Project Area, which and includes the subwatersheds of such named tributaries as Mill Creek, Rock Creek and Coffee Creek, and the second project area is located west of the Lowlands Project Area, north of the Headwaters Project Area and south of the Gorge Project Area. This portion of the Tributaries Project

Area contains the subwatersheds of such high quality streams as Indian Creek, Phelps Creek, Hoskins Creek, and Paine Creek. Important natural resources considered include, cold water habitat, wetlands, floodplains, core forest blocks, and rare species. Again each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

Each parcel within the watershed was further evaluated based on additional strategic rankings. These rankings include parcel size, proximity to protected land and partner priorities. Each parcel meeting the acreage requirement, or within a certain distance of existing protected land or included as a priority by a partner organization or agency was weighted more heavily and therefore considered a high priority. A statistical analysis of the final scores was performed and each parcel was categorized as being priority, high priority or an urgent priority parcel.

In HUC 020, there are a total of 1920.47 acres of priority parcels, 303.96 acres of high priority parcels, and 37.15 acres of urgent priority parcels for protection. There are currently 720.78 acres of protected land within HUC 020.

Map 13.020- LPPL of HUC 020



IMPERVIOUS SURFACE~ The Conversion of farmland, forests, wetlands, and meadows to rooftops, roads, and lawns creates a layer of impervious surface in the urban landscape. Impervious cover is a very useful indicator with which to measure impacts of land development on aquatic systems. The process of urbanization has a profound influence on the hydrology, morphology, water quality, and ecology of surface waters. Recent research has shown that streams in urban watersheds possess a fundamentally different character than streams in forested, rural, or even agricultural watersheds. The amount of impervious cover in the watershed can be used as an indicator to predict how severe these differences can be. In many regions of the country, as little as ten percent watershed impervious cover has been linked to stream degradation, with the degradation becoming more severe as impervious cover increases.

Impervious cover directly influences urban streams by dramatically increasing surface runoff during storm events. Depending on the degree of impervious cover, the annual volume of stormwater runoff can increase by two to 16 times its predevelopment rate, with proportional reductions in groundwater recharge. In natural settings, very little annual rainfall is converted to runoff and about half is infiltrated into the underlying soils and the water table. This water is filtered by the soils, supplies deep water aquifers, and helps support adjacent surface waters with clean water during dry periods. In urbanized areas, less and less annual rainfall is infiltrated and more and more volume is converted to runoff. Not only is this runoff volume greater, it also occurs more frequently and at higher magnitudes. As a result, less water is available to streams and waterways during dry periods and more flow occurs during storms.

The relationship between impervious cover and subwatershed quality can be predicted by a simple model that projects the current and future quality of streams and other water resources at the subwatershed level. Stream research generally indicates that

certain zones of stream quality exist, most notably at about 10% impervious cover, where sensitive stream elements are lost from the system. A second threshold appears at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition; diminished aquatic diversity, water quality, and habitat scores.

The model classifies streams into one of three categories; sensitive, impacted, and non-supporting. Each stream category can be expected to have unique characteristics as follows:

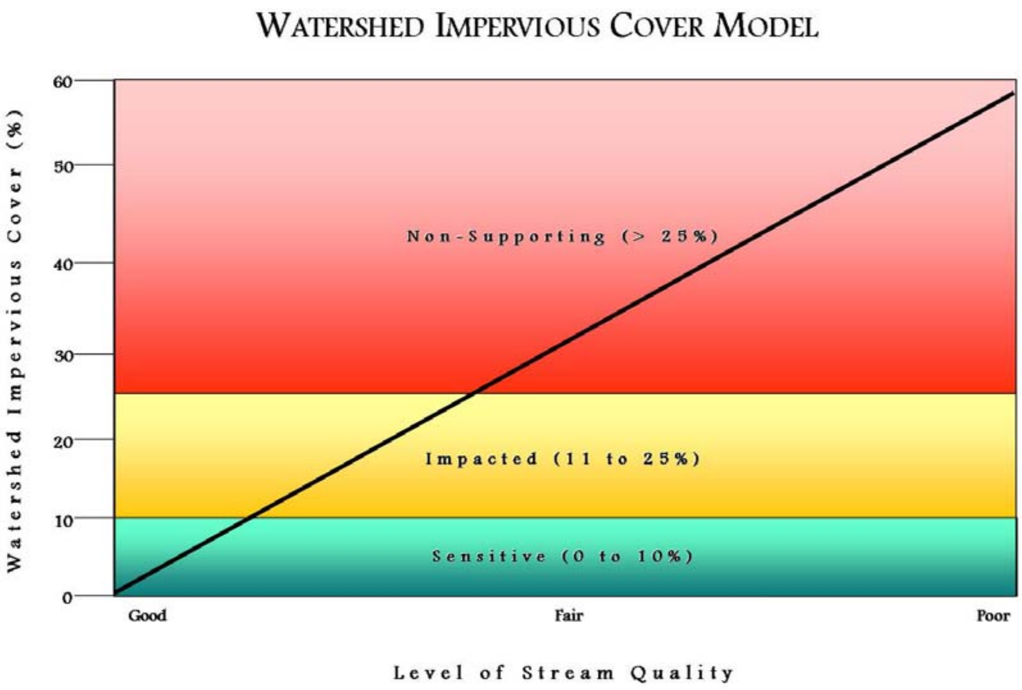
Sensitive Streams: These streams typically have a watershed impervious cover of zero to 10 percent. Consequently, sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Impacted Streams: Streams in this category possess a watershed impervious cover ranging from 11 to 25%, and show clear signs of degradation due to watershed urbanization. Greater storm flows begin to alter the stream geometry. Both erosion and channel widening are clearly evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to

fair levels, with the most sensitive fish and aquatic insects disappearing from the stream.

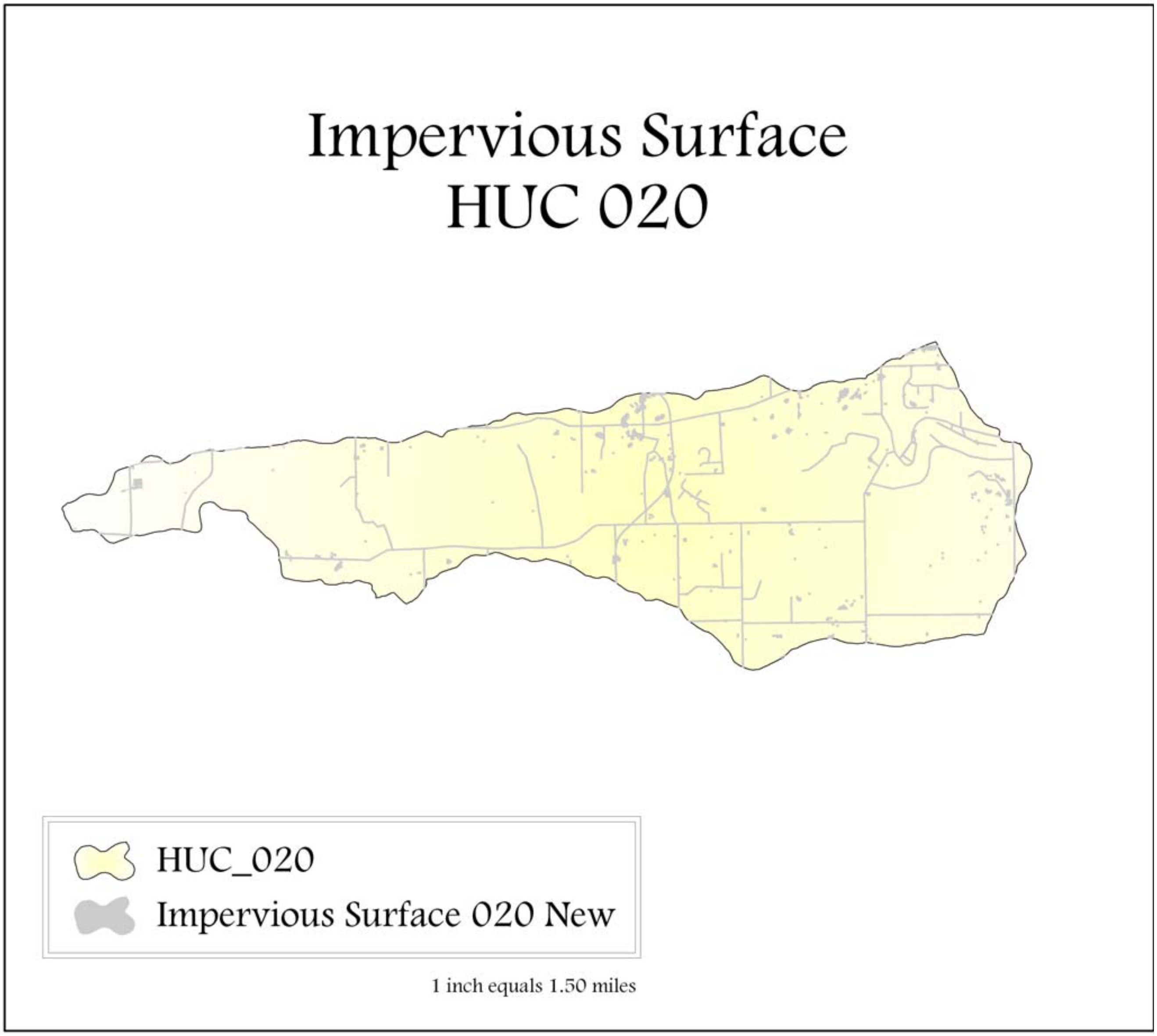
Non- Supporting Streams: Once watershed impervious cover exceeds 25%, stream quality crosses a second threshold. Streams in this category essentially become a conduit for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, down-cutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated, and the stream substrate can no longer provide habitat for insects or spawning areas for fish. Water quality is consistently rated as fair to poor, and water contact recreation is no longer possible due to the presence of high bacterial levels. Subwatersheds in the non-supporting category will generally display increases in nutrient loads to downstream receiving waters, eve if effective urban BMPs are installed and maintained. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish.

Graph 1.020- Impervious Cover Model



HUC 020 has an impervious cover of approximately 4.28%. Therefore, the streams in this subwatershed are considered "sensitive streams" by the impervious surface model. Sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Map 14.020- Impervious Surface of HUC 020



ATTAINMENT STATUS- *Ohio Water Quality Standards: Designated Aquatic Life Use*

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*

2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*

3) *Cold-water Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie

tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 mi.2 drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

Grand River Mainstem- Aquatic life in the Grand River is fully attaining standards for Exceptional Warmwater Habitat (EWH) from Sweitzer Road (RM 42.2) to the SR 2 bridge in Painesville (RM 5.2), and is fully meeting standards for Warmwater Habitat (WWH) downstream from the SR 2 bridge. The Seasonal Salmonid use designation currently in place should be retained.

The Grand River is an economic asset to Northeast Ohio, but is especially sensitive to pollution and disturbance because of limited summer base flows. Therefore, regional planning, stream protection policies, comprehensive construction site management plans, construction site performance bonds, identification and preservation of sensitive areas, and above all, defined limits to growth are needed to maintain the biological integrity of the Grand River.

The Grand River is the only Ohio tributary to Lake Erie that harbors a self-sustaining population of Great Lakes Muskellunge, and therefore is a priority for conservation. The Grand River is also has a native population of walleye and northern pike making it singularly unique among Ohio streams. The Grand River and its tributaries provide habitat for many species considered rare by Ohio EPA, or listed as threatened or endangered by the Ohio Department of Natural Resources including 32 macroinvertebrates and freshwater mussel species, and 11 fish species. The single greatest threat to the Grand River basin is suburbanization.

BIOLOGICAL INDICATORS- Fish communities in the Grand River have an exceptionally high degree of biological integrity. This is obvious in the consistently high IBI scores along the length of the mainstem and between sampling years, and is also evident in the unusually high percent composition of pollution intolerant species making up electrofishing samples (Figure 40). Furthermore, the Grand River is one of the few rivers in Ohio that has a full suite of endemic, naturally reproducing and self-sustaining top carnivores including walleye, northern pike and muskellunge. The later is the Great Lakes subspecies (*Esox masquinongy masquinongy*), and so represents a vitally important area for genetic and habitat conservation. Given the propensity for muskellunge to differentiate into unique strains, the population in the Grand River may well be a truly endemic strain. As it stands, it is the last naturally reproducing muskellunge population found in any of Ohio's Lake Erie tributaries.

PROBLEM STATEMENTS

PROBLEM 1

BACKGROUND: Based on the 2000 Census data, the projected population growth for all the counties located within the Lower Grand River Watershed, are expected to significantly increase. Similar growth in adjacent Counties has shown that an increase in development due to population increase has caused erosion and siltation of waterways, and ultimately degradation of water quality. Permanent protection of critical areas will ensure that high water quality will remain.

PROBLEM STATEMENT: NEED FOR FUNDING FOR LAND PROTECTION EFFORTS

All of the streams within this subwatershed are currently in attainment. Land protection of critical natural areas is paramount to maintaining the attantaiment status of the Grand River and it tributaries. Currently there are 720.78 acres of permanently protected acres in subwatershed 04110004060020 (Grand River below Coffee Creek to above Mill Creek (3)). Grand River Partners, Inc. Land Protection Priority List has identified 2,261.58 acres of priority land for protection.

GOALS:

1. Work to secure funding to preserve pristine water quality by protecting 2,261.58 acres of high quality land within subwatershed 04110004060020 (Grand River below Coffee Creek to above Mill Creek (3)).

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Permanent protection of 2,261.58 acres of subwatershed 04110004060020 (Grand River below Coffee Creek to above Mill Creek (3))	≈ $4,523,160 (≈$2,000/ acre conservation easement value)	Ashtabula SWCD, Ashtabula Metroparks, Grand River Partners, Inc., The Nature Conservancy, etc.	1/08-ongoing	Number of acres put into conservation easement protection

PROBLEM 2

BACKGROUND: The Harpersfield Dam, a historical landmark, is located in Harpersfield Township and is currently owned by the Ashtabula County Metroparks. This dam is failing, and the responsibility of repairing the dam lies on the Metroparks. Unfortunately, the Ashtabula County Metroparks have yet to pass a levy, and cannot afford to pay for the repairs that are needed for the dam to maintain its function. The Harpersfield Dam creates a barrier for a number of aquatic species including certain mussel species and their host species, thus preventing both the host and mussel to thrive above the dam. Another species that is prohibited is the sea lamprey, which is an invasive species that is detrimental to sport fishes. The loss of the dam would allow for these species to move into the Upper Grand River Watershed. The area bleow the dam is currently treated for sea lamprey using TFM, which is a chemical that kills the sea lamprey. However, this chemical effects a number of other non-target species such as mudpuppies, madtoms, and darters. The removal of the Harpersfiled Dam would potentially allow for the passage of the sea lamprey, and in turn the treatment of TFM on the entire Grand River.

PROBLEM STATEMENT: THE HARPERSFIELD DAM IS CURRENTLY FAILING AND IS IN THREAT OF COMPLETE COLLAPSE

Funding is not available for the repairs needed for the Harpersfield Dam. If the repairs are not made, the dam will fall. Research must be done to determine the impacts, both monetarily and biologically, to the Grand River if the dam does fall or if the dam is repaired. Additionally, careful attention must be paid to the sea lamprey and the treatment of this invasive species (TFM).

GOALS:

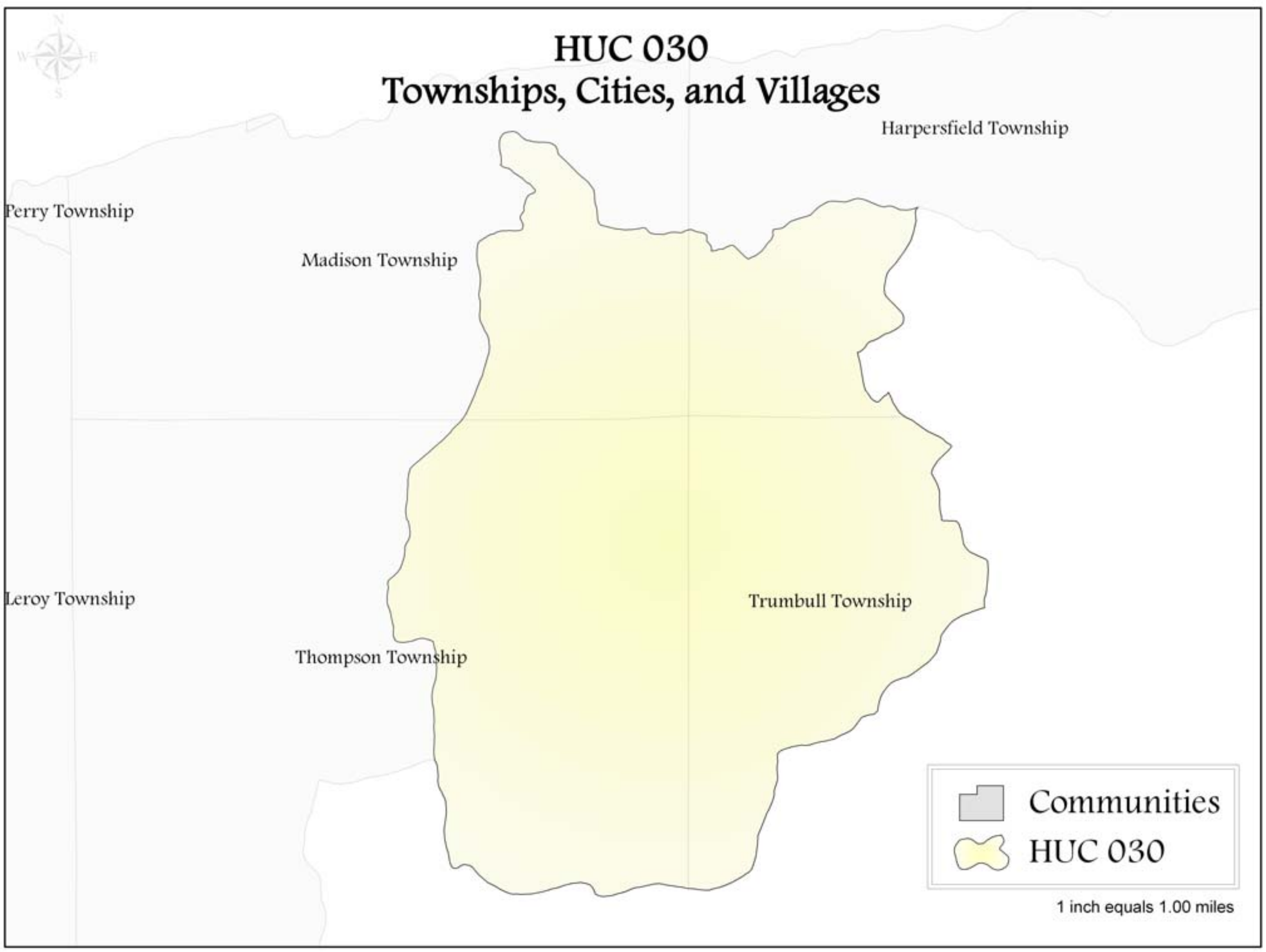
1. Perform a complete impact study of the Harpersfield Dam to determine the best case scenario for the maintenance of both the water quality and the biological quality of the Grand River and its tributaries. The study should take into account the implications on habitat, biology, and water quality of the Grand River, the dam's historical significance, and recreational opportunities that may be lost or gained.

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Environmental impact study of the Harpersfield Dam for both scenarios- repair and long term maintenance of dam, or removal of the dam	$200,000 to hire consultant	Hire consultant to perform complete impact study of the Harpersfield Dam	1/09-1/10	Document illustrating the different scenarios and the different environmental impacts of each

04110004060030 – Mill Creek (3)

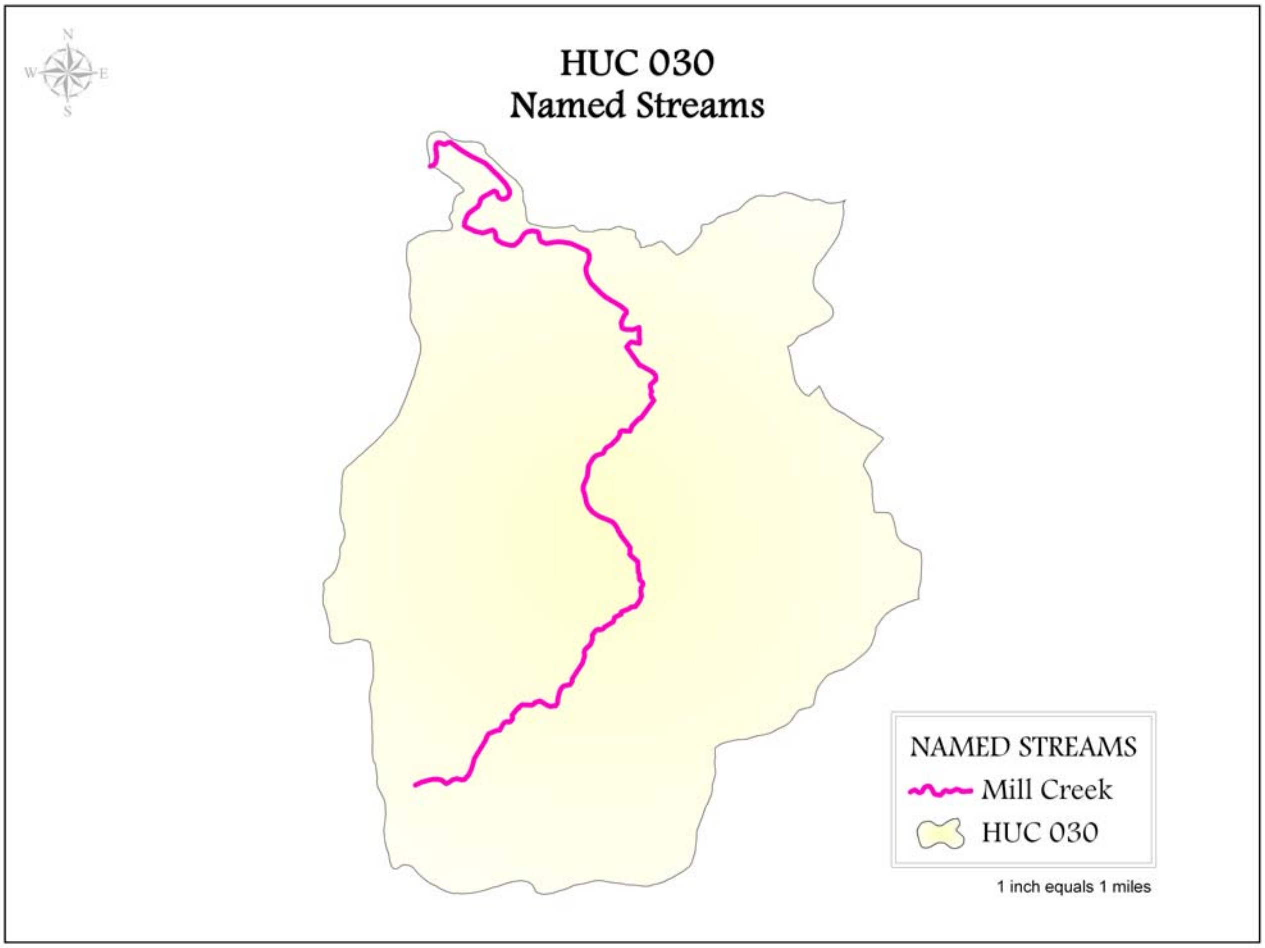
DESCRIPTION~ The 14-digit Hydraulic Unit Code 04110004060030 (HUC 030) is located within the 11-digit HUC 04110004060 know as the Lower Grand River Watershed. HUC 030 is approximately 13274 acres and approximately 21 square miles. This watershed encompasses portions of Harpersfield and Trumbull Townships in Ashtabula County, Madison Township in Lake County, and Thompson Township in Geauga County.

Map 1.030~ Communities of HUC 030



Mill Creek and its tributaries are some of the streams located within the Lower Grand River Watershed that show the highest degree of chemical integrity. Mill Creek is very analogous to Big Creek in that it also has high gradients, discontinuities in bedrock, and is subject to scouring flows that result in long bedrock glides, cascades and water falls. Mill Creek has habitat more conducive to supporting till-plain stream fish communities. An unnamed tributary to Mill Creek has a virtually intact physical stream habitat; most notably, the substrates are a nearly silt-free heterogeneous mix of fractured sandstone bedrock and glacial till.

Map 2.030- Named Streams of HUC 030



DEMOGRPAHICS~ Unfortunately, demographic statistics are collected on a per township or per county basis, thus making it difficult to determine the exact numbers for each subwatershed. Therefore, the data for each township located within each subwatershed was examined, and the totals and averages were taken of each; outliers were taken into account. The statistics for the townships of Harpersfield and Trumbull Townships in Ashtabula County, Madison Township in Lake County, and Thompson Township in Geauga County were utilized to determine the information below.

Total Population~

The total population for HUC 030 is approximately 24,875 with a 49.66/ 50.34% male to female ratio. The largest age group represented is the 35 to 44 years group (17.46% of the total population), followed by the 45 to 54 years group (14.71%), and the 25 to 34 years group (13.46%). 18,341 people represent the 18 and older groups, which accounts for 73.73% of the total population for the townships located within HUC 030. The average median age represented is 37.6.

The male to female ratio for the state of Ohio is 48.60/ 51.40%. The largest age group represented is the 35 to 44 years groups (15.90% of the total population), followed by the 45 to 54 years group (13.80%), and the 25 to 34 years group (13.40%). The median age for the people who reside in Ohio is 36.2.

Educational Attainment~

Of the 16,662 people who are over the age of 25 in the townships within the HUC 030 subwatershed, the majority education level is high school graduate (41.66%), followed by some college with no degree (22.85%), and 9th grade to 12th grade with no diploma received (11.79%).

Employment Status~

Approximately 13,160 (68.63%) people over the age of 16, in the townships of Harpersfield and Trumbull Townships in Ashtabula County, Madison Township in Lake County, and Thompson Township in Geauga County, are currently in the workforce. There are approximately 549 (2.86%) who are currently unemployed.

Household by type~

There are approximately 9,153 households in the Townships located within the HUC 030, of which 6,857 (74.92%) are family households. The average family size is 3.12 people.

Income (1999)~

The average median household income in 1999 for individual households in the townships of Harpersfield and Trumbull Townships in Ashtabula County, Madison Township in Lake County, and Thompson Township in Geauga County was $47,977. The majority of the households had an income of $50,000 to $74,999 (27.16%), followed by $35,000 to $49,999 (19.89%), and $25,000 to $34,999 (12.76%).

The average median family income in 1999 for families in the townships of Harpersfield and Trumbull Townships in Ashtabula County, Madison Township in Lake County, and Thompson Township in Geauga County, was $52,493. The majority of families had an income of $50,000 to $74,999 (23.81%), followed by $35,000 to $49,999 (16.13%), and $75,000 to $99,999 (9.84%).

The average median earnings for a male, full time, year round worker were $38,450 and $25,079 for a female, full time, year round worker.

Below Poverty Level (1999)~

There are 1,313 individuals within the HUC 030 subwatershed, for whom poverty status was determined. Of those, approximately 229 families are represented, and 133 are families with a female householder with no male present.

Occupation~

The residents of the townships of Harpersfield and Trumbull Townships in Ashtabula County, Madison Township in Lake County, and Thompson Township in Geauga County represent the following occupations; 3,193 management professionals, 1,684 service occupations, 3,232 sales and office occupations, 67 farming, fishing, and forestry occupations, 1,534 construction, extraction and maintenance occupations, and 2,882 production, transportation, and material moving occupations.

Race~

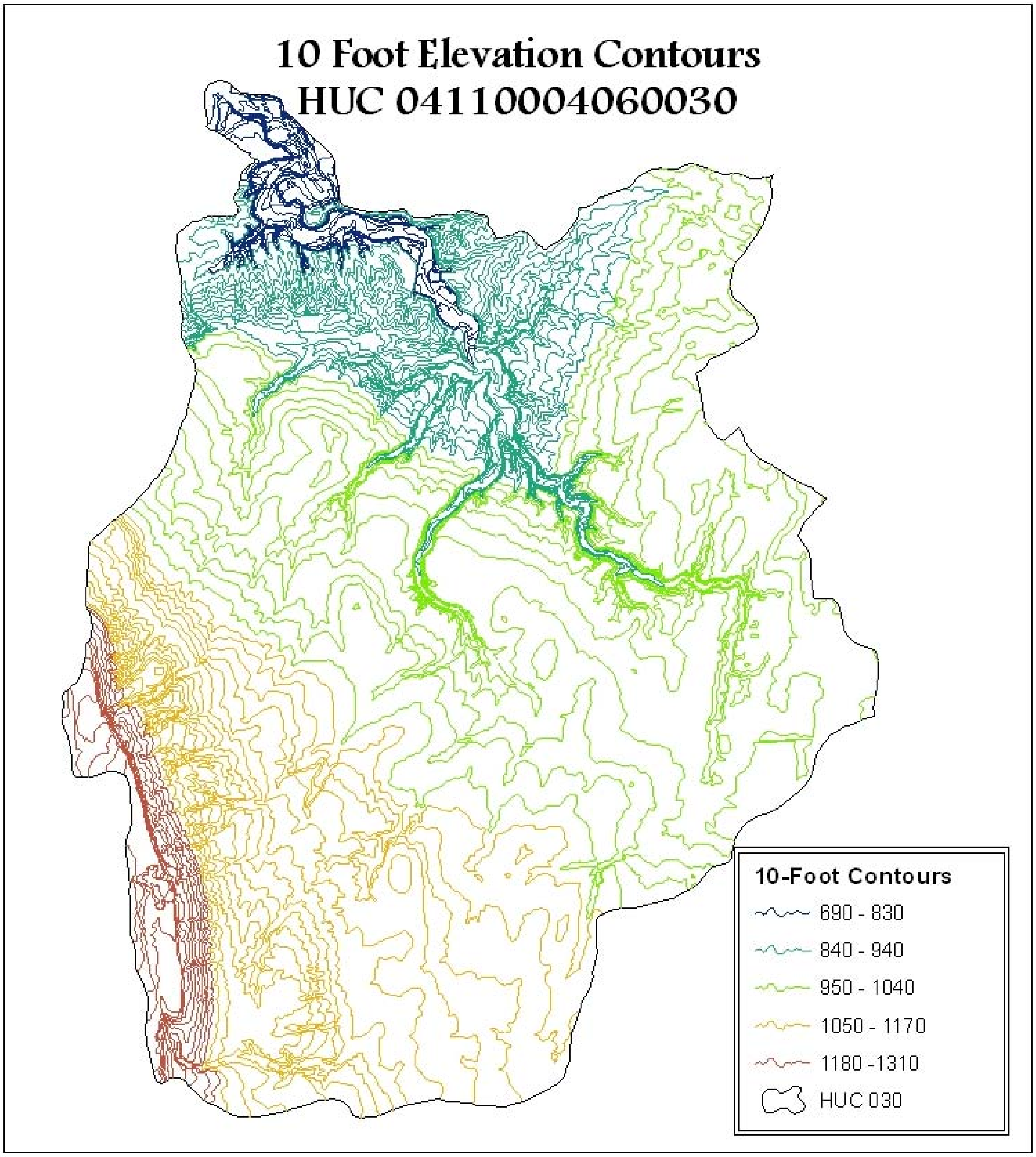
Approximately 89.38% of the population of the HUC 030 is white, 0.45% is African American, and 0.28% is Asian.

Other~

Within the HUC 030, approximately 20 residences are lacking complete plumbing facilities, 15 are lacking complete kitchen facilities, and 151 are without telephone service.

TOPOGRAPHY- The majority of HUC 030 is located within the West Tributaries Project Area of the Grand River Watershed. This area is known for its high bluffs, and the cold water streams that flow from these high elevations. HUC 030 has drastic elevation changes at it approaches the river, which gives the Grand River its amazing gorge and shale bluffs. The highest point in HUC 030 is 1310 feet and the lowest is 690 feet.

Map 3.030- Contours of HUC 030



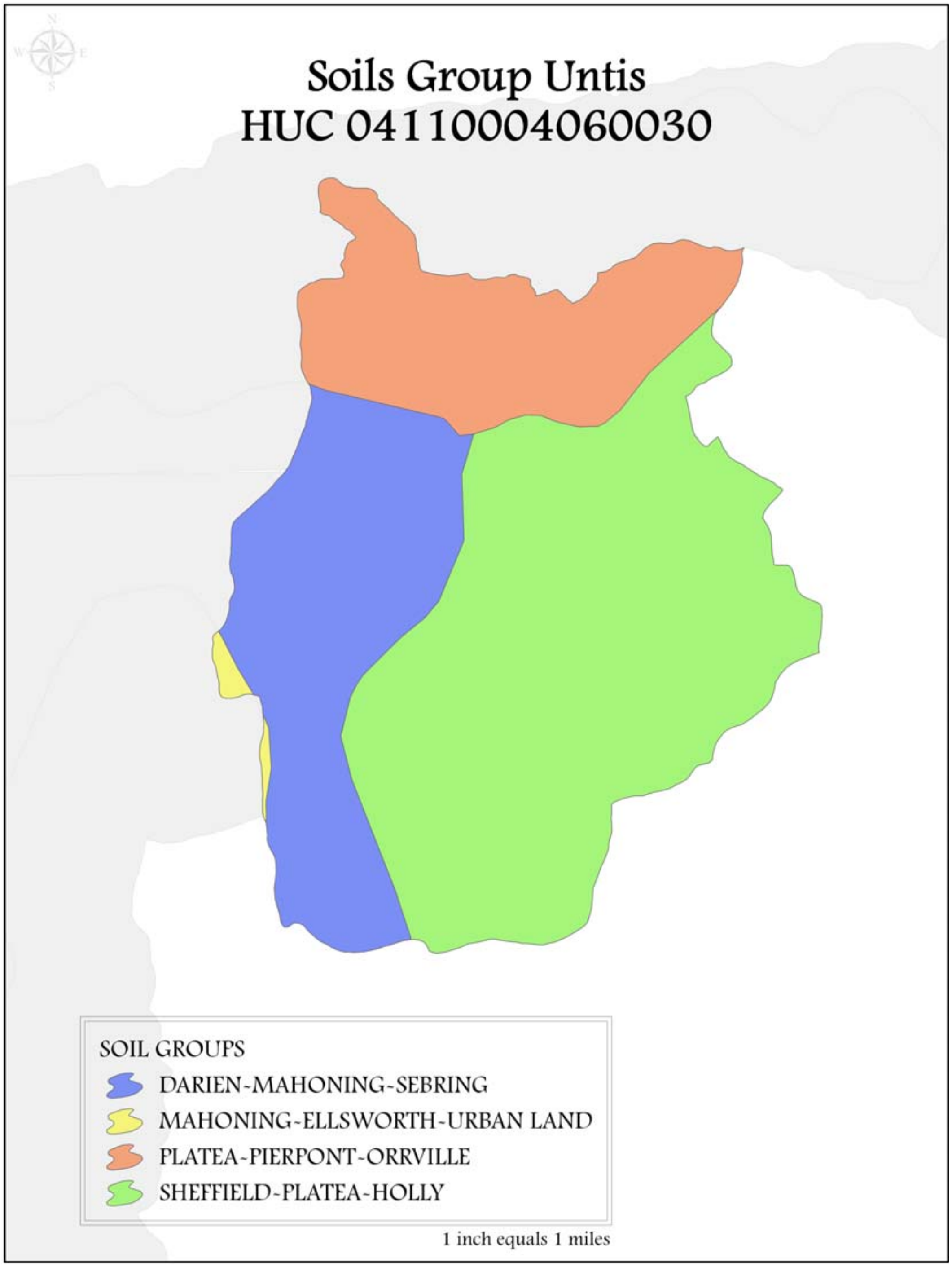
SOILS~ There are three soil groups represented within HUC 030; the Darien – Mahoning – Sebring (approximately 3,380 acres), the Platea – Pierpont – Orrville (approximately 2,613 acres), Mahoning – Ellsworth – Urban Land (approximately 86 acres) and the Sheffield – Platea – Holly (approximately 7,205 acres) groups.

Darien~ Mahoning~ Sebring: These soils are nearly level to sloping, somewhat poorly drained that formed in silty or loamy glacial till on till plains. Most areas are in natural shrubs and trees, but some areas are used for cultivated crops, pasture, and residential development. Wetness and slow or very slow permeability severely limit most uses. Water usually ponds in low areas after a rainfall. Erosion is a hazard in sloping areas that are used for cultivated crops.

Mahoning~ Ellsworth~ Urban Land: These soils are nearly level to very steep, somewhat poorly drained and moderately well drained that formed in silty or loamy glacial till on till plains. This mapping unit is found on long, gently sloping and short, undulating side slopes and broad flats in dissected areas along drainageways. Use of this map unit is diverse and includes urban and residential development, cultivated crops, and natural shrubs and trees. Wetness and the erosion hazard limit these soils for cultivated crops. Wetness also limits residential and urban development.

Platea~ Pierpont~ Orrville Group: This association is deep, nearly level to moderately steep, somewhat poorly drained to moderately well drained silty soils on glaciated uplands. This soil is found in undulating and hilly areas, but steep soils occur along rivers and streams including the Grand River. Grapes and small fruits are grown where the climate is suitable, particularly where air drainage is good. Very slow permeability, slope, and seasonal wetness are limitations for many nonfarm uses in this association.

Map 4.030- Soil Groups of HUC 030



A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. This lack of oxygen in the soil can lead to the formation of certain observable characteristics in hydric soils, such as a thick layer of organic matter (non-decomposed plant materials) in the upper part of the soil column. Other observable features include oxidized root channels and redoximorphic features (concentrations and depletions of Iron and other elements, i.e., mottling, gleying). The following National Soil Information System (NASIS) criteria reflect those soils that may meet the definition of hydric soils.

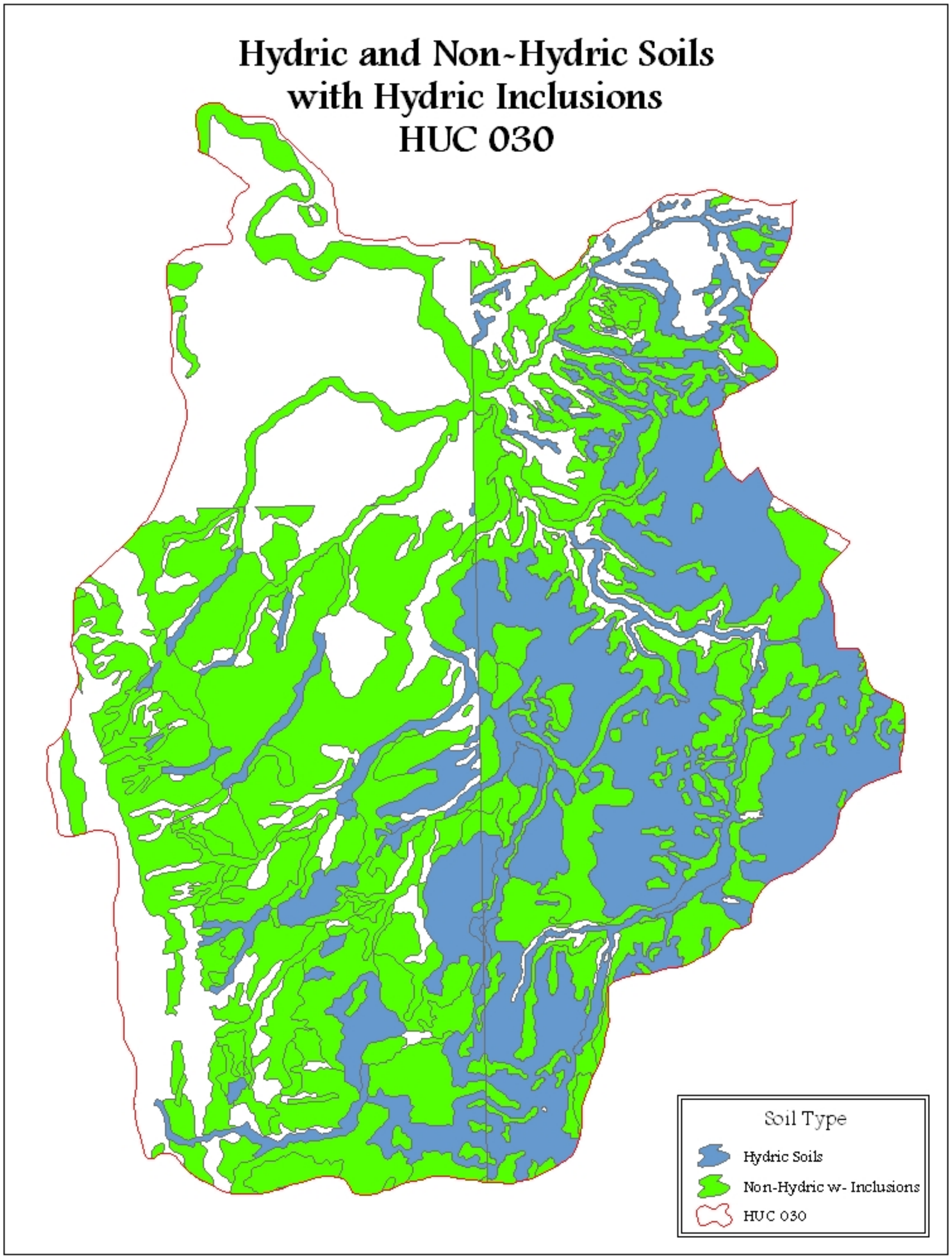
- All Histels except Folistels and Histosols except Folists, or
- Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:
- Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or
- poorly drained or very poorly drained and have either:
    - water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils
    - water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or
    - water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or

- Soils that are frequently ponded for long duration or very long duration during the growing season, or
- Soils that are frequently flooded for long duration or very long duration during the growing season.

In HUC 030, there are approximately 3,698 acres of hydric soils.

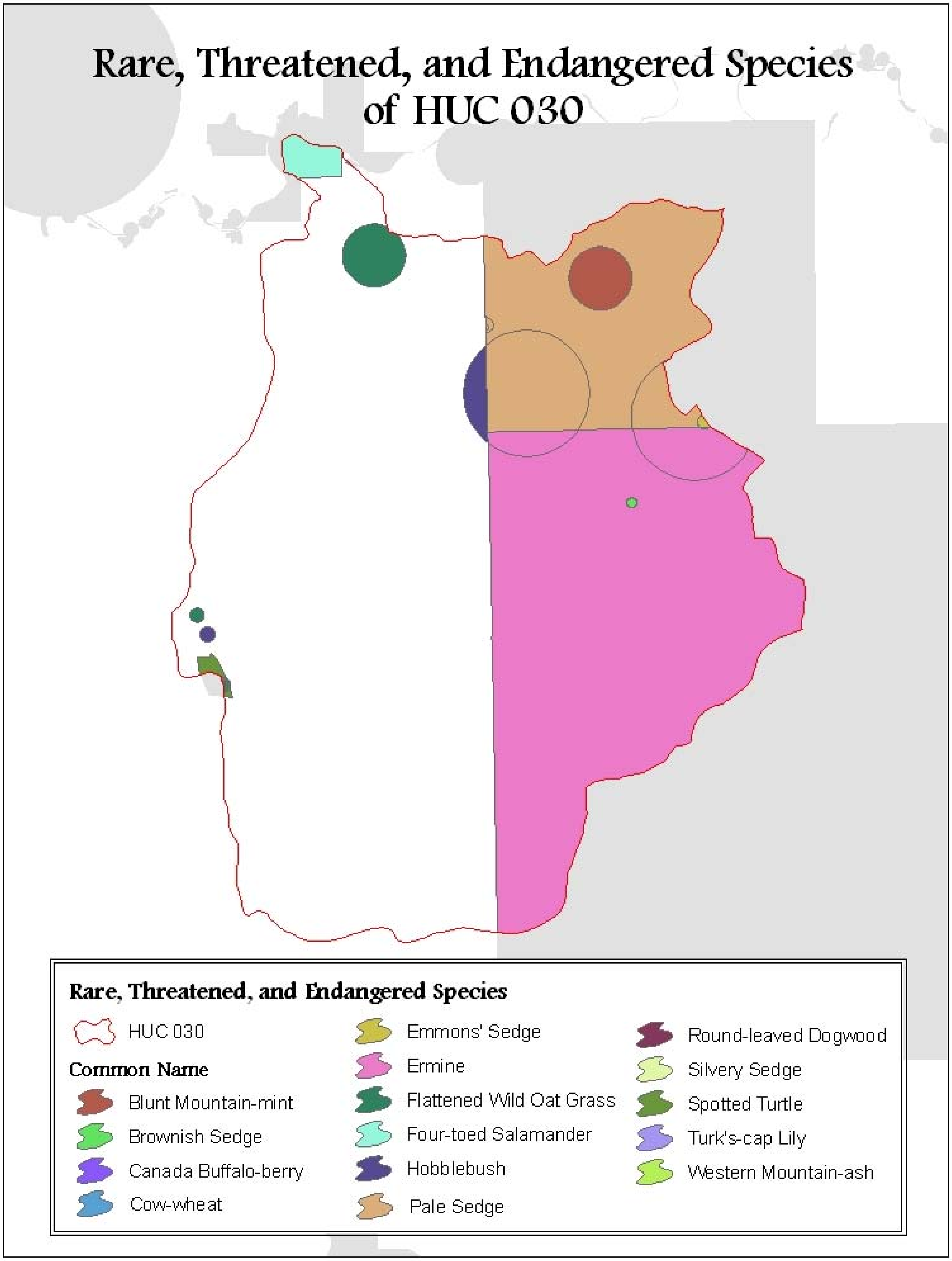
Non hydric soils can be of major importance to water quality as well. Many non-hydric soil types contain small areas of hydric soils, or hydric inclusions. These soils are generally not associated with having the properties of hydric soils, but the do have small pockets, which are too small to have been mapped by the soils surveys, to be considered hydric. Soil Survey books generally do not map "inclusions" of different soil types if the map units are less than 2 acres in size. These inclusions can be wetland soils within an upland soil series. Sometimes, the description will include the types of soils that are the most common inclusions in the series. HUC 030 contains roughly 5,970 acres of non hydric soils with hydric inclusions.

Map 5.030- Hydric and Non-Hydric Soils of HUC 030



RARE, THREATENED, and ENDANGERED SPECIES- The Grand River Watershed provides the perfect habitat for many rare, threatened, and endangered species. In fact, the Ohio Department of Natural Resources, Division of Wildlife recognized the unparalleled biodiversity and habitats of the Grand River Watershed, and chose this watershed to reintroduce the wild turkey, river otter, and snowshoe hare. The following species are found within HUC 030 in the Grand River Watershed; blunt mountain-mint, brownish sedge, Canada buffalo-berry, cow-wheat, emmon's sedge, ermine, flattened wild oat grass, four-toed salamander, hobblebush, pale sedge, round-leaved dogwood, silvery sedge, spotted turtle, Turk's-cap-lily, and western mountain-ash.

Map 6.030- Rare Species of HUC 030

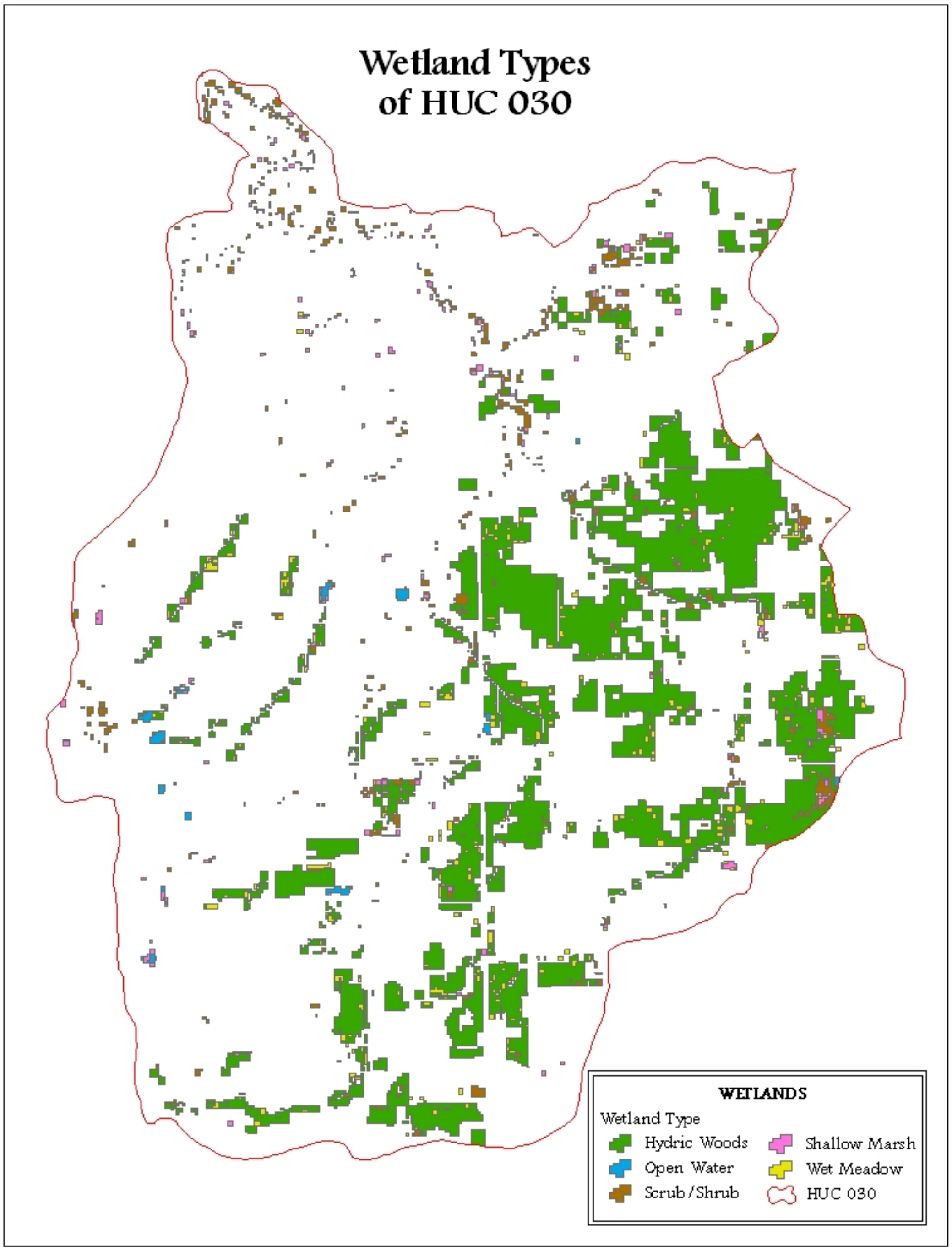


DAMS~ There are 18 dams located with in the Lower Grand River Watershed. In HUC 030 there are no dams.

WETLANDS~ Wetlands are typically highly productive habitats, often hosting considerable biodiversity. The Army Corps of Engineers and the Environmental Protection Agency define wetlands as; "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions". Wetlands are found under a wide range of hydrological conditions, but at least some of the time water saturates the soil. The result is a hydric soil, one characterized by an absence of free oxygen some or all of the time, and therefore called a "reducing environment." Plants called hydrophytes specifically adapted to the reducing conditions presented by such soils can survive in wetlands, whereas species intolerant of the absence of soil oxygen (called "upland" plants) can not survive. Adaptations to low soil oxygen characterize many wetland species.

HUC 030 has approximately 2,299 acres of wetlands; 1,899 acres of Hydric Woods, 22 acres of open water wetlands, 187 acres of scrub/shrub, 60 acres of shallow marsh, and 130 acres of wet meadow.

Map 7.030- Wetlands of HUC 030



DRASTIC- The DRASTIC maps, produced by the Ohio Department of Natural Resources, show the pollution potential for groundwater systems. The DRASTIC mapping system allows the pollution potential of any area to be evaluated systematically using the following existing information about an area:

D= Depth to Water

R= Net Recharge

A= Aquifer Media

S= Soil Media

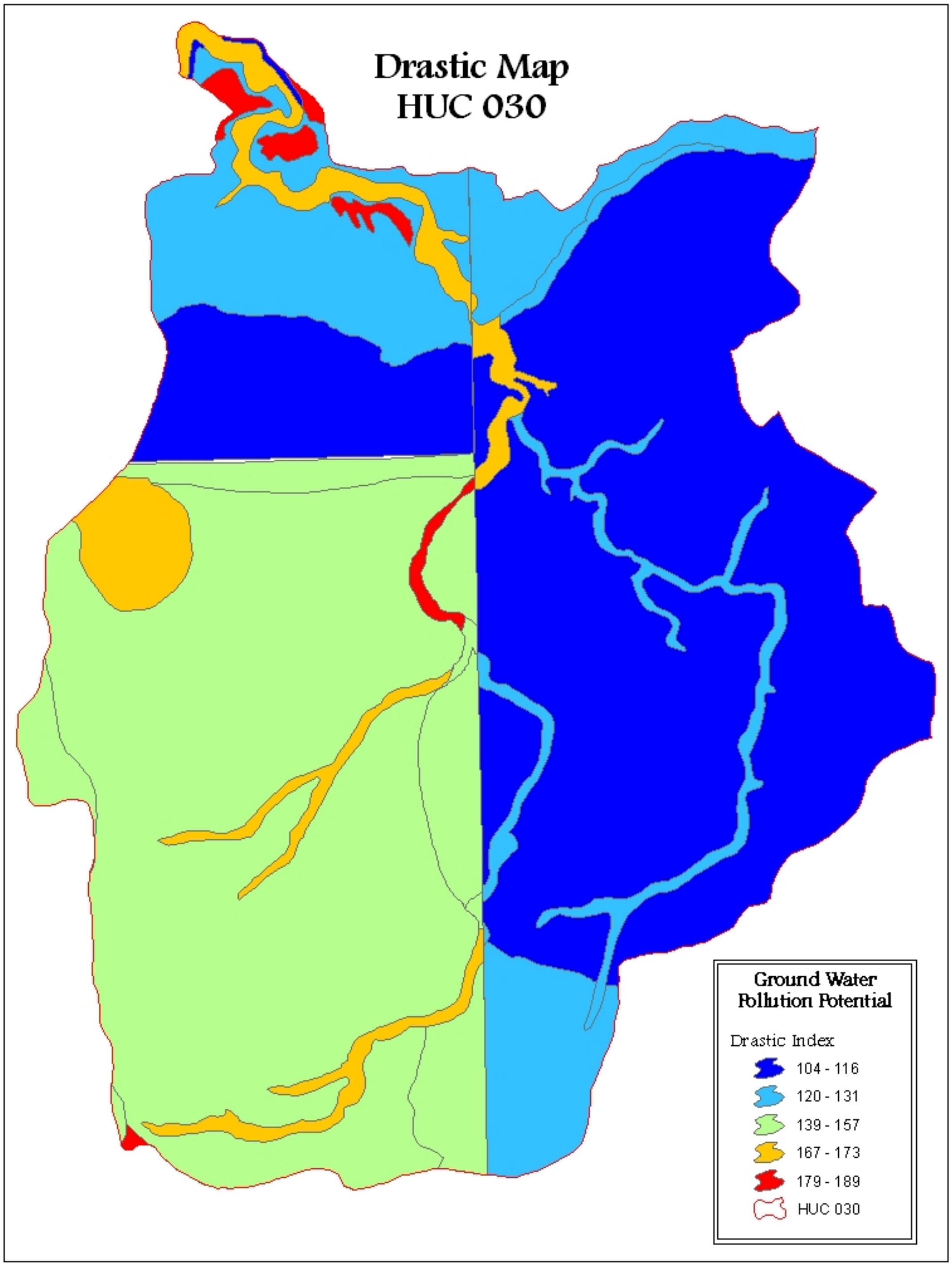
T= Topography

I= Impact of the Vadose Zone Media

C= Hydraulic Conductivity of the Aquifer

In evaluating an area's vulnerability to contamination, the DRASTIC mapping system assumes a contaminant with the mobility of water is introduced at the surface and flushed into the groundwater by precipitation. A pollution potential map can assist in developing ground water protection strategies. By identifying areas more vulnerable to contamination, officials can direct resources to areas where special attention or protection efforts might be warranted. This information can be utilized effectively at the local level for integration into land use decisions and as an educational tool to promote public awareness of ground water resources. Pollution potential maps may be used to prioritize ground water monitoring and/or contamination clean-up efforts. Areas that are identified as being vulnerable to contamination may benefit from increased ground water monitoring for pollutants or from additional efforts to clean up an aquifer. HUC 030 has a maximum DRASTIC index of 189. Approximately 1.05% of HUC 030 has a high DRASTIC index.

Map 8.030- DRASTIC of HUC 030

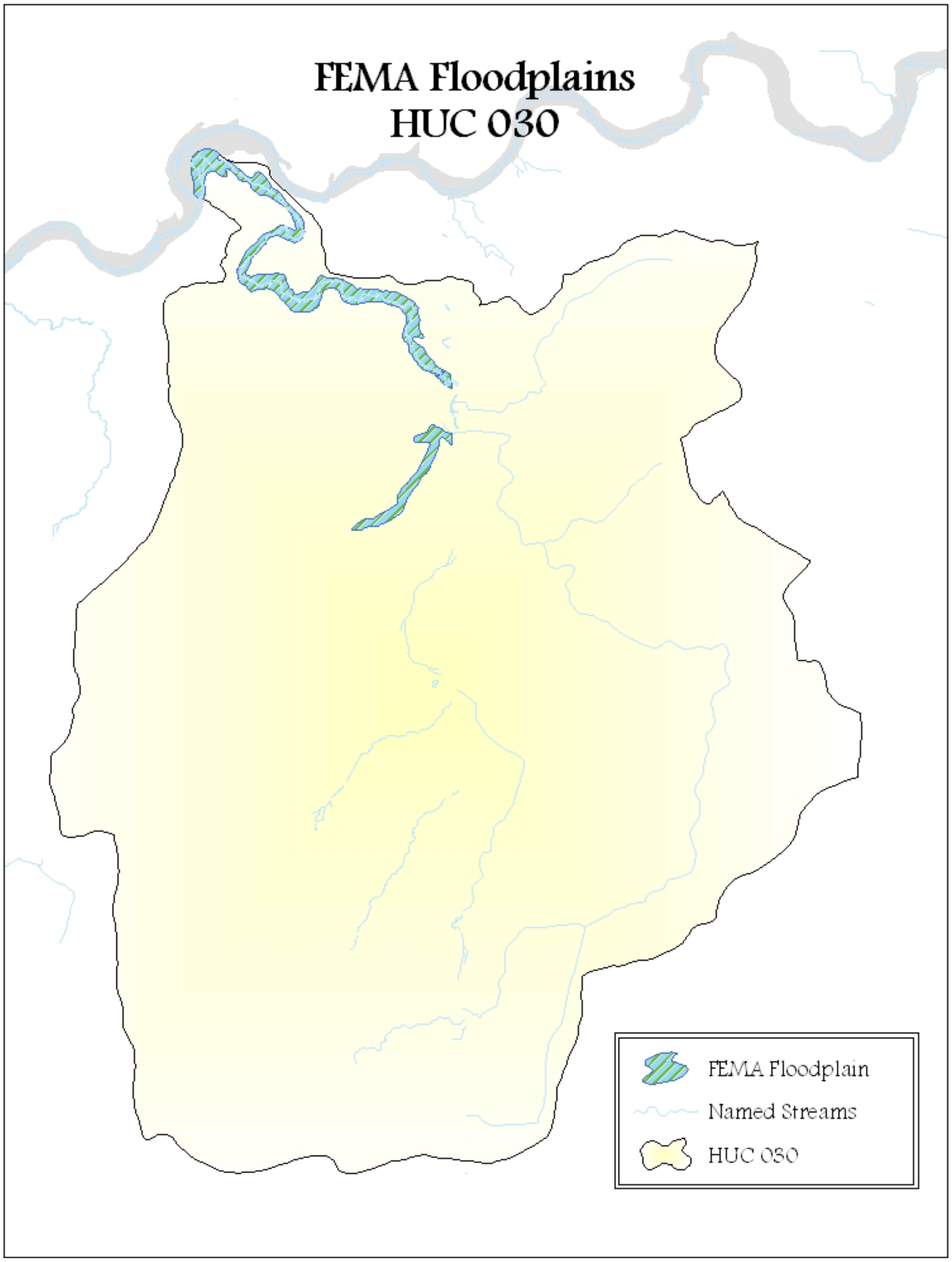


FLOODPLAINS- Floodplains are the low, flat, periodically flooded lands adjacent to rivers, lakes and oceans and subject to geomorphic (land-shaping) and hydrologic (water flow) processes. FEMA, the Federal Emergency Management Agency, has developed areas within watersheds that are designated as 100-year and 500- year floodplains. A "100-year flood" is defined as a flood event that has a 1 in 100 chance of occurring in any given year, and a 500-year flood has a 1 in 500 chance. HUC 030 has 199 acres of designated 100-year floodplain, which represents approximately 1.5% of the watershed.

Current the only regulation that protects the Ashtabula portion of the floodplains is established by the Federal Emergency Management Agency, and is enforced by the Ashtabula County Subdivision Regulations.

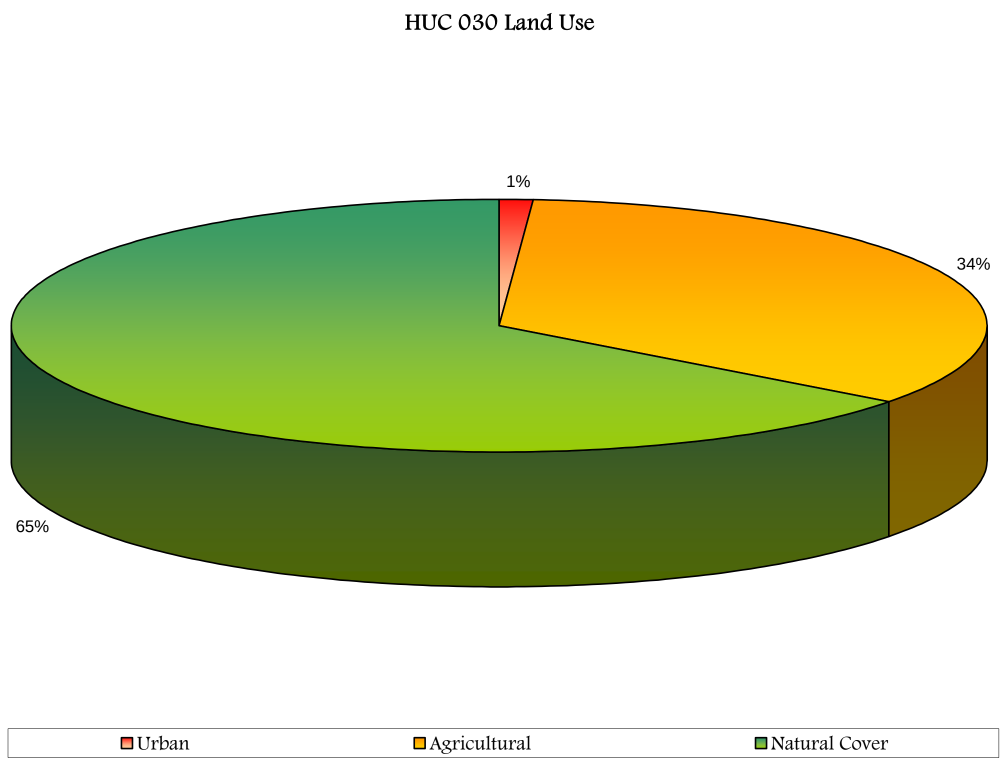
Current Lake County has an ordinance in place which protects the riparian areas and floodplains of the Grand River and its named tributaries that are located within Lake County.

Map 9.030- Floodplains of HUC 030



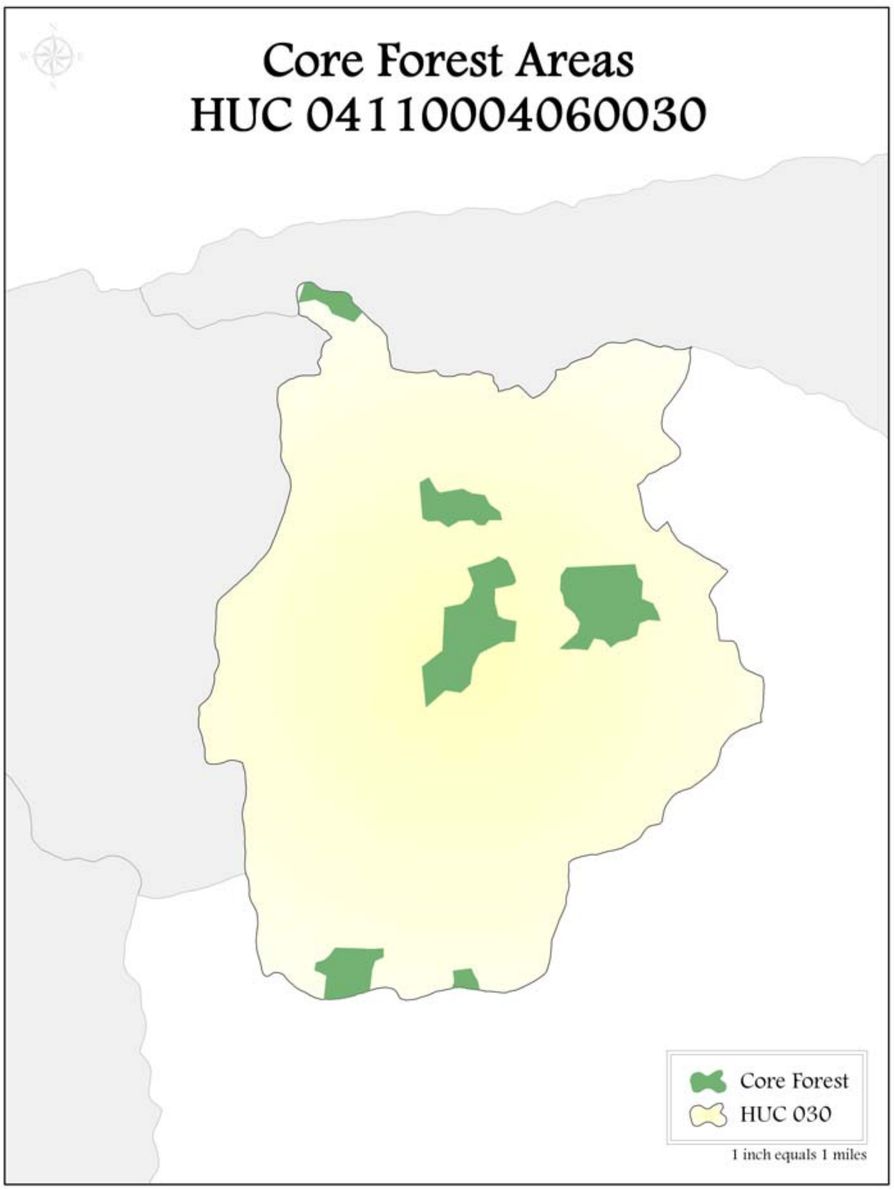
LAND USE- HUC 030 is a very rural subwatershed. Much of this watershed is in natural cover, with very few urban areas. However, suburbanization is a threat to this area of the Grand River Watershed. Here, land is plentiful and still remains at a very low cost. Population density is extremely low (5.9), but is inspected to increase due to suburbanization.

Chart 1.030- Landuse of HUC 030



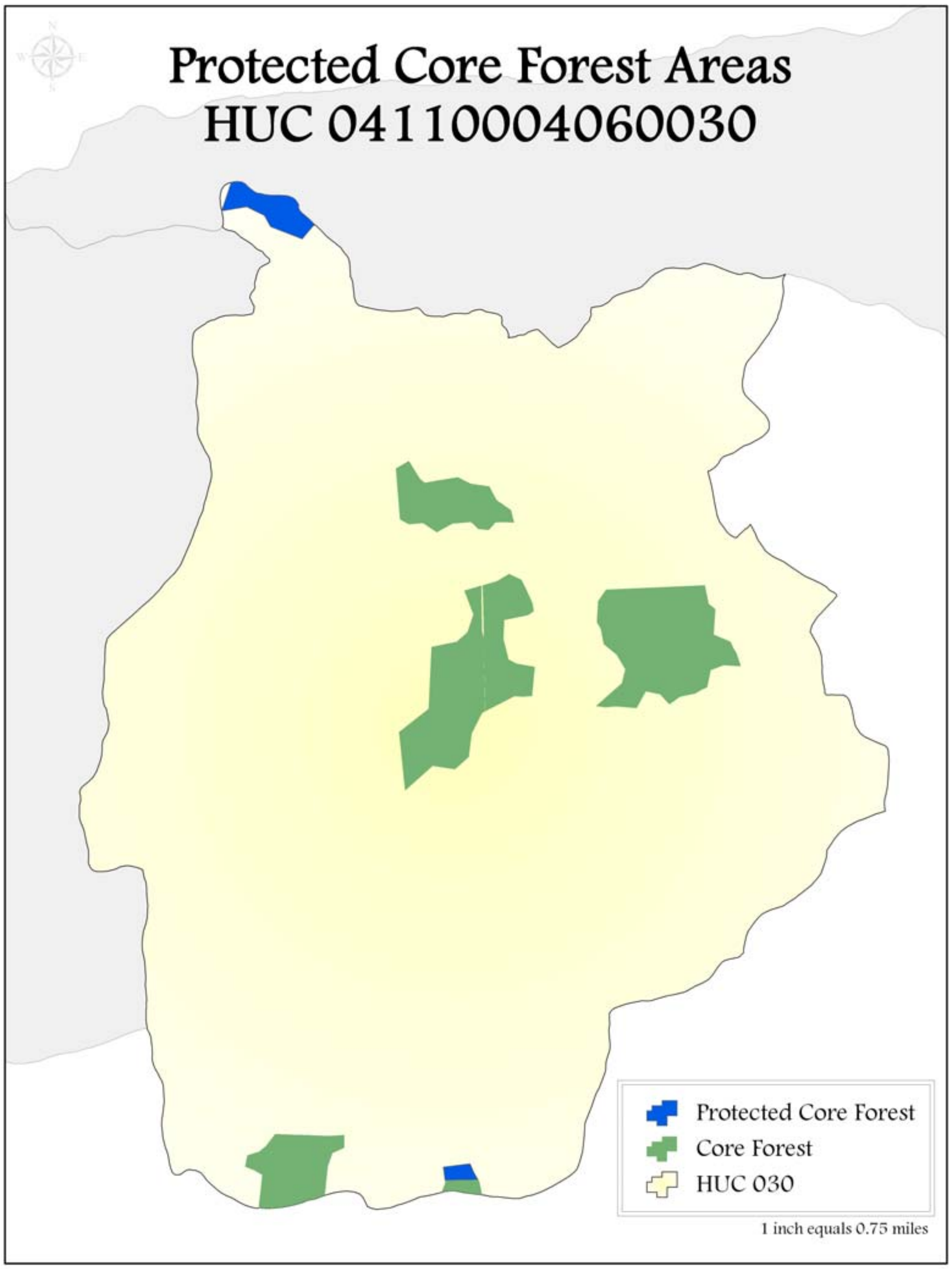
Since the large majority of the watershed remaining is in natural cover, there are many large tracts of undisturbed forest blocks. The Nature Conservancy realized the importance of these large tracts of forest, or "Core Forest Areas", for not only their natural resources value but their importance for breeding populations as well. Core Forest Areas are forested areas of 100 acres or more with a forested buffer zone from pastures and agriculture, and no roads within at least 300 meters. These numbers were determined by the habits and lifecycles of certain forest species; a pair of pileated woodpeckers will need at least 100 acres in order to breed, certain amphibian populations use forest areas up to 200 meters away from their wetland habitat for breeding purposes, and cowbirds will penetrate up to 150 meters of the core forest areas. HUC 030 contains six Core Forest Areas, which total 941.99 acres, or roughly 7.11% of the HUC 030 watershed.

Map 10.030- Core Forest of HUC 030



These Core Forest Areas are very important habitats that need to be preserved. There are currently 67.10 acres of the 941.99 acres of Core Forest in permanent protection, or approximately 7.12%.

Map 11.030- Protected Core Forest of HUC 030



GRPI~ LAND PROTECTION PRIORITY LIST~ Grand River Partners, Inc.'s goal is to protect the natural resources of the Grand River and its watershed. Grand River Partners, Inc. utilizes the conservation easement as the primary tool to protect such resources. Conservation easements are a great tool to protect resources on private lands but still maintain them in private hands. The Grand River watershed is approximately 712 square miles. Obviously Grand River Partners, Inc. cannot protect all of the 712 square miles (455,000 acres) with conservation easements. Grand River Partners, Inc. believes that water quality can be protected by conserving the "right" 25% of a watershed. In the specific case of the Grand River, this represents roughly 114,000 acres. Protecting 114,000 acres is an achievable goal considering the number of partner organizations and the fact that approximately 25% of the 114,000 acres has already been protected.

The challenge remains to protect the remaining 86,000 acres of the "right" land. To fulfill this goal, Grand River Partners, Inc. developed a parcel based **Land Protection Priority List**. Before any prioritization process could begin, any parcel less then five acres was removed from the potential list of priorities. To make fair comparisons an analysis of the watershed was conducted to determine the unique areas within the watershed. From this analysis, the Grand River Watershed was divided into 5 distinct project areas based on the unique natural features of each. The parcel prioritization process involved a two tier analysis. The first, Tier 1, involved an analysis of natural resources. The second, Tier 2, involved a strategic analysis that took into account parcel size, proximity to other protected land, and partner priorities.

The Headwaters Project Area consists of the area drained by all the unnamed tributaries that together form the Grand River. The area begins more or less upstream of the crossing with SR 534 at the southern end of the watershed. In summary, important

natural resources ranked for each parcel located in the Headwaters Project Area are intact riparian areas, the Grand River main stem, wetlands, unnamed tributaries, floodplains, core forest blocks and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Lowlands Project Area begins at the crossing of SR 534 with the mainstem in the southern portion of the watershed and extends between the 810' contour interval north to the crossing where the Grand River intersects Windsor-Mechanicsville Road. Important Natural Resources identified in the Lowlands Project Area are swamp forests, wetlands, intact riparian areas, core forest blocks, mainstem, rare species, floodplains, TNC subwatershed ranking, and named tributaries. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Gorge Project Area begins at the crossing of the mainstem and Windsor-Mechanicsville Road bridge and extends upstream to the crossing with SR 84. The Gorge Project Area is bordered to the north by the watershed boundary and to the south by the 950' contour interval. The important natural characters of the Gorge are the mainstem, wetlands, floodplains, intact riparian areas, named tributaries, core forest blocks, steep slopes, TNC subwatershed rankings, and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Estuarine/Urban Project Area begins at the State Route 84 crossing with the Grand River and ends in Fairport Harbor Village and Grand River Village at its terminus with Lake Erie. The Estuarine/Urban Project Area includes the subwatershed of Red Creek which extends to the west just north of the City of Painesville. In this project area the

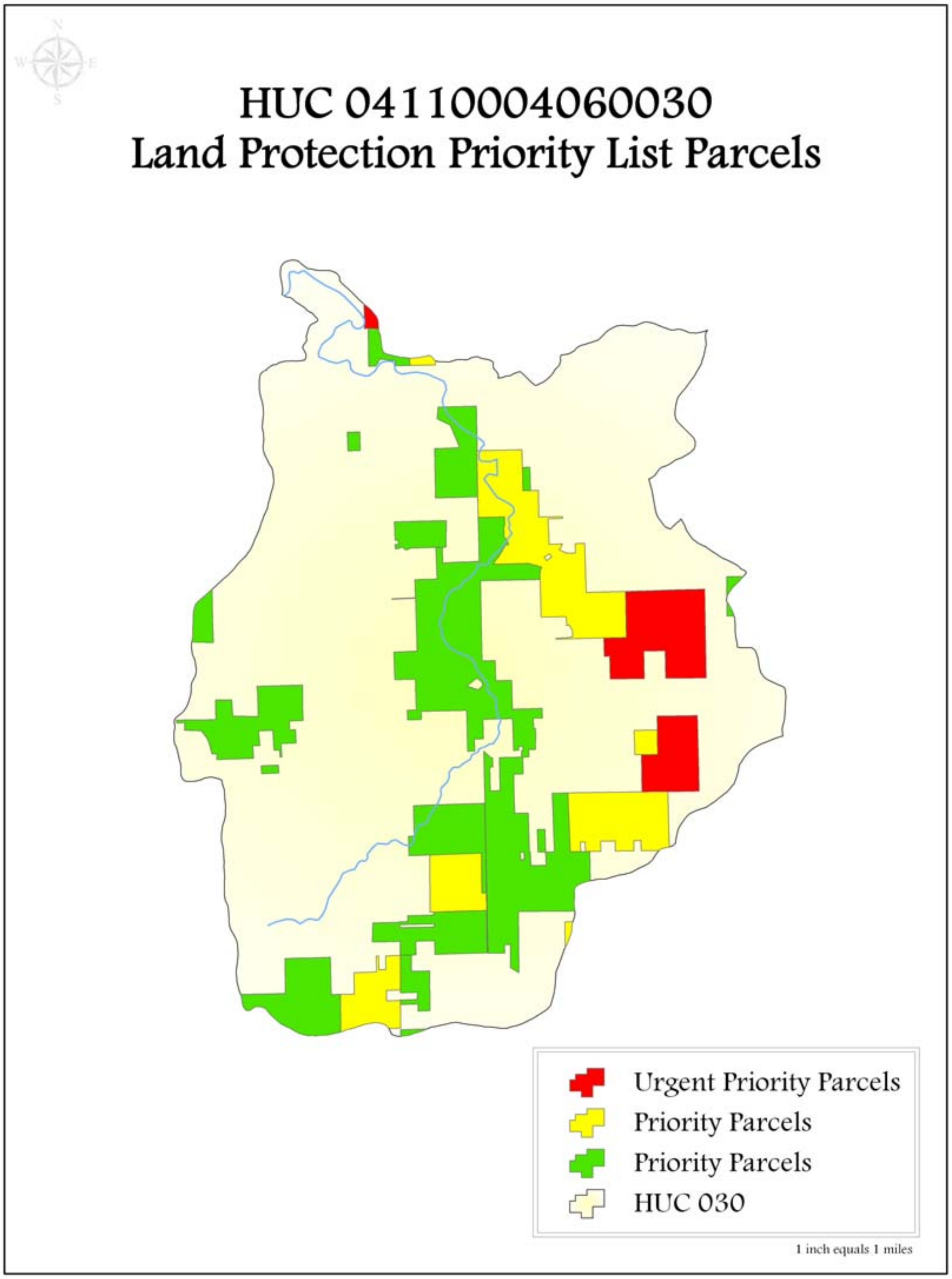
mainstem, river access points, wetlands, intact riparian areas, floodplains and named tributaries were considered important natural features. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The last area is the Tributaries Project Area which consists of two areas; one is located east of the Grand River Lowlands Project Area, which and includes the subwatersheds of such named tributaries as Mill Creek, Rock Creek and Coffee Creek, and the second project area is located west of the Lowlands Project Area, north of the Headwaters Project Area and south of the Gorge Project Area. This portion of the Tributaries Project Area contains the subwatersheds of such high quality streams as Indian Creek, Phelps Creek, Hoskins Creek, and Paine Creek. Important natural resources considered include, cold water habitat, wetlands, floodplains, core forest blocks, and rare species. Again each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

Each parcel within the watershed was further evaluated based on additional strategic rankings. These rankings include parcel size, proximity to protected land and partner priorities. Each parcel meeting the acreage requirement, or within a certain distance of existing protected land or included as a priority by a partner organization or agency was weighted more heavily and therefore considered a high priority. A statistical analysis of the final scores was performed and each parcel was categorized as being priority, high priority or an urgent priority parcel.

In HUC 030, there are a total of 1737.85 acres of priority parcels, 1007.95 acres of high priority parcels, and 476.99 acres of urgent priority parcels for protection. Currently there are 1,178.54 acres of protected land within HUC 030.

Map 12.030- LPPL of HUC 030



IMPERVIOUS SURFACE~ The Conversion of farmland, forests, wetlands, and meadows to rooftops, roads, and lawns creates a layer of impervious surface in the urban landscape. Impervious cover is a very useful indicator with which to measure impacts of land development on aquatic systems. The process of urbanization has a profound influence on the hydrology, morphology, water quality, and ecology of surface waters. Recent research has shown that streams in urban watersheds possess a fundamentally different character than streams in forested, rural, or even agricultural watersheds. The amount of impervious cover in the watershed can be used as an indicator to predict how severe these differences can be. In many regions of the country, as little as ten percent watershed impervious cover has been linked to stream degradation, with the degradation becoming more severe as impervious cover increases.

Impervious cover directly influences urban streams by dramatically increasing surface runoff during storm events. Depending on the degree of impervious cover, the annual volume of stormwater runoff can increase by two to 16 times its predevelopment rate, with proportional reductions in groundwater recharge. In natural settings, very little annual rainfall is converted to runoff and about half is infiltrated into the underlying soils and the water table. This water is filtered by the soils, supplies deep water aquifers, and helps support adjacent surface waters with clean water during dry periods. In urbanized areas, less and less annual rainfall is infiltrated and more and more volume is converted to runoff. Not only is this runoff volume greater, it also occurs more frequently and at higher magnitudes. As a result, less water is available to streams and waterways during dry periods and more flow occurs during storms.

The relationship between impervious cover and subwatershed quality can be predicted by a simple model that projects the current and future quality of streams and other water resources at the subwatershed level. Stream research generally indicates that

certain zones of stream quality exist, most notably at about 10% impervious cover, where sensitive stream elements are lost from the system. A second threshold appears at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition; diminished aquatic diversity, water quality, and habitat scores.

The model classifies streams into one of three categories; sensitive, impacted, and non-supporting. Each stream category can be expected to have unique characteristics as follows:

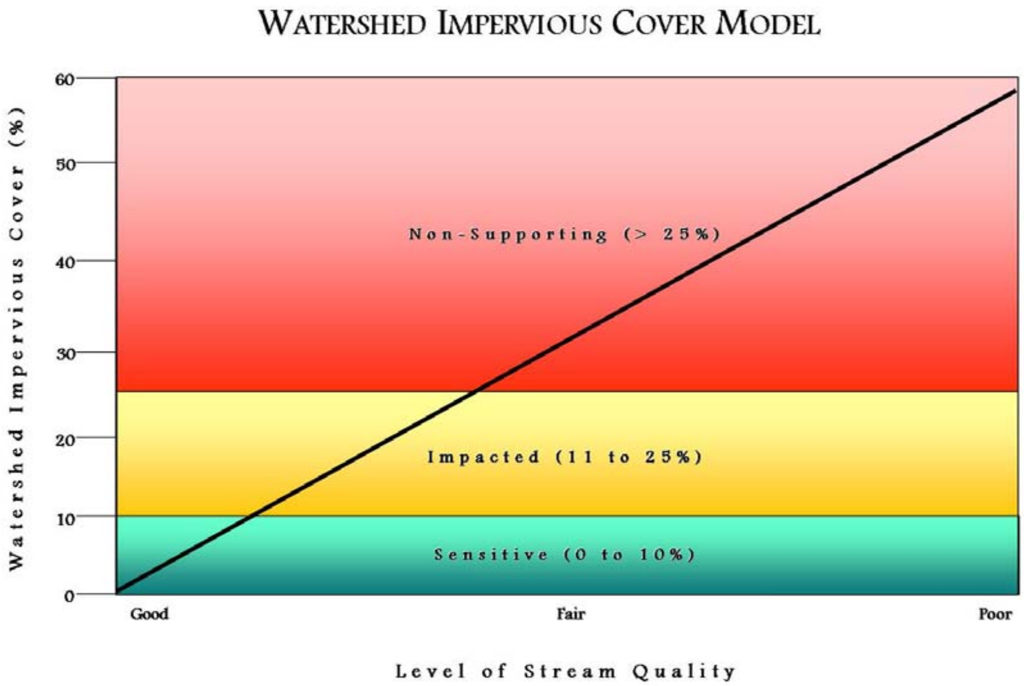
Sensitive Streams: These streams typically have a watershed impervious cover of zero to 10 percent. Consequently, sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Impacted Streams: Streams in this category possess a watershed impervious cover ranging from 11 to 25%, and show clear signs of degradation due to watershed urbanization. Greater storm flows begin to alter the stream geometry. Both erosion and channel widening are clearly evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to

fair levels, with the most sensitive fish and aquatic insects disappearing from the stream.

Non- Supporting Streams: Once watershed impervious cover exceeds 25%, stream quality crosses a second threshold. Streams in this category essentially become a conduit for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, down-cutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated, and the stream substrate can no longer provide habitat for insects or spawning areas for fish. Water quality is consistently rated as fair to poor, and water contact recreation is no longer possible due to the presence of high bacterial levels. Subwatersheds in the non-supporting category will generally display increases in nutrient loads to downstream receiving waters, eve if effective urban BMPs are installed and maintained. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish.

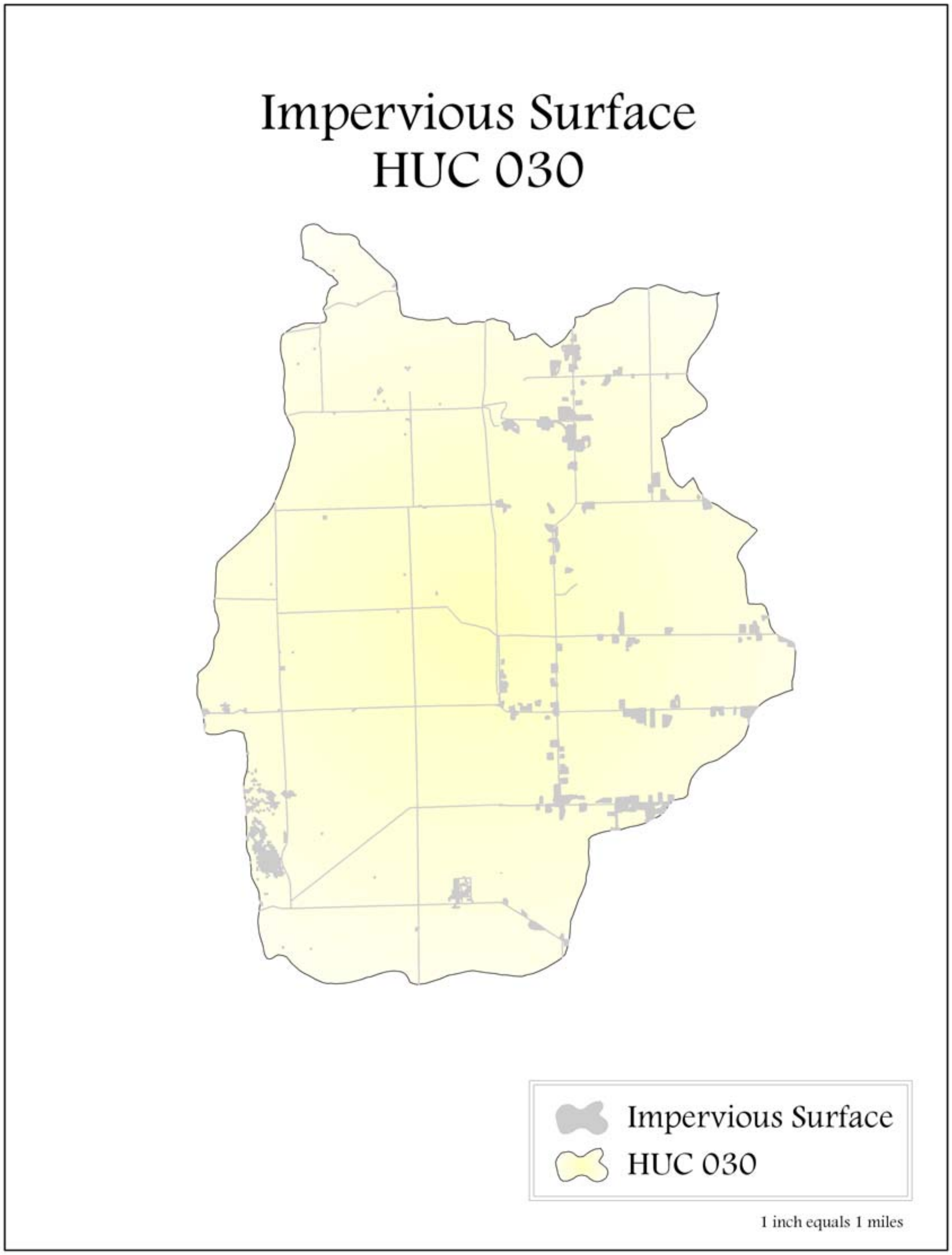
Graph 1.030- Impervious Cover Model



Center for Watershed Protection, Rapid Watershed Planning Handbook

HUC 030 has an impervious cover of approximately 4.08%. Therefore, the streams in this subwatershed are considered "sensitive streams" by the impervious surface model. Sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Map 13.030- Impervious Surface of HUC 030



ATTAINMENT STATUS- *Ohio Water Quality Standards: Designated Aquatic Life Use*

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*

2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*

3) *Cold-water Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie

tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 $mi.^2$ drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

Mill Creek- Mill Creek has a default WWH aquatic life use, this use has been confirmed for the reach downstream from Doty Road (RM 1.5). Upstream from Doty Road, Mill Creek is recommended for a CWH aquatic life use. Being a direct high quality tributary to the Grand River, protecting the existing hydrology of Mill Creek is important to sustaining base flows and maintaining the long-term health of the Grand River.

Unnamed Tributary to Mill Creek- This formerly undesignated stream is recommended for a CWH aquatic life use. This is one of the highest quality small streams in the

Grand River basin. It is *bona fide* coldwater and has incredibly excellent habitat. This rare resource should be protected accordingly.

Grand River- Aquatic life in the Grand River is fully attaining standards for Exceptional Warmwater Habitat (EWH) from Sweitzer Road (RM 42.2) to the SR 2 bridge in Painesville (RM 5.2), and is fully meeting standards for Warmwater Habitat (WWH) downstream from the SR 2 bridge. The Seasonal Salmonid use designation currently in place should be retained.

The Grand River is an economic asset to Northeast Ohio, but is especially sensitive to pollution and disturbance because of limited summer base flows. Therefore, regional planning, stream protection policies, comprehensive construction site management plans, construction site performance bonds, identification and preservation of sensitive areas, and above all, defined limits to growth are needed to maintain the biological integrity of the Grand River.

The Grand River is the only Ohio tributary to Lake Erie that harbors a self-sustaining population of Great Lakes Muskellunge, and therefore is a priority for conservation. The Grand River is also has a native population of walleye and northern pike making it singularly unique among Ohio streams. The Grand River and its tributaries provide habitat for many species considered rare by Ohio EPA, or listed as threatened or endangered by the Ohio Department of Natural Resources including 32 macroinvertebrates and freshwater mussel species, and 11 fish species. The single greatest threat to the Grand River basin is suburbanization.

BIOLOGICAL INDICATORS- Fish communities in the Grand River have an exceptionally high degree of biological integrity. This is obvious in the consistently high IBI scores along the length of the mainstem and between sampling years, and is also evident in the unusually high percent composition of pollution intolerant species making up electrofishing samples. Furthermore, the Grand River is one of the few rivers in Ohio that has a full suite of endemic, naturally reproducing and self-sustaining top carnivores including walleye, northern pike and muskellunge. The later is the Great Lakes subspecies (*Esox masquinongy masquinongy*), and so represents a vitally important area for genetic and habitat conservation. Given the propensity for muskellunge to differentiate into unique strains, the population in the Grand River may well be a truly endemic strain. As it stands, it is the last naturally reproducing muskellunge population found in any of Ohio's Lake Erie tributaries.

Being a snow-belt stream, fish communities in the lower reaches of Mill Creek are, again, subject to the natural limitations of torrential scouring flows, lengthy stretches of shallow bedrock, and low summer flows. Not surprisingly, the fish sample from Mill Creek at Doty Road, only marginally meet the IBI biocriterion. The fish sampled from the branch of Mill Creek draining from the east (sampled at Atkins Road) inexplicably scored Fair; no impairment is suspected.

Mill Creek supports exceptionally high quality macroinvertebrate communities including many infrequently collected sensitive taxa and three state listed taxa. Upper Mill Creek and an unnamed tributary to Mill Creek were characterized by coolwater/coldwater macroinvertebrate communities. The unusually high quality macroinvertebrate communities in these streams were probably due to the streams flowing through highly wooded ravines with continuous groundwater flow and limited development.

PROBLEM STATEMENTS

PROBLEM 1

BACKGROUND: Based on the 2000 Census data, the projected population growth for all the counties located within the Lower Grand River Watershed is expected to significantly increase. Similar growth in adjacent Counties has shown that an increase in development due to population increase has caused erosion and siltation of waterways, and ultimately degradation of water quality. Permanent protection of critical areas will ensure that high water quality will remain.

PROBLEM STATEMENT: NEED FOR FUNDING FOR LAND PROTECTION EFFORTS

All of the streams within this subwatershed are currently in attainment. Land protection of critical natural areas is paramount to maintaining the attantaiment status of the Grand River and it tributaries. Currently there are 1,178.54 acres of permanently protected land in subwatershed 04110004060030 (Mill Creek (3)). Grand River Partners, Inc. Land Protection Priority List has identified 3,222.79 acres of priority land for protection. This land includes high quality natural resources including riparian buffers, core forests, high quality streams, coldwater streams, upland forests, wetlands, and more.

GOALS:

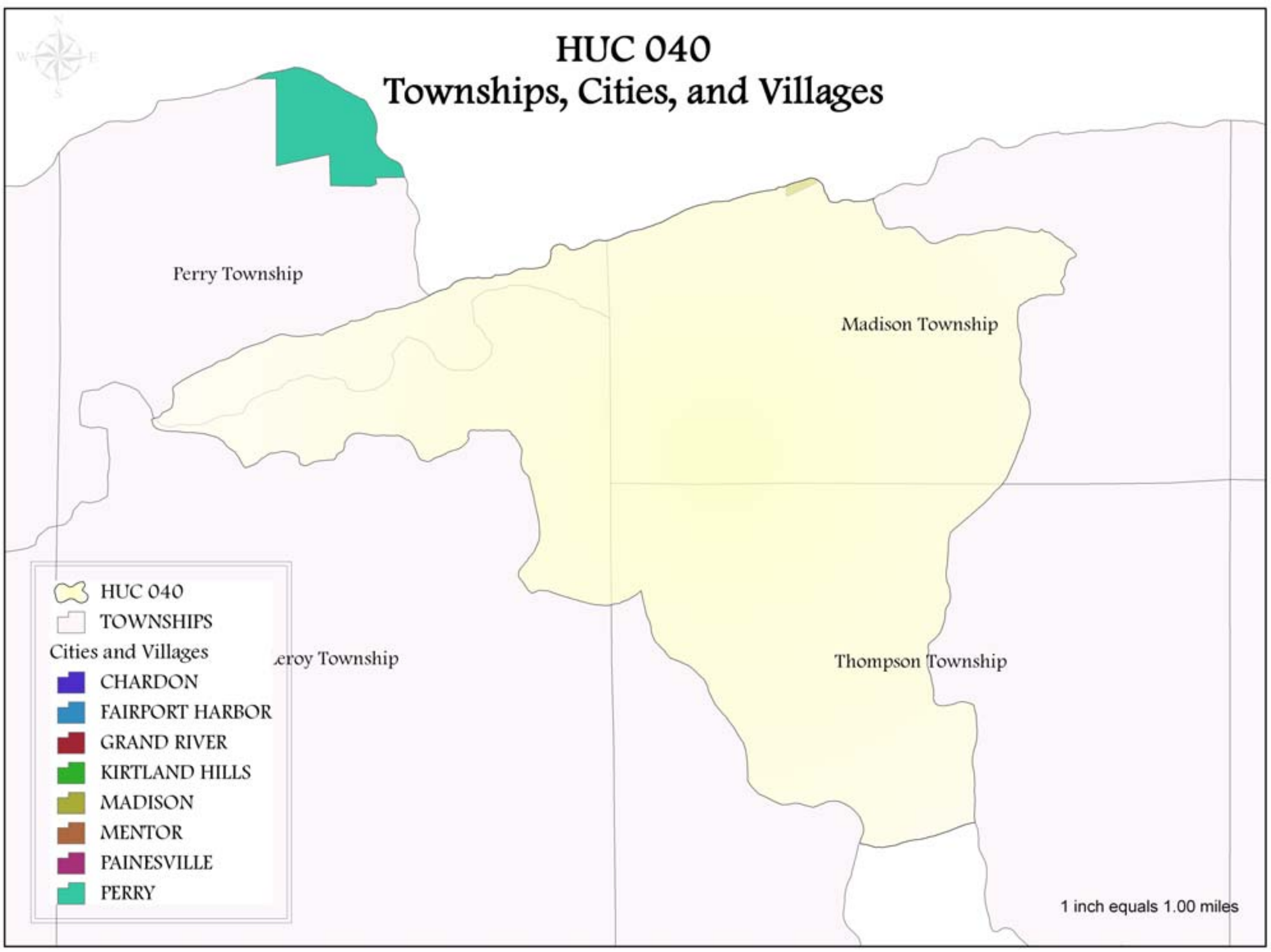
1. Work to secure funding to preserve pristine water quality by protecting an additional 3,222.79 acres of high quality land within subwatershed 04110004060030 (Mill Creek (3)).

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Permanent protection of 3,222.79 acres of subwatershed 04110004060030 (Mill Creek (3))	≈ $4,834,185 (≈$1,500/ acre conservation easement value)	Ashtabula SWCD, Ashtabula Metroparks, Grand River Partners, Inc., The Nature Conservancy, Lake SWCD, etc.	1/08-ongoing	Number of acres put into conservation easement protection

04110004060040 - Grand River below Mill Creek (3) to above Paine Creek

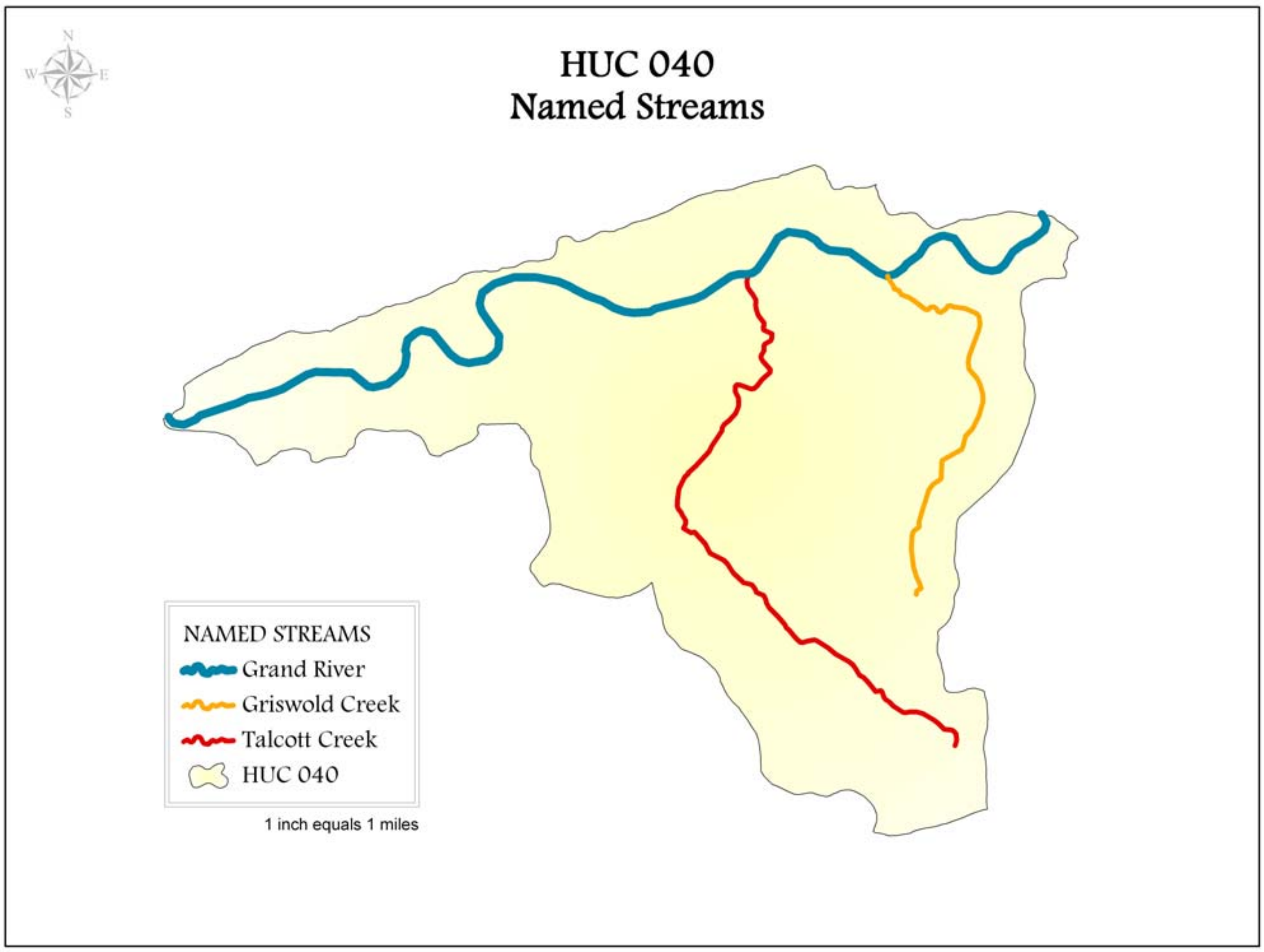
DESCRIPTION: The 14-digit Hydraulic Unit Code 04110004060040 (HUC 040) is located within the 11-digit HUC 04110004060 know as the Lower Grand River Watershed. HUC 040 is approximately 12,500 acres and approximately 20 square miles. This watershed encompasses portions of the Village of Madison and Madison, Perry, and Leroy Townships in Lake County, and Thompson Township in Geauga County.

Map 1.040- Communities of HUC 040



Mill Creek is analogous to Big Creek in that it also has high gradients, discontinuities in bedrock, and is subject to scouring flows that result in long bedrock glides, cascades and water falls. And like Big Creek the headwaters of Mill Creek have habitat more conducive to supporting till-plain stream fish communities. An unnamed tributary to Mill Creek sampled near the junction of Belle and Short Roads, has a virtually intact physical stream habitat; most notably, the substrates are a nearly silt-free heterogeneous mix of fractured sandstone bedrock and glacial till.

Map 2.040- Named Streams of HUC 040



DEMOGRPAHICS- Unfortunately, demographic statistics are collected on a per township or per county basis, thus making it difficult to determine the exact numbers for each subwatershed. Therefore, the data for each township located within each subwatershed was examined, and the totals and averages were taken of each; outliers were taken into account. The statistics for the Village of Madison and Madison, Perry, and Leroy Townships in Lake County, and Thompson Township in Geauga County were utilized to determine the information below.

Total Population-

The total population for HUC 040 is approximately 32,173 with a 49.89/ 50.11% male to female ratio. The largest age group represented is the 35 to 44 years group (17.89% of the total population), followed by the 45 to 54 years group (15.07%), and the 25 to 34 years group (12.61%). 23,509 people represent the 18 and older group, which accounts for 73.07% of the total population for the townships located within HUC 040. The average median age represented is 37.6.

The male to female ratio for the state of Ohio is 48.60/ 51.40%. The largest age group represented is the 35 to 44 years groups (15.90% of the total population), followed by the 45 to 54 years group (13.80%), and the 25 to 34 years group (13.40%). The median age for the people who reside in Ohio is 36.2.

Educational Attainment-

Of the 21,398 people who are over the age of 25 in the townships within the HUC 040 subwatershed, the majority education level is high school graduate

(39.77%), followed by some college with no degree (23.94%), and 9th grade to 12th grade with no diploma received (10.88%).

Employment Status~

Approximately 17,051 people over the age of 16, in the Village of Madison and Madison, Perry, and Leroy Townships in Lake County, and Thompson Township in Geauga County, are currently in the workforce. There are approximately 654 (2.66%) who are currently unemployed.

Household by type~

There are approximately 11,592 households in the Townships located within the HUC 040, of which 8,902 (76.79%) are family households. The average family size is 3.16 people.

Income (1999)~

The average median household income in 1999 for individual households in the Village of Madison and Madison, Perry, and Leroy Townships in Lake County, and Thompson Township in Geauga County was $52,601. The majority of the households had an income of $50,000 to $74,999 (27.25%), followed by $35,000 to $49,999 (18.43%), and $75,000 to $99,999 (13.97%).

The average median family income in 1999 for families in the Village of Madison and Madison, Perry, and Leroy Townships in Lake County, and Thompson Township in Geauga County, was $57,977. The majority of families had an income of $50,000 to $74,999 (24.00%), followed by $35,000 to $49,999 (15.12%), and $75,000 to $99,999 (12.24%).

The average median earnings for a male, full time, year round worker were $41,180 and $26,691 for a female, full time, year round worker.

Below Poverty Level (1999)~

There are 1,381 individuals within the HUC 040 subwatershed, for whom poverty status was determined. Of those, approximately 236 families are represented, and 124 are families with a female householder with no male present.

Occupation~

The residents of the Village of Madison and Madison, Perry, and Leroy Townships in Lake County and Thompson Township in Geauga County represent the following occupations; 4,402 management professionals, 2,101 service occupations, 4,351 sales and office occupations, 81 farming, fishing, and forestry occupations, 1,960 construction, extraction and maintenance occupations, and 3,483 production, transportation, and material moving occupations.

Race~

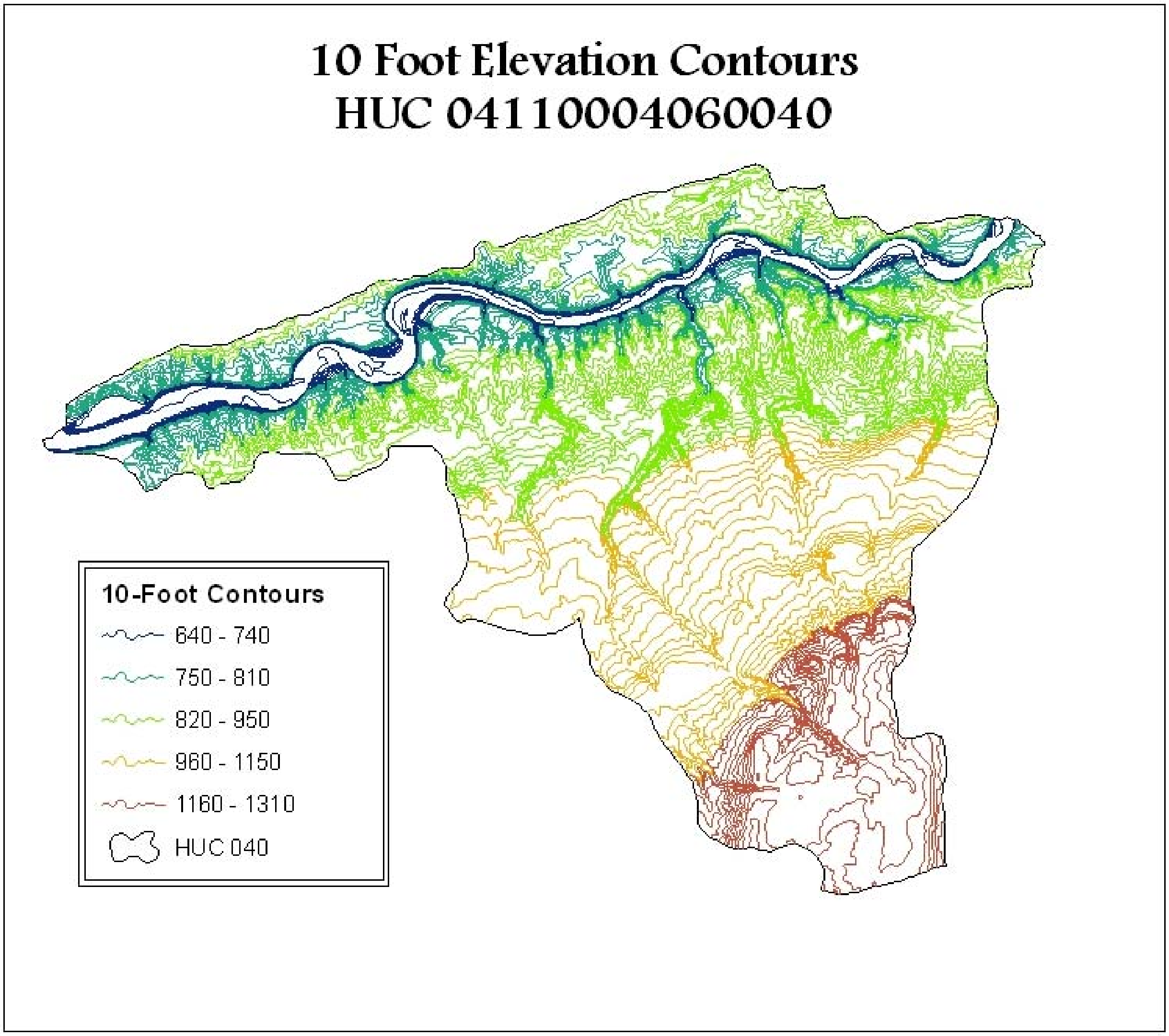
Approximately 91.72% of the population of the HUC 040 is white, 0.34% is African American, and 0.27% is Asian.

Other~

Within the HUC 040, approximately 11 residences are lacking complete plumbing facilities, 27 are lacking complete kitchen facilities, and 156 are without telephone service.

TOPOGRAPHY- The majority of HUC 040 is located within the West Tributary and Gorge Project areas of the Grand River Watershed. This area is known for its high bluffs, the cold water streams that flow from the high elevations, and the gorge which leads to the Grand River. HUC 040 has drastic elevation changes at it approaches the river, which gives the Grand River its amazing gorge and shale bluffs. The highest point in HUC 040 is 1310 feet and the lowest is 640 feet.

Map 3.040- Contours of HUC 040



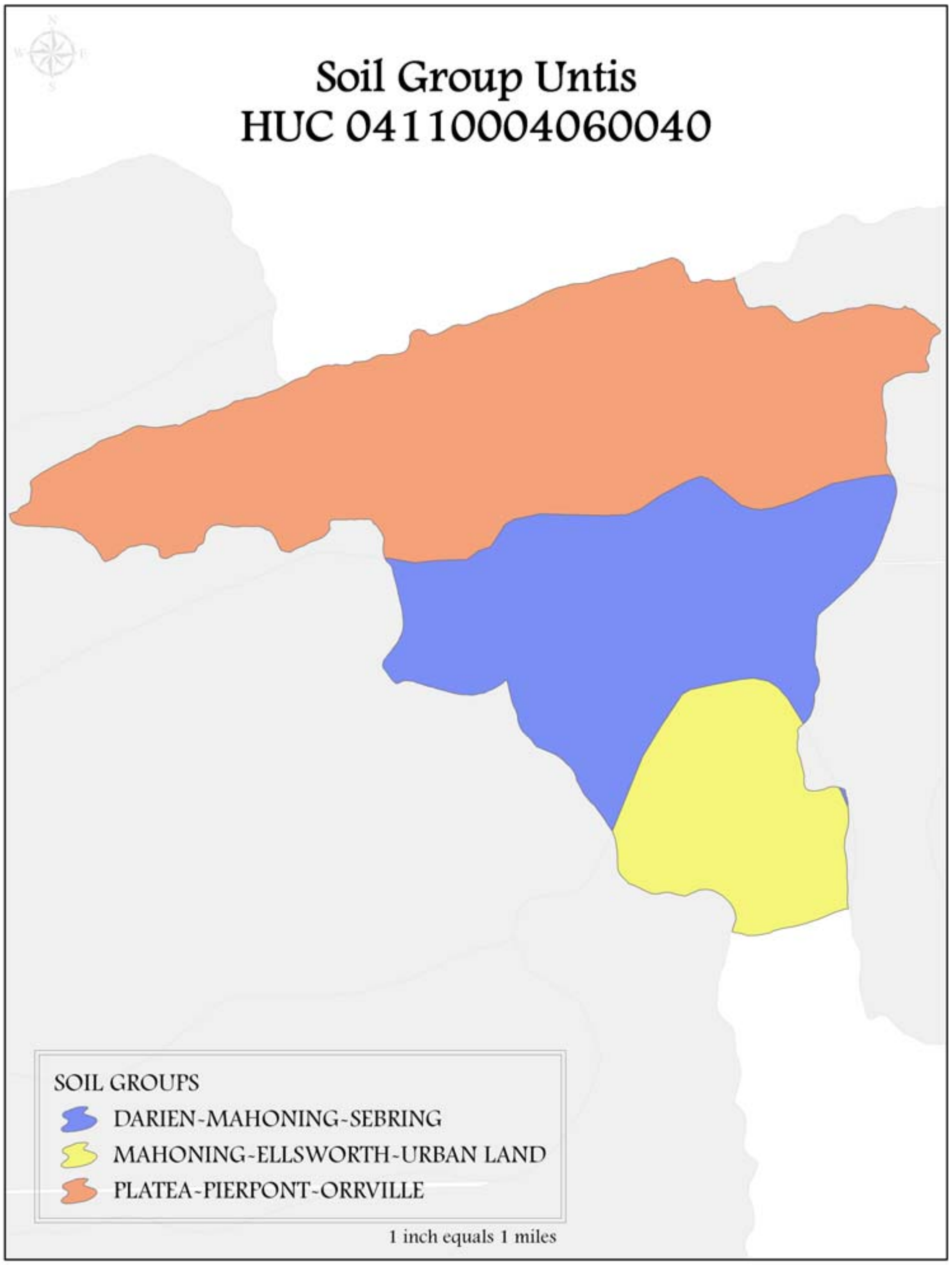
SOILS- There are three soil groups represented within HUC 040; the Darien – Mahoning – Sebring (approximately 4,002 acres), the Platea – Pierpont – Orrville (approximately 6,687 acres), and Mahoning – Ellsworth – Urban Land (approximately 1,820 acres) groups.

Darien- Mahoning- Sebring: These soils are nearly level to sloping, somewhat poorly drained that formed in silty or loamy glacial till on till plains. Most areas are in natural shrubs and trees, but some areas are used for cultivated crops, pasture, and residential development. Wetness and slow or very slow permeability severely limit most uses. Water usually ponds in low areas after a rainfall. Erosion is a hazard in sloping areas that are used for cultivated crops.

Platea- Pierpont- Orrville Group: This association is deep, nearly level to moderately steep, somewhat poorly drained to moderately well drained silty soils on glaciated uplands. This soil is found in undulating and hilly areas, but steep soils occur along rivers and streams including the Grand River. Grapes and small fruits are grown where the climate is suitable, particularly where air drainage is good. Very slow permeability, slope, and seasonal wetness are limitations for many nonfarm uses in this association.

Mahoning- Ellsworth- Urban Land: These soils are nearly level to very steep, somewhat poorly drained and moderately well drained that formed in silty or loamy glacial till on till plains. This mapping unit is found on long, gently sloping and short, undulating side slopes and broad flats in dissected areas along drainageways. Use of this map unit is diverse and includes urban and residential development, cultivated crops, and natural shrubs and trees. Wetness and the erosion hazard limit these soils for cultivated crops. Wetness also limits residential and urban development.

Map 4.040- Soil Groups of HUC 040



A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. This lack of oxygen in the soil can lead to the formation of certain observable characteristics in hydric soils, such as a thick layer of organic matter (non-decomposed plant materials) in the upper part of the soil column. Other observable features include oxidized root channels and redoximorphic features (concentrations and depletions of Iron and other elements, i.e., mottling, gleying). The following National Soil Information System (NASIS) criteria reflect those soils that may meet the definition of hydric soils.

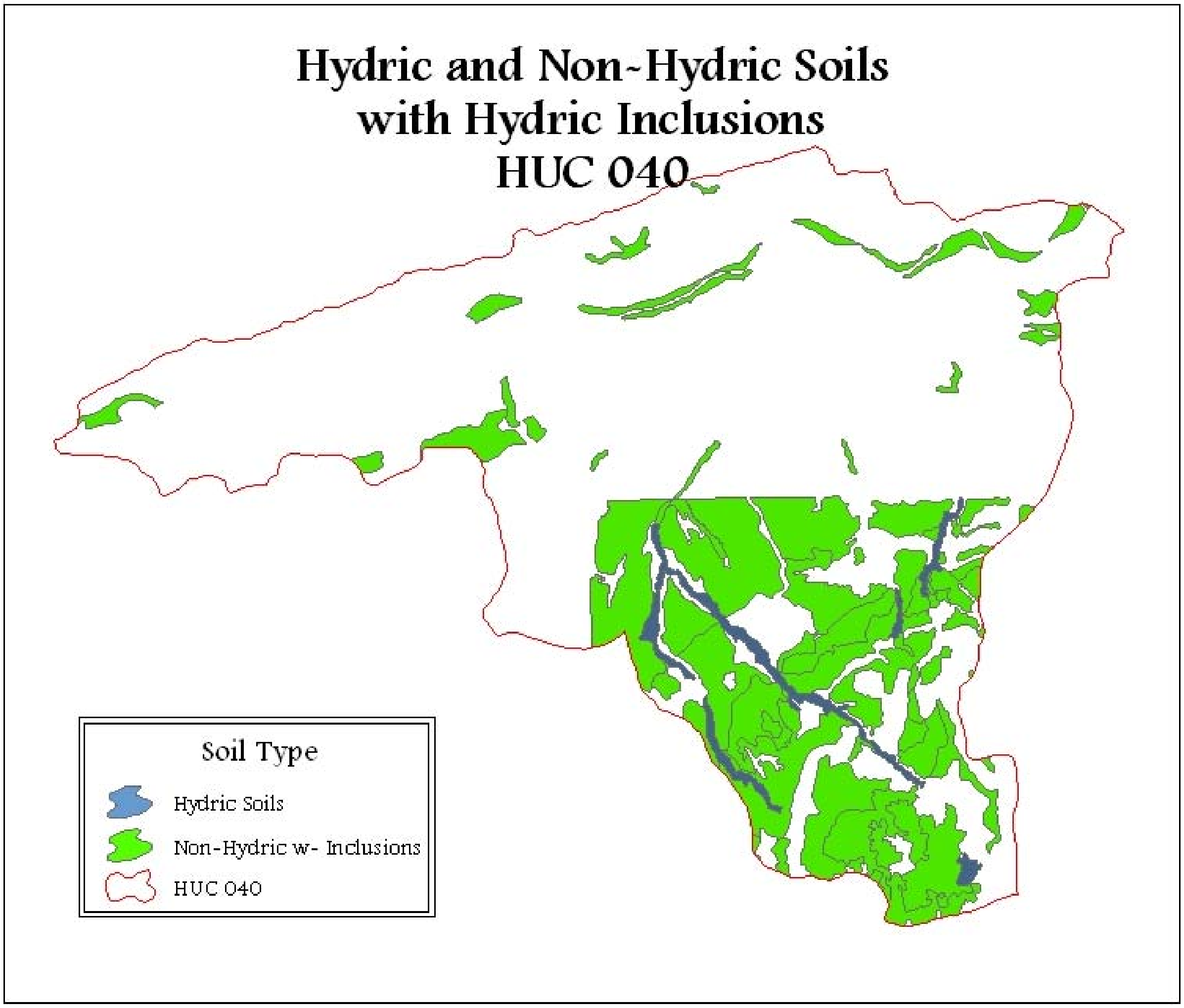
- All Histels except Folistels and Histosols except Folists, or
- Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:
- Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or
- poorly drained or very poorly drained and have either:
    - water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils
    - water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or
    - water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or

- Soils that are frequently ponded for long duration or very long duration during the growing season, or
- Soils that are frequently flooded for long duration or very long duration during the growing season.

In HUC 040, there are approximately 210 acres of hydric soils.

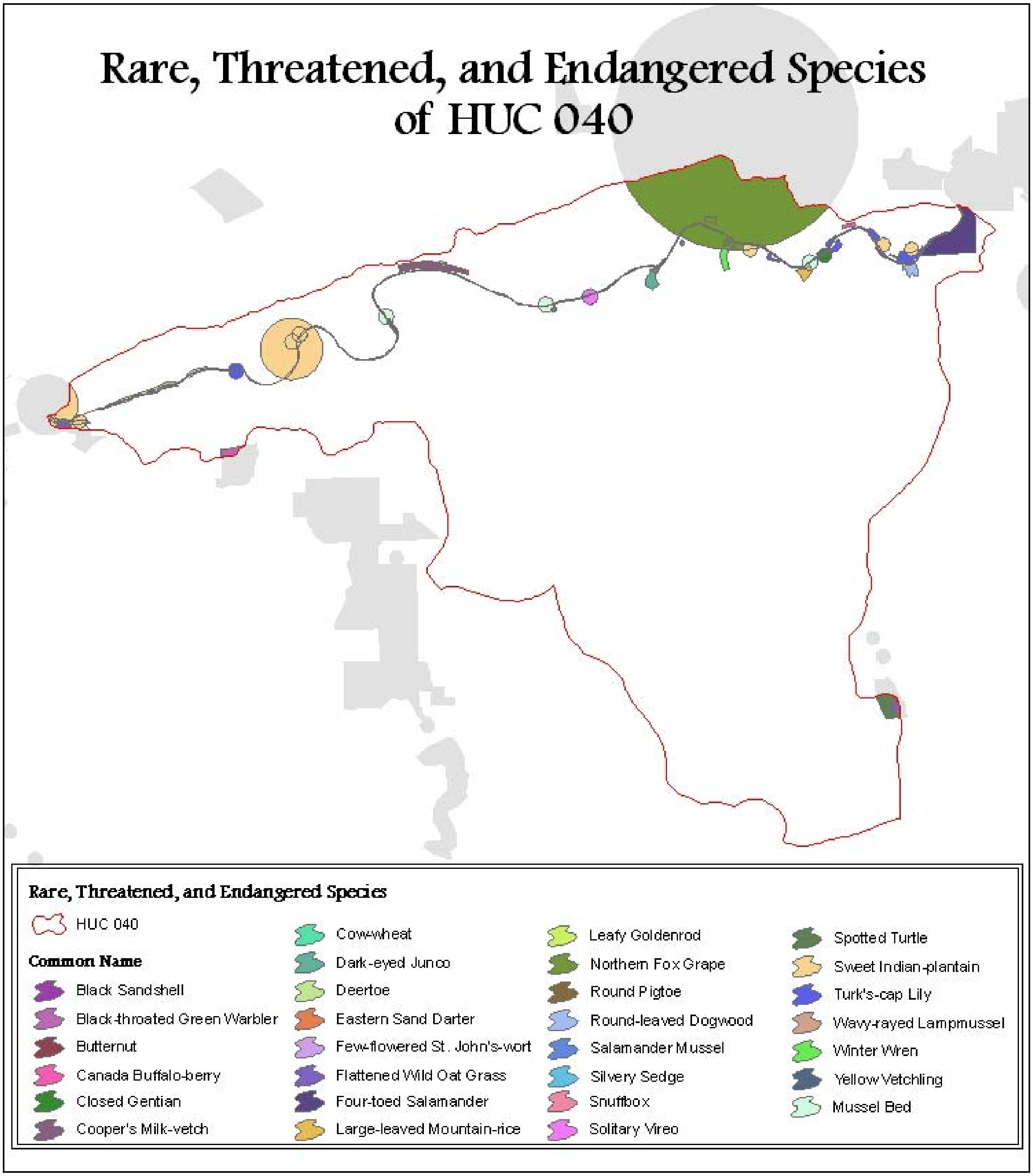
Non hydric soils can be of major importance to water quality as well. Many non-hydric soil types contain small areas of hydric soils, or hydric inclusions. These soils are generally not associated with having the properties of hydric soils, but the do have small pockets, which are too small to have been mapped by the soils surveys, to be considered hydric. Soil Survey books generally do not map "inclusions" of different soil types if the map units are less than 2 acres in size. These inclusions can be wetland soils within an upland soil series. Sometimes, the description will include the types of soils that are the most common inclusions in the series. HUC 040 contains roughly 3,105 acres of non hydric soils with hydric inclusions.

Map 5.040- Hydric and Non-Hydric of HUC 040



RARE, THREATENED, and ENDANGERED SPECIES- The Grand River Watershed provides the perfect habitat for many rare, threatened, and endangered species. In fact, the Ohio Department of Natural Resources, Division of Wildlife recognized the unparalleled biodiversity and habitats of the Grand River Watershed, and chose this watershed to reintroduce the wild turkey, river otter, and snowshoe hare. The following species are found within HUC 040 in the Grand River Watershed; black-throated green warbler, black sandshell mussel, butternut, Canada buffalo-berry, cow-wheat, dark-eyed junco, deertoe mussel, eastern sand darter, few-flowered St. John's-wort, flattened wild oat grass, four-toed salamander, large-leaved mountain-rice, leafy goldenrod, northern fox grape, round-leaved dogwood, round pigtoe mussel, salamander mussel, silvery sedge, snuffbox mussel, solitary vireo, sweet-Indian plantain, Turk's-cap-lily, wavy-rayed lampmussel, winter wren, yellow vetching, mussel beds, and hemlock-hardwood forest.

Map 6.040- Rare Species of HUC 040

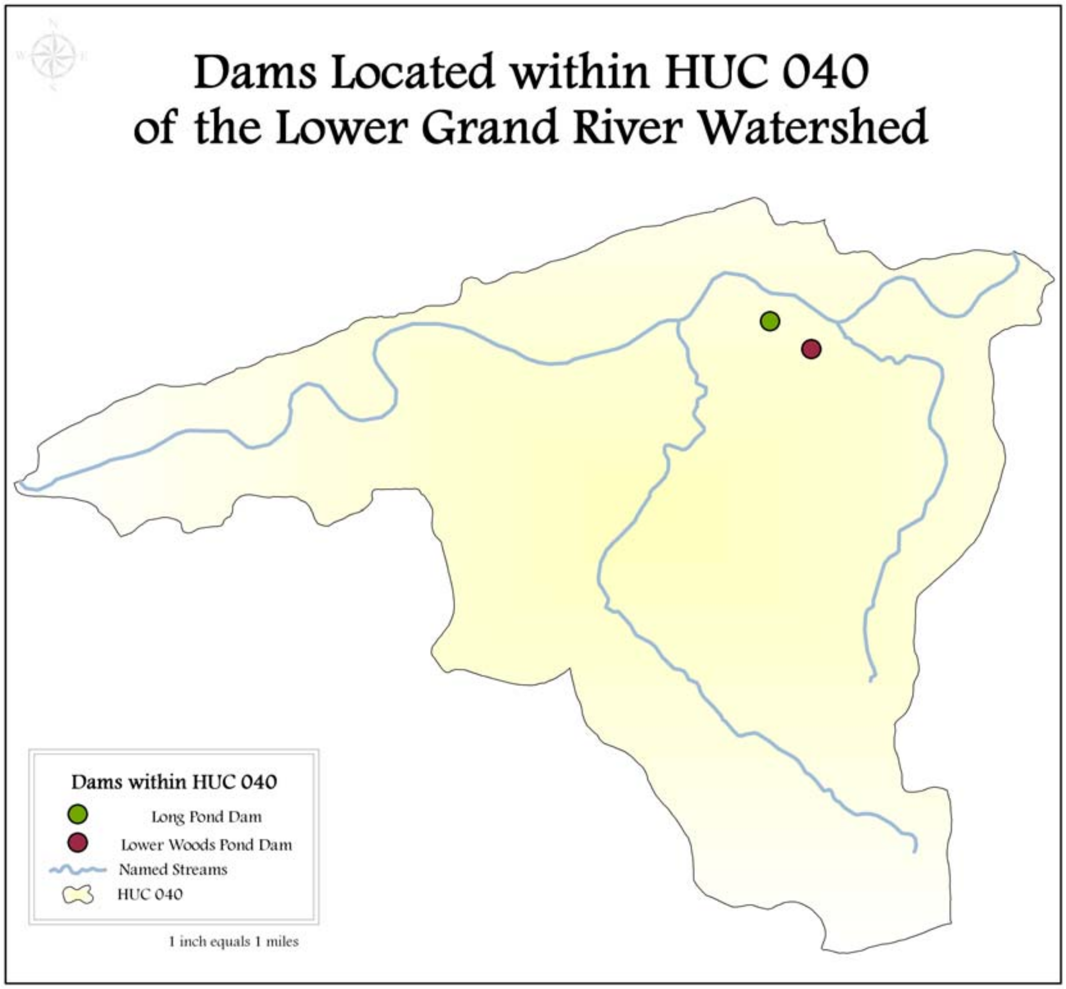


DAMS~ There are 18 dams located with in the Lower Grand River Watershed. In HUC 040 there are two dams; the ***Lower Woods Pond Dam*** and the ***Long Pond Dam***.

- The ***Lower Woods Pond Dam***, NID OH002797, is located in Madison Township, Lake County. This is a privately owned, earthen dam, located on an unnamed tributary to the Grand River. The purpose for this dam is strictly recreational, and is 3.2 acres in size. The drainage area of this dam is 0.06 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the ***Lower Woods Pond Dam*** is low, meaning that no loss of human life is probable and economic and/or environmental losses, disruption of lifeline facilities, and other impacts would not be expected.

- The ***Long Pond Dam***, NID OH001872, is located in Madison Township, Lake County. This is a privately owned, earthen dam, located on an unnamed tributary to the Grand River. The purpose for this dam is strictly recreational, and is 6.7 acres in size. The drainage area of this dam is 0.07 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the ***Lower Woods Pond Dam*** is low, meaning that no loss of human life is probable and economic and/or environmental losses, disruption of lifeline facilities, and other impacts would not be expected.

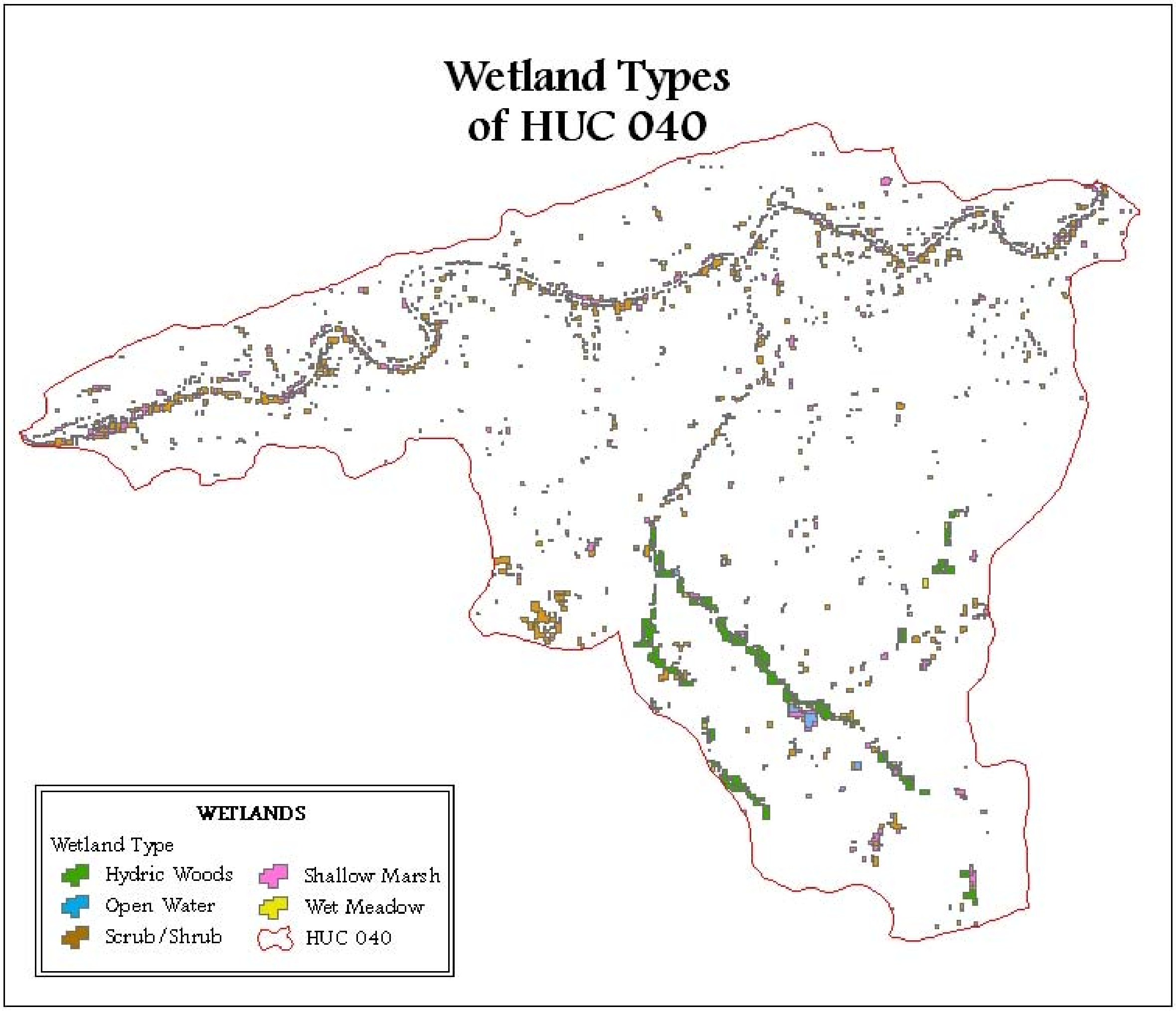
Map 7.040- Dams of HUC 040



WETLANDS- Wetlands are typically highly productive habitats, often hosting considerable biodiversity. The Army Corps of Engineers and the Environmental Protection Agency define wetlands as; "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions". Wetlands are found under a wide range of hydrological conditions, but at least some of the time water saturates the soil. The result is a hydric soil, one characterized by an absence of free oxygen some or all of the time, and therefore called a "reducing environment." Plants called hydrophytes specifically adapted to the reducing conditions presented by such soils can survive in wetlands, whereas species intolerant of the absence of soil oxygen (called "upland" plants) can not survive. Adaptations to low soil oxygen characterize many wetland species.

HUC 040 has approximately 634 acres of wetlands; 131 acres of Hydric Woods, 10 acres of open water wetlands, 297 acres of scrub/shrub, 180 acres of shallow marsh, and 15 acres of wet meadow.

Map 8.040- Wetlands of HUC 040



DRASTIC- The DRASTIC maps, produced by the Ohio Department of Natural Resources, show the pollution potential for groundwater systems. The DRASTIC mapping system allows the pollution potential of any area to be evaluated systematically using the following existing information about an area:

D= Depth to Water

R= Net Recharge

A= Aquifer Media

S= Soil Media

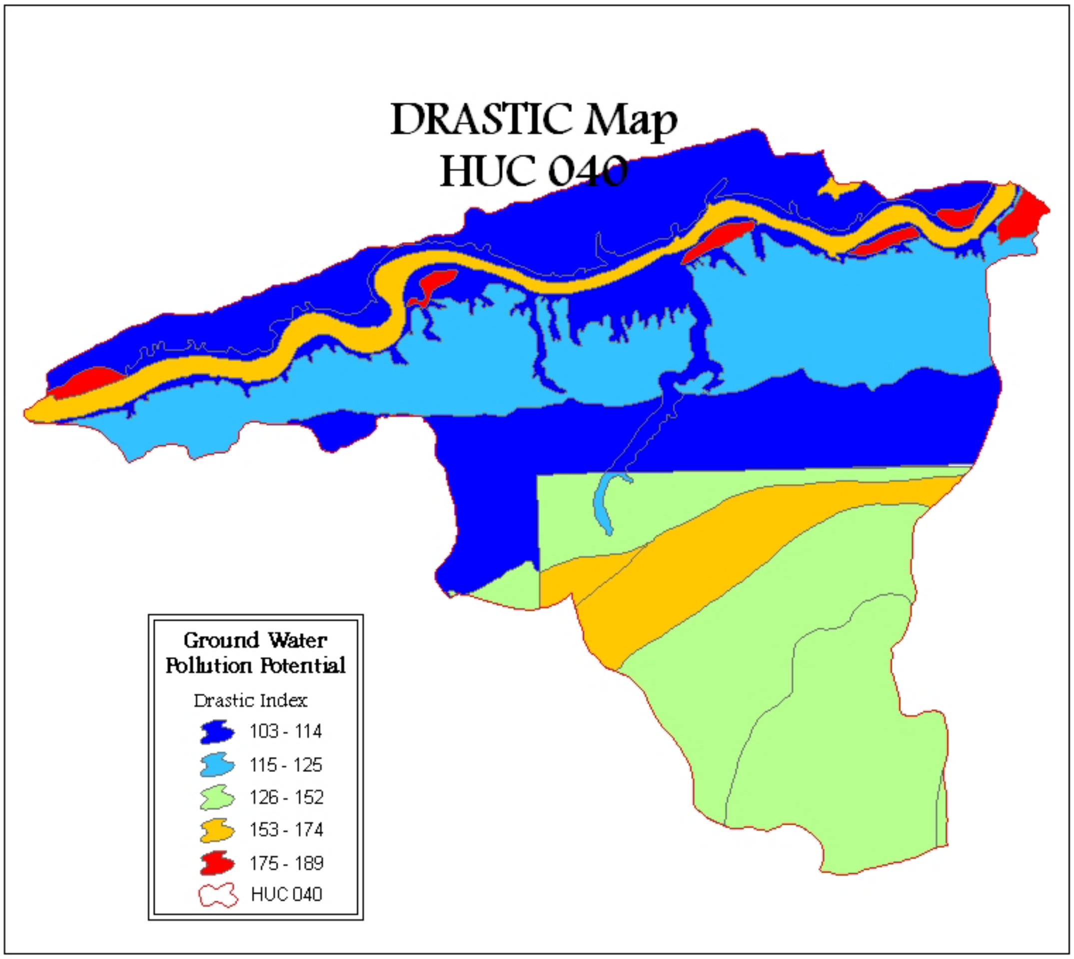
T= Topography

I= Impact of the Vadose Zone Media

C= Hydraulic Conductivity of the Aquifer

In evaluating an area's vulnerability to contamination, the DRASTIC mapping system assumes a contaminant with the mobility of water is introduced at the surface and flushed into the groundwater by precipitation. A pollution potential map can assist in developing ground water protection strategies. By identifying areas more vulnerable to contamination, officials can direct resources to areas where special attention or protection efforts might be warranted. This information can be utilized effectively at the local level for integration into land use decisions and as an educational tool to promote public awareness of ground water resources. Pollution potential maps may be used to prioritize ground water monitoring and/or contamination clean-up efforts. Areas that are identified as being vulnerable to contamination may benefit from increased ground water monitoring for pollutants or from additional efforts to clean up an aquifer. HUC 040 has a maximum DRASTIC index of 189. Approximately 1.64% of HUC 040 has a high DRASTIC index.

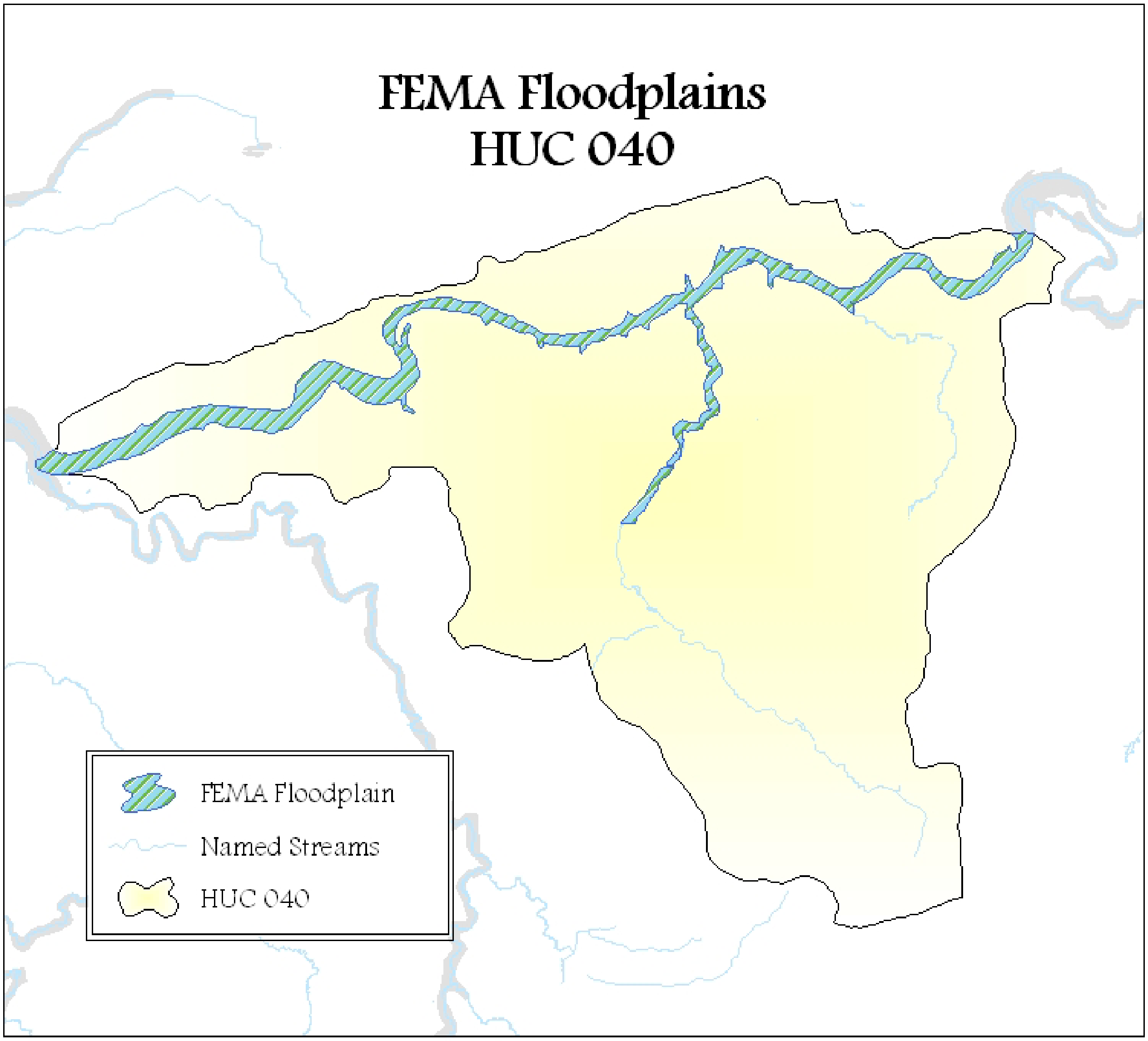
Map 9.040- DRASTIC of HUC 040



FLOODPLAINS- Floodplains are the low, flat, periodically flooded lands adjacent to rivers, lakes and oceans and subject to geomorphic (land-shaping) and hydrologic (water flow) processes. FEMA, the Federal Emergency Management Agency, has developed areas within watersheds that are designated as 100-year and 500- year floodplains. A "100-year flood" is defined as a flood event that has a 1 in 100 chance of occurring in any given year, and a 500-year flood has a 1 in 500 chance. HUC 040 has 768 acres of designated 100-year floodplain, which represents approximately 6.1% of the watershed.

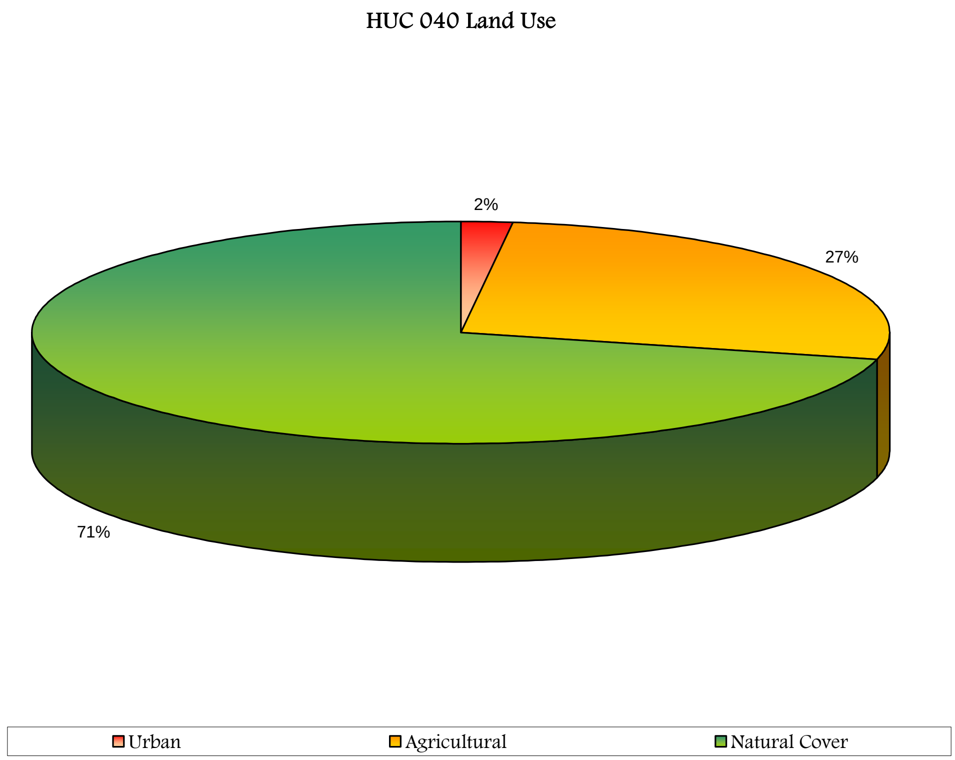
Current both Lake and Geauga Counties have an ordinance in place which protects the riparian areas and floodplains of the Grand River and its named tributaries.

Map 10.040- Floodplains of HUC 040



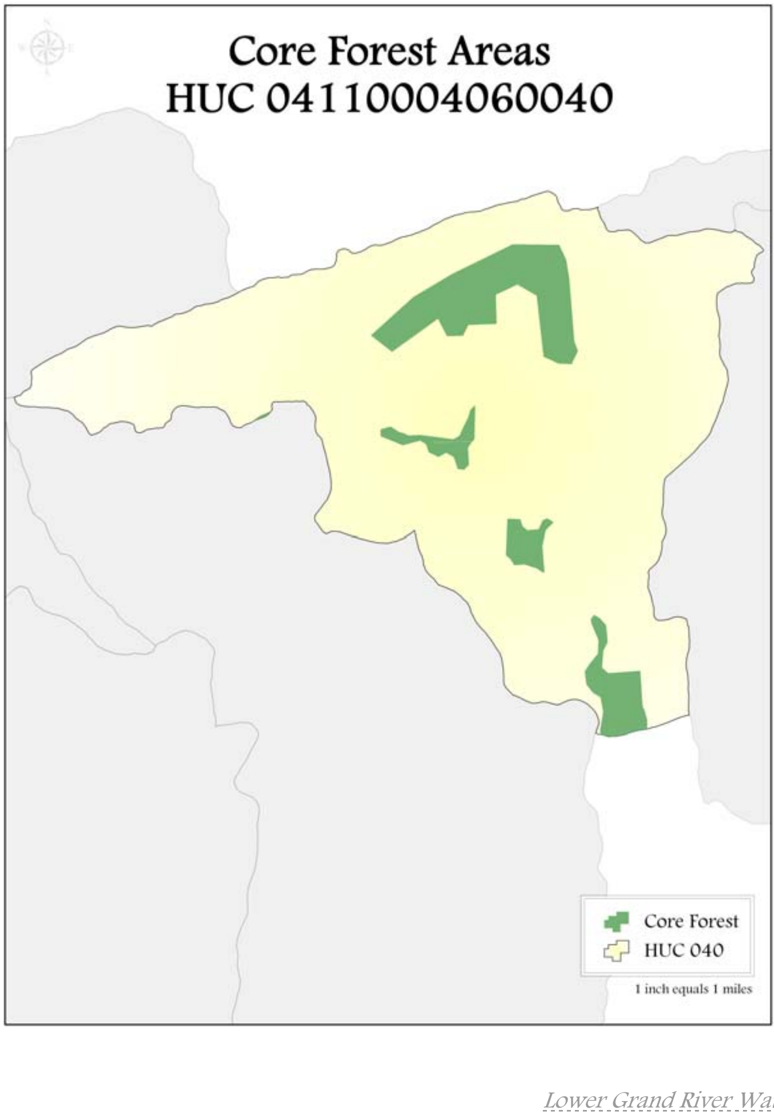
LAND USE~ HUC 040 is a very rural subwatershed. Much of this watershed is in natural cover, with very few urban areas. However, suburbanization is a threat to this area of the Grand River Watershed. Here, land is plentiful and still remains at a relatively low cost. Population density is low (8.2), but is inspected to increase due to suburbanization.

Chart 1.040~ Landuse in HUC 040



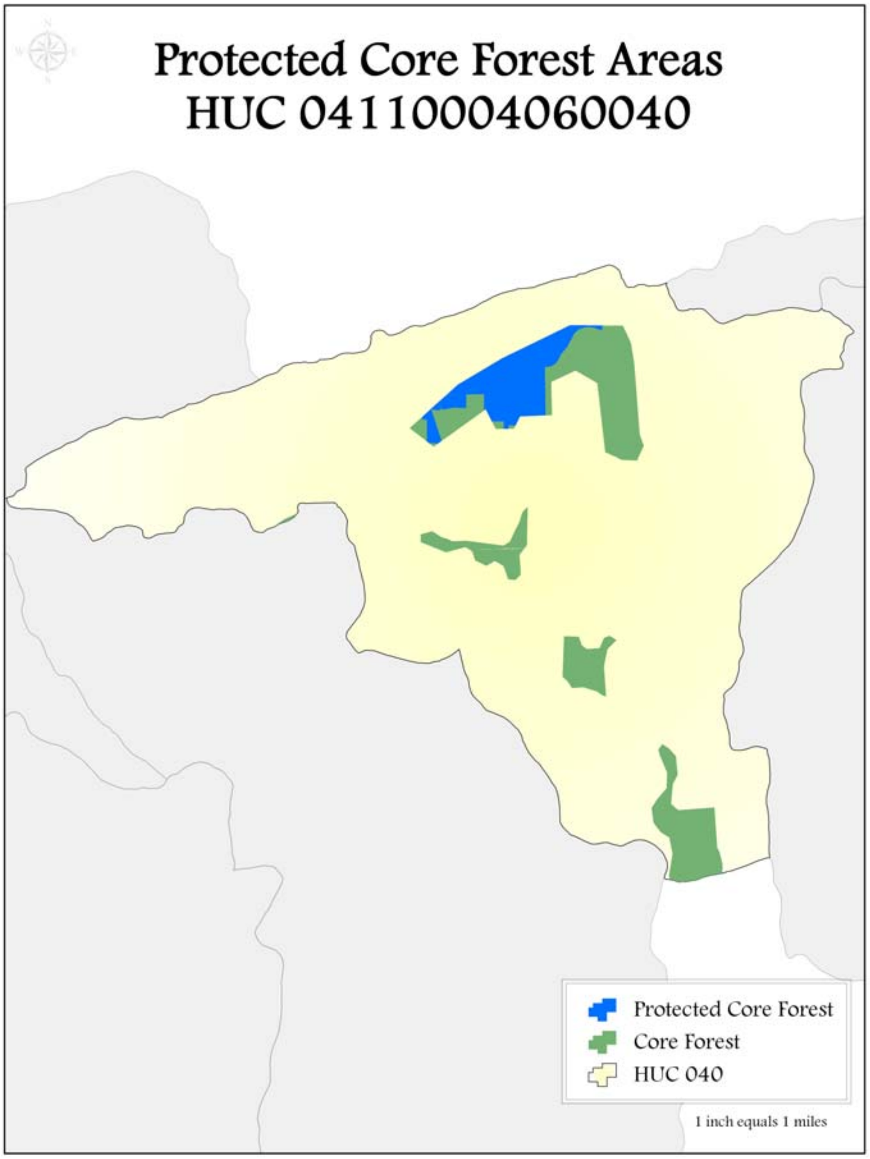
Since the vast majority of the watershed remaining in natural cover, there are many large tracts of undisturbed forest blocks. The Nature Conservancy realized the importance of these large tracts of forest, or "Core Forest Areas", for not only their natural resources value but their importance for breeding populations as well. Core Forest Areas are forested areas of 100 acres or more with a forested buffer zone from pastures and agriculture, and no roads within at least 300 meters. These numbers were determined by the habits and lifecycles of certain forest species; a pair of pileated woodpeckers will need at least 100 acres in order to breed, certain amphibian populations use forest areas up to 200 meters away from their wetland habitat for breeding purposes, and cowbirds will penetrate up to 150 meters of the core forest areas. HUC 040 contains four Core Forest Areas, which total 1206.23 acres, or roughly 9.65% of the HUC 040 watershed.

Map 11.040- Core Forest of HUC 040



These Core Forest Areas are very important habitats that need to be preserved. There are currently 322.50 acres of the 1206.23 acres of Core Forest in permanent protection, or approximately 26.74%.

Map 12.040- Protected Core Forest of HUC 040



GRPI~ LAND PROTECTION PRIORITY LIST~ Grand River Partners, Inc.'s goal is to protect the natural resources of the Grand River and its watershed. Grand River Partners, Inc. utilizes the conservation easement as the primary tool to protect such resources. Conservation easements are a great tool to protect resources on private lands but still maintain them in private hands. The Grand River watershed is approximately 712 square miles. Obviously Grand River Partners, Inc. cannot protect all of the 712 square miles (455,000 acres) with conservation easements. Grand River Partners, Inc. believes that water quality can be protected by conserving the "right" 25% of a watershed. In the specific case of the Grand River, this represents roughly 114,000 acres. Protecting 114,000 acres is an achievable goal considering the number of partner organizations and the fact that approximately 25% of the 114,000 acres has already been protected.

The challenge remains to protect the remaining 86,000 acres of the "right" land. To fulfill this goal, Grand River Partners, Inc. developed a parcel based **Land Protection Priority List**. Before any prioritization process could begin, any parcel less then five acres was removed from the potential list of priorities. To make fair comparisons an analysis of the watershed was conducted to determine the unique areas within the watershed. From this analysis, the Grand River Watershed was divided into 5 distinct project areas based on the unique natural features of each. The parcel prioritization process involved a two tier analysis. The first, Tier 1, involved an analysis of natural resources. The second, Tier 2, involved a strategic analysis that took into account parcel size, proximity to other protected land, and partner priorities.

The Headwaters Project Area consists of the area drained by all the unnamed tributaries that together form the Grand River. The area begins more or less upstream of the crossing with SR 534 at the southern end of the watershed. In summary, important

natural resources ranked for each parcel located in the Headwaters Project Area are intact riparian areas, the Grand River main stem, wetlands, unnamed tributaries, floodplains, core forest blocks and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Lowlands Project Area begins at the crossing of SR 534 with the mainstem in the southern portion of the watershed and extends between the 810' contour interval north to the crossing where the Grand River intersects Windsor-Mechanicsville Road. Important Natural Resources identified in the Lowlands Project Area are swamp forests, wetlands, intact riparian areas, core forest blocks, mainstem, rare species, floodplains, TNC subwatershed ranking, and named tributaries. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Gorge Project Area begins at the crossing of the mainstem and Windsor-Mechanicsville Road bridge and extends upstream to the crossing with SR 84. The Gorge Project Area is bordered to the north by the watershed boundary and to the south by the 950' contour interval. The important natural characters of the Gorge are the mainstem, wetlands, floodplains, intact riparian areas, named tributaries, core forest blocks, steep slopes, TNC subwatershed rankings, and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Estuarine/Urban Project Area begins at the State Route 84 crossing with the Grand River and ends in Fairport Harbor Village and Grand River Village at its terminus with Lake Erie. The Estuarine/Urban Project Area includes the subwatershed of Red Creek which extends to the west just north of the City of Painesville. In this project area the

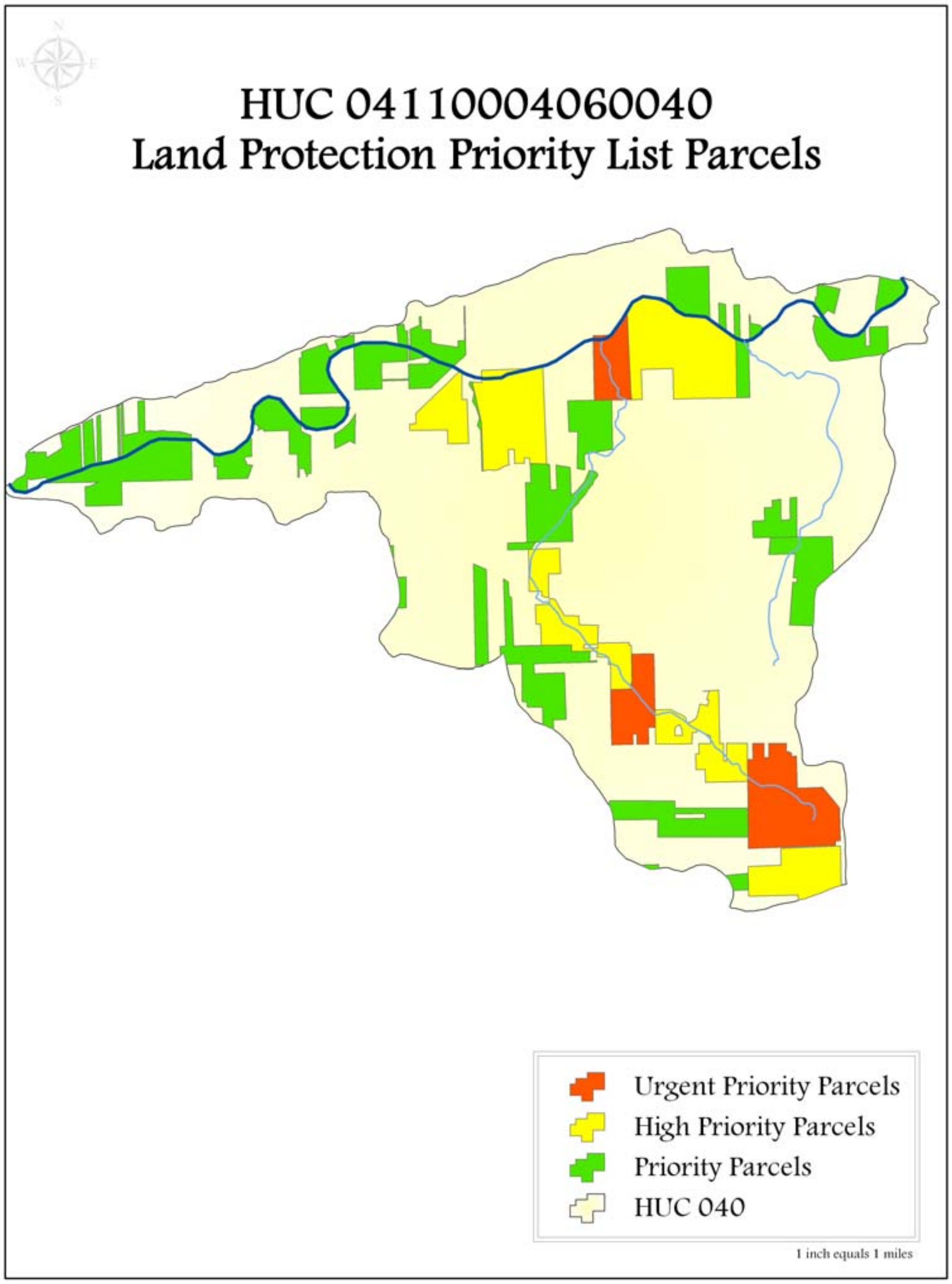
mainstem, river access points, wetlands, intact riparian areas, floodplains and named tributaries were considered important natural features. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The last area is the Tributaries Project Area which consists of two areas; one is located east of the Grand River Lowlands Project Area, which and includes the subwatersheds of such named tributaries as Mill Creek, Rock Creek and Coffee Creek, and the second project area is located west of the Lowlands Project Area, north of the Headwaters Project Area and south of the Gorge Project Area. This portion of the Tributaries Project Area contains the subwatersheds of such high quality streams as Indian Creek, Phelps Creek, Hoskins Creek, and Paine Creek. Important natural resources considered include, cold water habitat, wetlands, floodplains, core forest blocks, and rare species. Again each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

Each parcel within the watershed was further evaluated based on additional strategic rankings. These rankings include parcel size, proximity to protected land and partner priorities. Each parcel meeting the acreage requirement, or within a certain distance of existing protected land or included as a priority by a partner organization or agency was weighted more heavily and therefore considered a high priority. A statistical analysis of the final scores was performed and each parcel was categorized as being priority, high priority or an urgent priority parcel.

In HUC 040, there are a total of 1361.18 acres of priority parcels, 1230.08 acres of high priority parcels, and 547.74 acres of urgent priority parcels for protection. Currently there are 1,602.69 acres permanently protected within HUC 040.

Map 13.040- LPPL of HUC 040



IMPERVIOUS SURFACE~ The Conversion of farmland, forests, wetlands, and meadows to rooftops, roads, and lawns creates a layer of impervious surface in the urban landscape. Impervious cover is a very useful indicator with which to measure impacts of land development on aquatic systems. The process of urbanization has a profound influence on the hydrology, morphology, water quality, and ecology of surface waters. Recent research has shown that streams in urban watersheds possess a fundamentally different character than streams in forested, rural, or even agricultural watersheds. The amount of impervious cover in the watershed can be used as an indicator to predict how severe these differences can be. In many regions of the country, as little as ten percent watershed impervious cover has been linked to stream degradation, with the degradation becoming more severe as impervious cover increases.

Impervious cover directly influences urban streams by dramatically increasing surface runoff during storm events. Depending on the degree of impervious cover, the annual volume of stormwater runoff can increase by two to 16 times its predevelopment rate, with proportional reductions in groundwater recharge. In natural settings, very little annual rainfall is converted to runoff and about half is infiltrated into the underlying soils and the water table. This water is filtered by the soils, supplies deep water aquifers, and helps support adjacent surface waters with clean water during dry periods. In urbanized areas, less and less annual rainfall is infiltrated and more and more volume is converted to runoff. Not only is this runoff volume greater, it also occurs more frequently and at higher magnitudes. As a result, less water is available to streams and waterways during dry periods and more flow occurs during storms.

The relationship between impervious cover and subwatershed quality can be predicted by a simple model that projects the current and future quality of streams and other water resources at the subwatershed level. Stream research generally indicates that certain zones of stream quality exist, most notably at about 10% impervious cover, where sensitive stream elements are lost from the system. A second threshold appears at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition; diminished aquatic diversity, water quality, and habitat scores.

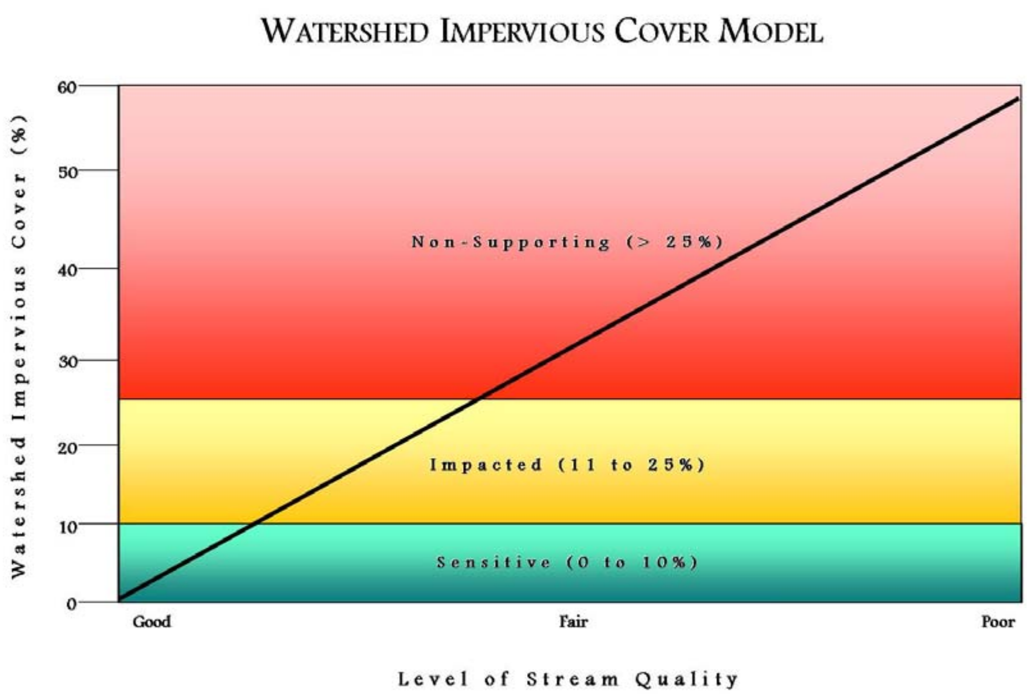
The model classifies streams into one of three categories; sensitive, impacted, and non-supporting. Each stream category can be expected to have unique characteristics as follows:

Sensitive Streams: These streams typically have a watershed impervious cover of zero to 10 percent. Consequently, sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Impacted Streams: Streams in this category possess a watershed impervious cover ranging from 11 to 25%, and show clear signs of degradation due to watershed urbanization. Greater storm flows begin to alter the stream geometry. Both erosion and channel widening are clearly evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with the most sensitive fish and aquatic insects disappearing from the stream.

Non- Supporting Streams: Once watershed impervious cover exceeds 25%, stream quality crosses a second threshold. Streams in this category essentially become a conduit for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, down-cutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated, and the stream substrate can no longer provide habitat for insects or spawning areas for fish. Water quality is consistently rated as fair to poor, and water contact recreation is no longer possible due to the presence of high bacterial levels. Subwatersheds in the non-supporting category will generally display increases in nutrient loads to downstream receiving waters, eve if effective urban BMPs are installed and maintained. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish.

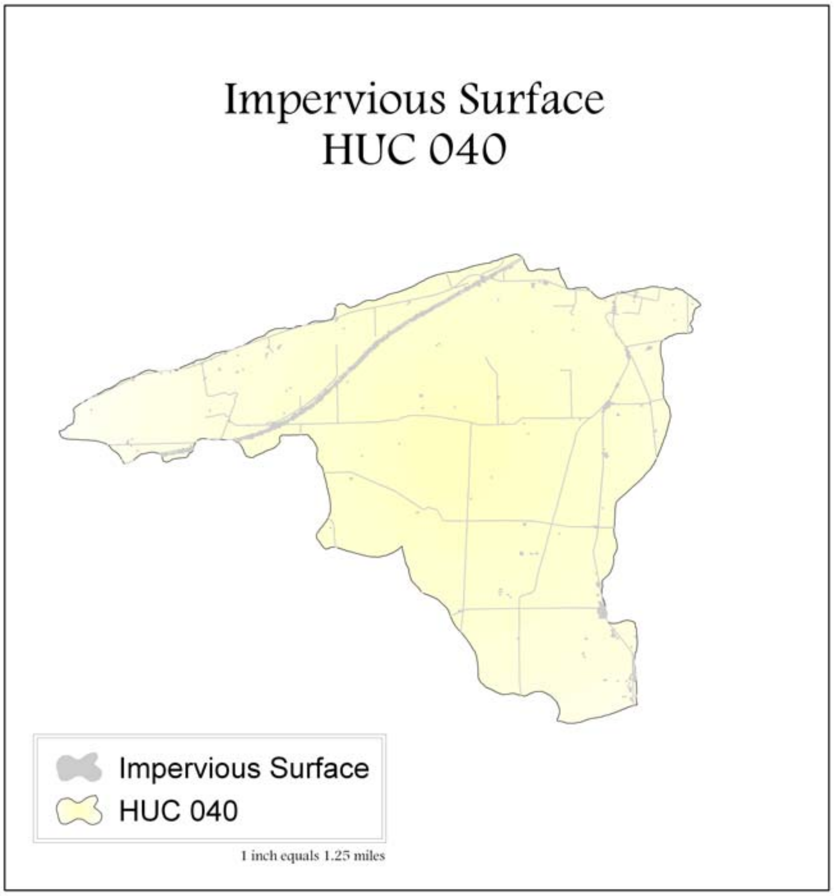
Graph 1.040- Impervious Cover Model



Center for Watershed Protection, Rapid Watershed Planning Handbook

HUC 040 has an impervious cover of approximately 2.47%. Therefore, the streams in this subwatershed are considered "sensitive streams" by the impervious surface model. Sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Map 14.040- Impervious Surface of HUC 040



ATTAINMENT STATUS- *Ohio Water Quality Standards: Designated Aquatic Life Use*

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*

2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*

3) *Cold-water Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie

tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 mi.^{2} drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

Talcott Creek- Talcott Creek is recommended for a CWH aquatic life use based on the presence of eight coldwater macroinvertebrate taxa. Being a direct coldwater tributary to the Grand River, protecting the existing hydrology of this stream is important to maintaining the long-term health of the Grand River.

Grand River- Aquatic life in the Grand River is fully attaining standards for Exceptional Warmwater Habitat (EWH) from Sweitzer Road (RM 42.2) to the SR 2 bridge in Painesville (RM 5.2), and is fully meeting standards for Warmwater Habitat (WWH) downstream from the SR 2 bridge. The Seasonal Salmonid use designation currently in place should be retained.

The Grand River is an economic asset to Northeast Ohio, but is especially sensitive to pollution and disturbance because of limited summer base flows. Therefore, regional planning, stream protection policies, comprehensive construction site management plans, construction site performance bonds, identification and preservation of sensitive areas, and above all, defined limits to growth are needed to maintain the biological integrity of the Grand River.

The Grand River is the only Ohio tributary to Lake Erie that harbors a self-sustaining population of Great Lakes Muskellunge, and therefore is a priority for conservation. The Grand River is also has a native population of walleye and northern pike making it singularly unique among Ohio streams. The Grand River and its tributaries provide habitat for many species considered rare by Ohio EPA, or listed as threatened or endangered by the Ohio Department of Natural Resources including 32 macroinvertebrates and freshwater mussel species, and 11 fish species. The single greatest threat to the Grand River basin is suburbanization.

BIOLOGICAL INDICATORS- Fish communities in the Grand River have an exceptionally high degree of biological integrity. This is obvious in the consistently high IBI scores along the length of the mainstem and between sampling years, and is also evident in the unusually high percent composition of pollution intolerant species making up electrofishing samples (Figure 40). Furthermore, the Grand River is one of the few rivers in Ohio that has a full suite of endemic, naturally reproducing and self-sustaining top carnivores including walleye, northern pike and muskellunge. The later is the Great Lakes subspecies (*Esox masquinongy masquinongy*), and so represents a vitally important area for genetic and habitat conservation. Given the propensity for muskellunge to differentiate into unique strains, the population in the Grand River may well be a truly endemic strain. As it stands, it is the last naturally reproducing muskellunge population found in any of Ohio's Lake Erie tributaries.

Being snow-belt streams, fish communities in Talcott Creek are, again, subject to the natural limitations of torrential scouring flows, lengthy stretches of shallow bedrock, and low summer flows. Not surprisingly, the fish sample from Talcott Creek did not meet the IBI biocriterion. Further upstream, at Ross Road and in a tributary sampled at Bell and Short Roads, where the effects of snow melt are less pronounced, and summer base-flow is more sustained relative to the drainage area owing to Thompson Ledges, fish samples met the WWH biocriterion.

Talcott Creek supports exceptionally high quality macroinvertebrate communities including many infrequently collected sensitive taxa and three state listed taxa. Talcott Creek is characterized by coolwater/coldwater macroinvertebrate communities. The unusually high quality macroinvertebrate communities in this stream are probably due to the stream flowing through highly wooded ravines with continuous groundwater flow and limited development.

PROBLEM STATEMENTS

PROBLEM 1

BACKGROUND: Based on the 2000 Census data, the projected population growth for all the counties located within the Lower Grand River Watershed is expected to significantly increase. Similar growth in adjacent Counties has shown that an increase in development due to population increase has caused erosion and siltation of waterways, and ultimately degradation of water quality. Permanent protection of critical areas will ensure that high water quality will remain.

PROBLEM STATEMENT: NEED FOR FUNDING FOR LAND PROTECTION EFFORTS

All of the streams within this subwatershed are currently in attainment. Land protection of critical natural areas is paramount to maintaining the attantaiment status of the Grand River and it tributaries. Currently there are 1,602.69 acres of permanently protected land in subwatershed 04110004060040 (Grand River below Mill Creek (3) to above Paine Creek). Grand River Partners, Inc. Land Protection Priority List has identified 3,139.0 acres of priority land for protection. This land includes high quality natural resources including riparian buffers, core forests, high quality streams, coldwater streams, upland forests, wetlands, and more.

GOALS:

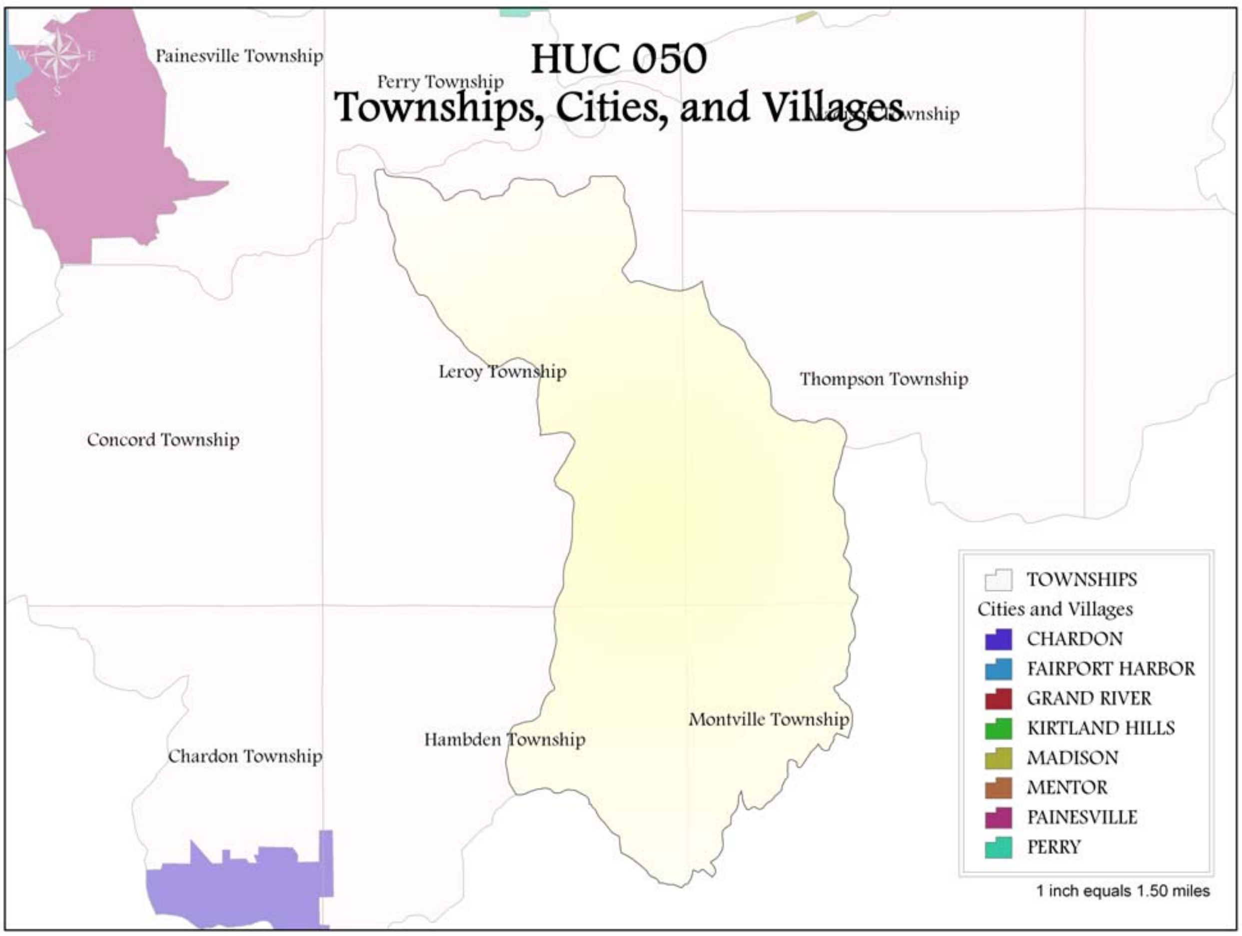
1. Work to secure funding to preserve pristine water quality by protecting an additional 3,222.79 acres of high quality land within subwatershed 04110004060040 (Grand River below Mill Creek (3) to above Paine Creek).

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Permanent protection of 3,139.0 acres of subwatershed 04110004060040 (Grand River below Mill Creek (3) to above Paine Creek)	≈ $6,278,000 (≈$2,000/ acre conservation easement value)	Grand River Partners, Inc., The Nature Conservancy, Lake SWCD, etc.	1/08- ongoing	Number of acres put into conservation easement protection

04110004060050 ~ Paine Creek

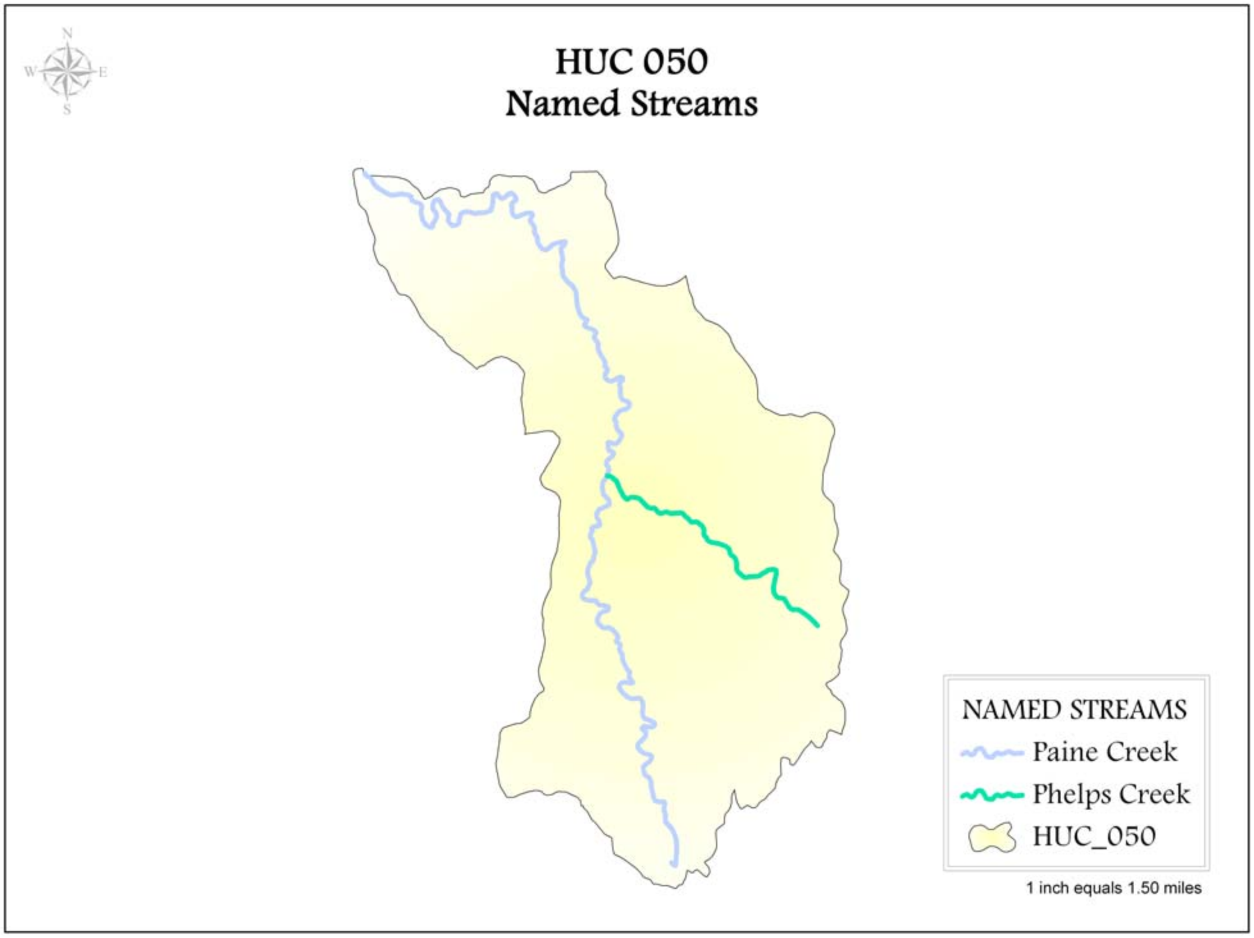
DESCRIPTION~ The 14-digit Hydraulic Unit Code 04110004060050 (HUC 050) is located within the 11-digit HUC 04110004060 know as the Lower Grand River Watershed. HUC 050 is approximately 18416 acres and approximately 29 square miles. This watershed encompasses portions of Leroy Township in Lake County, and Thompson, Montville, and Hambden Townships in Geauga County.

Map 1.050- Communities of HUC 050



Paine and Phelps Creeks are very analogous to Big Creek in that they also have high gradients, discontinuities in bedrock, and are subject to scouring flows that result in long bedrock glides, cascades and water falls. And like Big Creek the headwaters of Paine Creek (Bates Creek) have habitat more conducive to supporting till-plain stream fish communities. Bates Creek has virtually an intact physical stream habitat; most notably, the substrates are a nearly silt-free heterogeneous mix of fractured sandstone bedrock and glacial till.

Map 2.050- Named Streams of HUC 050



DEMOGRPAHICS~ Unfortunately, demographic statistics are collected on a per township or per county basis, thus making it difficult to determine the exact numbers for each subwatershed. The data for each township located within each subwatershed was examined, and the totals and averages were taken of each; outliers were taken into account. The statistics for Leroy Township in Lake County, and Thompson, Montville, and Hambden Townships in Geauga County were utilized to determine the information below.

Total Population~

The total population for HUC 050 is approximately 11,513 with a 50.67/ 49.33% male to female ratio. The largest age group represented is the 35 to 44 years group (18.20% of the total population), followed by the 45 to 54 years group (16.61%), and the 25 to 34 years group (11.77%). 8,467 people represent the 18 and older group, which accounts for 73.54% of the total population for the townships located within HUC 050. The average median age represented is 37.9.

The male to female ratio for the state of Ohio is 48.60/ 51.40%. The largest age group represented is the 35 to 44 years groups (15.90% of the total population), followed by the 45 to 54 years group (13.80%), and the 25 to 34 years group (13.40%). The median age for the people who reside in Ohio is 36.2.

Educational Attainment~

Of the 7,662 people who are over the age of 25 in the townships within the HUC 050 subwatershed, the majority education level is high school graduate

(38.40%), followed by some college with no degree (26.36%), and Bachelor's degree received (10.99%).

Employment Status~

Approximately 6,153 people over the age of 16 in Leroy Township in Lake County, and Thompson, Montville, and Hambden Townships in Geauga County, are currently in the workforce. There are approximately 171 (1.95%) who are currently unemployed.

Household by type~

There are approximately 2,642 households in the Townships located within the HUC 050, of which 2,134 (80.77%) are family households. The average family size is 3.15 people.

Income (1999)~

The average median household income in 1999 for individual households in Leroy Township in Lake County, and Thompson, Montville, and Hambden Townships in Geauga County was $54,238. The majority of the households had an income of $50,000 to $74,999 (28.94%), followed by $$75,000 to $99,999 (16.99%), and $35,000 to $49,999 (15.73%).

The average median family income in 1999 for families in Leroy Township in Lake County, and Thompson, Montville, and Hambden Townships in Geauga County, was $60,473. The majority of families had an income of $50,000 to $74,999 (32.19%), followed by $75,000 to $99,999 (19.53%), and $35,000 to $49,999 (15.76%).

The average median earnings for a male, full time, year round worker were $43.143 and $26,439 for a female, full time, year round worker.

Below Poverty Level (1999)~

There are 328 individuals within the HUC 050 subwatershed, for whom poverty status was determined. Of those, approximately 56 families are represented, and 0 are families with a female householder with no male present.

Occupation~

The residents of Leroy Township in Lake County, and Thompson, Montville, and Hambden Townships in Geauga County represent the following occupations; 1,763 management professionals, 732 service occupations, 1,629 sales and office occupations, 58 farming, fishing, and forestry occupations, 784 construction, extraction and maintenance occupations, and 1,016 production, transportation, and material moving occupations.

Race~

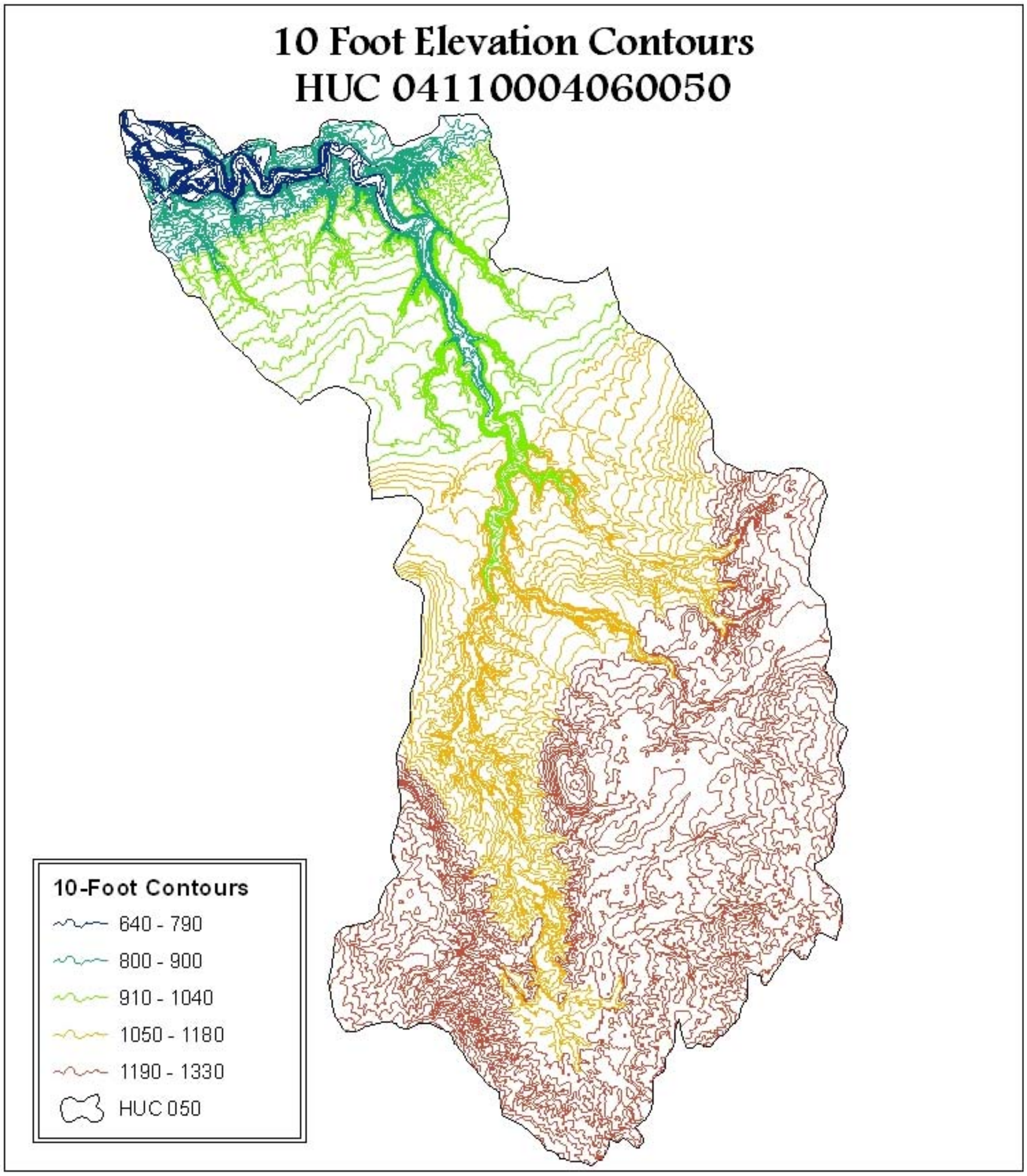
Approximately 78.72% of the population of the HUC 050 is white, 0.57% is African American, and 0.22% is Asian.

Other~

Within the HUC 050, approximately 0 residences are lacking complete plumbing facilities, 6 are lacking complete kitchen facilities, and 48 are without telephone service.

TOPOGRAPHY- The majority of HUC 050 is located within the West Tributary Project Area of the Grand River Watershed. This area is known for its high bluffs, the cold water streams that flow from the high elevations, and the gorge which leads to the Grand River. HUC 050 has drastic elevation changes at it approaches the river, which gives the Grand River its amazing gorge and shale bluffs. The highest point in HUC 050 is 1330 feet and the lowest is 640 feet.

Map 3.050- Contours of HUC 050



SOILS- There are five soil groups represented within HUC 050; the Darien – Mahoning – Sebring (approximately 5,772 acres), the Platea – Pierpont – Orrville (approximately 3,521 acres), Chili – Urban Land – Carlisle (approximately 318 acres), Rittman – Wadsworth – Orrville (approximately 31 acres), and Mahoning – Ellsworth – Urban Land (approximately 8,786 acres) groups.

Darien- Mahoning- Sebring: These soils are nearly level to sloping, somewhat poorly drained that formed in silty or loamy glacial till on till plains. Most areas are in natural shrubs and trees, but some areas are used for cultivated crops, pasture, and residential development. Wetness and slow or very slow permeability severely limit most uses. Water usually ponds in low areas after a rainfall. Erosion is a hazard in sloping areas that are used for cultivated crops.

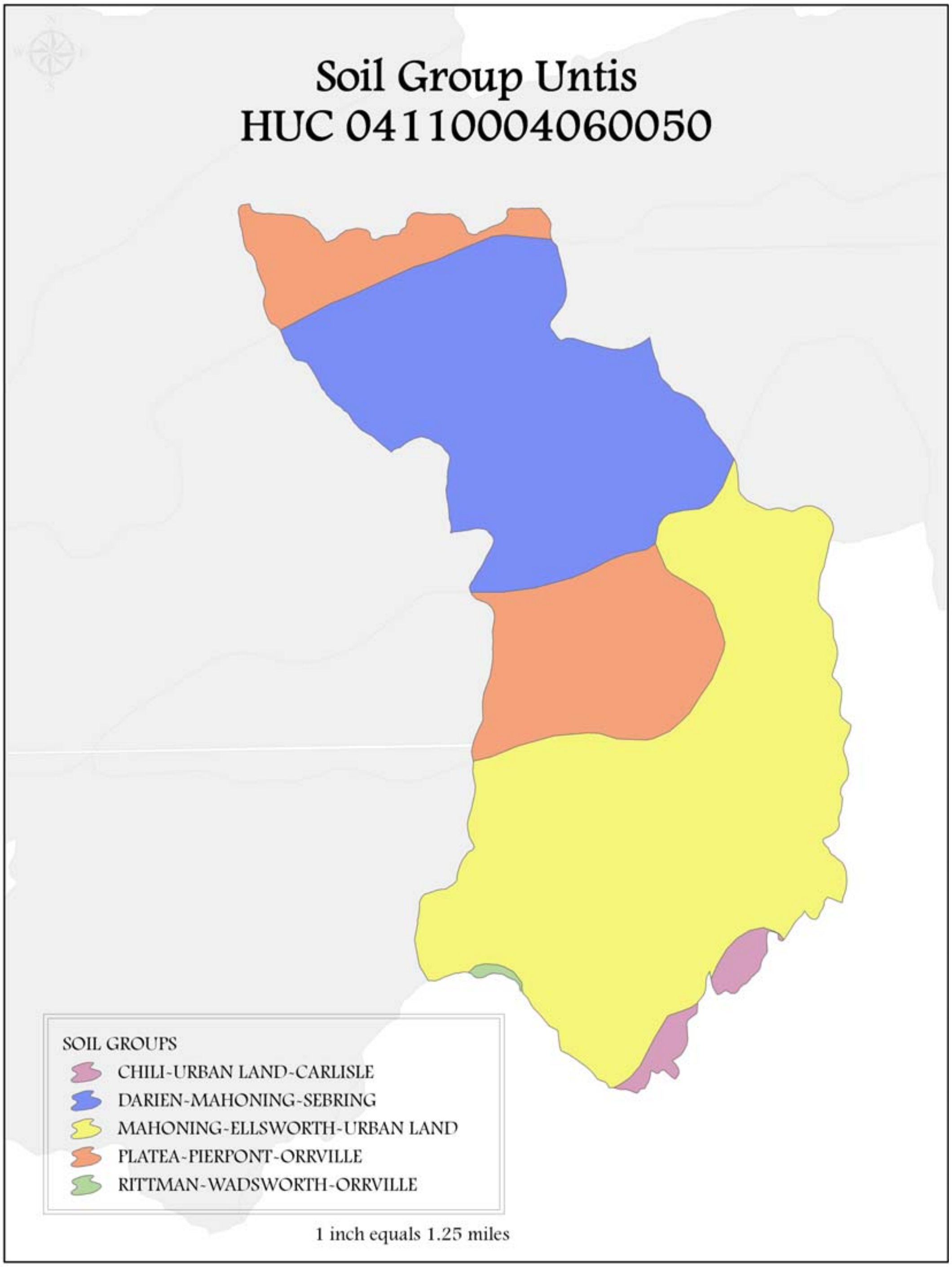
Platea- Pierpont- Orrville Group: This association is deep, nearly level to moderately steep, somewhat poorly drained to moderately well drained silty soils on glaciated uplands. This soil is found in undulating and hilly areas, but steep soils occur along rivers and streams including the Grand River. Grapes and small fruits are grown where the climate is suitable, particularly where air drainage is good. Very slow permeability, slope, and seasonal wetness are limitations for many nonfarm uses in this association.

Chili- Urban Land- Carlisle: These soils are nearly level to very steep, well drained soils that formed in medium, moderately coarse, and coarse textured glacial outwash. They are generally found in undulating, hummocky, and dissected areas on outwash plains and stream terraces. The Chili soils are well drained, medium textured, and nearly level to very steep. The soils in this association are used mainly as cropland; however the Carlisle soils are not. The Carlisle soils are in low areas in bogs and swales on terraces, uplands, and floodplains. They are poorly drained, and are ponded much of the year; thus making them best suited as habitat for wetland wildlife. The nearly level and gently sloping soils are well suited to use as cropland, pasture, and woodland and building site development. Erosion is a very serious hazard on the moderately steep to very steep slopes if vegetation is removed during construction. Cover should be maintained on the site as much as possible during construction to reduce the hazard of erosion.

Rittman- Wadsworth- Orrville: These soils are deep, nearly level to very steep, somewhat poorly drained and moderately well drained soils that formed in medium textured glacial till. These soils are located on flats, low knolls, hillsides, ridges, and side slopes along drainageways. Seasonal wetness, the slow or very slow permeability of the fragipan, and the erosion hazard are the major limitations on these soils. The nearly level to sloping soils are suited to cultivated crops, hay, and pasture. Ditches and subsurface drains are used to improve drainage. The soils in this drainage are better suited to houses without basements than to those with basements. Building sites should be landscaped to assist with surface drainage. Placing drains at the base or footings and coating the exterior walls of basements help prevent wetness. Local roads can be improved by providing artificial drainage and a suitable base material to reduce damage from frost action.

Mahoning- Ellsworth- Urban Land: These soils are nearly level to very steep, somewhat poorly drained and moderately well drained that formed in silty or loamy glacial till on till plains. This mapping unit is found on long, gently sloping and short, undulating side slopes and broad flats in dissected areas along drainageways. Use of this map unit is diverse and includes urban and residential development, cultivated crops, and natural shrubs and trees. Wetness and the erosion hazard limit these soils for cultivated crops. Wetness also limits residential and urban development.

Map 4.050- Soil Groups of HUC 050



A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. This lack of oxygen in the soil can lead to the formation of certain observable characteristics in hydric soils, such as a thick layer of organic matter (non-decomposed plant materials) in the upper part of the soil column. Other observable features include oxidized root channels and redoximorphic features (concentrations and depletions of Iron and other elements, i.e., mottling, gleying). The following National Soil Information System (NASIS) criteria reflect those soils that may meet the definition of hydric soils.

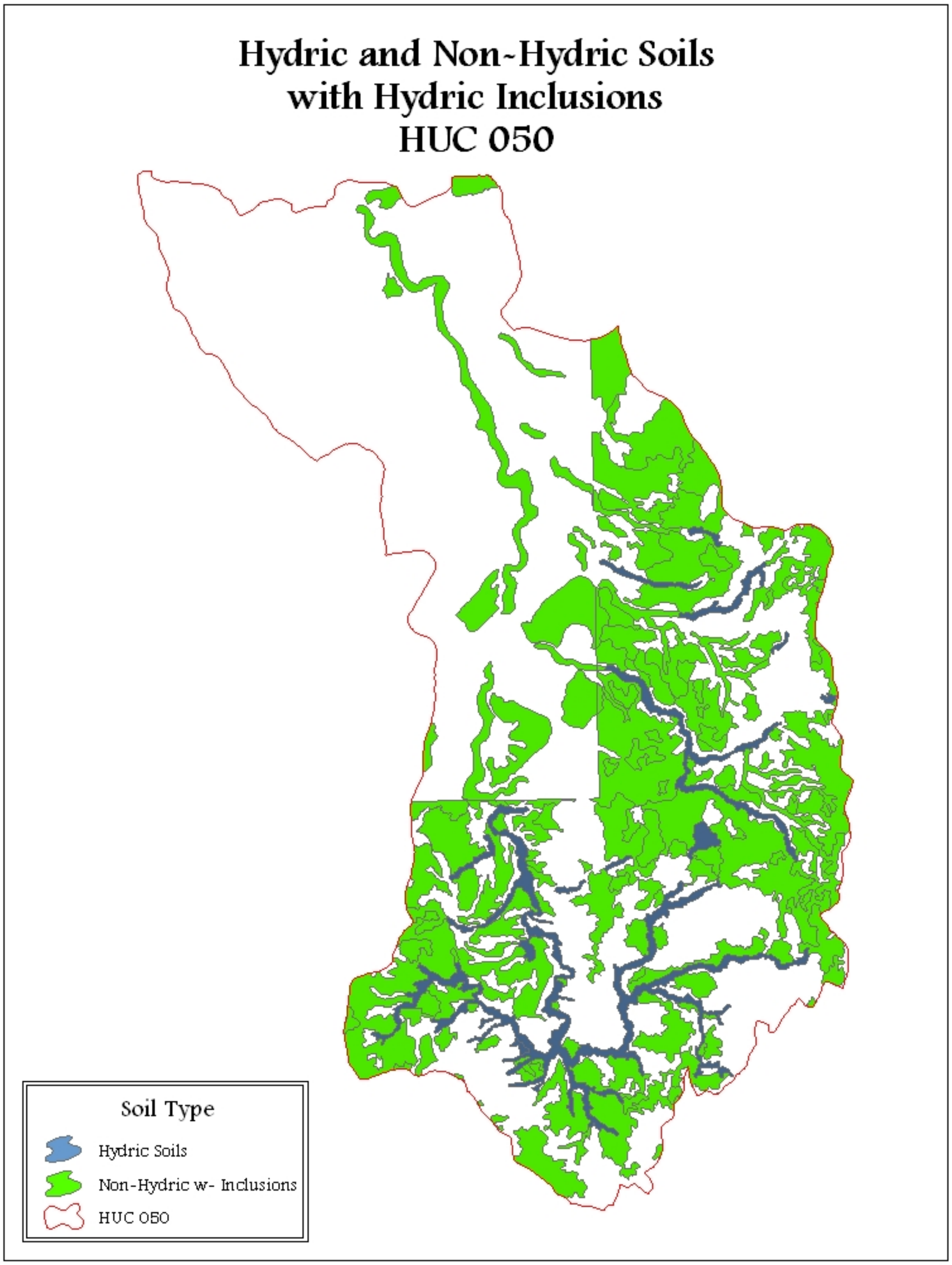
- All Histels except Folistels and Histosols except Folists, or
- Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:
- Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or
- poorly drained or very poorly drained and have either:
    - water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils
    - water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or
    - water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or

- Soils that are frequently ponded for long duration or very long duration during the growing season, or
- Soils that are frequently flooded for long duration or very long duration during the growing season.

In HUC 050, there are approximately 853 acres of hydric soils.

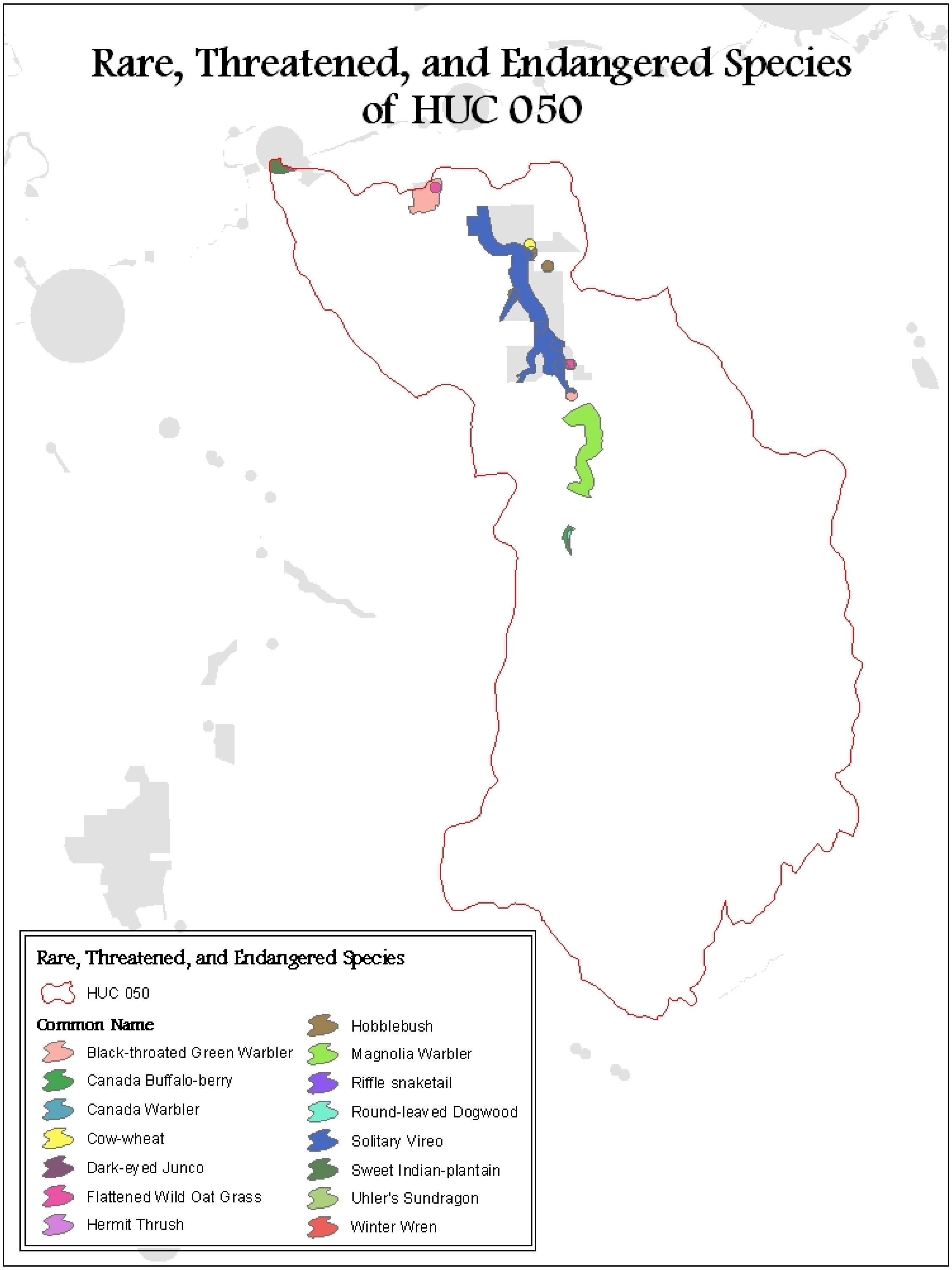
Non hydric soils can be of major importance to water quality as well. Many non-hydric soil types contain small areas of hydric soils, or hydric inclusions. These soils are generally not associated with having the properties of hydric soils, but the do have small pockets, which are too small to have been mapped by the soils surveys, to be considered hydric. Soil Survey books generally do not map "inclusions" of different soil types if the map units are less than 2 acres in size. These inclusions can be wetland soils within an upland soil series. Sometimes, the description will include the types of soils that are the most common inclusions in the series. HUC 050 contains roughly 6,549 acres of non hydric soils with hydric inclusions.

Map 5.050- Hydric and Non-Hydric Soils of HUC 050



RARE, THREATENED, and ENDANGERED SPECIES- The Grand River Watershed provides the perfect habitat for many rare, threatened, and endangered species. In fact, the Ohio Department of Natural Resources, Division of Wildlife recognized the unparalleled biodiversity and habitats of the Grand River Watershed, and chose this watershed to reintroduce the wild turkey, river otter, and snowshoe hare. The following species are found within HUC 050 in the Grand River Watershed; black-throated green warbler, Canada buffalo-berry, Canada warbler, cow-wheat, dark-eyed junco, flattened wild oat grass, hermit thrush, magnolia warbler, riffle snaketail, round-leaved dogwood, solitary vireo, sweet-Indian plantain, Uhler's sundragon, winter wren, mussel beds, beech-sugar maple forest, and hemlock-hardwood forest.

Map 6.050- Rare Species HUC 050



DAMS- There are 18 dams located with in the Lower Grand River Watershed. In HUC 050 there are three dams; the *Kitteredge Arboretum Lake Dam*, the *Cavotta Lake Dam*, and the *Girl Scouts Lake Dam*.

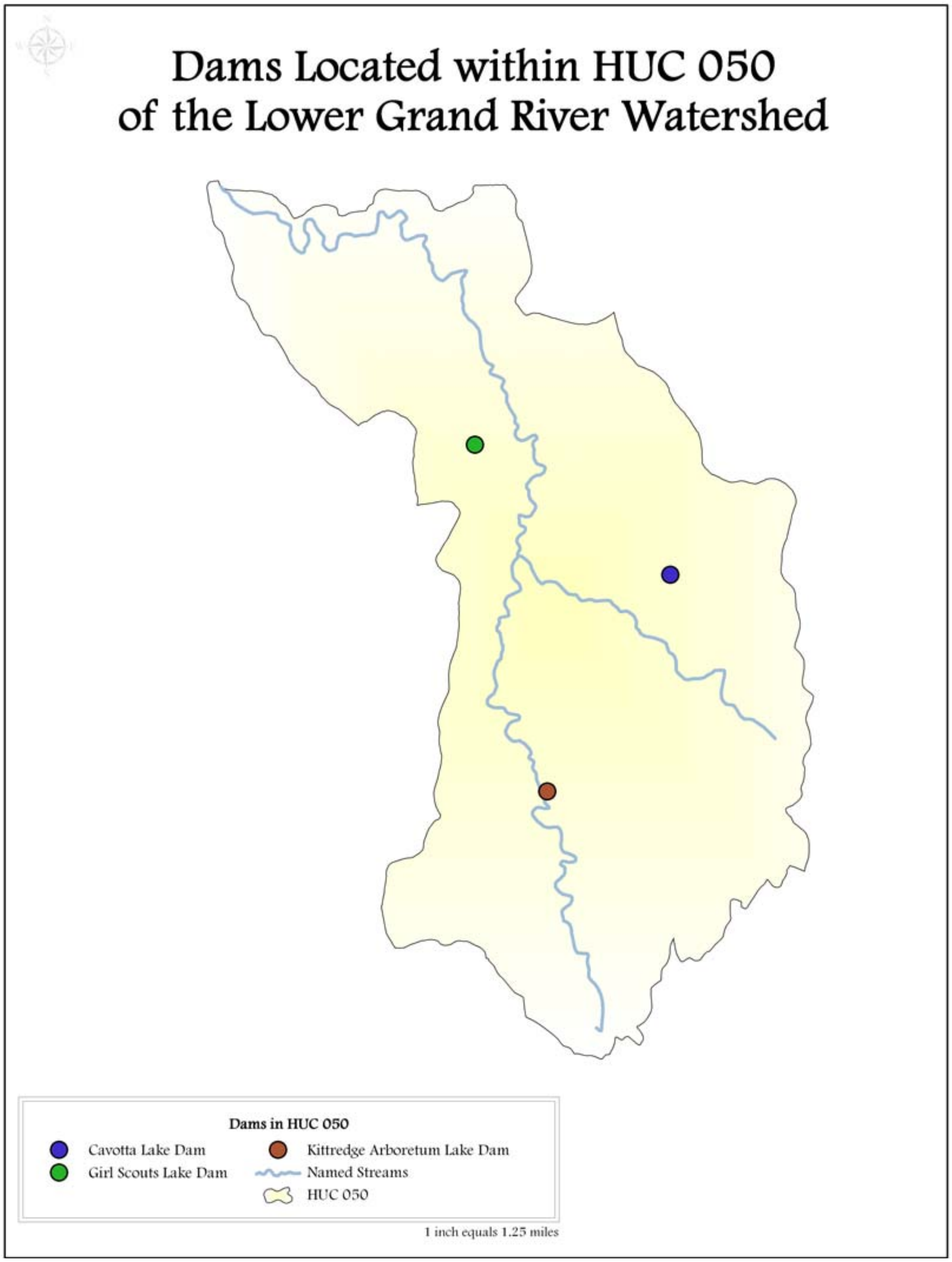
- The *Kitteredge Arboretum Lake Dam*, NID OH00366, is located in Hambden Township, Geauga County. This is a privately owned, earthen dam, located on an unnamed tributary to Bates Creek. The purpose for this dam is strictly recreational, and is 5 acres in size. The drainage area of this dam is 0.46 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Kitteredge Arboretum Lake Dam* is significant; meaning that no loss of human life is probable, but economic and/or environmental losses, disruption of lifeline facilities, and other impacts would be expected.

- The *Cavotta Lake Dam*, NID OH001612, is located in Thompson Township, Geauga County. This is a privately owned, earthen dam, located on an unnamed tributary to Pane Creek. The purpose for this dam is strictly recreational, and is 5.6 acres in size. The drainage area of this dam is 0.98 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Cavotta Lake Dam* is low, meaning that no loss of human life is probable and economic and/or environmental losses, disruption of lifeline facilities, and other impacts would not be expected.

- The *Girl Scouts Lake Dam*, NID OH00348, is located in Leroy Township, Lake County. This is a privately owned, earthen dam, located on an unnamed tributary to Pane Creek. The purpose for this dam is strictly recreational, and is 5.2 acres in size. The drainage area of this dam is 0.29

square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Girl Scouts Lake Dam* is low, meaning that no loss of human life is probable and economic and/or environmental losses, disruption of lifeline facilities, and other impacts would not be expected.

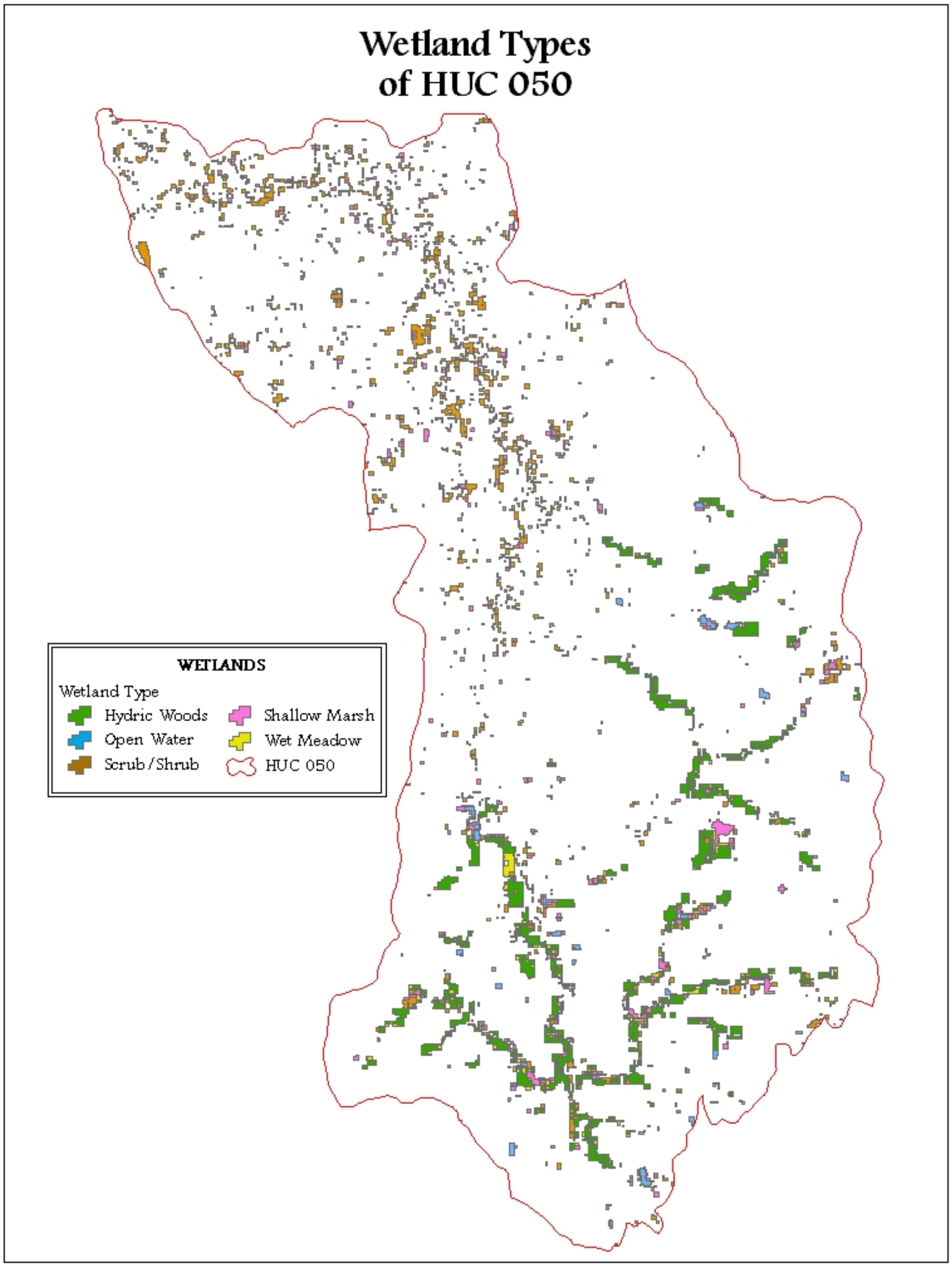
Map 7.050- Dams of HUC 050



WETLANDS- Wetlands are typically highly productive habitats, often hosting considerable biodiversity. The Army Corps of Engineers and the Environmental Protection Agency define wetlands as; “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions”. Wetlands are found under a wide range of hydrological conditions, but at least some of the time water saturates the soil. The result is a hydric soil, one characterized by an absence of free oxygen some or all of the time, and therefore called a "reducing environment." Plants called hydrophytes specifically adapted to the reducing conditions presented by such soils can survive in wetlands, whereas species intolerant of the absence of soil oxygen (called "upland" plants) can not survive. Adaptations to low soil oxygen characterize many wetland species.

HUC 050 has approximately 1363 acres of wetlands; 522 acres of Hydric Woods, 45 acres of open water wetlands, 518 acres of scrub/shrub, 205 acres of shallow marsh, and 73 acres of wet meadow.

Map 8.050- Wetlands of HUC 050



DRASTIC- The DRASTIC maps, produced by the Ohio Department of Natural Resources, show the pollution potential for groundwater systems. The DRASTIC mapping system allows the pollution potential of any area to be evaluated systematically using the following existing information about an area:

D= Depth to Water

R= Net Recharge

A= Aquifer Media

S= Soil Media

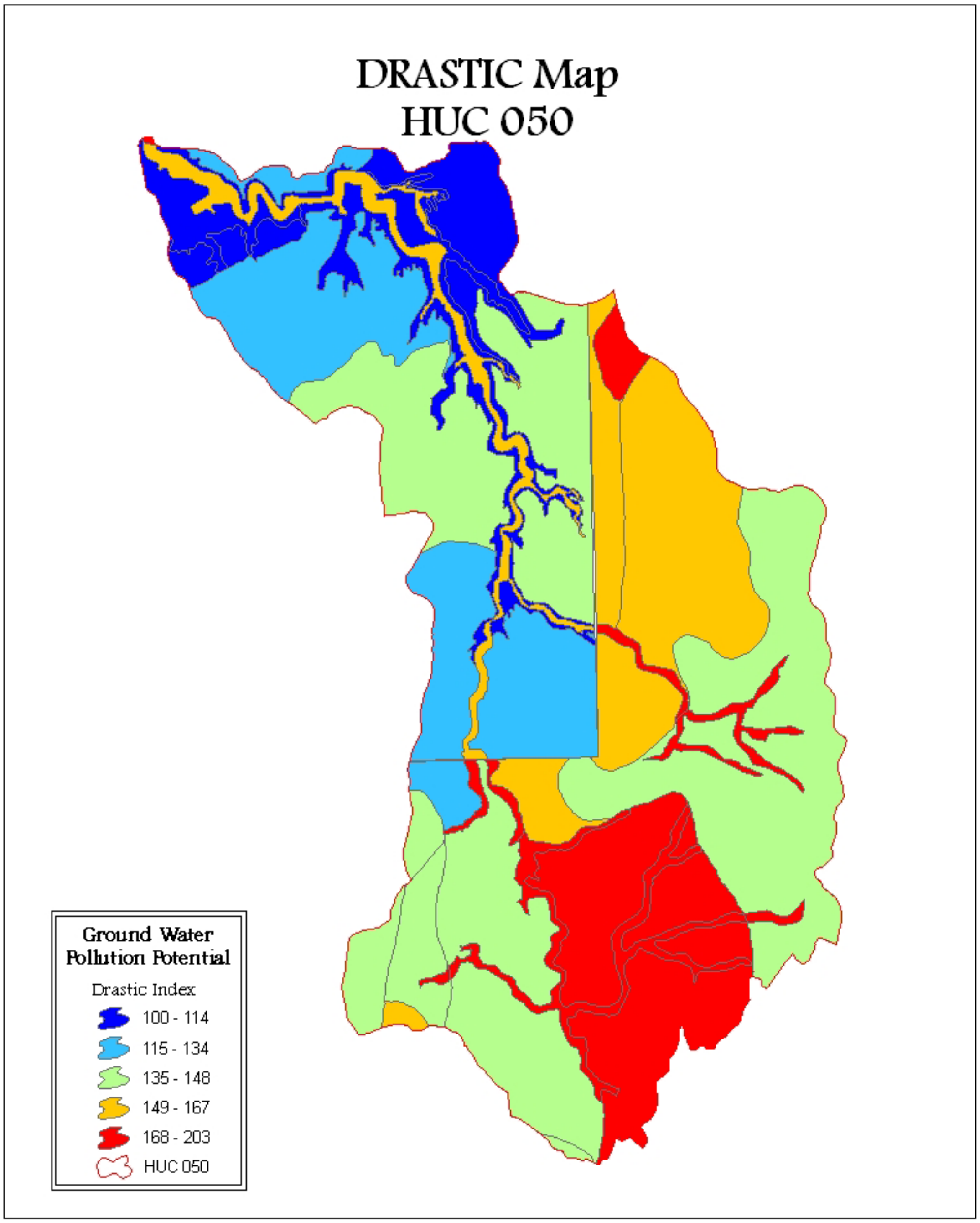
T= Topography

I= Impact of the Vadose Zone Media

C= Hydraulic Conductivity of the Aquifer

In evaluating an area's vulnerability to contamination, the DRASTIC mapping system assumes a contaminant with the mobility of water is introduced at the surface and flushed into the groundwater by precipitation. A pollution potential map can assist in developing ground water protection strategies. By identifying areas more vulnerable to contamination, officials can direct resources to areas where special attention or protection efforts might be warranted. This information can be utilized effectively at the local level for integration into land use decisions and as an educational tool to promote public awareness of ground water resources. Pollution potential maps may be used to prioritize ground water monitoring and/or contamination clean-up efforts. Areas that are identified as being vulnerable to contamination may benefit from increased ground water monitoring for pollutants or from additional efforts to clean up an aquifer. HUC 050 has a maximum DRASTIC index of 203. Approximately 16.39% of HUC 050 has a high DRASTIC index.

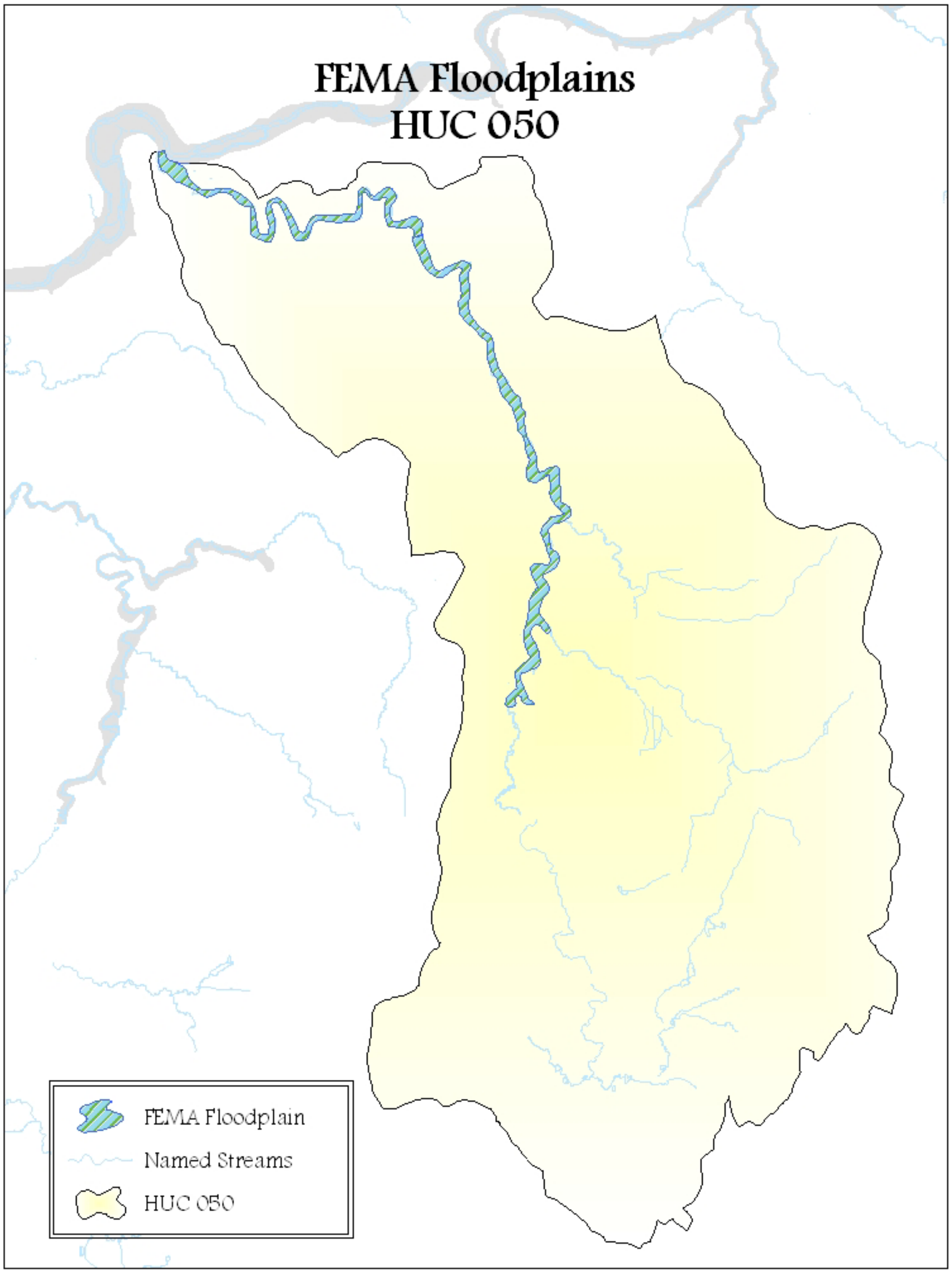
Map 9.050- DRASTIC of HUC 050



FLOODPLAINS- Floodplains are the low, flat, periodically flooded lands adjacent to rivers, lakes and oceans and subject to geomorphic (land-shaping) and hydrologic (water flow) processes. FEMA, the Federal Emergency Management Agency, has developed areas within watersheds that are designated as 100-year and 500- year floodplains. A "100-year flood" is defined as a flood event that has a 1 in 100 chance of occurring in any given year, and a 500-year flood has a 1 in 500 chance. HUC 050 has 364 acres of designated 100-year floodplain, which represents approximately 2.0% of the watershed.

Current both Lake and Geauga Counties have an ordinance in place which protects the riparian areas and floodplains of the Grand River and its named tributaries.

Map 10.050- Floodplains of HUC 050



LAND USE~ HUC 050 is a very rural subwatershed. Much of this watershed is in natural cover, with little to no urban areas. However, suburbanization is a threat to this area of the Grand River Watershed. Here, land is plentiful and still remains at a relatively low cost. Population density is extremely low (6.4), but is inspected to increase due to suburbanization.

Chart 1.050~ Existing Landuse

Paine Creek Existing Landuse		
Landuse Type	**Hectares**	**% of Total**
Comm/Indust/Transport	22	.3
Cropland	931	12
Forest	4770	64
High Density Residential	.09	.001
Low Density Residential	8	0
Pasture	1260	17
Transitional	0	0
Water	461	6
Total	7453	100

Chart 2.050- Existing Landuse

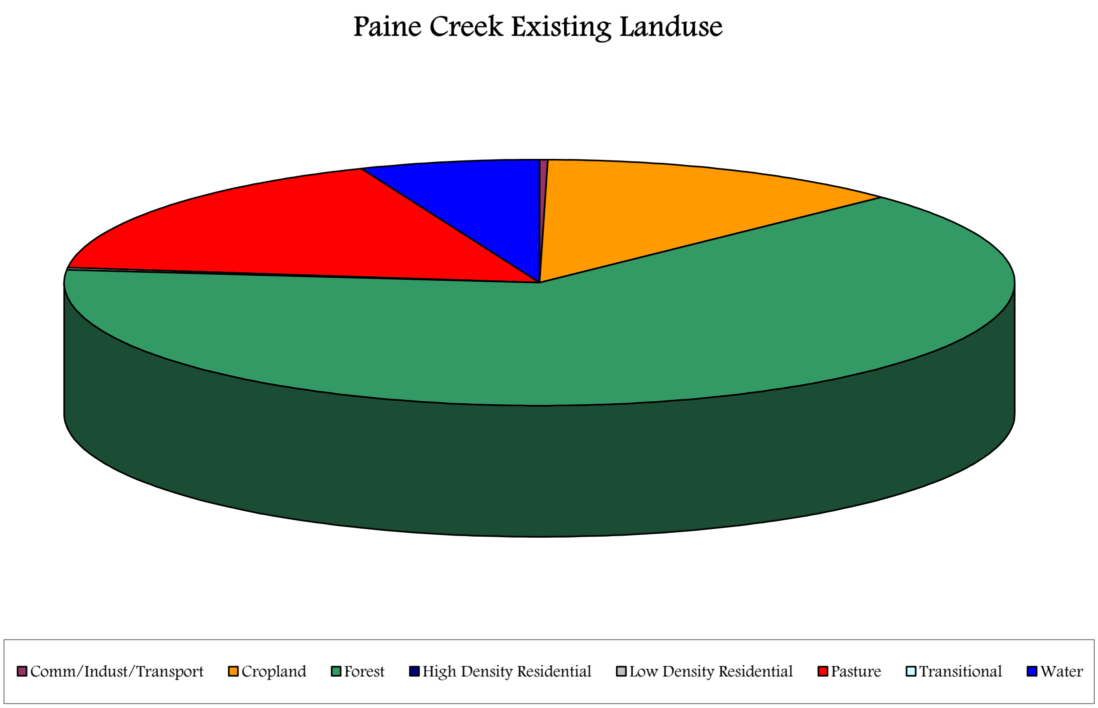
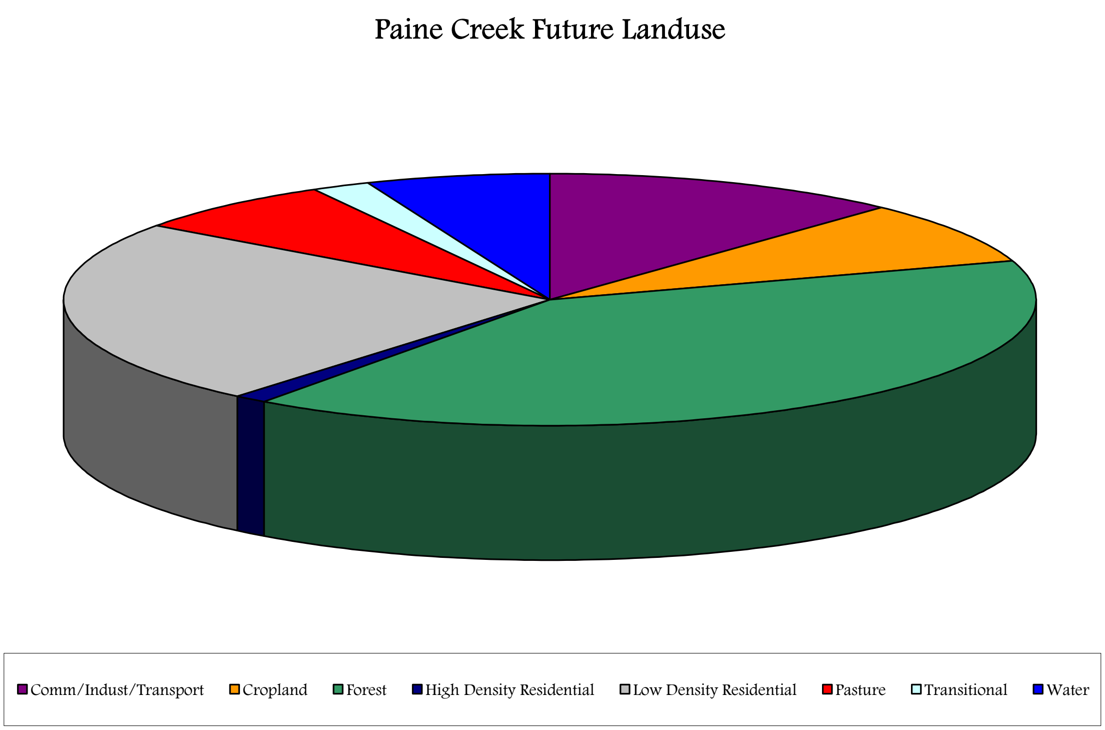


Chart 3.050- Future Landuse

Paine Creek Future Landuse		
Landuse Type	Hectares	% of Total
Comm/Indust/Transport	894	12
Cropland	596	8
Forest	2981	40
High Density Residential	75	1
Low Density Residential	1789	24

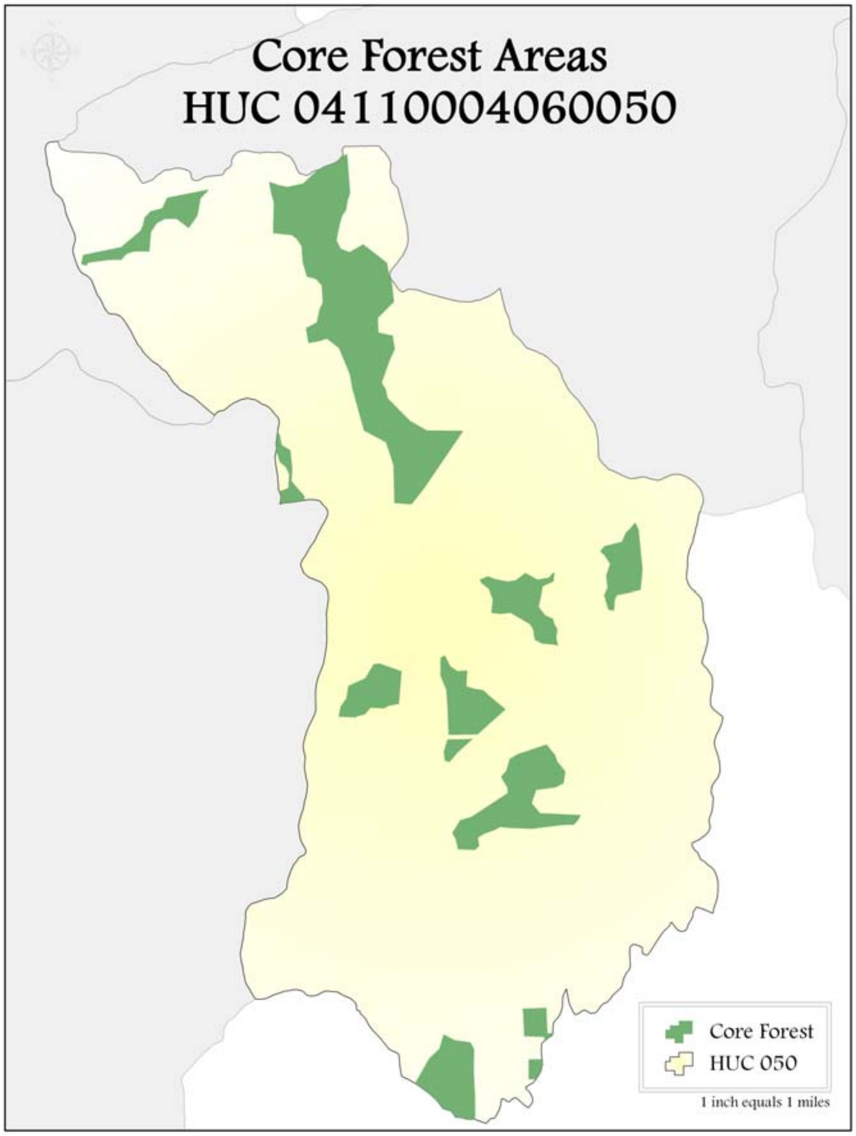
Pasture	522	7
Transitional	149	2
Water	447	6
Total	7453	100

Chart 4.050- Future Landuse



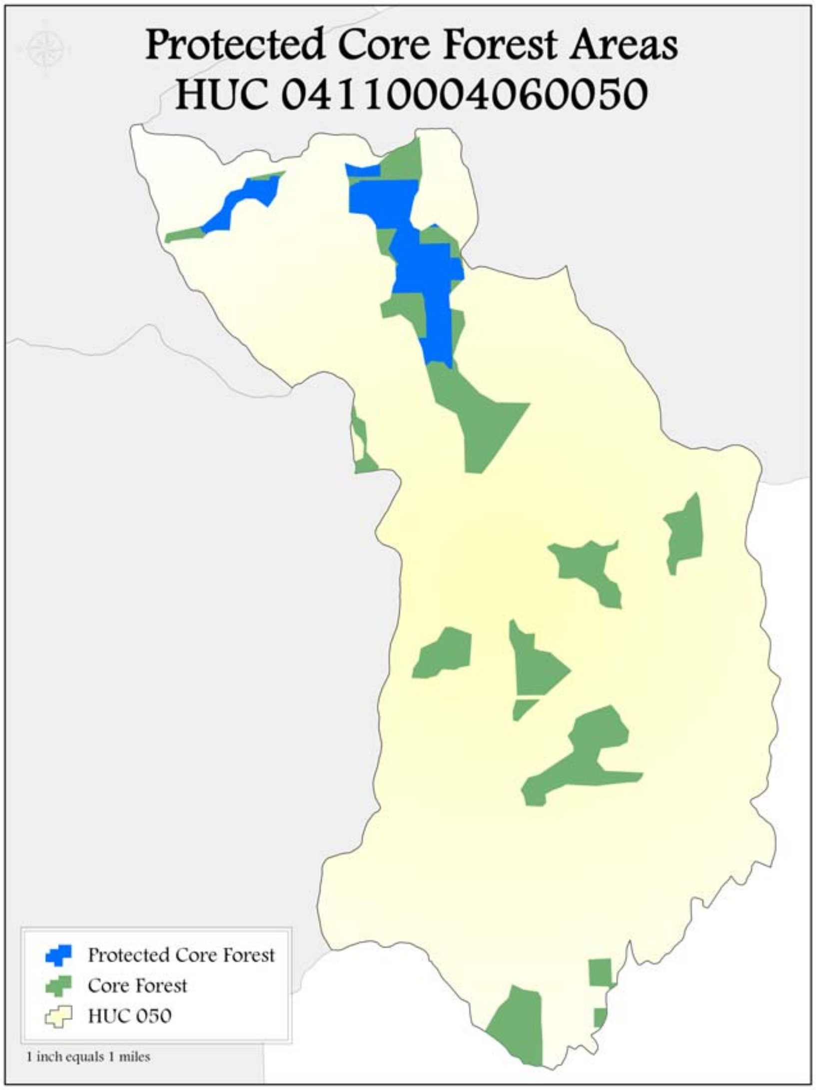
Since the majority of the watershed remaining is still in natural cover, there are many large tracts of undisturbed forest blocks. The Nature Conservancy realized the importance of these large tracts of forest, or "Core Forest Areas", for not only their natural resources value but their importance for breeding populations as well. Core Forest Areas are forested areas of 100 acres or more with a forested buffer zone from pastures and agriculture, and no roads within at least 300 meters. These numbers were determined by the habits and lifecycles of certain forest species; a pair of pileated woodpeckers will need at least 100 acres in order to breed, certain amphibian populations use forest areas up to 200 meters away from their wetland habitat for breeding purposes, and cowbirds will penetrate up to 150 meters of the core forest areas. HUC 050 contains twelve Core Forest Areas, which total 2274.16 acres, or roughly 12.35% of the HUC 050 watershed.

Map 11.050- Core Forest of HUC 050



These Core Forest Areas are very important habitats that need to be preserved. There are currently 594.35 acres of the 2274.16 acres of Core Forest in permanent protection, or approximately 26.13%.

Map 12.050- Protected Core Forest of HUC 050



GRPI~ LAND PROTECTION PRIORITY LIST~ Grand River Partners, Inc.'s goal is to protect the natural resources of the Grand River and its watershed. Grand River Partners, Inc. utilizes the conservation easement as the primary tool to protect such resources. Conservation easements are a great tool to protect resources on private lands but still maintain them in private hands. The Grand River watershed is approximately 712 square miles. Obviously Grand River Partners, Inc. cannot protect all of the 712 square miles (455,000 acres) with conservation easements. Grand River Partners, Inc. believes that water quality can be protected by conserving the "right" 25% of a watershed. In the specific case of the Grand River, this represents roughly 114,000 acres. Protecting 114,000 acres is an achievable goal considering the number of partner organizations and the fact that approximately 25% of the 114,000 acres has already been protected.

The challenge remains to protect the remaining 86,000 acres of the "right" land. To fulfill this goal, Grand River Partners, Inc. developed a parcel based **Land Protection Priority List**. Before any prioritization process could begin, any parcel less then five acres was removed from the potential list of priorities. To make fair comparisons an analysis of the watershed was conducted to determine the unique areas within the watershed. From this analysis, the Grand River Watershed was divided into 5 distinct project areas based on the unique natural features of each. The parcel prioritization process involved a two tier analysis. The first, Tier 1, involved an analysis of natural resources. The second, Tier 2, involved a strategic analysis that took into account parcel size, proximity to other protected land, and partner priorities.

The Headwaters Project Area consists of the area drained by all the unnamed tributaries that together form the Grand River. The area begins more or less upstream of the crossing with SR 534 at the southern end of the watershed. In summary, important

natural resources ranked for each parcel located in the Headwaters Project Area are intact riparian areas, the Grand River main stem, wetlands, unnamed tributaries, floodplains, core forest blocks and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Lowlands Project Area begins at the crossing of SR 534 with the mainstem in the southern portion of the watershed and extends between the 810' contour interval north to the crossing where the Grand River intersects Windsor-Mechanicsville Road. Important Natural Resources identified in the Lowlands Project Area are swamp forests, wetlands, intact riparian areas, core forest blocks, mainstem, rare species, floodplains, TNC subwatershed ranking, and named tributaries. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Gorge Project Area begins at the crossing of the mainstem and Windsor-Mechanicsville Road bridge and extends upstream to the crossing with SR 84. The Gorge Project Area is bordered to the north by the watershed boundary and to the south by the 950' contour interval. The important natural characters of the Gorge are the mainstem, wetlands, floodplains, intact riparian areas, named tributaries, core forest blocks, steep slopes, TNC subwatershed rankings, and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Estuarine/Urban Project Area begins at the State Route 84 crossing with the Grand River and ends in Fairport Harbor Village and Grand River Village at its terminus with Lake Erie. The Estuarine/Urban Project Area includes the subwatershed of Red Creek which extends to the west just north of the City of Painesville. In this project area the

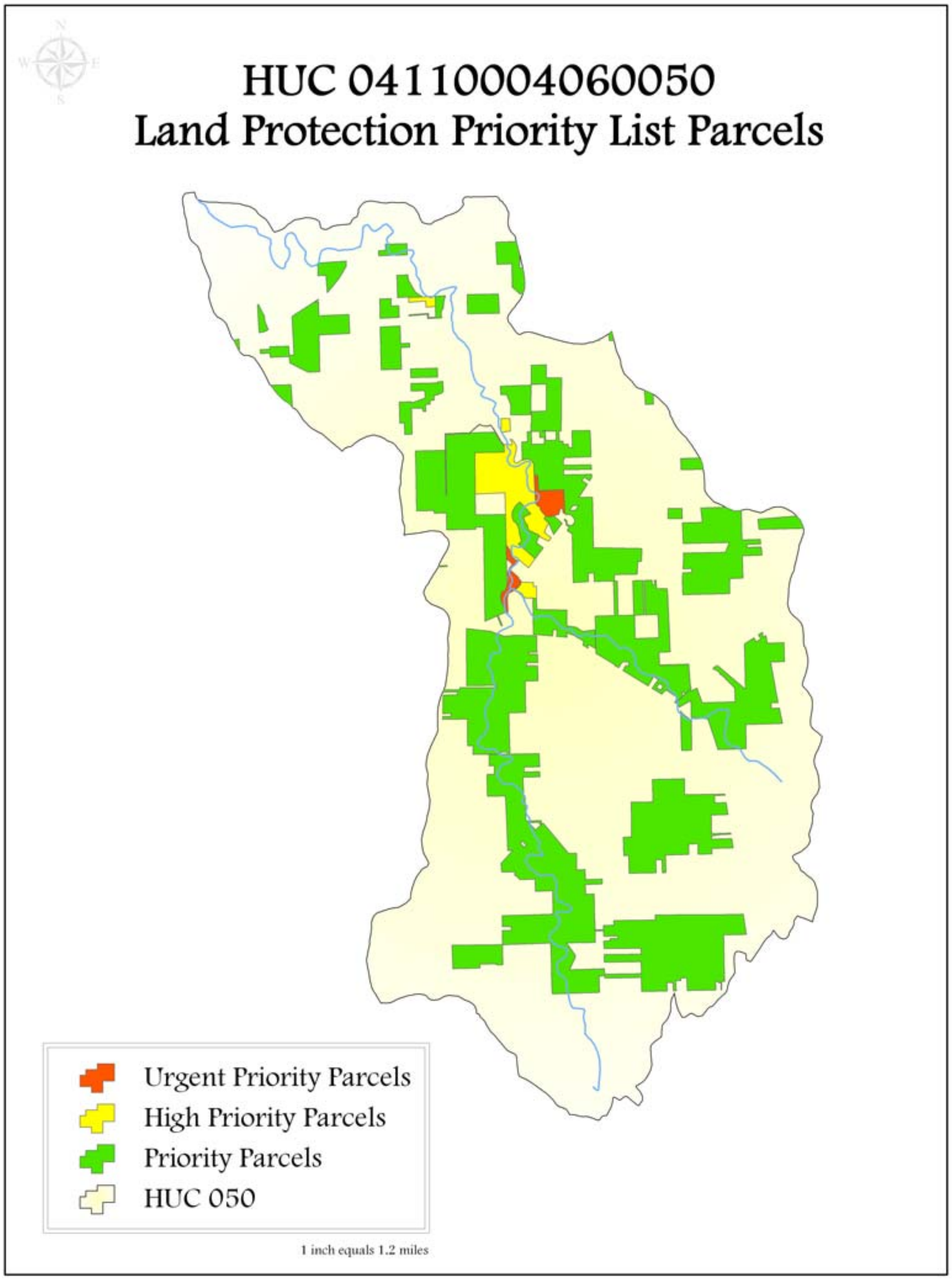
mainstem, river access points, wetlands, intact riparian areas, floodplains and named tributaries were considered important natural features. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The last area is the Tributaries Project Area which consists of two areas; one is located east of the Grand River Lowlands Project Area, which and includes the subwatersheds of such named tributaries as Mill Creek, Rock Creek and Coffee Creek, and the second project area is located west of the Lowlands Project Area, north of the Headwaters Project Area and south of the Gorge Project Area. This portion of the Tributaries Project Area contains the subwatersheds of such high quality streams as Indian Creek, Phelps Creek, Hoskins Creek, and Paine Creek. Important natural resources considered include, cold water habitat, wetlands, floodplains, core forest blocks, and rare species. Again each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

Each parcel within the watershed was further evaluated based on additional strategic rankings. These rankings include parcel size, proximity to protected land and partner priorities. Each parcel meeting the acreage requirement, or within a certain distance of existing protected land or included as a priority by a partner organization or agency was weighted more heavily and therefore considered a high priority. A statistical analysis of the final scores was performed and each parcel was categorized as being priority, high priority or an urgent priority parcel.

In HUC 050, there are a total of 4626.13 acres of priority parcels, 285.38 acres of high priority parcels, and 69.45 acres of urgent priority parcels for protection. Currently there are 1,841.83 acres of permanently protected land within HUC 050.

Map 13.050- LPPL of HUC 050



IMPERVIOUS SURFACE~ The Conversion of farmland, forests, wetlands, and meadows to rooftops, roads, and lawns creates a layer of impervious surface in the urban landscape. Impervious cover is a very useful indicator with which to measure impacts of land development on aquatic systems. The process of urbanization has a profound influence on the hydrology, morphology, water quality, and ecology of surface waters. Recent research has shown that streams in urban watersheds possess a fundamentally different character than streams in forested, rural, or even agricultural watersheds. The amount of impervious cover in the watershed can be used as an indicator to predict how severe these differences can be. In many regions of the country, as little as ten percent watershed impervious cover has been linked to stream degradation, with the degradation becoming more severe as impervious cover increases.

Impervious cover directly influences urban streams by dramatically increasing surface runoff during storm events. Depending on the degree of impervious cover, the annual volume of stormwater runoff can increase by two to 16 times its predevelopment rate, with proportional reductions in groundwater recharge. In natural settings, very little annual rainfall is converted to runoff and about half is infiltrated into the underlying soils and the water table. This water is filtered by the soils, supplies deep water aquifers, and helps support adjacent surface waters with clean water during dry periods. In urbanized areas, less and less annual rainfall is infiltrated and more and more volume is converted to runoff. Not only is this runoff volume greater, it also occurs more frequently and at higher magnitudes. As a result, less water is available to streams and waterways during dry periods and more flow occurs during storms.

The relationship between impervious cover and subwatershed quality can be predicted by a simple model that projects the current and future quality of streams and other water resources at the subwatershed level. Stream research generally indicates that

certain zones of stream quality exist, most notably at about 10% impervious cover, where sensitive stream elements are lost from the system. A second threshold appears at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition; diminished aquatic diversity, water quality, and habitat scores.

The model classifies streams into one of three categories; sensitive, impacted, and non-supporting. Each stream category can be expected to have unique characteristics as follows:

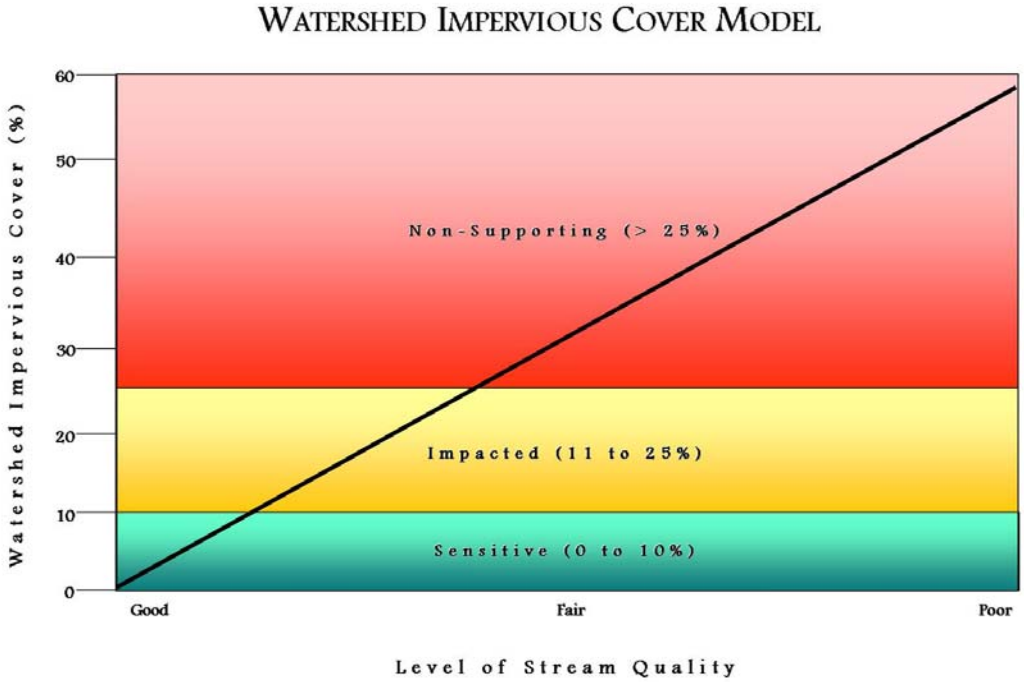
Sensitive Streams: These streams typically have a watershed impervious cover of zero to 10 percent. Consequently, sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Impacted Streams: Streams in this category possess a watershed impervious cover ranging from 11 to 25%, and show clear signs of degradation due to watershed urbanization. Greater storm flows begin to alter the stream geometry. Both erosion and channel widening are clearly evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to

fair levels, with the most sensitive fish and aquatic insects disappearing from the stream.

Non- Supporting Streams: Once watershed impervious cover exceeds 25%, stream quality crosses a second threshold. Streams in this category essentially become a conduit for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, down-cutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated, and the stream substrate can no longer provide habitat for insects or spawning areas for fish. Water quality is consistently rated as fair to poor, and water contact recreation is no longer possible due to the presence of high bacterial levels. Subwatersheds in the non-supporting category will generally display increases in nutrient loads to downstream receiving waters, eve if effective urban BMPs are installed and maintained. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish.

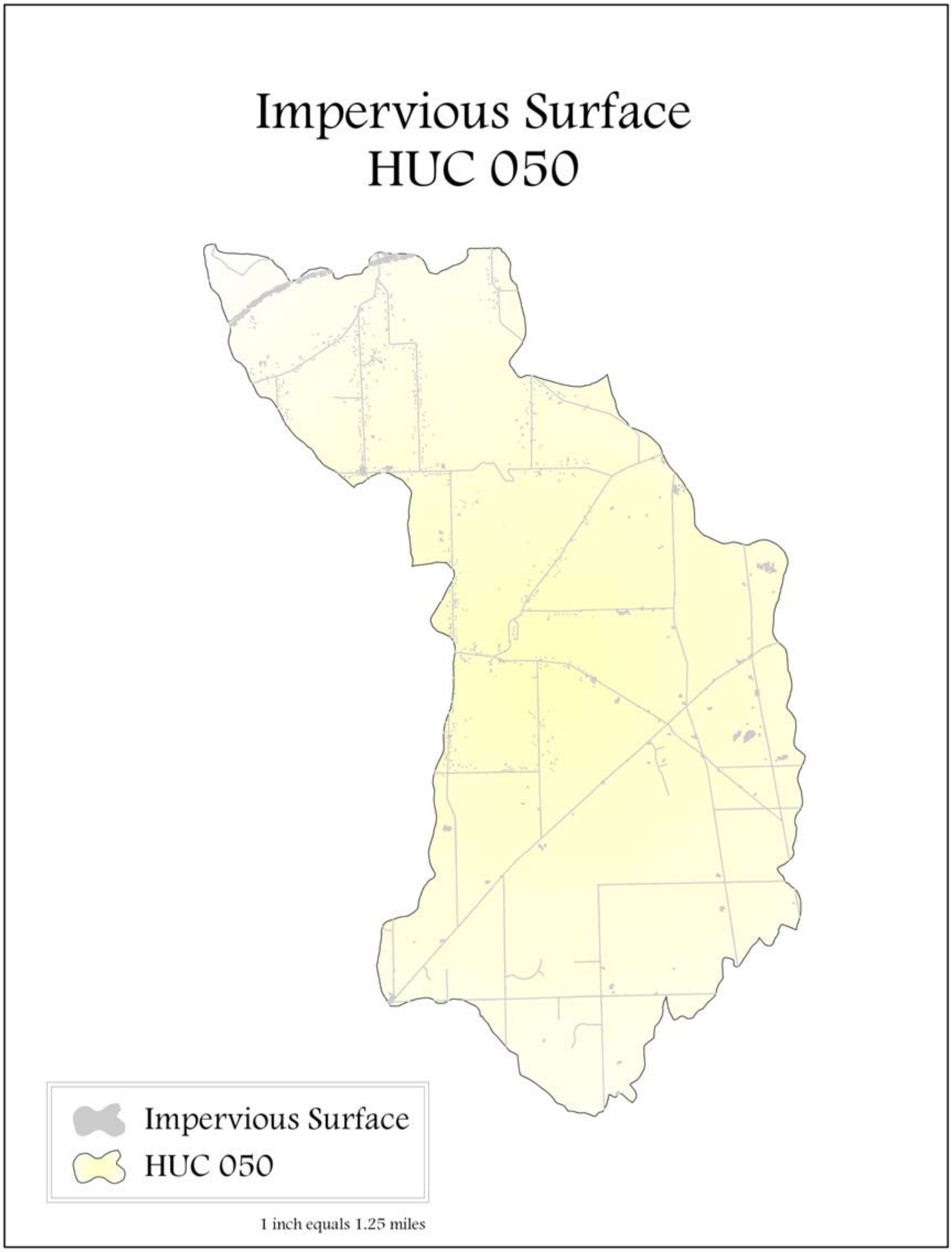
Graph 1.050- Impervious Cover Model



Center for Watershed Protection, Rapid Watershed Planning Handbook

HUC 050 has an impervious cover of approximately 2.02%. Therefore, the streams in this subwatershed are considered "sensitive streams" by the impervious surface model. Sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Map 14.050- Impervious Surface of HUC 050



USE ATTAINMENT STATUS- *Ohio Water Quality Standards: Designated Aquatic Life Use*

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*

2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*

3) *Cold-water Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie

tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 mi.2 drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

Paine Creek- Paine Creek downstream from Paine Falls is designated EWH and it is meeting that use. Upstream from Paine Falls, the default WWH designation was confirmed. Paine Creek has very limited summer base flows, and is therefore especially vulnerable to anthropogenic disturbance. Fortunately, the subwatershed is relatively undeveloped, and the lower six miles of the mainstem are protected as parkland. The tributaries originating from the east, off Thompson Ledges, are important to maintaining base flow to Paine Creek (and, axiomatically, to the Grand River), and should obviously be targeted for protection (easements, conservation ownership, etc.).

Unnamed Tributary to Paine Creek and Phelps Creek- Both of these streams originate off the Thompson Ledges formation, and are high quality coldwater streams, and are recommended for a dual EWH/CWH aquatic life use based on the macroinvertebrate communities found in each. All of the small streams and primary headwaters draining from Thompson Ledges should be targeted for protection.

Bates Creek- Bates Creek forms the headwaters of Paine Creek, has limited summer flow, and drains wet forests and wetlands. Its default aquatic life use designation of WWH was confirmed by this survey. The fish community rated fair due to the natural limitations inherent in streams draining wetlands. Follow-up monitoring to confirm wetlands as limiting the fish community in Bates Creek is warranted.

Grand River- Aquatic life in the Grand River is fully attaining standards for Exceptional Warmwater Habitat (EWH) from Sweitzer Road (RM 42.2) to the SR 2 bridge in Painesville (RM 5.2), and is fully meeting standards for Warmwater Habitat (WWH) downstream from the SR 2 bridge. The Seasonal Salmonid use designation currently in place should be retained.

The Grand River is an economic asset to Northeast Ohio, but is especially sensitive to pollution and disturbance because of limited summer base flows. Therefore, regional planning, stream protection policies, comprehensive construction site management plans, construction site performance bonds, identification and preservation of sensitive areas, and above all, defined limits to growth are needed to maintain the biological integrity of the Grand River.

The Grand River is the only Ohio tributary to Lake Erie that harbors a self-sustaining population of Great Lakes Muskellunge, and therefore is a priority for conservation. The Grand River is also has a native population of walleye and northern pike making it singularly unique among Ohio streams. The Grand River and its tributaries provide habitat for many species considered rare by Ohio EPA, or listed as threatened or endangered by the Ohio Department of Natural Resources including 32 macroinvertebrates and freshwater mussel species, and 11 fish species. The single greatest threat to the Grand River basin is suburbanization.

BIOLOGICAL INDICATORS- Fish communities in the Grand River have an exceptionally high degree of biological integrity. This is obvious in the consistently high IBI scores along the length of the mainstem and between sampling years, and is also evident in the unusually high percent composition of pollution intolerant species making up electrofishing samples (Figure 40). Furthermore, the Grand River is one of the few rivers in Ohio that has a full suite of endemic, naturally reproducing and self-sustaining top carnivores including walleye, northern pike and muskellunge. The later is the Great Lakes subspecies (*Esox masquinongy masquinongy*), and so represents a vitally important area for genetic and habitat conservation. Given the propensity for muskellunge to differentiate into unique strains, the population in the Grand River may well be a truly endemic strain. As it stands, it is the last naturally reproducing muskellunge population found in any of Ohio's Lake Erie tributaries.

Because the stream habitat in Paine Creek and its tributaries is largely dominated by bedrock and heavily influenced alternately by torrential flows from snow-melt and very low summer flows, fish communities are naturally limited such that they are hard pressed to meet the biocriteria expectations derived for till-plains-type streams. Despite the natural limitations to the fish community, Paine Creek is highly aesthetic and supports populations of bigeye chub and river chub, both pollution intolerant species with declining state-wide distributions. Bigeye chub are particularly susceptible to smothering silts; fortunately, like Big Creek, Paine Creek's floodplain and valley slopes have largely been preserved through conservation easements and parkland. The unique ecological aspects of the Paine Creek watershed is also evident from data collected by the Lake County Soil and Water Conservation Service and Ohio EPA-NEDO showing that a number of small, direct tributaries to Paine Creek are Class III primary headwaters.

Bates Creek at Radcliffe Road contains nearly silt-free, well-structured physical habitat (QHEI = 83.5), and is naturally limited by wetlands and low stream flow. The effect of low stream flow is apparent in the metric scores for the number of headwater, sensitive and darter/sculpin species as each departed significantly from that expected for the given stream size. New home construction and shifting landuses are ruled-out as a possible cause of impairment given that the population density in census blocks straddling the Bates Creek subwatershed has remained fairly stable between the 1990 and 2000 censuses, increasing roughly 23% from approximately 90 people per square mile, to 112 people per square mile. By contrast, population densities in the Kellogg Creek subwatershed average approximately1500 people per square mile (Kellogg Creek can support a higher density than Paine Creek because groundwater ameliorates the impacts of suburbanization). Furthermore, sedimentation was simply not evident.

The Paine Creek subwatershed and its tributaries support exceptionally high quality macroinvertebrate communities including many infrequently collected sensitive taxa and three state listed taxa. Upper Paine Creek, Phelps Creek, and a tributary to Paine Creek were characterized by coolwater/coldwater macroinvertebrate communities. The unusually high quality macroinvertebrate communities in these streams are probably due to the streams flowing through highly wooded ravines with continuous groundwater flow and limited development.

PROBLEM STATEMENTS

PROBLEM 1

BACKGROUND: Based on the 2000 Census data, the projected population growth for all the counties located within the Lower Grand River Watershed is expected to significantly increase. Notably, the development rate in Leroy Township is increasing drastically. Similar growth in adjacent Counties has shown that an increase in development due to population increase has caused erosion and siltation of waterways, and ultimately degradation of water quality. Because Paine Creek is underlain by low-yielding shallow bedrock aquifers, it is susceptible to disturbances within its subwatershed (HUC 04110004060050- Paine Creek). To insure continued existences of exceptional biological communities in this subwatershed, the wide riparian buffers, high percent of forest cover and low density development must be maintained.

PROBLEM STATEMENT: NEED FOR FUNDING FOR LAND PROTECTION EFFORTS

All of the streams within this subwatershed are currently in attainment. Land protection of critical natural areas is paramount to maintaining the attantaiment status of the Grand River and it tributaries. Currently there are 1,841.83 acres of permanently protected land in subwatershed HUC 04110004060050 (Paine Creek). Grand River Partners, Inc. Land Protection Priority List has identified 4,980.96 acres of priority land for protection in this subwatershed (Paine Creek). This land includes high quality natural resources including riparian buffers, core forests, high quality streams, coldwater streams, upland forests, wetlands, and more.

GOALS:

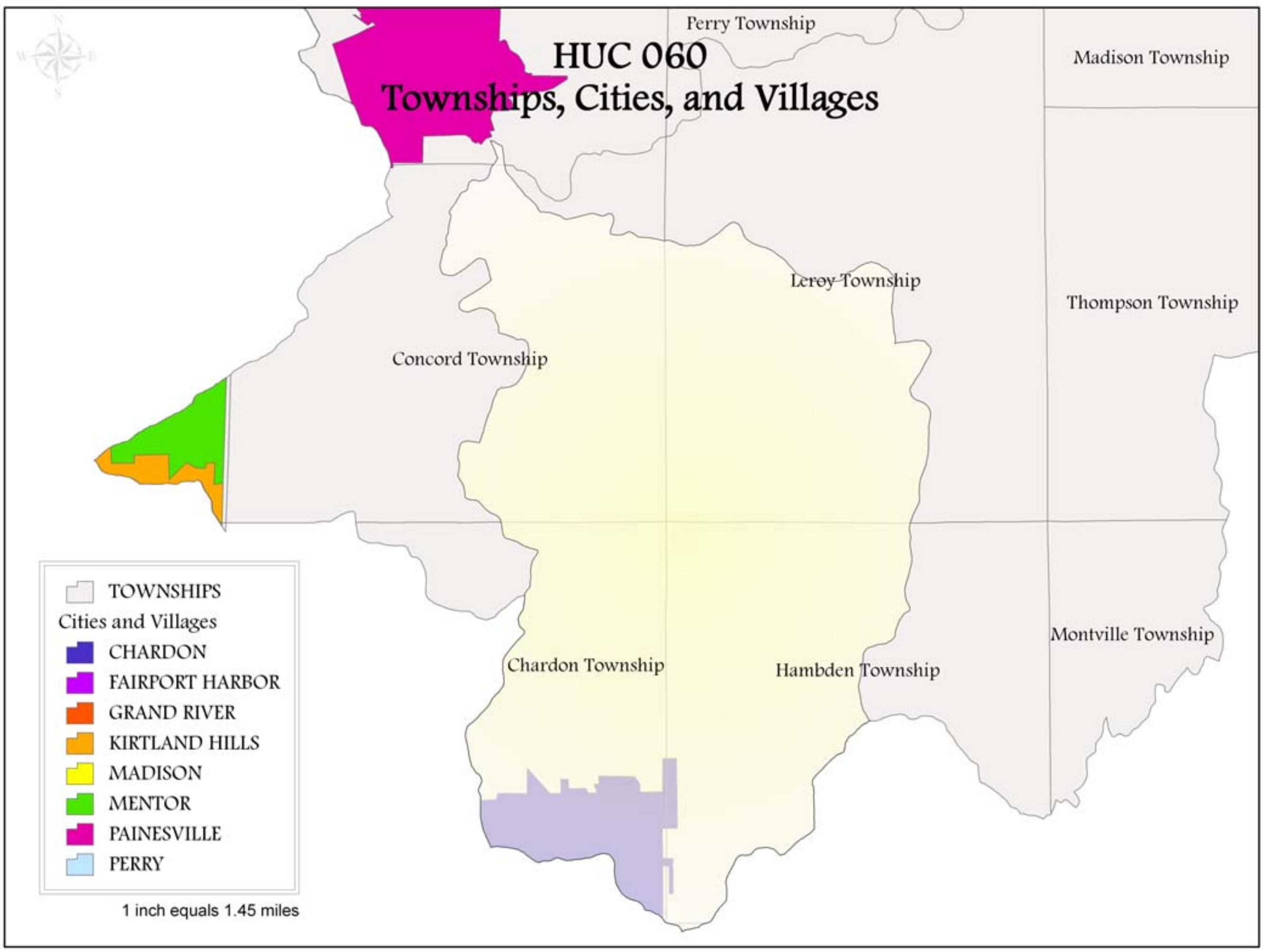
1. Work to secure funding to preserve pristine water quality by protecting an additional 4,980.96 acres of high quality land within subwatershed 04110004060050 (Paine Creek).

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Permanent protection of 4,980.96 acres of subwatershed 04110004060050 (Paine Creek)	≈$17,433,360 (≈$3,500/ acre conservation easement value)	Grand River Partners, Inc., The Nature Conservancy, Lake SWCD, etc.	1/08-ongoing	Number of acres put into conservation easement protection

04110004060060 - Big Creek [except Kellogg Creek]

DESCRIPTION- The 14-digit Hydraulic Unit Code 04110004060060 (HUC 060) is located within the 11-digit HUC 04110004060 know as the Lower Grand River Watershed. HUC 060 is approximately 23,790 acres and approximately 37 square miles. This watershed encompasses portions of Leroy, Painesville, and Concord Townships in Lake County, and the City of Chardon, and Claridon, Chardon and Hambden Townships in Geauga County.

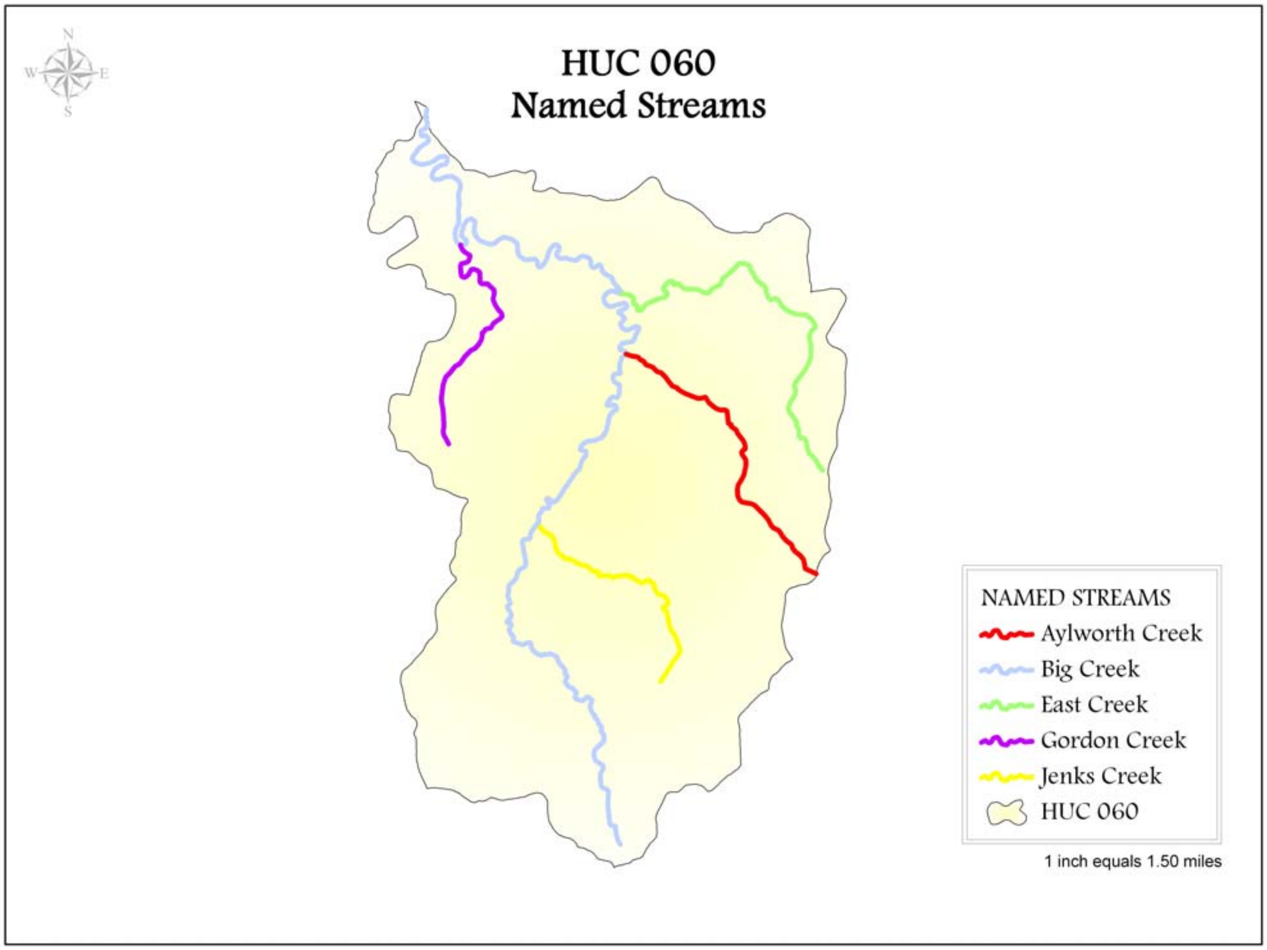
Map 1.060- Communities of HUC 060



Big Creek and its tributaries drain the heart of Ohio's snow belt. A high gradient, combined with torrential, scouring flows and discontinuities in bedrock have resulted in beautiful cascades and waterfalls along the length of Big Creek and in many of its tributaries, especially the portion of the drainage in Lake County. The scouring flows, however, result in long stretches of bedrock punctuated by short aggregations of glacial till and fractured bedrock; the effect is more apparent moving downstream, and is reflected in successively decreasing QHEI scores downstream from SR 608 (RM 9.3) [Table 10]. The upshot is that from a fish's eye-view, the habitat becomes marginal in the lower 5 miles of the creek. Identical conditions exist in East Creek and Gordon Creek, and to a lesser extent in Ellison Creek.

The headwater portion of the Big Creek drainage in Geauga County, being smaller and therefore subject to less scouring energy, and having a thicker glacial drift than the portion in Lake County, generally has stream habitat that is more conducive to supporting fish communities in accordance with expectations derived for till-plain streams.

Map 2.060- Named Streams of HUC 060



DEMOGRPAHICS- Unfortunately, demographic statistics are collected on a per township or per county basis, thus making it difficult to determine the exact numbers for each subwatershed. Therefore, the data for each township located within each subwatershed was examined, and the totals and averages were taken of each; outliers were taken into account. The statistics for Leroy, Painesville, and Concord Townships in Lake County, and the City of Chardon, and Claridon, Chardon and Hambden Townships in Geauga County were utilized to determine the information below.

Total Population~

The total population for HUC 060 is approximately 31,215 with a 49.87/ 50.13% male to female ratio. The largest age group represented is the 35 to 44 years group (18.14% of the total population), followed by the 45 to 54 years group (17.98%), and the 25 to 34 years group (9.68%). 23,234 people represent the 18 and older group, which accounts for 73.43% of the total population for the townships located within HUC 060. The average median age represented is 39.4.

The male to female ratio for the state of Ohio is 48.60/ 51.40%. The largest age group represented is the 35 to 44 years groups (15.90% of the total population), followed by the 45 to 54 years group (13.80%), and the 25 to 34 years group (13.40%). The median age for the people who reside in Ohio is 36.2.

Educational Attainment~

Of the 31,292 people who are over the age of 25 in the townships within the HUC 060 subwatershed, the majority education level is high school graduate (32.86%), followed by some college with no degree (23.77%), and Bachelor's degree received (18.05%).

Employment Status~

Approximately 52,424 people over the age of 16 in Leroy, Painesville, and Concord Townships in Lake County, and the City of Chardon, and Claridon, Chardon and Hambden Townships in Geauga County, are currently in the workforce. There are approximately 717 (2.01%) who are currently unemployed.

Household by type~

There are approximately 17,326 households in the Townships located within the HUC 060, of which 13,071 (75.44%) are family households. The average family size is 3.09 people.

Income (1999)~

The average median household income in 1999 for individual households in Leroy, Painesville, and Concord Townships in Lake County, and the City of Chardon, and Claridon, Chardon and Hambden Townships in Geauga County was $8,669. The majority of the households had an income of $50,000 to $74,999 (24.60%), followed by $$35,000 to $49,999 (16.68%), and $75,000 to $99,999 (16.39%).

The average median family income in 1999 for families in Leroy, Painesville, and Concord Townships in Lake County, and the City of Chardon, and Claridon, Chardon and Hambden Townships in Geauga County, was $66,032. The majority of families had an income of $50,000 to $74,999 (26.45%), followed by $75,000 to $99,999 (19.78%), and $35,000 to $49,999 (16.47%).

The average median earnings for a male, full time, year round worker were $46,498 and $29,799 for a female, full time, year round worker.

Below Poverty Level (1999)~

There are 1,610 individuals within the HUC 060 subwatershed, for whom poverty status was determined. Of those, approximately 347 families are represented, and 150 are families with a female householder with no male present.

Occupation~

The residents of Leroy, Painesville, and Concord Townships in Lake County, and the City of Chardon, and Claridon, Chardon and Hambden Townships in Geauga County represent the following occupations; 9,009 management professionals, 603 service occupations, 6,910 sales and office occupations, 72 farming, fishing, and forestry occupations, 2,157 construction, extraction and maintenance occupations, and 707 production, transportation, and material moving occupations.

Race~

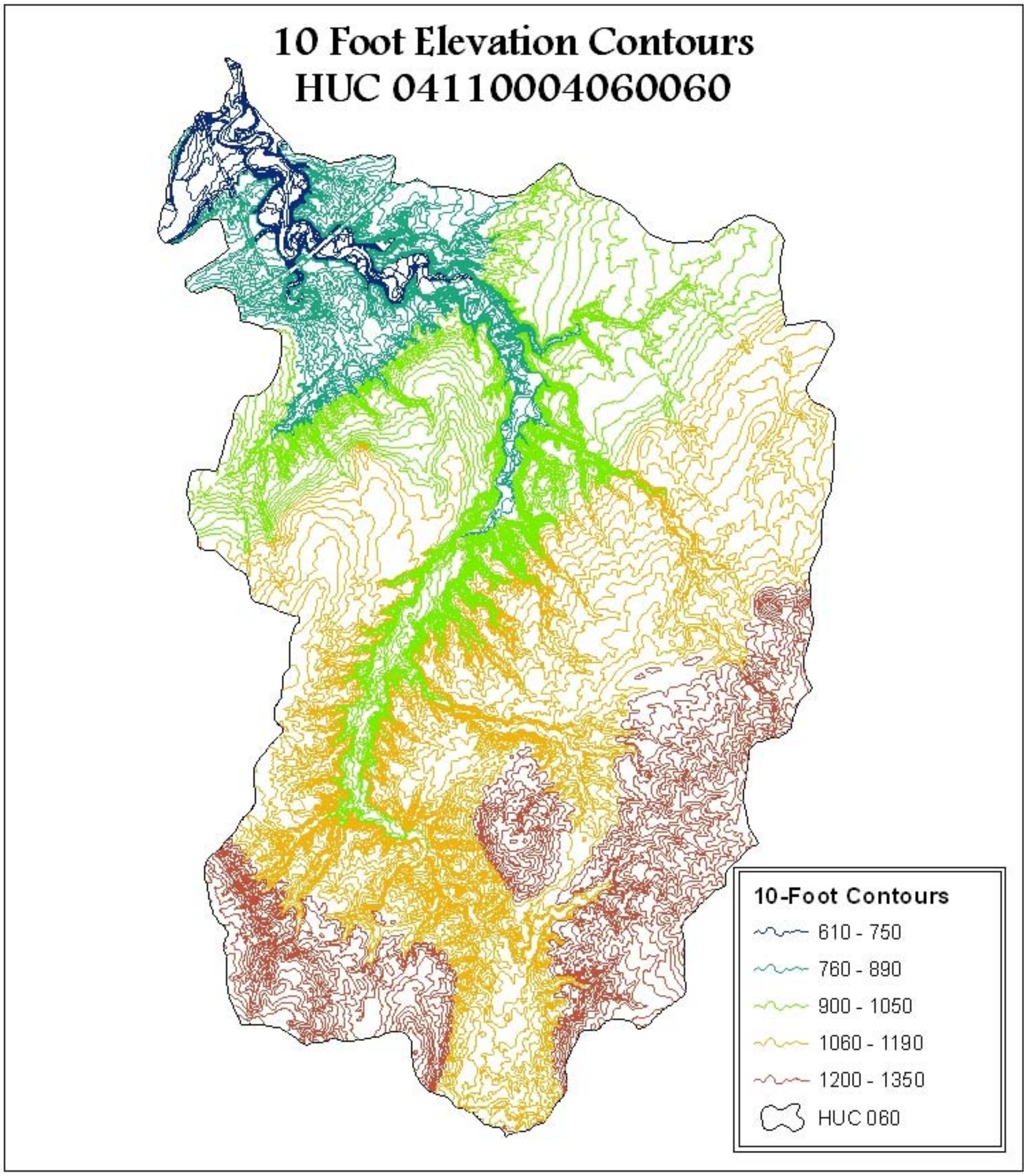
Approximately 98.17% of the population of the HUC 060 is white, 0.89% is African American, and 0.63% is Asian.

Other~

Within the HUC 060, approximately 49 residences are lacking complete plumbing facilities, 34 are lacking complete kitchen facilities, and 128 are without telephone service.

TOPOGRAPHY~ The majority of HUC 060 is located within the West Tributary Project Area of the Grand River Watershed. This area is known for its high bluffs, the cold water streams that flow from the high elevations, and the gorge which leads to the Grand River. HUC 060 has drastic elevation changes at it approaches the river, which gives the Grand River its amazing gorge and shale bluffs. The highest point in HUC 060 is 1350 feet and the lowest is 610 feet.

Map 3.060- 10 foot Contours of HUC 060



SOILS- There are five soil groups represented within HUC 060; the Darien – Mahoning – Sebring (approximately 6,952 acres), the Platea – Pierpont – Orrville (approximately 5,118 acres), Conotton – Conneaut – Tyner (approximately 520 acres), Rittman – Wadsworth – Orrville (approximately 116 acres), and Mahoning – Ellsworth – Urban Land (approximately 11,099 acres) groups.

Darien- Mahoning- Sebring: These soils are nearly level to sloping, somewhat poorly drained that formed in silty or loamy glacial till on till plains. Most areas are in natural shrubs and trees, but some areas are used for cultivated crops, pasture, and residential development. Wetness and slow or very slow permeability severely limit most uses. Water usually ponds in low areas after a rainfall. Erosion is a hazard in sloping areas that are used for cultivated crops.

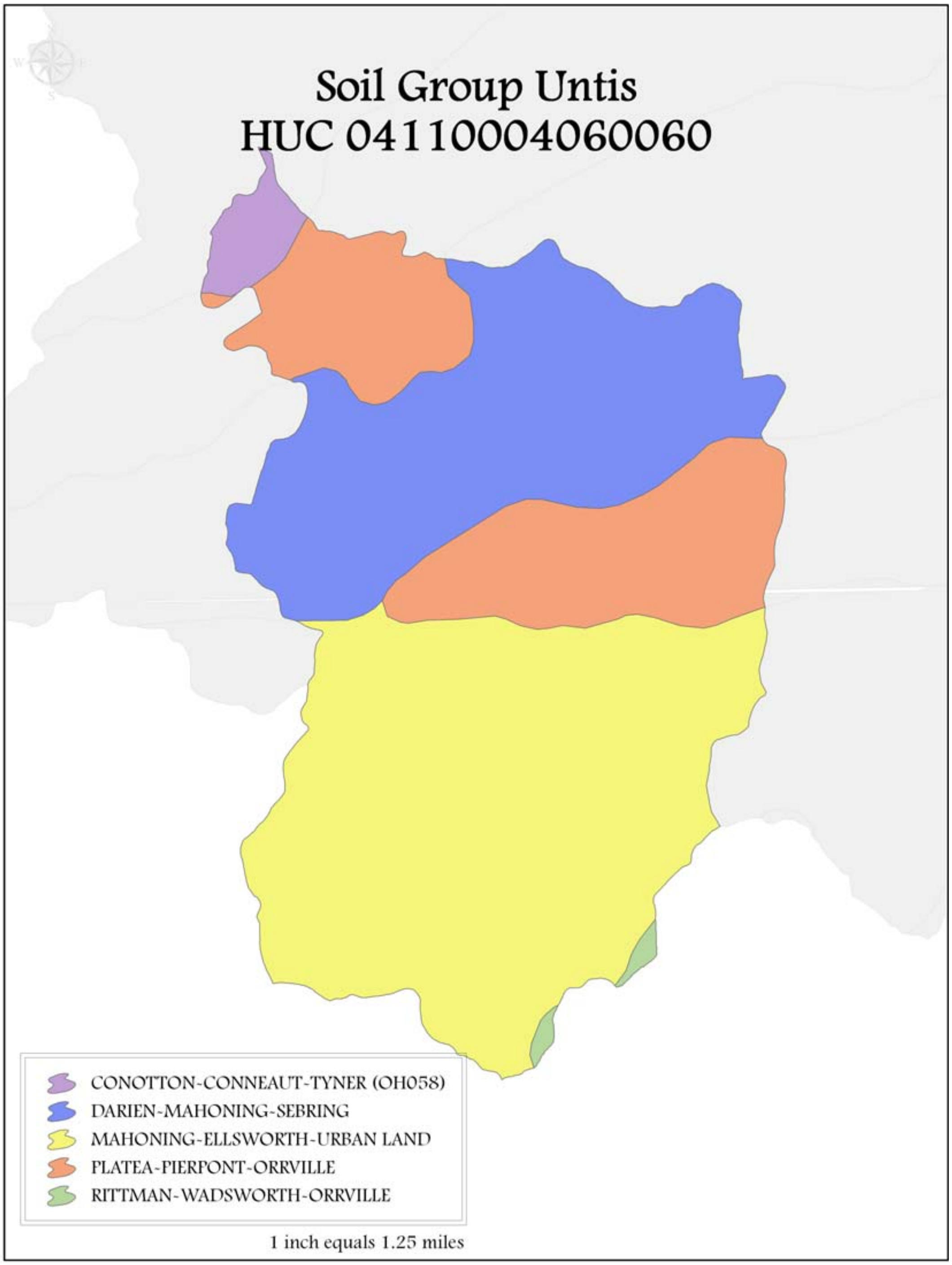
Platea- Pierpont- Orrville Group: This association is deep, nearly level to moderately steep, somewhat poorly drained to moderately well drained silty soils on glaciated uplands. This soil is found in undulating and hilly areas, but steep soils occur along rivers and streams including the Grand River. Grapes and small fruits are grown where the climate is suitable, particularly where air drainage is good. Very slow permeability, slope, and seasonal wetness are limitations for many nonfarm uses in this association.

Conotton- Conneaut- Tyner: These soils are nearly level and gently sloping, poorly drained and somewhat poorly drained soils that formed in silty glacial till or loamy material over silty glacial till on the lake plain. This soil group is located on slightly undulating broad flats on the lake plain. These soils are mostly covered by natural brush and trees, except where residential development has occurred. Most undeveloped areas are not drained. Some adequately drained areas are used for nurseries. Wetness is the main limitation for farming.

Rittman- Wadsworth- Orrville: These soils are deep, nearly level to very steep, somewhat poorly drained and moderately well drained soils that formed in medium textured glacial till. These soils are located on flats, low knolls, hillsides, ridges, and side slopes along drainageways. Seasonal wetness, the slow or very slow permeability of the fragipan, and the erosion hazard are the major limitations on these soils. The nearly level to sloping soils are suited to cultivated crops, hay, and pasture. Ditches and subsurface drains are used to improve drainage. The soils in this drainage are better suited to houses without basements than to those with basements. Building sites should be landscaped to assist with surface drainage. Placing drains at the base or footings and coating the exterior walls of basements help prevent wetness. Local roads can be improved by providing artificial drainage and a suitable base material to reduce damage from frost action.

Mahoning- Ellsworth- Urban Land: These soils are nearly level to very steep, somewhat poorly drained and moderately well drained that formed in silty or loamy glacial till on till plains. This mapping unit is found on long, gently sloping and short, undulating side slopes and broad flats in dissected areas along drainageways. Use of this map unit is diverse and includes urban and residential development, cultivated crops, and natural shrubs and trees. Wetness and the erosion hazard limit these soils for cultivated crops. Wetness also limits residential and urban development.

Map 4.060- Soil Groups of HUC 060



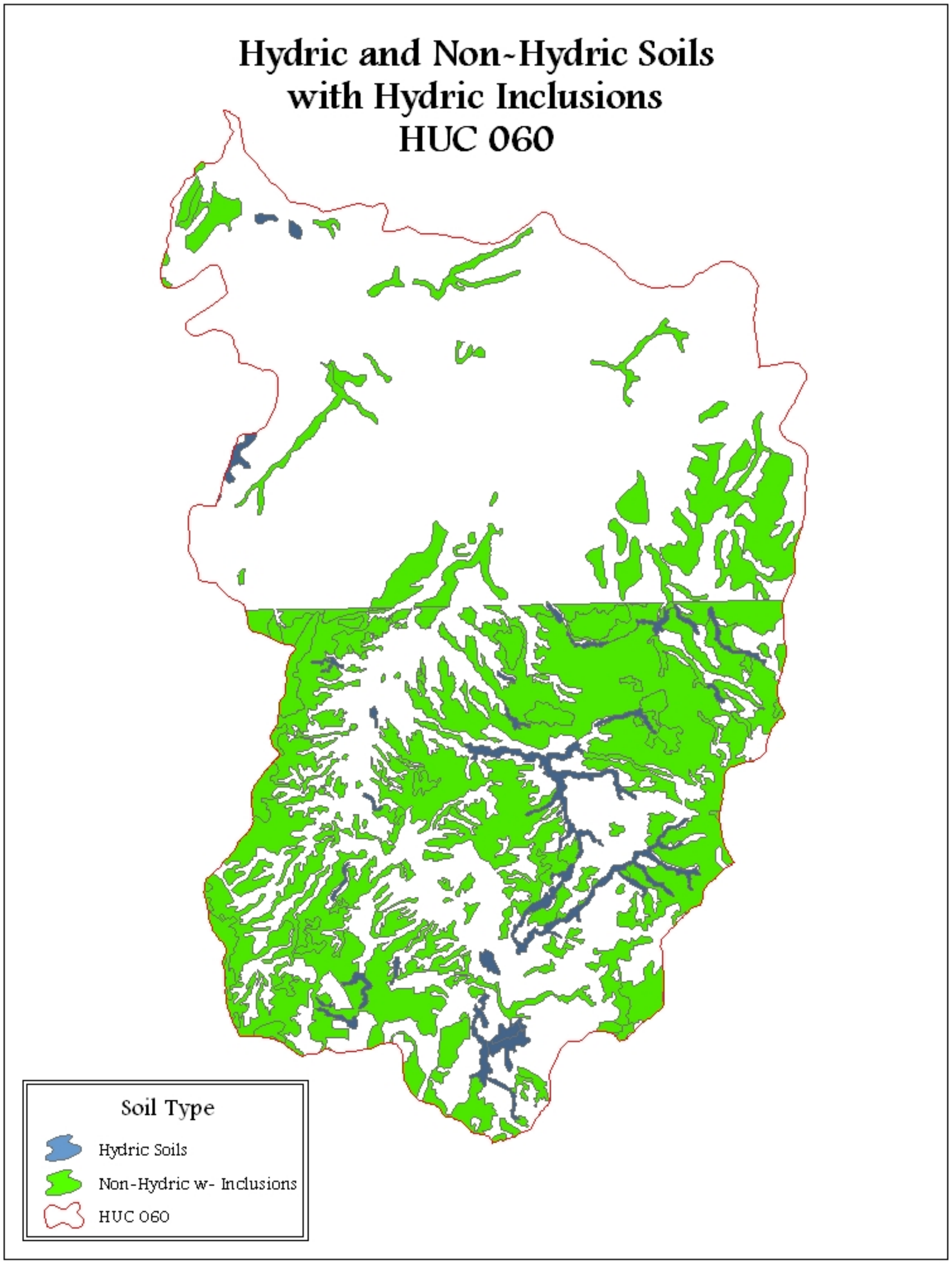
A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. This lack of oxygen in the soil can lead to the formation of certain observable characteristics in hydric soils, such as a thick layer of organic matter (non-decomposed plant materials) in the upper part of the soil column. Other observable features include oxidized root channels and redoximorphic features (concentrations and depletions of Iron and other elements, i.e., mottling, gleying). The following National Soil Information System (NASIS) criteria reflect those soils that may meet the definition of hydric soils.

- All Histels except Folistels and Histosols except Folists, or
- Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:
- Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or
- poorly drained or very poorly drained and have either:
    - water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils
    - water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or
    - water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or
- Soils that are frequently ponded for long duration or very long duration during the growing season, or
- Soils that are frequently flooded for long duration or very long duration during the growing season.

In HUC 060, there are approximately 592 acres of hydric soils.

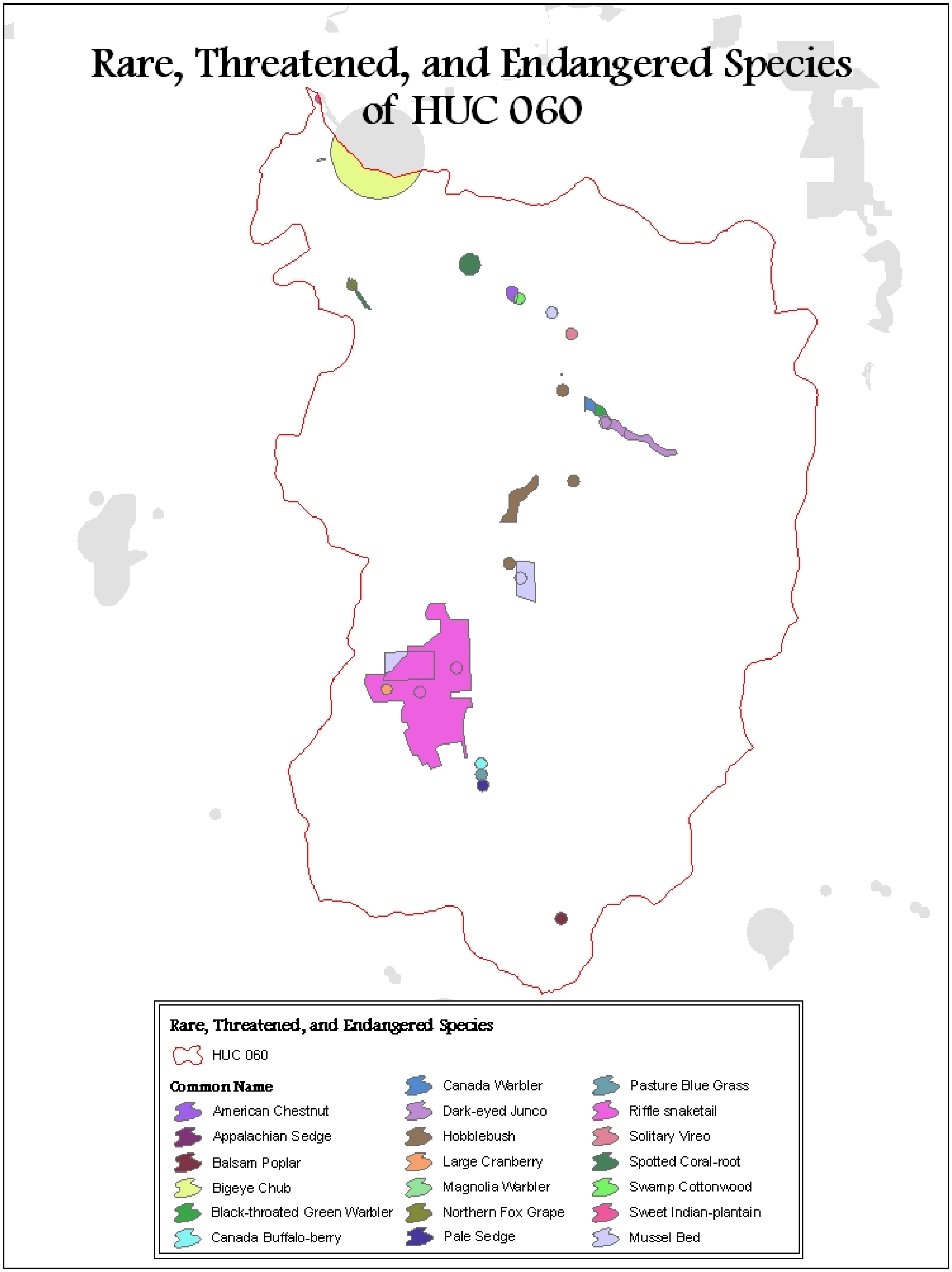
Non hydric soils can be of major importance to water quality as well. Many non-hydric soil types contain small areas of hydric soils, or hydric inclusions. These soils are generally not associated with having the properties of hydric soils, but the do have small pockets, which are too small to have been mapped by the soils surveys, to be considered hydric. Soil Survey books generally do not map "inclusions" of different soil types if the map units are less than 2 acres in size. These inclusions can be wetland soils within an upland soil series. Sometimes, the description will include the types of soils that are the most common inclusions in the series. HUC 060 contains roughly 7,803 acres of non hydric soils with hydric inclusions.

Map 5.060- Hydric and Non-hydric soils of HUC 060



RARE, THREATENED, and ENDANGERED SPECIES- The Grand River Watershed provides the perfect habitat for many rare, threatened, and endangered species. In fact, the Ohio Department of Natural Resources, Division of Wildlife recognized the unparalleled biodiversity and habitats of the Grand River Watershed, and chose this watershed to reintroduce the wild turkey, river otter, and snowshoe hare. The following species are found within HUC 060 in the Grand River Watershed; American chestnut, Appalachian sedge, balsam poplar, bigeye chub, black-throated green warbler, Canada buffalo-berry, Canada warbler, dark-eyed junco, hobblebush, large cranberry, magnolia warbler, northern fox grape, pale sedge, pasture blue grass, riffle snaketail, solitary vireo, spotted coral-root, swamp cottonwood, sweet-Indian plantain, and beech-sugar maple forest.

Map 6.060- Rare Species of HUC 060

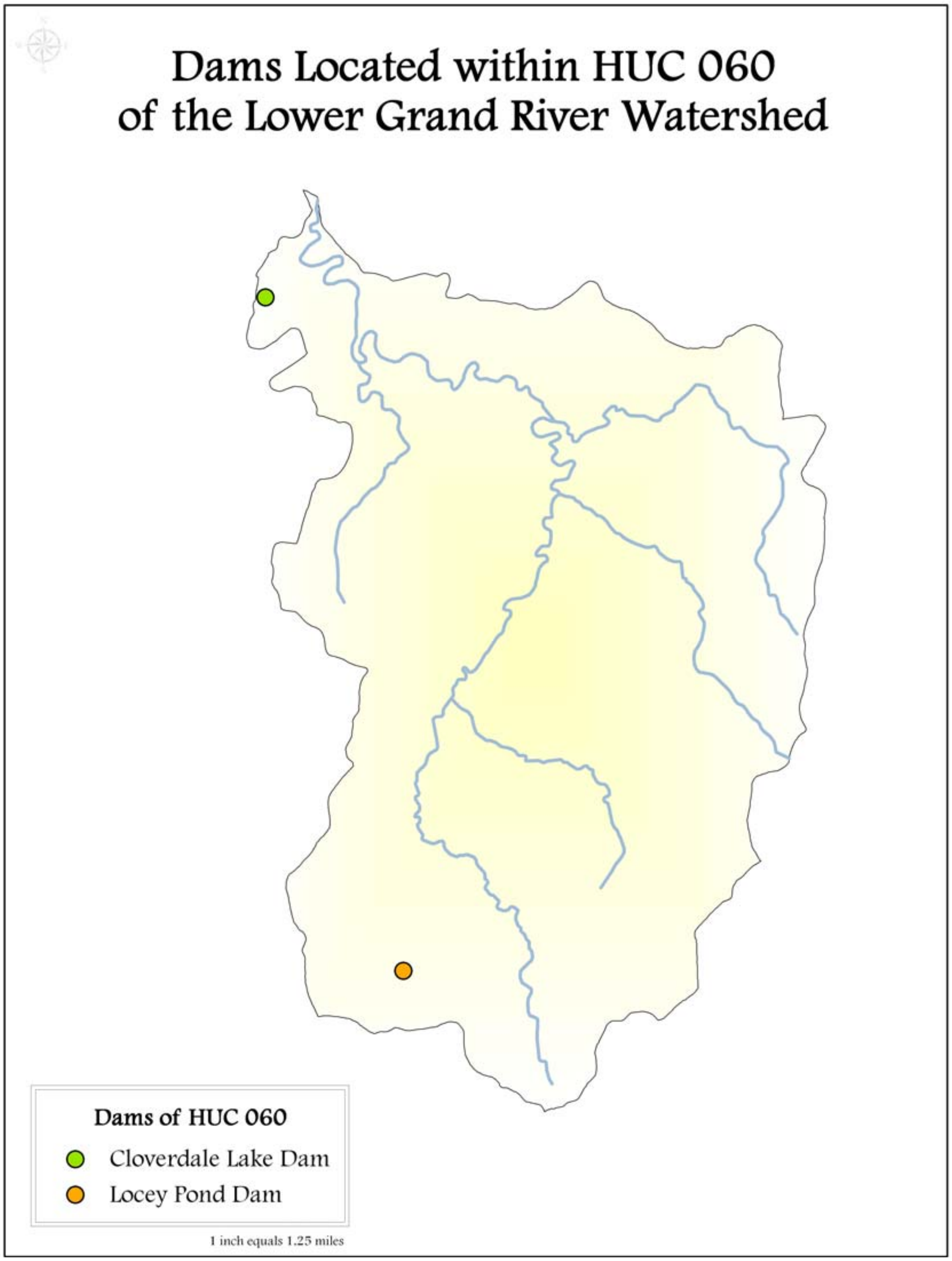


DAMS~ There are 18 dams located with in the Lower Grand River Watershed. In HUC 060 there are two dams; the *Locey Pond Dam,* and the *Cloverdale Lake Dam*.

- The *Locey Pond Dam*, NID OH001622, is located in the Village of Chardon, Geauga County. This is a privately owned, earthen dam, located on an unnamed tributary to Big Creek. The purpose for this dam is strictly recreational, and is 5 acres in size. The drainage area of this dam is 0.12 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Locey Pond Dam* is low, meaning that no loss of human life is probable and economic and/or environmental losses, disruption of lifeline facilities, and other impacts would not be expected.

- The *Cloverdale Lake Dam*, NID OH00349, is located in the Concord Township, Lake County. This is a privately owned, earthen dam, located on an unnamed tributary to Big Creek. The purpose for this dam is strictly recreational, and is 35.10 acres in size. The drainage area of this dam is 0.272 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Cloverdale Lake Dam* is significant; meaning that no loss of human life is probable, but economic and/or environmental losses, disruption of lifeline facilities, and other impacts would be expected.

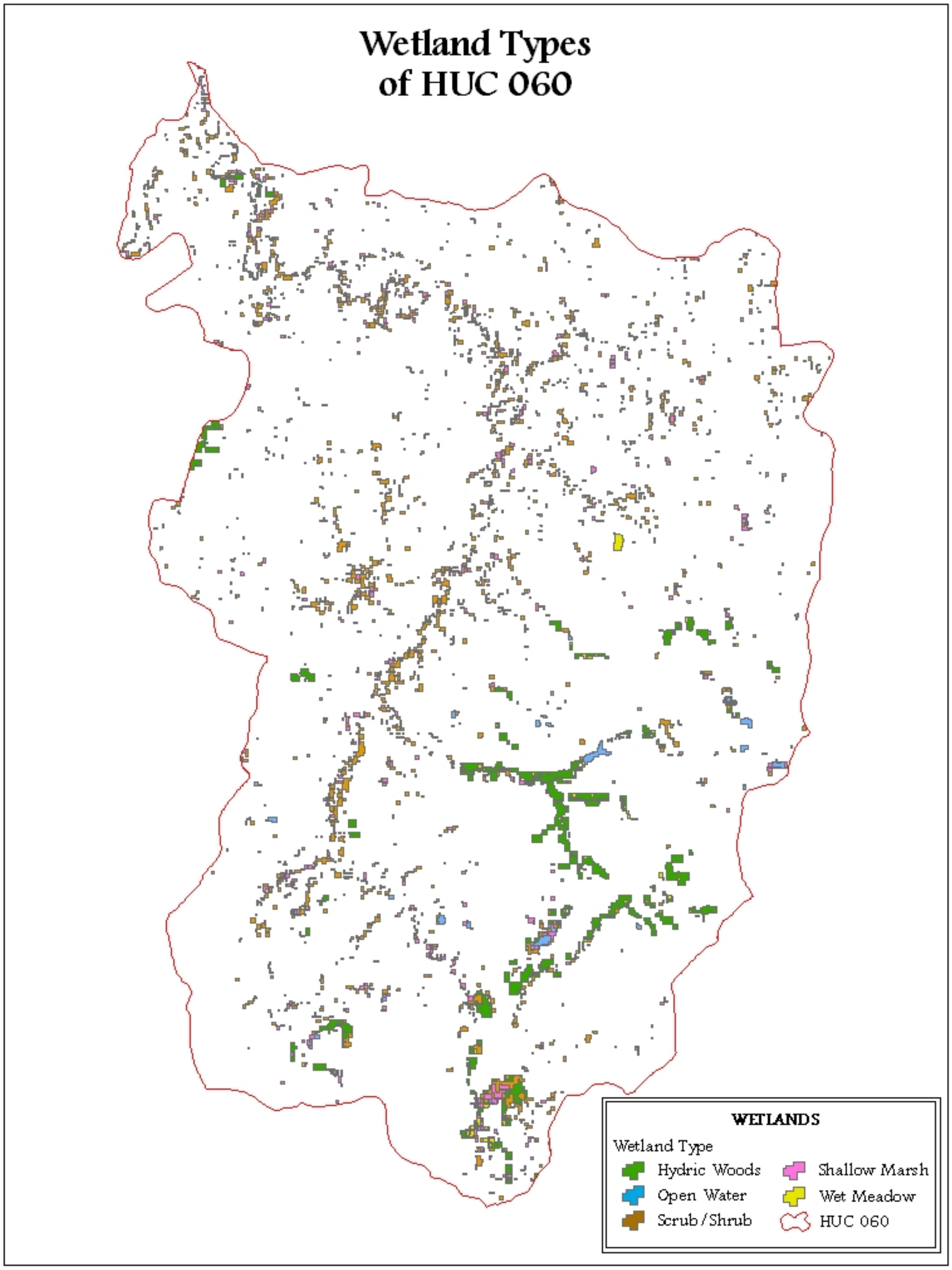
Map 7.060- Dams of HUC 060



WETLANDS- Wetlands are typically highly productive habitats, often hosting considerable biodiversity. The Army Corps of Engineers and the Environmental Protection Agency define wetlands as; “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions”. Wetlands are found under a wide range of hydrological conditions, but at least some of the time water saturates the soil. The result is a hydric soil, one characterized by an absence of free oxygen some or all of the time, and therefore called a "reducing environment." Plants called hydrophytes specifically adapted to the reducing conditions presented by such soils can survive in wetlands, whereas species intolerant of the absence of soil oxygen (called "upland" plants) can not survive. Adaptations to low soil oxygen characterize many wetland species.

HUC 060 has approximately 1324 acres of wetlands; 351 acres of Hydric Woods, 44 acres of open water wetlands, 644 acres of scrub/shrub, 243 acres of shallow marsh, and 41 acres of wet meadow.

Map 8.060- Wetlands of HUC 060



DRASTIC- The DRASTIC maps, produced by the Ohio Department of Natural Resources, show the pollution potential for groundwater systems. The DRASTIC mapping system allows the pollution potential of any area to be evaluated systematically using the following existing information about an area:

D= Depth to Water

R= Net Recharge

A= Aquifer Media

S= Soil Media

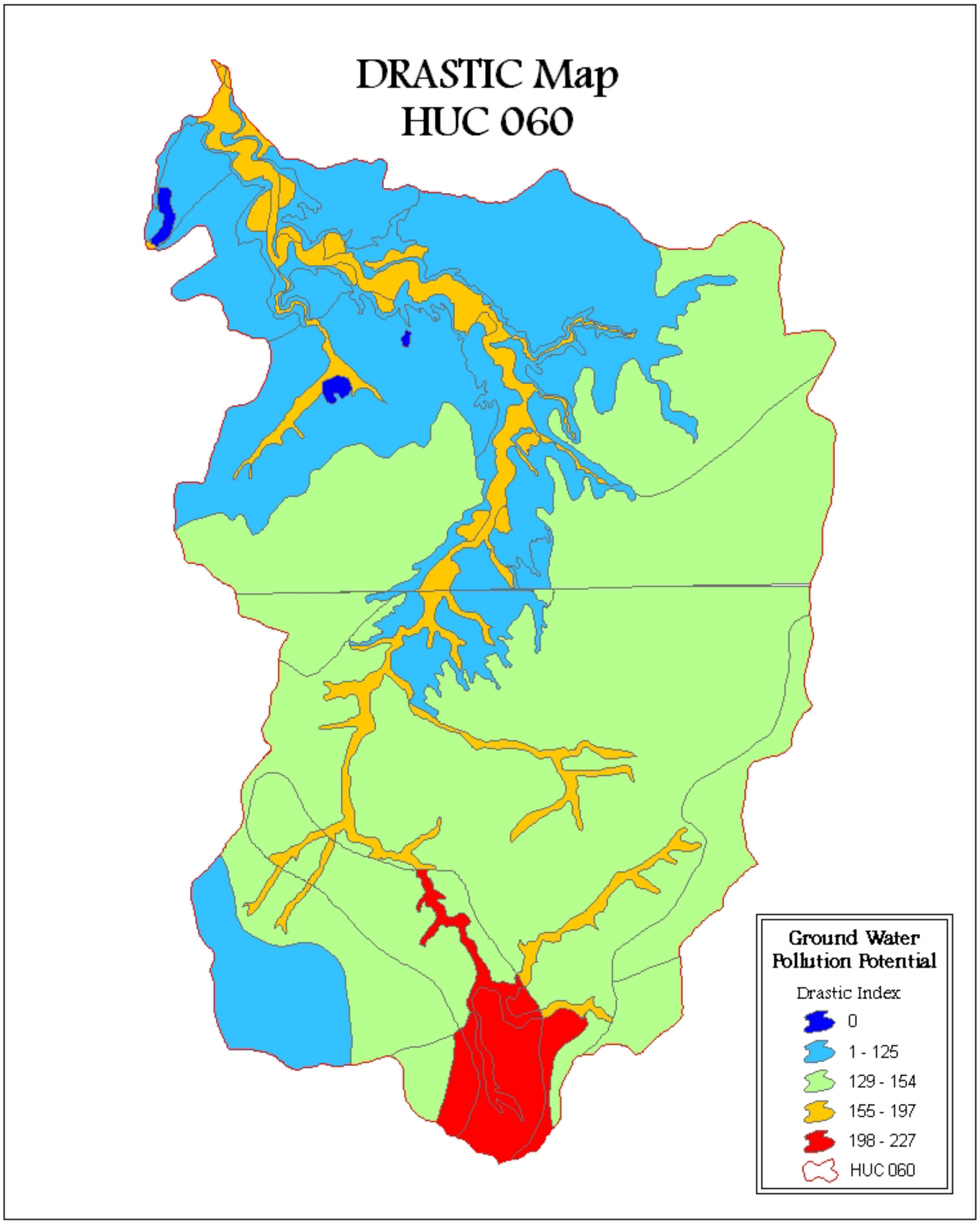
T= Topography

I= Impact of the Vadose Zone Media

C= Hydraulic Conductivity of the Aquifer

In evaluating an area's vulnerability to contamination, the DRASTIC mapping system assumes a contaminant with the mobility of water is introduced at the surface and flushed into the groundwater by precipitation. A pollution potential map can assist in developing ground water protection strategies. By identifying areas more vulnerable to contamination, officials can direct resources to areas where special attention or protection efforts might be warranted. This information can be utilized effectively at the local level for integration into land use decisions and as an educational tool to promote public awareness of ground water resources. Pollution potential maps may be used to prioritize ground water monitoring and/or contamination clean-up efforts. Areas that are identified as being vulnerable to contamination may benefit from increased ground water monitoring for pollutants or from additional efforts to clean up an aquifer. HUC 060 has a maximum DRASTIC index of 227. Approximately 3.76% of HUC 060 has a high DRASTIC index.

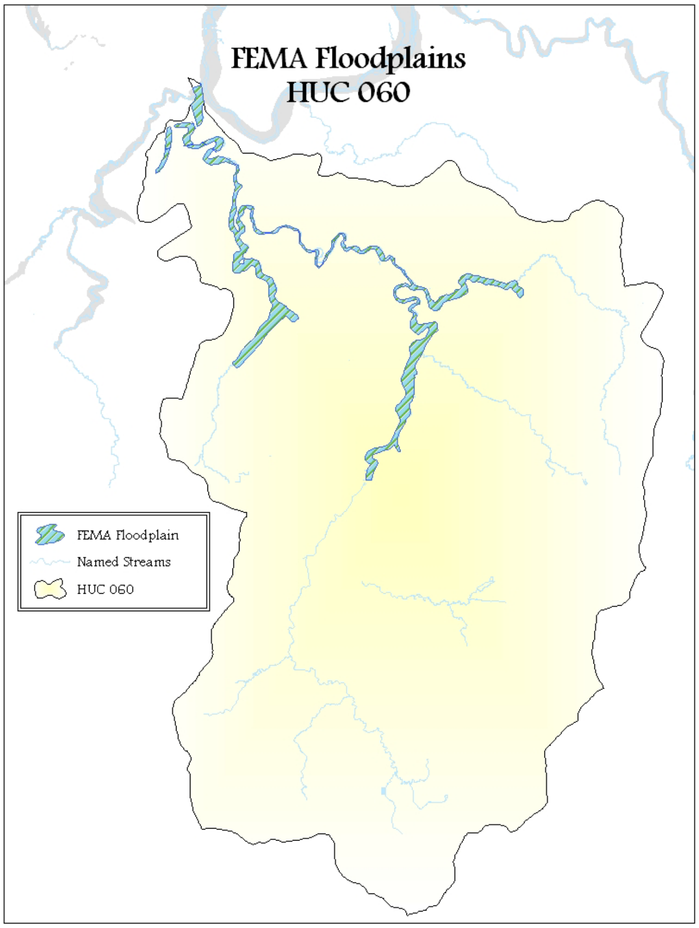
Map 9.060- DRASTIC of HUC 060



FLOODPLAINS- Floodplains are the low, flat, periodically flooded lands adjacent to rivers, lakes and oceans and subject to geomorphic (land-shaping) and hydrologic (water flow) processes. FEMA, the Federal Emergency Management Agency, has developed areas within watersheds that are designated as 100-year and 500- year floodplains. A "100-year flood" is defined as a flood event that has a 1 in 100 chance of occurring in any given year, and a 500-year flood has a 1 in 500 chance. HUC 060 has 537 acres of designated 100-year floodplain, which represents approximately 2.3% of the watershed.

Current both Lake and Geauga Counties have an ordinance in place which protects the riparian areas and floodplains of the Grand River and its named tributaries.

Map 10.060- Floodplains of HUC 060



WASTE WATER TREATMENT PLANT (WWTP): *Big Creek - Chardon Village WWTP*

The Village of Chardon WWTP was originally constructed in 1916 and most recently updated in August 2001 with the installation of oxidation ditches and a new sand filter. The current NPDES permit expired on September 30, 2004 and a renewal draft permit is set to expire on January 31, 2009. Current daily average design flow after plant expansion is 1.808 mgd. Effluent flow during the 2004 survey was about 60% of design flow. Wet stream processes include flow equalization basins, bar screening, grit removal, oxidation ditch, phosphorus removal, final settling, tertiary filtration, and ultraviolet disinfection. Pollutant loadings for select chemical parameters and effluent flow over the past two decades have remained relatively constant from 2001 to 2004, after the most recent upgrade. Prior to 1999 the WWTP reported violations of effluent discharge limits for total suspended solids, ammonia-N, total phosphorus, and BOD, in addition to recording average daily effluent flows well above the previous design criterion.

LANDUSE: HUC 060 is a relatively rural subwatershed. Much of this watershed is in natural cover, with an increase in urban areas and a decrease in agricultural areas. However, suburbanization is a major threat to this area of the Grand River Watershed. Here, open land is quickly being split and sold to developers. Population density remains somewhat low (11.2), but is inspected to grow due to the increase of development in the area.

Because the Big Creek subwatershed is at risk of increased imperviousness from Painesville and Chardon expansion, an expansion model was performed, within the

TMDL, to simulate the effects of increased imperviousness. The results of the model simulation are listed in the tables below.

Chart 1.060- Existing Landuse

Big Creek Existing Landuse		
Landuse Type	**Hectares**	**% of Total**
Comm/Indust/Transport	135	1
Cropland	634	7
Forest	6518	68
High Density Residential	14	.15
Low Density Residential	430	4
Pasture	1406	15
Transitional	13	.14
Water	474	4.9
Total	9624	100

Chart 2.060- Existing Landuse

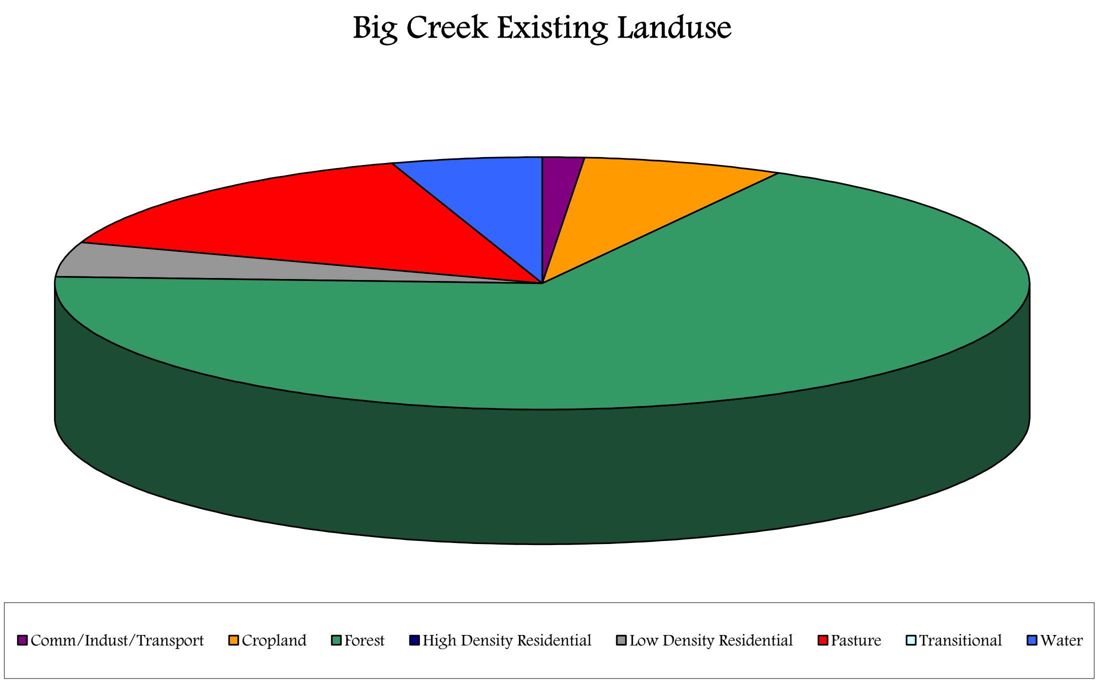


Chart 3.060- Future Landuse

Big Creek Future Landuse		
Landuse Type	**Hectares**	**% of Total**
Comm/Indust/Transport	1258	13
Cropland	770	8
Forest	3850	40
High Density Residential	96	1
Low Density Residential	2310	24

Pasture	674	7
Transitional	192	2
Water	474	4.9
Total	9624	100

Chart 4.060- Future Landuse

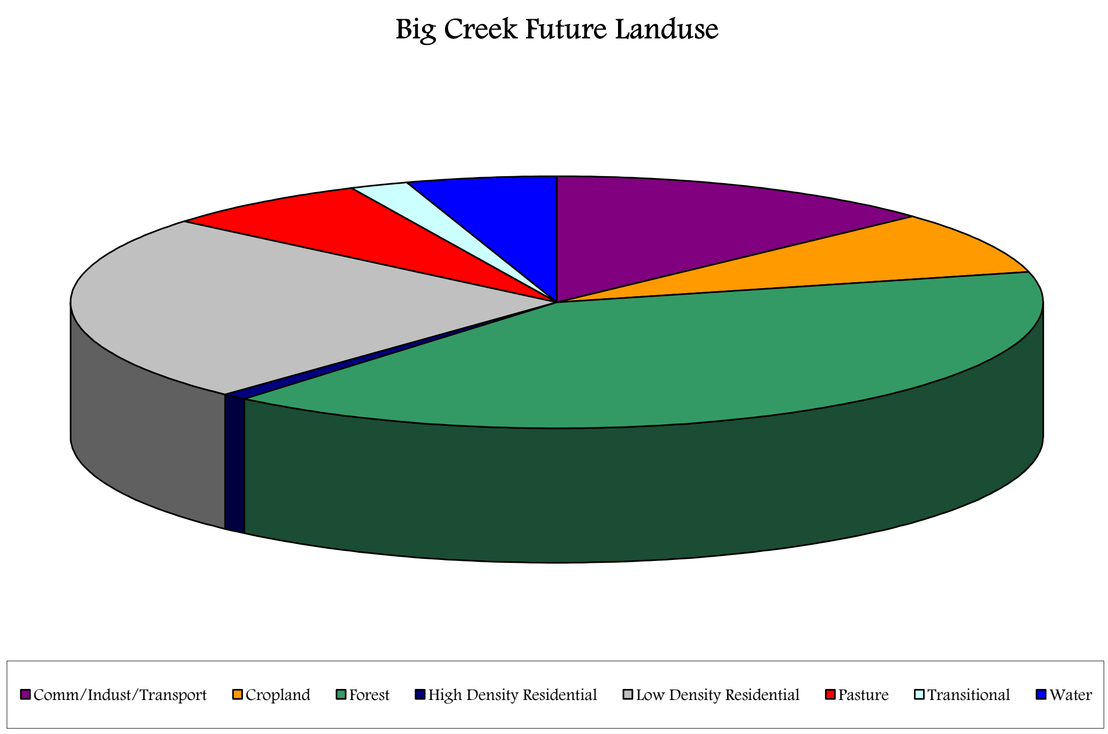
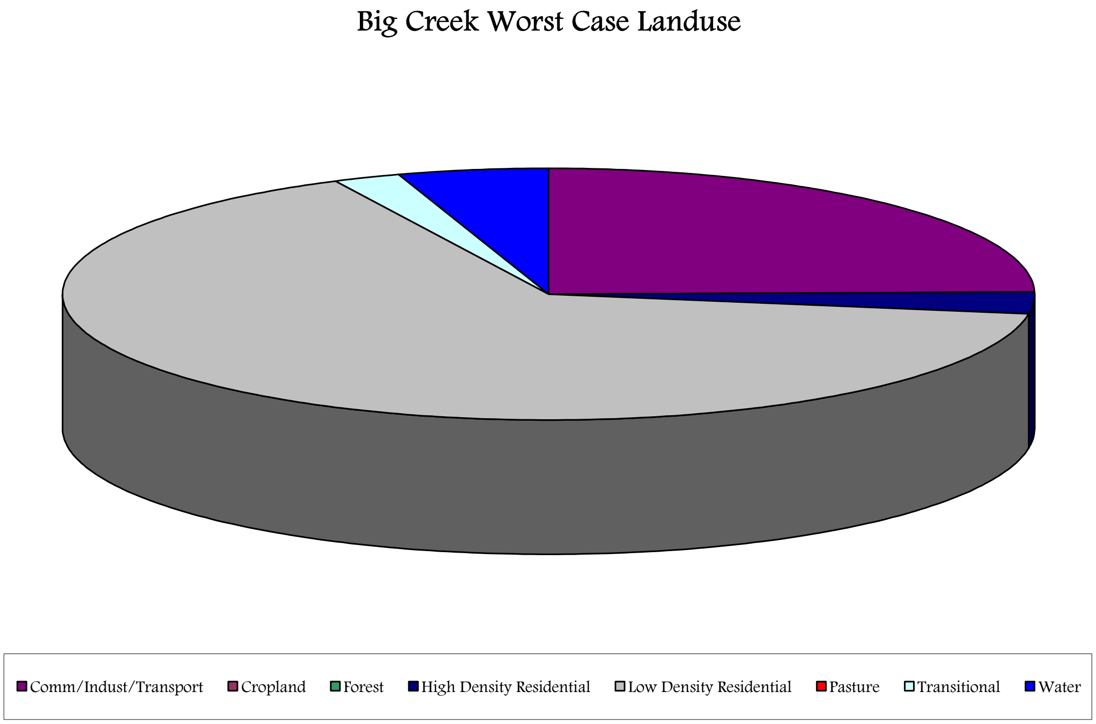


Chart 5.060- Worst Case Landuse

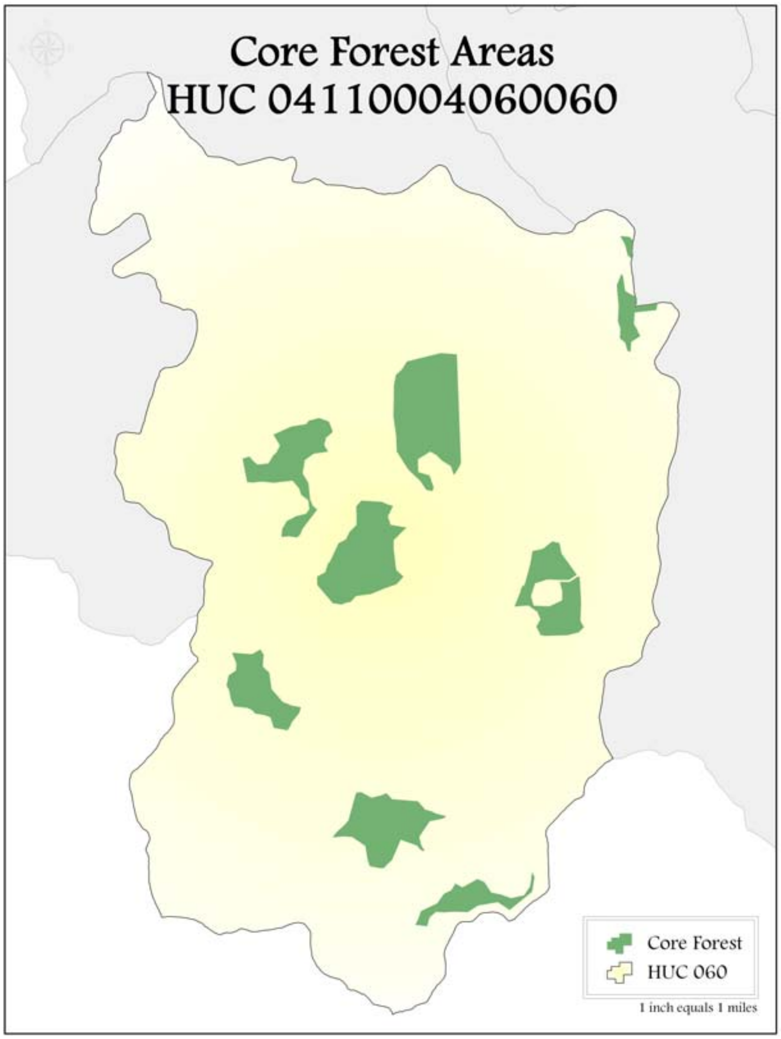
Big Creek Worst Case Future Landuse		
Landuse Type	**Hectares**	**% of Total**
Comm/Indust/Transport	2368	25
Cropland	0	0
Forest	0	0
High Density Residential	260	2.7
Low Density Residential	6294	65
Pasture	0	0
Transitional	200	2.1
Water	481	5
Total	9603	100

Chart 6.060- Worst Case Landuse



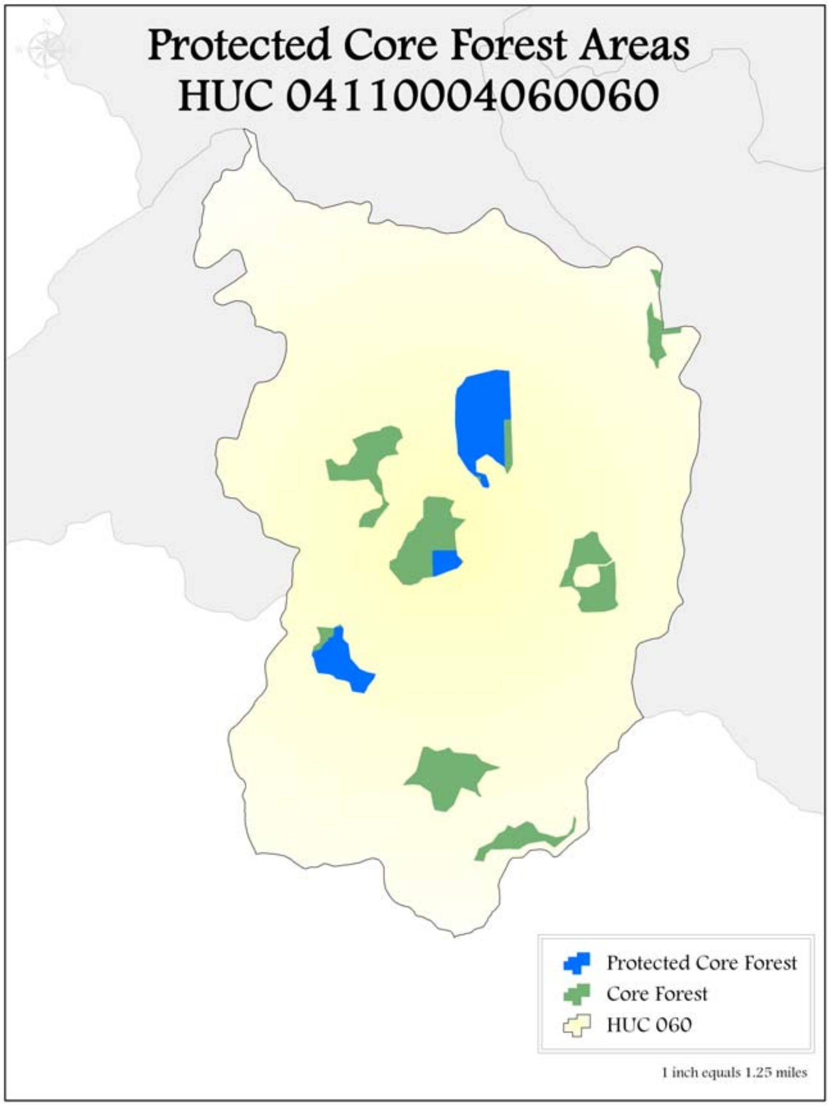
Since the large majority of the watershed remaining is in natural cover, there are many large tracts of undisturbed forest blocks. The Nature Conservancy realized the importance of these large tracts of forest, or "Core Forest Areas", for not only their natural resources value but their importance for breeding populations as well. Core Forest Areas are forested areas of 100 acres or more with a forested buffer zone from pastures and agriculture, and no roads within at least 300 meters. These numbers were determined by the habits and lifecycles of certain forest species; a pair of pileated woodpeckers will need at least 100 acres in order to breed, certain amphibian populations use forest areas up to 200 meters away from their wetland habitat for breeding purposes, and cowbirds will penetrate up to 150 meters of the core forest areas. HUC 060 contains two Core Forest Areas, which total 1936.59 acres, or roughly 8.14% of the HUC 060 watershed.

Map 11.060- Core Forest of HUC 060



These Core Forest Areas are very important habitats that need to be preserved. There are currently 628.84 acres of the 1936.59 acres of Core Forest in permanent protection, or approximately 32.47%.

Map 12.060- Protected Core Forest of HUC 060



GRPI- LAND PROTECTION PRIORITY LIST- Grand River Partners, Inc.'s goal is to protect the natural resources of the Grand River and its watershed. Grand River Partners, Inc. utilizes the conservation easement as the primary tool to protect such resources. Conservation easements are a great tool to protect resources on private lands but still maintain them in private hands. The Grand River watershed is approximately 712 square miles. Obviously Grand River Partners, Inc. cannot protect all of the 712 square miles (455,000 acres) with conservation easements. Grand River Partners, Inc. believes that water quality can be protected by conserving the "right" 25% of a watershed. In the specific case of the Grand River, this represents roughly 114,000 acres. Protecting 114,000 acres is an achievable goal considering the number of partner organizations and the fact that approximately 25% of the 114,000 acres has already been protected.

The challenge remains to protect the remaining 86,000 acres of the "right" land. To fulfill this goal, Grand River Partners, Inc. developed a parcel based **Land Protection Priority List**. Before any prioritization process could begin, any parcel less then five acres was removed from the potential list of priorities. To make fair comparisons an analysis of the watershed was conducted to determine the unique areas within the watershed. From this analysis, the Grand River Watershed was divided into 5 distinct project areas based on the unique natural features of each. The parcel prioritization process involved a two tier analysis. The first, Tier 1, involved an analysis of natural resources. The second, Tier 2, involved a strategic analysis that took into account parcel size, proximity to other protected land, and partner priorities.

The Headwaters Project Area consists of the area drained by all the unnamed tributaries that together form the Grand River. The area begins more or less upstream of the crossing with SR 534 at the southern end of the watershed. In summary, important natural resources ranked for each parcel located in the Headwaters Project Area are intact riparian areas, the Grand River main stem, wetlands, unnamed tributaries, floodplains, core forest blocks and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Lowlands Project Area begins at the crossing of SR 534 with the mainstem in the southern portion of the watershed and extends between the 810' contour interval north to the crossing where the Grand River intersects Windsor-Mechanicsville Road. Important Natural Resources identified in the Lowlands Project Area are swamp forests, wetlands, intact riparian areas, core forest blocks, mainstem, rare species, floodplains, TNC subwatershed ranking, and named tributaries. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Gorge Project Area begins at the crossing of the mainstem and Windsor-Mechanicsville Road bridge and extends upstream to the crossing with SR 84. The Gorge Project Area is bordered to the north by the watershed boundary and to the south by the 950' contour interval. The important natural characters of the Gorge are the mainstem, wetlands, floodplains, intact riparian areas, named tributaries, core forest blocks, steep slopes, TNC subwatershed rankings, and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

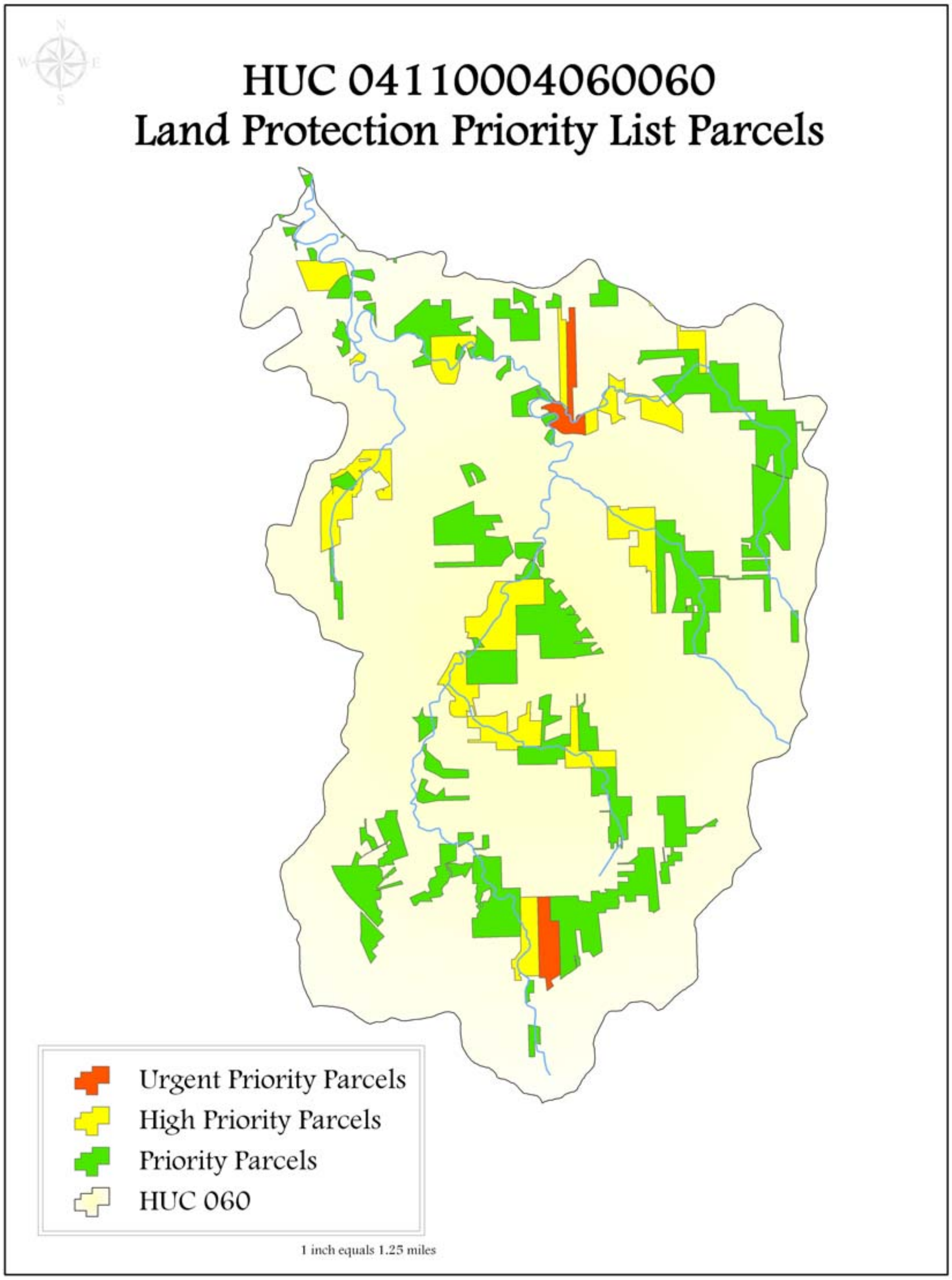
The Estuarine/Urban Project Area begins at the State Route 84 crossing with the Grand River and ends in Fairport Harbor Village and Grand River Village at its terminus with Lake Erie. The Estuarine/Urban Project Area includes the subwatershed of Red Creek which extends to the west just north of the City of Painesville. In this project area the mainstem, river access points, wetlands, intact riparian areas, floodplains and named tributaries were considered important natural features. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The last area is the Tributaries Project Area which consists of two areas; one is located east of the Grand River Lowlands Project Area, which and includes the subwatersheds of such named tributaries as Mill Creek, Rock Creek and Coffee Creek, and the second project area is located west of the Lowlands Project Area, north of the Headwaters Project Area and south of the Gorge Project Area. This portion of the Tributaries Project Area contains the subwatersheds of such high quality streams as Indian Creek, Phelps Creek, Hoskins Creek, and Paine Creek. Important natural resources considered include, cold water habitat, wetlands, floodplains, core forest blocks, and rare species. Again each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

Each parcel within the watershed was further evaluated based on additional strategic rankings. These rankings include parcel size, proximity to protected land and partner priorities. Each parcel meeting the acreage requirement, or within a certain distance of existing protected land or included as a priority by a partner organization or agency was weighted more heavily and therefore considered a high priority. A statistical analysis of the final scores was performed and each parcel was categorized as being priority, high priority or an urgent priority parcel.

In HUC 060, there are a total of 3276.62 acres of priority parcels, 1378.77 acres of high priority parcels, and 214.95 acres of urgent priority parcels for protection. Currently there are 2,495.52 acres of permanently protected land within HUC 060.

Map 13.060- LPPL of HUC 060



IMPERVIOUS SURFACE~ The Conversion of farmland, forests, wetlands, and meadows to rooftops, roads, and lawns creates a layer of impervious surface in the urban landscape. Impervious cover is a very useful indicator with which to measure impacts of land development on aquatic systems. The process of urbanization has a profound influence on the hydrology, morphology, water quality, and ecology of surface waters. Recent research has shown that streams in urban watersheds possess a fundamentally different character than streams in forested, rural, or even agricultural watersheds. The amount of impervious cover in the watershed can be used as an indicator to predict how severe these differences can be. In many regions of the country, as little as ten percent watershed impervious cover has been linked to stream degradation, with the degradation becoming more severe as impervious cover increases.

Impervious cover directly influences urban streams by dramatically increasing surface runoff during storm events. Depending on the degree of impervious cover, the annual volume of stormwater runoff can increase by two to 16 times its predevelopment rate, with proportional reductions in groundwater recharge. In natural settings, very little annual rainfall is converted to runoff and about half is infiltrated into the underlying soils and the water table. This water is filtered by the soils, supplies deep water aquifers, and helps support adjacent surface waters with clean water during dry periods. In urbanized areas, less and less annual rainfall is infiltrated and more and more volume is converted to runoff. Not only is this runoff volume greater, it also occurs more frequently and at higher magnitudes. As a result, less water is available to streams and waterways during dry periods and more flow occurs during storms.

The relationship between impervious cover and subwatershed quality can be predicted by a simple model that projects the current and future quality of streams and other water resources at the subwatershed level. Stream research generally indicates that

certain zones of stream quality exist, most notably at about 10% impervious cover, where sensitive stream elements are lost from the system. A second threshold appears at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition; diminished aquatic diversity, water quality, and habitat scores.

The model classifies streams into one of three categories; sensitive, impacted, and non-supporting. Each stream category can be expected to have unique characteristics as follows:

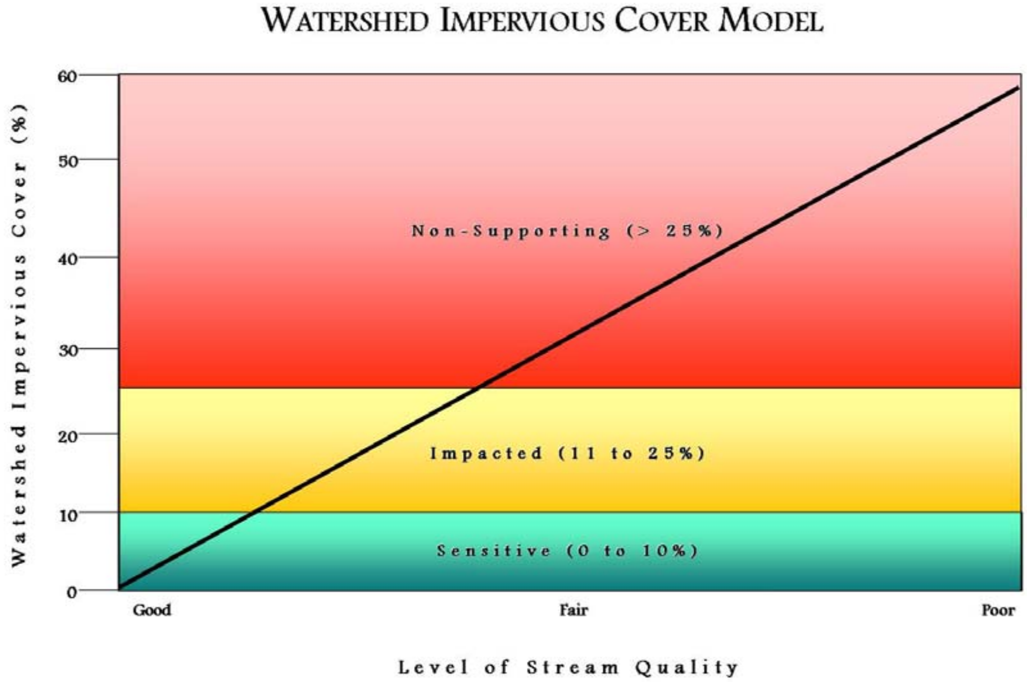
Sensitive Streams: These streams typically have a watershed impervious cover of zero to 10 percent. Consequently, sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Impacted Streams: Streams in this category possess a watershed impervious cover ranging from 11 to 25%, and show clear signs of degradation due to watershed urbanization. Greater storm flows begin to alter the stream geometry. Both erosion and channel widening are clearly evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to

fair levels, with the most sensitive fish and aquatic insects disappearing from the stream.

Non- Supporting Streams: Once watershed impervious cover exceeds 25%, stream quality crosses a second threshold. Streams in this category essentially become a conduit for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, down-cutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated, and the stream substrate can no longer provide habitat for insects or spawning areas for fish. Water quality is consistently rated as fair to poor, and water contact recreation is no longer possible due to the presence of high bacterial levels. Subwatersheds in the non-supporting category will generally display increases in nutrient loads to downstream receiving waters, eve if effective urban BMPs are installed and maintained. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish.

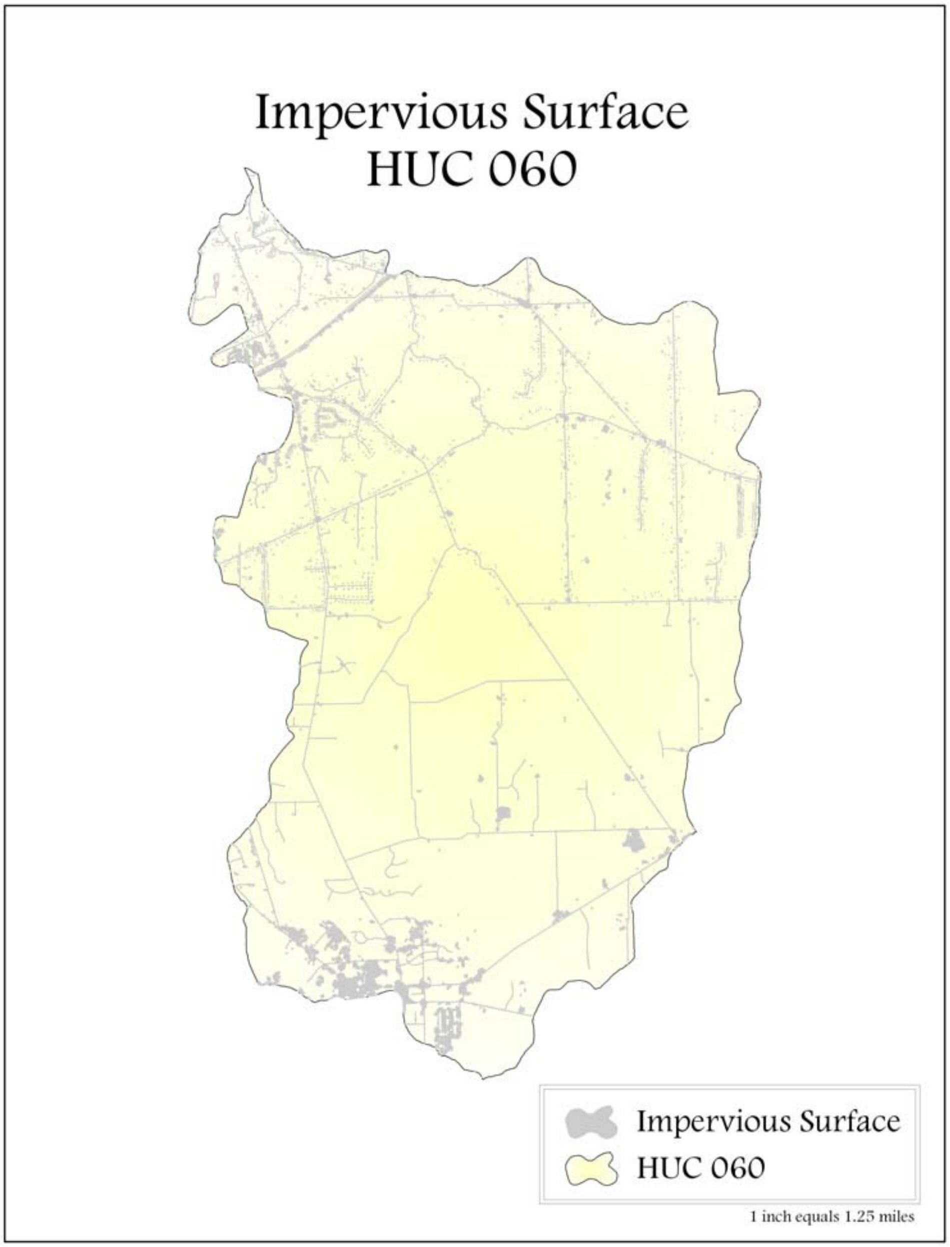
Graph 1.060- Impervious Cover Model



Center for Watershed Protection, Rapid Watershed Planning Handbook

HUC 060 has an impervious cover of approximately 4.31%. Therefore, the streams in this subwatershed are considered "sensitive streams" by the impervious surface model. Sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Map 14.060- Impervious Surface of HUC 060



ATTAINMENT STATUS- *Ohio Water Quality Standards: Designated Aquatic Life Use*

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*

2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*

3) *Cold-water Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and*

where the activities have been sanctioned by state or federal law; the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 mi.$_2$ drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

Big Creek~ Big Creek is designated WWH for aquatic life use, and is attaining that use from its confluence with the Grand River to upstream from Woodin Road. A small portion of the stream is in partial attainment of the WWH standard, owning to urban/suburban stormwater runoff from Chardon. Big Creek is impaired due to habitat alteration, which is quantified using a habitat TMDL equation which reflects the relationship between the QHEI score, modified attributes, and aquatic community performance. Big Creek is partially impaired due to natural limitations, namely featureless bedrock substrates.

Big Creek is one of several streams that have been highlighted by the Ohio EPA as those that are at the breaking point. These threatened streams are, with the exception of one Big Creek site, presently not impaired due to urbanization, on the contrary, they are vibrant, healthy and sensitive aquatic systems. This fact warranted a hydraulic modeling effort to determine the potential future effects of urbanization, specifically, increased imperviousness.

The Big Creek subwatershed drains the most rapidly suburbanizing townships in the Lower Grand River Watershed. Aggressive management is required to preserve the existing beneficial uses. Also, because Big Creek is a major tributary if the flow limited Grand River Mainstem, preserving the existing hydrology of Big Creek and its tributaries is important for maintaining the long-term health of the Grand River.

Jordan (Gordon) Creek- Jordan (Gordon) Creek currently has a default WWH designation, but is recommended for Coldwater Habitat based on the presence of seven coldwater macroinvertebrate taxa. The pace of suburban development within the Jordan Creek subwatershed is likely reaching the tipping point for sustained biotic integrity. Therefore, management should be directed toward naturalized landscapes that preserve as much ecological function as possible.

East Creek, Jenks Creek, and Cutts Creek- East, Jenks, and Cutts Creeks have a CWH aquatic life use, all are meeting that use based on the presence of coldwater macroinvertebrate taxa. Comprehensive landuse planning, conservation easements, pre- and post-construction site management, a strong stream protection policy, and naturalized landscapes for new residential (or commercial) development will be needed to maintain the biotic integrity of these waters.

Grand River- Aquatic life in the Grand River is fully attaining standards for Exceptional Warmwater Habitat (EWH) from Sweitzer Road (RM 42.2) to the SR 2 bridge in Painesville (RM 5.2), and is fully meeting standards for Warmwater Habitat (WWH) downstream from the SR 2 bridge. The Seasonal Salmonid use designation currently in place should be retained.

The Grand River is an economic asset to Northeast Ohio, but is especially sensitive to pollution and disturbance because of limited summer base flows. Therefore, regional planning, stream protection policies, comprehensive construction site management plans, construction site performance bonds, identification and preservation of sensitive areas, and above all, defined limits to growth are needed to maintain the biological integrity of the Grand River.

The Grand River is the only Ohio tributary to Lake Erie that harbors a self-sustaining population of Great Lakes Muskellunge, and therefore is a priority for conservation. The Grand River is also has a native population of walleye and northern pike making it singularly unique among Ohio streams. The Grand River and its tributaries provide habitat for many species considered rare by Ohio EPA, or listed as threatened or endangered by the Ohio Department of Natural Resources including 32 macroinvertebrates and freshwater mussel species, and 11 fish species. The single greatest threat to the Grand River basin is suburbanization.

BIOLOGICAL INDICATORS- Fish communities in the Grand River have an exceptionally high degree of biological integrity. This is obvious in the consistently high IBI scores along the length of the mainstem and between sampling years, and is also evident in the unusually high percent composition of pollution intolerant species making up electrofishing samples (Figure 40). Furthermore, the Grand River is one of the few rivers in Ohio that has a full suite of endemic, naturally reproducing and self-sustaining top carnivores including walleye, northern pike and muskellunge. The later is the Great Lakes subspecies (*Esox masquinongy masquinongy*), and so represents a vitally important area for genetic and habitat conservation. Given the propensity for muskellunge to differentiate into unique strains, the population in the Grand River may well be a truly endemic strain. As it stands, it is the last naturally reproducing muskellunge population found in any of Ohio's Lake Erie tributaries.

Considerable improvement in fish communities occurred between 1995 and 2004 in Big Creek, consequently to dechlorinization of the Chardon WWTP effluent in June of 1995. The improvement was most apparent in an increased number of fish species, an overall increased relative abundance of most fishes, and a decrease by roughly half in the relative composition of pollution tolerant species. All sites on Big Creek met the IBI biocriterion for WWH. Like the Grand River, Big Creek is deeply incised within a steep valley. Significant portions of the valley and slope to the uplands are preserved as conservation areas through private easements, Lake Metroparks, the Cleveland Museum of Natural History, and the Geauga Park District. The challenge for Big Creek now is to prevent suburban development from saturating the uplands and eroding the gains made by improved sewage treatment and land conservation.

Direct tributaries to Big Creek sampled since 2000 include Cutts Creek, Jenks Creek, Aylworth Creek, East Creek and Jordan Creek. Jordan Creek and East Creek did not meet the biocriterion for WWH headwaters; however, in East Creek, numerous salamanders were collected in the riffles, suggesting that it functions as a primary headwater stream, and the IBI score may not accurately reflect water quality or aquatic life use attainment. Cutts Creek and Aylworth Creek are similar to East Creek in that they also function equally as a primary headwater stream at the locations sampled. Jordan Creek, at the location sampled, was lacking in habitat, being primarily bedrock with little or no cover. A follow-up sample should be collected to verify the status of its aquatic life use. Jenks Creek is a beautiful, fully attaining headwater stream well-worth preserving.

Big Creek was evaluated from its headwaters in the vicinity of the Chardon WWTP to Fay Road. The macroinvertebrate communities were degraded both upstream and downstream from the WWTP. There was no indication of a further impact from the WWTP discharge. Sensitive taxa diversity remained about the same or was slightly higher and the predominance of tolerant organisms did not increase downstream from the WWTP. The impact observed was attributed to urban development but should be further investigated to see if there are any specific improvements or unknown sources of impairment that can be corrected. Community performance gradually improved downstream with exceptional communities present at Williams Road and Fay Road. The middle reach of Big Creek (Woodin Rd. to SR 608) was characterized by coolwater/coldwater macroinvertebrate communities.

The Big Creek tributaries Cutts Creek, Jenks Creek, East Creek, and Jordan Creek were all supporting coolwater/coldwater macroinvertebrate communities. Cutts Creek, Jenks Creek, and Jordan Creek were only meeting WWH expectations while East Creek was supporting an exceptional community. Increased development in this basin may be depressing community diversity and composition compared to the Paine and Mill Creek basins.

PROBLEM STATEMENTS

PROBLEM 1

BACKGROUND: Based on the 2000 Census data, the projected population growth for all the counties located within the Lower Grand River Watershed is expected to significantly increase. Residential development is increasing rapidly in both Chardon and Concord Townships located within HUC 04110004060060 (Big Creek [except Kellogg Creek]). Riparian buffers and ground water flow, being integral to sustaining high quality biological communities, must be given consideration in plans for development. It has been determined that the remaining sensitive lands, including riparian buffers, core forest areas, and pristine wildlife habitat, should be put under permanent protection through conservation easements, fee simple purchases, etc.

PROBLEM STATEMENT: NEED FOR FUNDING FOR LAND PROTECTION EFFORTS

All of the streams within this subwatershed are currently in attainment. Land protection of critical natural areas is paramount to maintaining the attantaiment status of the Grand River and it tributaries. Currently there are 2495.52 acres of permanently protected land in subwatershed HUC 04110004060060 (Big Creek [except Kellogg Creek]). Grand River Partners, Inc. Land Protection Priority List has identified 4,870.34 acres of priority land for protection in this subwatershed (Big Creek [except Kellogg Creek]). This land includes high quality natural resources including riparian buffers, core forests, high quality streams, coldwater streams, upland forests, wetlands, and more.

GOALS:

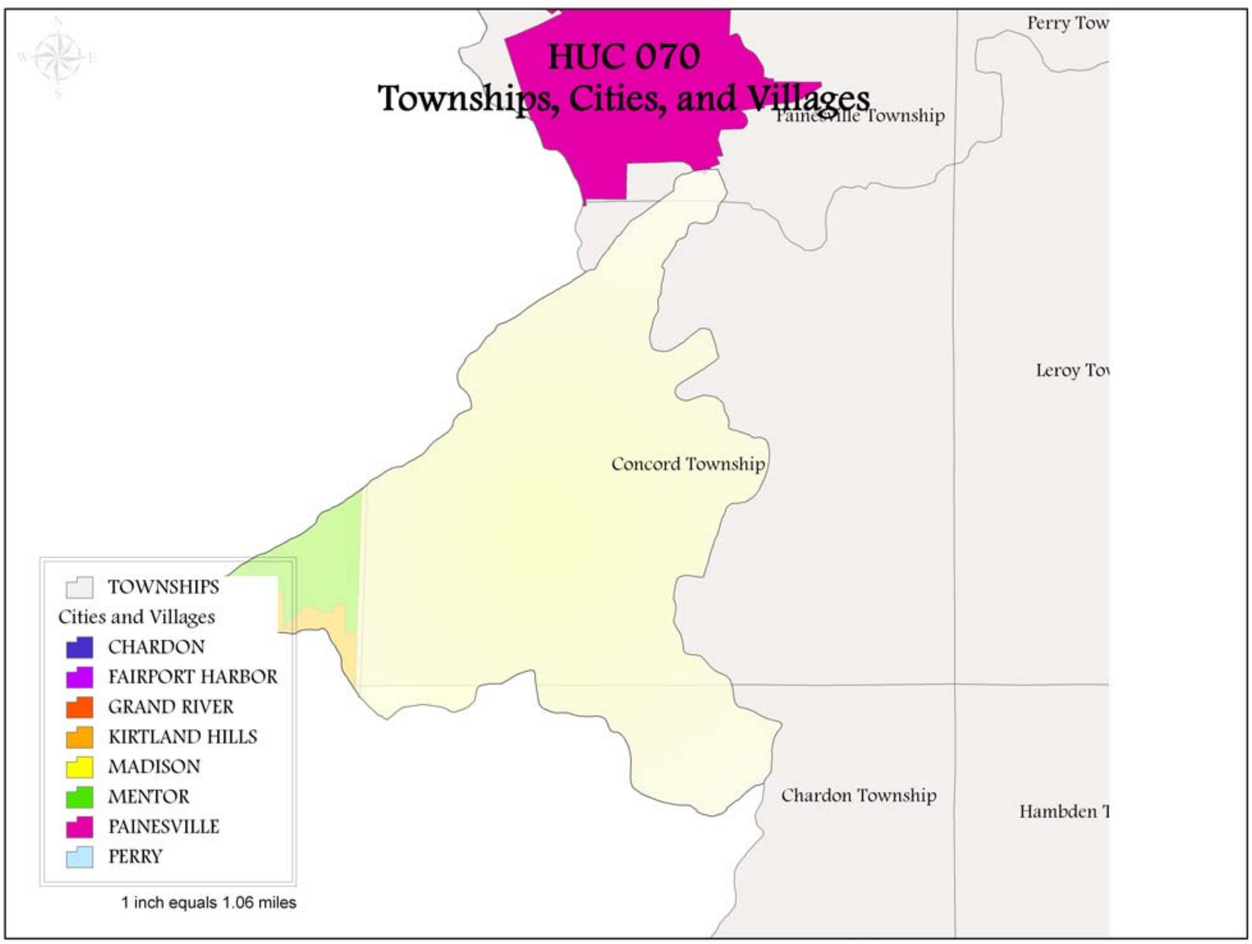
2. Work to secure funding to preserve pristine water quality by protecting an additional 4,870.34 acres of high quality land within subwatershed 04110004060060 (Big Creek [except Kellogg Creek]).

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Permanent protection of 4,870.34 acres of subwatershed 04110004060060 (Big Creek [except Kellogg])	≈$21,316,530 (≈$4,500/ acre conservation easement value)	Grand River Partners, Inc., The Nature Conservancy, Lake SWCD, Geauga Park District, etc.	1/08-ongoing	Number of acres put into conservation easement protection

04110004060070 ~ Kellogg Creek

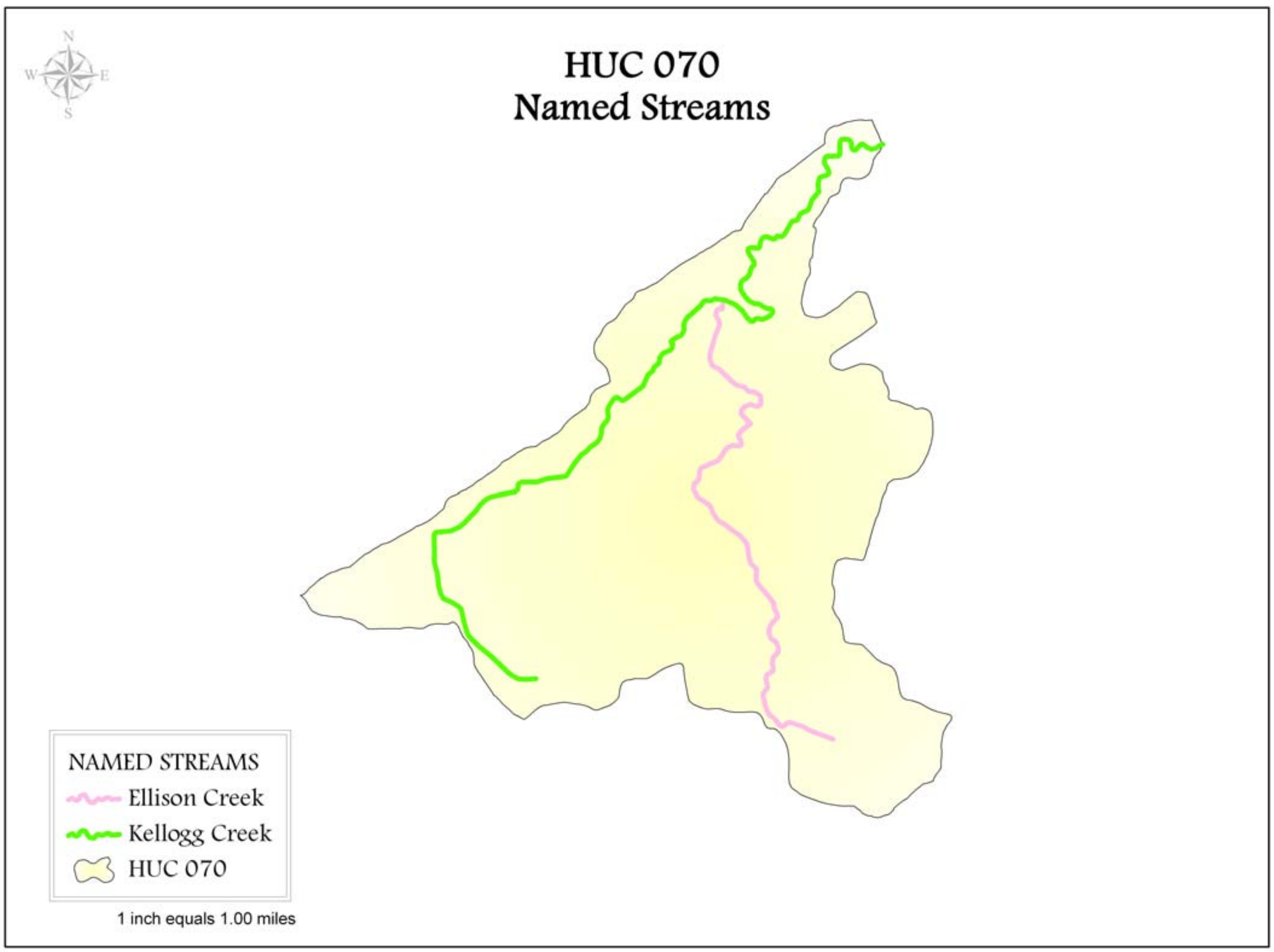
DESCRIPTION~ The 14-digit Hydraulic Unit Code 04110004060070 (HUC 070) is located within the 11-digit HUC 04110004060 know as the Lower Grand River Watershed. HUC 070 is approximately 8356 acres and approximately 13 square miles. This watershed encompasses portions of the Cities of Kirtland, Painesville, and Mentor, and Concord and Painesville Townships in Lake County, and Chardon Township in Geauga County.

Map 1.070~ Communities of HUC 070



Kellogg Creek runs parallel to the Portage Escarpment, and therefore tends to be rich in glacial till. In all likelihood, Kellogg Creek was formerly a *bona fide* coldwater stream; however, suburban development has altered the character of the stream. The headwater reach between King Memorial Road and Johnny Cake Ridge appears to have been channelized in its past, and downstream (upstream SR 86) had a bedload of pulverized shale, an artifact of suburbanized land use. Despite these limitations, the habitat in Kellogg Creek is capable of supporting a WWH fish community.

Map 2.070- Named Streams of HUC 070



DEMOGRPAHICS~ Unfortunately, demographic statistics are collected on a per township or per county basis, thus making it difficult to determine the exact numbers for each subwatershed. Therefore, the data for each township located within each subwatershed was examined, and the totals and averages were taken of each; outliers were taken into account. The statistics for the Cities of Kirtland, Painesville, and Mentor, and Concord and Painesville Townships in Lake County, and Chardon Township in Geauga County were utilized to determine the information below.

Total Population~

The total population for HUC 070 is approximately 38,607 with a 49.17/ 50.83% male to female ratio. The largest age group represented is the 35 to 44 years group (17.45% of the total population), followed by the 45 to 54 years group (16.87%), and the 25 to 34 years group (11.04%). 29,132 people represent the 18 and older group, which accounts for 75.46% of the total population for the townships located within HUC 070. The average median age represented is 40.0.

The male to female ratio for the state of Ohio is 48.60/ 51.40%. The largest age group represented is the 35 to 44 years groups (15.90% of the total population), followed by the 45 to 54 years group (13.80%), and the 25 to 34 years group (13.40%). The median age for the people who reside in Ohio is 36.2.

Educational Attainment~

Of the 26,564 people who are over the age of 25 in the townships within the HUC 070 subwatershed, the majority education level is high school graduate

(32.37%), followed by some college with no degree (23.20%), and Bachelor's degree received (19.16%).

Employment Status~

Approximately 21,619 people over the age of 16 in the Cities of Kirtland, Painesville, and Mentor, and Concord and Painesville Townships in Lake County, and Chardon Township in Geauga County, are currently in the workforce. There are approximately 619 (2.04%) who are currently unemployed.

Household by type~

There are approximately 14,797 households in the Townships located within the HUC 070, of which 11,024 (74.50%) are family households. The average family size is 3.06 people.

Income (1999)~

The average median household income in 1999 for individual households in the Cities of Kirtland, Painesville, and Mentor, and Concord and Painesville Townships in Lake County, and Chardon Township in Geauga County was $60,034. The majority of the households had an income of $50,000 to $74,999 (24.29%), followed by $35,000 to $49,999 (16.87%), and $75,000 to $99,999 (15.92%).

The average median family income in 1999 for families in the Cities of Kirtland, Painesville, and Mentor, and Concord and Painesville Townships in Lake County, and Chardon Township in Geauga County was $67,328. The majority of families had an income of $50,000 to $74,999 (26.07%), followed by $75,000 to $99,999 (19.35%), and $35,000 to $49,999 (16.60%).

The average median earnings for a male, full time, year round worker were $47,110 and $31,180 for a female, full time, year round worker.

Below Poverty Level (1999)~

There are 1,373 individuals within the HUC 070 subwatershed, for whom poverty status was determined. Of those, approximately 296 families are represented, and 150 are families with a female householder with no male present.

Occupation~

The residents of the Cities of Kirtland, Painesville, and Mentor, and Concord and Painesville Townships in Lake County and Chardon Township in Geauga County represent the following occupations; 7,865 management professionals, 2,579 service occupations, 5,886 sales and office occupations, 44 farming, fishing, and forestry occupations, 1,702 construction, extraction and maintenance occupations, and 2,912 production, transportation, and material moving occupations.

Race~

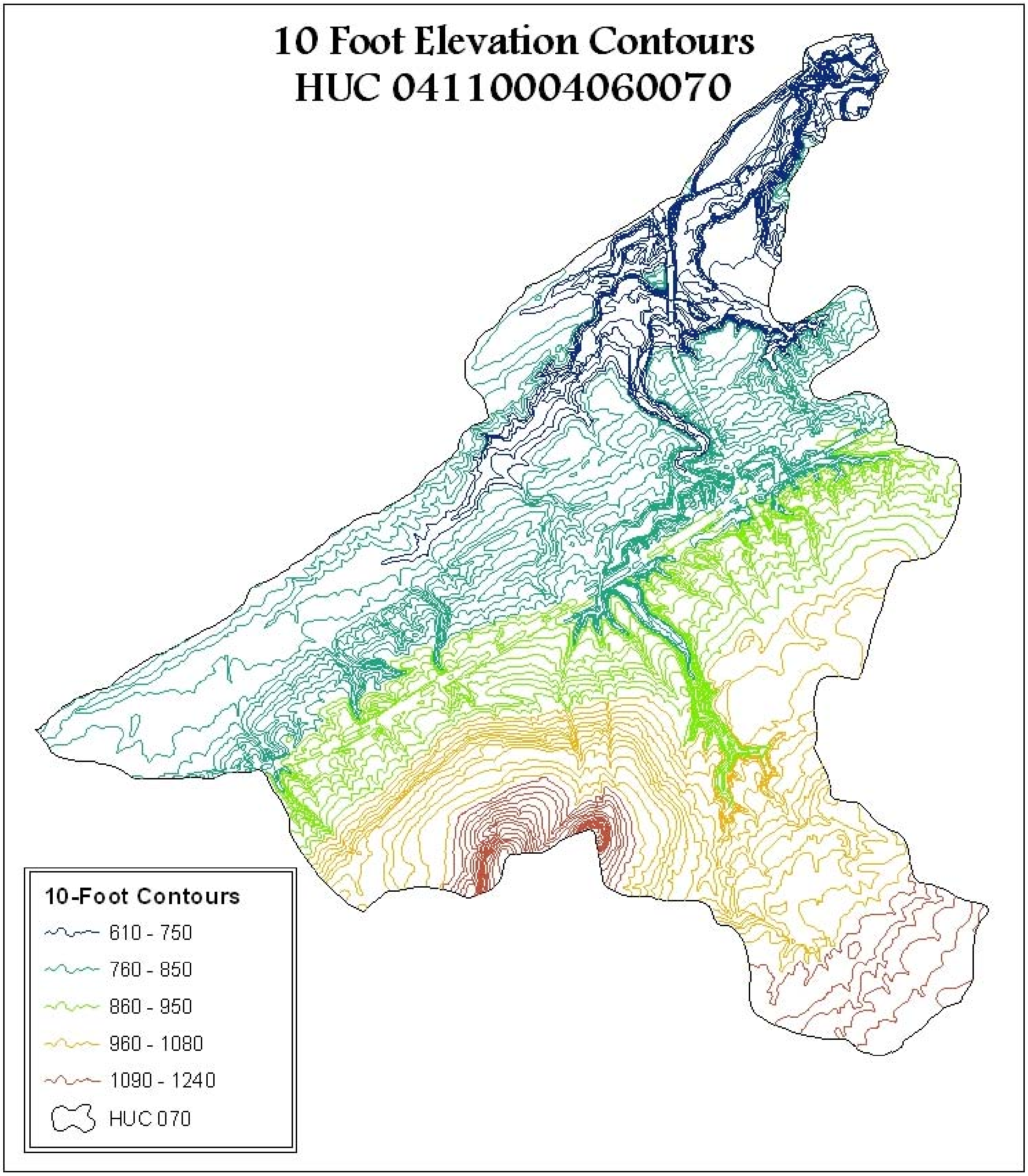
Approximately 97.99% of the population of the HUC 070 is white, 0.95% is African American, and 0.71% is Asian.

Other~

Within the HUC 070, approximately 79 residences are lacking complete plumbing facilities, 43 are lacking complete kitchen facilities, and 127 are without telephone service.

TOPOGRAPHY~ The majority of HUC 070 is located within the West Tributary Project Area of the Grand River Watershed. This area is known for its high bluffs, the cold water streams that flow from the high elevations, and the gorge which leads to the Grand River. HUC 070 has drastic elevation changes at it approaches the river, which gives the Grand River its amazing gorge and shale bluffs. The highest point in HUC 070 is 1240 feet and the lowest is 610 feet.

Map 3.070- 10 foot contours of HUC 070



SOILS~ There are four soil groups represented within HUC 070; the Darien – Mahoning – Sebring (approximately 3,225 acres), the Platea – Pierpont – Orrville (approximately 3,450 acres), Conotton – Conneaut – Tyner (approximately 968 acres), and Mahoning – Ellsworth – Urban Land (approximately 718 acres) groups.

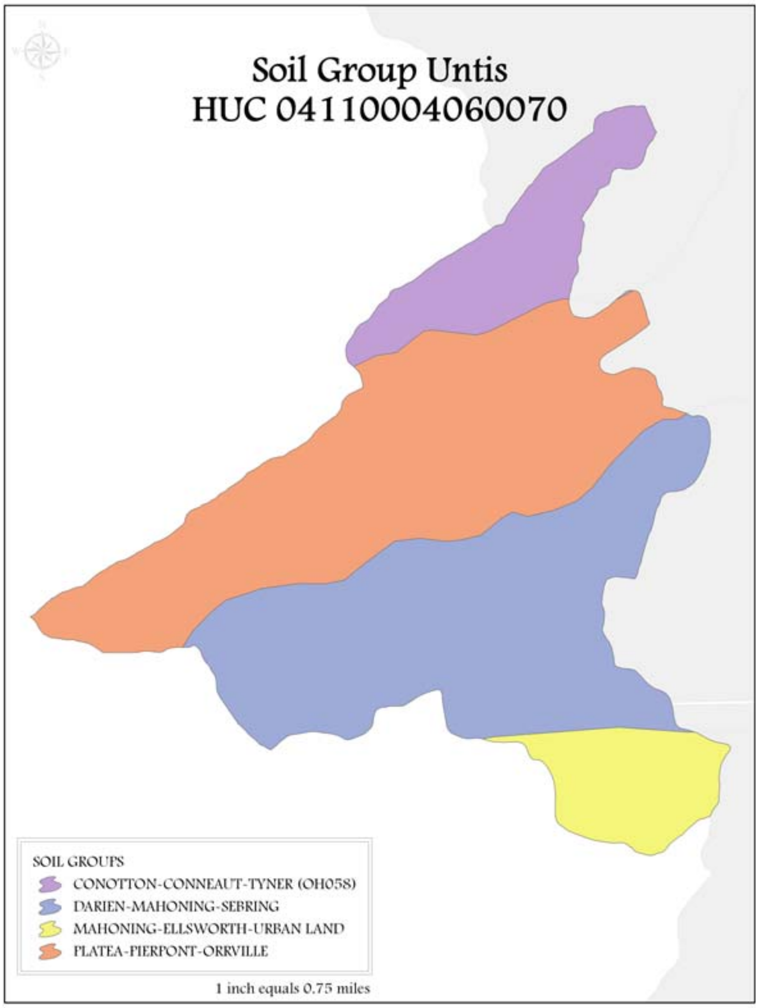
Darien~ Mahoning~ Sebring: These soils are nearly level to sloping, somewhat poorly drained that formed in silty or loamy glacial till on till plains. Most areas are in natural shrubs and trees, but some areas are used for cultivated crops, pasture, and residential development. Wetness and slow or very slow permeability severely limit most uses. Water usually ponds in low areas after a rainfall. Erosion is a hazard in sloping areas that are used for cultivated crops.

Platea~ Pierpont~ Orrville Group: This association is deep, nearly level to moderately steep, somewhat poorly drained to moderately well drained silty soils on glaciated uplands. This soil is found in undulating and hilly areas, but steep soils occur along rivers and streams including the Grand River. Grapes and small fruits are grown where the climate is suitable, particularly where air drainage is good. Very slow permeability, slope, and seasonal wetness are limitations for many nonfarm uses in this association.

Conotton~ Conneaut~ Tyner: These soils are nearly level and gently sloping, poorly drained and somewhat poorly drained soils that formed in silty glacial till or loamy material over silty glacial till on the lake plain. This soil group is located on slightly undulating broad flats on the lake plain. These soils are mostly covered by natural brush and trees, except where residential development has occurred. Most undeveloped areas are not drained. Some adequately drained areas are used for nurseries. Wetness is the main limitation for farming.

Mahoning- Ellsworth- Urban Land: These soils are nearly level to very steep, somewhat poorly drained and moderately well drained that formed in silty or loamy glacial till on till plains. This mapping unit is found on long, gently sloping and short, undulating side slopes and broad flats in dissected areas along drainageways. Use of this map unit is diverse and includes urban and residential development, cultivated crops, and natural shrubs and trees. Wetness and the erosion hazard limit these soils for cultivated crops. Wetness also limits residential and urban development.

Map 4.070- Soil Groups of HUC 070



A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. This lack of oxygen in the soil can lead to the formation of certain observable characteristics in hydric soils, such as a thick layer of organic matter (non-decomposed plant materials) in the upper part of the soil column. Other observable features include oxidized root channels and redoximorphic features (concentrations and depletions of Iron and other elements, i.e., mottling, gleying). The following National Soil Information System (NASIS) criteria reflect those soils that may meet the definition of hydric soils.

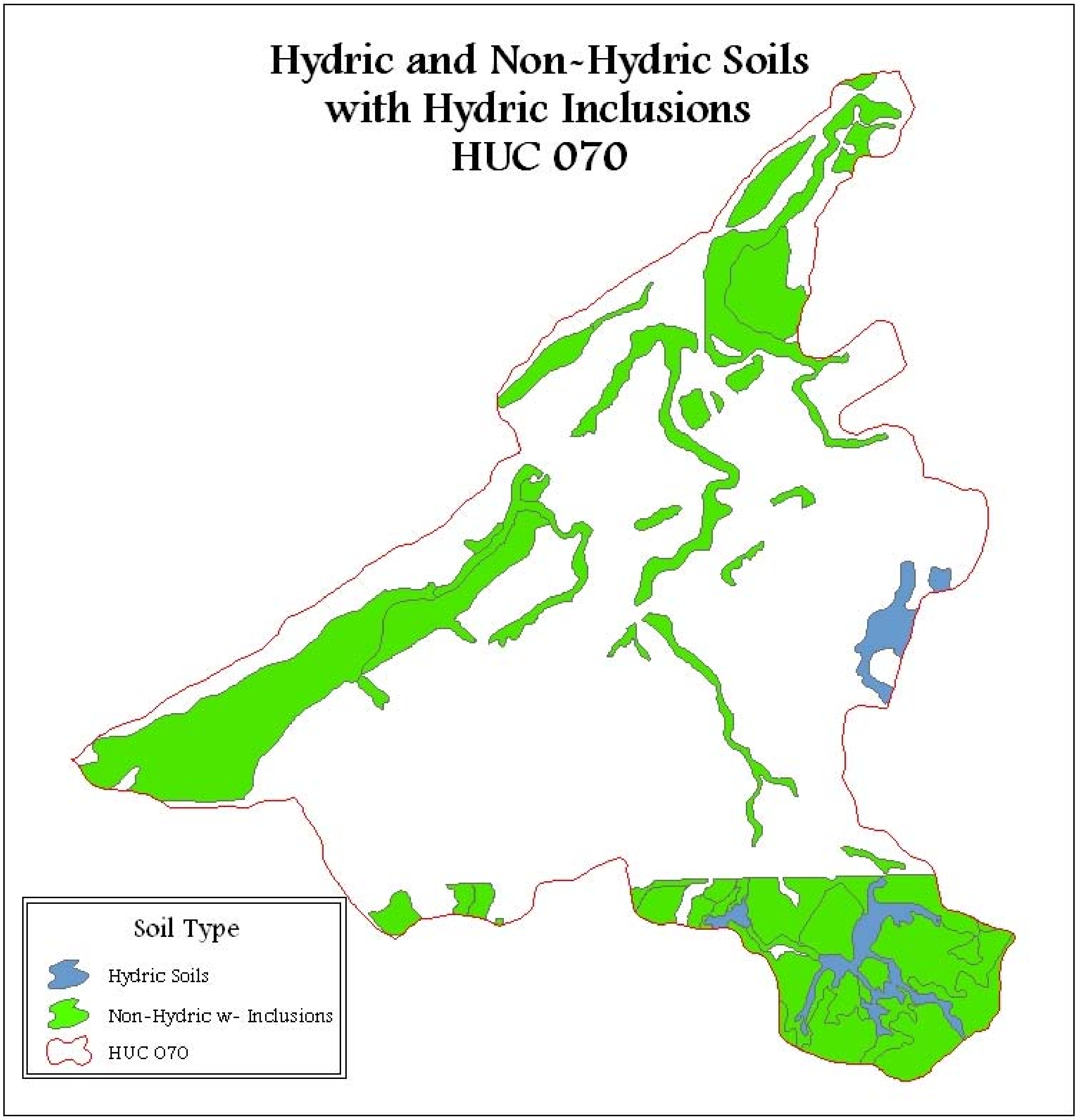
- All Histels except Folistels and Histosols except Folists, or
- Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:
- Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or
- poorly drained or very poorly drained and have either:
    - water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils
    - water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or
    - water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or

- Soils that are frequently ponded for long duration or very long duration during the growing season, or
- Soils that are frequently flooded for long duration or very long duration during the growing season.

In HUC 070, there are approximately 202 acres of hydric soils.

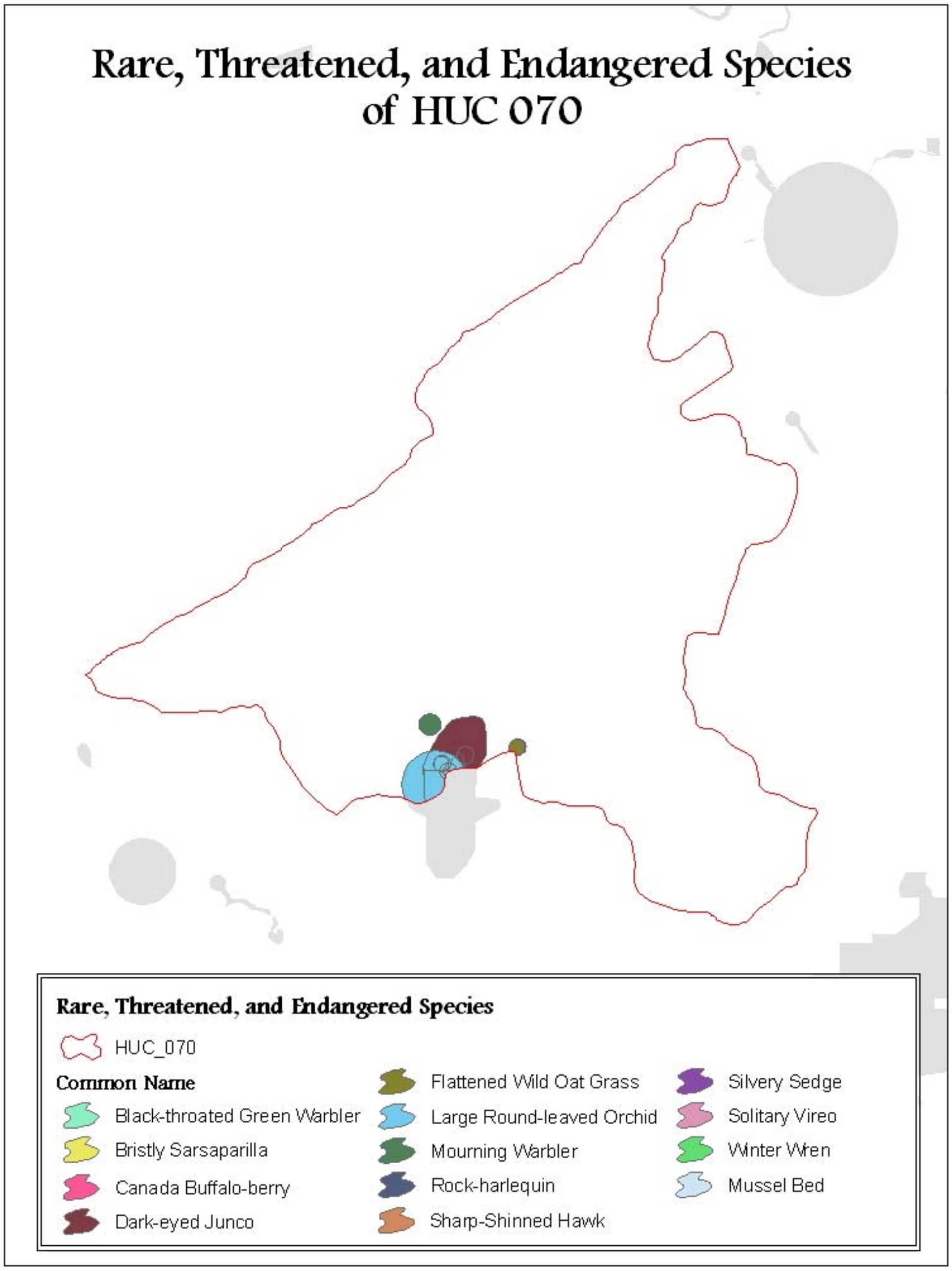
Non hydric soils can be of major importance to water quality as well. Many non-hydric soil types contain small areas of hydric soils, or hydric inclusions. These soils are generally not associated with having the properties of hydric soils, but the do have small pockets, which are too small to have been mapped by the soils surveys, to be considered hydric. Soil Survey books generally do not map "inclusions" of different soil types if the map units are less than 2 acres in size. These inclusions can be wetland soils within an upland soil series. Sometimes, the description will include the types of soils that are the most common inclusions in the series. HUC 070 contains roughly 2,325 acres of non hydric soils with hydric inclusions.

Map 5.070- Hydric and Non-hydric Soils of HUC 070



RARE, THREATENED, and ENDANGERED SPECIES- The Grand River Watershed provides the perfect habitat for many rare, threatened, and endangered species. In fact, the Ohio Department of Natural Resources, Division of Wildlife recognized the unparalleled biodiversity and habitats of the Grand River Watershed, and chose this watershed to reintroduce the wild turkey, river otter, and snowshoe hare. The following species are found within HUC 070 in the Grand River Watershed; black-throated green warbler, bristly sarsaparilla, Canada buffalo-berry, dark-eyed junco, flattened wild oat grass, large round-leaved orchid, mourning warbler, rock-harlequin, sharp-shinned hawk, silvery sedge, solitary vireo, winter wren, non-calcareous cliff communities, and hemlock-hardwood forest.

Map 6.070- Rare Species of HUC 070



DAMS~ There are 18 dams located with in the Lower Grand River Watershed. In HUC 070 there are five dams; the *Hoose Road Retention Dam, Lake Erie College Dam, Little Mountain Dam A, Quail Hollow Lake Dam,* and the *Brightwood Lake Dam.*

- The *Hoose Road Retention Dam*, NID OH002833, is located in the City of Mentor, Lake County. This is a federally owned, earthen dam, located on an unnamed tributary to Kellogg Creek. The purpose for this dam is strictly for flood control and stormwater management, and is .73 acres in size. The drainage area of this dam is 0.87 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Hoose Road Retention Dam* is high, meaning that a loss of human life is probable.

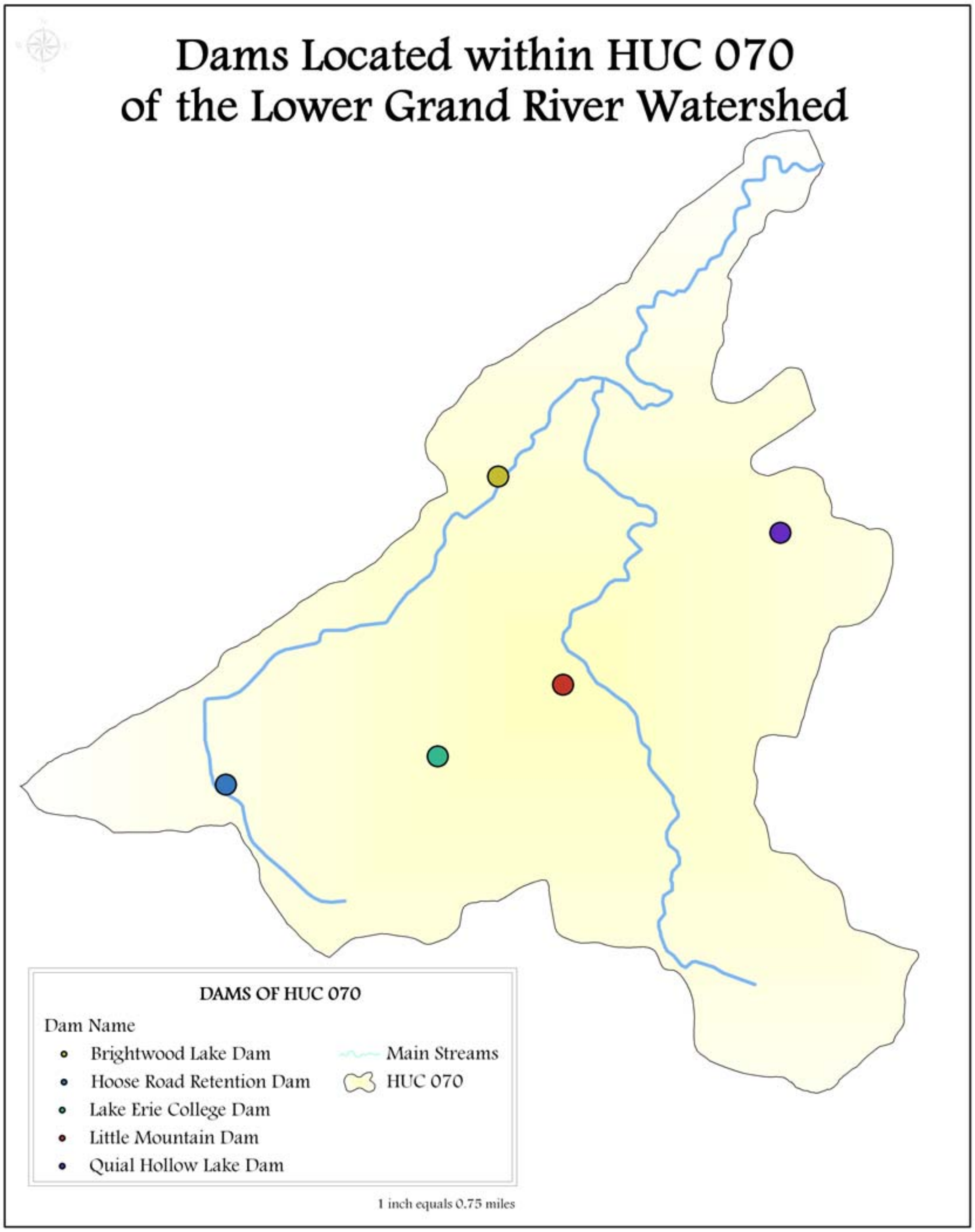
- The *Lake Erie College Dam*, NID OH001873, is located in Concord Township, Lake County. This is a privately owned, earthen dam, located on an unnamed tributary to Kellogg Creek. The purpose for this dam is strictly recreational, and is 5.7 acres in size. The drainage area of this dam is 0.29 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Lake Erie College Dam* is low, meaning that no loss of human life is probable and economic and/or environmental losses, disruption of lifeline facilities, and other impacts would not be expected.

- *Little Mountain Dam A*, NID OH003012, is located in Concord Township, Lake County. This is a privately owned, earthen dam. The purpose for this dam is strictly for water supply. The potential hazard to the downstream area resulting from failure or misoperation of the *Little Mountain Dam A* is significant; meaning that no loss of human life is probable, but economic and/or environmental losses, disruption of lifeline facilities, and other impacts would be expected.

- The *Quail Hollow Lake Dam*, NID OH00934, is located in Concord Township, Lake County. This is a privately owned, earthen dam, located on an unnamed tributary to Ellison Creek. The purpose for this dam is for both the water supply and recreational, and is 7.3 acres in size. The drainage area of this dam is 0.33 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Quail Hollow Lake Dam* is low, meaning that no loss of human life is probable and economic and/or environmental losses, disruption of lifeline facilities, and other impacts would not be expected.

- The *Brightwood Lake Dam*, NID OH001874, is located in Concord Township, Lake County. This is a privately owned, earthen dam, located on Kellogg Creek. The purpose for this dam is strictly for recreation, and is 11.4 acres in size. The drainage area of this dam is 5.31 square miles. The potential hazard to the downstream area resulting from failure or misoperation of the *Brightwood Lake Dam* is high, meaning that a loss of human life is probable.

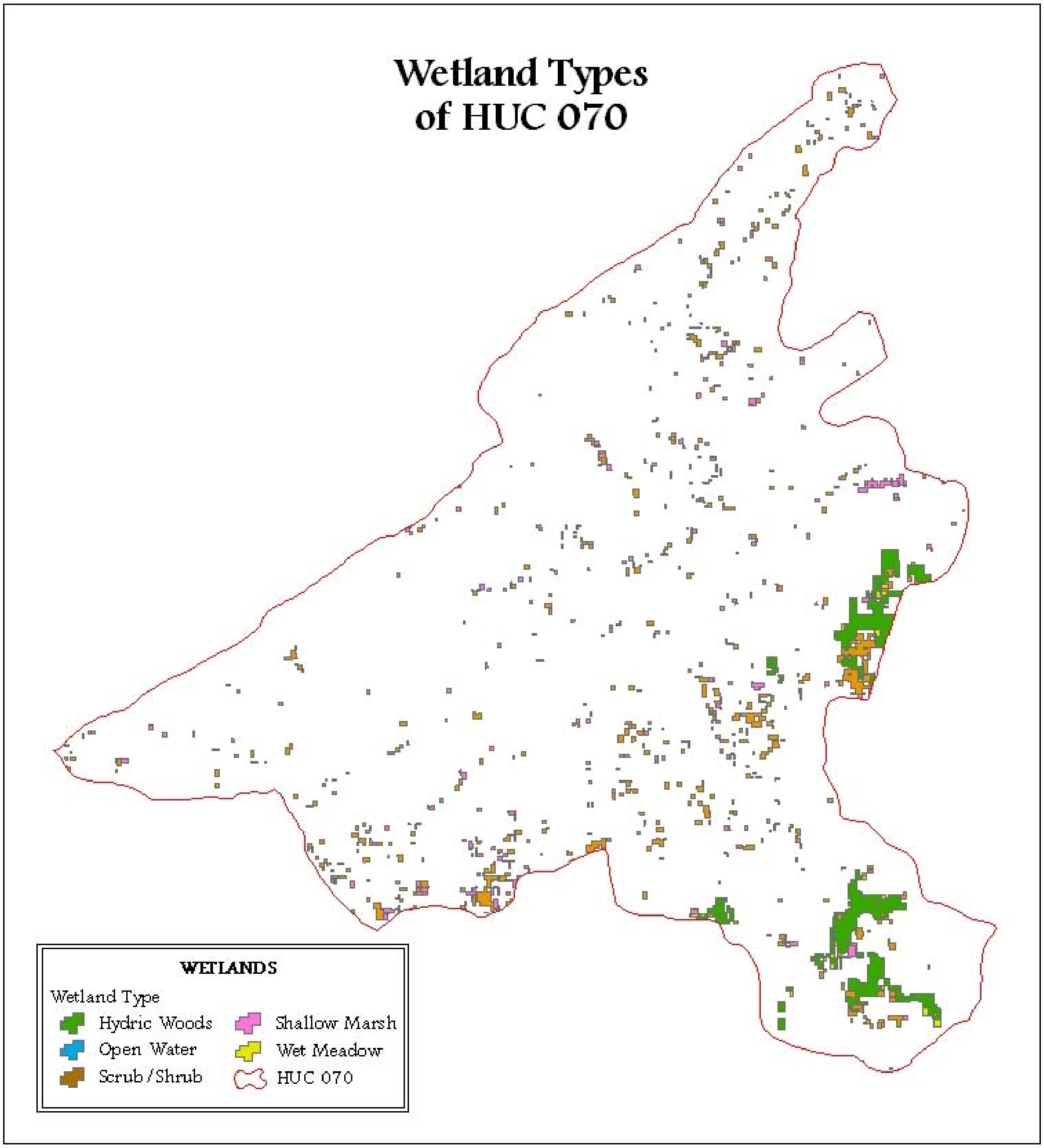
Map 7.070-Dams of HUC 070



WETLANDS- Wetlands are typically highly productive habitats, often hosting considerable biodiversity. The Army Corps of Engineers and the Environmental Protection Agency define wetlands as; "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions". Wetlands are found under a wide range of hydrological conditions, but at least some of the time water saturates the soil. The result is a hydric soil, one characterized by an absence of free oxygen some or all of the time, and therefore called a "reducing environment." Plants called hydrophytes specifically adapted to the reducing conditions presented by such soils can survive in wetlands, whereas species intolerant of the absence of soil oxygen (called "upland" plants) can not survive. Adaptations to low soil oxygen characterize many wetland species.

HUC 070 has approximately 420 acres of wetlands; 157 acres of Hydric Woods, .31 acres of open water wetlands, 190 acres of scrub/shrub, 64 acres of shallow marsh, and 9 acres of wet meadow.

Map 8.070-Wetlands of HUC 070



DRASTIC: The DRASTIC maps, produced by the Ohio Department of Natural Resources, show the pollution potential for groundwater systems. The DRASTIC mapping system allows the pollution potential of any area to be evaluated systematically using the following existing information about an area:

D= Depth to Water

R= Net Recharge

A= Aquifer Media

S= Soil Media

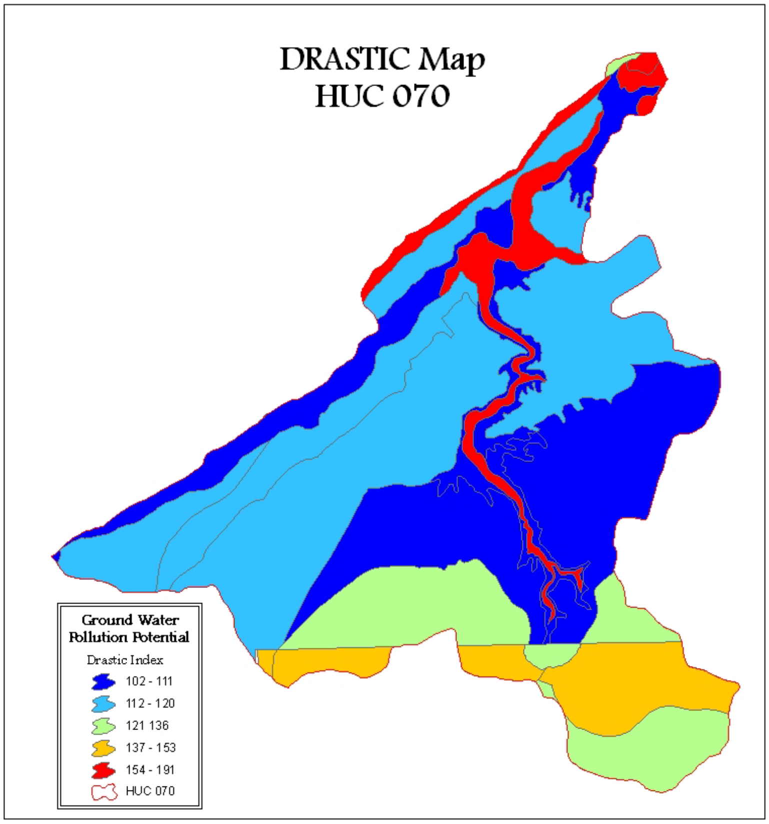
T= Topography

I= Impact of the Vadose Zone Media

C= Hydraulic Conductivity of the Aquifer

In evaluating an area's vulnerability to contamination, the DRASTIC mapping system assumes a contaminant with the mobility of water is introduced at the surface and flushed into the groundwater by precipitation. A pollution potential map can assist in developing ground water protection strategies. By identifying areas more vulnerable to contamination, officials can direct resources to areas where special attention or protection efforts might be warranted. This information can be utilized effectively at the local level for integration into land use decisions and as an educational tool to promote public awareness of ground water resources. Pollution potential maps may be used to prioritize ground water monitoring and/or contamination clean-up efforts. Areas that are identified as being vulnerable to contamination may benefit from increased ground water monitoring for pollutants or from additional efforts to clean up an aquifer. HUC 070 has a maximum DRASTIC index of 191. Approximately 6.68% of HUC 070 has a high DRASTIC index.

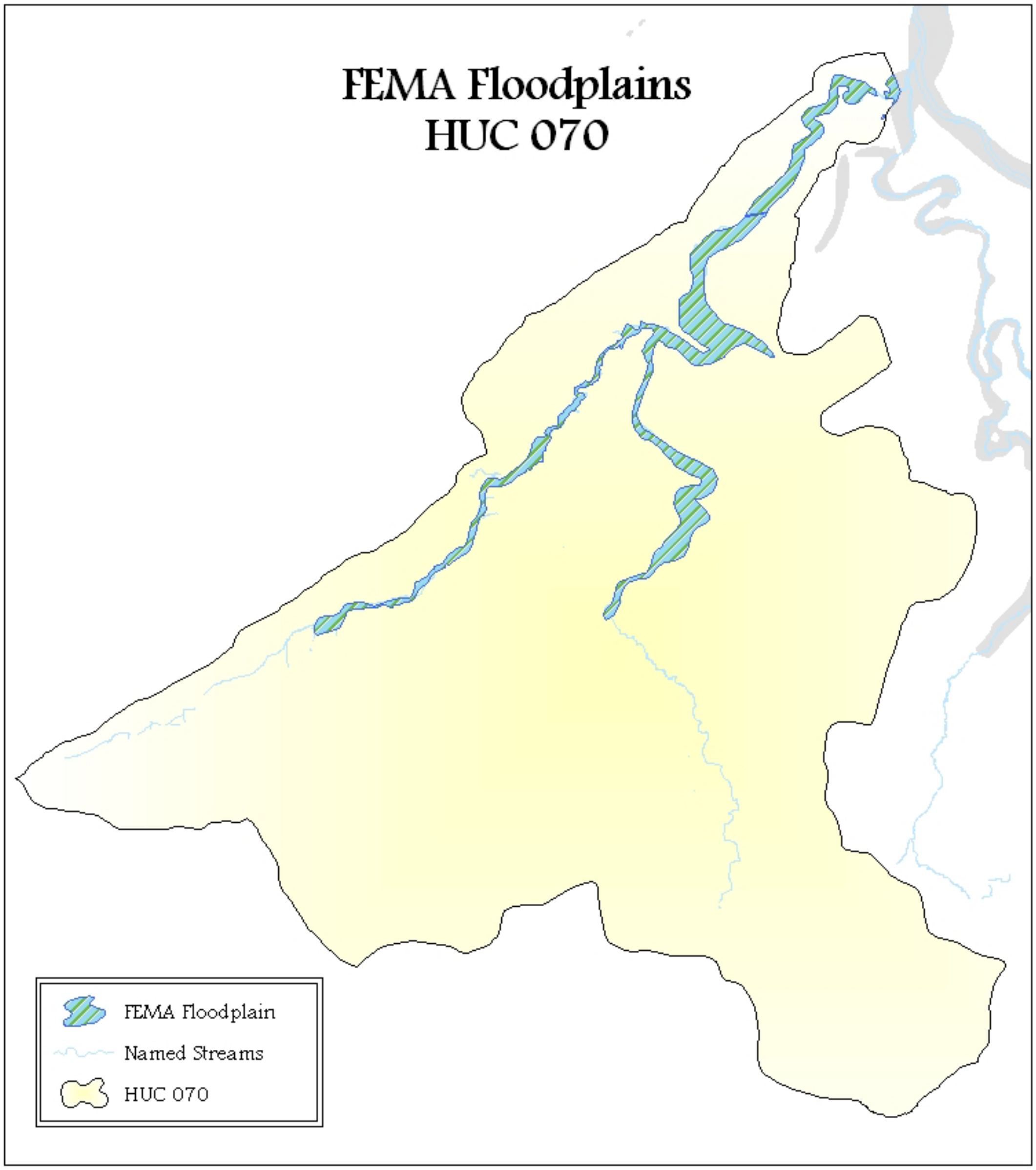
Map 9.070-DRASTIC of HUC 070



FLOODPLAINS- Floodplains are the low, flat, periodically flooded lands adjacent to rivers, lakes and oceans and subject to geomorphic (land-shaping) and hydrologic (water flow) processes. FEMA, the Federal Emergency Management Agency, has developed areas within watersheds that are designated as 100-year and 500- year floodplains. A "100-year flood" is defined as a flood event that has a 1 in 100 chance of occurring in any given year, and a 500-year flood has a 1 in 500 chance. HUC 070 has 299 acres of designated 100-year floodplain, which represents approximately 3.6% of the watershed.

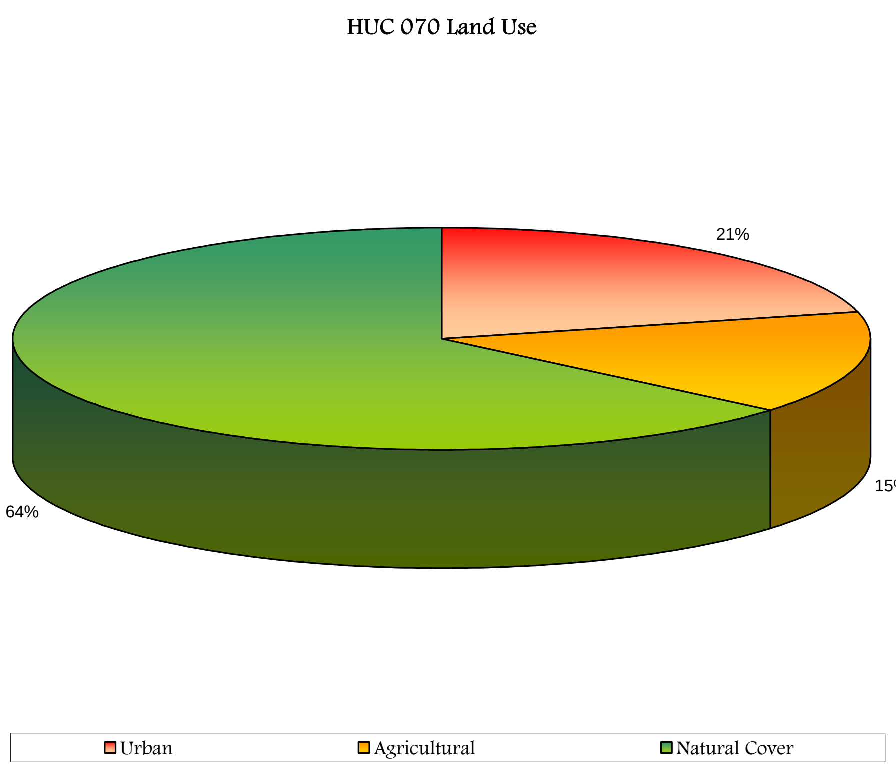
Currently both Lake and Geauga Counties have an ordinance in place which protects the riparian areas and floodplains of the Grand River and its named tributaries.

Map 10.070-Floodplains of HUC 070



LAND USE~ HUC 070 is a relatively urban subwatershed. The majority of this watershed is in natural cover, but urban areas are much more prevalent than in other subwatersheds. Suburbanization is a major threat to this area of the Grand River Watershed. Here, open land is quickly being split and sold to developers. Population density is relatively high (22.9), and is inspected to grow due to the increase of development in the area. There are no remaining core forest areas in this subwatershed.

Chart 1.070~ Landuse in HUC 070



Although the majority of the watershed remaining is in natural cover, no core forest blocks are found within this subwatershed. The Nature Conservancy realized the importance of these large tracts of forest, or "Core Forest Areas", for not only their natural resources value but their importance for breeding populations as well. Core Forest Areas are forested areas of 100 acres or more with a forested buffer zone from pastures and agriculture, and no roads within at least 300 meters. These numbers were determined by the habits and lifecycles of certain forest species; a pair of pileated woodpeckers will need at least 100 acres in order to breed, certain amphibian populations use forest areas up to 200 meters away from their wetland habitat for breeding purposes, and cowbirds will penetrate up to 150 meters of the core forest areas. HUC 070 contains no Core Forest Areas. Unfortunately, due to the increased development in HUC 070, no large tracts of forest remain.

GRPI~ LAND PROTECTION PRIORITY LIST~ Grand River Partners, Inc.'s goal is to protect the natural resources of the Grand River and its watershed. Grand River Partners, Inc. utilizes the conservation easement as the primary tool to protect such resources. Conservation easements are a great tool to protect resources on private lands but still maintain them in private hands. The Grand River watershed is approximately 712 square miles. Obviously Grand River Partners, Inc. cannot protect all of the 712 square miles (455,000 acres) with conservation easements. Grand River Partners, Inc. believes that water quality can be protected by conserving the "right" 25% of a watershed. In the specific case of the Grand River, this represents roughly 114,000 acres. Protecting 114,000 acres is an achievable goal considering the number of partner organizations and the fact that approximately 25% of the 114,000 acres has already been protected.

The challenge remains to protect the remaining 86,000 acres of the "right" land. To fulfill this goal, Grand River Partners, Inc. developed a parcel based **Land Protection**

Priority List. Before any prioritization process could begin, any parcel less then five acres was removed from the potential list of priorities. To make fair comparisons an analysis of the watershed was conducted to determine the unique areas within the watershed. From this analysis, the Grand River Watershed was divided into 5 distinct project areas based on the unique natural features of each. The parcel prioritization process involved a two tier analysis. The first, Tier 1, involved an analysis of natural resources. The second, Tier 2, involved a strategic analysis that took into account parcel size, proximity to other protected land, and partner priorities.

The Headwaters Project Area consists of the area drained by all the unnamed tributaries that together form the Grand River. The area begins more or less upstream of the crossing with SR 534 at the southern end of the watershed. In summary, important natural resources ranked for each parcel located in the Headwaters Project Area are intact riparian areas, the Grand River main stem, wetlands, unnamed tributaries, floodplains, core forest blocks and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Lowlands Project Area begins at the crossing of SR 534 with the mainstem in the southern portion of the watershed and extends between the 810' contour interval north to the crossing where the Grand River intersects Windsor-Mechanicsville Road. Important Natural Resources identified in the Lowlands Project Area are swamp forests, wetlands, intact riparian areas, core forest blocks, mainstem, rare species, floodplains, TNC subwatershed ranking, and named tributaries. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Gorge Project Area begins at the crossing of the mainstem and Windsor-Mechanicsville Road bridge and extends upstream to the crossing with SR 84. The Gorge Project Area is bordered to the north by the watershed boundary and to the south by the 950' contour interval. The important natural characters of the Gorge are the mainstem, wetlands, floodplains, intact riparian areas, named tributaries, core forest blocks, steep slopes, TNC subwatershed rankings, and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Estuarine/Urban Project Area begins at the State Route 84 crossing with the Grand River and ends in Fairport Harbor Village and Grand River Village at its terminus with Lake Erie. The Estuarine/Urban Project Area includes the subwatershed of Red Creek which extends to the west just north of the City of Painesville. In this project area the mainstem, river access points, wetlands, intact riparian areas, floodplains and named tributaries were considered important natural features. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

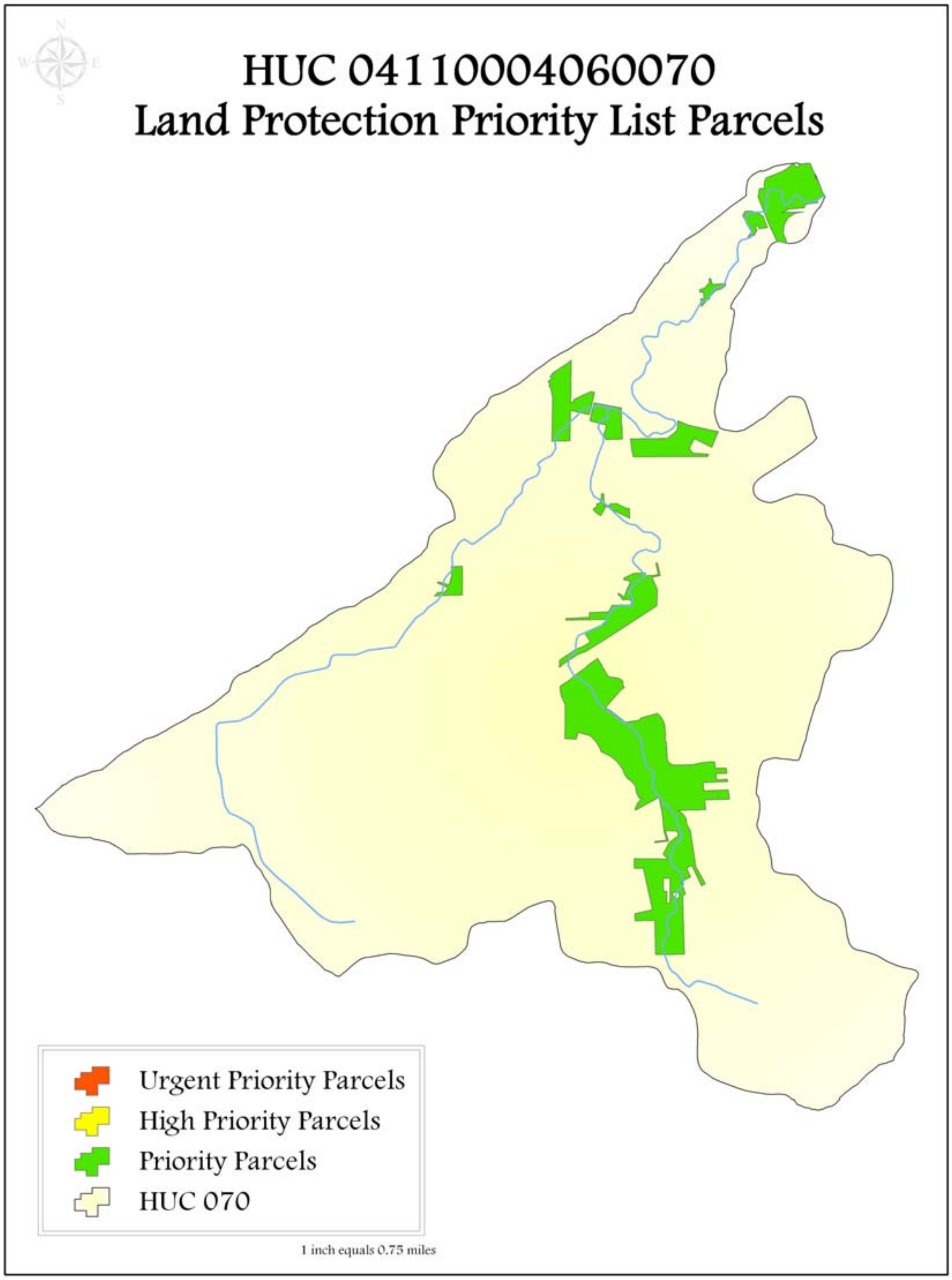
The last area is the Tributaries Project Area which consists of two areas; one is located east of the Grand River Lowlands Project Area, which and includes the subwatersheds of such named tributaries as Mill Creek, Rock Creek and Coffee Creek, and the second project area is located west of the Lowlands Project Area, north of the Headwaters Project Area and south of the Gorge Project Area. This portion of the Tributaries Project Area contains the subwatersheds of such high quality streams as Indian Creek, Phelps Creek, Hoskins Creek, and Paine Creek. Important natural resources considered include, cold water habitat, wetlands, floodplains, core forest blocks, and rare species.

Again each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

Each parcel within the watershed was further evaluated based on additional strategic rankings. These rankings include parcel size, proximity to protected land and partner priorities. Each parcel meeting the acreage requirement, or within a certain distance of existing protected land or included as a priority by a partner organization or agency was weighted more heavily and therefore considered a high priority. A statistical analysis of the final scores was performed and each parcel was categorized as being priority, high priority or an urgent priority parcel.

In HUC 070, there are a total of 605.86 acres of priority parcels. Due to urbanization, this subwatershed does not have the number of urgent priority parcels and high priority parcels that the other subwatersheds in the Lower Grand River Watershed have. Currently there are 175.51 acres of permanently protected land within HUC 070.

Map 11.070- LPPL of HUC 070



IMPERVIOUS SURFACE~ The Conversion of farmland, forests, wetlands, and meadows to rooftops, roads, and lawns creates a layer of impervious surface in the urban landscape. Impervious cover is a very useful indicator with which to measure impacts of land development on aquatic systems. The process of urbanization has a profound influence on the hydrology, morphology, water quality, and ecology of surface waters. Recent research has shown that streams in urban watersheds possess a fundamentally different character than streams in forested, rural, or even agricultural watersheds. The amount of impervious cover in the watershed can be used as an indicator to predict how severe these differences can be. In many regions of the country, as little as ten percent watershed impervious cover has been linked to stream degradation, with the degradation becoming more severe as impervious cover increases.

Impervious cover directly influences urban streams by dramatically increasing surface runoff during storm events. Depending on the degree of impervious cover, the annual volume of stormwater runoff can increase by two to 16 times its predevelopment rate, with proportional reductions in groundwater recharge. In natural settings, very little annual rainfall is converted to runoff and about half is infiltrated into the underlying soils and the water table. This water is filtered by the soils, supplies deep water aquifers, and helps support adjacent surface waters with clean water during dry periods. In urbanized areas, less and less annual rainfall is infiltrated and more and more volume is converted to runoff. Not only is this runoff volume greater, it also occurs more frequently and at higher magnitudes. As a result, less water is available to streams and waterways during dry periods and more flow occurs during storms.

The relationship between impervious cover and subwatershed quality can be predicted by a simple model that projects the current and future quality of streams and other water resources at the subwatershed level. Stream research generally indicates that

certain zones of stream quality exist, most notably at about 10% impervious cover, where sensitive stream elements are lost from the system. A second threshold appears at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition; diminished aquatic diversity, water quality, and habitat scores.

The model classifies streams into one of three categories; sensitive, impacted, and non-supporting. Each stream category can be expected to have unique characteristics as follows:

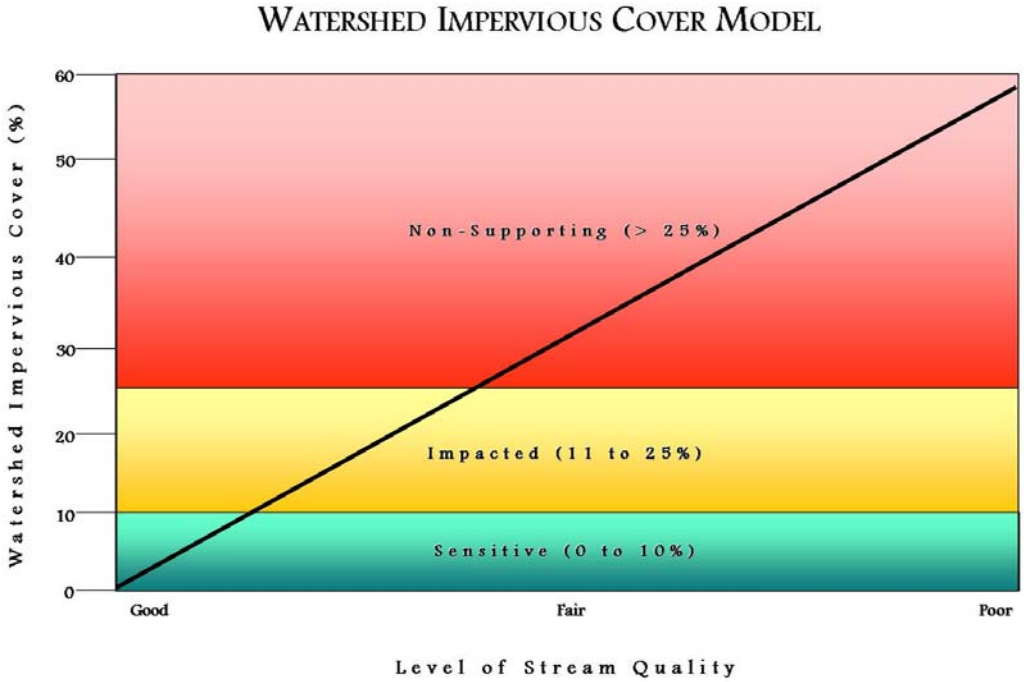
Sensitive Streams: These streams typically have a watershed impervious cover of zero to 10 percent. Consequently, sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Impacted Streams: Streams in this category possess a watershed impervious cover ranging from 11 to 25%, and show clear signs of degradation due to watershed urbanization. Greater storm flows begin to alter the stream geometry. Both erosion and channel widening are clearly evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to

fair levels, with the most sensitive fish and aquatic insects disappearing from the stream.

Non- Supporting Streams: Once watershed impervious cover exceeds 25%, stream quality crosses a second threshold. Streams in this category essentially become a conduit for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, down-cutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated, and the stream substrate can no longer provide habitat for insects or spawning areas for fish. Water quality is consistently rated as fair to poor, and water contact recreation is no longer possible due to the presence of high bacterial levels. Subwatersheds in the non-supporting category will generally display increases in nutrient loads to downstream receiving waters, eve if effective urban BMPs are installed and maintained. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish.

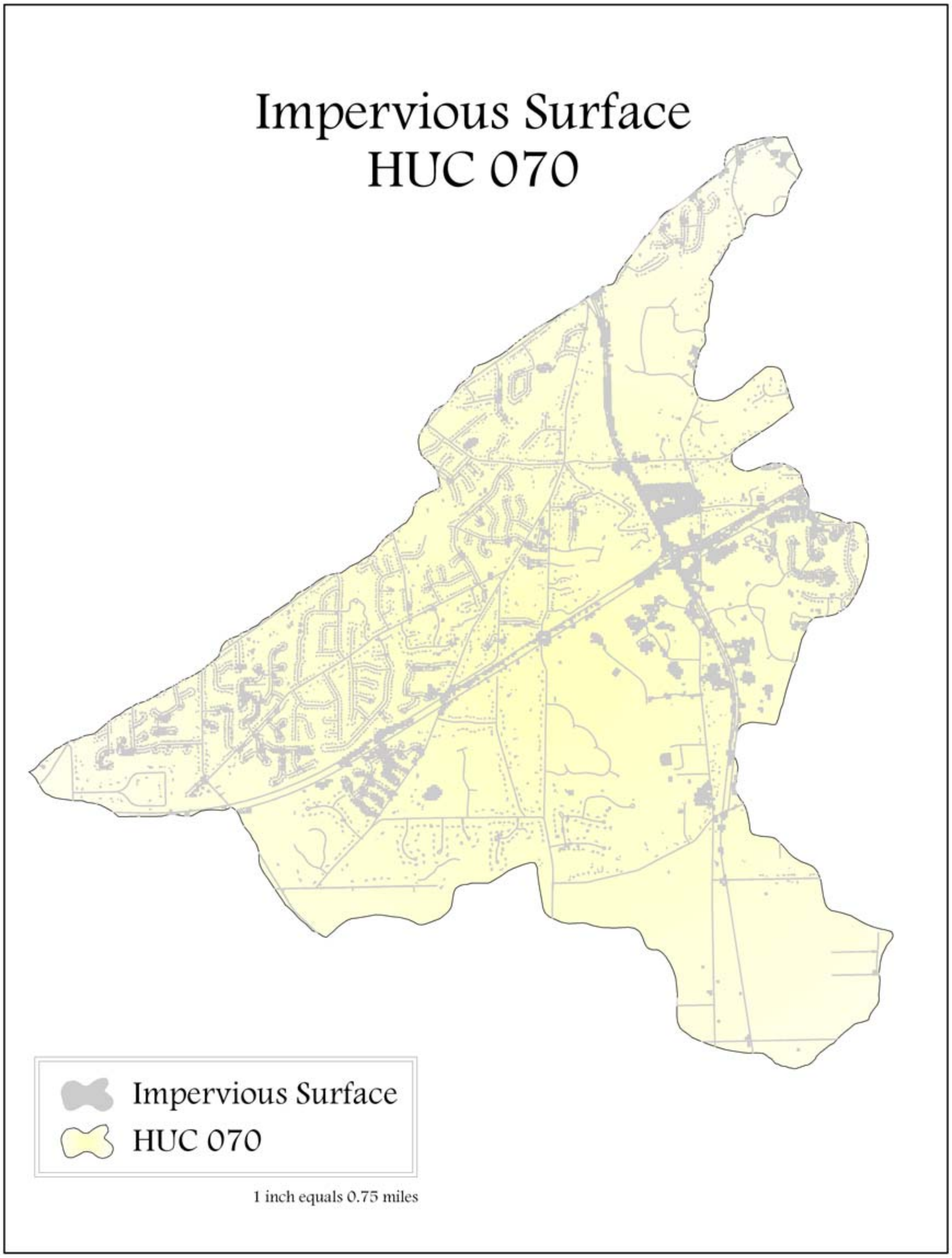
Graph 1.070- Impervious Cover Model



Center for Watershed Protection, Rapid Watershed Planning Handbook

HUC 070 has an impervious cover of approximately 12.16%. Therefore, the streams in this subwatershed are considered "impacted streams" by the impervious surface model. Impacted streams show clear signs of degradation due to watershed urbanization. Greater storm flows begin to alter the stream geometry, carry pollutants into the water, and can raise the temperature of the stream. Both erosion and channel widening are clearly evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with the most sensitive fish and aquatic insects disappearing from the stream.

Map 12.070- Impervious Surface of HUC 070



ATTAINMENT STATUS- *Ohio Water Quality Standards: Designated Aquatic Life Use*

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*

2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*

3) *Cold-water Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie

tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 $mi.^2$ drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

Kellogg and Ellison Creeks- Kellogg and Ellison Creeks have a WWH aquatic life use designation. Ellison Creek is currently meeting this use, albeit narrowly. Kellogg Creek is impaired upstream from I-90, but continues to meet WWH from there to its confluence with Big Creek. Kellogg Creek also has a seasonal salmonid aquatic life use, as is appropriate. The presence of naturally reproduced steelhead trout in Ellison Creek demonstrates that it should also be designated seasonal salmonid habitat. The existing population density and inertia toward continued growth in Concord Township is likely to preclude any recovery of impaired segments and in all probability will push currently attaining segments past their tipping points and into non-attainment. Therefore, the management goal for Kellogg Creek and its tributaries should be directed at minimizing downstream impacts to the Grand River mainstem.

Grand River- Aquatic life in the Grand River is fully attaining standards for Exceptional Warmwater Habitat (EWH) from Sweitzer Road (RM 42.2) to the SR 2 bridge in Painesville (RM 5.2), and is fully meeting standards for Warmwater Habitat (WWH) downstream from the SR 2 bridge. The Seasonal Salmonid use designation currently in place should be retained.

The Grand River is an economic asset to Northeast Ohio, but is especially sensitive to pollution and disturbance because of limited summer base flows. Therefore, regional planning, stream protection policies, comprehensive construction site management plans, construction site performance bonds, identification and preservation of sensitive areas, and above all, defined limits to growth are needed to maintain the biological integrity of the Grand River.

The Grand River is the only Ohio tributary to Lake Erie that harbors a self-sustaining population of Great Lakes Muskellunge, and therefore is a priority for conservation. The Grand River is also has a native population of walleye and northern pike making it singularly unique among Ohio streams. The Grand River and its tributaries provide habitat for many species considered rare by Ohio EPA, or listed as threatened or endangered by the Ohio Department of Natural Resources including 32 macroinvertebrates and freshwater mussel species, and 11 fish species. The single greatest threat to the Grand River basin is suburbanization.

BIOLOGICAL INDICATORS- Fish communities in the Grand River have an exceptionally high degree of biological integrity. This is obvious in the consistently high IBI scores along the length of the mainstem and between sampling years, and is also evident in the unusually high percent composition of pollution intolerant species making up electrofishing samples (Figure 40). Furthermore, the Grand River is one of the few rivers in Ohio that has a full suite of endemic, naturally reproducing and self-sustaining top carnivores including walleye, northern pike and muskellunge. The later is the Great Lakes subspecies (*Esox masquinongy masquinongy*), and so represents a vitally important area for genetic and habitat conservation. Given the propensity for muskellunge to differentiate into unique strains, the population in the Grand River may well be a truly endemic strain. As it stands, it is the last naturally reproducing muskellunge population found in any of Ohio's Lake Erie tributaries.

Kellogg Creek, including Ellison Creek, is the second most suburbanized subwatershed in the Grand River basin. Census data from 2000 shows population densities exceeding 1000 people per square mile in census blocks traversed by SR 84. The most upstream site sampled (Brennel Road, RM 5.7) had a poor fish community, reflecting significant degradation due to residential land use. Fish communities at the remaining downstream sites were stressed as evidenced by a higher-than-expected proportion of tolerant fishes, and fewer than expected numbers of pollution sensitive species. However, despite the evident stress, all the remaining sites at least marginally satisfied the WWH biocriterion owning to the ameliorative influences of riparian buffers, high gradient and groundwater inputs. Ellison Creek is similarly stressed, though more by recent construction than total suburban landuse, and though stressed, the IBI scores at the three locations sampled met the WWH biocriterion. Again, a high gradient and riparian buffers help ameliorate suburban impacts.

The remnant coldwater character of Kellogg Creek and Ellison Creek was evident in the collection of redside dace and naturally reproduced young-of-the-year steelhead trout in both streams. Fish communities in both creeks are not likely to retain their remaining biotic integrity with further increases in suburban development.

Ellison Creek was sampled at three stations and Kellogg Creek at two in 2000 to evaluate stormwater runoff controls associated with the construction of a golf course east of Hermitage Road and adjacent to Ellison Creek. The upstream Ellison Creek station was supporting a diverse community including eight coolwater taxa. The station located downstream from the golf course construction had a marked reduction in diversity of sensitive, and coolwater taxa. Increased siltation was observed at this station, presumably from upstream construction. Sensitive taxa diversity increased slightly near the mouth, but remained well below that present upstream from the golf course. Excessive silt continued to be present at this station. The Kellogg Creek stations sampled in 2000 upstream and downstream from the confluence of Ellison Creek both had impaired communities, but did not exhibit any discernable impact from Ellison Creek. Low sensitive taxa diversity in conjunction with high predominance of flatworms and aquatic sow bugs (pollution facultative) at both stations was probably an indication of enrichment and mild toxicity from the surrounding developed areas. Sampling in 2004 found similar results near the mouth of Ellison Creek with an impaired community that was just barely meeting WWH expectations. Kellogg Creek sampling found a highly degraded community farther upstream at Button Road and near the mouth at SR86 a community that improved to barely meet WWH expectations.

PROBLEM STATEMENTS

PROBLEM 1

BACKGROUND: Kellogg Creek is impaired upstream from I-90, but continues to meet WWH from there to its confluence with Big Creek. The existing population density and inertia toward continued growth in Concord Township is likely to preclude any recovery of impaired segments and in all probability will push currently attaining segments past their tipping points and into non-attainment.

PROBLEM STATEMENT: NEED FOR FUNDING FOR LAND PROTECTION EFFORTS TO MINIMIZE DOWNSTREAM IMPACTS TO KELLOGG CREEK

Currently there are 175.51 acres of permanently protected land in subwatershed HUC 04110004060070 (Kellogg Creek). Grand River Partners, Inc. Land Protection Priority List has identified 605.86 acres of priority land for protection in this subwatershed (Kellogg Creek). This land includes high quality natural resources including riparian buffers, core forests, high quality streams, upland forests, wetlands, and more. Furthermore, the permanent protection of this land will enable Kellogg Creek to have a valid chance of maintaining its attainment status downstream from I-90.

GOALS:

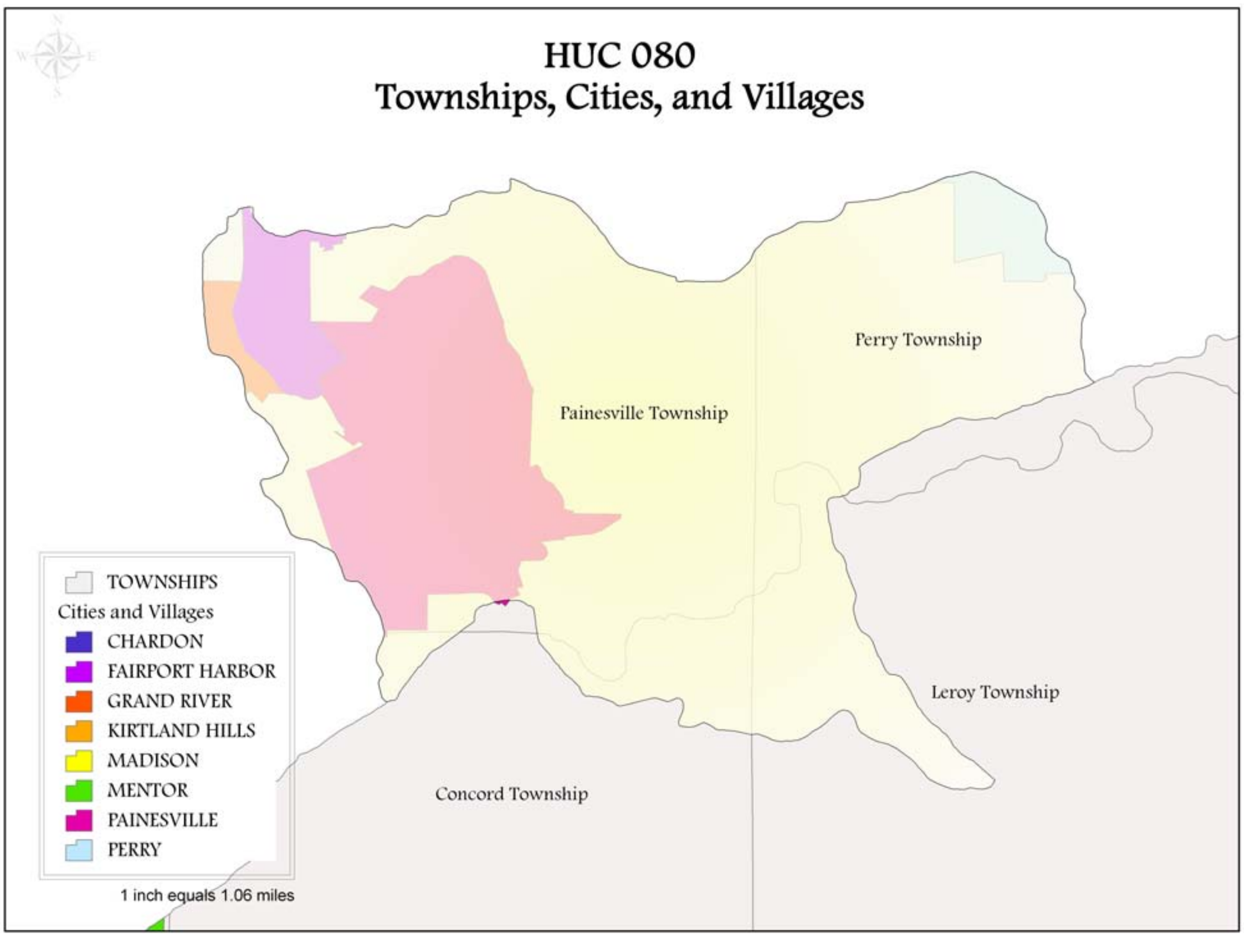
3. Work to secure funding to preserve pristine water quality by protecting an additional 605.86 acres of high quality land within subwatershed 04110004060070 (Kellogg Creek).

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Permanent protection of 605.86 acres of subwatershed 04110004060070 (Kellogg Creek)	≈$4,543,950 (≈$7,500/ acre conservation easement value)	Grand River Partners, Inc., The Nature Conservancy, Lake SWCD, etc.	1/08-ongoing	Number of acres put into conservation easement protection

04110004060080 – Grand River below Big Creek to Lake Erie [except Big Creek]

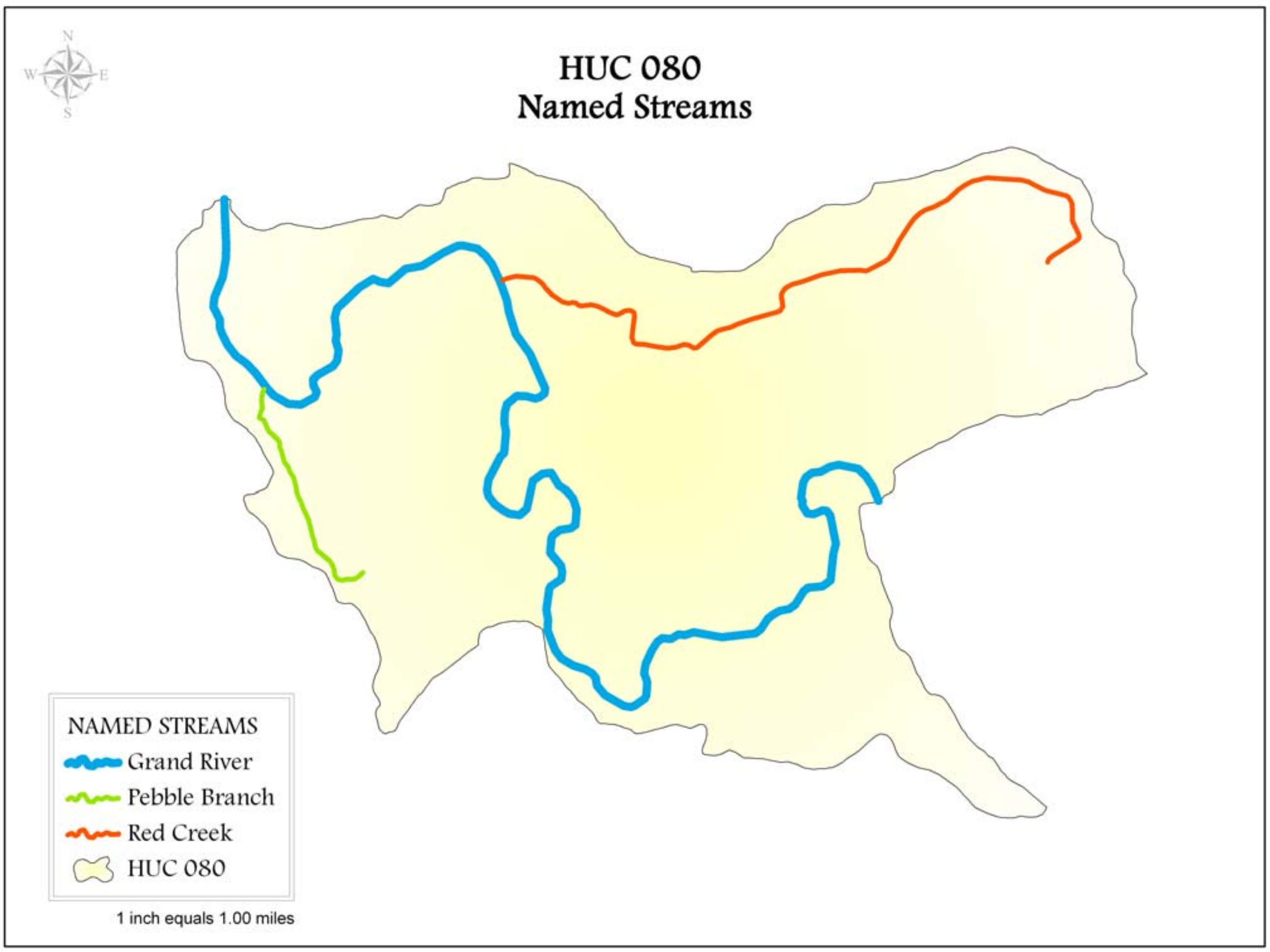
DECSRIPTION- The 14-digit Hydraulic Unit Code 04110004060080 (HUC 080) is located within the 11-digit HUC 04110004060 know as the Lower Grand River Watershed. HUC 080 is approximately 16774 acres and approximately 26 square miles. This watershed encompasses portions of the Perry, Grand River, Fairport Harbor Villages, the City of Painesville, and Concord, Painesville, Perry, and Leroy Townships in Lake County.

Map 1.080- Communities of HUC 080



Red Creek drains a suburbanized former lake plain; consequently, its parent, fine-grained lacustrine substrates are moderately embedded with silt. The lower reach, where sampled, had not been channelized, and so has sufficient habitat attributes to support a warmwater stream fish assemblage. Also, Red Creek has sustained flow throughout the summer owing to ground water from beach ridges and a thick soil horizon. The estimated amount of impervious surface, based on 1994 Landsat satellite imagery is ~ 7.5%, which further suggests that Red Creek has the potential to support a WWH fish assemblage.

Map 2.080- Named Streams of HUC 080



DEMOGRPAHICS~ Unfortunately, demographic statistics are collected on a per township or per county basis, thus making it difficult to determine the exact numbers for each subwatershed. Therefore, the data for each township located within each subwatershed was examined, and the totals and averages were taken of each; outliers were taken into account. The statistics for the Perry, Grand River, Fairport Harbor Villages, the City of Painesville, and Concord, Painesville, Perry, and Leroy Townships in Lake County were utilized to determine the information below.

Total Population~

The total population for HUC 080 is approximately 45,206 with a 49.40/ 50.60% male to female ratio. The largest age group represented is the 35 to 44 years group (17.67% of the total population), followed by the 45 to 54 years group (16.70%), and the 25 to 34 years group (11.22%). 33,852 people represent the 18 and older group, which accounts for 74.88% of the total population for the townships located within HUC 080. The average median age represented is 39.0.

The male to female ratio for the state of Ohio is 48.60/ 51.40%. The largest age group represented is the 35 to 44 years groups (15.90% of the total population), followed by the 45 to 54 years group (13.80%), and the 25 to 34 years group (13.40%). The median age for the people who reside in Ohio is 36.2.

Educational Attainment~

Of the 30,815 people who are over the age of 25 in the townships within the HUC 080 subwatershed, the majority education level is high school graduate

(34.39%), followed by some college with no degree (23.64%), and Bachelor's degree received (17.10%).

Employment Status~

Approximately 25,094 people over the age of 16 in Perry, Grand River, Fairport Harbor Villages, the City of Painesville, and Concord, Painesville, Perry, and Leroy Townships in Lake County, are currently in the workforce. There are approximately 747 (2.12%) who are currently unemployed.

Household by type~

There are approximately 15,971 households in the Townships located within the HUC 080, of which 11,945 (74.79%) are family households. The average family size is 3.10 people.

Income (1999)~

The average median household income in 1999 for individual households in Perry, Grand River, Fairport Harbor Villages, the City of Painesville, and Concord, Painesville, Perry, and Leroy Townships in Lake County was $58,253. The majority of the households had an income of $50,000 to $74,999 (25.28%), followed by $75,000 to $99,999 (16.46%), and $35,000 to $49,999 (16.46%).

The average median family income in 1999 for families in Perry, Grand River, Fairport Harbor Villages, the City of Painesville, and Concord, Painesville, Perry, and Leroy Townships in Lake County was $64,606. The majority of families had an income of $50,000 to $74,999 (27.41%), followed by $75,000 to $99,999 (19.77%), and $35,000 to $49,999 (16.19%).

The average median earnings for a male, full time, year round worker were $45,474 and $28,659 for a female, full time, year round worker.

Below Poverty Level (1999)~

There are 1,597 individuals within the HUC 080 subwatershed, for whom poverty status was determined. Of those, approximately 344 families are represented, and 175 are families with a female householder with no male present.

Occupation~

The residents of the Perry, Grand River, Fairport Harbor Villages, the City of Painesville, and Concord, Painesville, Perry, and Leroy Townships in Lake County represent the following occupations; 8,627 management professionals, 2,969 service occupations, 6,718 sales and office occupations, 64 farming, fishing, and forestry occupations, 2,239 construction, extraction and maintenance occupations, and 3,718 production, transportation, and material moving occupations.

Race~

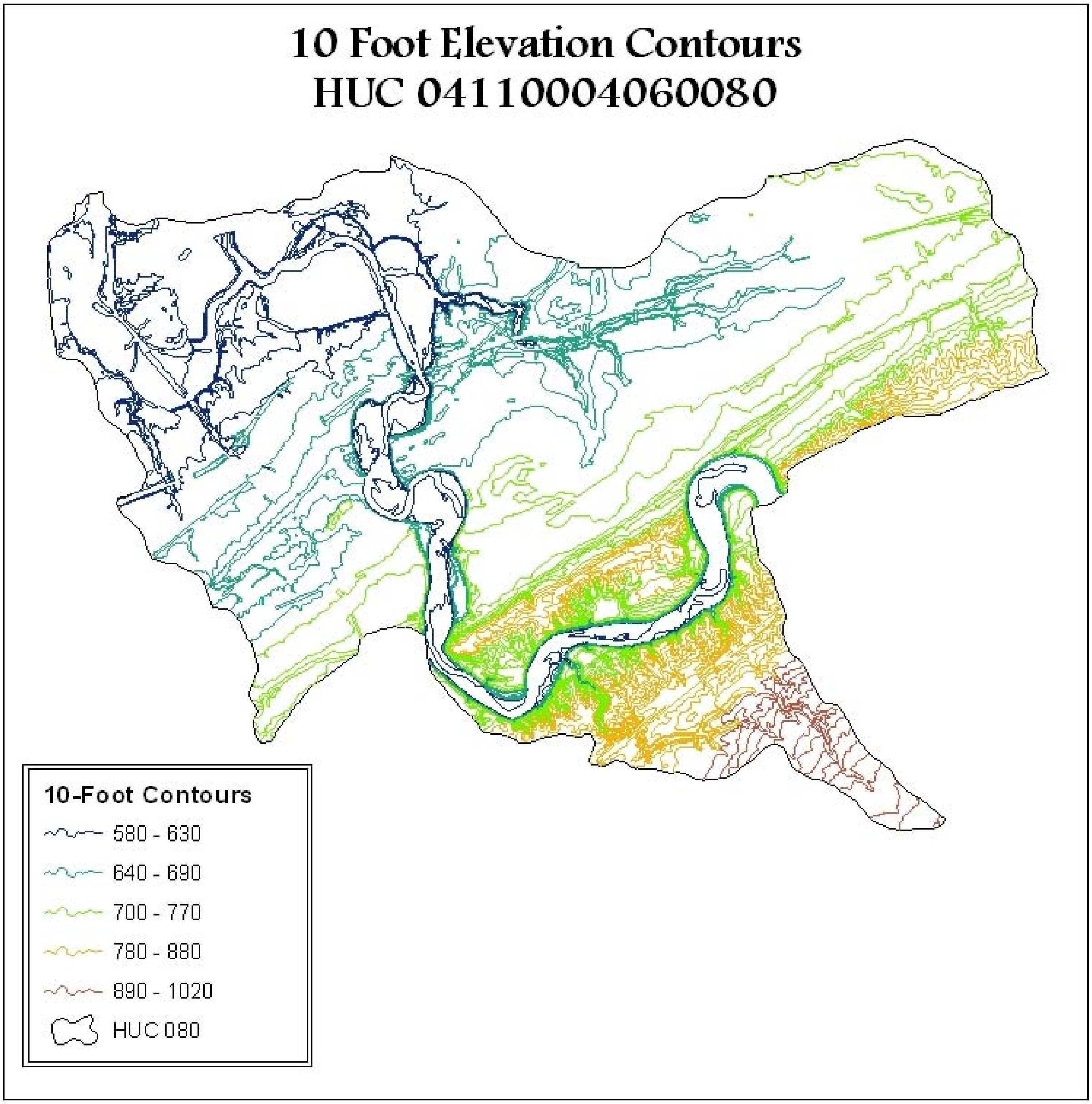
Approximately 98.23% of the population of the HUC 080 is white, 0.30% is African American, and 0.46% is Asian.

Other~

Within the HUC 080, approximately 49 residences are lacking complete plumbing facilities, 34 are lacking complete kitchen facilities, and 133 are without telephone service.

TOPOGRAPHY: The majority of HUC 080 is located within the Estuarine/ Urban Project Area of the Grand River Watershed. This area is primarily urban land. There are numerous marinas and other access points along the river in this section. HUC 080 provides less topography and elevation changes as it approaches its mouth at Lake Erie. The highest point in HUC 080 is 1020 feet and the lowest is 580 feet.

Map 3.080- 10 foot Contours of HUC 080



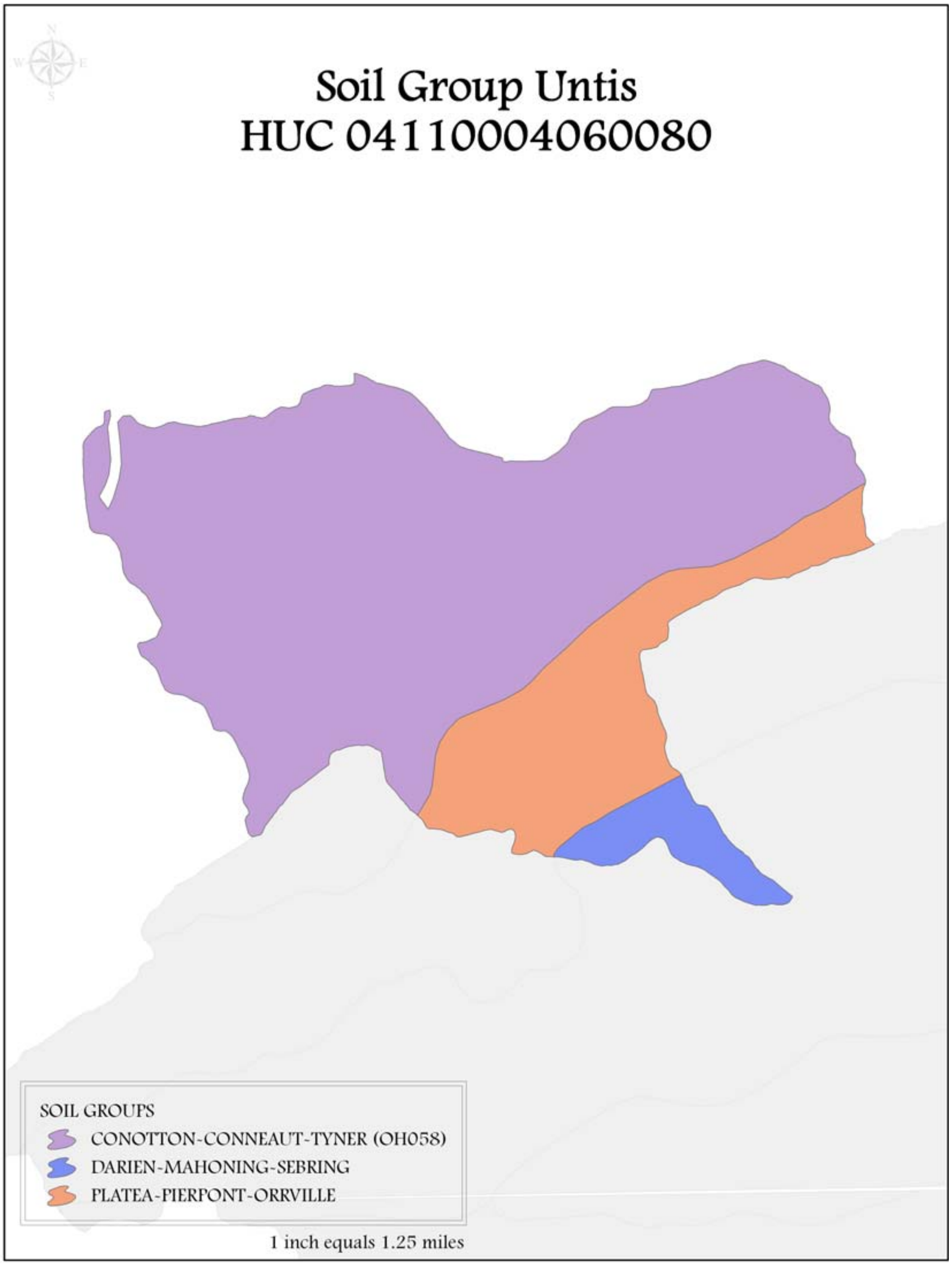
SOILS~ There are three soil groups represented within HUC 080; the Darien – Mahoning – Sebring (approximately 739 acres), the Platea – Pierpont – Orrville (approximately 3,161 acres), and Conotton – Conneaut – Tyner (approximately 12,807 acres) groups.

Darien~ Mahoning~ Sebring: These soils are nearly level to sloping, somewhat poorly drained that formed in silty or loamy glacial till on till plains. Most areas are in natural shrubs and trees, but some areas are used for cultivated crops, pasture, and residential development. Wetness and slow or very slow permeability severely limit most uses. Water usually ponds in low areas after a rainfall. Erosion is a hazard in sloping areas that are used for cultivated crops.

Platea~ Pierpont~ Orrville Group: This association is deep, nearly level to moderately steep, somewhat poorly drained to moderately well drained silty soils on glaciated uplands. This soil is found in undulating and hilly areas, but steep soils occur along rivers and streams including the Grand River. Grapes and small fruits are grown where the climate is suitable, particularly where air drainage is good. Very slow permeability, slope, and seasonal wetness are limitations for many nonfarm uses in this association.

Conotton~ Conneaut~ Tyner: These soils are nearly level and gently sloping, poorly drained and somewhat poorly drained soils that formed in silty glacial till or loamy material over silty glacial till on the lake plain. This soil group is located on slightly undulating broad flats on the lake plain. These soils are mostly covered by natural brush and trees, except where residential development has occurred. Most undeveloped areas are not drained. Some adequately drained areas are used for nurseries. Wetness is the main limitation for farming.

Map 4.080- Soil Groups of HUC 080



A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions. This lack of oxygen in the soil can lead to the formation of certain observable characteristics in hydric soils, such as a thick layer of organic matter (non-decomposed plant materials) in the upper part of the soil column. Other observable features include oxidized root channels and redoximorphic features (concentrations and depletions of Iron and other elements, i.e., mottling, gleying). The following National Soil Information System (NASIS) criteria reflect those soils that may meet the definition of hydric soils.

- All Histels except Folistels and Histosols except Folists, or

- Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:

- Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or

- poorly drained or very poorly drained and have either:
    - o water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils
    - o water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or
    - o water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or

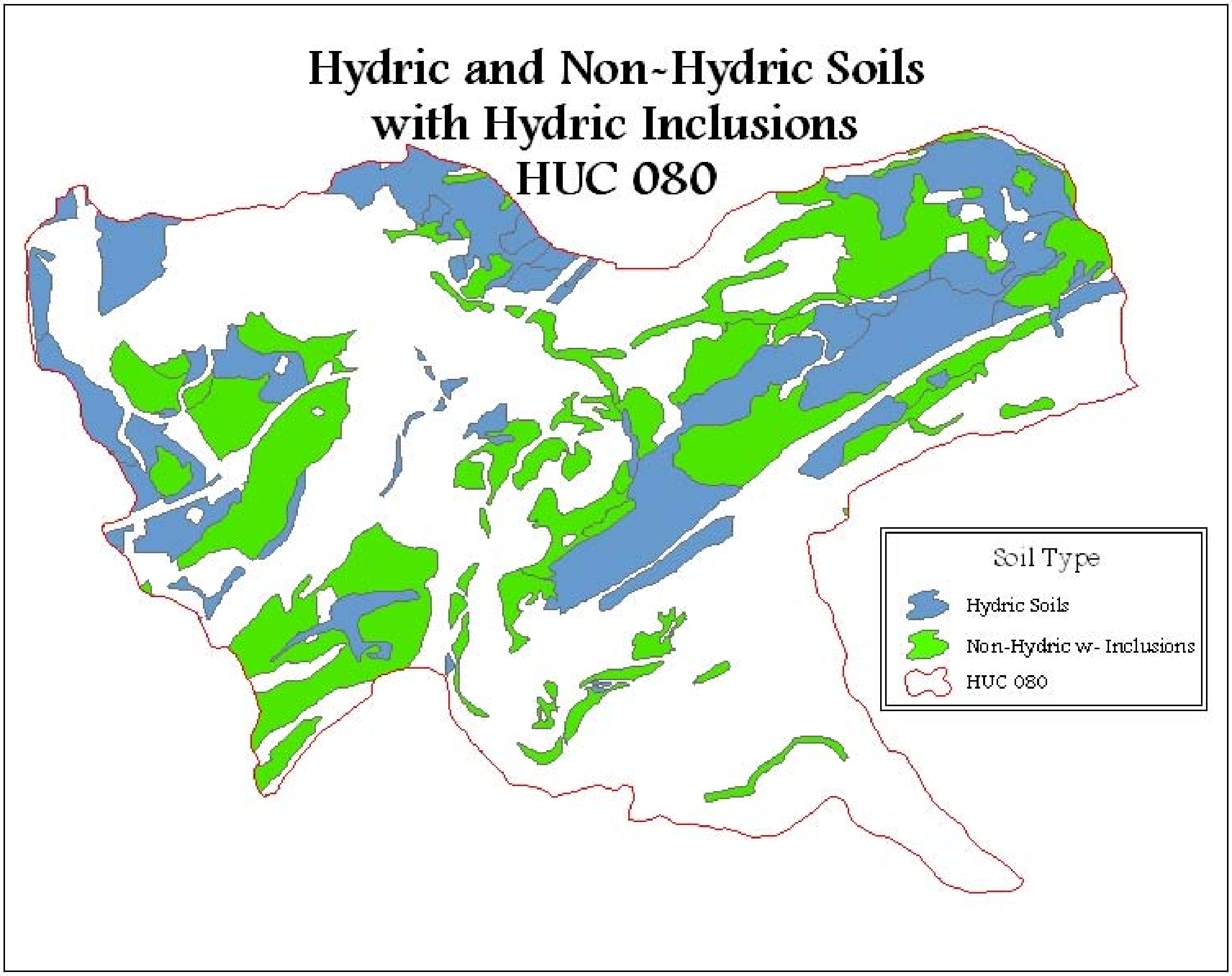
- Soils that are frequently ponded for long duration or very long duration during the growing season, or

- Soils that are frequently flooded for long duration or very long duration during the growing season.

In HUC 080, there are approximately 3,320 acres of hydric soils.

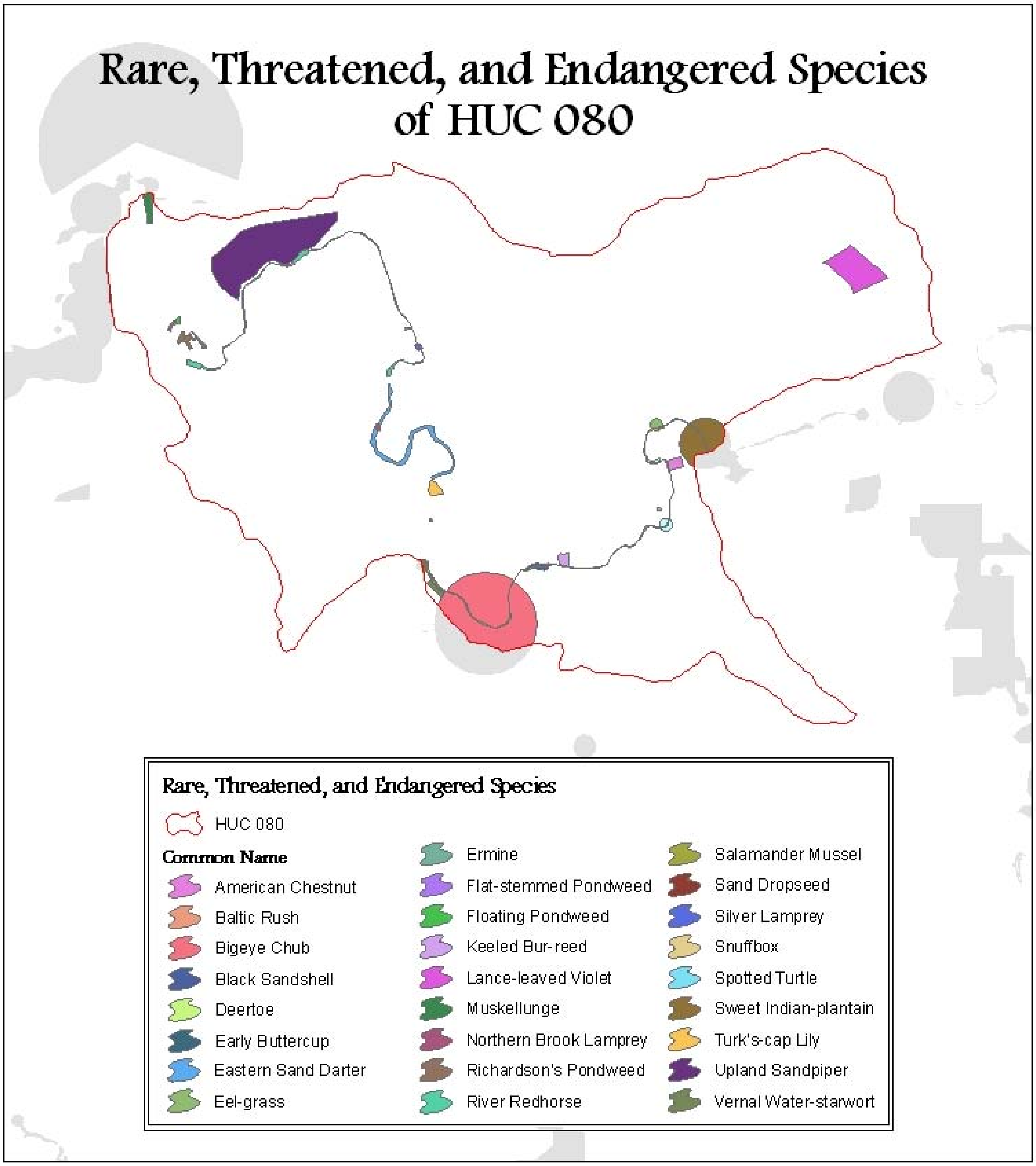
Non hydric soils can be of major importance to water quality as well. Many non-hydric soil types contain small areas of hydric soils, or hydric inclusions. These soils are generally not associated with having the properties of hydric soils, but the do have small pockets, which are too small to have been mapped by the soils surveys, to be considered hydric. Soil Survey books generally do not map "inclusions" of different soil types if the map units are less than 2 acres in size. These inclusions can be wetland soils within an upland soil series. Sometimes, the description will include the types of soils that are the most common inclusions in the series. HUC 080 contains roughly 3,704 acres of non hydric soils with hydric inclusions.

Map 5.080- Hydric and Non-hydric Soils of HUC 080



RARE, THREATENED, and ENDANGERED SPECIES- The Grand River Watershed provides the perfect habitat for many rare, threatened, and endangered species. In fact, the Ohio Department of Natural Resources, Division of Wildlife recognized the unparalleled biodiversity and habitats of the Grand River Watershed, and chose this watershed to reintroduce the wild turkey, river otter, and snowshoe hare. The following species are found within HUC 080 in the Grand River Watershed; American chestnut, Baltic rush, bigeye chub, black sandshell mussel, deertoe mussel, dark-eyed junco, early buttercup, eastern sand darter, eel-grass, ermine, flat-stemmed pondweed, floating pondweed, keeled bur-reed, lance-leaved violet, muskellunge, northern brook lamprey, Richardson's pondweed, river redhorse, salamander mussel, sand dropseed, silver lamprey, snuffbox mussel, spotted turtle, sweet Indian-plantain, Turk's-cap-lily, upland sandpiper, vernal water-starwort, and mussel bed.

Map 6.080- Rare Species of HUC 080

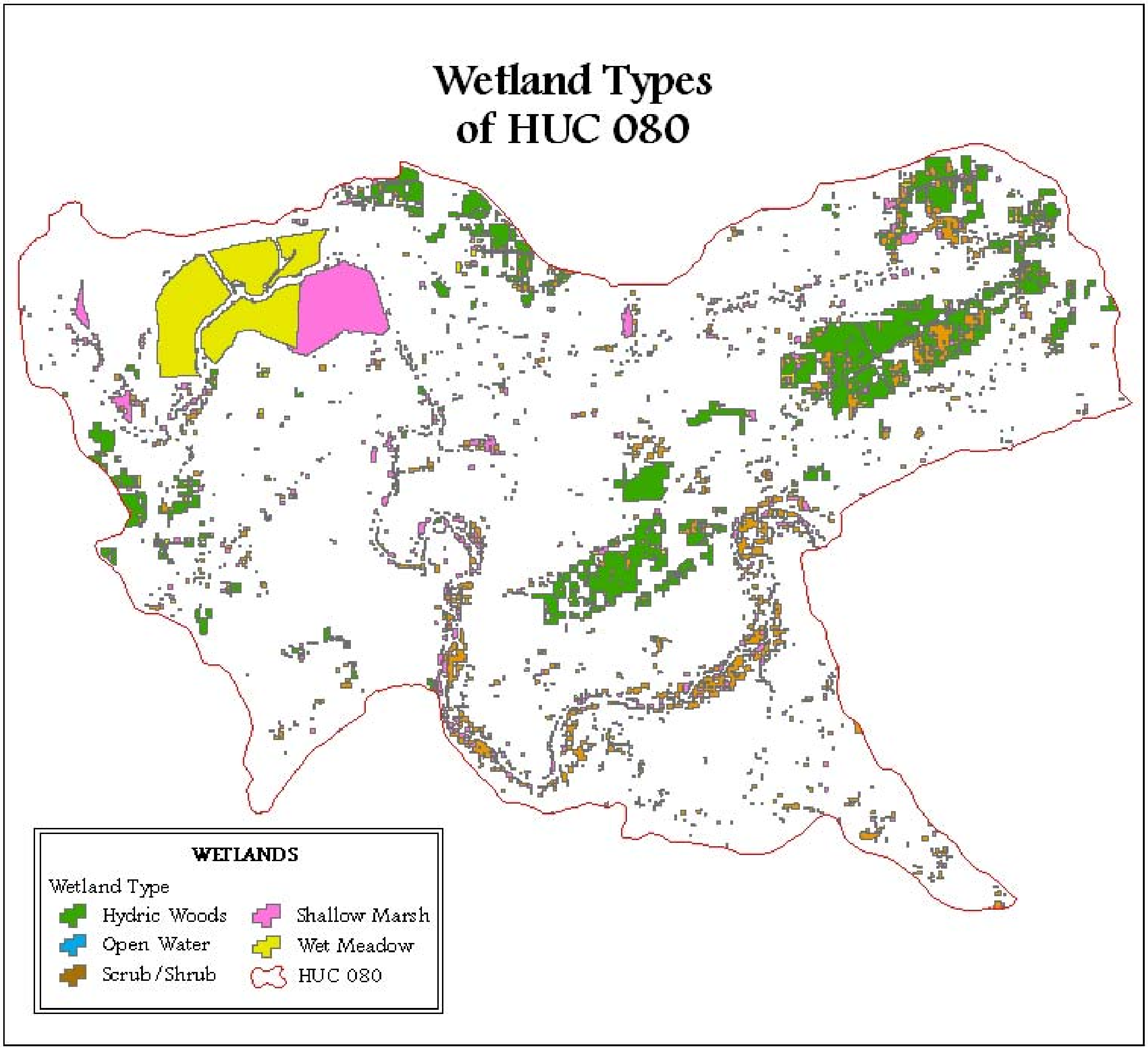


DAMS~ There are 18 dams located with in the Lower Grand River Watershed. In HUC 080, there no dams.

WETLANDS~ Wetlands are typically highly productive habitats, often hosting considerable biodiversity. The Army Corps of Engineers and the Environmental Protection Agency define wetlands as; "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions". Wetlands are found under a wide range of hydrological conditions, but at least some of the time water saturates the soil. The result is a hydric soil, one characterized by an absence of free oxygen some or all of the time, and therefore called a "reducing environment." Plants called hydrophytes specifically adapted to the reducing conditions presented by such soils can survive in wetlands, whereas species intolerant of the absence of soil oxygen (called "upland" plants) can not survive. Adaptations to low soil oxygen characterize many wetland species.

HUC 080 has approximately 2,737 acres of wetlands; 1,014 acres of Hydric Woods, 621 acres of scrub/shrub, 561 acres of shallow marsh, and 540 acres of wet meadow.

Map 7.080- Wetlands of HUC 080



DRASTIC- The DRASTIC maps, produced by the Ohio Department of Natural Resources, show the pollution potential for groundwater systems. The DRASTIC mapping system allows the pollution potential of any area to be evaluated systematically using the following existing information about an area:

D= Depth to Water

R= Net Recharge

A= Aquifer Media

S= Soil Media

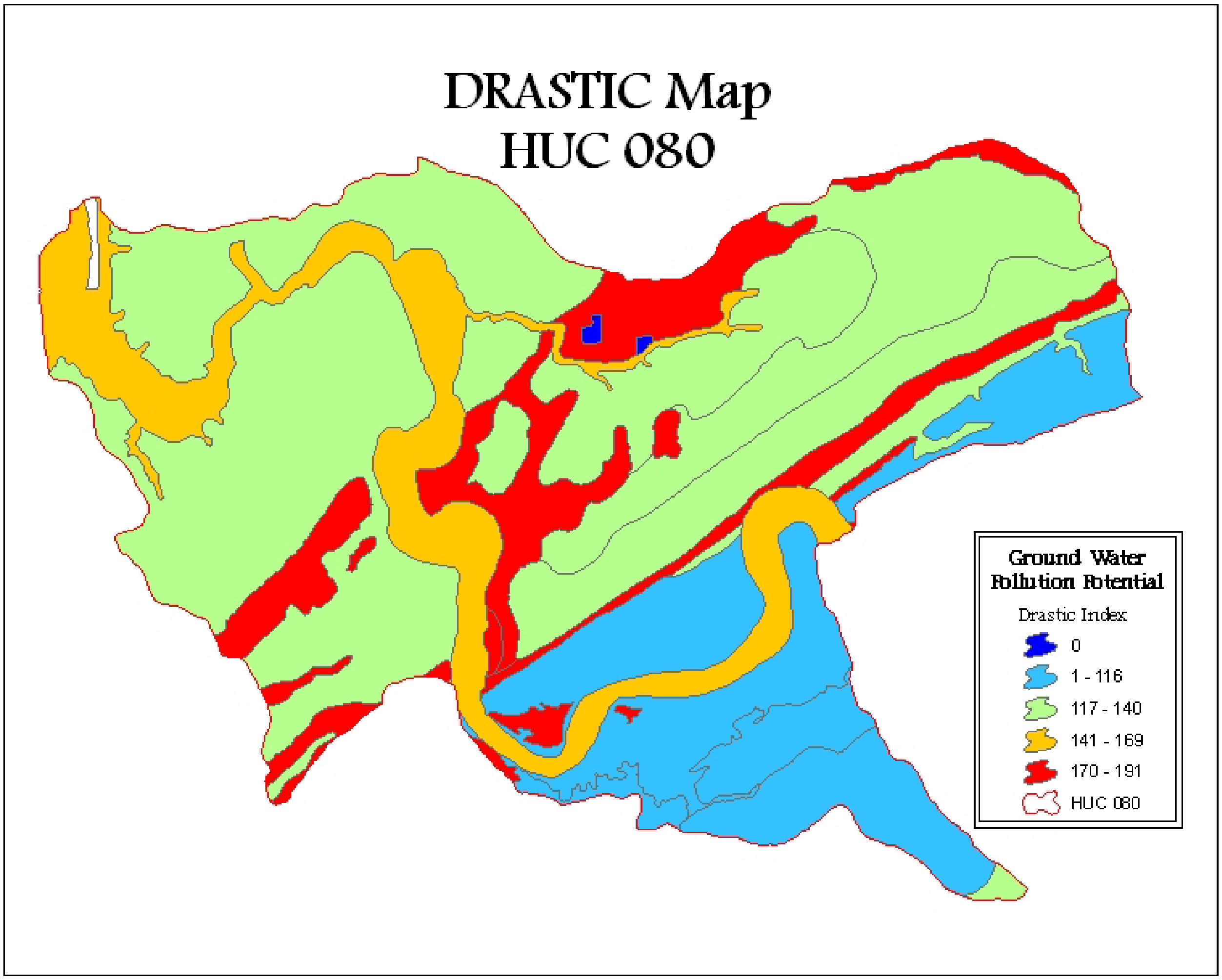
T= Topography

I= Impact of the Vadose Zone Media

C= Hydraulic Conductivity of the Aquifer

In evaluating an area's vulnerability to contamination, the DRASTIC mapping system assumes a contaminant with the mobility of water is introduced at the surface and flushed into the groundwater by precipitation. A pollution potential map can assist in developing ground water protection strategies. By identifying areas more vulnerable to contamination, officials can direct resources to areas where special attention or protection efforts might be warranted. This information can be utilized effectively at the local level for integration into land use decisions and as an educational tool to promote public awareness of ground water resources. Pollution potential maps may be used to prioritize ground water monitoring and/or contamination clean-up efforts. Areas that are identified as being vulnerable to contamination may benefit from increased ground water monitoring for pollutants or from additional efforts to clean up an aquifer. HUC 080 has a maximum DRASTIC index of 191. Approximately 13.14% of HUC 080 has a high DRASTIC index.

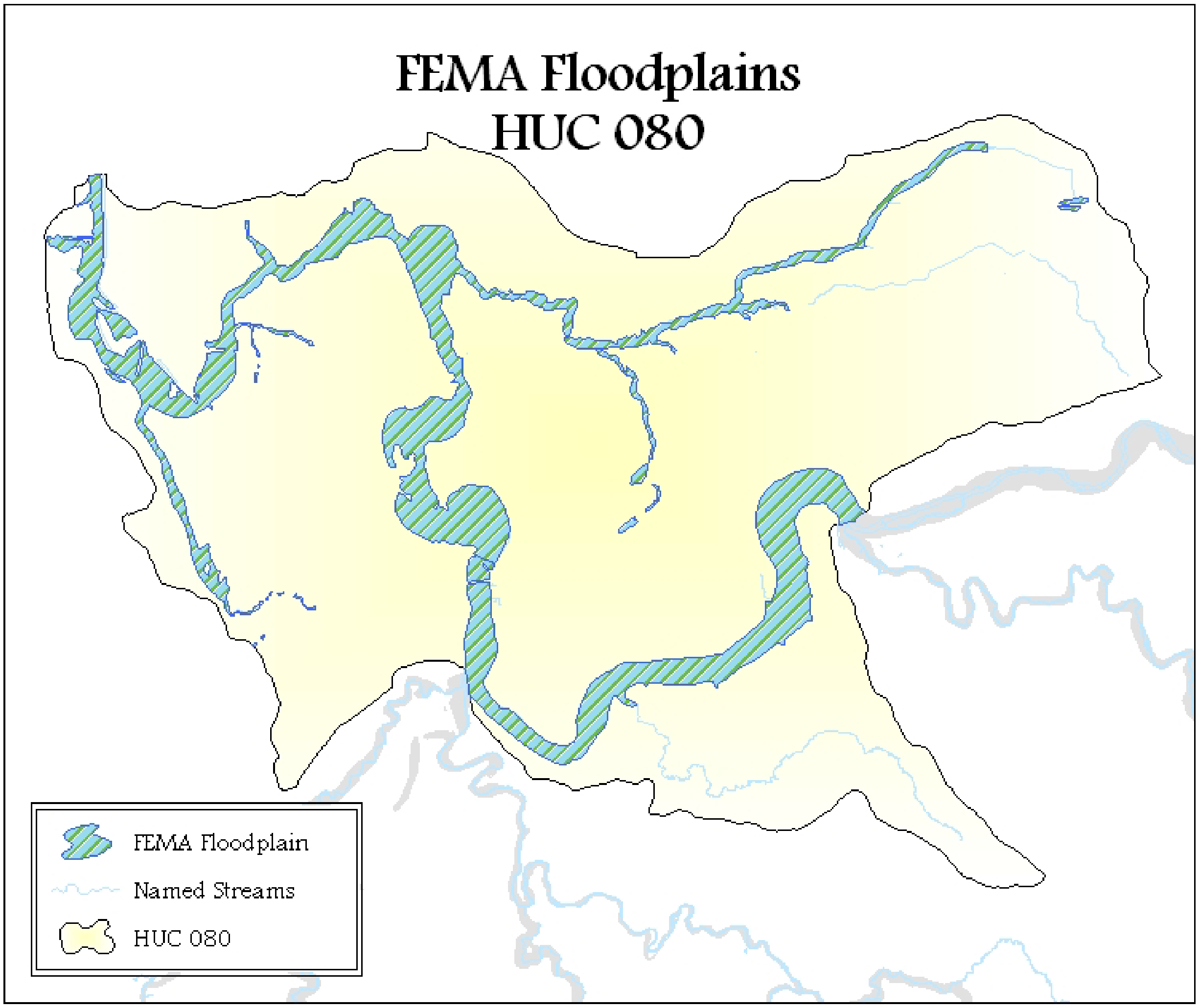
Map 8.080- DRASTIC of HUC 080



FLOODPLAINS- Floodplains are the low, flat, periodically flooded lands adjacent to rivers, lakes and oceans and subject to geomorphic (land-shaping) and hydrologic (water flow) processes. FEMA, the Federal Emergency Management Agency, has developed areas within watersheds that are designated as 100-year and 500- year floodplains. A "100-year flood" is defined as a flood event that has a 1 in 100 chance of occurring in any given year, and a 500-year flood has a 1 in 500 chance. HUC 080 has 1926 acres of designated 100-year floodplain, which represents approximately 11.5% of the watershed.

Current Lake County has an ordinance in place which protects the riparian areas and floodplains of the Grand River and its named tributaries.

Map 9.080- Floodplains of HUC 080



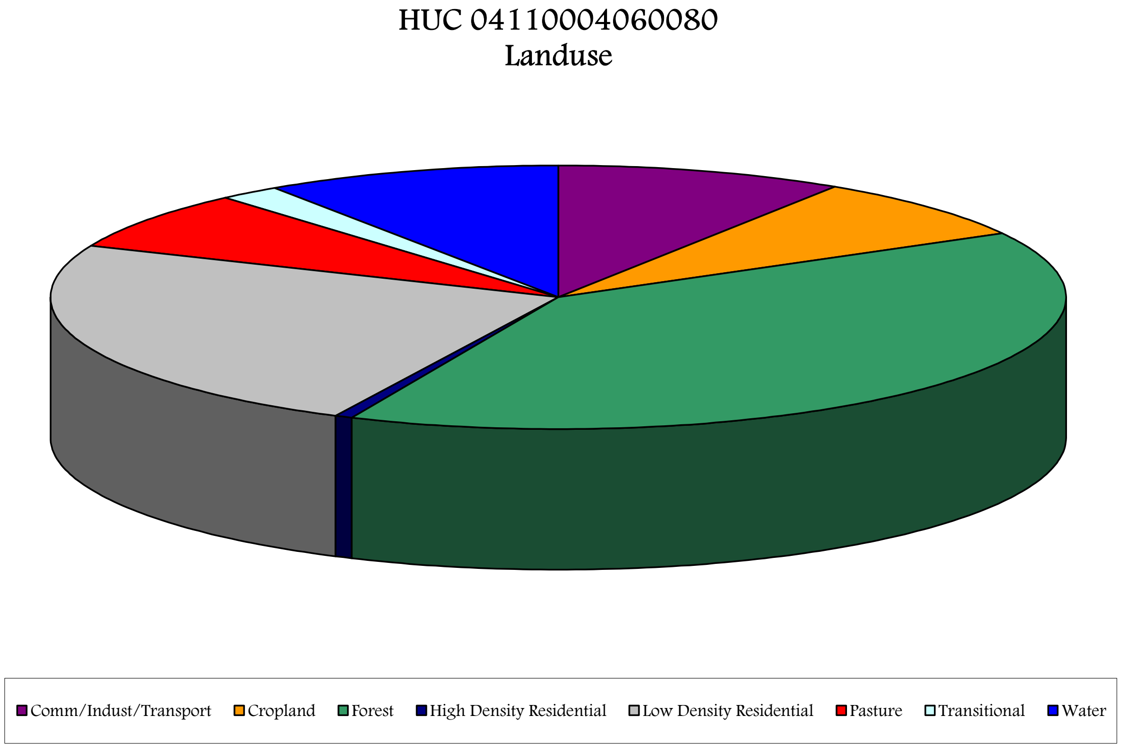
WASTE WATER TREATMENT PLANT (WWTP)- The city of Painesville WWTP was originally constructed in 1978 and most recently upgraded in 2000. The current NPDES permit expires on July 31, 2007. Daily average design flow is 6.0 mgd. Effluent flow during the 2004 survey was near 50% of design flow. Wet stream processes include influent screening, comminutor, grit removal, primary settling, intermediate settling, activated sludge, phosphorus removal, final settling, tertiary filtration, and chlorination/ dechlorination. The city has an approved pre-treatment program. Pollutant loadings for select chemical parameters and effluent flow over the past two decades have remained relatively constant from 2000 to 2004, after the most recent upgrade. Bioassay tests conducted in 2001 showed 100% mortality to both fathead minnows and *Ceriodaphnia* during a July 25-26 sample, however, no toxicity was found in a follow-up August 29-30 test. Sometime after September 28, 2004 the WWTP switched from one stage to two stage nitrification on a trial basis, which resulted in a plant upset and highly elevated levels of ammonia-N in the effluent. Ammonia-N as high as high as 19.58 mg/l was reported on monthly operating reports. The trial nitrification test was discontinued and by November 14, 2004 the ammonia-N concentration in the effluent returned to normal levels (0.61 mg/l).

LAND USE- HUC 080 is a highly urbanized subwatershed. This subwatershed is the most urbanized in the Lower Grand River Watershed. Here, any open land is quickly being split and sold to developers. Population density is very high (46.9), and is inspected to grow due to the increase of development in the area.

Chart 1.080- Landuse in HUC 080

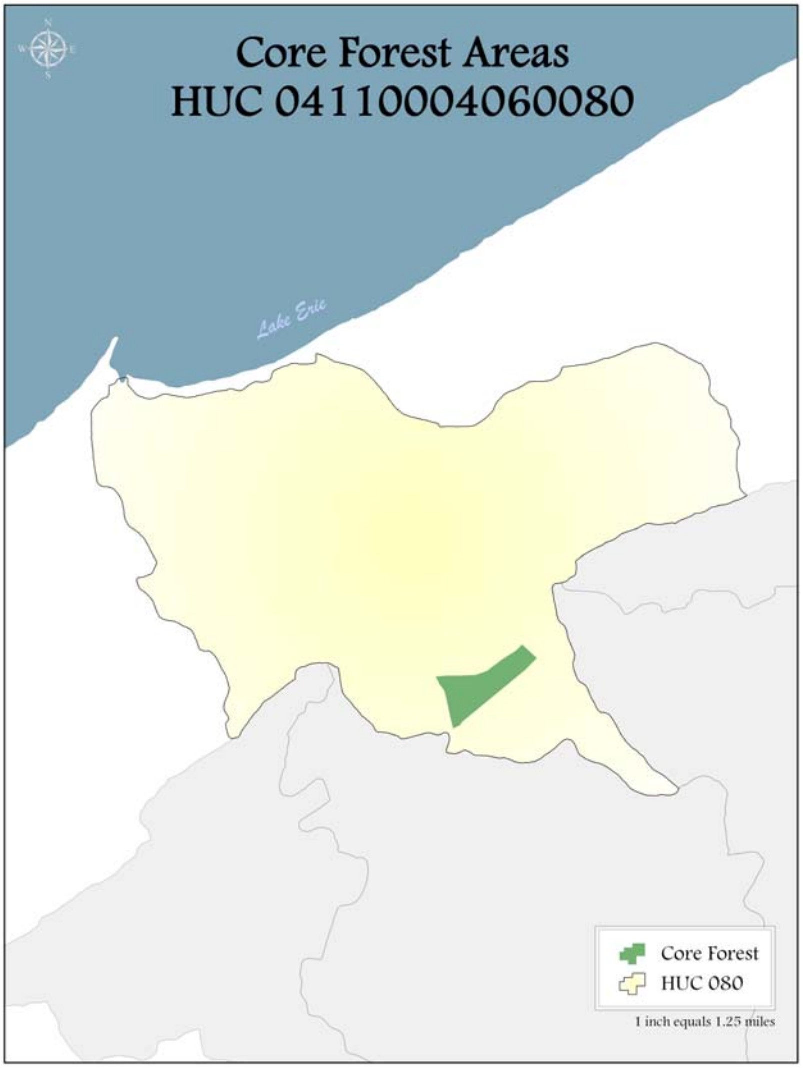
HUC 04110004060080		
Landuse Type	**Hectares**	**% of Total**
Comm/Indust/Transport	926	9
Cropland	809	8
Forest	4018	40
High Density Residential	66	1
Low Density Residential	2468	24
Pasture	720	7
Transitional	203	2
Water	959	9
Total	10170	100

Chart 2.080- Landuse Pie chart



The Nature Conservancy realized the importance of these large tracts of forest, or "Core Forest Areas", for not only their natural resources value but their importance for breeding populations as well. Core Forest Areas are forested areas of 100 acres or more with a forested buffer zone from pastures and agriculture, and no roads within at least 300 meters. These numbers were determined by the habits and lifecycles of certain forest species; a pair of pileated woodpeckers will need at least 100 acres in order to breed, certain amphibian populations use forest areas up to 200 meters away from their wetland habitat for breeding purposes, and cowbirds will penetrate up to 150 meters of the core forest areas. Although this watershed is highly urbanized, there is still a large portion of the watershed that remains forested, due mainly to the amount of preserved land in the watershed. HUC 080 contains one Core Forest Area, which totals 289.43 acres, or roughly 1.73% of the HUC 080 watershed.

Map 10.080- Core Forest Areas of HUC 080



These Core Forest Areas are very important habitats that need to be preserved. There are currently 129.04 acres of the 289.43 acres of Core Forest in permanent protection, or approximately 44.58%.

Map 11.080- Protected Core Forest Areas of HUC 080

GRPI- LAND PROTECTION PRIORITY LIST- Grand River Partners, Inc.'s goal is to protect the natural resources of the Grand River and its watershed. Grand River Partners, Inc. utilizes the conservation easement as the primary tool to protect such resources. Conservation easements are a great tool to protect resources on private lands but still maintain them in private hands. The Grand River watershed is approximately 712 square miles. Obviously Grand River Partners, Inc. cannot protect all of the 712 square miles (455,000 acres) with conservation easements. Grand River Partners, Inc.

believes that water quality can be protected by conserving the "right" 25% of a watershed. In the specific case of the Grand River, this represents roughly 114,000 acres. Protecting 114,000 acres is an achievable goal considering the number of partner organizations and the fact that approximately 25% of the 114,000 acres has already been protected.

The challenge remains to protect the remaining 86,000 acres of the "right" land. To fulfill this goal, Grand River Partners, Inc. developed a parcel based **Land Protection Priority List**. Before any prioritization process could begin, any parcel less then five acres was removed from the potential list of priorities. To make fair comparisons an analysis of the watershed was conducted to determine the unique areas within the watershed. From this analysis, the Grand River Watershed was divided into 5 distinct project areas based on the unique natural features of each. The parcel prioritization process involved a two tier analysis. The first, Tier 1, involved an analysis of natural resources. The second, Tier 2, involved a strategic analysis that took into account parcel size, proximity to other protected land, and partner priorities.

The Headwaters Project Area consists of the area drained by all the unnamed tributaries that together form the Grand River. The area begins more or less upstream of the crossing with SR 534 at the southern end of the watershed. In summary, important natural resources ranked for each parcel located in the Headwaters Project Area are intact riparian areas, the Grand River main stem, wetlands, unnamed tributaries, floodplains, core forest blocks and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Lowlands Project Area begins at the crossing of SR 534 with the mainstem in the southern portion of the watershed and extends between the 810' contour interval north to the crossing where the Grand River intersects Windsor-Mechanicsville Road. Important Natural Resources identified in the Lowlands Project Area are swamp forests, wetlands, intact riparian areas, core forest blocks, mainstem, rare species, floodplains, TNC subwatershed ranking, and named tributaries. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The Grand River Gorge Project Area begins at the crossing of the mainstem and Windsor-Mechanicsville Road bridge and extends upstream to the crossing with SR 84. The Gorge Project Area is bordered to the north by the watershed boundary and to the south by the 950' contour interval. The important natural characters of the Gorge are the mainstem, wetlands, floodplains, intact riparian areas, named tributaries, core forest blocks, steep slopes, TNC subwatershed rankings, and rare species. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

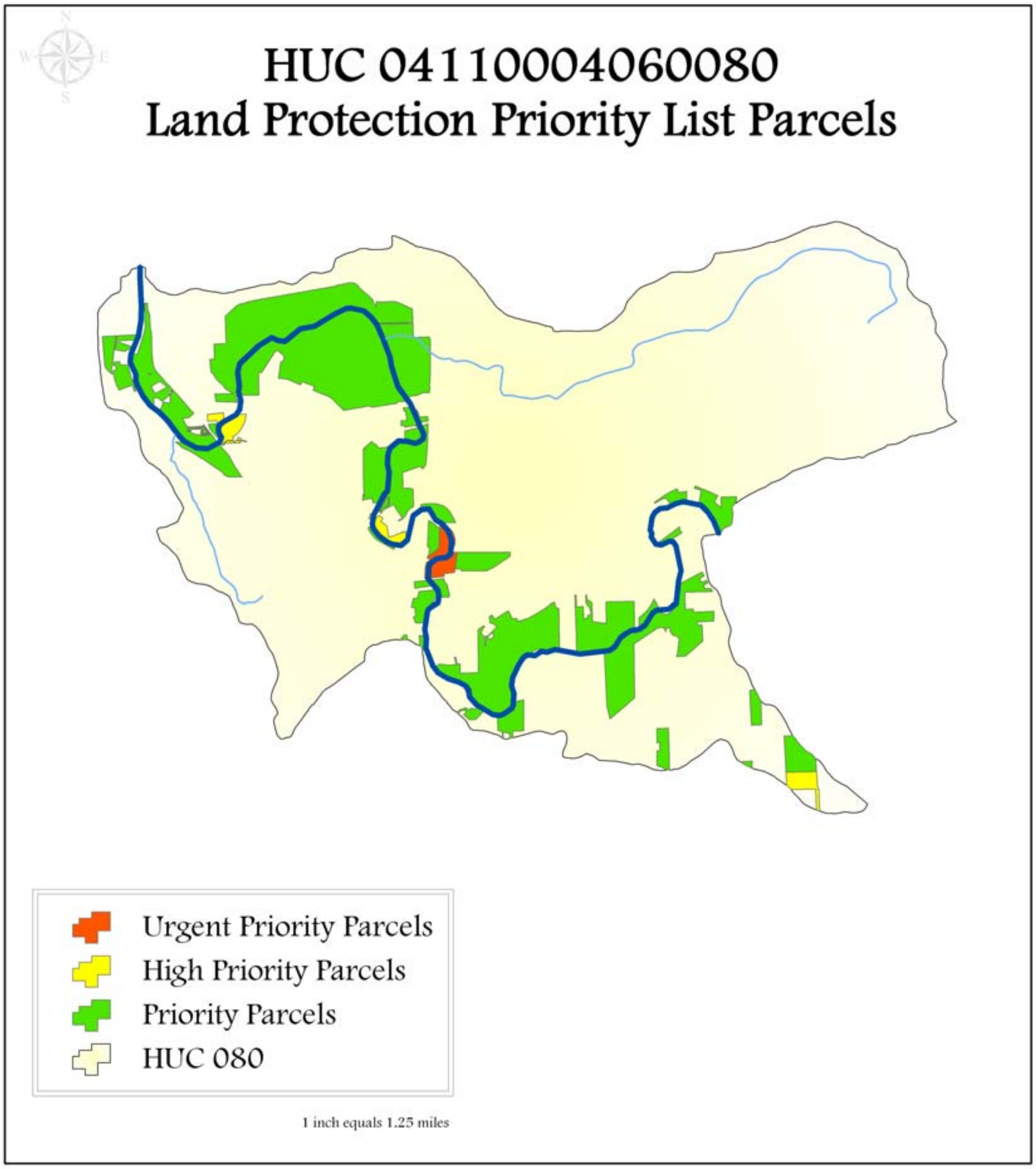
The Estuarine/Urban Project Area begins at the State Route 84 crossing with the Grand River and ends in Fairport Harbor Village and Grand River Village at its terminus with Lake Erie. The Estuarine/Urban Project Area includes the subwatershed of Red Creek which extends to the west just north of the City of Painesville. In this project area the mainstem, river access points, wetlands, intact riparian areas, floodplains and named tributaries were considered important natural features. Each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

The last area is the Tributaries Project Area which consists of two areas; one is located east of the Grand River Lowlands Project Area, which and includes the subwatersheds of such named tributaries as Mill Creek, Rock Creek and Coffee Creek, and the second project area is located west of the Lowlands Project Area, north of the Headwaters Project Area and south of the Gorge Project Area. This portion of the Tributaries Project Area contains the subwatersheds of such high quality streams as Indian Creek, Phelps Creek, Hoskins Creek, and Paine Creek. Important natural resources considered include, cold water habitat, wetlands, floodplains, core forest blocks, and rare species. Again each parcel within this project area was ranked based on the presence or absence of each of the above natural resources.

Each parcel within the watershed was further evaluated based on additional strategic rankings. These rankings include parcel size, proximity to protected land and partner priorities. Each parcel meeting the acreage requirement, or within a certain distance of existing protected land or included as a priority by a partner organization or agency was weighted more heavily and therefore considered a high priority. A statistical analysis of the final scores was performed and each parcel was categorized as being priority, high priority or an urgent priority parcel.

In HUC 080, there are a total of 2633.93 acres of priority parcels, 97.85 acres of high priority parcels, and 60.15 acres of urgent priority parcels for protection. Currently there are 811.78 acres of permanently protected land within HUC 080.

Map 12.080- LPPL of HUC 080



IMPERVIOUS SURFACE- The Conversion of farmland, forests, wetlands, and meadows to rooftops, roads, and lawns creates a layer of impervious surface in the urban landscape. Impervious cover is a very useful indicator with which to measure impacts of land development on aquatic systems. The process of urbanization has a profound influence on the hydrology, morphology, water quality, and ecology of surface waters. Recent research has shown that streams in urban watersheds possess a fundamentally different character than streams in forested, rural, or even agricultural watersheds. The amount of impervious cover in the watershed can be used as an indicator to predict how severe these differences can be. In many regions of the country, as little as ten percent watershed impervious cover has been linked to stream degradation, with the degradation becoming more severe as impervious cover increases.

Impervious cover directly influences urban streams by dramatically increasing surface runoff during storm events. Depending on the degree of impervious cover, the annual volume of stormwater runoff can increase by two to 16 times its predevelopment rate, with proportional reductions in groundwater recharge. In natural settings, very little annual rainfall is converted to runoff and about half is infiltrated into the underlying soils and the water table. This water is filtered by the soils, supplies deep water aquifers, and helps support adjacent surface waters with clean water during dry periods. In urbanized areas, less and less annual rainfall is infiltrated and more and more volume is converted to runoff. Not only is this runoff volume greater, it also occurs more frequently and at higher magnitudes. As a result, less water is available to streams and waterways during dry periods and more flow occurs during storms.

The relationship between impervious cover and subwatershed quality can be predicted by a simple model that projects the current and future quality of streams and other water resources at the subwatershed level. Stream research generally indicates that certain zones of stream quality exist, most notably at about 10% impervious cover, where sensitive stream elements are lost from the system. A second threshold appears at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition; diminished aquatic diversity, water quality, and habitat scores.

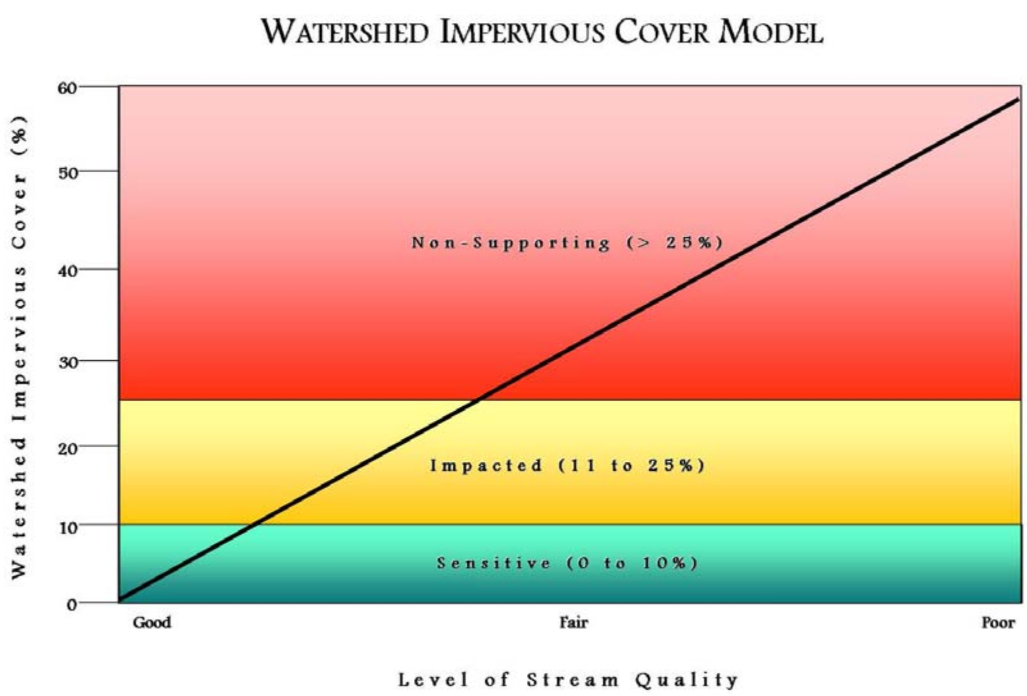
The model classifies streams into one of three categories; sensitive, impacted, and non-supporting. Each stream category can be expected to have unique characteristics as follows:

Sensitive Streams: These streams typically have a watershed impervious cover of zero to 10 percent. Consequently, sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however, these streams are often expected to recover.

Impacted Streams: Streams in this category possess a watershed impervious cover ranging from 11 to 25%, and show clear signs of degradation due to watershed urbanization. Greater storm flows begin to alter the stream geometry. Both erosion and channel widening are clearly evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with the most sensitive fish and aquatic insects disappearing from the stream.

Non- Supporting Streams: Once watershed impervious cover exceeds 25%, stream quality crosses a second threshold. Streams in this category essentially become a conduit for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, down-cutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated, and the stream substrate can no longer provide habitat for insects or spawning areas for fish. Water quality is consistently rated as fair to poor, and water contact recreation is no longer possible due to the presence of high bacterial levels. Subwatersheds in the non-supporting category will generally display increases in nutrient loads to downstream receiving waters, eve if effective urban BMPs are installed and maintained. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish.

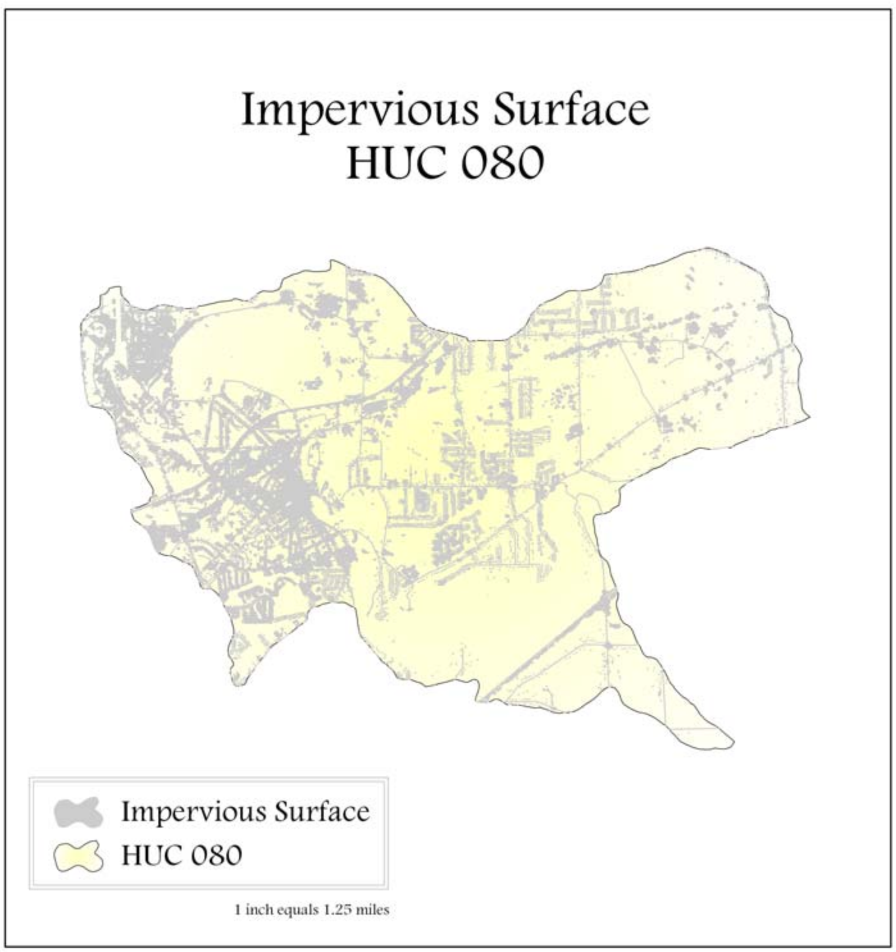
Graph 1.080- Impervious Cover Model



Center for Watershed Protection, Rapid Watershed Planning Handbook

HUC 080 has an impervious cover of approximately 16.58%. Therefore, the streams in this subwatershed are considered "impacted streams" by the impervious surface model. Impacted streams show clear signs of degradation due to watershed urbanization. Greater storm flows begin to alter the stream geometry, carry pollutants into the water, and can raise the temperature of the stream. Both erosion and channel widening are clearly evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with the most sensitive fish and aquatic insects disappearing from the stream.

Map 13.080- Impervious Surface of HUC 080



ATTAINMENT STATUS~ *Ohio Water Quality Standards: Designated Aquatic Life Use*

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*

2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*

3) *Cold-water Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie

tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 $mi._2$ drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

Red Creek- Aquatic life in Red Creek did not meet standards for WWH, and is not likely to given that the subwatershed is densely populated. Suburban landuse within the Red Creek subwatershed is so dense as to likely preclude attainment of the WWH aquatic life use given the current state of stormwater management. Red Creek is impaired due to flow alteration and toxicity. A fish indice matrix is used to quantify the toxicity pollutant and flow alteration. It uses specific aspects of the IBI scoring system to parse out indicators of urbanization.

The Grand River and its tributaries are, with few exceptions, physically, biologically and chemically unimpaired and in tact. The exceptions are Red and Kellogg Creeks, both of which flow through Painesville but are physically intact with wooded riparian zones and high QHEI score, both scoring 67 at sites near their mouths. The problem is toxic runoff from the urban areas. Should an urban stream aquatic life use classification come into existence, Red Creek would be an obvious candidate.

Grand River- Aquatic life in the Grand River is fully attaining standards for Exceptional Warmwater Habitat (EWH) from Sweitzer Road (RM 42.2) to the SR 2 bridge in Painesville (RM 5.2), and is fully meeting standards for Warmwater Habitat (WWH) downstream from the SR 2 bridge. The Seasonal Salmonid use designation currently in place should be retained.

The Grand River is an economic asset to Northeast Ohio, but is especially sensitive to pollution and disturbance because of limited summer base flows. Therefore, regional planning, stream protection policies, comprehensive construction site management plans, construction site performance bonds, identification and preservation of sensitive areas, and above all, defined limits to growth are needed to maintain the biological integrity of the Grand River.

The Grand River is the only Ohio tributary to Lake Erie that harbors a self-sustaining population of Great Lakes Muskellunge, and therefore is a priority for conservation. The Grand River is also has a native population of walleye and northern pike making it singularly unique among Ohio streams. The Grand River and its tributaries provide habitat for many species considered rare by Ohio EPA, or listed as threatened or endangered by the Ohio Department of Natural Resources including 32 macroinvertebrates and freshwater mussel species, and 11 fish species. The single greatest threat to the Grand River basin is suburbanization.

Within HUC 080, is the former Diamond Shamrock Works site. This site has recently been proposed for development, and is currently a brownfield/ reclamation site. Waste containment ponds from the abandoned Diamond Alkali chemical plant are located adjacent to the Grand River. The Diamond Shamrock Works produced chromate compounds, chlorine, chlorinated paraffins, and coke. Diamond Shamrock also accepted and disposed of used spent pickle liquor from nearby steel industries. Eight pollution sources are associated with the Diamond Shamrock Works; 0.75 million tons of chromate waste materials, three waste lakes, a waste water retention basin, a hazardous waste landfill, chromate effluent treatment lagoons, and contaminated soils in the main production area. As part of a remedial effort, clay dikes and caps have been placed around and over the waste lagoons; however, chromium continues to leak into the Grand River, with at least two known discharges reported during the spring of 2004 that violated water quality standards for hexavalent chromium.

BIOLOGICAL INDICATORS- Fish communities in the Grand River have an exceptionally high degree of biological integrity. This is obvious in the consistently high IBI scores along the length of the mainstem and between sampling years, and is also evident in the unusually high percent composition of pollution intolerant species making up electrofishing samples (Figure 40). Furthermore, the Grand River is one of the few rivers in Ohio that has a full suite of endemic, naturally reproducing and self-sustaining top carnivores including walleye, northern pike and muskellunge. The later is the Great Lakes subspecies (*Esox masquinongy masquinongy*), and so represents a vitally important area for genetic and habitat conservation. Given the propensity for muskellunge to differentiate into unique strains, the population in the Grand River may well be a truly endemic strain. As it stands, it is the last naturally reproducing muskellunge population found in any of Ohio's Lake Erie tributaries.

Fish samples were collected at three locations along the area flanking the Diamond Shamrock waste lakes (Figure 42). IBI and MIWb scores for each of the locations sampled met applicable biocriteria (WWH and/or lacustuary IBI; warmwater habitat MIWb); however, the percent of fish having anomalous deformities, eroded fins, lesions, or tumors (DELT) was elevated above background conditions at each location sampled, all compositional metrics were suppressed, and the relative abundance of all non-pollution tolerant fish was lower than expected. Furthermore, samples collected in 2000 and 2001 by Enviroscience showed significant impairment in the reach as reflected in both the IBI and MIWb scores (Figures 39 and 44). Collectively these findings demonstrate that recovery in the lower Grand is transient and incomplete. The reach, therefore, remains impaired.

The macroinvertebrate community sampled on Red Creek was highly degraded with low sensitive taxa diversity. Stream substrates were embedded, which is an indication of increased sedimentation and possibly an increase in flow flashiness. The impact at this station may be a combination of various causes associated with the surrounding urban area.

FORMER DIAMOND SHAMROCK FACILITY- The Diamond Shamrock Painesville Works site is an approximately 1,100 acre former chemical manufacturing facility located in Lake County. The Grand River bisects the Diamond Shamrock Painesville Works site and Lake Erie borders it to the north (see Picture 1.080 below). The facility operated from 1912 through 1977 and manufactured a variety of products that included soda ash, baking soda, chromium compounds, carbon tetrachloride, hydrochloric and sulfuric acids, chlorinated wax, and coke. Diamond Shamrock also generated their own electricity in an on-site power plant. A number of solution mining wells were located on the property for the purpose of extracting salt from deposits located beneath the site for use in manufacturing processes. Several individuals and companies purchased property from Diamond Shamrock and operated industrial facilities within the former facility boundaries, including an aluminum smelting plant, a polyvinyl chloride monomer facility, and a coke plant.

Picture 1.080- Aerial photograph of the Diamond Shamrock Painesville Works site

The data collected to date indicates that exceedances of the water quality criteria for hexavalent chromium continue to be caused by releases of contaminated groundwater for Operable Unit 20 within the Diamond Shamrock Painesville Works site. Load reductions for hexavalent chromium of over 40 percent under low flow conditions in the Grand River must be the minimum design target for corrective measures to be taken at Operable Unit 20 to protect water quality. These measures will have to be maintained in perpetuity, since the amount of time necessary to completely attenuate the source of hexavalent chromium is extensive and removal of the waste mass causing the release appears impracticable. It is likely that efforts necessary to control the release of hexavalent chromium will be sufficient to also address localized problems relating to the release of total dissolved solids to the river.

It is recommended that sufficient long-term monitoring of both total dissolved solids and dissolved hexavalent chromium be carried out as long as site operation and maintenance is necessary to control sources of these pollutants associated with Operable Unit 20. Periodic review of the sampling plans and procedures, as well as the analytical results obtained from the monitoring efforts by the Ohio EPA is vital in order to ensure that progress is made in meeting the water quality criteria.

PROBLEM STATEMENTS

PROBLEM 1

BACKGROUND: Based on the 2000 Census data, the projected population growth for all the counties located within the Lower Grand River Watershed is expected to significantly increase. Impervious surface in this rather urban subwatershed has had a direct impact on the health of the streams. Riparian buffers and ground water flow, are integral to sustaining high quality biological communities, and must be given consideration in plans for development. It has been determined that the remaining sensitive lands, including riparian buffers, core forest areas, and pristine wildlife habitat, should be put under permanent protection through conservation easements, fee simple purchases, etc.

PROBLEM STATEMENT: NEED FOR FUNDING FOR LAND PROTECTION EFFORTS

Currently there are 811.78 acres of permanently protected land in subwatershed HUC 04110004060080 (Grand River below Big Creek to Lake Erie). Grand River Partners, Inc. Land Protection Priority List has identified 2,791.93 acres of priority land for protection in this subwatershed (Grand River below Big Creek to Lake Erie). This land contains high quality natural resources including riparian buffers, core forests, high quality streams, coldwater streams, upland forests, wetlands, and more.

GOALS:

1. Work to secure funding to preserve pristine water quality by protecting an additional 2,791.93 acres of high quality land within subwatershed 04110004060080 (Grand River below Big Creek to Lake Erie).

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Permanent protection of 2,791.93 acres of subwatershed 04110004060080 (Grand River below Big Creek to Lake Erie)	≈$13,959,650 (≈$5,000/ acre conservation easement value)	Grand River Partners, Inc., The Nature Conservancy, Lake SWCD, etc.	1/08-ongoing	Number of acres put into conservation easement protection

P R O B L E M 2

BACKGROUND: Subwatershed 04110004060080 (Grand River below Big Creek to Lake Erie) is an urban subwatershed. Red Creek is in non-attainment and is not likely to meet its attainment due to improper stormwater practices.

PROBLEM STATEMENT: AREAS OF POTENTIAL SOTRMWATER RESTORATION PROJECTS HAVE NOT BEEN IDENTIFIED

The Lake County Stormwater Management Department has been working with the urbanized areas of Lake County in order to address water quantity while aiming to maintain water quality.

GOALS:

2. Develop a restoration potential study within the Red Creek subwatershed to determine areas for potential restoration and water quality improvement projects.

Task Description (objective)	Resources	How	Time Frame	Performance Indicators
Research Red Creek draniage to determine areas of highest restoration potential.	$25,000 for Lake County Stormwater Department to do study	Utilize GIS and ground truthing to identify areas where water quality can be increase through restoration project	1/10- 1/11	Report containing specific restoration projects

COASTAL NONPOINT SOURCE POLLUTION CONTROL PLAN

for the

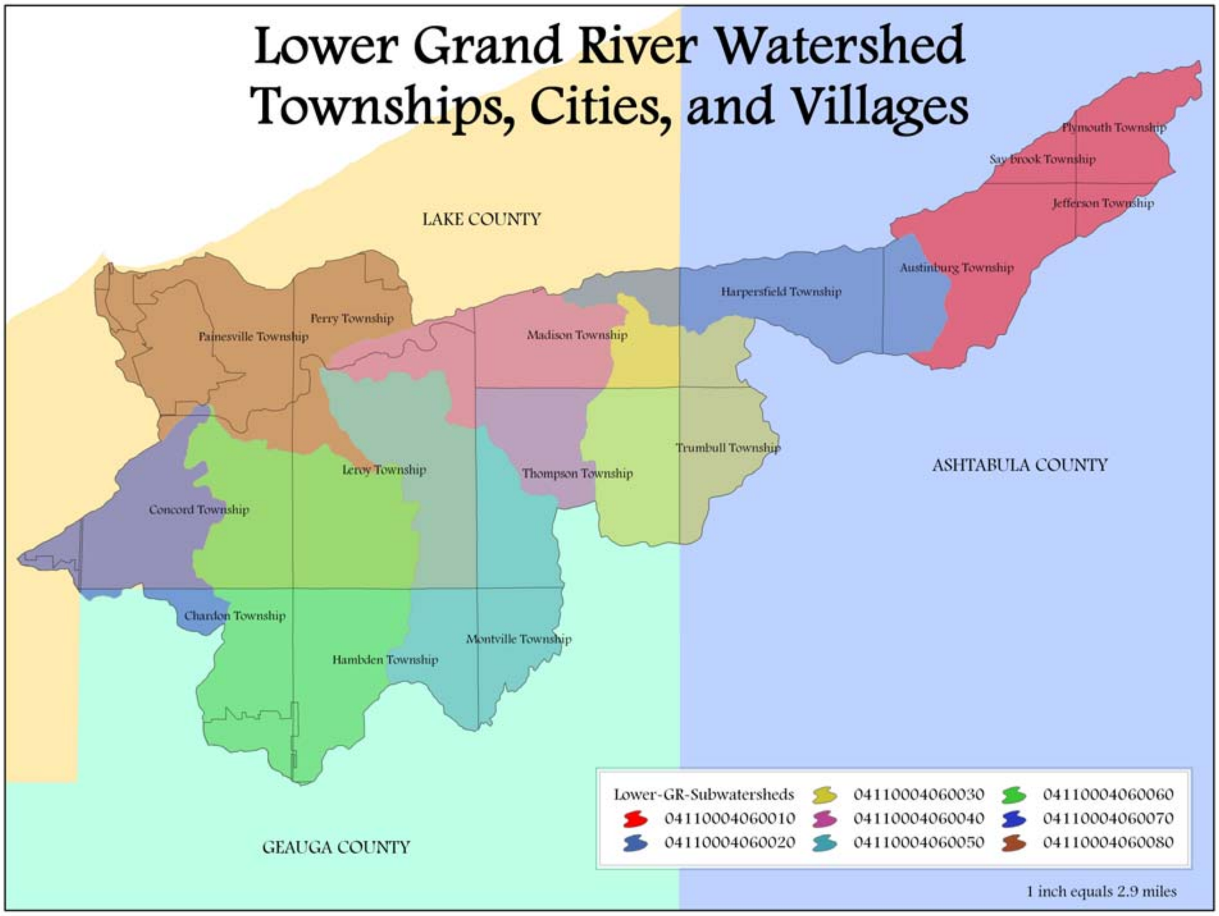
LOWER GRAND RIVER WATERSHED

Lower Grand River Watershed Coastal Nonpoint Source Pollution Control Plan

The Coastal Nonpoint Pollution Control Program (CNPCP) was developed in Ohio to meet the federal criteria laid out in the Coastal Zone Management Act of 1972 which was amended and reauthorized under the Coastal Zone Act Reauthorization amendments of 1990. Under this reauthorization, each state with an approved coastal zone management plan was charged with the task of developing strategies to address the ever growing threats that nonpoint source pollution has on water quality. Specifically, Ohio's CNPCP focus is to protect and restore water quality of Lake Erie by developing watershed specific strategies that adhere to the prevention and control of nonpoint source pollution occurring in its Ohio based tributaries. These individual watershed based programs are developed on a local scale and address the unique land-use, hydraulic, geological, and demographic characteristics of each rivers drainage system.

The following is a summary of the Coastal Nonpoint Source Pollution Program for the Lower Grand River Watershed. The Lower Grand River Watershed encompasses the following 14 digit HUCs of the Grand River Watershed: 04110004060010, 04110004060020, 04110004060030, 04110004060040, 04110004060050, 04110004060060, 04110004060070, and 04110004060080. This plan was developed by Grand River Partners, Inc., with the assistance of the Grand River Partnership. A list of the agencies who will receive a copy of the plan, which helped develop the plan, and who endorse the plan is included in the Lower Grand River Watershed Plan.

Communities located within each of the 14-digit HUCs within the Lower Grand River Watershed



5.3.1 New Development Management Measures (Urban)

New development practices and management measures are broken down by the counties below due to the vastly different implementation levels that currently exist between Lake, Geauga, and Ashtabula Counties. It should be noted that the following measures only apply to specific communities that do not fall under the NPDES Phase II Permit of the Clean Water Act as enacted in March of 2003. The western and central portions of Lake and Geauga Counties are currently experiencing extreme development pressure with moderate pressure occurring in the eastern portions of both. Ashtabula County is currently exhibiting slight residential development on its eastern edge in isolated areas around communities such as Harpersfield and southern Geneva. Population growth and associated urban impacts are the greatest single threat to water quality in the Grand River Watershed.

Lake County

In Lake County all communities except for Leroy Township are covered by Phase II of the NPDES permit and are therefore exempt. Currently, Leroy Township is required to adhere to the County wide Erosion and Sediment Control (ESC) Regulations that were revised in 2005 to meet the new standards of the NPDES permit. These regulations are administered by the Lake County Soil and Water Conservation District with the strong support from the Lake County Commissioners. Additionally in Lake County, all Grand River Watershed communities except for Leroy Township have either joined the Lake County Stormwater Management Department (LSMD) or have developed their own programs to meet the NPDES requirements for stormwater management. The LSMD is a utility developed by the Lake County Engineer whose purpose is to design, review, install and maintain all existing and proposed drainage infrastructure in accordance with the NPDES permit. A strategy is to be developed to educate Leroy Township officials and persuade them to join the LSMD to bring their stormwater management practices up to the standards of the rest of the Lake County.

Geauga County

The Geauga County Commissioners with the assistance of Chagrin River Watershed Partners (CRWP) has adopted countywide ordinances for both erosion and sediment control and stormwater management that meet the criteria of Phase II of the NPDES Permit. These regulations apply to all new development projects that are one acre or greater in size and are administered by both the Geauga Soil and Water

Conservation District (GSWCD) and the Geauga County Engineers (GCE) with the support of the Geauga County Commissioners and the Planning Commission. These programs are largely self sufficient and must continue to be supported both financially and legally by the Geauga County Commissioners.

Ashtabula County

Currently, Ashtabula County does not fall under Phase II of the NPDES permit and does not have any updated ESC or stormwater management regulations that apply to new construction projects. This is largely due to the fact the development pressure in this region of the watershed is still in its infancy, which coincidentally is the opportune time to establish these types of regulations. Adoption of Phase II compliant Erosion and Sediment Control Regulations is a priority for water quality protection in Ashtabula County. The Ashtabula Soil and Water Conservation District (ASWCD) is the most likely candidate to take the lead on the drafting and adoption these regulations with the support of the Ashtabula County Commissioner. Moving forward, the ASWCD will be responsible to hire the appropriate staff to review, approve, inspect, and enforce the mandates of these regulations.

5.3.2 Watershed Protection Management Measure (Urban)

The Grand River is currently the cleanest and most biologically diverse river of its size flowing into Lake Erie in both the Untied States and Canada[1]. The most threatening impact to this watershed is undoubtedly the onslaught of residential, commercial and industrial development pressure, which it will be subject to over the next two decades. Even once all appropriate ordinances and regulations that govern water quality are in place, open space and habitat protection will still be a

[1] United States Geological Survey, Water Resources Investigations Report, 97-4256

priority to protect the delicate ecosystems and groundwater recharge areas that the Grand River relies on. The Center for Watershed Protection suggests that once a watershed has been developed to the point that 10% of its land cover has become impervious, irreversible changes begin to occur with respected to both water quality and quantity which is largely due to nonpoint source pollution. It is estimated that the impervious surface for the lower portion of the Grand River Watershed is approximately 2% and climbing.

To combat this, it has been determined that Grand River Partners, Inc (GRPI) and the now over 30 member agencies of the Grand River Partnership, must protect an average of 3000 acres per year for the next 30 years. These facts are support by Grand River Partners, Inc.'s 2006 *Land Protection Priority Project*, The Nature Conservancy's *Natural Condition Analysis of the Grand River Watershed*, and the Davey Resource Group's *Riparian Corridor Protection Plan for the Grand River*. Additionally the ODNR Division of Wildlife, the Cleveland Natural History Museum, and the Trust for Public Land have all identified land protection as the single greatest challenge for protecting the Grand River from nonpoint source pollution associated with urban development.

For the lower portions of the watershed alone, it has been conservatively projected that the necessary scale of land protection will cost $50.2 million in Lake County, $19.4 million in Geauga County, and $11.2 million in Ashtabula County at today's property values. Although this seems like an almost insurmountable funding request, this can easily be accomplished once GRPI can raise just $3 million for its newly developed Grand River Land Protection Fund. These funds can be used as leverage match for state and federal dollars as well as match for challenge grants from private donors and philanthropic organizations. Additionally, the interest from these funds can easily cover yearly operating cost for GRPI with its projected expansions of staff in the next five years. Once this fund is in place, Grand River Partners, Inc. will have both the capacity capital to take a proactive approach to conservation easements and land acquisition deals and adequately be able to compete with the development pressure.

5.3.3 New Site Development (Urban)

The prevention of most urban nonpoint sources of pollution can easily be addressed with proper planning an attention to site specific natural resources before site development takes place. This involves a coordinated effort on the part of many review agencies including the local SWCD, the Planning Commission, Zoning Commission, and County Engineer and with the assistance of state and federal agencies such as the Ohio EPA, the ODNR, and the US Army Corps of Engineers. On a localized level, it is critical to adopt regulations and ordinances that specifically address urban issues like sediment runoff, stormwater pollution, and construction on highly erodible soils. Additionally, excess water quantities from urban areas must be monitored to protect from flooding, channel destabilization, and habitat washout. Finally, amendments to existing zoning laws that allow for progressive conservation zoning practices must be passed on a local level. To address these issues, local regulations must be implemented and existing regulations must be modified to achieve the maximum protection of natural resources while still maintaining economic viability for parcels within the watershed.

Lake County

In Lake County, all communities in the Lower Grand River Watershed with the exception of Leroy Township are exempt from the Coastal Zone Program due to the fact they fall under Phase II of the NPDES Permit. The Lake County Planning Commission has adopted a county wide Riparian and Wetland Setback Ordinance that pertains to all structures and onsite disposal facilities in all new subdivisions.

Leroy Township will enact a complementary riparian and wetland setback ordinance (CRWP Model) that addresses all projects not covered by the Planning Commission's "subdivision only" regulation. Also, Leroy Township should draft and implement a steep slope ordinance that prohibits development on steep ravine slopes and highly erodible soils. Finally, Leroy Township must amend existing zoning regulation to allow for conservation style zoning which will maintain and protect the critical natural resources on any given parcel.

In addition, the Lake County Engineer must develop a new GIS layer of all of the FEMA recognized floodplain areas of the county and enact county wide regulation that prevent, or at least seek to mitigate, any filling and grading impacts that lessen areas within designated 100 year floodplain areas.

The Lake SWCD's Headwater Stream Initiative is to be completed in Grand River Watershed communities in Lake County. This program uses HHEI and QHEI methodology to classify streams according to habitat potential and has given Lake County an invaluable baseline dataset for planning purposes. Currently, the Lake SWCD has completed the headwater tributary assessments for almost 90% of the Grand River tributaries and is expected to finish by 2008.

Geauga County

Similarly to Lake County, the Geauga County Planning Commission has adopted riparian and wetland setbacks that only deal with structures in new subdivisions. The non-Phase II communities of Chardon Twp., Hambden Twp., Thompson Twp., and Montville Twp. must enact a complementary riparian and wetland setback ordinance (CRWP Model) that addresses all projects not covered by the Planning Commission "subdivision only" regulation.

Also, these communities must draft and implement a steep slope ordinance that prohibits development on steep ravine slopes and highly erodible soils. Finally, these townships must amend existing zoning regulation to allow for conservation style zoning which will maintain and protect critical natural resources on any given parcel.

In addition, the Geauga County Engineer and/or Building Department must develop a new GIS layer of all of the FEMA recognized floodplain areas of the county and enact county wide regulation that will prevent, or at least seek to mitigate, any filling and grading impacts that lessen areas within designated 100 year floodplain areas.

An HHEI program similar to that of Lake County's Headwater Stream Initiative is to be implemented in Grand River Watershed communities Geauga County. This program would use HHEI and QHEI methodology to classify streams according to habitat potential and give Geauga County a needed baseline dataset for planning purposes.

Ashtabula County

Ashtabula County has not yet begun to feel the residential and commercial development pressure that Lake and Geauga Counties have. Ashtabula County would benefit both from a natural resource and an economic perspective, by taking a proactive approach to protect its scenic and water quality resources. Riparian and wetland setback regulations and guidelines must be adopted by the Ashtabula County Planning Commission for subdivisions, and local township regulations should be enacted as well for all townships in the Lower Grand River Watershed.

Also, these communities must draft and implement a steep slope ordinance that prohibits development on steep ravine slopes and highly erodible soils. Finally, these townships must amend existing zoning regulation to allow for conservation style zoning will still maintain and protect critical natural resources on any given parcel.

In addition, the Ashtabula County Engineer and/or Building Department must develop a new GIS layer of all of the FEMA recognized floodplain areas of the county and enact a county wide regulation that will prevent, or at least seek to mitigate, any filling and grading impacts that lessen areas within the designated 100 year floodplain areas.

An HHEI program similar to that of Lake County's Headwater Stream Initiative is to be implemented in Grand River Watershed communities Ashtabula County. This program would use HHEI and QHEI methodology to classify streams according to habitat potential and give Ashtabula County a needed baseline dataset for planning purposes.

5.5.1 Existing Development Management (Urban)

In areas of the Lower Grand River Watershed that have already been urbanized or have experienced moderate to high residential or commercial development, there are often improvements to stormwater infrastructure that can be fixed, improved, or maintained which can lead to improvements in water quality. These improvements will only be successful if they incorporate aspects of education for the general public as well as for public officials and policy makers. The action items for these types of measures must include individual, neighborhood, and community wide responses that incorporate changes in day to day water management practices.

Lake County

In Lake County, all communities in the Lower Grand River Watershed, with the exception of Leroy Township, are exempt from the Coastal Zone Program due to the fact they fall under Phase II of the NPDES Permit. In Leroy Township, education initiatives that demonstrate both the environmental and economic importance of proper stormwater management must be developed for both community leaders and the general public. These education programs are currently being conducted in Lake County communities that have joined the Lake County Stormwater Management Department (LSMD). Community leaders in Leroy Township must be encouraged to join the LSMD and take advantage of the various education and planning components they provide.

Upon joining the LSMD, Leroy Township will be able to identify, fix and maintain problems within the existing stormwater management infrastructure. The township will be able to take a proactive approach on projects that seek to improve water quality such as retro fitting existing stormwater basin outlet structures to meet the new water quality detention of the Phase II Permit and changing existing roadside ditching practices to grassed swale designs that filter salt and pollutants from street and roadside stormwater. Additionally, the township has to identify and restore buffers along riparian areas where possible. All retrofits and/or improvements to Stormwater BMPs in the Lower Grand River Watershed for Lake County must be focused on restoring groundwater recharge and ensuring that negative thermal impacts currently associated with stormwater discharges are addressed.

Neighborhoods must take advantage of the LSMD's street sweeper truck and implement storm drain stenciling programs on a subdivision wide basis. Individuals would be provided education and assistance with programs that help them detach their gutters from directly discharging into the storm sewer systems by installing rain barrels and rain gardens in their place. By joining the LSMD, Leroy Township can make all of these resources available to community officials, neighborhoods, and individual residents.

Geauga County

The Lower Grand River communities not affected by Phase II of the NPDES permit in Geauga County have not seen the development pressure as in Lake County. In Geauga County, existing development improvement campaigns would most likely be lead by the Geauga SWCD. Similarly to the LSMD, the Geauga SWCD would take the lead on educating public officials and the general public of the environmental and economic importance of proper stormwater management.

The non-Phase II communities of Chardon Twp., Hambden Twp., Thompson Twp., and Montville Twp. should be encouraged to implement programs similar to those suggested for Lake County.

Programs that encourage basin retrofits, grassed swales, and riparian restoration must be implemented on a township level while programs that encourage and assist storm drain stenciling, rain gardens, rain barrels, and gutter releases must be promoted by the Geauga SWCD. All retrofits and/or improvements to Stormwater BMPs in the Lower Grand River Watershed for Geauga County should be focused on restoring groundwater recharge and ensuring that negative thermal impacts currently associated with stormwater discharges are addressed.

Ashtabula County

Ashtabula County communities in the Lower Grand River Watershed are even more removed from development pressure than those of Geauga County. Due to this lack of existing development, exploration of stormwater related programs is probably the best option for the next few years. In areas where residential and commercial developments have occurred, retrofits and improvements to existing stormwater infrastructure can be focused on addressing thermal impacts and restoring the groundwater recharge that is critical to the water quality of the Grand River.

5.6.1 New On-site Disposal Systems

New onsite disposal of sewage treatment systems (STS) rules, effective January 1, 2007, were adopted on a statewide level by the Public Health Council as revisions to Chapter 3701-29 of the Ohio Administrative Code. These regulations allow for "flexible, alternative design options" for projects that are built on or within a site having challenging soils conditions or topographic limitations. The new STS rules also outline practices for soils that have seasonal or perched water table conditions which are the dominate soil type in the Lower Grand River Watershed. These rules apply to Lake, Geauga, and Ashtabula Counties and are to be administered by each county's respective Health District with oversight from the Ohio Department of Health, Bureau of Environmental Health. Specific information for each county's program and the details of the new regulations can be found at the following websites:

http://www.odh.ohio.gov/odhPrograms/eh/sewage/sewage1.aspx

http://www.epa.state.oh.us/dsw/permits/GP_HouseholdSewageTreatmentPlants.html

5.6.2 Operating Existing On-Site Disposal Systems

Existing on-site sewage treatment systems are currently monitored by the individual General Health Districts of Lake, Geauga, and Ashtabula counties. Individual systems in each county are at various stages of effectiveness and age. Maintenance of these systems in addition to updating them to meet the new statewide (STS) regulation criteria (effective January 1, 2007) is critical to the amount of nutrient levels entering the headwaters of the Grand River. As old systems are retired or forced to upgrade, new system designs that meet the criteria of the new STS regulations must implemented.

Each county's health district will also need to develop a plan for additional support for monitoring and tracking all existing on-site disposal systems in each perspective county. This is an immense undertaking which will involve the locating of all outfalls in the county, development of specific GIS based tracking software for these outfalls, and the addition of at least one employee to oversee the program.

Along with this, public officials, inspectors, developers, contractors, and the general public will all need education to address the specifics of the new regulations and the responsibilities of each party involved. To do this, each Health District must implement education drives that include yearly developer seminars, contractor workshops and a myriad of public education and facts sheets. Also, each district should develop demonstration disposal systems for alternative STS options that can be used as educational opportunities for installation and maintenance workshops for installers and homeowners to both upgrading and maintaining existing on-site disposal systems.

5.8.1 Planning, Siting, and Developing Roads and Highways(Ohio Local),

5.8.5 Operation and Maintenance of Roads, Highways and Bridges, and

5.8.6 Runoff Systems for Roads, Highways, and Bridges

Since the above management measures are all dealing with the local roads within the Lower Grand River Watershed, their implementation strategies are discussed in detail together.

The planning, maintenance, and operation of new and existing roadways and their stormwater management systems in the Lower Grand River Watershed is the responsibility of the individual township Road Departments, the County Engineer, and the Ohio Department of Transportation (ODOT). New BMP designs that are specifically developed for the water quality needs of each natural drainage system, must be incorporated into all new roadway projects and retrofitted into existing roadways where logistically possible.

An inventory of all of the current practices must first be completed throughout the watershed. A GIS database of these areas must be developed to document all existing BMPs as well as tracking all new BMPs on new and proposed projects. This GIS database could then be easily compared with sensitive natural resource components such as steep slope areas, highly erodible soils, wetland areas, and both HHEI and QHEI classifications for headwater streams. Decisions could then easily be made as to not only the best location of new roadways, but also what BMPs are best suited to meet the water quality needs of very specific locations. This database would be best developed and maintained by the County Engineer with the assistance of the local SWCD and that specific county's GIS Department.

The second step is to develop a series of education programs that would teach planners, engineers, and public officials both the environmental and economic importance of properly locating roadways with respect to natural resources. Additionally, separate programs must be developed that emphasize the technical aspects of new and alternative BMPs that are specialized for different streams and subwatersheds. Also, a design manual must be developed that addresses stormwater BMPs that are specific to linear projects. These programs and workshops would best be presented by the County Engineers Associations and ODOT with the assistance of the ODNR, the Ohio EPA and the local SWCDs, and would include demonstrations of alterative BMPs. Ideally, the seminars would occur at least yearly with the BMP workshops occurring twice a year.

Maintenance of new and existing roadways and their drainage BMPs will fall on the responsibility of ODOT, the County Engineer, and the local township Road Departments. New ditch maintenance and cleaning policies must be implemented that incorporate retro-fits; either grassed swale or two stage channel design. Also, bioswales and infiltration trenches will have to be installed where pollution sensitive receiving waters are present. The maintenance and monitoring of these practices would be incorporated into the maintenance programs currently existing for the responsible road crews. Once the above survey has been complete, costs that truly reflect yearly maintenance and operation costs can be determined.

5.8.2 Bridges

The Lower Grand River Watershed is defined by its water quality and habitats, which like any watershed, is a product of the quality of its headwater tributaries. The gravel beds, sand bars, and point bars found in the riffles and pools of these smaller tributaries are nursery and breeding grounds for the dozens of fish, amphibian, and macroinvertebrate species that give the Grand River the biodiversity it is known for. Too often, culverts and improperly sized road and driveway crossings block critical floodplain areas creating choke points in the stream that cause channel entrenchment, unnatural flow velocities, and substrate washout. Modifications of natural stream channels in this manner cause debris blockages, head-cuts, and extreme flows that ultimately prevent aquatic species from reaching critical upstream breeding areas. To remedy this, changes in bridge policies and the regulations that govern the design and construction of bridges must be addressed in Lake, Geauga, and Ashtabula counties.

Construction of new bridges in each county should be designed according to the recommendations of the forth coming Ohio EPA TMDL for the Lower Grand River Watershed. These recommendations include completely spanning (not culverting) the natural channel width, while maintaining natural substrate composition and appropriate amount of floodplain access for all perennial headwater streams that are classified as Class III according to HHEI or QHEI methodology. Additionally, all streams that are designated as *warmwater habitat*, *exceptional warm water habitat*, or *coldwater habitat* streams by the Ohio EPA, should have a span instead of any culverting. This will maintain the natural channel dimensions, substrate composition, and floodplain access that exist prior to the bridge being installed. Bridges constructed for uses of the individual driveways of residential lots in subdivisions must also take these criteria into account and install the necessary measures. Additionally, bridges that are to be rebuilt must conform to these standards if they occur over the above mentioned streams. All HHEI and/or QHEI assessments must be performed by the local SWCD, OHIO EPA, or other qualified conservation organizations.

To accomplish this, policies in bridge construction and maintenance must be changed on a state, county, and local level to include the above mentioned criteria for designs crossing higher quality streams and headwater tributaries throughout the Lower Grand River Watershed. Amendments to county planning commission subdivision regulations must be added to address this, while policies within the county bridge regulations as well as any applicable township zoning regulation must be modified to meet these standards. As always, education workshops and seminars emphasizing the need and value of these standards must be developed and given to community leaders and members of the planning and engineering communities.

7.4.1 Channelization and Channel Modifications (Physical and Chemical Characteristics)

7.4.2 Channelization and Channel Modifications (Instream and Riparian Habitats)

Channelization issues in the Lower Grand River Watershed typically stem from two separate issues; agricultural and urban drainage modifications. Agricultural modifications usually entail the relocation and ditching of existing headwater tributaries and wetlands to make way for field improvements for either nurseries or row crop fields. Modified streams in urban areas are relocated or channelized for "convenience" sake to make way for commercial and residential development, but also include ineffective hard armoring tactics designed to protect ditch and stream banks from erosion and subsequent loss of property. These impacts to stream channels lead to stream entrenchment, head-cuts, and lack of access to floodplains, and in many smaller subwatersheds, are the single greatest cause of sediment and nonpoint source pollution. The challenges in the Lower Grand River Watershed will be to first identify all modified channels and then restore them to their natural state to the maximum extent practical.

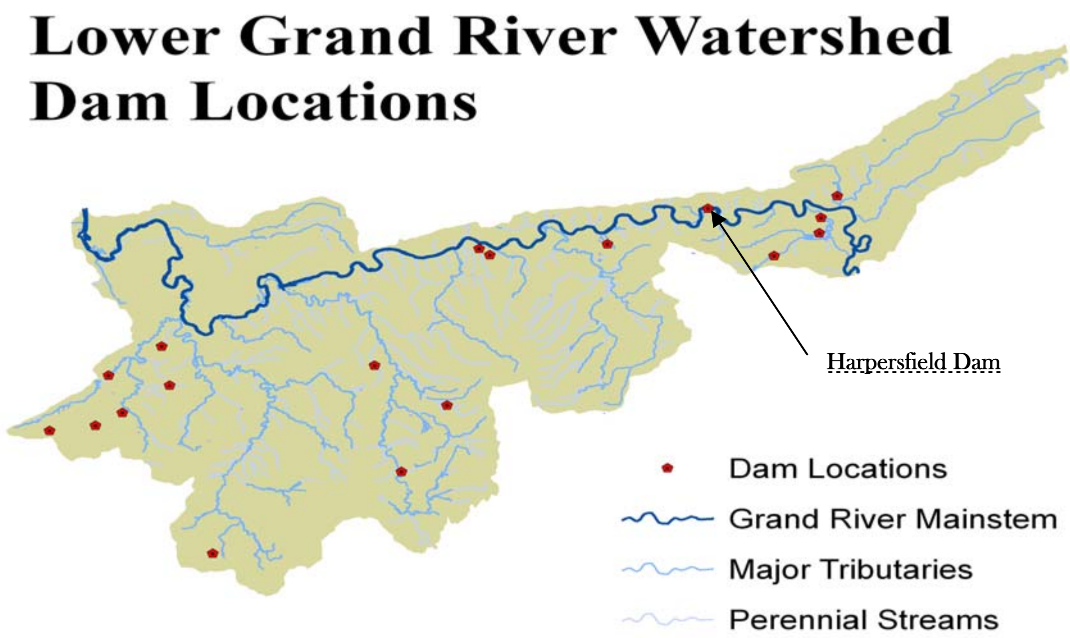
An inventory of all of the modified stream channels must be completed through the Lower Grand River Watershed portions of Lake, Geauga, and Ashtabula counties. This inventory must include all non-roadside ditches, drain tile systems, and channelized and/or modified stream segments that occur in the region. The local SWCDs and/or the county engineer are the most likely agencies to take on this task. Both GIS surveys and onsite inspections of all ditches and streams should be able to yield a comprehensive assessment of all existing channelized areas. A GIS database must be developed for this information to be used in the assessment and restoration phases of this project.

Once the surveys are complete, an assessment of all potential restoration areas must be developed. Restoration potential and strategies for these drainage systems will vary based on current land uses and the willingness of landowners to participate in the programs. Various restoration plans will include reverting ditches back into natural

stream channels, plugging ditches and drain tiles where wetlands were originally, and changing existing agricultural ditches to grassed waterways where applicable.
Additionally, riparian restoration plans that include the replanting of native streamside shrubs and trees and implementing vegetative buffers along agricultural drainage ways must be implemented.
Once willing landowners have been identified, projects will be implemented by the local county engineer, the SWCDs, the ODNR and the NRCS with guidance from the NRCS Engineering Field Handbook, Rainwater and Land Develop Manual, and Rosgden Stream Morphology Methodology.

7.5.3 Dams

There are currently 18 major dams in the Lower Grand River Watershed that meet the Coastal NPS criteria. Only one of these 18 dams, Harpersfield Dam, is constructed on the mainstem of the Grand River and is discussed in more detail below. The majority of these dams have been constructed to back up water into small and medium sized lakes that provide habitat for various fish and waterfowl species. Drinking water, fishing, and other recreational activities are typically the main uses for these impoundments. The negative aspects of these dams is the fact that that are often very costly to maintain and they often prevent fish migration as most of them have been installed over smaller tributaries in the watershed. The map below shows the location of each major dam in the watershed and further detailed information about all of the dams is located in the Lower Grand River Watershed Plan.



Harpersfield Dam

The most significant of these dams, and the *only* dam on the entire mainstem of the Grand River, is Harpersfield Dam which is located in Harpersfield Township in Ashtabula County. It is a 228 foot long concrete-gravity dam that has a drainage area behind it of 575 square miles. This dam is currently on the decline from a structural standpoint and will have to be replaced or removed in the next decade.

This dam blocks fish migration from Lake Erie to the headwaters. However, the dam also blocks the invasive and detrimental Sea Lamprey from accessing and breeding in the lowlands of the Grand River Watershed. These issues have created somewhat of a controversy as to whether or not the dam should be removed or repaired.

Dam strategies

Action items for dams and dam issues in the Lower Grand River Watershed include the development of a true impact study of the actual relationship these dams have on aquatic life populations in this portion of the watershed. Additionally, each County Engineer department must develop and implement a basic annual monitoring program for all existing and new dams, with the goal of providing technical assistance and maintenance education to landowners who have dams on their property. BMP strategies for new dams shall include the development of erosion and sediment control plans for both the construction of new dams, as well as for long term maintenance of existing dams. Additionally, new dams must comply with all section 404 and 401 permits and must have approval from the director of the ODNR for proposed dams on the mainstem that are above the Rt. 84 bridge in the *Wild and Scenic* designated stretches of the Grand River. The Ohio EPA and the ODNR Division of Wildlife are ultimately responsible for enforcement of any dam violation that occurs under **ORC 1531, Clean Water Act ORC 6111, and OAC 3745-1.** The details of the responsible parties for dams in Ohio can be found in tables Chapter 7- Table 7.2-7.4 of the ODNR Coastal Nonpoint Pollution Control Plan found at:

http://www.dnr.ohio.gov/soilandwater/Coastalnonpointprogram.htm .

7.6.1 Eroding Streambanks and Shorelines

Eroding stream banks in the Lower Grand River Watershed are typically problems that originate with improper stream and river management practices upstream from the issue. Practices such as improper detention, filling of floodplains, and undersized culvert and bridge crossings are all unnatural disturbances which lead to changes in both the width and the depth of a downstream channel by adding both velocity and turbidity to the water column. These changes, more often than not, lead to widening and/or deepening of the stream channel thus leading to bank erosion. In the past, engineered solutions included hard armoring of stream banks with riprap, gabions, tire structures, and the insertion of both concrete and steel walls. Although these do provide temporary fixes to localized problems, they do not address the cause of the problems and are typically only a temporary short-term solution.

Educational seminars and technical workshops should be provided by the ODNR and local SWCDs to teach both design engineers and county engineers new alternative BMPs that stress natural channel design, vegetative bioengineering strategies, and floodplain expansion. These programs must incorporate Rosgden Stream Methodology, engineering guidelines of the Rainwater and Land Development Manual, and guidelines from the Center of Watershed Protection. Demonstration projects must be constructed that incorporate these practices as well as detailed engineering schematics and cost effectiveness comparisons between standard and "green" engineering solutions.

Finally, areas where stream bank erosion is occurring must be identified and mapped into a GIS database for Lake, Geauga, and Ashtabula Counties. The County Engineer and the local SWCD should identify bank erosion areas of greatest concern and work with both upstream and downstream landowners to remedy the problem. Bioengineering and alternative solutions will be sought and implemented in these areas that not only fix the localized erosion issues, but also address the causes of these issues to prevent further impacts in the future.

NPDES Phase II Communities are exempt from certain Minimum Control Measures of the Coastal Nonpoint Source Control Program. The following is the list of Phase II Communities who are exempt from certain Minimum Control Measures outlined in the Coastal Plan.

Ashtabula County- There are currently no Communities within Ashtabula County that are under NPDES Phase II.

Lake County- all Communities within the Lower Grand River Watershed in Lake County are under NPDES Phase II rules; Painesville Township, Perry Township, Concord Township, and Madison Township. Leroy Township is the only exemption.

Geauga County- There are no Communities in Geauga County within the Lower Grand River Watershed that are under the NPDES Phase II rules. The Communities that are under the Phase II rules are located within the Chagrin River Watershed. However, Geauga County has adopted NPDES Phase II rules (regulations and ordinances) for the entire county.

Management Measure	HUCs *(entire or portions of)*	Agencies	Strategy	Cost*	Timeline	Target Area	Guidance Document/BMP Manual	Enforcement/ Endorsement Agency
5.3.1 – New Development								
GEAUGA COUNTY	030, 040, 050, 060, 070	Geauga SWCD, Planning Commission, County Engineer, County Commissioners	Continue ongoing Countywide NPDES Phase II program *(not all townships are included under Phase II rules, however, ordnances and regulations have been adopted countywide)*	$15,000 Geauga SWCD staff time to continue ongoing programs	Ongoing	Geauga County	Geauga County ESC Regulations, Stormwater Manual, Setback ordinances, etc.	Geauga SWCD, County Prosecutor
LAKE COUNTY	020, 030, 040, 050, 060, 070, 080	Lake SWCD, Planning Commission, Lake County Stormwater Department, County Engineer, Township Trustees	Work with Leroy Township officials to join the Stormwater Program in place by Lake County	$5,000 Lake SWCD staff time to work with and educate Leroy Township Officials	January 2008- December 2011	Leroy Township, Lake County	Lake County Stormwater Regulations/ ESC Regulations	Lake County Stormwater Department, Lake SWCD, Count Prosecutor
ASHTABULA COUNTY	010, 020, 030	Ashtabula SWCD, Planning Commission, County Commissioners, County Engineer	Develop and adopt Countywide Erosion and Sediment Control Regulations for Subdivision and Individual Lot Construction	$10,000 for Ashtabula SWCD staff salary and benefits for development of ESC Regulations $100,000 first year for start-up of program for Ashtabula SWCD $60,000 carry-on for program for Ashtabula SWCD	January 2008- December 2010	Ashtabula County	Lake and Geauga ESC Regulations., Rainwater Manual	Ashtabula SWCD, County Prosecutor

5.3.2 – Watershed Protection	All HUCs	GRPI, Grand River Partnership	Conservation Easement Acquisition/ Land Purchase	LAKE: $50.2 million for GRPI for land protection ASHTABULA: $19.4 million for GRPI for land protection GEAUGA: $11.2 million for GRPI for land protection	Ongoing	Lower Grand River Watersh ed	Land Protection Priority Project, The Nature Conservancy's Natural Condition Analysis of the Grand River Watershed	GRPI, Grand River Partnership
5.3.3 – Site Development LAKE COUNTY	020, 030, 040, 050, 060, 070, 080	County Engineer, Leroy Township Zoning, Lake SWCD	Develop and adopt Township riparian, wetland, and steep slope set back ordinances Develop Conservation Development Zoning regulations. Update county	$15,000 for Lake SWCD to develop and adopt township zoning ordinance $15,000 for Lake SWCD to develop Conservation Development Zoning Regulations. $3,000 for Lake	June 2008-December 2013	Leroy Townshi p, Lake County in the Lower Grand River Watersh ed	Chagrin River Watershed Partners Model Ordinances, FEMA Guidelines, OEPA HHEI Protocol	County Engineer, Township Zoning, Lake SWCD

			floodplain information (GIS)	SWCD to update floodplain GIS data layer				
GEAUGA COUNTY	030, 040, 050, 060, 070	County Engineer, Non Phase II Communities, Geauga SWCD	Develop and adopt Township riparian, wetland, and steep slope set back ordinances	$15,000 for Geauga SWCD to develop and adopt township zoning ordinance	June 2008-December 2013	Non-Phase II Communities in Geauga County, Ohio	Chagrin River Watershed Partners Model Ordinances, FEMA Guidelines, OEPA HHEI Protocol	County Engineer, Township Zoning, Geauga SWCD
			Develop HHEI monitoring program for headwater streams	$15,000 for first year start-up, $10,000 carry-on				
			Develop Conservation Development Zoning regs.	$15,000 for Geauga SWCD to develop Conservation Development Zoning Regs.				
			Update county floodplain information (GIS)	$3,000 for Planning Commission to update floodplain GIS data layer				
ASHTABULA COUNTY	010, 020,	County Engineer,	Develop HHEI monitoring program	$15,000 Ashtabula	January 2009-	Ashtabula	Chagrin River Watershed	County Engineer,

	030	County Planning Commission, Ashtabula SWCD	for headwater streams Develop and adopt riparian and wetland set back and steep slope regulation for subdivisions Update floodplain information Develop Conservation Development Zoning Regulations	SWCD for first year start-up, $10,000 carry-on $15,000 Ashtabula SWCD to develop and adopt subdivision regulation $3,000 for Planning Commission to update floodplain GIS data layer $15,000 Ashtabula SWCD to develop regulation	December 2015	County portions of the Lower Grand River Watersh ed	Partners Model Ordinances, FEMA Guidelines, OEPA HHEI Protocol	Township Zoning, Ashtabula SWCD
5.5.1- Existing Development LAKE COUNTY:	020, 030,	Leroy Township,	Work with Leroy Township to have them	$2,000 for Lake SMD for public	January 2008-	Leroy Townshi	OEPA NPDES Phase II	Leroy Township, Lake

	040, 050, 060, 070, 080	County Engineer, LSMD	join the LSMD	meetings/ presentations	December 2010	p, Lake County	regulations	SWCD, LSMD
GEAUGA COUNTY:	030, 040, 050, 060, 070	Geauga SWCD, County Engineer, Non-Phase II Communities	Education campaign for non-phase II communities on importance of proper stormwater management	$25,000 Geauga SWCD for publication, meetings, presentations, etc.	January 2008-December 2010	Non-phase II commu nities in Geauga County	OEPA NPDES Phase II regulations	Geauga SWCD, County Engineer, Non-phase II Communities
ASHTABULA COUNTY:	010, 020, 030	Ashtabula SWCD, County Engineer, Planning Commission	Review existing Countywide stormwater management program and infrastructure	$15,000 Ashtabula SWCD, County Engineer, Planning Commission to review existing program policies and structures	January 2008-December 2010	Ashtabu la County	OEPA NPDES Phase II regulations	Ashtabula SWCD, County Engineer, Planning Commission
5.6.1 – New On-Site Disposal Systems								
LAKE COUNTY	020, 030,	County Health Department,	Train sanitary design engineers, installers,	$5,000 per training held	March 2008-	Lake County	County Regulations,	County Prosecutor,

GEAUGA/ ASHTABULA COUNTIES	040, 050, 060, 070, 080	State Health Board	and contractors	for sanitary design engineers, installers, and contractors	December 2010	portion of the Lower Grand River Watershed	Chapter 3701-29 of the Ohio Administrative Code effective January 1, 2007	State Prosecutor
	010, 020, 030, 040, 050, 060, 070	County Health Department	Update County regulations to bring up to new State Standards Train sanitary design engineers, installers, and contractors on new regulations.	$10,000 for County Health Departments to develop regulations $5,000 per training held for sanitary design engineers, installers, and contractors on new regulations	March 2008-December 2010	Ashtabula and Geauga portions of the Lower Grand River Watershed	Lake County regulations, Chapter 3701-29 of the Ohio Administrative Code effective January 1, 2007	County Prosecutor, State Prosecutor
5.6.2 – Operating HSTS LAKE/ GEAUGA COUNTIES	020, 030, 040, 050, 060, 070,	County Health Districts	Develop a program to: o detect outfall locations o Develop a GIS database of these locations	$50 per home per year assessment for inspection $60,000 to hire	March 2008-December 2010	Lake and Geauga portions of the Lower	Lake County regulations, State regulations.	Lake/ Geauga Health Departments

	080		o Monitor existing systems o Demonstration Project on new or alternative systems	additional inspector for increased volume $10,000 per county for demonstration site		Grand River Watersh ed		
ASHTABULA COUNTY	010, 020, 030	County Health District	Develop program to: o Detect outfall locations o Develop GIS database of these locations o Monitor existing systems o Demonstration project on new or alternative systems	$50 per home per year assessment for inspection $60,000 to hire additional inspector for increased volume $10,000 for demonstration site	March 2008-December 2010	Ashtabu la portions of the Lower Grand River Watersh ed	Lake County regulations, State regulations.	Ashtabula Health Department
5.8.1 – Planning, Siting, and Developing Local Roads and								

Highways ALL COUNTIES	All HUCs	County Engineers, SWCDs	Develop countywide BMP Manual for all linear projects Provide Trainings to County Planners, County Engineer, Public Officials	$30,000 for County Engineer for development of BMP Manual for linear projects $6,000 for development of BMPs for linear projects trainings $3,000 per training to County Planners, County Engineer, & Public Officials	January 2009-December 2012	Lower Grand River Watershed with a focus on Ashtabula County where development is most likely to increase	ODOT Manual, Rainwater Manual, Center for Watershed Protection	County Engineers/ County Prosecutors
5.8.2 – Local Bridges ALL COUNTIES	All HUCs	County Engineer, Local Road Departments, Local SWCDs, Public Officials, OEPA	Develop a regulation which takes ORAM, QHEI, HHEI scores and Use Designation into account with development of new stream crossings	$20,000 to draft a ordinance/ regulation	January 2007-December 2012	All stream crossings in the Lower Grand River	ORAM, QHEI, HHEI, ODOT Manual, Rainwater Manual, TMDL for the Lower Grand River	County Engineer, OEPA, County Prosecutor

			Education campaign including public meetings/presentations, publications, and trainings	$25,000 for all presentation/ publication development, trainings developed and hosted		Watershed	Watershed, Center for Watershed Protection	
5.8.5 – Operation and Maintenance of Roads, Highways, and Bridges ALL COUNTIES	All HUCs	County Engineer, Road Department	Provide trainings for BMP design to County Engineers Provide trainings for BMP installation and maintenance to local road departments	$3,000 per each type of training	January 2007-December 2012	Lower Grand River Watershed	ODOT Manual, Rainwater Manual, Center for Watershed Protection	County Engineer
5.8.6 – Runoff Systems for Roads, Highways,								

and Bridges ALL COUNTIES	All HUCs	County Engineer, local road departments, local SWCDs	Develop a ditch/ outfall mapping program (GIS) Identify hotspots Have a demonstration project in each county if applicable Explore the incorporation of new designs into existing regulations.	$15,000 to have consultant map and identify hotspots $150,000 for the cost of a demonstration/ retrofit project $5,000 for County Engineer to research the feasibility of incorporating new design into existing regulations.	January 2010- December 2015	Lower Grand River Watershed	GIS, ODOT Manual, Rainwater Manual, Center for Watershed Protection	Local SWCDs, County Engineer, Road Departments
7.4.1 – Operation and Maintenance Program for Existing Modified Channels – Surface								

Water ALL COUNTIES	All HUCs	Local SWCDs, County Engineer, ODNR, Army Corp of Engineers, OEPA	Identify/ Map channelized/ drained areas Identify each area as either a potential wetland restoration or a retrofit project Complete a restoration project	$5,000 to hire consultant to complete inventory of channelization $5,000 – for staff to work with agencies and landowners to determine potential demonstration sites Restoration Projects: o $50,000 wetland restoration o $50,000 for channel redesign/ improveme nt	January 2010- December 2015	Channel ized areas within the Lower Grand River Watersh ed specifica lly agricult ural areas	OEPA, ODNR, Rainwater Manual, Center for Watershed Protection	Local SWCDs, County Engineer, OEPA, ODNR, US Army Corp of Engineers
7.4.2 – Operation and								

Maintenance Program for Existing Modified Channels – Instream and Riparian Habitat ALL COUNTIES	All HUCs	County Engineer, Local SWCDs, Ohio EPA	Have local SWCDs develop GIS data on stream channelization and identify areas for stream restoration projects. Work with local agencies to develop a project site in each county if applicable.	$5,000 per county for consultant to complete GIS inventory of channelization. $5,000 per county for staff to work with agencies and landowners to determine potential demonstration sites. $100 per linear foot for restoration project	January 2010-December 2015	Channelized stream sections in the Lower Grand River Watershed, specifically Coffee and Center Creeks	Rosgden Stream Morphology Methodology	County Engineer, SWCDs, OEPA, ODNR, Army Corp of Engineers

7.5.3 – Dams ALL COUNTIES	All HUCs	Ohio Division of Wildlife, Ohio EPA	Hire consultant to monitor and provide an impact study of the dams in the Lower Grand River Watershed.	$50,000 –cost for hiring consultant to do study and develop annual monitoring program $10,000 for implementation of basic annual monitoring program.	January 2010-December 2015	The eighteen dams located within the Lower Grand River Watershed	ODOW/ OEPA dam specifications	ODOW/ OEPA
7.6.1 – Eroding Streambanks and Shorelines ALL COUNTIES	All HUCs	SWCDs, County Engineer,	Develop GIS datalayer of Highly Erodible Soils. Work with local SWCDs to develop specific BMPs to address development	$10,000 – SWCDs staff time to develop GIS datalayer of highly erodible soils. $3,000 – for SWCD staff to develop list of acceptable	June 2008-December 2012	Lower Grand River Watershed focusing on the Gorge Section of the Grand	Rainwater Manual, Rosgden Stream Morphology Methodology, Center for Watershed Protection	County Engineers, SWCDs

			on highly erodible soils. Demonstration project that utilizes bioengineering practices for streambank erosion	BMP's. $3,000 – for training to developers and contractor on new BMPs for highly erodible soils $100,000 per county for funding for restoring degraded streambanks to be used as demonstration project sites		River		

SECTION IV

PLAN UPDATE AND DISTRIBUTION

The Lower Grand River Watershed Plan will be administered and updated by Grand River Partners, Inc. The completed final draft of the Lower Grand River Watershed Plan will be available on the Grand River Partners, Inc website,www.grandriverpartners.org, and will be distributed to the Grand River Partnership. In addition, Grand River Partners, Inc. will announce the completion of the Lower Grand River Watershed Plan at the Grand River Partnership quarterly meeting, Grand River Partners, Inc. Annual Meeting, and through the local media in order to encourage new stakeholder involvement. Grand River Partners, Inc. will use the web site, public announcements, and news releases to inform, educate, and involve the public in on-going outreach.

The Upper Grand River Watershed Plan could become the responsibility of Grand River Partners, Inc. Unfortunately, the funding for the administrator of the Upper Grand River Watershed Plan fell through, and the position is no longer. It has been agreed that Grand River Partners, Inc. will explore taking on the additional responsibilities of the plan. However, the Lower Grand River Watershed Plan will remain as the priority for the Watershed Coordinator, and updates and revisions to the Upper Grand River Watershed Plan will not occur until the Lower Grand River Watershed Plan is fully endorsed and action items are being implemented. The main goal is to have both plans fully endorsed, and melded together to form a comprehensive plan that will best benefit the two drastically different sections of the Grand River Watershed.

Abbreviations and Acronyms

AOC - Area of Concern

BMPs - Best Management Practices

CAFO - Concentrated Animal Feeding Operation

CD - Conservation District

CMNH- Cleveland Museum of Natural History

CREP - Conservation Reserve Enhancement Program

CRP - Conservation Reserve Program

CWA - Clean Water Act

CWH - Coldwater Habitat

DC - District Conservationist

DNAP - Division of Natural Areas and Preserves (Within ODNR)

DSW - Division of Surface Water (OEPA)

EQIP - Environmental Quality Incentives Program

EWH - Exceptional Warmwater Habitat

FS - Forest Service

FWS - Fish and Wildlife Service

GIS - Geographic Information System

GLC - Great Lakes Commission

GLNPO - Great Lakes National Program Office

GLPF - Great Lakes Protection Fund

GRPI – Grand River Partners, Inc.

HEL - Highly Erodible Land

HHEI- Headwater Habitat Evaluation Index

IBI - Index of Biotic Integrity

IJC - International Joint Commission

LEPF - Lake Erie Protection Fund

LPPL- Land Protection Priority List

MWH - Modified Warmwater Habitat

NEPA - National Environmental Policy Act

NPDES - National Pollutant Discharge Elimination System

NPS - Nonpoint Source (Pollution)

NRCS - Natural Resources Conservation Service

OARDC - Ohio Agricultural Research and Development Center

ODA - Ohio Department of Agriculture

ODH - Ohio Department of Health

ODNR - Ohio Department of Natural Resources

OEEF - Ohio Environmental Education Fund

OEMA - Ohio Emergency Management Agency

OEPA - Ohio Environmental Protection Agency

OGRIP - Ohio Geographically Referenced Information Program

QHEI- Qualitative Habitat Evaluation Index

RAP - Remedial Action Plan

RC&D - Resource Conservation and Development Areas

RFP - Request for Proposal

SWCD - Soil and Water Conservation District

TMDL - Total Maximum Daily Load

TNC- The Nature Conservancy

USACE – United States Army Corps of Engineers

USDA - U.S. Department of Agriculture

USEPA - U.S. Environmental Protection Agency

USFWS – United States Fish and Wildlife Service

USGS - United States Geological Survey

WHP - Wellhead Protection

WRP - Wetland Reserve Program

WREP- Wetland Reserve Enhancement Program

WWH - Warmwater Habitat

Glossary of Watershed Terms

A

Absorption. The entrance of water into the soil or rocks by all natural processes. It includes the *infiltration* of precipitation or snowmelt, gravity flow of streams into the valley alluvium (*see* Bank storage) into sinkholes or other large openings, and the movement of atmospheric moisture.

Annual flood. The highest peak discharge in a *water year.*

Annual flood series. A list of *annual floods.*

Average discharge. In the annual series of the Geological Survey's reports on surface-water supply--the arithmetic average of all complete water years of record whether or not they are consecutive. Average discharge is not published for less than 5 years of record. The term "average" is generally reserved for average of record and "mean" is used for averages of shorter periods, namely, daily mean discharge.

B

Backwater. Water backed up or retarded in its course as compared with its normal or natural condition of flow. In *stream gaging,* a rise in *stage* produced by a temporary obstruction such as ice or weeds, or by the flooding of the stream below. The difference between the observed stage and that indicated by the *stage-discharge relation,* is reported as backwater.

Bank. The margins of a *channel.* Banks are called right or left as viewed facing in the direction of the flow.

Bankfull stage. Stage at which a stream first overflows its natural banks. *(See also* Flood stage. Bankfull stage is a hydraulic term, whereas flood stage implies damage.)

Bank storage. The water absorbed into the banks of a stream channel, when the stages rise above the water table in the bank formations, then returns to the channel as effluent seepage when the stages fall below the water table. (After Houk, 1951, p. 179.)

Base discharge (for peak discharge). In the Geological Survey's annual reports on surface-water supply, the discharge above which peak discharge data are published. The base discharge at each station is selected so that an average of about three peaks a year will be presented. (*See also* Partial-duration flood series.)

Base flow. *See* Base runoff.

Base runoff. Sustained or fair weather runoff. In most streams, base runoff is composed largely of groundwater effluent. (Langbein and others, 1947, p. 6.) The term *base flow is* often used in the same sense as base runoff. However, the distinction is the same as that between streamflow and runoff. When the concept in the terms *base flow* and base runoff is that of the natural flow in a stream, base runoff is the logical term. *(See also* ***Ground-water runoff*** *and* Direct runoff.)

Basic hydrologic data. Includes inventories of features of land and water that vary only from place to place (topographic and geologic maps are examples), and records of processes that vary with both place and time. (Records of precipitation, streamflow, ground-water, and quality-of-water analyses are examples.)

Basic hydrologic information is a broader term that includes surveys of the water resources of particular areas and a study of their physical and related economic processes, interrelations and mechanisms.

Braiding of river channels. Successive division and rejoining (of riverflow) with accompanying islands is the important characteristic denoted by the synonymous terms, braided or anastomosing stream. (Leopold and Wolman, 1957, p. 40.) A braided stream is composed of *anabranches.*

C

Catchment area. *See* Drainage basin.

Cfs. Abbreviation of *cubic feet per second* .

Cfs-day. The volume of water represented by a flow of 1 cubic foot per second for 24 hours. It equals 86,400 cubic feet, 1.983471 acre-feet, or 646,317 gallons.

Cfsm (cubic feet per second per square mile). The average number of cubic feet of water per second flowing from each square mile of area drained by a stream, assuming that the runoff is distributed uniformly in time and area.

Channel (watercourse). An open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. River, creek, run, branch, anabranch, and tributary are some of the terms used to describe natural channels. Natural channels may be single or braided *(see* **Braiding of river channels)** . Canal and floodway are some of the terms used to describe artificial channels.

Channel storage. The volume of water at a given time in the *channel* or over the *flood plain* of the *streams* in a *drainage basin* or river *reach.* Channel storage is great during the progress of a *flood event. (See* Horton, 1935, p. 3.)

Climate. The sum total of the meteorological elements that characterize the average and extreme condition of the atmosphere over a long period of time at any one place or region of the earth's surface. The collective state of the atmosphere at a given place or over a given area within a specified period of time. (Landsberg, 1945, p. 928.)

Climatic year. A continuous 12-month period during which a complete annual cycle occurs, arbitrarily selected for the presentation of data relative to hydrologic or meteorologic phenomena. The climatic year is usually designated by the calendar year during which most of the 12 months occur. (*See* **Water year**.)

Concentration time. *See* **Time of concentration.**

Condensation. The process by which water changes from the vapor state into the liquid or solid state. It is the reverse of evaporation.

Conservation storage. Storage of water for later release for useful purposes such as municipal water supply, power, or irrigation in contrast with storage capacity used for flood control.

Consumptive use. The quantity of water absorbed by the crop and transpired or used directly in the building of plant tissue together with that evaporated from the cropped area. (U.S. Bur. of Reclamation, 1952, p. 3.)

The quantity of water transpired and evaporated from a cropped area or the normal loss of water from the soil by evaporation and plant transpiration. (Blaney, 1951b, p. 190.) (*see also* **Water requirement** *and* Blaney, 1951a, p. 4.)

The quantity of water discharged to the atmosphere or incorporated in the products of the process in connection with vegetative growth, food processing, or an industrial process (MacKichan, 1957, p. 2.)

Consumptive use, net. The consumptive use decreased by the estimated contribution by rainfall toward the production of irrigated crops. (Simons, 1953, p. 12.) *(See* **Effective precipitation (3)**.) Net consumptive use is sometimes called crop irrigation requirement.

Consumptive waste. The water that returns to the atmosphere without benefiting man. (Thomas, 1951, p. 217.)

Contents. The volume of water in a reservoir. Unless otherwise indicated reservoir content is computed on the basis of a level pool and does not include *bank storage.*

Control. A natural constriction of the channel, a long reach of the channel, a stretch of rapids, or an artificial structure downstream from a *gaging station* that determines the *stage-discharge relation* at the gage.

A control may be complete or partial. A complete control exists where the stage-discharge relation at a gaging station is entirely independent of fluctuations in stage downstream from the control. A partial control exists where downstream fluctuations have some effect upon the stage-discharge relation at a gaging station. A control, either partial or complete, may also be shifting. Most natural controls are shifting to a degree, but a shifting control exists where the stagedischarge relation experiences frequent changes owing to impermanent bed or banks.

Correlation. The process of establishing a relation between a variable and one or more related variables. Correlation is simple if there is only one independent variable; multiple, if there is more than one independent variable. For gaging station records, the usual variables are the short-term gaging-station record and one or more long-term gaging-station records. (Searcy, 1960.)

Correlative estimate. A discharge determined by correlation. A correlative estimate represents a likely value of the discharge for any particular period--commonly a month--according to a specified method of analysis. (After Langbein and Hardison, 1955, [no. 826], p. 826-8.)

Cubic feet per second. A unit expressing rates of discharge. One cubic foot per second is equal to the discharge of a stream of rectangular cross section, 1 foot wide and 1 foot deep, flowing water an average velocity of 1 foot per second.

Current meter. An instrument for measuring the speed of flowing water. The Geological Survey uses a rotating cup meter.

Cycle. A regularly recurring succession of events such as the cycle of the seasons. Use of cycle to describe a group of wet years followed or preceded by a group of dry years is to be avoided.

D

Dependable yield, *n*-years. The minimum supply of a given water development that is available on demand, with the understanding that lower yields will occur once in *n* years, on the average. (Paulsen, 1950, p. 801.)

Depletion. The progressive withdrawal of water from surface- or ground-water reservoirs at a rate greater than that of replenishment. (*see* Recession curve *and* streamflow depletion.)

Depression storage. The volume of water contained in natural depressions in the land surface, such as puddles. (After Horton, 1935, p. 2)

Direct runoff. The runoff entering stream channels promptly after rainfall or snowmelt. Superposed on *base runoff,* it forms the bulk of the hydrograph of a *flood.*

See also **surface runoff.** The terms *base runoff* and *direct runoff* are time classifications of runoff. The terms *ground-water runoff* and *surface runoff* are classifications according to source.

Discharge. In its simplest concept discharge means outflow; therefore, the use of this term is not restricted as to course or location, and it can be applied to describe the flow of water from a pipe or from a drainage basin. If the discharge occurs in some course or channel, it is correct to speak of the discharge of a canal or of a river. It is also correct to speak of the discharge of a canal or stream into a lake, a stream, or an ocean. *(See also* Streamflow *and* Runoff.)

The data in the reports of the Geological Survey on surface water represent the total fluids measured. Thus, the terms discharge, streamflow, and runoff represent water with the solids dissolved in it and the sediment mixed with it. Of these terms, discharge is the most comprehensive. The discharge of drainage basins is distinguished as follows:

> Yield. Total water runout or crop; includes runoff plus underflow. Runoff. That part of water yield that appears in streams. Streamflow. The actual flow in streams, whether or not subject to regulation, or underflow.

Each of these terms can be reported in total volumes (such as acre-feet) or time rates (such as cubic feet per second or acre-feet per year). The differentiation between runoff as a volume and streamflow as a rate is not accepted.

Discharge rating curve. *See* Stage discharge relation.

Distribution graph (distribution hydrograph). A *unit hydrograph* of *direct runoff* modified to show the proportions of the volume of runoff that occurs during successive equal units of time. (After Hoyt and others, 1936, p. 124.)

Diversion. The taking of water from a stream or other body of water into a canal, pipe, or other conduit.

Drainage area. The drainage area of a stream at a specified location is that area, measured in a horizontal plane, which is enclosed by a drainage divide. *(See* [U.S.] Federal Inter-Agency River Basin Committee, Subcommittee on Hydrology, 1951, p. 11.) 1

Drainage basin. A part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

Drainage density. Length of all *channels* above those of a specified *stream order* per unit of *drainage area.*

Drainage divide. The rim of a *drainage basin*. *(See* Watershed.)

Drought. A period of deficient precipitation or runoff extending over an indefinite number of days, but with no set standard by which to determine the amount of deficiency needed to constitute a drought. Thus, there is no universally accepted quantitative definition of drought; generally, each investigator establishes his own definition.

The following paragraph (Hoyt, 1936, p. 2) discusses the problem of defining a drought:

When in an area that is ordinarily classed as humid, natural vegetation becomes desiccated or defoliates unseasonably and crops fail to mature owing to lack of precipitation, or when precipitation is insufficient to meet the needs of established human activities, drought conditions may be said to prevail. Although water for irrigation or other uses in arid areas is always limited, special shortages in such areas are also regarded as droughts. Unsatisfactory distribution of precipitation throughout the year may be as effective a factor in causing a drought as a shortage in the total amount. Temperature and wind may also play an important part, especially in relation to the damage done.

E

Effective precipitation (rainfall). 1. That part of the precipitation that produces runoff. 2. A weighted average of current and antecedent precipitation that is "effective" in correlating with runoff. 3. As described by U.S. Bureau of Reclamation (1952, p. 4), that part of the precipitation falling on an irrigated area that is effective in meeting the *consumptive use* requirements.

Epilimnion. *See* thermal stratification.

Evaporation. The process by which water is changed from the liquid or the solid state into the vapor state. In hydrology, evaporation is vaporization that takes place at a temperature below the boiling point.

Evaporation opportunity (relative evaporation). The ratio of the rate of evaporation from a land or water surface in contact with the atmosphere, to the *evaporativity* under existing atmospheric conditions. It is the ratio of actual to potential rate of evaporation, generally stated as a percentage. (Derived from Meinzer, 1923, p. 14.)

The opportunity for a given rate of evaporation to continue is determined by the available moisture supply. (Meyer, 1928, p. 244.)

Evaporation pan. An open tank used to contain water for measuring the amount of evaporation. The U.S. Weather Bureau class *A* pan is 4 feet in diameter, 10 inches deep, set up on a timber grillage so that the top rim is about 16 inches from the ground. The water level in the pan during the course of observation is maintained between 2 and 3 inches below the rim.

Evaporation, total. The sum of water lost from a given land area during any specific time by transpiration from vegetation and building of plant tissue; by evaporation from water surfaces, moist soil, and snow; and by interception. *** It has been variously termed "evaporation," "evaporation from land areas," "evapotranspiration," "total loss," "water losses," and "fly off." (Lee, 1949, p. 314.)

Evaporativity (potential rate of evaporation). The rate of evaporation under the existing atmospheric conditions from a surface of water that is chemically pure and has the temperature of the atmosphere. (Meinzer, 1923, p. 13.)

Evapotranspiration. Water withdrawn from a land area by *evaporation* from water surfaces and moist soil and plant *transpiration*. It is a coined word; probably the first recorded use is on page 296 of the Transactions of the American Geophysical Union, part 2, 1934.

Evapotranspiration, potential. *See* Potential evapotranspiration.

Excessive rainfall. *See* Rainfall, excessive.

F

Field capacity. *See* Field-moisture capacity.

Field-moisture capacity. The quantity of water which can be permanently retained in the soil in opposition to the downward pull of gravity. (Horton, 1935, p. 3.)

Field-moisture deficiency. The quantity of water, which would be required to restore the *soil moisture* to *field-moisture capacity.* (Horton, 1935, p. 3.)

Flood. An overflow or inundation that comes from a river or other body of water (Barrows, 1948, p. 4), and causes or threatens damage.

Any relatively high streamflow overtopping the natural or artificial banks in any reach of a stream. (Leopold and Maddock, 1954, p. 249-251.)

A relatively high flow as measured by either gage height or discharge quantity. (Jarvis and others, 1936, p. 463.)

A glossary of flood terms is given in "The Flood Control Controversy." (Leopold and Maddock, 1954, p. 249-251.) *See* Annual flood.

Flood-control storage. Storage of water in reservoirs to abate flood damage. *(See* Retarding reservoir.)

Flood crest. *See* Flood peak.

Flood event. *See* Flood wave.

Flood-frequency curve. 1. A graph showing the number of times per year on the average, plotted as abscissa, that floods of magnitude, indicated by the ordinate, are equaled or exceeded. 2. A similar graph but with *recurrence intervals* of floods plotted as abscissa. *(See* Dalrymple, 1960.)

Flood, maximum probable. The largest flood for which there is any reasonable expectancy in this climatic era. (Leopold and Maddock, 1954, p.112.)

Flood peak. The highest value of the stage or discharge attained by a flood; thus, peak stage or peak discharge. Flood crest has nearly the same meaning, but since it connotes the top of the *flood wave,* it is properly used only in referring to stage--thus, crest stage, but not crest discharge.

Flood plain. A strip of relatively smooth land bordering a stream, built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current. It is called a living flood plain if it is overflowed in times of highwater; but a fossil flood plain if it is beyond the reach of the highest flood. (Bryan, 1922, p. 88.)

The lowland that borders a river, usually dry but subject to flooding. (Hoyt and Langbein, 1955, p. 12.)

That land outside of a stream channel described by the perimeter of the *maximum probable* flood. (After White, 1945, p. 44.)

Flood profile. A graph of elevation of the water surface of a river in flood, plotted as ordinate, against distance, measured in the downstream direction, plotted as abscissa. A flood profile may be drawn to show elevation at a given time, crests during a particular flood, or to show stages of *concordant flows.*

Flood routing. The process of determining progressively the timing and shape of a *flood wave* at successive points along a river. *(See* Carter and Godfrey, 1960.)

Floods above a base. *See* Partial-duration flood series.

Flood stage. The gage height of the lowest bank of the reach in which the gage is situated. The term "lowest bank" is, however, not to be taken to mean an unusually low place or break in the natural bank through which the water inundates an unimportant and small area. (Linsley, 1942, p. 89.)

The stage at which overflow of the natural banks of a stream begins to cause damage in the reach in which the elevation is measured. (U.S. Weather Bur.)

See also Bankfull stage.

Flood wave. A distinct rise in stage culminating in a crest and followed by recession to lower stages.

Floodway. A part of the flood plain otherwise leveed, reserved for emergency diversion of water during floods. A part of the flood plain which, to facilitate the passage of floodwater, is kept clear of encumbrances.

The channel of a river or stream and those parts of the flood plains adjoining the channel, which are reasonably required to carry and discharge the floodwater or floodflow of any river or stream (Erbe and Flores, 1957, p. 443).

Flood zone. The land bordering a stream which is subject to floods of about equal frequency; for example, a strip of the *flood plain* subject to flooding more often that once but not as frequently as twice in a century. (*See* White, 1945, p. 44.)

Flow-duration curve. A cumulative frequency curve that shows the percentage of time that specified discharges are equaled or exceeded. *(See* Searcy, 1959.)

Forest influences. Effects resulting from the presence of forest or brush upon climate, soil water, runoff, streamflow, floods, erosion, and soil productivity. (Kittredge, 1948, p. l.)

G

Gage height. The water-surface elevation referred to some arbitrary gage datum. Gage height is often used interchangeably with the more general term *stage* although gage height is more appropriate when used with a reading on a gage.

Gaging station. A particular site on a stream, canal, lake, or reservoir where systematic observations of *gage height* or *discharge* are obtained. (*See also* **Stream-gaging station.**)

Glacier. Bodies of land ice that consist of recrystallized snow accumulated on the surface of the ground (Matthes, 1949, p. 150), and that move slowly downslope.

Ground water. Water in the ground that is in the *zone of saturation,* from which wells, springs, and *ground-water runoff* are supplied. (After Meinzer, 1949, p. 385.)

Ground-water outflow. That part of the discharge from a drainage basin that occurs through the ground water. The term "underflow" is often used to describe the ground-water outflow that takes place in valley alluvium (instead of the surface *channel)* and thus is not measured at a *gaging station.*

Ground-water runoff. That part of the runoff which has passed into the ground, has become ground water, and has been discharged into a stream channel as spring or seepage water. *See also* **Base runoff** *and* **Direct runoff**.

H

Heat budget, annual (of a lake). The amount of heat necessary to raise the water from the minimum temperature of winter to the maximum temperature of summer. (Welch, 1952, p. 65.)

Hydrograph. A graph showing stage, flow, velocity, or other property of water with respect to time.

Hydrologic budget. An accounting of the inflow to, outflow from, and storage in, a hydrologic unit, such as a drainage basin, aquifer, soil zone, lake, reservoir, or irrigation project.

Hydrologic cycle. A convenient term to denote the circulation of water from the sea, through the atmosphere, to the land; and thence, with many delays, back to the sea by overland and subterranean routes, and in part by way of the atmosphere; also the many short circuits of the water that is returned to the atmosphere without reaching the sea. (After Meinzer, 1949, p. 1.)

Hydrologic equation. The equation balancing the *hydrologic budget.*

Hydrology. The science encompassing the behavior of water as it occurs in the atmosphere, on the surface of the ground, and underground. (Am. Soc. Civil Engineers, 1949, p. 1.)

The science that relates to the water of the earth. (Meinzer, 1923, p. 9.)

The science treating of the waters of the earth, their occurrence, distribution, and movements. (Jarvis and others, 1936, p. 464.)

In practice the study of the water of the oceans and the atmosphere is considered part of the sciences of oceanography and meteorology.

Hypolimnion. *See* **Thermal stratification.**

I

Infiltration. The flow of a fluid into a substance through pores or small openings. It connotes flow into a substance in contradistinction to the word *percolation,* which connotes flow through a porous substance. (Horton, 1942, p. 480.) *See also* Schiff and Dreibelbis (1949, p. 76) and Musgrave (1946, p. 726-747).

Infiltration capacity. The maximum rate at which the soil, when in a given condition, can absorb falling rain or melting snow. (After Horton, 1935, p. 2.)

Infiltration index. An average rate of infiltration, in inches per hour, equal to the average rate of rainfall such that the volume of rain fall at greater rates equals the total direct runoff. (Langbein and others, 1947, p. 11.)

Interception. The process and the amount of rain or snow stored on leaves and branches and eventually evaporated back to the air. Interception equals the precipitation on the vegetation minus *stem flow* and *throughfall* (after Hoover, 1953, p. 1.)

Irrigated area. The gross farm area upon which water is artificially applied for the production of crops, with no reduction for access roads, canals, or farm buildings. (Simons, 1953, p. 8.)

Irrigation. The controlled application of water to arable lands to supply water requirements not satisfied by rainfall. (After Houk, 1951, p. 1.)

Irrigation Efficiency. The percentage of water applied that can be accounted for in soil-moisture increase. (Pillsbury, Compton, and Picker, 1944, p. 7.)

Irrigation requirement. The quantity of water, exclusive of precipitation, that is required for crop production. It includes surface evaporation and other economically unavoidable wastes. (Blaney, 1951a, p. 4.)

Irrigation, supplemental. *See* Supplemental irrigation.

J

K

L

Lag. Variously defined as time from beginning (or center of mass) of rainfall to peak (or center of mass) of runoff. (After Am. Soc. Civil Engineers, 1949, p. 106.)

Limnology. That branch of hydrology pertaining to the study of lakes.

Low-flow frequency curve. A graph showing the magnitude and frequency of minimum flows for a period of given length. Frequency is usually expressed as the average interval, in years, between recurrences of an annual minimum flow equal to or less than that shown by the magnitude scale.

M

Maximum probable flood. *See* Flood, maximum probable.

Meander. The winding of a stream channel.

Meander amplitude. Distance between points of maximum curvature of successive meanders of opposite phase in a direction normal to the general course of the meander belt, measured between centerlines of channels.

Meander belt. Area between lines drawn tangential to the extreme limits of fully developed meanders.

Meander breadth. The distance between the lines used to define the *meander belt.*

Meander length. Distance in the general course of the meanders between corresponding points of successive meanders of the same phase.

Twice the distance between successive points of inflection of the meander wave. (Leopold and Wolman, 1957, p. 55.)

Meromictic lake. A lake in which some water remains partly or wholly unmixed with the main water mass at circulation periods is said to be meromictic. The process leading to a meromictic state is termed meromixis The perennially stagnant deep layer of a meromictic lake is called the monimolimnion. The part of a meromictic lake in which free circulation can occur is called the mixolimnion. The boundary between the monimolimnion and the mixolimnion is called thechemocline. (Hutchinson, 1957, p. 480.)

Moisture. Water diffused in the atmosphere or the ground.

Moisture equivalent. The ratio of (a) the weight of water which the soil, after saturation, will retain against a centrifugal force 1,000 times the force of gravity, to (b) the weight of the soil when dry. The ratio is stated as a percentage. (Meinzer, 1923, p. 25; *see also* Briggs and McLane, 1907, p. 5.)

Mudflow. A well-mixed mass of water and alluvium which, because of its high viscosity and low fluidity as compared with water, moves at a much slower rate, usually piling up and spreading over the fan like a sheet of wet mortar or concrete. (Woolley, 1946, p. 75.)

N

Normal. A central value (such as arithmetic average or median) of annual quantities for a 30-year period ending with an even 10-year, thus 1921-50; 1931-60, and so forth. This definition accords with that recommended by the Subcommittee on Hydrology of the Federal Inter-Agency Committee on Water Resources.

O

Overland flow. The flow of rainwater or snowmelt over the land surface toward stream channels. After it enters a stream, it becomes *runoff.*

P

Partial-duration flood series. A list of all flood peaks that exceed a chosen base stage or discharge, regardless of the number of peaks occurring in a year. (Also called *basic-stage flood series*, or *floods above a base.)*

Percolation. The movement, under hydrostatic pressure, of water through the interstices of a rock or soil, except the movement through large openings such as caves. (Meinzer, 1923, p. 42; *see also* Rorabaugh, 1951, p. 165.)

Percolation, deep. In irrigation or farming practice, the amount of water that passes below the root zone of the crop or vegetation. (Barrett and Milligan, 1953, p. 24.)

Pondage. Small-scale storage at a waterpower plant to equalize daily or weekly fluctuations in riverflow or to permit irregular hourly use of the water for power generation to accord with fluctuations in load. (After Barrows, 1943, p. 166.)

Pool. A deep reach of a stream. The reach of a stream between two riffles. Natural streams often consist of a succession of pools and riffles.

Potential evapotranspiration. *Water loss* that will occur if at no time there is a deficiency of water in the soil for use of vegetation. (Thornthwaite, 1944, p. 687.)

Potential natural water loss. The *water loss* during years when the annual precipitation greatly exceeds the average water loss. It represents the approximate upper limit to water loss under the type and density of vegetation native to a basin, actual conditions of moisture supply, and other basin characteristics, whereas *potential evapotranspiration* represents the hypothetical condition of no deficiency of water in the soil at any time for use of the type and density of vegetation that would develop. (After Troxell and others, 1954, pl. 11*B*.)

Potential rate of evaporation. *See* Evaporativity.

Precipitation. As used in hydrology, precipitation is the discharge of water, in liquid or solid state, out of the atmosphere, generally upon a land or water surface. It is the common process by which atmospheric water becomes surface or subsurface water * * *. The term "precipitation" is also commonly used to designate the quantity of water that is precipitated. (Meinzer, 1923, p. 15.)

Precipitation includes rainfall, snow, hail, and sleet, and is therefore a more general term than rainfall.

Q

R

Rain. Liquid *precipitation.*

Rainfall. The quantity of water that falls as rain only. Not synonymous with *precipitation.*

Rainfall excess. The volume of rainfall available for direct runoff. It is equal to the total rainfall minus *interception, depression storage,* and *absorption. (See* Am. Soc. Civil Engineers, 1949, p. 106.)

Rainfall, excessive. Rainfall in which the rate of fall is greater than certain adopted limits, chosen with regard to the normal precipitation (excluding snow) of a given place or area. In the U.S. Weather Bureau, it is defined, for States along the southern Atlantic coast and the Gulf coast, as rainfall in which the depth of precipitation is 0.90 inch at the end of 30 minutes and 1.50 inches at the end of an hour, and for the rest of the country as rainfall in which the depth of precipitation at the end of each of the same periods is 0.50 and 0.80 inch, respectively.

Reach. 1. The length of channel uniform with respect to discharge, depth, area, and slope. 2. The length of a channel for which a single gage affords a satisfactory measure of the stage and discharge. 3. The length of a river between two gaging stations. 4. More generally, any length of a river.

Recession curve. A hydrograph showing the decreasing rate of *runoff* following a period of rain or snowmelt. Since direct runoff and base runoff recede at different rates, separate curves, called direct runoff recession curves or base runoff recession curves, are generally drawn. The term "depletion curve" in the sense of base runoff recession is not recommended.

Recurrence interval (return period). The average interval of time within which the given flood will be equaled or exceeded once. (Am. Soc. of Civil Engineers, 1953, p. 1221.)

Regime. "Regime theory" is a theory of the forming of channels in material carried by the streams. As used in this sense, the word "regime" applies only to streams that make at least part of their boundaries from their transported load and part of their transported load from their boundaries, carrying out the process at different places and times in any one stream in a balanced or alternating manner that prevents unlimited growth or removal of boundaries. A stream, river, or canal of this type is called a "regime stream, river, or canal." A regime channel is said to be "in regime" when it has achieved average equilibrium; that is, the average values of the quantities that constitute regime do not show a definite trend over a considerable period--generally of the order of a decade. In unspecialized use "regime" and "regimen" are synonyms. (After Blench, 1957, p. 2.)

Regimen of a stream. The system or order characteristic of a stream; in other words, its habits with respect to velocity and volume, form of and changes in channel, capacity to transport sediment, and amount of material supplied for transportation. The term is also applied to a stream which has reached an equilibrium between corrosion and deposition or, in other words, to a graded stream. (Bryan, 1922. p. 89)

Regulation. The artificial manipulation of the flow of a stream.

Re-regulating reservoirs. A reservoir for reducing diurnal fluctuations resulting from the operation of an upstream reservoir for power production.

Reservoir. A pond, lake, or basin, either natural or artificial, for the storage, regulation, and control of water.

Residual-mass curve. A graph of the cumulative departures from a given reference such as the arithmetic average, generally as ordinate, plotted against time or date, as abscissa. (*See* Mass curve.)

Retarding reservoir. Ungated reservoir for temporary storage of flood water. Sometimes called detention reservoir.

Return flow. That part of irrigation water that is not consumed by evapotranspiration and that returns to its source or another body of water. The term is also applied to the water that is discharged from industrial plants. Also called return water.

Riffle. A rapid in a stream.

Riparian. Pertaining to the banks of a stream.

Runoff. That part of the precipitation that appears in surface streams. It is the same as *streamflow* unaffected by *artificial diversions, storage*, or other works of man in or on the stream channels. Runoff may be classified as follows:

Classification as to speed of appearance after rainfall or snow melting:

Direct runoff Base runoff

Classification as to source:

Surface runoff (*see* Overland flow) Storm seepage Ground-water runoff (*see* Stream, gaining)

Runout. *See* Water yield.

S

Second-foot. Same as *cfs*. This term is no longer used in published reports of the U.S. Geological Survey.

Sediment. Fragmental material that originates from weathering of rocks and is transported by, suspended in, or deposited by water or air or is accumulated in beds by other natural agencies. (Colby, Hembree, and Jochens, 1953, p. 24.)

Sediment discharge. The rate at which dry weight of sediment passes a section of a stream or is the quantity of sediment, as measured by dry weight, or by volume, that is discharged in a given time. (Colby, Hembree, and Jochens, 1953, p. 24.)

Seiche. The free oscillation of the bulk of water in a lake and the motion caused by it on the surface of the lake. (Bergsten, 1926, p. 1.)

Shifting control. *See* Control.

Skimming. The diversion of water from a stream or conduit by a shallow overflow used to avoid diversion of sand, silt, or other debris carried as bottom load.

Snow. A form of precipitation composed of ice crystals.

Snow density. Ratio between the volume of melt water derived from a sample of snow and the initial volume of the sample. This is numerically equal to the specific gravity of the snow. (Linsley, Kohler, and Paulhus, 1949, p. 127.)

Snowline. The general altitude to which the continuous snow cover of high mountains retreats in summer, chiefly controlled by the depth of the winter snowfall and by the temperature of the summer.

Snowline, temporary. A line sometimes drawn on a weather map during the winter showing the southern limit of the snow cover.

Snow, quality of. The ratio of heat of melting of snow, in calories per gram to the 80 calories per gram for melting pure ice at 0 degrees C. (Bernard and Wilson, 1941, p., 178-179.) *(See also* Wilson, 1942b, p. 553-556.)

Percentage by weight which is ice (Linsley, Kohler, and Paulhus, 1949, p. 129).

Soil moisture (Soil water) . Water diffused in the soil, the upper part of the *zone of aeration* from which water is discharged by the *transpiration* of plants or by soil evaporation. *See* Field-moisture capacity *and* Field-moisture deficiency.

Stage. The height of a water surface above an established datum plane; also *gage height.*

Stage-capacity curve. A graph showing the relation between the surface elevation of the water in a reservoir, usually plotted as ordinate, against the volume below that elevation, plotted as abscissa.

Stage-discharge curve (rating curve). A graph showing the relation between the gage height, usually plotted as ordinate, and the amount of water flowing in a channel, expressed as volume per unit of time, plotted as abscissa.

Stage-discharge relation. The relation expressed by the *stage-discharge curve.*

Stage, flood. *See* Flood stage.

Stemflow. Rainfall or snowmelt led to the ground down the trunks or stems of plants. (Hoover, 1953, p. 1).

Storage. 1. Water artificially impounded in surface or underground reservoirs, for future use. The term *regulation* refers to the action of this storage in modifying *streamflow. See also* Conservation storage, Total storage, Dead storage, *and* Usable storage. 2. Water naturally detained in a drainage basin, such as *ground water, channel storage,* and *depression storage*. The term "drainage basin storage" or simply "basin storage" is sometimes used to refer collectively to the amount of water in natural storage in a drainage basin.

Storage, bank. *See* Bank storage.

Storage, conservation. *See* Conservation storage.

Storage, dead. *See* Dead storage.

Storage, depression. *See* Depression storage.

Storage ratio. The net available storage divided by the mean flow for 1 year. (Hazen, 1930, p. 1446.) *(See also* Thomas and Harbeck, 1956, p. 14.)

Storage-required frequency curve. A graph showing the frequency with which storage equal to or greater than selected amounts will be required to maintain selected rates of regulated flow.

Storage, total. *See* Total storage.

Storage, usable. *See* Usable Storage.

Storm. A disturbance of the ordinary average conditions of the atmosphere which, unless specifically qualified, may include any or all meteorological disturbances, such as wind, rain, snow, hail, or thunder.

Stormflow. *See* Direct runoff.

Storm seepage. That part of precipitation which infiltrates the surface soil, and moves toward the streams as ephemeral, shallow, perched ground water above the main ground-water level. Storm seepage is usually part of the *direct runoff.*

Stream. A general term for a body of flowing water. In hydrology the term is generally applied to the water flowing in a natural *channel* as distinct from a canal. More generally as in the term *stream gaging,* it is applied to the water flowing in any channel, natural or artificial. Streams in natural channels may be classified as follows (after Meinzer, 1923, p. 5658):

Relation to time.

Perennial. One which flows continuously. **Intermittent or seasonal.** One which flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas. **Ephemeral.** One that flows only in direct response to precipitation, and whose channel is at all times above the water table.

Relation to space.

Continuous. One that does not have interruptions in space. **Interrupted**. One which contains alternating reaches, that are either perennial, intermittent, or ephemeral.

Relation to ground water.

Gaining. A stream or reach of a stream that receives water from the *zone of saturation.* **Losing.** A stream or reach of a stream that contributes water to the *zone of saturation.* **Insulated.** A stream or reach of a stream that neither contributes water to the *zone of saturation* nor receives water from it. It is separated from the zones of saturation by an impermeable bed. **Perched.** A perched stream is either a losing stream or an insulated stream that is separated from the underlying ground water by a *zone of aeration.*

Streamflow. The discharge that occurs in a natural *channel.* Although the term *discharge* can be applied to the flow of a canal, the word streamflow uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than *runoff,* as streamflow may be applied to discharge whether or not it is affected by *diversion* or *regulation.*

Streamflow depletion. The amount of water that flows into a valley, or onto a particular land area, minus the water that flows out the valley or off from the particular land area. (Blaney, 1951a, p. 4.)

Stream gaging. The process and art of measuring the depths, areas, velocities, and rates of flow in natural or artificial channels. (*see* Corbett and others, 1943.)

Stream-gaging station. A *gaging station* where a record of discharge of a stream is obtained. Within the Geological Survey this term is used only for those gaging stations where a continuous record of discharge is obtained.

Stream order. A method of numbering streams as part of a drainage basin network. The smallest unbranched mapped tributary is called first order, the stream receiving the tributary is called second order, and so on. It is usually necessary to specify the scale of the map used. A first-order stream on a 1:62,500 map, may be a third-order stream on a 1:12,000 map. (After Leopold and Miller, 1956, p. 16.)

Tributaries which have no branches are designated as of the first order, streams which receive only first-order tributaries are of the second order, larger branches which receive only first-order and second-order tributaries are designated third order, and so on, the main stream being always of the highest order. (Horton, 1932, p. 356.)

Submeander. Small meander contained with banks of main channel, associated with relatively low discharges.

Subsurface runoff. *See* Storm seepage.

Supplemental irrigation. Commonly, irrigation as carried on in humid areas. The term means that the irrigation water is supplementary to the natural rainfall rather than being the primary source of moisture as in the arid and semiarid West. Supplementary irrigation is used generally to prevent retardation of growth during periods of drought. (Huffman, 1953, p. 231.)

Supplemental sources. When irrigation water supplies are obtained from more than one source, the source furnishing the principal supply is commonly designated the primary source, and the sources furnishing the additional supplies, the supplemental sources. (Houk, 1951, p. 396.)

Surface runoff. That part of the runoff which travels over the soil surface to the nearest stream channel. It is also defined as that part of the runoff of a drainage basin that has not passed beneath the surface since precipitation. The term is misused when applied in the sense of direct runoff. *See also,* Runoff, Overland flow, Direct runoff, Ground-water runoff, *and* Surface water.

Surface water. Water on the surface of the earth.

T

Tank. An artificial reservoir for stock water; local in Southwest.

Terrace. A berm or discontinuous segments of a berm, in a valley at some height above the *flood plain,* representing a former abandoned flood plain of the stream.

Thermal stratification (of a lake) . Vertical temperature stratification that shows the following: The upper layer of the lake, known as the epilimnion, in which the water temperature is virtually uniform; a stratum next below, known as the thermocline, in which there is a marked drop in temperature per unit of depth; and the lowermost region or stratum, known as the hypolimnion, in which the temperature from its upper limit to the bottom is nearly uniform. (Welch, 1952, p. 51.)

Thermocline. *See* Thermal stratification.

Time of concentration. The time required for water to flow from the farthest point on the watershed to the gaging station. (Ramser, 1927, p. 804.)

Total storage. The volume of a reservoir below the maximum controllable level including dead storage. (Thomas and Harbeck, 1956, p. 13.)

Transpiration. The quantity of water absorbed and transpired and used directly in the building of plant tissue, in a specified time. It does not include soil evaporation. (After Blaney, 1951a, p. 4.)

The process by which water vapor escapes from the living plant, principally the leaves, and enters the atmosphere. * * * As considered practically, transpiration also includes *guttation.* (Lee, 1949, p. 260.)

Trend. A statistical term referring to the direction or rate of increase or decrease in magnitude of the individual members of a time series of data when random fluctuations of individual members are disregarded.

U

Underflow. The downstream flow of water through the permeable deposits that underlie a stream and that are more or less limited by rocks of low permeability.

Unit hydrograph. The *hydrograph* of *direct runoff* from a storm uniformly distributed over the *drainage basin* during a specified unit of time; the hydrograph is reduced in vertical scale to correspond to a volume of runoff of 1 inch from the drainage basin. (After Am. Soc. Civil Engineers, 1949, p. 105.)

The hydrograph of surface runoff (not including ground-water runoff) on a given basin due to an *effective rainfall* falling for a unit of time. (Sherman, 1949, p. 514.) *(See also* Hoyt and others, 1936, p. 124.)

Usable storage. The volume normally available for release from a reservoir below the stage of the maximum controllable level. (Thomas and Harbeck, 1956, p. 13.)

V

W

Water balance. *See* Hydrologic budget.

Water content of snow. *See* Water equivalent of snow.

Water crop. *See* Water yield.

Water equivalent of snow. Amount of water that would be obtained if the snow should be completely melted. Water content may be merely the amount of liquid water in the snow at the time of observation. (Wilson, 1942a, p. 153-154.)

Water loss. The difference between the average precipitation over a drainage basin and the *water yield* from the basin for a given period. (After Williams and others, 1940, p. 3.) The basic concept is that water loss is equal to *evapotranspiration,* that is, water that returns to the atmosphere and thus is no longer available for use. However, the term is also applied to differences between measured inflow and outflow even where part of the difference may be seepage.

Water requirement. The quantity of water, regardless of its source, required by a crop in a given period of time, for its normal growth under field conditions. It includes surface evaporation and other economically unavoidable wastes. (Blaney, 1951a, p. 4.)

Watershed. The divide separating one *drainage basin* from another and in the past has been generally used to convey this meaning. However, over the years, use of the term to signify drainage basin or catchment area has come to predominate, although drainage basin is preferred. *Drainage divide,* or just divide, is used to denote the boundary between one drainage area and another. Used alone, the term "watershed" is ambiguous and should not be used unless the intended meaning is made clear.

Water table. The upper surface of a zone of saturation. No water table exists where that surface is formed by an impermeable body. (Meinzer ,1923, p. 22.)

Water year. In Geological Survey reports dealing with surface-water supply, the 12-month period, October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ended September 30, 1959, is called the "1959 water year."

Water yield (water crop or runout). The runoff from the drainage basin, including *ground-water outflow* that appears in the stream plus ground-water outflow that bypasses the gaging station and leaves the basin underground. Water yield is the *precipitation* minus the *evpotranspiration.*

Withdrawal use of water. The water removed from the ground or diverted from a stream or lake for use. (MacKichan, 1957, p. 2.)

X

Y

Year. *See* Climatic year; Water year.

Z

Zone of aeration. The zone above the water table. Water in the zone of aeration does not flow into a well.

Zone of saturation. The zone in which the functional permeable rocks are saturated with water under hydrostatic pressure. (Meinzer, 1923, p. 21.) Water in the zone of saturation will flow into a well, and is called *ground water.*

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